FAIRCHILD SEMICONDUCTOR

MADE IN FAIRCHILD

# DISCRETE PRODUCTS

DATABOOK

JULY 1973

FAIRCHILD DISCRETE PRODUCTS DATABOOK ▪ JULY 1973

# DISCRETE PRODUCTS

## CONTENTS AND SECTION SELECTOR

THE 1973 FAIRCHILD DISCRETE PRODUCTS DATA BOOK PROVIDES COMPREHENSIVE TECHNICAL DATA FOR DIODES □ SMALL SIGNAL TRANSISTORS □ MULTIPLE DIODES AND TRANSISTORS □ POWER TRANSISTORS AND UNENCAPSULATED COMPONENTS □ □ DISCRETE OPTOELECTRONIC DEVICES □ RF POWER TRANSISTORS AND MICROWAVE DEVICES ARE EXCLUDED □ □ THESE PRODUCTS ARE MANUFACTURED BY FAIRCHILD'S MICROWAVE AND OPTOELECTRONICS DIVISION □ AND INFORMATION REGARDING THEM MAY BE OBTAINED BY FILLING OUT ONE OF THE TEAR-OUT CARDS AT THE BACK OF THIS BOOK OR BY CONTACTING ANY FAIRCHILD FIELD SALES OFFICE □ □ THE DATA BOOK IS DIVIDED INTO NINE SEPARATE SECTIONS □ □ A BRIEF DESCRIPTION OF THE CONTENT AND USAGE NOTES PRECEDES THE INDIVIDUAL SECTIONS □ □ □

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FAIRCHILD
SEMICONDUCTOR

# DISCRETE PRODUCTS

## CONTENTS AND SECTION SELECTOR

# INTRODUCTION

## INDEX AND DEVICE CROSS REFERENCE

The following numerical list of devices, which Fairchild supplies, was compiled on the basis of technology, cost, performance and availability. The content of each column is described below.

1. Industry Type Number

   A listing of the devices which Fairchild can supply directly, or for which a substitution can be recommended, is contained in the first column. The PRO-ELECTRON devices are in boldface type.

2. Recommended Fairchild Device

   a. If the Recommended Device and the Industry Device Type are the same, it indicates that Fairchild can supply the Industry Type in accordance with the official registered data or the original manufacturer's published data, as applicable.

   b. CF indicates Consult Factory. This notation is for devices which are useful in two or more applications, or where a Recommended Fairchild Device lends itself to special applications. It would also be used where a different device would be recommended as more suitable for certain applications.

   Please contact either the factory or the nearest Fairchild Field Sales Office to discuss your applications. (A complete listing of Sales Offices is contained at the back of this book.) Field Applications Engineers are located in many of the Sales Offices to provide on the spot technical assistance.

3. Data Sheet

   This column lists a type number identifying the detailed data sheet (Section 4) for the Recommended Fairchild Device. Some older device types do not have definitive specifications. Therefore, the Recommended Fairchild Device number may be shown but no data sheet has been included since it is not recommended that this type be used for new system design work. For example, the 2N697 has been a popular designer's choice as a general workhorse device. The leakage and collector saturation voltage specifications reflect the original nonepitaxial mesa manufacturing process that was used to make the device in 1960. Today almost all suppliers use a Planar* epitaxial product with significantly better characteristics.

An asterisk (*) indicates there is a complete data sheet included in Section 4.

4. Short Form Data

   This column refers to the page of the Selection Guide by Application and Short Form Data Listing (Section 3) which contains the abbreviated data listing for the Recommended Fairchild Device.

5. Family Characteristics

   This column refers to the subsection of Section 5 which contains the characterization data typical of the product family from which the Recommended Fairchild Device is supplied. Manufacturers may use different device processes to supply a given device type. This frequently occurs if the type is an older one with relaxed specifications. Where this option is desired, no reference has been made to the generic family source, and Fairchild reserves the right to make changes to line sources.

* Planar is a patented Fairchild process

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| **BA100** | BA100 | | 3-7 | |
| **BA103** | FDH900 | FDH900 | | D6 |
| **BA104** | FDH444 | FD400 | | D4 |
| **BA108** | FDH999 | FDH900 | | D6 |
| **BA114** | FDH999 | FDH900 | | D6 |
| **BA115** | FDH400 | FD400 | | D4 |
| **BA116** | FDH900 | FDH900 | | D6 |
| **BA127** | FDH444 | FD400 | | D4 |
| ***BA128** | BA128 | BA128 | 3-7 | D6 |
| ***BA129** | BA129 | BA129 | 3-7 | D5 |
| ***BA130** | BA130 | BA130 | 3-7 | D5 |
| **BA136** | BA136 | | 3-7 | |
| **BA137** | BAY72 | BAY72 | | D4 |
| **BA147/25** | FDH900 | FDH900 | | D6 |
| **BA147/50** | 1N457 | 1N457 | | D5 |
| **BA147/100** | FDH444 | FD400 | | D4 |
| **BA147/150** | FDH400 | FD400 | | D4 |
| **BA151** | FDH999 | FDH900 | | D6 |
| **BA153** | FDH900 | FDH900 | | D6 |
| **BA155** | BA155 | | 3-7 | |
| ***BA164** | BA164 | BA164 | 3-7 | D6 |
| **BA168** | 1N4148 | 1N914 | | D6 |
| **BA170** | FDH900 | FDH900 | | D6 |
| **BA174** | FDH900 | FDH900 | | D6 |
| **BA175** | 1N4150 | 1N3600 | | D6 |
| **BA177** | FDH900 | FDH900 | | D6 |
| **BA179** | FDH900 | FDH900 | | D6 |
| **BA180** | FDH999 | FDH900 | | D6 |
| **BA181** | FDH999 | FDH900 | | D6 |
| ***BA216** | BA216 | BA216 | 3-7 | D6 |
| ***BA217** | BA217 | BA217 | 3-7 | D6 |
| **BA218** | BA218 | | 3-7 | |
| **BA219** | BA219 | | 3-7 | |
| **BAV10** | 1N4148 | 1N914 | | D6 |
| **BAW10** | 1N4150 | 1N3600 | | D6 |
| **BAW11** | FDH444 | FD400 | | D4 |
| **BAW12** | FDH400 | FD400 | | D4 |
| **BAW13** | 1N485B | 1N482 | | D5 |
| **BAW16** | FDH400 | FD400 | | D4 |
| **BAW17** | 1N3595 | 1N3595 | | D5 |
| **BAW18** | 1N485B | 1N482 | | D5 |
| **BAW24** | FDH999 | FDH900 | | D6 |
| **BAW25** | FDH900 | FDH900 | | D6 |
| **BAW26** | FDH999 | FDH900 | | D6 |
| **BAW27** | FDH900 | FDH900 | | D6 |
| **BAW33** | FDH600 | FD600 | | D6 |
| **BAW43** | 1N3595 | 1N3595 | | D5 |
| **BAW45** | FDH999 | FDH900 | | D6 |
| **BAW46** | FDH600 | FD600 | | D6 |
| **BAW47** | 1N4148 | 1N914 | | D6 |
| **BAW48** | FDH666 | FD600 | | D6 |
| **BAW49** | FDH444 | FD400 | | D4 |
| **BAW50** | FDH400 | FD400 | | D4 |
| **BAW51** | BAY73 | BAY73 | | D5 |
| **BAW52** | FDH400 | FD400 | | D4 |
| **BAW53** | FDH999 | FDH900 | | D6 |
| **BAW54** | FDH666 | FD600 | | D6 |
| **BAW55** | FDH600 | FD600 | | D6 |
| **BAX12** | FDH400 | FD400 | | D4 |
| ***BAX13** | BAX13 | BAX13 | 3-3 | D6 |
| **BAX16** | BAX16 | | 3-7 | |
| **BAX20** | FDH900 | FDH900 | | D6 |
| **BAX21** | 1N4448 | 1N914 | | D6 |
| **BAX22** | FDH444 | FD400 | | D4 |
| **BAX25** | FD777 | FD700 | | D7 |
| **BAX26** | FD700 | FD700 | | D7 |
| **BAX27** | FD700 | FD700 | | D7 |
| **BAX33** | FA2311E | FA2310E | | D6 |
| **BAX34** | FA2313E | FA2310E | | D6 |
| **BAX35** | FA2313E | FA2310E | | D6 |
| **BAX36** | FA2321E | FA2310E | | D4 |
| **BAX37** | FA2323E | FA2310E | | D4 |
| **BAX38** | FA2323E | FA2310E | | D4 |
| **BAX39** | FA4311E | FA2310E | | D6 |
| **BAX40** | FA4313E | FA2310E | | D6 |
| **BAX41** | FA4313E | FA2310E | | D6 |
| **BAX42** | FA4321E | FA2310E | | D4 |
| **BAX43** | FA4323E | FA2310E | | D4 |
| **BAX44** | FA4323E | FA2310E | | D4 |
| **BAX51** | FSA2502M | FSA2500M | | D11 |
| **BAX52** | FSA2704M | FSA2702M | | D11 |
| **BAX53** | FSA2705M | FSA2702M | | D11 |
| **BAX72** | FSA1410M | FSA1410M | | D11 |
| **BAX73** | FSA1411M | FSA1410M | | D11 |
| **BAX78** | 1N4150 | 1N3600 | | D6 |
| **BAX79** | 1N4150 | 1N3600 | | D6 |
| **BAX80** | 1N4148 | 1N914 | | D6 |
| **BAX81** | 1N4153 | 1N4151 | | D6 |
| **BAX82** | 1N4154 | 1N4151 | | D6 |
| **BAX83** | 1N4148 | 1N914 | | D6 |
| **BAX84** | 1N4151 | 1N4151 | | D6 |
| **BAX85** | 1N4151 | 1N4151 | | D6 |
| **BAX86A** | 1N4148 | 1N914 | | D6 |
| **BAX86B** | 1N4148 | 1N914 | | D6 |
| **BAX87** | BAX13 | BAX12 | | D6 |
| **BAX88** | FDH999 | FDH900 | | D6 |
| **BAX89A** | FDH999 | FDH900 | | D6 |
| **BAX89B** | 1N4151 | 1N4151 | | D6 |
| **BAX90A** | 1N4154 | 1N4151 | | D6 |
| **BAX90B** | 1N4151 | 1N4151 | | D6 |
| **BAX90C** | 1N4154 | 1N4151 | | D6 |
| **BAX91A** | 1N4151 | 1N4151 | | D6 |
| **BAX91B** | 1N4148 | 1N914 | | D6 |
| **BAX91C** | 1N4148 | 1N914 | | D6 |
| **BAX92** | 1N4151 | 1N4151 | | D6 |
| **BAX93** | 1N4151 | 1N4151 | | D6 |
| **BAX94** | 1N4151 | 1N4151 | | D6 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| **BAX95** | FDH600 | FD600 | | D6 |
| **BAX96A** | 1N4446 | 1N914 | | D6 |
| **BAX96B** | 1N4446 | 1N914 | | D6 |
| **BAY17** | 1N4150 | 1N3600 | | D6 |
| **BAY18** | BAY72 | BAY72 | | D4 |
| **BAY19** | FDH400 | FD400 | | D4 |
| **BAY20** | 1N485B | 1N482 | | D5 |
| **BAY31** | 1N4154 | 1N4151 | | D6 |
| **BAY32** | 1N485B | 1N482 | | D5 |
| **BAY33** | 1N485B | 1N482 | | D5 |
| **BAY36** | 1N4154 | 1N4151 | | D6 |
| **BAY38** | 1N4151 | 1N4151 | | D6 |
| **BAY41** | 1N4150 | 1N3600 | | D6 |
| **BAY42** | 1N4150 | 1N3600 | | D6 |
| **BAY43** | 1N4150 | 1N3600 | | D6 |
| **BAY44** | 1N4150 | 1N3600 | | D6 |
| **BAY45** | FDH400 | FD400 | | D4 |
| **BAY60** | 1N4154 | 1N4151 | | D6 |
| **BAY63** | FDH600 | FD600 | | D6 |
| **BAY64** | FDH999 | FDH900 | | D6 |
| **BAY67** | FDH900 | FDH900 | | D6 |
| **BAY68** | FDH999 | FDH900 | | D6 |
| **BAY69** | FDH900 | FDH900 | | D6 |
| ***BAY71** | BAY71 | BAY71 | 3-3 | D6 |
| ***BAY72** | BAY72 | BAY72 | 3-5 | D4 |
| ***BAY73** | BAY73 | BAY73 | 3-8 | D5 |
| ***BAY74** | BAY74 | BAY74 | 3-3 | D6 |
| **BAY80** | FDH444 | FD400 | | D4 |
| ***BAY82** | BAY82 | BAY82 | 3-1 | D7 |
| **BAY83** | FDH900 | FDH900 | | D6 |
| **BAY86** | 1N457 | 1N457 | | D5 |
| **BAY87** | FDH400 | FD400 | | D4 |
| **BAY93** | FDH999 | FDH900 | | D6 |
| **BAY94** | 1N4154 | 1N4151 | | D6 |
| **BAY95** | 1N4151 | 1N4151 | | D6 |
| **BAY97** | 1N4154 | 1N4151 | | D6 |
| **BAY98** | FDH400 | FD400 | | D4 |
| **BAY99** | FDH900 | FDH900 | | D6 |
| **BC107** | BC317 | BC317 | | SS18 |
| **BC107A** | BC317A | BC317 | | SS18 |
| **BC107B** | BC317B | BC317 | | SS18 |
| **BC108** | BC318 | BC317 | | SS18 |
| **BC108A** | BC318A | BC317 | | SS18 |
| **BC108B** | BC318B | BC317 | | SS18 |
| **BC108C** | BC318C | BC317 | | SS18 |
| **BC109** | BC319 | BC317 | | SS18 |
| **BC109B** | BC319B | BC317 | | SS18 |
| **BC109C** | BC319C | BC317 | | SS18 |
| **BC110** | 2N3701 | 2N3700 | | SS17 |
| ***BC113** | BC113 | BC113 | 3-29 | SS18 |
| ***BC114** | BC114 | BC113 | 3-29 | SS18 |
| ***BC115** | BC115 | BC115 | 3-29 | SS15 |
| **BC116** | BC116A | BC116A | | SS15 |
| ***BC116A** | BC116A | BC116A | 3-27 | SS15 |
| **BC117** | BC117 | | 3-33 | |
| **BC118** | BC118 | | 3-24 | |
| ***BC119** | BC119 | BC119 | 3-20 | SS15 |
| ***BC125** | BC125 | BC125 | 3-23 | SS15 |
| ***BC126** | BC126 | BC125 | 3-27 | SS22 |
| **BC132** | 2N3565 | 2N3565 | | SS8 |
| **BC134** | BC134 | | 3-23 | |
| **BC135** | BC118 | | | |
| **BC136** | BC125 | BC125 | | SS15 |
| **BC137** | BC116A | BC116A | | SS15 |
| **BC138** | BC119 | BC119 | | SS15 |
| ***BC139** | BC139 | BC119 | 3-25 | SS22 |
| ***BC140** | BC140 | BC140 | 3-20 | SS17 |
| ***BC140-6** | BC140-6 | BC140 | 3-20 | SS17 |
| ***BC140-10** | BC140-10 | BC140 | 3-20 | SS17 |
| ***BC140-16** | BC140-16 | BC140 | 3-20 | SS17 |
| **BC140-25** | BC140-25 | BC140 | 3-20 | SS17 |
| ***BC141** | BC141 | BC140 | 3-20 | SS17 |
| ***BC141-6** | BC141-6 | BC140 | 3-20 | SS17 |
| ***BC141-10** | BC141-10 | BC140 | 3-20 | SS17 |
| ***BC141-16** | BC141-16 | BC140 | 3-20 | SS17 |
| ***BC141-25** | BC141-25 | BC140 | 3-20 | SS17 |
| ***BC142** | BC142 | BC142 | 3-21 | SS17 |
| ***BC143** | BC143 | BC143 | 3-26 | SS24 |
| **BC144** | BC286 | BC286 | | SS17 |
| **BC145** | BC117 | | | |
| **BC147** | BC317 | BC317 | | SS18 |
| **BC147A** | BC317A | BC317 | | SS18 |
| **BC147B** | BC317B | BC317 | | SS18 |
| **BC148** | BC318 | BC317 | | SS18 |
| **BC148A** | BC318A | BC317 | | SS18 |
| **BC148B** | BC318B | BC317 | | SS18 |
| **BC148C** | BC318C | BC317 | | SS18 |
| **BC149** | BC319 | BC317 | | SS18 |
| **BC149B** | BC319B | BC317 | | SS18 |
| **BC149C** | BC319C | BC317 | | SS18 |
| ***BC153** | BC153 | BC153 | 3-32 | SS33 |
| ***BC154** | BC154 | BC153 | 3-32 | SS33 |
| **BC157** | BC320 | BC320 | | SS33 |
| **BC157A** | BC320A | BC320 | | SS33 |
| **BC157B** | BC320B | BC320 | | SS33 |
| **BC158** | BC321 | BC320 | | SS33 |
| **BC158A** | BC321A | BC320 | | SS33 |
| **BC158B** | BC321B | BC320 | | SS33 |
| **BC159** | BC322 | BC320 | | SS33 |
| **BC159B** | BC322B | BC320 | | SS33 |
| ***BC160** | BC160 | BC140 | 3-25 | SS24 |
| ***BC160-6** | BC160-6 | BC140 | 3-25 | SS24 |
| ***BC160-10** | BC160-10 | BC140 | 3-25 | SS24 |
| ***BC160-16** | BC160-16 | BC140 | 3-25 | SS24 |
| ***BC160-25** | BC160-25 | BC140 | 3-25 | SS24 |
| ***BC161** | BC161 | BC140 | 3-25 | SS24 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| *BC161-6 | BC161-6 | BC140 | 3-25 | SS24 |
| *BC161-10 | BC161-10 | BC140 | 3-25 | SS24 |
| *BC161-16 | BC161-16 | BC140 | 3-25 | SS24 |
| BC161-25 | BC161-25 | BC140 | 3-25 | SS24 |
| BC167 | BC317 | BC317 | | SS18 |
| BC167A | BC317A | BC317 | | SS18 |
| BC167B | BC317B | BC317 | | SS18 |
| BC168 | BC318 | BC317 | | SS18 |
| BC168A | BC318A | BC317 | | SS18 |
| BC168B | BC318B | BC317 | | SS18 |
| BC168C | BC318C | BC317 | | SS18 |
| BC169 | BC319 | BC317 | | SS18 |
| BC169B | BC319B | BC317 | | SS18 |
| BC169C | BC319C | BC317 | | SS18 |
| BC170 | BC318 | BC317 | | SS18 |
| BC170A | BC318A | BC317 | | SS18 |
| BC170B | BC318B | BC317 | | SS18 |
| BC170C | BC318C | BC317 | | SS18 |
| BC171 | BC317 | BC317 | | SS18 |
| BC171A | BC317A | BC317 | | SS18 |
| BC171B | BC317B | BC317 | | SS18 |
| BC172 | BC318 | BC317 | | SS18 |
| BC172A | BC318A | BC317 | | SS18 |
| BC172B | BC318B | BC317 | | SS18 |
| BC172C | BC318C | BC317 | | SS18 |
| BC173 | BC319 | BC317 | | SS18 |
| BC173B | BC319B | BC317 | | SS18 |
| BC173C | BC319C | BC317 | | SS18 |
| BC177 | BC177 | | 3-31 | |
| BC177VI | BC177VI | | 3-31 | |
| BC177A | BC177A | | 3-31 | |
| BC177B | BC177B | | 3-31 | |
| BC178 | BC178 | | 3-31 | |
| BC178VI | BC178VI | | 3-31 | |
| BC178A | BC178A | | 3-31 | |
| BC178B | BC178B | | 3-31 | |
| BC179 | BC179 | | 3-31 | |
| BC179A | BC179A | | 3-31 | |
| BC179B | BC179B | | 3-31 | |
| BC182 | BC317 | BC317 | | SS18 |
| BC182A | BC317A | BC317 | | SS18 |
| BC182B | BC317B | BC317 | | SS18 |
| BC183 | BC318 | BC317 | | SS18 |
| BC183A | BC318A | BC317 | | SS18 |
| BC183B | BC318B | BC317 | | SS18 |
| BC183C | BC318C | BC317 | | SS18 |
| BC184 | BC319 | BC317 | | SS18 |
| BC184B | BC319B | BC317 | | SS18 |
| BC184C | BC319C | BC317 | | SS18 |
| BC197 | BC317 | BC317 | | SS18 |
| BC197A | BC317A | BC317 | | SS18 |
| BC197B | BC317B | BC317 | | SS18 |
| BC198 | BC318 | BC317 | | SS18 |
| BC198A | BC318A | BC317 | | SS18 |
| BC198B | BC318B | BC317 | | SS18 |
| BC198C | BC318C | BC317 | | SS18 |
| BC199 | BC319 | BC317 | | SS18 |
| BC199B | BC319B | BC317 | | SS18 |
| BC199C | BC319C | BC317 | | SS18 |
| BC200 | BC322 | BC320 | | SS33 |
| *BC204 | BC204 | BC204 | 3-32 | SS23 |
| *BC204A | BC204A | BC204 | 3-32 | SS23 |
| BC204B | BC204B | BC204 | 3-32 | SS23 |
| *BC205 | BC205 | BC205 | 3-32 | SS23 |
| *BC205A | BC205A | BC205 | 3-32 | SS23 |
| *BC205B | BC205B | BC205 | 3-32 | SS23 |
| *BC205C | BC205C | BC205 | | SS23 |
| *BC206 | BC206 | BC206 | 3-32 | SS33 |
| *BC206B | BC206B | BC206 | 3-32 | SS33 |
| *BC206C | BC206C | BC206 | | SS33 |
| *BC207 | BC207 | BC207 | 3-30 | SS18 |
| *BC207A | BC207A | BC207 | 3-30 | SS18 |
| *BC207B | BC207B | BC207 | 3-30 | SS18 |
| *BC208 | BC208 | BC207 | 3-29 | SS18 |
| *BC208A | BC208A | BC207 | 3-29 | SS18 |
| *BC208B | BC208B | BC207 | 3-29 | SS18 |
| *BC208C | BC208C | BC207 | 3-29 | SS18 |
| *BC209 | BC209 | BC207 | 3-29 | SS18 |
| *BC209B | BC209B | BC207 | 3-29 | SS18 |
| *BC209C | BC209C | BC207 | 3-29 | SS18 |
| BC212 | BC320 | BC320 | | SS33 |
| BC212A | BC320A | BC320 | | SS33 |
| BC212B | BC320B | BC320 | | SS33 |
| BC213 | BC321 | BC320 | | SS33 |
| BC213A | BC321A | BC320 | | SS33 |
| BC213B | BC321B | BC320 | | SS33 |
| BC214 | BC322 | BC320 | | SS33 |
| BC214B | BC322B | BC320 | | SS33 |
| BC221 | 2N3638A | 2N3638 | | SS22 |
| BC222 | BC125 | BC125 | | SS15 |
| *BC225 | BC225 | BC153 | 3-32 | SS33 |
| BC231 | MPS6534M | MPS6533M | | SS22 |
| BC232 | MPS6531 | MPS6530 | | SS15 |
| BC237 | BC317 | BC317 | | SS18 |
| BC237A | BC317A | BC317 | | SS18 |
| BC237B | BC317B | BC317 | | SS18 |
| BC238 | BC318 | BC317 | | SS18 |
| BC238A | BC318A | BC317 | | SS18 |
| BC238B | BC318B | BC317 | | SS18 |
| BC238C | BC318C | BC317 | | SS18 |
| BC239 | BC319 | BC317 | | SS18 |
| BC239B | BC319B | BC317 | | SS18 |
| BC239C | BC319C | BC317 | | SS18 |
| BC251 | BC320 | BC320 | | SS33 |
| BC251A | BC320A | BC320 | | SS33 |
| BC251B | BC320B | BC320 | | SS33 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| **BC251C** | BC526C | BC526 | | SS33 |
| **BC252** | BC321 | BC320 | | SS33 |
| **BC252A** | BC321A | BC320 | | SS33 |
| **BC252B** | BC321B | BC320 | | SS33 |
| **BC252C** | BC321C | BC320 | | SS33 |
| **BC253** | BC322 | BC320 | | SS33 |
| **BC253B** | BC322B | BC320 | | SS33 |
| **BC253C** | BC322C | BC320 | | SS33 |
| **BC264** | 2N5485 | 2N5485 | | |
| **BC267** | BC317 | BC317 | | SS18 |
| **BC268** | BC318 | BC317 | | SS18 |
| **BC269** | BC319 | BC317 | | SS18 |
| **BC270** | BC283 | | | |
| **BC280** | 2N930 | 2N930 | | SS8 |
| **BC282** | BC282 | | 3-20 | |
| **BC283** | BC283 | | 3-25 | |
| **BC284** | 2N915 | | | SS14 |
| **BC285** | 2N3114 | | | SS16 |
| ***BC286** | BC286 | BC286 | 3-21 | SS17 |
| ***BC287** | BC287 | BC286 | 3-26 | SS24 |
| **BC288** | BFX34 | BFX34 | | PWR1 |
| **BC307** | BC320 | BC320 | | SS33 |
| **BC307A** | BC320A | BC320 | | SS33 |
| **BC307B** | BC320B | BC320 | | SS33 |
| **BC308** | BC321 | BC320 | | SS33 |
| **BC308A** | BC321A | BC320 | | SS33 |
| **BC308B** | BC321B | BC320 | | SS33 |
| **BC308C** | BC321C | BC320 | | SS33 |
| **BC309** | BC322 | BC320 | | SS33 |
| **BC309B** | BC322B | BC320 | | SS33 |
| **BC310** | BC286 | BC286 | | SS17 |
| **BC311** | BC287 | BC286 | | SS24 |
| **BC315** | 2N5087 | 2N5086 | | SS33 |
| ***BC317** | BC317 | BC317 | 3-30 | SS18 |
| ***BC317A** | BC317A | BC317 | 3-30 | SS18 |
| ***BC317B** | BC317B | BC317 | 3-30 | SS18 |
| ***BC318** | BC318 | BC317 | 3-29 | SS18 |
| ***BC318A** | BC318A | BC317 | 3-29 | SS18 |
| ***BC318B** | BC318B | BC317 | 3-29 | SS18 |
| ***BC318C** | BC318C | BC317 | 3-29 | SS18 |
| ***BC319** | BC319 | BC317 | 3-29 | SS18 |
| ***BC319B** | BC319B | BC317 | 3-29 | SS18 |
| ***BC319C** | BC319C | BC317 | 3-29 | SS18 |
| ***BC320** | BC320 | BC320 | 3-32 | SS33 |
| ***BC320A** | BC320A | BC320 | 3-32 | SS33 |
| ***BC320B** | BC320B | BC320 | 3-32 | SS33 |
| ***BC321** | BC321 | BC320 | 3-32 | SS33 |
| ***BC321A** | BC321A | BC320 | 3-32 | SS33 |
| ***BC321B** | BC321B | BC320 | 3-32 | SS33 |
| ***BC321C** | BC321C | BC320 | 3-32 | SS33 |
| ***BC322** | BC322 | BC320 | 3-32 | SS33 |
| ***BC322B** | BC322B | BC320 | 3-32 | SS33 |
| ***BC322C** | BC322C | BC320 | | SS33 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| ***BC323** | BC323 | BC323 | 3-36 | PWR1 |
| **BC327** | BC527 | BC527 | | SS24 |
| **BC328** | BC528 | BC527 | | SS24 |
| **BC337** | BC537 | BC527 | | SS17 |
| **BC338** | BC538 | BC527 | | SS17 |
| **BC407** | BC207 | BC207 | | SS18 |
| **BC407A** | BC207A | BC207 | | SS18 |
| **BC408** | BC208 | BC207 | | SS18 |
| **BC408A** | BC208A | BC207 | | SS18 |
| **BC408B** | BC208B | BC207 | | SS18 |
| **BC408C** | BC208C | BC207 | | SS18 |
| **BC409** | BC209 | BC207 | | SS18 |
| **BC409B** | BC209B | BC207 | | SS18 |
| **BC409C** | BC209C | BC207 | | SS18 |
| **BC477** | BC177 | | | |
| **BC478** | BC178 | | | |
| **BC479** | BC179 | | | |
| **BC512** | BC320 | BC320 | | SS33 |
| **BC512A** | BC320A | BC320 | | SS33 |
| **BC512B** | BC320B | BC320 | | SS33 |
| **BC513** | BC321 | BC320 | | SS33 |
| **BC513A** | BC321A | BC320 | | SS33 |
| **BC513B** | BC321B | BC320 | | SS33 |
| **BC513C** | BC321C | BC320 | | SS33 |
| **BC514** | BC322 | BC320 | | SS33 |
| **BC514B** | BC322B | BC320 | | SS33 |
| **BC514C** | BC322C | BC320 | | SS33 |
| ***BC520** | BC520 | BC520 | 3-30 | SS8 |
| ***BC521** | BC521 | BC520 | 3-30 | SS8 |
| ***BC522** | BC522 | BC522 | | |
| ***BC523** | BC523 | BC523 | 3-30 | SS8 |
| ***BC526** | BC526 | BC526 | 3-32 | SS33 |
| ***BC526A** | BC526A | BC526 | 3-32 | SS33 |
| ***BC526B** | BC526B | BC526 | 3-32 | SS33 |
| ***BC526C** | BC526C | BC526 | 3-32 | SS33 |
| ***BC527** | BC527 | BC527 | 3-28 | SS24 |
| ***BC527-6** | BC527-6 | BC527 | 3-28 | SS24 |
| ***BC527-10** | BC527-10 | BC527 | 3-28 | SS24 |
| ***BC527-16** | BC527-16 | BC527 | 3-28 | SS24 |
| ***BC527-25** | BC527-25 | BC527 | 3-28 | SS24 |
| ***BC528** | BC528 | BC527 | 3-28 | SS24 |
| ***BC528-6** | BC528-6 | BC527 | 3-28 | SS24 |
| ***BC528-10** | BC528-10 | BC527 | 3-28 | SS24 |
| ***BC528-16** | BC528-16 | BC527 | 3-28 | SS24 |
| ***BC528-25** | BC528-25 | BC527 | 3-28 | SS24 |
| ***BC530** | BC530 | BC530 | 3-34 | SS25 |
| ***BC531** | BC531 | BC530 | 3-34 | SS25 |
| ***BC532** | BC532 | BC532 | 3-33 | |
| ***BC533** | BC533 | BC532 | 3-33 | |
| ***BC534** | BC534 | BC534 | 3-28 | SS24 |
| ***BC535** | BC535 | BC534 | 3-24 | SS17 |
| ***BC537** | BC537 | BC527 | 3-24 | SS17 |
| ***BC537-6** | BC537-6 | BC527 | 3-24 | SS17 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| *BC537-10 | BC537-10 | BC527 | 3-24 | SS17 |
| *BC537-16 | BC537-16 | BC527 | 3-24 | SS17 |
| *BC537-25 | BC537-25 | BC527 | 3-24 | SS17 |
| *BC538 | BC538 | BC527 | 3-24 | SS17 |
| *BC538-6 | BC538-6 | BC527 | 3-24 | SS17 |
| *BC538-10 | BC538-10 | BC527 | 3-24 | SS17 |
| *BC538-16 | BC528-16 | BC527 | 3-24 | SS17 |
| *BC538-25 | BC538-25 | BC527 | 3-24 | SS17 |
| BC582 | BC317 | BC317 | | SS18 |
| BC582A | BC317A | BC317 | | SS18 |
| BC582B | BC317B | BC317 | | SS18 |
| BC583 | BC318 | BC317 | | SS18 |
| BC583A | BC318A | BC317 | | SS18 |
| BC583B | BC318B | BC317 | | SS18 |
| BC583C | BC318C | BC317 | | SS18 |
| BC584 | BC319 | BC317 | | SS18 |
| BC584B | BC319B | BC317 | | SS18 |
| BC584C | BC319C | BC317 | | SS18 |
| BCY42 | 2N2221 | 2N2218 | | SS15 |
| BCY43 | 2N2222 | 2N2218 | | SS15 |
| BCY58 | 2N3947 | 2N3946 | | SS14 |
| BCY59 | 2N3947 | 2N3946 | | SS14 |
| BCY65E | 2N3947 | 2N3946 | | SS14 |
| BCY70 | BCY70 | | 3-25 | |
| BCY71 | BCY71 | | 3-25 | |
| BCY72 | BCY72 | | 3-25 | |
| BCY78 | 2N3962 | 2N3962 | | SS33 |
| BCY78IX | 2N3964 | 2N3962 | | SS33 |
| BCY78VII | 2N3962 | 2N3962 | | SS33 |
| BCY78VIII | 2N3964 | 2N3962 | | SS33 |
| BCY78X | 2N3964 | 2N3962 | | SS33 |
| BCY79 | 2N3962 | 2N3962 | | SS33 |
| BCY79IX | 2N3964 | 2N3962 | | SS33 |
| BCY79VII | 2N3962 | 2N3962 | | SS33 |
| BCY79VIII | 2N3964 | 2N3962 | | SS33 |
| *BD115 | BD115 | BD115 | 3-33 | |
| BD124 | 2N3054 | 2N3054 | | PWR5 |
| BD130 | 2N3055 | 2N3055 | | PWR6 |
| BD135 | CF | | | |
| BD136 | CF | | | |
| BD137 | CF | | | |
| BD138 | CF | | | |
| BD139 | CF | | | |
| BD140 | CF | | | |
| BD142 | 2N3055 | 2N3055 | | PWR6 |
| BD162 | 2N4910 | 2N4231 | | PWR5 |
| BD163 | 2N4910 | 2N4231 | | PWR5 |
| BD181 | 2N4913 | 2N4913 | | PWR6 |
| BD182 | 2N3055 | 2N3055 | | PWR6 |
| BD183 | 2N3716 | 2N3713 | | PWR6 |
| *BD220 | BD220 | BD220 | 3-37 | PWR5 |
| *BD221 | BD221 | BD220 | 3-37 | PWR5 |

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|---|---|---|---|---|
| *BD222 | BD222 | BD220 | 3-37 | PWR5 |
| *BD223 | BD223 | BD223 | 3-37 | PWR14 |
| *BD224 | BD224 | BD223 | 3-37 | PWR14 |
| *BD225 | BD225 | BD223 | 3-37 | PWR14 |
| BD239 | 2N6121 | 2N6121 | | PWR5 |
| BD239A | 2N6122 | 2N6121 | | PWR5 |
| BD239B | 2N6123 | 2N6121 | | PWR5 |
| BD240 | 2N6124 | 2N6124 | | PWR14 |
| BD240A | 2N6125 | 2N6124 | | PWR14 |
| BD240B | 2N6126 | 2N6124 | | PWR14 |
| BD241 | 2N6121 | 2N6121 | | PWR5 |
| BD241A | 2N6122 | 2N6121 | | PWR5 |
| BD241B | 2N6123 | 2N6121 | | PWR5 |
| BD242 | 2N6124 | 2N6124 | | PWR14 |
| BD242A | 2N6125 | 2N6124 | | PWR14 |
| BD242B | 2N6126 | 2N6124 | | PWR14 |
| BDX10 | 2N3055 | 2N3055 | | PWR6 |
| BDX13 | 2N5301 | 2N5301 | | PWR7 |
| BDX22 | SE9051 | 2N6233 | | PWR9 |
| BDX24 | 2N5878 | 2N5877 | | PWR6 |
| BDX40 | 2N5302 | 2N5301 | | PWR7 |
| BDX41 | 2N5301 | | | PWR7 |
| BDY10 | 2N4907 | 2N4901 | | PWR15 |
| BDY11 | 2N4909 | 2N4901 | | PWR15 |
| BDY12 | 2N4910 | 2N4231 | | PWR5 |
| BDY13 | 2N3054 | 2N3054 | | PWR5 |
| BDY17 | 2N5301 | 2N5301 | | PWR7 |
| BDY18 | 2N5302 | 2N5302 | | PWR7 |
| BDY23 | 2N4914 | 2N4913 | | PWR6 |
| BDY24 | 2N4915 | 2N4913 | | PWR6 |
| BDY25 | 2N3055 | 2N3055 | | PWR6 |
| BDY38 | 2N4914 | 2N4913 | | PWR6 |
| BDY39 | 2N3055 | 2N3055 | | PWR6 |
| BDY55 | 2N3055 | 2N3055 | | PWR6 |
| BDY56 | 2N3055 | 2N3055 | | PWR6 |
| BDY71 | 2N3054 | 2N3054 | | PWR5 |
| BDY73 | 2N3715 | 2N3713 | | PWR6 |
| BDY76 | 2N5302 | 2N5301 | | PWR7 |
| BDY78 | 2N3054 | 2N3054 | | PWR5 |
| BF115 | 2N918 | 2N918 | | SS27 |
| BF152 | BF152 | | 3-35 | |
| BF153 | 2N3563 | 2N918 | | SS27 |
| BF154 | 2N3564 | 2N3564 | | SS2 |
| BF155 | SE5023 | SE5020 | | SS3 |
| BF156 | SE7002 | | | SS16 |
| BF157 | BF257 | BF257 | | |
| BF158 | 2N3563 | 2N918 | | SS27 |
| BF159 | BF159 | | 3-35 | |
| BF160 | BF160 | | 3-35 | |
| BF161 | SE5023 | SE5020 | | SS3 |
| BF162 | BF162 | | 3-35 | |
| BF163 | BF163 | | 3-35 | |
| BF165 | 2N3564 | 2N3564 | | SS2 |

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|---|---|---|---|---|
| **BF166** | SE5023 | SE5020 | | SS3 |
| ***BF167** | BF167 | BF167 | 3-34 | |
| **BF173** | SE5035 | SE5035 | | SS12 |
| **BF174** | BF257 | BF257 | | |
| **BF176** | PE5025 | PE5025 | | SS6 |
| **BF177** | SE7002 | | | SS16 |
| **BF178** | BF257 | BF257 | | |
| **BF179** | BF258 | BF257 | | |
| **BF180** | SE5020 | SE5020 | | SS3 |
| **BF181** | SE5020 | SE5020 | | SS3 |
| **BF182** | SE5020 | SE5020 | | SS3 |
| **BF183** | SE5020 | SE5020 | | SS3 |
| **BF184** | 2N3688 | 2N3688 | | SS1 |
| **BF185** | 2N3688 | 2N3688 | | SS1 |
| **BF194** | PN3688 | 2N3688 | | SS1 |
| **BF195** | PN3688 | 2N3688 | | SS1 |
| **BF196** | BF167 | BF167 | | |
| **BF197** | PE5030B | PE5029 | | SS12 |
| **BF198** | BF167 | BF167 | | |
| **BF199** | PE5030B | PE5029 | | SS12 |
| **BF200** | BF222 | BF222 | | |
| ***BF222** | BF222 | BF222 | 3-34 | SS3 |
| **BF244** | 2N5484 | 2N5484 | | |
| **BF245** | 2N5484 | 2N5484 | | |
| **BF251** | BF167 | BF167 | | |
| **BF254** | PN3688 | 2N3688 | | SS1 |
| **BF255** | PN3688 | 2N3688 | | SS1 |
| **BF256** | 2N5484 | 2N5484 | | |
| ***BF257** | BF257 | BF257 | 3-33 | |
| ***BF258** | BF258 | BF257 | 3-33 | |
| ***BF259** | BF259 | BF257 | 3-33 | |
| **BF270** | BF167 | BF167 | | |
| **BF271** | PE5030B | PE5029 | | SS12 |
| **BF273** | PE5029 | PE5029 | | SS12 |
| **BF274** | PE5029 | PE5029 | | SS12 |
| **BF311** | PE5025 | PE5025 | | SS6 |
| **BF314** | PE5010 | PE5010 | | SS19 |
| **BF334** | PN3688 | 2N3688 | | SS1 |
| **BF335** | PN3688 | 2N3688 | | SS1 |
| ***BF336** | BF336 | BF336 | 3-33 | |
| ***BF337** | BF337 | BF336 | 3-33 | |
| ***BF338** | BF338 | BF336 | 3-33 | |
| **BF350** | FT0601 | FT0601 | | SS26 |
| **BF351** | FT0601 | FT0601 | | SS26 |
| **BF352** | FT0601 | FT0601 | | SS26 |
| **BF353** | FT0601 | FT0601 | | SS26 |
| **BF354** | FT0601 | FT0601 | | SS26 |
| **BF456** | BF257 | BF257 | | |
| **BF457** | BF257 | BF257 | | |
| **BF458** | BF258 | BF257 | | |
| **BF459** | BF259 | BF257 | | |
| **BFR10** | 2N2218A | 2N2218A | | SS15 |
| **BFR11** | 2N2221A | 2N2218A | | SS15 |

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|---|---|---|---|---|
| **BFR16** | 2N2484 | 2N2484 | | SS8 |
| **BFR17** | 2N3117 | 2N2484 | | SS8 |
| **BFR18** | 2N871 | | | SS17 |
| **BFR19** | 2N3110 | 2N3107 | | SS17 |
| **BFR20** | 2N3109 | 2N3109 | | SS17 |
| **BFR21** | 2N3108 | 2N3107 | | SS17 |
| **BFR22** | 2N1893 | 2N1893 | | SS17 |
| **BFR23** | 2N4031 | 2N4030 | | SS24 |
| **BFR24** | 2N4032 | 2N4030 | | SS24 |
| **BFW19** | 2N3137 | 2N3137 | | SS2 |
| **BFW20** | 2N3962 | 2N3962 | | SS33 |
| **BFW22** | 2N3964 | 2N3962 | | SS33 |
| **BFW23** | 2N3965 | 2N3962 | | SS33 |
| **BFW29** | 2N2219A | 2N2218A | | SS15 |
| **BFW31** | 2N2907 | 2N2904 | | SS22 |
| **BFW32** | 2N2222 | 2N2218 | | SS15 |
| **BFW33** | 2N1893 | 2N1893 | | SS17 |
| **BFW36** | 2N3114 | | | SS16 |
| **BFW37** | 2N3114 | | | SS16 |
| **BFW39** | 2N2915 | 2N2915 | | SS8 |
| **BFW39A** | 2N2919A | 2N2915 | | SS8 |
| **BFW40** | 2N2916 | 2N2916 | | SS8 |
| **BFW41** | 2N918 | 2N918 | | SS27 |
| **BFW45** | SE7001 | | | SS16 |
| **BFW51** | 2N2974 | 2N2915 | | SS8 |
| **BFW51A** | 2N2978 | 2N2915 | | SS8 |
| **BFW52** | 2N2978 | 2N2915 | | SS8 |
| **BFW52A** | 2N2979 | 2N2915 | | SS8 |
| **BFW57** | PE6020 | PE6020 | | SS17 |
| **BFW58** | PE6020 | PE6020 | | SS17 |
| **BFW59** | PE6020 | PE6020 | | SS17 |
| **BFW60** | PE6020 | PE6020 | | SS17 |
| **BFW66** | 2N2219A | 2N2218A | | SS15 |
| **BFW67** | 2N5058 | 2N5058 | | SS11 |
| **BFW68** | 2N2222A | 2N2218A | | SS15 |
| **BFX11** | 2N3726 | 2N3726 | | SS22 |
| **BFX12** | 2N2894 | 2N2894 | | SS30 |
| **BFX13** | 2N2894 | 2N2894 | | SS30 |
| **BFX17** | 2N3725 | 2N3724 | | SS13 |
| **BFX18** | SE5023 | SE5020 | | SS3 |
| **BFX19** | SE5022 | SE5020 | | SS3 |
| **BFX20** | SE5021 | SE5020 | | SS3 |
| **BFX21** | SE5020 | SE5020 | | SS3 |
| **BFX29** | 2N2905A | 2N2904 | | SS22 |
| **BFX30** | 2N2905A | 2N2904 | | SS22 |
| **BFX31** | SE5023 | SE5020 | | SS3 |
| **BFX33** | 2N3137 | 2N3137 | | SS2 |
| ***BFX34** | BFX34 | BFX34 | 3-36 | PWR1 |
| **BFX35** | 2N3504 | | | SS22 |
| **BFX36** | 2N4024 | 2N4020 | | SS33 |
| ***BFX37** | BFX37 | BFX37 | 3-31 | SS33 |
| ***BFX38** | BFX38 | BFX38 | 3-25 | SS24 |
| ***BFX39** | BFX39 | BFX38 | 3-25 | SS24 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| *BFX40 | BFX40 | BFX38 | 3-26 | SS24 |
| *BFX41 | BFX41 | BFX38 | 3-26 | SS24 |
| BFX43 | 2N2369 | 2N2369 | | SS28 |
| BFX44 | 2N2368 | | | SS28 |
| BFX45 | 2N2222 | 2N2218 | | SS15 |
| BFX48 | BFX48 | | 3-25 | |
| BFX50 | 2N2222A | 2N2218A | | SS15 |
| BFX51 | 2N2221A | 2N2218A | | SS15 |
| BFX52 | 2N2222A | 2N2218A | | SS15 |
| BFX62 | 2N918 | 2N918 | | SS27 |
| BFX63 | 2N3962 | 2N3962 | | SS33 |
| BFX66 | 2N998 | 2N998 | | |
| BFX67 | 2N997 | 2N997 | | |
| BFX68 | 2N1711 | 2N718A | | SS15 |
| BFX68A | 2N1711 | 2N718A | | SS15 |
| BFX69 | 2N1613 | 2N718A | | SS15 |
| BFX69A | 2N3110 | 2N3107 | | SS17 |
| BFX73 | 2N918 | 2N918 | | SS27 |
| BFX75 | 2N1132 | | | SS22 |
| BFX84 | 2N3108 | 2N3107 | | SS17 |
| BFX85 | 2N3107 | 2N3107 | | SS17 |
| BFX86 | 2N3109 | 2N3107 | | SS17 |
| BFX87 | 2N2904A | 2N2904 | | SS22 |
| BFX88 | 2N2904 | 2N2904 | | SS22 |
| BFX93 | 2N930 | 2N930 | | SS8 |
| BFX93A | 2N2484 | 2N2484 | | SS8 |
| BFX94 | 2N2221 | 2N2218 | | SS15 |
| BFX95 | 2N2222 | 2N2218 | | SS15 |
| BFX96 | 2N2218 | 2N2218 | | SS15 |
| BFX97 | 2N2219 | 2N2218 | | SS15 |
| BFX98 | 2N3923 | 2N3923 | | SS16 |
| *BFY50 | BFY50 | BFY50 | 3-20 | SS17 |
| *BFY51 | BFY51 | BFY50 | 3-20 | SS17 |
| *BFY52 | BFY52 | BFY50 | 3-20 | SS17 |
| *BFY56 | BFY56 | BFY56 | | SS17 |
| BFY57 | BFY57 | | 3-33 | |
| BFY63 | 2N3137 | 2N3137 | | SS2 |
| *BFY64 | BFY64 | BFY64 | 3-25 | SS22 |
| BFY72 | 2N2218A | 2N2218A | 3-20 | SS15 |
| BFY74 | 2N915 | | | SS14 |
| BFY75 | 2N915 | | | SS14 |
| BFY77 | 2N930 | 2N930 | | SS8 |
| BSS10 | 2N3013 | 2N3009 | | SS5 |
| BSS11 | 2N2369A | 2N2369 | | SS28 |
| BSS12 | 2N3011 | | | SS28 |
| BSS30 | 2N1893 | 2N1893 | | SS17 |
| BSS31 | 2N3019 | 2N3019 | | SS17 |
| BSS32 | 2N1893 | 2N1893 | | SS17 |
| BSV64 | BFX34 | BFX34 | | PWR1 |
| BSV77 | 2N3725 | 2N3724 | | SS13 |
| BSV89 | 2N2368 | | | SS28 |
| BSV90 | 2N2369 | 2N2369 | | SS28 |
| BSV91 | 2N2369A | 2N2369 | | SS28 |
| BSV92 | 2N3011 | 2N3011 | | SS28 |
| BSW11 | 2N3646 | 2N3646 | | SS5 |
| BSW12 | 2N3646 | 2N3646 | | SS5 |
| BSW19 | 2N3014 | 2N3009 | | SS5 |
| BSW21 | 2N2906 | 2N2904 | | SS22 |
| BSW22 | 2N2907 | 2N2904 | | SS22 |
| BSW23 | 2N2904 | 2N2904 | | SS22 |
| BSW24 | 2N2906 | 2N2904 | | SS22 |
| BSW25 | 2N2894A | 2N2894 | | SS32 |
| BSW26 | 2N4047 | 2N3724 | | SS13 |
| BSW27 | 2N4047 | 2N3724 | | SS13 |
| BSW28 | 2N4047 | 2N3724 | | SS13 |
| BSW29 | 2N4046 | 2N3724 | | SS13 |
| BSW32 | 2N5830 | 2N5830 | | SS16 |
| BSW41 | 2N2221 | 2N2218 | | SS15 |
| BSW42 | BC317 | BC317 | | SS18 |
| BSW43 | BS318 | BC317 | | SS18 |
| BSW44 | BC321 | BC320 | | SS33 |
| BSW45 | BC322 | BC320 | | SS33 |
| BSW65 | 2N3019 | 2N3019 | | SS17 |
| BSW66 | 2N3019 | 2N3019 | | SS17 |
| BSW70 | 2N2222 | 2N2218 | | SS15 |
| BSW72 | 2N2906 | 2N2904 | | SS22 |
| BSW73 | 2N2907 | 2N2904 | | SS22 |
| BSW74 | 2N2906 | 2N2904 | | SS22 |
| BSW75 | 2N2907 | 2N2904 | | SS22 |
| BSW82 | 2N2221 | 2N2218 | | SS15 |
| BSW83 | 2N2222 | 2N2218 | | SS15 |
| BSW84 | 2N2221 | 2N2218 | | SS15 |
| BSW85 | 2N2222 | 2N2218 | | SS15 |
| BSW88 | 2N3694 | 2N3693 | | |
| BSW89 | 2N3694 | 2N3693 | | |
| BSX20 | BSX20 | | 3-17 | |
| BSX26 | BSX26 | | 3-17 | |
| BSX27 | BSX27 | | | |
| BSX28 | BSX28 | | 3-17 | |
| BSX29 | BSX29 | | 3-19 | |
| *BSX32 | BSX32 | BSX32 | 3-17 | SS13 |
| BSX33 | 2N3701 | 2N3701 | | SS17 |
| BSX36 | 2N2906 | 2N2904 | | SS22 |
| BSX39 | BSX39 | | 3-17 | |
| BSX44 | 2N709 | 2N709 | | SS29 |
| BSX48 | 2N4013 | 2N3724 | | SS13 |
| BSX49 | 2N4013 | 2N3724 | | SS13 |
| BSX59 | 2N3725 | 2N3724 | | SS13 |
| BSX60 | 2N3724 | 2N3724 | | SS13 |
| BSX61 | 2N3725 | 2N3724 | | SS13 |
| BSX62 | BFX34 | BFX34 | | PWR1 |
| BSX63 | BFX34 | BFX34 | | PWR1 |
| BSX66 | 2N2368 | | | SS28 |
| BSX67 | 2N744 | | | SS28 |
| BSX76 | 2N2369 | 2N2369 | | SS28 |
| BSX77 | 2N2369 | 2N2369 | | SS28 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| **BSX78** | 2N2369 | 2N2369 | | SS28 |
| **BSX87** | 2N914 | | | SS5 |
| **BSX87A** | 2N708 | | | SS5 |
| **BSX88** | 2N708 | | | SS5 |
| **BSX88A** | 2N914 | | | SS5 |
| **BSX90** | 2N2368 | | | SS28 |
| **BSX91** | 2N744 | | | SS5 |
| **BSX92** | 2N2368 | | | SS28 |
| **BSX93** | 2N2369 | 2N2369 | | SS28 |
| **BSY17** | 2N2368 | | | SS28 |
| **BSY18** | 2N744 | | | SS28 |
| **BSY19** | 2N708 | | | SS5 |
| **BSY38** | 2N2368 | | | SS28 |
| **BSY39** | 2N744 | | | SS28 |
| **BSY40** | 2N2894 | 2N2894 | | SS30 |
| **BSY41** | 2N2894 | 2N2894 | | SS30 |
| **BSY51** | 2N697 | | | |
| **BSY52** | 2N1711 | 2N718A | | |
| **BSY53** | 2N1613 | 2N718A | | |
| **BSY54** | 2N1711 | 2N718A | | |
| **BSY55** | 2N1893 | 2N1893 | | SS17 |
| **BSY56** | 2N3019 | 2N3019 | | SS17 |
| **BSY78** | 2N2222 | 2N2218 | | SS15 |
| **BSY79** | 2N3114 | | | |
| **BSY95** | 2N2369 | 2N2369 | | SS28 |
| **BSY95A** | 2N2369 | 2N2369 | | SS28 |
| **BUY24** | 2N5069 | 2N5067 | | PWR6 |
| **BUY46** | 2N3054 | 2N3054 | | PWR5 |
| **BUY68** | BFX34 | BFX34 | | PWR1 |
| **BZX43** | FCT1021 | FCT1021 | | D3 |
| **BZX44** | FCT1022 | FCT1021 | | D3 |
| **BZX45** | FCT1025 | FCT1021 | | |
| **BZX46C3V3** | 1N746A | 1N746 | | D8 |
| **BZX46C3V6** | 1N747A | 1N746 | | D8 |
| **BZX46D3V9** | 1N748A | 1N746 | | D8 |
| **BZX46C4V3** | 1N749A | 1N746 | | D8 |
| **BZX46C4V7** | 1N750A | 1N746 | | D8 |
| **BZX46C5V1** | 1N751A | 1N746 | | D8 |
| **BZX46C5V6** | 1N752A | 1N746 | | D8 |
| **BZX46C6V2** | 1N753A | 1N746 | | D8 |
| **BZX46C6V8** | 1N754A | 1N746 | | D8 |
| **BZX46C7V5** | 1N755A | 1N746 | | D8 |
| **BZX46C8V2** | 1N756A | 1N746 | | D8 |
| **BZX46C9V1** | 1N757A | 1N746 | | D8 |
| **BZX46C10** | 1N758A | 1N746 | | D8 |
| **BZX46C11** | 1N962B | 1N957 | | D8 |
| **BZX46C12** | 1N963B | 1N957 | | D8 |
| **BZX46C13** | 1N964B | 1N957 | | D8 |
| **BZX46C15** | 1N965B | 1N957 | | D8 |
| **BZX46C16** | 1N966B | 1N957 | | D8 |
| **BZX46C18** | 1N967B | 1N957 | | D8 |
| **BZX46C20** | 1N968B | 1N957 | | D8 |
| **BZX46C22** | 1N969B | 1N957 | | D8 |
| **BZX46C24** | 1N970B | 1N957 | | D8 |
| **BZX46C27** | 1N971B | 1N957 | | D8 |
| **BZX46C30** | 1N972B | 1N957 | | D8 |
| **BZX46C33** | 1N973B | 1N957 | | D8 |
| **BZX63C6V8** | 1N957B | 1N957 | | D8 |
| **BZX63C7V5** | 1N958B | 1N957 | | D8 |
| **BZX63C8V2** | 1N959B | 1N957 | | D8 |
| **BZX63C9V1** | 1N960B | 1N957 | | D8 |
| **BZX63C10** | 1N961B | 1N957 | | D8 |
| **BZX64C11** | 1N962B | 1N957 | | D8 |
| **BZX64C12** | 1N963B | 1N957 | | D8 |
| **BZX64C13** | 1N964B | 1N957 | | D8 |
| **BZX64C15** | 1N965B | 1N957 | | D8 |
| **BZX64C16** | 1N966B | 1N957 | | D8 |
| **BZX64C18** | 1N967B | 1N957 | | D8 |
| **BZX64C20** | 1N968B | 1N957 | | D8 |
| **BZX64C22** | 1N969B | 1N957 | | D8 |
| **BZX64C24** | 1N970B | 1N957 | | D8 |
| **BZX64C27** | 1N971B | 1N957 | | D8 |
| **BZX65C30** | 1N972B | 1N957 | | D8 |
| **BZX65C33** | 1N973B | 1N957 | | D8 |
| **BZX71C5V1** | 1N751A | 1N746 | | D8 |
| **BZX71C5V6** | 1N752A | 1N746 | | D8 |
| **BZX71C6V2** | 1N753A | 1N746 | | D8 |
| **BZX71C6V8** | 1N957B | 1N957 | | D8 |
| **BZX71C7V5** | 1N958B | 1N957 | | D8 |
| **BZX71C8V2** | 1N959B | 1N957 | | D8 |
| **BZX71C9V1** | 1N960B | 1N957 | | D8 |
| **BZX71C10** | 1N961B | 1N957 | | D8 |
| **BZX71C11** | 1N962B | 1N957 | | D8 |
| **BZX71C12** | 1N963B | 1N957 | | D8 |
| **BZX71C13** | 1N964B | 1N957 | | D8 |
| **BZX71C15** | 1N965B | 1N957 | | D8 |
| **BZX71C16** | 1N966B | 1N957 | | D8 |
| **BZX71C18** | 1N967B | 1N957 | | D8 |
| **BZX71C20** | 1N968B | 1N957 | | D8 |
| **BZX71C22** | 1N969B | 1N957 | | D8 |
| **BZX71C24** | 1N970B | 1N957 | | D8 |
| **BZX79C4V7** | 1N750A | 1N746 | | D8 |
| **BZX79C5V1** | 1N751A | 1N746 | | D8 |
| **BZX79C5V6** | 1N752A | 1N746 | | D8 |
| **BZX79C6V2** | 1N753A | 1N746 | | D8 |
| **BZX79C6V8** | 1N957B | 1N957 | | D8 |
| **BZX79C7V5** | 1N958B | 1N957 | | D8 |
| **BZX79C8V2** | 1N959B | 1N957 | | D8 |
| **BZX79C9V1** | 1N960B | 1N957 | | D8 |
| **BZX79C10** | 1N961B | 1N957 | | D8 |
| **BZX79C11** | 1N962B | 1N957 | | D8 |
| **BZX79C12** | 1N963B | 1N957 | | D8 |
| **BZX79C13** | 1N964B | 1N957 | | D8 |
| **BZX79C15** | 1N965B | 1N957 | | D8 |
| **BZX79C16** | 1N966B | 1N957 | | D8 |
| **BZX79C18** | 1N967B | 1N957 | | D8 |

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|---|---|---|---|---|
| **BZX79C20** | 1N968B | 1N957 | | D8 |
| **BZX79C22** | 1N969B | 1N957 | | D8 |
| **BZX79C24** | 1N970B | 1N957 | | D8 |
| **BZX79C27** | 1N971B | 1N957 | | D8 |
| **BZX79C30** | 1N972B | 1N957 | | D8 |
| **BZX79C33** | 1N973B | 1N957 | | D8 |
| **BZY85C4V3** | 1N749A | 1N746 | | D8 |
| **BZY85C4V7** | 1N750A | 1N746 | | D8 |
| **BZY85C5V1** | 1N751A | 1N746 | | D8 |
| **BZY85C5V6** | 1N752A | 1N746 | | D8 |
| **BZY85C6V2** | 1N753A | 1N746 | | D8 |
| **BZY85C6V8** | 1N754A | 1N746 | | D8 |
| **BZY85C7V5** | 1N755A | 1N746 | | D8 |
| **BZY85C8V2** | 1N756A | 1N746 | | D8 |
| **BZY85C9V1** | 1N757A | 1N746 | | D8 |
| **BZY85C10** | 1N758A | 1N746 | | D8 |
| **BZY85C11** | 1N962B | 1N957 | | D8 |
| **BZY85C12** | 1N963B | 1N957 | | D8 |
| **BZY85C13** | 1N964B | 1N957 | | D8 |
| **BZY85C15** | 1N965B | 1N957 | | D8 |
| **BZY85C16** | 1N966B | 1N957 | | D8 |
| **BZY85C18** | 1N967B | 1N957 | | D8 |
| **BZY85C20** | 1N968B | 1N957 | | D8 |
| **BZY85C22** | 1N969B | 1N957 | | D8 |
| **BZY85C24** | 1N970B | 1N957 | | D8 |
| **BZY85C27** | 1N971B | 1N957 | | D8 |
| **BZY85C30** | 1N972B | 1N957 | | D8 |
| **BZY85C33** | 1N973B | 1N957 | | D8 |
| **BZY85D4V7** | 1N750 | 1N746 | | D8 |
| **BZY85D5V6** | 1N752 | 1N746 | | D8 |
| **BZY85D6V8** | 1N754 | 1N746 | | D8 |
| **BZY85D8V2** | 1N756 | 1N746 | | D8 |
| **BZY85D10** | 1N758 | 1N746 | | D8 |
| **BZY85D12** | 1N759 | 1N746 | | D8 |
| **BZY85D15** | 1N965A | 1N957 | | D8 |
| **BZY85D18** | 1N967A | 1N957 | | D8 |
| **BZY85D22** | 1N969A | 1N957 | | D8 |
| **BZY88C3V3** | 1N746A | 1N746 | | D8 |
| **BZY88C3V6** | 1N747A | 1N746 | | D8 |
| **BZY88C3V9** | 1N748A | 1N746 | | D8 |
| **BZY88C4V3** | 1N749A | 1N746 | | D8 |
| **BZY88C4V7** | 1N750A | 1N746 | | D8 |
| **BZY88C5V1** | 1N751A | 1N746 | | D8 |
| **BZY88C5V6** | 1N752A | 1N746 | | D8 |
| **BZY88C6V2** | 1N753A | 1N746 | | D8 |
| **BZY88C6V8** | 1N754A | 1N746 | | D8 |
| **BZY88C7V5** | 1N755A | 1N746 | | D8 |
| **BZY88C8V2** | 1N756A | 1N746 | | D8 |
| **BZY88C9V1** | 1N757A | 1N746 | | D8 |
| **BZY88C10** | 1N961B | 1N957 | | D8 |
| **BZY88C11** | 1N962B | 1N957 | | D8 |
| **BZY88C12** | 1N963B | 1N957 | | D8 |
| **BZY88C13** | 1N964B | 1N957 | | D8 |

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|---|---|---|---|---|
| **BZY88C15** | 1N965B | 1N957 | | D8 |
| **BZY88C16** | 1N966B | 1N957 | | D8 |
| **BZY88C18** | 1N967B | 1N957 | | D8 |
| **BZY88C20** | 1N968B | 1N957 | | D8 |
| **BZY88C22** | 1N969B | 1N957 | | D8 |
| **BZY88C24** | 1N970B | 1N957 | | D8 |
| **BZY88C27** | 1N971B | 1N957 | | D8 |
| **BZY88C30** | 1N972B | 1N957 | | D8 |
| **BZY88C33** | 1N973B | 1N957 | | D8 |
| D12A8 | 2N3728 | 2N3728 | | SS15 |
| D12E026 | 2N3728 | 2N3728 | | SS15 |
| D12E126 | 2N2976 | 2N2917 | | SS8 |
| D16G6 | 2N5770 | 2N918 | | SS27 |
| D16P1 | MPSA13 | MPSA13 | | SS20 |
| D29E1 | 2N4402 | 2N4402 | | SS22 |
| D29E1J1 | 2N4402 | 2N4402 | | SS22 |
| D29E2 | 2N4403 | 2N4402 | | SS22 |
| D29E2J1 | 2N4403 | 2N4402 | | SS22 |
| D29E4 | 2N4402 | 2N4402 | | SS22 |
| D29E4K1 | 2N4402 | 2N4402 | | SS22 |
| D29E5 | 2N4403 | 2N4402 | | SS22 |
| D29E5J1 | 2N4403 | 2N4402 | | SS22 |
| D29E6 | 2N4403 | 2N4402 | | SS22 |
| D29E6J1 | 2N4403 | 2N4402 | | SS22 |
| D29E7 | 2N4403 | 2N4402 | | SS22 |
| D29E7J1 | 2N4403 | 2N4402 | | SS22 |
| D29E9 | MPSA05 | MPSA05 | | SS17 |
| D29E9J1 | MPSA05 | MPSA05 | | SS17 |
| D29E10 | MPSA05 | MPSA05 | | SS17 |
| D29E10J1 | MPSA05 | MPSA05 | | SS17 |
| D29F1 | 2N3905 | 2N3905 | | SS23 |
| D29F2 | 2N3905 | 2N3905 | | SS23 |
| D29F3 | 2N3906 | 2N3905 | | SS23 |
| D29F4 | 2N5087 | 2N5086 | | SS33 |
| D29F5 | 2N5086 | 2N5086 | | SS33 |
| D29F6 | 2N5086 | 2N5086 | | SS33 |
| D29F7 | 2N5087 | 2N5086 | | SS33 |
| D32K1 | 2N5845 | 2N5845 | | SS13 |
| D32K2 | 2N5845 | 2N5845 | | SS13 |
| D32P1 | PE5025 | PE5025 | | SS6 |
| D32P2 | 2N4123 | 2N4123 | | SS14 |
| D32P3 | 2N4123 | 2N4123 | | SS14 |
| D32P4 | 2N4124 | 2N4123 | | SS14 |
| D33D21 | 2N4400 | 2N4400 | | SS15 |
| D33D21J1 | 2N4400 | 2N4400 | | SS15 |
| D33D22 | 2N4401 | 2N4400 | | SS15 |
| D33D22J1 | 2N4401 | 2N4400 | | SS15 |
| D33D24 | 2N4400 | 2N4400 | | SS15 |
| D33D24J1 | 2N4400 | 2N4400 | | SS15 |
| D33D25 | 2N4401 | 2N4400 | | SS15 |
| D33D25J1 | 2N4401 | 2N4400 | | SS15 |
| D33D26 | 2N4401 | 2N4400 | | SS15 |
| D33D26J1 | 2N4401 | 2N4400 | | SS15 |

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|---|---|---|---|---|
| D33D27 | 2N4401 | 2N4400 | | SS15 |
| D33D27J1 | 2N4401 | 2N4400 | | SS15 |
| D33D29 | MPSA55 | MPSA55 | | SS24 |
| D33D29J1 | MPSA55 | MPSA55 | | SS24 |
| D33D30 | MPSA55 | MPSA55 | | SS24 |
| D33D30J1 | MPSA55 | MPSA55 | | SS24 |
| D40N1 | SE7055 | SE7055 | | SS11 |
| D40N2 | SE7055 | SE7055 | | SS11 |
| D40N3 | SE7056 | SE7055 | | SS11 |
| D40N4 | SE7056 | SE7055 | | SS11 |
| D42C1 | 2N6121 | 2N6121 | | PWR5 |
| D42C2 | 2N6121 | 2N6121 | | PWR5 |
| D42C3 | 2N6121 | 2N6121 | | PWR5 |
| D42C4 | 2N6121 | 2N6121 | | PWR5 |
| D42C5 | 2N6121 | 2N6121 | | PWR5 |
| D42C6 | 2N6121 | 2N6121 | | PWR5 |
| D42C7 | 2N6122 | 2N6121 | | PWR5 |
| D42C8 | 2N6122 | 2N6121 | | PWR5 |
| D42C9 | 2N6122 | 2N6121 | | PWR5 |
| D42C10 | 2N6123 | 2N6121 | | PWR5 |
| D42C11 | 2N6123 | 2N6121 | | PWR5 |
| D43C1 | 2N6124 | 2N6124 | | PWR14 |
| D43C2 | 2N6124 | 2N6124 | | PWR14 |
| D43C3 | 2N6124 | 2N6124 | | PWR14 |
| D43C4 | 2N6124 | 2N6124 | | PWR14 |
| D43C5 | 2N6124 | 2N6124 | | PWR14 |
| D43C6 | 2N6124 | 2N6124 | | PWR14 |
| D43C7 | 2N6125 | 2N6124 | | PWR14 |
| D43C8 | 2N6125 | 2N6124 | | PWR14 |
| D43C9 | 2N6125 | 2N6124 | | PWR14 |
| D43C10 | 2N6126 | 2N6124 | | PWR14 |
| D43C11 | 2N6126 | 2N6124 | | PWR14 |
| D44C1 | 2N6121 | 2N6121 | | PWR5 |
| D44C2 | 2N6121 | 2N6121 | | PWR5 |
| D44C3 | 2N6121 | 2N6121 | | PWR5 |
| D44C4 | 2N6121 | 2N6121 | | PWR5 |
| D44C5 | 2N6121 | 2N6121 | | PWR5 |
| D44C6 | 2N6121 | 2N6121 | | PWR5 |
| D44C7 | 2N6122 | 2N6121 | | PWR5 |
| D44C8 | 2N6122 | 2N6121 | | PWR5 |
| D44C9 | 2N6122 | 2N6121 | | PWR5 |
| D44C10 | 2N6123 | 2N6121 | | PWR5 |
| D44C11 | 2N6123 | 2N6121 | | PWR5 |
| D44H1 | 2N6129 | 2N6129 | | PWR10 |
| D44H2 | 2N6129 | 2N6129 | | PWR10 |
| D44H4 | 2N6129 | 2N6129 | | PWR10 |
| D44H5 | 2N6129 | 2N6129 | | PWR10 |
| D44H7 | 2N6130 | 2N6129 | | PWR10 |
| D44H8 | 2N6130 | 2N6129 | | PWR10 |
| D44H10 | 2N6131 | 2N6129 | | PWR10 |
| D45C1 | 2N6124 | 2N6124 | | PWR14 |
| D45C2 | 2N6124 | 2N6124 | | PWR14 |
| D45C3 | 2N6124 | 2N6124 | | PWR14 |
| D45C4 | 2N6124 | 2N6124 | | PWR14 |
| D45C5 | 2N6124 | 2N6124 | | PWR14 |
| D45C6 | 2N6124 | 2N6124 | | PWR14 |
| D45C7 | 2N6125 | 2N6124 | | PWR14 |
| D45C8 | 2N6125 | 2N6124 | | PWR14 |
| D45C9 | 2N6125 | 2N6124 | | PWR14 |
| D45C10 | 2N6126 | 2N6124 | | PWR14 |
| D45C11 | 2N6126 | 2N6124 | | PWR14 |
| D45H1 | 2N6132 | 2N6132 | | PWR17 |
| D45H2 | 2N6132 | 2N6132 | | PWR17 |
| D45H4 | 2N6132 | 2N6132 | | PWR17 |
| D45H5 | 2N6132 | 2N6132 | | PWR17 |
| D45H7 | 2N6133 | 2N6132 | | PWR17 |
| D45H8 | 2N6133 | 2N6132 | | PWR17 |
| D45H10 | 2N6134 | 2N6132 | | PWR17 |
| DA1701 | 1N4148 | 1N914 | | D6 |
| DA1702 | 1N4148 | 1N914 | | D6 |
| DA1703 | 1N4148 | 1N914 | | D6 |
| DA1704 | 1N4148 | 1N914 | | D6 |
| DN918** | DN918 | | 3-36 | SS27 |
| DN2222A** | DN2222A | | 3-36 | SS15 |
| DN2369A** | DN2369A | | 3-36 | SS28 |
| DN2484** | DN2484 | | 3-45 | SS8 |
| DN2894 | DN2894 | | | |
| DN2907** | DN2907 | | 3-45 | SS22 |
| DN3014** | DN3014 | | 3-45 | SS5 |
| DN3019** | DN3019 | | 3-45 | SS17 |
| DN3250** | DN3250 | | 3-45 | |
| DN3468** | DN3468 | | 3-45 | SS7 |
| DN3725** | DN3725 | | 3-45 | SS13 |
| DN3742** | DN3742 | | 3-45 | |
| DN3904** | DN3904 | | 3-45 | SS14 |
| DN3906** | DN3906 | | 3-45 | SS23 |
| DN3923** | DN3923 | | 3-45 | SS16 |
| DN3930** | DN3930 | | 3-45 | SS25 |
| DN3962** | DN3962 | | 3-45 | SS33 |
| DN4033** | DN4033 | | 3-45 | SS24 |
| DN4209** | DN4209 | | 3-45 | SS31 |
| DN5455** | DN5455 | | 3-45 | SS21 |
| DT230A | FDH400 | FD400 | | D4 |
| DT230B | FDH400 | FD400 | | D4 |
| DT230F | FDH400 | FD400 | | D4 |
| DT230G | FDH400 | FD400 | | D4 |
| DT230HI | FDH400 | FD400 | | D4 |
| EN697 | EN697 | | 3-23 | SS15 |
| EN706 | EN706 | | 3-18 | SS28 |
| EN708 | EN708 | | 3-18 | SS28 |
| EN718A | EN718A | | 3-23 | SS15 |
| EN722 | EN722 | | 3-27 | SS22 |
| EN744 | EN744 | | 3-18 | SS28 |
| EN870 | EN870 | | 3-24 | SS17 |
| EN871 | EN871 | | 3-24 | SS17 |
| EN914 | EN914 | | 3-18 | SS5 |

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|---|---|---|---|---|
| EN915 | EN915 | | 3-24 | SS14 |
| EN916 | EN916 | | 3-22 | SS14 |
| EN918 | EN918 | | 3-35 | SS27 |
| EN930 | EN930 | | 3-30 | SS8 |
| EN956 | EN956 | | 3-23 | SS15 |
| EN1132 | EN1132 | | 3-27 | SS22 |
| EN1613 | EN1613 | | 3-23 | SS15 |
| EN1711 | EN1711 | | 3-23 | SS15 |
| EN2219 | EN2219 | | 3-23 | SS15 |
| EN2222 | EN2222 | | 3-23 | SS15 |
| EN2369A | EN2369A | | 3-18 | SS28 |
| EN2484 | EN2484 | | 3-30 | SS8 |
| EN2894A | EN2894A | | 3-19 | SS32 |
| EN2905 | EN2905 | | 3-28 | SS22 |
| EN2907 | EN2907 | | 3-28 | SS22 |
| EN3009 | EN3009 | | 3-18 | SS5 |
| EN3011 | EN3011 | | 3-18 | SS28 |
| EN3013 | EN3013 | | 3-18 | SS5 |
| EN3014 | EN3014 | | 3-18 | SS5 |
| EN3250 | EN3250 | | 3-27 | SS23 |
| EN3502 | EN3502 | | 3-28 | SS22 |
| EN3504 | EN3504 | | 3-28 | SS22 |
| EN3903 | EN3903 | | 3-23 | SS14 |
| EN3904 | EN3904 | | 3-23 | SS14 |
| EN3905 | EN3905 | | 3-27 | SS23 |
| EN3906 | EN3906 | | 3-27 | SS23 |
| EN3962 | EN3962 | | 3-32 | SS33 |
| EN4123 | EN4123 | | 3-22 | SS14 |
| EN4124 | EN4124 | | 3-22 | SS14 |
| EN4125 | EN4125 | | 3-27 | SS23 |
| EN4126 | EN4126 | | 3-27 | SS23 |
| EN5172 | EN5172 | | 3-22 | SS8 |
| *FA2310E | FA2310E | FA2310E | | D6 |
| *FA2310U | FA2310U | FA2310E | | D6 |
| *FA2311E | FA2311E | FA2310E | | D6 |
| *FA2311U | FA2311U | FA2310E | | D6 |
| *FA2312E | FA2312E | FA2310E | | D6 |
| *FA2312U | FA2312U | FA2310E | | D6 |
| *FA2313E | FA2313E | FA2310E | | D6 |
| *FA2313U | FA2313U | FA2310E | | D6 |
| *FA2320E | FA2320E | FA2310E | | D4 |
| *FA2320U | FA2320U | FA2310E | | D4 |
| *FA2321E | FA2321E | FA2310E | | D4 |
| *FA2321U | FA2321U | FA2310E | | D4 |
| *FA2322E | FA2322E | FA2310E | | D4 |
| *FA2322U | FA2322U | FA2310E | | D4 |
| *FA2323E | FA2323E | FA2310E | | D4 |
| *FA2323U | FA2323U | FA2310E | | D4 |
| *FA2324E | FA2324E | FA2310E | | D4 |
| *FA2324U | FA2324U | FA2310E | | D4 |
| *FA2325E | FA2325E | FA2310E | | D4 |
| *FA2325U | FA2325U | FA2310E | | D4 |
| *FA2330E | FA2330E | FA2310E | | D5 |

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| *FA2331E | FA2331E | FA2310E | | D5 |
| *FA2331U | FA2331U | FA2310E | | D5 |
| *FA2332E | FA2332E | FA2310E | | D5 |
| *FA2332U | FA2332U | FA2310E | | D5 |
| *FA2333E | FA2333E | FA2310E | | D5 |
| *FA2333U | FA2333U | FA2310E | | D5 |
| *FA2334E | FA2334E | FA2310E | | D5 |
| *FA2334U | FA2334U | FA2310E | | D5 |
| *FA2335E | FA2335E | FA2310E | | D5 |
| *FA2335U | FA2335U | FA2310E | | D5 |
| *FA2360E | FA2360E | FA2310E | | D6 |
| *FA2360U | FA2360U | FA2310E | | D6 |
| *FA2361E | FA2361E | FA2310E | | D6 |
| *FA2361U | FA2361U | FA2310E | | D6 |
| *FA3310 | FA3310 | FA2310E | | D6 |
| *FA3311 | FA3311 | FA2310E | | D6 |
| *FA3312 | FA3312 | FA2310E | | D6 |
| *FA3313 | FA3313 | FA2310E | | D6 |
| *FA3320 | FA3320 | FA3210E | | D4 |
| *FA3321 | FA3321 | FA2310E | | D4 |
| *FA3322 | FA3322 | FA2310E | | D4 |
| *FA3323 | FA3323 | FA2310E | | D4 |
| *FA3324 | FA3324 | FA2310E | | D4 |
| *FA3325 | FA3325 | FA2310E | | D4 |
| *FA3330 | FA3330 | FA2310E | | D5 |
| *FA3331 | FA3331 | FA2310E | | D5 |
| *FA3332 | FA3332 | FA2310E | | D5 |
| *FA3333 | FA3333 | FA2310E | | D5 |
| *FA3334 | FA3334 | FA2310E | | D5 |
| *FA3335 | FA3335 | FA2310E | | D5 |
| *FA3360 | FA3360 | FA2310E | | D6 |
| *FA3361 | FA3361 | FA2310E | | D6 |
| *FA4310E | FA4310E | FA2310E | | D6 |
| *FA4310U | FA4310U | FA2310E | | D6 |
| *FA4311E | FA4311E | FA2310E | | D6 |
| *FA4311U | FA4311U | FA2310E | | D6 |
| *FA4312E | FA4312E | FA2310E | | D6 |
| *FA4312U | FA4312U | FA2310E | | D6 |
| *FA4313E | FA4313E | FA2310E | | D6 |
| *FA4313U | FA4313U | FA2310E | | D6 |
| *FA4320E | FA4320E | FA2310E | | D4 |
| *FA4320U | FA4320U | FA2310E | | D4 |
| *FA4321E | FA4321E | FA2310E | | D4 |
| *FA4321U | FA4321U | FA2310E | | D4 |
| *FA4322E | FA4322E | FA2310E | | D4 |
| *FA4322U | FA4322U | FA2310E | | D4 |
| *FA4323E | FA4323E | FA2310E | | D4 |
| *FA4323U | FA4323U | FA2310E | | D4 |
| *FA4324E | FA4324E | FA2310E | | D4 |
| *FA4324U | FA4324U | FA2310E | | D4 |
| *FA4325E | FA4325E | FA2310E | | D4 |
| *FA4325U | FA4325U | FA2310E | | D4 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
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| *FA4331E | FA4331E | FA2310E | | D5 |
| *FA4331U | FA4331U | FA2310E | | D5 |
| *FA4332E | FA4332E | FA2310E | | D5 |
| *FA4332U | FA4332U | FA2310E | | D5 |
| *FA4333E | FA4333E | FA2310E | | D5 |
| *FA4333U | FA4333U | FA2310E | | D5 |
| *FA4334E | FA4334E | FA2310E | | D5 |
| *FA4334U | FA4334U | FA2310E | | D5 |
| *FA4335E | FA4335E | FA2310E | | D5 |
| *FA4335U | FA4335U | FA2310E | | D5 |
| *FA4360E | FA4360E | FA2310E | | D6 |
| *FA4360U | FA4360U | FA2310E | | D6 |
| *FA4361E | FA4361E | FA2310E | | D6 |
| *FA4361U | FA4361U | FA2310E | | D6 |
| *FCT1021 | FCT1021 | FCT1021 | 3-12 | D3 |
| *FCT1022 | FCT1022 | FCT1021 | 3-12 | D3 |
| *FCT1025 | FCT1025 | FCT1021 | 3-12 | |
| *FCT1121 | FCT1121 | FCT1021 | 3-12 | D3 |
| *FCT1122 | FCT1122 | FCT1021 | 3-12 | D3 |
| *FCT1125 | FCT1125 | FCT1021 | 3-12 | D3 |
| FD100 | 1N4153 | 1N4151 | | D6 |
| *FD300 | FD300 | FD300 | 3-8 | D5 |
| *FD333 | FD333 | FD300 | 3-8 | D5 |
| *FD400 | FD400 | FD400 | 3-5 | D4 |
| *FD444 | FD444 | FD400 | 3-5 | D4 |
| *FD600 | FD600 | FD600 | 3-3 | D6 |
| *FD666 | FD666 | FD600 | 3-4 | D6 |
| *FD700 | FD700 | FD700 | 3-3 | D7 |
| *FD777 | FD777 | FD700 | 3-3 | D7 |
| FDC485B** | FDC485B | | | D5 |
| FDC3070** | FDC3070 | | 3-16 | D4 |
| FDC3600** | FDC3600 | | 3-16 | D6 |
| FDC4376** | FDC4376 | | 3-16 | D7 |
| *FDH300 | FDH300 | FD300 | 3-8 | D5 |
| *FDH333 | FDH333 | FD300 | 3-8 | D5 |
| *FDH400 | FDH400 | FD400 | 3-5 | D4 |
| *FDH444 | FDH444 | FD400 | 3-5 | D4 |
| *FDH600 | FDH600 | FD600 | 3-3 | D6 |
| *FDH666 | FDH666 | FD600 | 3-4 | D6 |
| *FDH900 | FDH900 | FDH900 | 3-7 | D6 |
| *FDH999 | FDH999 | FDH900 | 3-7 | D6 |
| FDN400 | FDH400 | FD400 | | D4 |
| FDN444 | FDH444 | FD400 | | D4 |
| *FDN600 | FDN600 | FD600 | 3-3 | D6 |
| FDN666 | FDN666 | FD600 | 3-4 | D6 |
| *FDN700 | FDN700 | FD700 | | D7 |
| *FDN777 | FDN777 | FD700 | | D7 |
| FDS100 | FDS100 | | | SS24 |
| FDS200 | FDS200 | | | SS15 |
| FE3819 | 2N5486 | 2N5485 | | |
| FE4302 | 2N5486 | 2N5484 | | |
| FE4303 | 2N5486 | 2N5484 | | |
| FE4304 | 2N5486 | 2N5484 | | |
| FE5245 | 2N5485 | 2N5484 | | |
| FE5246 | 2N5485 | 2N5484 | | |
| FE5247 | 2N5486 | 2N5484 | | |
| FE5457 | 2N5457 | | | |
| FE5458 | 2N5458 | | | |
| FE5459 | 2N5459 | | | |
| FE5484 | 2N5484 | 2N5484 | | |
| FE5485 | 2N5485 | 2N5484 | | |
| FE5486 | 2N5486 | 2N5484 | | |
| *FH1100 | FH1100 | FH1100 | 3-9 | D12 |
| *FJT1100 | FJT1100 | FJT1100 | 3-8 | D2 |
| *FJT1101 | FJT1101 | FJT1100 | | D2 |
| *FJT2000 | FJT2000 | FJT1100 | 3-8 | D2 |
| *FPQ3467 | FPQ3467 | FPQ3467 | 3-44 | SS7 |
| *FPQ3468 | FPQ3468 | FPQ3467 | 3-44 | SS7 |
| *FPQ3724 | FPQ3724 | FPQ3724 | 3-44 | SS13 |
| *FPQ3725 | FPQ3725 | FPQ3724 | 3-44 | SS13 |
| *FQ3467 | FQ3467 | FPQ3467 | 3-44 | SS7 |
| *FQ3468 | FQ3468 | FPQ3467 | 3-44 | SS7 |
| *FQ3724 | FQ3724 | FPQ3724 | 3-44 | SS13 |
| *FQ3725 | FQ3725 | FPQ3724 | 3-44 | SS13 |
| FSA1169 | FSA2781M | FSA2702M | | D11 |
| FSA1171 | FSA2782M | FSA2702M | | D11 |
| FSA1172 | FSA2782M | FSA2702M | | D11 |
| FSA1173 | FSA2783M | FSA2702M | | D11 |
| FSA1174 | FSA2784M | FSA2702M | | D11 |
| FSA1175 | FSA2786M | FSA2702M | | D11 |
| FSA1176 | FSA1411M | FSA1410M | | D11 |
| FSA1177 | FSA2775M | FSA2702M | | D11 |
| FSA1178 | FSA2775M | FSA2702M | | D11 |
| FSA1179 | FSA2776M | FSA2702M | | D11 |
| FSA1181 | FSA2776M | FSA2702M | | D11 |
| FSA1182 | FSA2777M | FSA2702M | | D11 |
| FSA1183 | FSA2778M | FSA2702M | | D11 |
| FSA1184 | FSA2787M | FSA2702M | | D11 |
| FSA1185 | FSA2787M | FSA2702M | | D11 |
| FSA1186 | FSA2704M | FSA2702M | | D11 |
| FSA1187 | FSA2705M | FSA2702M | | D11 |
| FSA1188 | FSA2788M | FSA2702M | | D11 |
| FSA1189 | FSA2788M | FSA2702M | | D11 |
| FSA1191 | FSA2702M | FSA2702M | | D11 |
| FSA1192 | FSA2703M | FSA2702M | | D11 |
| FSA1193 | FSA2702M | FSA2702M | | D11 |
| FSA1194 | FSA2703M | FSA2702M | | D11 |
| FSA1195 | FSA2773M | FSA2702M | | D11 |
| FSA1196 | FSA2774M | FSA2702M | | D11 |
| FSA1197 | FSA2704M | FSA2702M | | D11 |
| FSA1198 | FSA2705M | FSA2702M | | D11 |
| FSA1199 | FSA2770M | FSA2702M | | D11 |
| FSA1201 | FSA2770M | FSA2702M | | D11 |
| FSA1202 | FSA2781M | FSA2702M | | D11 |

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|---|---|---|---|---|
| FSA1203 | FSA2783M | FSA2702M | | D11 |
| FSA1204 | FSA2785M | FSA2702M | | D11 |
| *FSA1410M | FSA1410M | FSA1410M | 3-13 | D11 |
| *FSA1411M | FSA1411M | FSA1410M | 3-13 | D11 |
| FSA1412M | FSA2502M | FSA2500M | | D11 |
| FSA1413M | FSA2788M | FSA2502M | | D11 |
| *FSA2002M | FSA2002M | FSA1410M | 3-13 | D11 |
| *FSA2003M | FSA2003M | FSA1410M | 3-13 | D11 |
| *FSA2500M | FSA2500M | FSA2500M | 3-13 | D11 |
| *FSA2501M | FSA2501M | FSA2500M | 3-13 | D11 |
| *FSA2502M | FSA2502M | FSA2500M | 3-13 | D11 |
| *FSA2503M | FSA2503M | FSA2500M | 3-13 | D11 |
| *FSA2504M | FSA2504M | FSA2500M | 3-13 | D11 |
| *FSA2508M | FSA2508M | FSA2500M | 3-13 | D11 |
| *FSA2509M | FSA2509M | FSA2500M | 3-13 | D11 |
| *FSA2510M | FSA2510M | FSA2500M | 3-13 | D11 |
| *FSA2563M | FSA2563M | FSA2563M | 3-13 | D11 |
| *FSA2564M | FSA2564M | FSA2563M | 3-13 | D11 |
| *FSA2565M | FSA2565M | FSA2563M | 3-13 | D11 |
| *FSA2566M | FSA2566M | FSA2563M | 3-13 | D11 |
| *FSA2619M | FSA2619M | FSA2619M | 3-13 | D11 |
| *FSA2620M | FSA2620M | FSA2619M | 3-13 | D11 |
| *FSA2621M | FSA2621M | FSA2619M | 3-13 | D11 |
| *FSA2702M | FSA2702M | FSA2702M | 3-14 | D11 |
| *FSA2703M | FSA2703M | FSA2702M | 3-14 | D11 |
| *FSA2704M | FSA2704M | FSA2702M | 3-14 | D11 |
| *FSA2705M | FSA2705M | FSA2702M | 3-14 | D11 |
| *FSA2719M | FSA2719M | FSA2619M | 3-13 | D11 |
| *FSA2720M | FSA2720M | FSA2619M | 3-13 | D11 |
| *FSA2721M | FSA2721M | FSA2619M | 3-13 | D11 |
| *FSA2770M | FSA2770M | FSA2702M | 3-14 | D11 |
| *FSA2771M | FSA2771M | FSA2702M | 3-15 | D11 |
| *FSA2772M | FSA2772M | FSA2702M | 3-15 | D11 |
| *FSA2773M | FSA2773M | FSA2702M | 3-15 | D11 |
| *FSA2774M | FSA2774M | FSA2702M | 3-15 | D11 |
| *FSA2775M | FSA2775M | FSA2702M | 3-15 | D11 |
| *FSA2776M | FSA2776M | FSA2702M | 3-15 | D11 |
| *FSA2777M | FSA2777M | FSA2702M | 3-15 | D11 |
| *FSA2778M | FSA2778M | FSA2702M | 3-14 | D11 |
| *FSA2779M | FSA2779M | FSA2702M | 3-14 | D11 |
| *FSA2780M | FSA2780M | FSA2702M | 3-14 | D11 |
| *FSA2781M | FSA2781M | FSA2702M | 3-15 | D11 |
| *FSA2782M | FSA2782M | FSA2702M | 3-15 | D11 |
| *FSA2783M | FSA2783M | FSA2702M | 3-15 | D11 |
| *FSA2784M | FSA2784M | FSA2702M | 3-14 | D11 |
| *FSA2785M | FSA2785M | FSA2702M | 3-14 | D11 |
| *FSA2786M | FSA2786M | FSA2702M | 3-14 | D11 |
| *FSA2787M | FSA2787M | FSA2702M | 3-15 | D11 |
| *FSA2788M | FSA2788M | FSA2702M | 3-13 | D11 |
| *FT0601 | FT0601 | FT0601 | 3-40 | SS26 |
| *FT709 | FT709 | 2N709 | 3-17 | SS29 |
| FT2974 | 2N2974 | 2N2915 | | SS8 |
| FT2975 | 2N2975 | 2M2916 | | SS8 |

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|---|---|---|---|---|
| FT2978 | 2N2978 | 2N2915 | | SS8 |
| FT2979 | 2N2979 | 2N2915 | | SS8 |
| *FT3723 | FT3723 | 2N3722 | 3-17 | SS9 |
| FT3820 | 2N4360 | 2N4342 | | |
| FT3903 | 2N3946 | 2N3946 | | SS14 |
| FT3904 | 2N3947 | 2N3946 | | SS14 |
| FT3905 | 2N3250 | 2N3250 | | |
| FT3906 | 2N3251 | 2N3250 | | |
| FT3909 | 2N4360 | 2N4342 | | |
| GE-10 | MPS2924 | MPS2923 | | SS14 |
| GE-11 | 2N5770 | 2N918 | | SS27 |
| GE-17 | MPSA05 | MPSA05 | | SS17 |
| GE-20 | 2N4400 | 2N4400 | | SS15 |
| GE-26 | 2N6122 | 2N6121 | | PWR5 |
| GE-27 | SE7056 | SE7055 | | SS11 |
| GE-28 | 2N6122 | 2N6121 | | PWR5 |
| GE-29 | 2N6125 | 2N6124 | | PWR14 |
| GE-504A | 1N4004 | 1N4001 | | |
| GEMR-6 | 2N6121 | 2N6121 | | PWR5 |
| GER4001 | 1N4001 | 1N4001 | | D10 |
| GER4002 | 1N4002 | 1N4001 | | D10 |
| GER4003 | 1N4003 | 1N4001 | | D10 |
| GER4004 | 1N4004 | 1N4001 | | D10 |
| GER4005 | 1N4005 | 1N4001 | | D10 |
| GET706 | 2N5772 | 2N3646 | | SS5 |
| GET708 | 2N5772 | 2N3646 | | SS5 |
| GET914 | 2N5772 | 2N3646 | | SS5 |
| GET929 | 2N5209 | 2N5209 | | SS18 |
| GET930 | 2N5209 | 2N5209 | | SS18 |
| GET2221 | PN2221 | 2N2218 | | SS15 |
| GET2221A | PN2221A | 2N2218A | | SS15 |
| GET2222 | PN2222 | 2N2218 | | SS15 |
| GET2222A | PN2222A | 2N2218A | | SS15 |
| GET2369 | 2N5769 | 2N2369 | | SS28 |
| GET2484 | 2N5961 | 2N5961 | | SS8 |
| GET2904 | PN2904 | 2N2904 | | SS22 |
| GET2905 | PN2905 | 2N2904 | | SS22 |
| GET2906 | PN2906 | 2N2904 | | SS22 |
| GET2907 | PN2907 | 2N2904 | | SS22 |
| GET3013 | 2N5772 | 2N3646 | | SS5 |
| GET3014 | 2N5772 | 2N3646 | | SS5 |
| GET3563 | 2N3563 | 2N918 | | SS27 |
| GET3638 | 2N3638 | 2N3638 | | SS22 |
| GET3638A | 2N3638A | 2N3638 | | SS22 |
| GET3646 | 2N3646 | 2N3646 | | SS5 |
| GET5305 | MPSA13 | MPSA13 | | SS20 |
| GET5306 | MPSA14 | MPSA13 | | SS20 |
| GET5306A | MPSA14 | MPSA13 | | SS20 |
| GET5307 | MPSA13 | MPSA13 | | SS20 |
| GET5308 | MPSA14 | MPSA13 | | SS20 |
| GET5308A | MPSA14 | MPSA13 | | SS20 |
| KE4220 | 2N5486 | 2N5484 | | |
| KE4221 | 2N5486 | 2N5484 | | |

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|---|---|---|---|---|
| KE4222 | 2N5486 | 2N5484 | | |
| KE4416 | 2N5486 | 2N5484 | | |
| MD708 | 2N3425 | | | SS5 |
| MD708A | 2N3425 | | | SS5 |
| MD708B | 2N3425 | | | SS5 |
| *MD918 | MD918 | MD918 | 3-43 | SS27 |
| *MD918A | MD918A | MD918 | 3-41 | SS27 |
| *MD918B | MD918B | MD918 | 3-41 | SS27 |
| MD984 | MD3250 | MD3250 | | SS23 |
| MD1120 | 2N3410 | 2N3409 | | SS15 |
| MD1121 | 2N3410 | 2N3409 | | SS15 |
| MD1122 | 2N3411 | 2N3409 | | SS15 |
| MD1129 | 2N2642 | 2N2639 | | SS8 |
| MD1130 | MD3251A | MD3250 | | SS23 |
| MD1132 | MD918A | MD918 | | SS27 |
| *MD2218 | MD2218 | MD2218 | 3-43 | SS15 |
| *MD2218A | MD2218A | MD2218 | 3-43 | SS15 |
| *MD2219 | MD2219 | MD2218 | 3-43 | SS15 |
| *MD2219A | MD2219A | MD2218 | 3-43 | SS15 |
| *MD2369 | MD2369 | MD2369 | 3-43 | SS28 |
| *MD2369A | MD2369A | MD2369 | 3-41 | SS28 |
| *MD2369B | MD2369 | MD2369 | 3-41 | SS28 |
| *MD2904 | MD2904 | MD2904 | 3-43 | SS22 |
| *MD2904A | MD2904A | MD2904 | 3-43 | SS22 |
| *MD2905 | MD2905 | MD2904 | 3-43 | SS22 |
| *MD2905A | MD2905A | MD2904 | 3-43 | SS22 |
| *MD3250 | MD3250 | MD3250 | 3-43 | SS23 |
| *MD3250A | MS3250 | MD3250 | 3-42 | SS23 |
| *MD3251 | MD3251 | MD3250 | 3-43 | SS23 |
| *MD3251A | MD3251A | MD3250 | 3-42 | SS23 |
| MD8001 | 2N2916A | 2N2916 | | SS8 |
| MD8002 | 2N2920 | 2N2920 | | SS8 |
| MD8003 | 2N2920 | 2N2920 | | SS8 |
| MF3304 | 2N3304 | | | SS31 |
| MFE120 | FT0601 | FT0601 | | SS26 |
| MFE121 | FT0601 | FT0601 | | SS26 |
| MFE122 | FT0601 | FT0601 | | SS26 |
| MFE2000 | 2N5485 | 2N5484 | | |
| MFE2001 | 2N5486 | 2N5484 | | |
| MFE3001 | 2N5486 | 2N5484 | | |
| MFE3004 | FT0601 | FT0601 | | SS26 |
| MFE3005 | FT0601 | FT0601 | | SS26 |
| MFE3006 | FT0601 | FT0601 | | SS26 |
| MFE3007 | FT0601 | FT0601 | | SS26 |
| MFE3008 | FT0601 | FT0601 | | SS26 |
| MFE4011 | 2N4342 | 2N4342 | | SS34 |
| MFE4012 | 2N4342 | 2N4342 | | SS34 |
| MHQ3467 | FPQ3467 | FPQ3467 | | SS7 |
| MJ400 | CF | | | |
| MJ410 | CF | | | |
| MJ411 | CF | | | |
| MJ413 | CF | | | |
| MJ420 | 2N3440 | 2N3439 | | PWR8 |

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|---|---|---|---|---|
| MF421 | 2N3439 | 2N3439 | | PWR8 |
| MJ423 | CF | | | |
| MJ424 | CF | | | |
| MJ425 | CF | | | |
| MJ431 | CF | | | |
| MJ450 | 2N4398 | 2N4398 | | PWR16 |
| MJ480 | 2N5067 | 2N5067 | | PWR6 |
| MJ481 | 2N5068 | 2N5067 | | PWR6 |
| MJ490 | 2N4901 | 2N4901 | | PWR15 |
| MJ491 | 2N4902 | 2N4901 | | PWR15 |
| MJ500 | 2N5003 | 2N5002 | | PWR11 |
| MJ501 | 2N5003 | 2N5002 | | PWR11 |
| MJ802 | CF | | | |
| MJ900 | CF | | | |
| MJ901 | CF | | | |
| MJ1000 | CF | | | |
| MJ1001 | CF | | | |
| MJ1800 | CF | | | |
| MJ2249 | 2N3766 | 2N3766 | | PWR18 |
| MJ2250 | 2N3767 | 2N3766 | | PWR18 |
| MJ2251 | CF | | | |
| MJ2252 | CF | | | |
| MJ2253 | 2N4899 | 2N3740 | | PWR14 |
| MJ2254 | 2N4900 | 2N3740 | | PWR14 |
| MJ2267 | 2N3791 | 2N3789 | | PWR15 |
| MJ2268 | 2N3791 | 2N3789 | | PWR15 |
| MJ2500 | CF | | | |
| MJ2501 | CF | | | |
| MJ2801 | CF | | | |
| MJ2840 | 2N3715 | 2N3713 | | PWR6 |
| MJ2841 | 2N3716 | 2N3713 | | PWR6 |
| MJ2901 | CF | | | |
| MJ2940 | 2N3791 | 2N3789 | | PWR15 |
| MJ2941 | 2N3792 | 2N3789 | | PWR15 |
| MJ2955 | 2N3791 | 2N3789 | | PWR15 |
| MJ3000 | CF | | | |
| MJ3001 | CF | | | |
| MJ3040 | CF | | | |
| MJ3041 | CF | | | |
| MJ3042 | CF | | | |
| MJ3101 | CF | | | |
| MJ3201 | CF | | | |
| MJ3202 | CF | | | |
| MJ3430 | CF | | | |
| MJ3701 | 2N4898 | 2N3740 | | PWR14 |
| MJ3771 | CF | | | |
| MJ3772 | CF | | | |
| MJ4000 | CF | | | |
| MJ4001 | CF | | | |
| MJ4010 | CF | | | |
| MJ4011 | CF | | | |
| MJ4030 | CF | | | |
| MJ4031 | CF | | | |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| MJ4032 | CF | | | |
| MJ4033 | CF | | | |
| MJ4034 | CF | | | |
| MJ4035 | CF | | | |
| MJ4502 | CF | | | |
| MJ6257 | CF | | | |
| MJ6302 | CF | | | |
| MJ6700 | 2N5002 | 2N5002 | | PWR19 |
| MJ6701 | 2N5002 | 2N5002 | | PWR19 |
| MJE105 | 2N6133 | 2N6132 | | PWR17 |
| MJE105K | 2N6133 | 2N6132 | | PWR17 |
| MJE170 | 2N5323 | 2N5320 | | PWR12 |
| MJE171 | 2N5323 | 2N5320 | | PWR12 |
| MJE172 | 2N5322 | 2N5320 | | PWR12 |
| MJE180 | 2N5321 | 2N5320 | | PWR2 |
| MJE181 | 2N5321 | 2N5320 | | PWR2 |
| MJE182 | 2N5320 | 2N5320 | | PWR2 |
| MJE200 | 2N4895 | 2N4895 | | PWR1 |
| MJE205 | 2N6130 | 2N6129 | | PWR10 |
| MJE205K | 2N6130 | 2N6129 | | PWR10 |
| MJE220 | 2N5321 | 2N5320 | | PWR2 |
| MJE221 | 2N5320 | 2N5320 | | PWR2 |
| MJE222 | 2N5321 | 2N5320 | | PWR2 |
| MJE223 | 2N5321 | 2N5320 | | PWR2 |
| MJE224 | 2N5320 | 2N5320 | | PWR2 |
| MJE225 | 2N5321 | 2N5320 | | PWR2 |
| MJE230 | 2N5323 | 2N5320 | | PWR12 |
| MJE231 | 2N5322 | 2N5320 | | PWR12 |
| MJE232 | 2N5323 | 2N5320 | | PWR12 |
| MJE233 | 2N5323 | 2N5320 | | PWR12 |
| MJE234 | 2N5322 | 2N5320 | | PWR12 |
| MJE235 | 2N5323 | 2N5320 | | PWR12 |
| MJE240 | 2N5320 | 2N5320 | | PWR2 |
| MJE242 | 2N5320 | 2N5320 | | PWR2 |
| MJE243 | 2N5681 | 2N5679 | | PWR3 |
| MJE244 | 2N5682 | 2N5679 | | PWR3 |
| MJE250 | 2N5322 | 2N5320 | | PWR12 |
| MJE251 | 2N5322 | 2N5320 | | PWR12 |
| MJE252 | 2N5322 | 2N5320 | | PWR12 |
| MJE253 | 2N5679 | 2N5679 | | PWR13 |
| MJE254 | 2N5679 | 2N5679 | | PWR13 |
| MJE340 | CF | | | |
| MJE340K | CF | | | |
| MJE341 | CF | | | |
| MJE341K | CF | | | |
| MJE344 | CF | | | |
| MJE344K | CF | | | |
| MJE370 | 2N6124 | 2N6124 | | PWR14 |
| MJE370K | 2N6124 | 2N6124 | | PWR14 |
| MJE371 | 2N6124 | 2N6124 | | PWR14 |
| MJE371K | 2N6124 | 2N6124 | | PWR14 |
| MJE520 | 2N6121 | 2N6121 | | PWR5 |
| MJE520K | 2N6121 | 2N6121 | | PWR5 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| MJE521 | 2N6121 | 2N6121 | | PWR5 |
| MJE521K | 2N6121 | 2N6121 | | PWR5 |
| MJE700 | CF | | | |
| MJE701 | CF | | | |
| MJE702 | CF | | | |
| MJE703 | CF | | | |
| MJE710 | 2N5323 | 2N5320 | | PWR12 |
| MJE711 | 2N5323 | 2N5320 | | PWR12 |
| MJE712 | 2N5322 | 2N5320 | | PWR12 |
| MJE720 | 2N5321 | 2N5320 | | PWR2 |
| MJE721 | 2N5321 | 2N5320 | | PWR2 |
| MJE722 | 2N5320 | 2N5320 | | PWR2 |
| MJE800 | CF | | | |
| MJE801 | CF | | | |
| MJE802 | CF | | | |
| MJE803 | CF | | | |
| MJE1090 | CF | | | |
| MJE1091 | CF | | | |
| MJE1092 | CF | | | |
| MJE1093 | CF | | | |
| MJE1100 | CF | | | |
| MJE1101 | CF | | | |
| MJE1102 | CF | | | |
| MJE1103 | CF | | | |
| MJE2010 | 2N6124 | 2N6124 | | PWR14 |
| MJE2011 | 2N6125 | 2N6124 | | PWR14 |
| MJE2020 | 2N6121 | 2N6121 | | PWR5 |
| MJE2021 | 2N6122 | 2N6121 | | PWR5 |
| MJE2360 | CF | | | |
| MJE2361 | CF | | | |
| MJE2370 | 2N5323 | 2N5320 | | PWR12 |
| MJE2371 | 2N5323 | 2N5320 | | PWR12 |
| MJE2480 | 2N6121 | 2N6121 | | PWR5 |
| MJE2481 | 2N6121 | 2N6121 | | PWR5 |
| MJE2482 | 2N6129 | 2N6129 | | PWR10 |
| MJE2483 | 2N6130 | 2N6129 | | PWR10 |
| MJE2490 | 2N6124 | 2N6124 | | PWR14 |
| MJE2491 | 2N6125 | 2N6124 | | PWR14 |
| MJE2520 | 2N5321 | 2N5320 | | PWR2 |
| MJE2521 | 2N5321 | 2N5320 | | PWR2 |
| MJE2522 | 2N6121 | 2N6121 | | PWR5 |
| MJE2523 | 2N6122 | 2N6121 | | PWR5 |
| MJE2801 | CF | | | |
| MJE2801K | CF | | | |
| MJE2901 | 2N3789 | 2N3789 | | PWR15 |
| MJE2901K | 2N3789 | 2N3789 | | PWR15 |
| MJE2955 | 2N3791 | 2N3789 | | PWR15 |
| MJE2955K | 2N3791 | 2N3789 | | PWR15 |
| MJE3054 | 2N6122 | 2N6121 | | PWR5 |
| MJE3055 | CF | | | |
| MJE3055K | CF | | | |
| MJE3370 | 2N6124 | 2N6124 | | PWR14 |
| MJE3371 | 2N6124 | 2N6124 | | PWR14 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| MJE3439 | 2N3439 | 2N3439 | | PWR8 |
| MJE3440 | 2N3440 | 2N3439 | | PWR8 |
| MJE3520 | 2N6121 | 2N6121 | | PWR5 |
| MJE3521 | 2N6121 | 2N6121 | | PWR5 |
| MJE3738 | CF | | | |
| MJE3739 | CF | | | |
| MJE3740 | 2N6125 | 2N6124 | | PWR14 |
| MJE3741 | 2N6126 | 2N6124 | | PWR14 |
| MJE4918 | 2N6124 | 2N6124 | | PWR14 |
| MJE4919 | 2N6125 | 2N6124 | | PWR14 |
| MJE4920 | 2N6126 | 2N6124 | | PWR14 |
| MJE4921 | 2N6121 | 2N6121 | | PWR5 |
| MJE4922 | 2N6122 | 2N6121 | | PWR5 |
| MJE4923 | 2N6123 | 2N6121 | | PWR5 |
| MJE5190 | 2N6121 | 2N6121 | | PWR5 |
| MJE5191 | 2N6122 | 2N6121 | | PWR5 |
| MJE5192 | 2N6123 | 2N6121 | | PWR5 |
| MJE5193 | 2N6124 | 2N6124 | | PWR14 |
| MJE5194 | 2N6125 | 2N6124 | | PWR14 |
| MJE5195 | 2N6126 | 2N6124 | | PWR14 |
| MJE5655 | CF | | | |
| MJE5656 | CF | | | |
| MJE5657 | CF | | | |
| MJE5974 | 2N6132 | 2N6132 | | PWR17 |
| MJE5975 | 2N6133 | 2N6132 | | PWR17 |
| MJE5976 | 2N6134 | 2N6132 | | PWR17 |
| MJE5977 | 2N6129 | 2N6129 | | PWR10 |
| MJE5978 | 2N6130 | 2N6129 | | PWR10 |
| MJE5980 | 2N6131 | 2N6129 | | PWR10 |
| MJE5980 | CF | | | |
| MJE5981 | CF | | | |
| MJE5982 | CF | | | |
| MJE5983 | CF | | | |
| MJE5984 | CF | | | |
| MJE5985 | CF | | | |
| MJE6040 | CF | | | |
| MJE6041 | CF | | | |
| MJE6042 | CF | | | |
| MJE6043 | CF | | | |
| MJE6044 | CF | | | |
| MJE6045 | CF | | | |
| MM1748 | 2N2894A | 2N2894 | | SS32 |
| MM1803 | 2N3137 | 2N3137 | | SS2 |
| MM1812 | 2N3440 | 2N3439 | | PWR8 |
| MM1941 | 2N918 | 2N918 | | SS27 |
| MM2193A | 2N2218A | 2N2218A | | SS15 |
| MM2258 | SE7055 | SE7055 | | SS11 |
| MM2259 | SE7055 | SE7055 | | SS11 |
| MM2260 | SE7055 | SE7055 | | SS11 |
| MM2270 | 2N2270 | | | SS15 |
| MM2483 | 2N2483 | 2N2483 | | SS8 |
| MM2894A | 2N2894A | 2N2894 | | SS32 |
| MM3000 | SE7002 | | | SS16 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| MM3001 | SE7001 | | | SS16 |
| MM3003 | SE7055 | SE7055 | | SS11 |
| MM3005 | 2N5681 | 2N5679 | | PWR3 |
| MM3306 | 2N5681 | 2N5679 | | PWR3 |
| MM3007 | 2N5681 | 2N5679 | | PWR3 |
| MM3008 | SE7055 | SE7055 | | SS11 |
| MM3009 | SE7055 | SE7055 | | SS11 |
| MM3019 | 2N3019 | 2N3019 | | SS17 |
| MM3020 | 2N3020 | 2N3019 | | SS17 |
| MM3053 | 2N3053 | 2N3053 | | SS17 |
| MM3726 | 2N3468 | 2N3467 | | SS7 |
| MM3903 | 2N3946 | 2N3946 | | SS14 |
| MM3904 | 2N3947 | 2N3946 | | SS14 |
| MM3905 | 2N3250 | 2N3250 | | |
| MM3906 | 2N3251 | 2N3250 | | |
| MM4208 | 2N4208 | 2N4208 | | SS31 |
| MM4208A | 2N4208 | 2N4208 | | SS31 |
| MM4209 | 2N4209 | 2N4208 | | SS31 |
| MM4209A | 2N4209 | 2N4208 | | SS31 |
| MM5005 | 2N5679 | 2N5679 | | PWR13 |
| MM5006 | 2N5679 | 2N5679 | | PWR13 |
| MM5007 | 2N5679 | 2N5679 | | PWR13 |
| MM8006 | 2N918 | 2N918 | | SS27 |
| MM8007 | 2N918 | 2N918 | | SS27 |
| *MPF102 | MPF102 | MPF102 | 3-40 | SS34 |
| *MPF108 | MPF108 | MPF102 | 3-40 | SS34 |
| *MPF109 | MPF109 | MPF102 | 3-40 | SS34 |
| *MPF111 | MPF111 | MPF111 | 3-40 | |
| *MPF112 | MPF112 | MPF111 | 3-40 | |
| MPF120 | FT0601 | FT0601 | | SS26 |
| MPF121 | FT0601 | FT0601 | | SS26 |
| MPF122 | FT0601 | FT0601 | | SS26 |
| MPF161 | 2N4360 | 2N4342 | | SS34 |
| MPF256 | 2N5486 | 2N5484 | | |
| MPF820 | 2N5486 | 2N5484 | | |
| MPQ3725 | FPQ3725 | FPQ3724 | | SS13 |
| *MPS706 | MPS706 | 2N706 | 3-18 | SS5 |
| *MPS706A | MPS706A | 2N706 | 3-18 | SS5 |
| *MPS834 | MPS834 | 2N834 | 3-18 | SS28 |
| *MPS918 | MPS918 | 2N918 | 3-35 | SS27 |
| *MPS2369 | MPS2369 | 2N2369 | 3-18 | SS28 |
| *MPS2711 | MPS2711 | MPS2711 | 3-22 | SS14 |
| *MPS2712 | MPS2712 | MPS2711 | 3-22 | SS14 |
| MPS2713 | MPS2713 | | 3-18 | SS15 |
| MPS2714 | MPS2714 | | 3-18 | SS15 |
| *MPS2923 | 2N2923 | MPS2923 | 3-22 | |
| *MPS2924 | MPS2924 | MPS2923 | 3-22 | |
| *MPS2925 | MPS2925 | MPS2923 | 3-22 | |
| *MPS2926 | MPS2926 | MPS2926 | 3-22 | |
| *MPS3392 | MPS3392 | MPS3392 | 3-22 | |
| *MPS3393 | MPS3393 | MPS3392 | 3-22 | |
| *MPS3394 | MPS3394 | MPS3392 | 3-22 | |
| *MPS3395 | MPS3395 | MPS3392 | 3-22 | |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| *MPS3563 | MPS3563 | 2N918 | 3-35 | |
| *MPS3638 | MPS3638 | 2N3638 | 3-27 | |
| *MPS3638A | MPS3638A | 2N3638 | 3-27 | |
| *MPS3639 | MPS3639 | 2N3639 | 3-19 | |
| *MPS3640 | MPS3640 | 2N3639 | 3-19 | |
| *MPS3646 | MPS3646 | 2N3646 | 3-10 | |
| *MPS3693 | MPS3693 | 2N3693 | 3-24 | |
| *MPS3694 | MPS3694 | 2N3693 | 3-23 | |
| *MPS3702 | MPS3702 | MPS3702 | 3-27 | |
| *MPS3703 | MPS3703 | MPS3702 | 3-27 | |
| *MPS3704 | MPS3704 | MPS3704 | 3-23 | |
| *MPS3705 | MPS3705 | MPS3704 | 3-23 | |
| *MPS3706 | MPS3706 | MPS3704 | 3-22 | |
| *MPS3707 | MPS3707 | MPS3707 | 3-29 | |
| *MPS3708 | MPS3708 | MPS3707 | 3-30 | |
| *MPS3709 | MPS3709 | MPS3707 | 3-30 | |
| *MPS3710 | MPS3710 | MPS3707 | 3-30 | |
| *MPS3711 | MPS3711 | MPS3707 | 3-29 | |
| *MPS3721 | MPS3721 | MPS2926 | 3-22 | |
| MPS3725 | 2N5845 | 2N5845 | | SS13 |
| *MPS4354 | MPS4354 | 2N4354 | 3-28 | |
| *MPS4355 | MPS4355 | 2N4354 | 3-28 | |
| *MPS4356 | MPS4356 | 2N4354 | 3-28 | |
| *MPS5172 | MPS5172 | MPS5172 | 3-22 | |
| *MPS5551M | MPS5551M | 2N5550 | 3-33 | |
| MPS6507 | PE5031 | PE5029 | | SS12 |
| MPS6511 | PE5025 | PE5025 | | SS6 |
| *MPS6512 | MPS6512 | MPS6512 | 3-22 | SS14 |
| *MPS6513 | MPS6513 | MPS6512 | 3-22 | SS14 |
| *MPS6514 | MPS6514 | MPS6512 | 3-22 | SS14 |
| *MPS6515 | MPS6515 | MPS6512 | 3-22 | SS14 |
| *MPS6516 | MPS6516 | MPS6516 | 3-27 | SS23 |
| *MPS6517 | MPS6517 | MPS6516 | 3-27 | SS23 |
| *MPS6518 | MPS6518 | MPS6516 | 3-27 | SS23 |
| *MPS6519 | MPS6519 | MPS6516 | 3-27 | SS23 |
| *MPS6520 | MPS6520 | MPS6520 | 3-29 | SS14 |
| *MPS6521 | MPS6521 | MPS6520 | 3-29 | SS14 |
| *MPS6522 | MPS6522 | MPS6522 | 3-32 | SS23 |
| *MPS6523 | MPS6523 | MPS6522 | 3-32 | SS23 |
| *MPS6530 | MPS6530 | MPS6530 | 3-23 | SS15 |
| *MPS6531 | MPS6531 | MPS6530 | 3-23 | SS15 |
| *MPS6532 | MPS6532 | MPS6530 | 3-23 | SS15 |
| MPS6533 | MPS6533M | MPS6533M | | SS22 |
| *MPS6533M | MPS6533M | MPS6533M | 3-27 | SS22 |
| MPS6534 | MPS6534M | MPS6533M | | SS22 |
| *MPS6534M | MPS6534M | MPS6533M | 3-27 | SS22 |
| MPS6535 | MPS6535M | MPS6533M | | SS22 |
| *MPS6535M | MPS6535M | MPS6533M | 3-27 | SS22 |
| MPS6539 | PE5031 | PE5029 | | SS12 |
| MPS6540 | PE5031 | PE5029 | | SS12 |
| MPS6542 | PE5029 | PE5029 | | SS12 |
| MPS6543 | 2N5770 | 2N918 | | SS27 |
| MPS6544 | PE5030B | PE5029 | | SS12 |
| MPS6545 | PE5030B | PE5029 | | SS12 |
| MPS6546 | PE5031 | PE5029 | | SS12 |
| MPS6547 | PE5031 | PE5029 | | SS12 |
| MPS6548 | 2N5770 | 2N918 | | SS27 |
| *MPS6560 | MPS6560 | MPS6560 | 3-22 | SS15 |
| *MPS6561 | MPS6561 | MPS6560 | 3-22 | SS15 |
| *MPS6562 | MPS6562 | MPS6560 | 3-27 | SS24 |
| *MPS6563 | MPS6563 | MPS6560 | 3-27 | SS22 |
| *MPS6565 | MPS6565 | MPS6565 | 3-23 | |
| *MPS6566 | MPS6566 | MPS6566 | 3-23 | |
| MPS6567 | PE5029 | PE5029 | | SS12 |
| MPS6568 | PE5010 | PE5010 | | SS19 |
| MPS6568A | PE5010 | PE5010 | | SS19 |
| MPS6569 | PE5010 | PE5010 | | SS19 |
| MPS6570 | PE5010 | PE5010 | | SS19 |
| *MPS6571 | MPS6571 | MPS6571 | 3-29 | |
| *MPSA05 | MPSA05 | MPSA05 | 3-24 | SS17 |
| *MPSA06 | MPSA06 | MPSA05 | 3-24 | SS17 |
| *MPSA09 | MPSA09 | MPSA09 | 3-30 | |
| *MPSA10 | MPSA10 | MPSA10 | 3-23 | |
| *MPSA12 | MPSA12 | MPSA12 | 3-43 | SS20 |
| *MPSA13 | MPSA13 | MPSA13 | 3-43 | SS20 |
| *MPSA14 | MPSA14 | MPSA13 | 3-43 | SS20 |
| MPSA18 | 2N5962 | 2N5961 | | SS8 |
| *MPSA20 | MPSA20 | MPSA20 | 3-23 | |
| *MPSA42 | MPSA42 | MPSA42 | 3-33 | |
| *MPSA43 | MPSA43 | MPSA42 | 3-33 | |
| *MPSA55 | MPSA55 | MPSA55 | 3-28 | SS24 |
| *MPSA56 | MPSA56 | MPSA55 | 3-28 | SS24 |
| *MPSA70 | MPSA70 | MPSA20 | | |
| *MPSA92 | MPSA92 | MPSA92 | 3-34 | SS4 |
| *MPSA93 | MPSA93 | MPSA92 | 3-34 | SS4 |
| MPSH02 | PE5010 | PE5010 | | SS19 |
| MPSH07 | PE5010 | PE5010 | | SS19 |
| MPSH08 | PE5010 | PE5010 | | SS19 |
| MPSH10 | PE3100 | PE3100 | | SS12 |
| MPSH11 | PE3100 | PE3100 | | SS12 |
| MPSH19 | PE5031 | PE5029 | | SS12 |
| MPSH20 | PE5031 | PE5029 | | SS12 |
| MPSH24 | PE5031 | PE5029 | | SS12 |
| MPSH30 | PE5010 | PE5010 | | SS19 |
| MPSH31 | PE5010 | PE5010 | | SS19 |
| MPSH32 | PE5010 | PE5010 | | SS19 |
| MPSH34 | PE5030B | PE5029 | | SS12 |
| MPSH37 | PE5029 | PE5029 | | SS12 |
| *MPSL01 | MPSL01 | MPSL01 | 3-33 | SS16 |
| *MPSL07 | MPSL07 | MPSL07 | 3-19 | SS31 |
| *MPSL08 | MPSL08 | MPSL07 | 3-19 | SS31 |
| *MPSL51 | MPSL51 | MPSL01 | 3-34 | SS25 |
| MPSU03 | SE7055 | SE7055 | | SS11 |
| MPSU04 | SE7055 | SE7055 | | SS11 |
| MPSU10 | SE7056 | SE7055 | | SS11 |
| MPSU55 | 2N6125 | 2N6124 | | PWR14 |

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|---|---|---|---|---|
| MPSU56 | 2N6126 | 2N6124 | | PWR14 |
| MPSU57 | 2N6126 | 2N6124 | | PWR14 |
| MZ70-3.3 | 1N746 | 1N746 | | D8 |
| MZ70-3.3A | 1N746 | 1N746 | | D8 |
| MZ70-3.3B | 1N746B | 1N746 | | D8 |
| MZ70-3.6 | 1N747 | 1N746 | | D8 |
| MZ70-3.6A | 1N747 | 1N746 | | D8 |
| MZ70-3.6B | 1N747B | 1N746 | | D8 |
| MZ70-3.9 | 1N748 | 1N746 | | D8 |
| MZ70-3.9A | 1N748 | 1N746 | | D8 |
| MZ70-3.9B | 1N748B | 1N746 | | D8 |
| MZ70-4.3 | 1N749 | 1N746 | | D8 |
| MZ70-4.3A | 1N749 | 1N746 | | D8 |
| MZ70-4.3B | 1N749B | 1N746 | | D8 |
| MZ70-4.7 | 1N750 | 1N746 | | D8 |
| MZ70-4.7A | 1N750 | 1N746 | | D8 |
| MZ70-4.7B | 1N750B | 1N746 | | D8 |
| MZ70-5.1 | 1N751 | 1N746 | | D8 |
| MZ70-5.1A | 1N751 | 1N746 | | D8 |
| MZ70-5.1B | 1N751B | 1N746 | | D8 |
| MZ70-5.6 | 1N752 | 1N746 | | D8 |
| MZ70-5.6A | 1N752 | 1N746 | | D8 |
| MZ70-5.6B | 1N752B | 1N746 | | D8 |
| MZ70-6.2 | 1N753 | 1N746 | | D8 |
| MZ70-6.2A | 1N753 | 1N746 | | D8 |
| MZ70-6.2B | 1N753B | 1N746 | | D8 |
| MZ70-6.8 | 1N754 | 1N746 | | D8 |
| MZ70-6.8A | 1N754 | 1N746 | | D8 |
| MZ70-6.8B | 1N754B | 1N746 | | D8 |
| MZ70-7.5 | 1N755 | 1N746 | | D8 |
| MZ70-7.5A | 1N755 | 1N746 | | D8 |
| MZ70-7.5B | 1N755B | 1N746 | | D8 |
| MZ70-8.2 | 1N756 | 1N746 | | D8 |
| MZ70-8.2A | 1N756 | 1N746 | | D8 |
| MZ70-8.2B | 1N756B | 1N746 | | D8 |
| MZ70-9.1 | 1N757 | 1N746 | | D8 |
| MZ70-9.1A | 1N757 | 1N746 | | D8 |
| MZ70-9.1B | 1N757B | 1N746 | | D8 |
| MZ70-10 | 1N758 | 1N746 | | D8 |
| MZ70-10A | 1N758 | 1N746 | | D8 |
| MZ70-10B | 1N758B | 1N746 | | D8 |
| MZ70-11 | 1N962A | 1N957 | | D8 |
| MZ70-11A | 1N962A | 1N957 | | D8 |
| MZ70-11B | 1N962B | 1N957 | | D8 |
| MZ70-12 | 1N759 | 1N957 | | D8 |
| MZ70-12A | 1N759 | 1N957 | | D8 |
| MZ70-12B | 1N759B | 1N957 | | D8 |
| MZ70-13 | 1N964A | 1N957 | | D8 |
| MZ70-13A | 1N964A | 1N957 | | D8 |
| MZ70-13B | 1N964B | 1N957 | | D8 |
| MZ70-15 | 1N965A | 1N957 | | D8 |
| MZ70-15A | 1N965A | 1N957 | | D8 |
| MZ70-15B | 1N965B | 1N957 | | D8 |
| MZ70-16 | 1N966A | 1N957 | | D8 |
| MZ70-16A | 1N966A | 1N957 | | D8 |
| MZ70-16B | 1N966B | 1N957 | | D8 |
| MZ70-18 | 1N967A | 1N957 | | D8 |
| MZ70-18A | 1N967A | 1N957 | | D8 |
| MZ70-18B | 1N967B | 1N957 | | D8 |
| MZ70-20 | 1N968A | 1N957 | | D8 |
| MZ70-20A | 1N968A | 1N957 | | D8 |
| MZ70-20B | 1N968B | 1N957 | | D8 |
| MZ70-22 | 1N969A | 1N957 | | D8 |
| MZ70-22A | 1N969A | 1N957 | | D8 |
| MZ70-22B | 1N969B | 1N957 | | D8 |
| MZ70-24 | 1N970A | 1N957 | | D8 |
| MZ70-24A | 1N970A | 1N957 | | D8 |
| MZ70-24B | 1N970B | 1N957 | | D8 |
| MZ70-27 | 1N971A | 1N957 | | D8 |
| MZ70-27A | 1N971A | 1N957 | | D8 |
| MZ70-27B | 1N971B | 1N957 | | D8 |
| MZ70-30 | 1N972A | 1N957 | | D8 |
| MZ70-30A | 1N972A | 1N957 | | D8 |
| MZ70-30B | 1N972B | 1N957 | | D8 |
| MZ70-33 | 1N973A | 1N957 | | D8 |
| MZ70-33A | 1N973A | 1N957 | | D8 |
| MZ70-33B | 1N973B | 1N957 | | D8 |
| MZ92-3.3 | 1N746 | 1N746 | | D8 |
| MZ92-3.6 | 1N747 | 1N746 | | D8 |
| MZ92-3.9 | 1N748 | 1N746 | | D8 |
| MZ92-4.3 | 1N749 | 1N746 | | D8 |
| MZ92-4.7 | 1N750 | 1N746 | | D8 |
| MZ92-5.1 | 1N751 | 1N746 | | D8 |
| MZ92-5.6 | 1N752 | 1N746 | | D8 |
| MZ92-6.2 | 1N753 | 1N746 | | D8 |
| MZ92-6.8 | 1N957 | 1N957 | | D8 |
| MZ92-7.5 | 1N958 | 1N957 | | D8 |
| MZ92-8.2 | 1N959 | 1N957 | | D8 |
| MZ92-9.1 | 1N960 | 1N957 | | D8 |
| MZ92-10 | 1N961 | 1N957 | | D8 |
| MZ92-11 | 1N962 | 1N957 | | D8 |
| MZ92-12 | 1N963 | 1N957 | | D8 |
| MZ92-13 | 1N964 | 1N957 | | D8 |
| MZ92-15 | 1N965 | 1N957 | | D8 |
| MZ92-16 | 1N966 | 1N957 | | D8 |
| MZ92-18 | 1N967 | 1N957 | | D8 |
| MZ92-20 | 1N968 | 1N957 | | D8 |
| MZ92-22 | 1N969 | 1N957 | | D8 |
| MZ92-24 | 1N970 | 1N957 | | D8 |
| MZ92-27 | 1N971 | 1N957 | | D8 |
| MZ92-30 | 1N972 | 1N957 | | D8 |
| MZ92-33 | 1N973 | 1N957 | | D8 |
| MZ500-4 | 1N746 | 1N746 | | D8 |
| MZ500-5 | 1N747 | 1N746 | | D8 |
| MZ500-6 | 1N748 | 1N746 | | D8 |
| MZ500-7 | 1N749 | 1N746 | | D8 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| MZ500-8 | 1N750 | 1N746 | | D8 |
| MZ500-9 | 1N751 | 1N746 | | D8 |
| MZ500-10 | 1N752 | 1N746 | | D8 |
| MZ500-11 | 1N753 | 1N746 | | D8 |
| MZ500-12 | 1N957A | 1N957 | | D8 |
| MZ500-13 | 1N958A | 1N957 | | D8 |
| MZ500-14 | 1N959A | 1N957 | | D8 |
| MZ500-15 | 1N960A | 1N957 | | D8 |
| MZ500-16 | 1N961A | 1N957 | | D8 |
| MZ500-17 | 1N962A | 1N957 | | D8 |
| MZ500-18 | 1N963A | 1N957 | | D8 |
| MZ500-19 | 1N964A | 1N957 | | D8 |
| MZ500-20 | 1N965A | 1N957 | | D8 |
| MZ500-21 | 1N966A | 1N957 | | D8 |
| MZ500-22 | 1N967A | 1N957 | | D8 |
| MZ500-23 | 1N968A | 1N957 | | D8 |
| MZ500-24 | 1N969A | 1N957 | | D8 |
| MZ500-25 | 1N970A | 1N957 | | D8 |
| MZ500-26 | 1N971A | 1N957 | | D8 |
| MZ500-27 | 1N972A | 1N957 | | D8 |
| MZ500-28 | 1N973A | 1N957 | | D8 |
| NF500 | 2N5486 | 2N5484 | | |
| NF501 | 2N5486 | 2N5484 | | |
| NF506 | 2N5486 | 2N5484 | | |
| NF520 | 2N5486 | 2N5484 | | |
| NF521 | 2N5485 | 2N5484 | | |
| NF522 | 2N5485 | 2N5484 | | |
| NF523 | 2N5485 | 1N5484 | | |
| NF530 | 2N5485 | 2N5484 | | |
| NF531 | 2N5485 | 2N5484 | | |
| NF532 | 2N5485 | 2N5484 | | |
| NF533 | 2N5485 | 2N5484 | | |
| NF5457 | 2N5485 | 2N5484 | | |
| NF5458 | 2N5485 | 2N5484 | | |
| NF5459 | 2N5486 | 2N5484 | | |
| NF5485 | 2N5485 | 2N5484 | | |
| NF5486 | 2N5486 | 2N5484 | | |
| P1086E | 2N4360 | 2N4342 | | SS34 |
| P1087E | 2N4360 | 2N4342 | | SS34 |
| *PE3100 | PE3100 | PE3100 | 3-35 | SS12 |
| *PE5010 | PE5010 | PE5010 | 3-35 | SS19 |
| *PE5013 | PE5013 | PE5010 | 3-35 | SS19 |
| *PE5015 | PE5015 | PE5010 | 3-35 | SS19 |
| *PE5025 | PE5025 | PE5025 | 3-35 | SS6 |
| *PE5029 | PE5029 | PE5029 | 3-35 | SS12 |
| *PE5030B | PE5030B | PE5029 | 3-35 | SS12 |
| *PE5031 | PE5031 | PE5029 | 3-35 | SS12 |
| *PE6020 | PE6020 | PE6020 | 3-22 | SS17 |
| *PE6021 | PE6021 | PE6020 | 3-22 | SS17 |
| PF510 | 2N4360 | 2N4342 | | SS34 |
| PF511 | 2N4360 | 2N4342 | | SS34 |
| *PN1613 | PN1613 | 2N718A | 3-23 | |
| *PN1711 | PN1711 | 2N718A | 3-23 | |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| *PN1893 | PN1893 | 2N1893 | 3-24 | SS17 |
| *PN2218 | PN2218 | 2N2218 | 3-23 | SS15 |
| *PN2218A | PN2218A | 2N2218A | 3-23 | SS15 |
| *PN2219 | PN2219 | 2N2218 | 3-23 | SS15 |
| *PN2219A | PN2219A | 2N2218A | 3-23 | SS15 |
| *PN2221 | PN2221 | 2N2218 | | SS15 |
| *PN2221A | PN2221A | 2N2218A | 3-23 | SS15 |
| *PN2222 | PN2222 | 2N2218 | 3-23 | SS15 |
| *PN2222A | PN2222A | 2N2218A | 3-23 | SS15 |
| *PN2484 | PN2484 | 2N2484 | 3-30 | SS8 |
| *PN2904 | PN2904 | 2N2904 | 3-28 | SS22 |
| *PN2904A | PN2904A | 2N2904 | 3-28 | SS12 |
| *PN2905 | PN2905 | 2N2904 | 3-28 | SS12 |
| *PN2905A | PN2905A | 2N2904 | 3-28 | SS12 |
| *PN2906 | PN2906 | 2N2904 | 3-28 | SS12 |
| *PN2906A | PN2906A | 2N2904 | 3-28 | SS12 |
| *PN2907 | PN2907 | 2N2904 | 3-28 | SS12 |
| *PN2907A | PN2907A | 2N2904 | 3-28 | SS12 |
| *PN3250 | PN3250 | 2N3250 | 3-28 | |
| *PN3250A | PN3250A | 2N3250 | 3-28 | |
| *PN3251 | PN3251 | 2N3250 | 3-27 | |
| *PN3251A | PN3251A | 2N3250 | 3-28 | |
| *PN3565 | PN3565 | 2N3565 | 3-29 | SS8 |
| *PN3566 | PN3566 | 2N3565 | 3-23 | SS15 |
| *PN3567 | PN3567 | 2N3567 | 3-23 | |
| *PN3568 | PN3568 | 2N3567 | 3-24 | |
| *PN3569 | PN3569 | 2N3567 | 3-23 | |
| *PN3641 | PN3641 | 2N3641 | 3-23 | SS15 |
| *PN3642 | PN3642 | 2N3641 | 3-24 | SS15 |
| *PN3643 | PN3643 | 2N3641 | 3-23 | SS15 |
| *PN3644 | PN3644 | 2N3644 | 3-28 | SS22 |
| *PN3645 | PN3645 | 2N3644 | 3-28 | SS22 |
| *PN3688 | PN3688 | 2N3688 | 3-35 | SS1 |
| *PN3689 | PN3689 | 2N3688 | 3-35 | SS1 |
| *PN3690 | PN3690 | 2N3688 | 3-35 | SS1 |
| *PN3691 | PN3691 | 2N3691 | | |
| *PN3692 | PN3692 | 2N3691 | | |
| *PN4248 | PN4248 | 2N4248 | 3-32 | SS33 |
| *PN4249 | PN4249 | 2N4248 | 3-32 | SS33 |
| *PN4250 | PN4250 | 2N4248 | 3-32 | SS33 |
| *PN4250A | PN4250A | 2N4248 | 3-32 | SS33 |
| PN4257 | PN4258 | 2N4258 | | SS31 |
| PN4257A | PN4258A | 2N4258 | | SS31 |
| *PN4258 | PN4258 | 2N4258 | 3-19 | SS31 |
| *PN4258A | PN4258A | 2N4258 | 3-19 | SS31 |
| *PN4357 | PN4357 | PN4357 | 3-34 | SS4 |
| *PN4888 | PN4888 | 2N4888 | 3-34 | |
| *PN4889 | PN4889 | 2N4888 | 3-34 | |
| *PN4916 | PN4916 | 2N4916 | 3-27 | SS23 |
| *PN4917 | PN4917 | 2N4916 | 3-27 | SS23 |
| *PN5126 | PN5126 | 2N5126 | 3-35 | SS1 |
| *PN5128 | PN5128 | 2N5128 | 3-22 | SS15 |
| *PN5129 | PN5128 | 2N5128 | 3-22 | SS15 |

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| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| *PN5130 | PN5130 | 2N5130 | 3-35 | SS27 |
| *PN5131 | PN5131 | 2N5131 | 3-22 | |
| *PN5132 | PN5132 | 2N5131 | 3-22 | |
| *PN5133 | PN5133 | 2N5133 | 3-29 | SS8 |
| *PN5134 | PN5134 | 2N5134 | 3-18 | SS28 |
| *PN5135 | PN5135 | 2N5135 | 3-22 | SS15 |
| *PN5136 | PN5136 | 2N5135 | 3-22 | SS15 |
| *PN5137 | PN5137 | 2N5135 | 3-22 | SS15 |
| *PN5138 | PN5138 | 2N5138 | 3-22 | SS33 |
| *PN5139 | PN5139 | 2N5139 | 3-27 | |
| *PN5142 | PN5142 | 2N5142 | 3-27 | SS22 |
| *PN5143 | PN5143 | 2N5142 | 3-27 | SS22 |
| *PN5855 | PN5855 | 2N5855 | | SS24 |
| *PN5856 | PN5856 | 2N5855 | | SS17 |
| *PN5857 | PN5857 | 2N5855 | | SS24 |
| *PN5858 | PN5858 | 2N5855 | | SS17 |
| *PN5910 | PN5910 | 2N5771 | 3-19 | SS31 |
| *PN5964 | PN5964 | PN5964 | 3-33 | SS16 |
| *PN5965 | PN5965 | PN5964 | 3-33 | SS16 |
| *RF400 | RF400 | RF400 | 3-9 | D1 |
| *RF401 | RF401 | RF400 | 3-9 | D1 |
| SD345 | 2N6123 | 2N6121 | | PWR5 |
| SD445 | 2N6126 | 2N6124 | | PWR14 |
| SDA345 | 2N6122 | 2N6121 | | PWR5 |
| SDA445 | 2N6125 | 2N6124 | | PWR14 |
| SDB345 | 2N6123 | 2N6121 | | PWR5 |
| SDB445 | 2N6126 | 2N6124 | | PWR14 |
| SE1001 | SE1001 | | 3-24 | SS14 |
| SE1002 | SE1002 | | | SS14 |
| SE1010 | SE1010 | | 3-35 | SS2 |
| SE2001 | SE2001 | | 3-22 | SS14 |
| SE2002 | SE2002 | | 3-22 | SS14 |
| SE3001 | SE3001 | | 3-35 | SS27 |
| SE3002 | SE3002 | | 3-35 | SS27 |
| SE3646 | 2N3646 | 2N3646 | | SS22 |
| SE4001 | SE4001 | | 3-29 | SS8 |
| SE4002 | SE4002 | | 3-29 | SS8 |
| SE4010 | SE4010 | | 3-29 | SS8 |
| SE4020 | SE4020 | | 3-30 | SS8 |
| SE4021 | SE4021 | | 3-30 | SS8 |
| SE4022 | SE4022 | | | SS8 |
| SE5001 | 2N3688 | 2N3688 | | SS1 |
| SE5002 | 2N3689 | 2N3688 | | SS1 |
| SE5003 | 2N3690 | 2N3688 | | SS1 |
| SE5006 | SE5006 | 2N3688 | 3-35 | SS1 |
| *SE5020 | SE5020 | SE5020 | 3-34 | SS3 |
| *SE5021 | SE5021 | SE5020 | 3-34 | SS3 |
| *SE5022 | SE5022 | SE5020 | 3-34 | SS3 |
| *SE5023 | SE5023 | SE5020 | 3-34 | SS3 |
| *SE5024 | SE5024 | SE5020 | 3-34 | SS3 |
| SE5025 | PE5025 | PE5025 | | SS6 |
| SE5030B | PE5030B | PE5029 | | SS12 |
| *SE5035 | SE5035 | SE5035 | 3-34 | SS12 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| *SE5036 | SE5036 | SE5035 | 3-34 | SS12 |
| SE5040 | SE5040 | BF167 | 3-34 | |
| *SE5050 | SE5050 | SE5050 | 3-34 | SS3 |
| *SE5051 | SE5051 | SE5050 | 3-34 | SS3 |
| SE5052 | SE5052 | | 3-34 | SS3 |
| *SE5055 | SE5055 | SE5055 | 3-34 | SS10 |
| *SE5315 | SE5315 | FT0601 | | SS26 |
| SE6001 | 2N3567 | 2N3567 | | SS15 |
| SE6002 | 2N3566 | 2N3566 | | SS15 |
| *SE6020 | SE6020 | PE6020 | 3-24 | SS17 |
| *SE6021 | SE6021 | PE6020 | 3-24 | SS17 |
| SE6022 | PE6020 | PE6020 | | SS17 |
| SE6023 | PE6021 | PE6020 | | SS17 |
| SE7001 | SE7001 | | 3-33 | SS16 |
| SE7002 | SE7002 | | 3-33 | SS16 |
| SE7010 | SE7010 | | 3-33 | SS16 |
| *SE7055 | SE7055 | SE7055 | 3-33 | SS11 |
| *SE7056 | SE7056 | SE7055 | 3-33 | SS11 |
| *SE7057 | SE7057 | SE7055 | 3-33 | SS11 |
| SE7066 | CF | | | |
| SE8010 | 2N3722 | 2N3722 | | SS9 |
| *SE9051 | SE9051 | 2N6233 | 3-36 | PWR9 |
| *SE9052 | SE9052 | 2N6233 | 3-36 | PWR9 |
| *SE9331 | SE9331 | SE9331 | 3-36 | PWR8 |
| TIP29 | 2N6121 | 2N6121 | | PWR5 |
| TIP29A | 2N6122 | 2N6121 | | PWR5 |
| TIP29B | 2N6123 | 2N6121 | | PWR5 |
| TIP29C | 2N6123 | 2N6121 | | PWR5 |
| TIP30 | 2N6124 | 2N6124 | | PWR14 |
| TIP30A | 2N6125 | 2N6124 | | PWR14 |
| TIP30B | 2N6126 | 2N6124 | | PWR14 |
| TIP30C | 2N6126 | 2N6124 | | PWR14 |
| TIP31 | 2N6121 | 2N6121 | | PWR5 |
| TIP31A | 2N6122 | 2N6121 | | PWR5 |
| TIP31B | 2N6123 | 2N6121 | | PWR5 |
| TIP31C | 2N6123 | 2N6121 | | PWR5 |
| TIP32 | 2N6124 | 2N6124 | | PWR14 |
| TIP32A | 2N6125 | 2N6124 | | PWR14 |
| TIP32B | 2N6126 | 2N6124 | | PWR14 |
| TIP32C | 2N6126 | 2N6124 | | PWR14 |
| TIP33 | 2N6129 | 2N6129 | | PWR10 |
| TIP33A | 2N6130 | 2N6129 | | PWR10 |
| TIP33B | 2N6131 | 2N6129 | | PWR10 |
| TIP33C | 2N6131 | 2N6129 | | PWR10 |
| TIP34 | 2N6132 | 2N6132 | | PWR17 |
| TIP34A | 2N6133 | 2N6132 | | PWR17 |
| TIP34B | 2N6134 | 2N6132 | | PWR17 |
| TIP34C | 2N6134 | 2N6132 | | PWR17 |
| TIP41 | 2N6129 | 2N6129 | | PWR10 |
| TIP41A | 2N6130 | 2N6129 | | PWR10 |
| TIP41B | 2N6131 | 2N6129 | | PWR10 |
| TIP41C | 2N6131 | 2N6129 | | PWR10 |
| TIP42 | 2N6132 | 2N6132 | | PWR17 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| TIP42A | 2N6133 | 2N6132 | | PWR17 |
| TIP42B | 2N6134 | 2N6132 | | PWR17 |
| TIP42C | 2N6134 | 2N6132 | | PWR17 |
| TIP501 | 2N5321 | 2N5320 | | PWR2 |
| TIP502 | 2N5320 | 2N5320 | | PWR2 |
| TIP530 | SE9052 | 2N6233 | | PWR9 |
| TIP3055 | 2N6131 | 2N6129 | | PWR10 |
| TIS37 | 2N3905 | 2N3905 | | SS23 |
| TIS38 | 2N3905 | 2N3905 | | SS23 |
| TIS44 | 2N5772 | 2N3646 | | SS5 |
| TIS45 | 2N5772 | 2N3646 | | SS5 |
| TIS46 | 2N5772 | 2N3646 | | SS5 |
| TIS47 | 2N5769 | 2N2369 | | SS28 |
| TIS48 | 2N5769 | 2N2369 | | SS28 |
| TIS49 | 2N5769 | 2N2369 | | SS28 |
| TIS50 | 2N5771 | 2N5771 | | SS31 |
| TIS51 | 2N5769 | 2N2369 | | SS28 |
| TIS52 | 2N5772 | 2N3646 | | SS5 |
| TIS53 | MPS3640 | 2N3639 | | SS5 |
| TIS54 | MPS3640 | 2N3639 | | SS5 |
| TIS55 | 2N5772 | 2N3646 | | SS5 |
| TIS56 | SE5055 | SE5055 | | SS10 |
| TIS57 | SE5055 | SE5055 | | SS10 |
| TIS62 | 2N5770 | 2N918 | | SS27 |
| TIS63 | 2N5770 | 2N918 | | SS27 |
| TIS64 | 2N5770 | 2N918 | | SS27 |
| TIS84 | PE5031 | PE5029 | | SS12 |
| TIS85 | PE5030B | PE5029 | | SS12 |
| TIS86 | PE5031 | PE5029 | | SS12 |
| TIS87 | PE5031 | PE5029 | | SS12 |
| TIS88 | 2N5484 | 2N5484 | | |
| TIS90 | 2N4401 | 2N4400 | | SS15 |
| TIS90M | 2N4401 | 2N4400 | | SS15 |
| TIS91 | 2N4403 | 2N4402 | | SS22 |
| TIS91M | 2N4403 | 2N4402 | | SS22 |
| TIS92 | 2N4401 | 2N4400 | | SS15 |
| TIS92M | 2N4401 | 2N4400 | | SS15 |
| TIS93 | 2N4403 | 2N4402 | | SS22 |
| TIS93M | 2N4403 | 2N4402 | | SS22 |
| TIS97 | 2N5210 | 2N5209 | | |
| TIS98 | 2N5961 | 2N5961 | | SS8 |
| TIS99 | MPSA06 | MPSA05 | | SS17 |
| TIS100 | 2N5833 | 2N5830 | | SS16 |
| TIS101 | 2N5831 | 2N5830 | | SS16 |
| TIS104 | PE5030B | PE5029 | | SS12 |
| TP3638 | 2N3638 | 2N3638 | | SS22 |
| TP3638A | 2N3638A | 2N3638 | | SS22 |
| TP4123 | 2N4123 | 2N4123 | | SS14 |
| TP4124 | 2N4124 | 2N4123 | | SS14 |
| TP4125 | 2N4125 | 2N4125 | | SS23 |
| TP4126 | 2N4126 | 2N4125 | | SS23 |
| TP4257 | 2N4258 | 2N4258 | | SS31 |
| TP4258 | 2N4258 | 2N4258 | | SS31 |

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|---|---|---|---|---|
| TP4274 | 2N4274 | 2N4274 | | SS31 |
| TP4275 | 2N4275 | 2N4274 | | SS31 |
| TPS6512 | MPS6512 | MPS6512 | | SS14 |
| TPS6513 | MPS6513 | MPS6512 | | SS14 |
| TPS6514 | MPS6514 | MPS6512 | | SS14 |
| TPS6515 | MPS6515 | MPS6512 | | SS14 |
| TPS6516 | MPS6516 | MPS6516 | | SS23 |
| TPS6517 | MPS6517 | MPS6516 | | SS23 |
| TPS6518 | MPS6518 | MPS6516 | | SS23 |
| TPS6519 | MPS6519 | MPS6516 | | SS23 |
| TPS6522 | MPS6522 | MPS6522 | | SS23 |
| TPS6523 | MPS6523 | MPS6522 | | SS23 |
| 1N193 | FDH666 | FD600 | | |
| 1N194 | FDH666 | FD600 | | |
| 1N194A | FDH666 | FD600 | | |
| 1N195 | FDH666 | FD600 | | |
| 1N196 | FDH666 | FD600 | | |
| 1N300 | 1N482 | 1N482 | | D5 |
| 1N300A | 1N482 | 1N482 | | D5 |
| 1N300B | 1N482 | 1N482 | | D5 |
| 1N301 | 1N483 | 1N482 | | D5 |
| 1N301A | 1N483 | 1N482 | | D5 |
| 1N301B | 1N483 | 1N482 | | D5 |
| 1N316 | 1N4001 | 1N4001 | | D10 |
| 1N317 | 1N4002 | 1N4001 | | D10 |
| 1N318 | 1N4003 | 1N4001 | | D10 |
| 1N319 | 1N4004 | 1N4001 | | D10 |
| 1N320 | 1N4005 | 1N4001 | | D10 |
| 1N323 | 1N4001 | 1N4001 | | D10 |
| 1N324 | 1N4002 | 1N4001 | | D10 |
| 1N325 | 1N4003 | 1N4001 | | D10 |
| 1N326 | 1N4004 | 1N4001 | | D10 |
| 1N327 | 1N4005 | 1N4001 | | D10 |
| 1N330 | 1N456 | 1N456 | | D5 |
| 1N331 | 1N456 | 1N456 | | D5 |
| 1N350 | 1N457 | 1N457 | | D5 |
| 1N351 | 1N484 | 1N482 | | D5 |
| 1N352 | 1N485 | 1N482 | | D5 |
| 1N353 | 1N661 | 1N659 | | D4 |
| 1N359 | 1N4001 | 1N4001 | | D10 |
| 1N360 | 1N4002 | 1N4001 | | D10 |
| 1N361 | 1N4003 | 1N4001 | | D10 |
| 1N362 | 1N4004 | 1N4001 | | D10 |
| 1N363 | 1N4005 | 1N4001 | | D10 |
| 1N373 | 1N747 | 1N746 | | D8 |
| 1N374 | 1N749 | 1N746 | | D8 |
| 1N375 | 1N750 | 1N746 | | D8 |
| 1N376 | 1N752 | 1N746 | | D8 |
| 1N377 | 1N754 | 1N746 | | D8 |
| 1N378 | 1N757 | 1N746 | | D8 |
| 1N379 | 1N758 | 1N746 | | D8 |
| 1N380 | 1N964A | 1N957 | | D8 |
| 1N381 | 1N966A | 1N957 | | D8 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 1N382 | 1N968A | 1N957 | | D8 |
| 1N383 | 1N970A | 1N957 | | D8 |
| 1N384 | 1N972A | 1N957 | | D8 |
| 1N385 | 1N973A | 1N957 | | D8 |
| 1N432 | 1N482 | 1N482 | | D5 |
| 1N432A | 1N482 | 1N482 | | D5 |
| 1N433 | 1N485 | 1N482 | | D5 |
| 1N433A | 1N485 | 1N482 | | D5 |
| 1N434 | 1N485 | 1N482 | | D5 |
| 1N434A | 1N485 | 1N482 | | D5 |
| 1N440 | 1N4002 | 1N4001 | | D10 |
| 1N440B | 1N4002 | 1N4001 | | D10 |
| 1N441 | 1N4003 | 1N4001 | | D10 |
| 1N441B | 1N4003 | 1N4001 | | D10 |
| 1N442 | 1N4004 | 1N4001 | | D10 |
| 1N442B | 1N4004 | 1N4001 | | D10 |
| 1N443 | 1N4004 | 1N4001 | | D10 |
| 1N443B | 1N4004 | 1N4001 | | D10 |
| 1N444 | 1N4005 | 1N4001 | | D10 |
| 1N444B | 1N4005 | 1N4001 | | D10 |
| 1N445 | 1N4005 | 1N4001 | | D10 |
| 1N445B | 1N4005 | 1N4001 | | D10 |
| *1N456 | 1N456 | 1N456 | 3-8 | D5 |
| *1N456A | 1N456A | 1N456 | 3-8 | D5 |
| *1N457 | 1N457 | 1N457 | 3-8 | D5 |
| *1N457A | 1N457A | 1N457 | 3-8 | D5 |
| *1N458 | 1N458 | 1N458 | 3-8 | D5 |
| *1N458A | 1N458A | 1N458 | 3-8 | D5 |
| *1N459 | 1N459 | 1N459 | 3-8 | D5 |
| *1N459A | 1N459A | 1N459 | 3-8 | D5 |
| 1N460 | 1N484 | 1N482 | | D5 |
| 1N460A | 1N484 | 1N482 | | D5 |
| *1N461 | 1N461 | 1N461 | 3-7 | D5 |
| *1N461A | 1N461A | 1N461 | 3-7 | D5 |
| *1N462 | 1N462 | 1N462 | 3-7 | D5 |
| *1N462A | 1N462A | 1N462 | 3-7 | D5 |
| *1N463 | 1N463 | 1N463 | 3-7 | D5 |
| *1N463A | 1N463A | 1N463 | 3-7 | D5 |
| *1N464 | 1N464 | 1N464 | 3-7 | D5 |
| *1N464A | 1N464A | 1N464 | 3-7 | D5 |
| 1N466 | 1N747 | 1N746 | | D8 |
| 1N466A | 1N746A | 1N746 | | D8 |
| 1N467 | 1N749 | 1N746 | | D8 |
| 1N467A | 1N749A | 1N746 | | D8 |
| 1N468 | 1N750 | 1N746 | | D8 |
| 1N468A | 1N750A | 1N746 | | D8 |
| 1N469 | 1N753 | 1N746 | | D8 |
| 1N469A | 1N753A | 1N746 | | D8 |
| 1N470 | 1N754 | 1N746 | | D8 |
| 1N470A | 1N754A | 1N746 | | D8 |
| *1N482 | 1N482 | 1N482 | 3-7 | D5 |
| *1N482A | 1N482A | 1N482 | 3-8 | D5 |
| *1N482B | 1N482B | 1N482 | 3-8 | D5 |
| *1N483 | 1N483 | 1N482 | 3-7 | D5 |
| *1N483A | 1N483A | 1N482 | 3-8 | D5 |
| *1N483B | 1N483B | 1N482 | 3-8 | D5 |
| *1N484 | 1N484 | 1N482 | 3-7 | D5 |
| *1N484A | 1N484A | 1N482 | 3-8 | D5 |
| *1N484B | 1N484B | 1N482 | 3-8 | D5 |
| *1N485 | 1N485 | 1N482 | 3-7 | D5 |
| *1N485A | 1N485A | 1N482 | 3-8 | D5 |
| *1N485B | 1N485B | 1N482 | 3-8 | D5 |
| *1N486 | 1N486 | 1N482 | 3-8 | D5 |
| *1N486A | 1N486A | 1N482 | 3-8 | D5 |
| *1N486B | 1N486B | 1N482 | 3-8 | D5 |
| 1N530 | 1N4002 | 1N4001 | | D10 |
| 1N531 | 1N4003 | 1N4001 | | D10 |
| 1N532 | 1N4004 | 1N4001 | | D10 |
| 1N533 | 1N4004 | 1N4001 | | D10 |
| 1N534 | 1N4005 | 1N4001 | | D10 |
| 1N535 | 1N4005 | 1N4001 | | D10 |
| 1N536 | 1N4001 | 1N4001 | | D10 |
| 1N537 | 1N4002 | 1N4001 | | D10 |
| 1N538 | 1N4003 | 1N4001 | | D10 |
| 1N539 | 1N4004 | 1N4001 | | D10 |
| 1N540 | 1N4004 | 1N4001 | | D10 |
| 1N547 | 1N4005 | 1N4001 | | D10 |
| 1N596 | 1N4005 | 1N4001 | | D10 |
| 1N599 | 1N4001 | 1N4001 | | D10 |
| 1N599A | 1N4001 | 1N4001 | | D10 |
| 1N600 | 1N4002 | 1N4001 | | D10 |
| 1N600A | 1N4002 | 1N4001 | | D10 |
| 1N601 | 1N4003 | 1N4001 | | D10 |
| 1N601A | 1N4003 | 1N4001 | | D10 |
| 1N602 | 1N4003 | 1N4001 | | D10 |
| 1N602A | 1N4003 | 1N4001 | | D10 |
| 1N603 | 1N4004 | 1N4001 | | D10 |
| 1N603A | 1N4004 | 1N4001 | | D10 |
| 1N604 | 1N4004 | 1N4001 | | D10 |
| 1N604A | 1N4004 | 1N4001 | | D10 |
| 1N605 | 1N4005 | 1N4001 | | D10 |
| 1N605A | 1N4005 | 1N4001 | | D10 |
| 1N606 | 1N4005 | 1N4001 | | D10 |
| 1N606A | 1N4005 | 1N4001 | | D10 |
| 1N607 | 1N4001 | 1N4001 | | D10 |
| 1N607A | 1N4001 | 1N4001 | | D10 |
| 1N608 | 1N4002 | 1N4001 | | D10 |
| 1N608A | 1N4002 | 1N4001 | | D10 |
| 1N609 | 1N4003 | 1N4001 | | D10 |
| 1N609A | 1N4003 | 1N4001 | | D10 |
| 1N610 | 1N4003 | 1N4001 | | D10 |
| 1N610A | 1N4003 | 1N4001 | | D10 |
| 1N611 | 1N4004 | 1N4001 | | D10 |
| 1N611A | 1N4004 | 1N4001 | | D10 |
| 1N612 | 1N4004 | 1N4001 | | D10 |
| 1N612A | 1N4004 | 1N4001 | | D10 |

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|---|---|---|---|---|
| 1N613 | 1N4005 | 1N4001 | | D10 |
| 1N613A | 1N4005 | 1N4001 | | D10 |
| 1N614 | 1N4005 | 1N4001 | | D10 |
| 1N614A | 1N4005 | 1N4001 | | D10 |
| 1N619 | FDH666 | FD600 | | D6 |
| 1N622 | FDH444 | FD400 | | D4 |
| *1N625 | 1N625 | 1N625 | 3-6 | D6 |
| *1N626 | 1N626 | 1N625 | 3-5 | D4 |
| *1N627 | 1N627 | 1N625 | 3-5 | D4 |
| *1N628 | 1N628 | 1N625 | 3-5 | D4 |
| *1N629 | 1N629 | 1N625 | 3-5 | D4 |
| *1N643 | 1N643 | 1N643 | 3-5 | D4 |
| *1N643A | 1N643A | 1N643 | | D4 |
| 1N645 | 1N4003 | 1N4001 | | D10 |
| 1N645A | 1N4003 | 1N4001 | | D10 |
| 1N646 | 1N4004 | 1N4001 | | D10 |
| 1N647 | 1N4004 | 1N4001 | | D10 |
| 1N648 | 1N4005 | 1N4001 | | D10 |
| 1N649 | 1N4005 | 1N4001 | | D10 |
| *1N658 | 1N658 | 1N658 | 3-5 | D4 |
| 1N658A | 1N658A | | | D4 |
| *1N659 | 1N659 | 1N659 | 3-4 | D6 |
| 1N659A | 1N659 | 1N659 | | D6 |
| *1N660 | 1N660 | 1N659 | 3-5 | D4 |
| 1N660A | 1N660 | 1N659 | | D4 |
| *1N661 | 1N661 | 1N659 | 3-7 | D4 |
| 1N661A | 1N661 | 1N659 | | D4 |
| *1N662 | 1N662 | 1N662 | 3-5 | D4 |
| *1N662A | 1N662A | 1N662 | 3-5 | D4 |
| *1N663 | 1N663 | 1N662 | 3-5 | D4 |
| *1N663A | 1N663A | 1N662 | 3-5 | D4 |
| 1N664 | 1N756A | 1N746 | | D8 |
| 1N665 | 1N759A | 1N746 | | D8 |
| 1N666 | 1N965B | 1N957 | | D8 |
| 1N667 | 1N967B | 1N957 | | D8 |
| 1N668 | 1N969B | 1N957 | | D8 |
| 1N669 | 1N971B | 1N957 | | D8 |
| 1N674 | 1N750A | 1N746 | | D8 |
| 1N675 | 1N753A | 1N746 | | D8 |
| 1N676 | 1N4002 | 1N4001 | | D10 |
| 1N677 | 1N4002 | 1N4001 | | D10 |
| 1N678 | 1N4003 | 1N4001 | | D10 |
| 1N679 | 1N4003 | 1N4001 | | D10 |
| 1N681 | 1N4004 | 1N4001 | | D10 |
| 1N682 | 1N4004 | 1N4001 | | D10 |
| 1N683 | 1N4004 | 1N4001 | | D10 |
| 1N684 | 1N4004 | 1N4001 | | D10 |
| 1N685 | 1N4005 | 1N4001 | | D10 |
| 1N686 | 1N4005 | 1N4001 | | D10 |
| 1N687 | 1N4005 | 1N4001 | | D10 |
| 1N689 | 1N5005 | 1N4001 | | D10 |
| 1N690 | FDH400 | FD400 | | D4 |
| 1N691 | FDH400 | FD400 | | D4 |
| 1N692 | FDH400 | FD400 | | D4 |
| 1N693 | FDH400 | FD400 | | D4 |
| 1N696 | FDH666 | FD600 | | D6 |
| 1N697 | FDH666 | FD600 | | D6 |
| 1N701 | 1N758A | 1N746 | | D8 |
| 1N703 | 1N747 | 1N746 | | D8 |
| 1N703A | 1N747A | 1N746 | | D8 |
| 1N704 | 1N749 | 1N746 | | D8 |
| 1N704A | 1N749A | 1N746 | | D8 |
| 1N705 | 1N750 | 1N746 | | D8 |
| 1N705A | 1N750A | 1N746 | | D8 |
| 1N706 | 1N752 | 1N746 | | D8 |
| 1N706A | 1N752A | 1N746 | | D8 |
| 1N707 | 1N754 | 1N746 | | D8 |
| 1N707A | 1N754A | 1N746 | | D8 |
| 1N708 | 1N752 | 1N746 | | D8 |
| 1N708A | 1N752A | 1N746 | | D8 |
| 1N709 | 1N753 | 1N746 | | D8 |
| 1N709A | 1N753A | 1N746 | | D8 |
| 1N710 | 1N754 | 1N746 | | D8 |
| 1N710A | 1N754A | 1N746 | | D8 |
| 1N711 | 1N755 | 1N746 | | D8 |
| 1N711A | 1N755A | 1N746 | | D8 |
| 1N712 | 1N756 | 1N746 | | D8 |
| 1N712A | 1N756A | 1N746 | | D8 |
| 1N713 | 1N757 | 1N746 | | D8 |
| 1N713A | 1N757A | 1B746 | | D8 |
| 1N714 | 1N758 | 1N746 | | D8 |
| 1N714A | 1N758A | 1N746 | | D8 |
| 1N715 | 1N962A | 1N957 | | D8 |
| 1N715A | 1N962B | 1N957 | | D8 |
| 1N716 | 1N963A | 1N957 | | D8 |
| 1N716A | 1N963B | 1N957 | | D8 |
| 1N717 | 1N964A | 1N957 | | D8 |
| 1N717A | 1N964B | 1N957 | | D8 |
| 1N718 | 1N965A | 1N957 | | D8 |
| 1N718A | 1N965B | 1N957 | | D8 |
| 1N719 | 1N966A | 1N957 | | D8 |
| 1N719A | 1N966B | 1N957 | | D8 |
| 1N720 | 1N967A | 1N957 | | D8 |
| 1N720A | 1N967B | 1N957 | | D8 |
| 1N721 | 1N968A | 1N957 | | D8 |
| 1N721A | 1N968B | 1N957 | | D8 |
| 1N722 | 1N969A | 1N957 | | D8 |
| 1N722A | 1N969B | 1N957 | | D8 |
| 1N723 | 1N970A | 1N957 | | D8 |
| 1N723A | 1N970B | 1N957 | | D8 |
| 1N724 | 1N971A | 1N957 | | D8 |
| 1N724A | 1N971B | 1N957 | | D8 |
| 1N725 | 1N972B | 1N957 | | D8 |
| 1N725A | 1N972B | 1N957 | | D8 |
| 1N726 | 1N973A | 1N957 | | D8 |

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| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 1N726A | 1N973B | 1N957 | | D8 |
| *1N746 | 1N746 | 1N746 | 3-10 | D8 |
| *1N746A | 1N746A | 1N746 | 3-10 | D8 |
| *1N747 | 1N747 | 1N746 | 3-10 | D8 |
| *1N747A | 1N747A | 1N746 | | D8 |
| *1N748 | 1N748 | 1N746 | 3-10 | D8 |
| *1N748A | 1N748A | 1N746 | 3-10 | D8 |
| *1N749 | 1N749 | 1N746 | 3-10 | D8 |
| *1N749A | 1N749A | 1N746 | 3-10 | D8 |
| *1N750 | 1N750 | 1N746 | 3-10 | D8 |
| *1N750A | 1N750A | 1N746 | 3-10 | D8 |
| *1N751 | 1N751 | 1N746 | 3-10 | D8 |
| *1N751A | 1N751A | 1N746 | 3-10 | D8 |
| *1N752 | 1N752 | 1N746 | 3-10 | D8 |
| *1N752A | 1N752A | 1N746 | 3-10 | D8 |
| *1N753 | 1N753 | 1N746 | 3-10 | D8 |
| *1N753A | 1N753A | 1N746 | 3-10 | D8 |
| *1N754 | 1N754 | 1N746 | 3-10 | D8 |
| *1N754A | 1N754A | 1N746 | 3-10 | D8 |
| *1N755 | 1N755 | 1N746 | 3-10 | D8 |
| *1N755A | 1N755A | 1N746 | 3-10 | D8 |
| *1N756 | 1N756 | 1N746 | 3-10 | D8 |
| *1N756A | 1N756A | 1N746 | 3-10 | D8 |
| *1N757 | 1N757 | 1N746 | 3-10 | D8 |
| *1N757A | 1N757A | 1N746 | 3-10 | D8 |
| *1N758 | 1N758 | 1N746 | 3-10 | D8 |
| *1N758A | 1N758A | 1N746 | 3-10 | D8 |
| *1N759 | 1N759 | 1N746 | 3-10 | D8 |
| *1N759A | 1N759A | 1N746 | 3-11 | D8 |
| 1N761 | 1N750 | 1N746 | | D8 |
| 1N762 | 1N752 | 1N746 | | D8 |
| 1N763 | 1N754 | 1N746 | | D8 |
| 1N764 | 1N757 | 1N746 | | D8 |
| 1N765 | 1N758 | 1N746 | | D8 |
| 1N766 | 1N964A | 1N957 | | D8 |
| 1N767 | 1N966A | 1N957 | | D8 |
| 1N768 | 1N968A | 1N957 | | D8 |
| 1N769 | 1N970A | 1N957 | | D8 |
| 1N778 | 1N778 | | 3-5 | D4 |
| 1N779 | 1N779 | | 3-7 | D4 |
| 1N789 | 1N789 | | 3-6 | D6 |
| 1N790 | 1N790 | | 3-6 | D6 |
| 1N791 | 1N791 | | 3-6 | D4 |
| 1N792 | 1N792 | | 3-6 | D4 |
| 1N793 | 1N793 | | 3-5 | D6 |
| 1N794 | 1N794 | | 3-5 | D4 |
| 1N795 | 1N795 | | 3-7 | D4 |
| 1N796 | 1N796 | | 3-5 | D4 |
| 1N797 | 1N797 | | 3-5 | D6 |
| 1N798 | 1N660 | 1N659 | | D4 |
| 1N799 | 1N799 | | 3-7 | D4 |
| 1N800 | 1N3070 | 1N3070 | | D4 |
| 1N801 | 1N801 | | 3-5 | D4 |
| 1N802 | 1N3070 | 1N3070 | | D4 |
| 1N803 | 1N3070 | 1N3070 | | D4 |
| 1N804 | 1N804 | | 3-5 | D4 |
| 1N806 | 1N806 | | 3-5 | D4 |
| 1N807 | 1N807 | | 3-5 | D4 |
| 1N808 | 1N808 | | 3-5 | D4 |
| 1N809 | 1N809 | | 3-5 | D4 |
| 1N810 | FDH600 | FD600 | | D6 |
| 1N811 | 1N811 | | 3-6 | D6 |
| 1N812 | 1N812 | | 3-5 | D6 |
| 1N813 | 1N813 | | 3-6 | D6 |
| 1N814 | 1N814 | | 3-4 | D6 |
| 1N815 | 1N815 | | 3-6 | D6 |
| 1N816 | 1N816 | | 3-7 | D5 |
| 1N817 | 1N3070 | 1N3070 | | D4 |
| 1N818 | 1N818 | | 3-5 | D4 |
| 1N837 | 1N837 | | 3-5 | D4 |
| 1N837A | 1N837A | | 3-5 | D4 |
| 1N838 | 1N838 | | 3-5 | D4 |
| 1N839 | 1N839 | | 3-5 | D4 |
| 1N840 | 1N840 | | 3-5 | D4 |
| 1N841 | 1N841 | | 3-5 | D4 |
| 1N842 | 1N842 | | 3-5 | D4 |
| 1N843 | 1N843 | | 3-5 | D4 |
| 1N844 | 1N844 | | 3-7 | D4 |
| 1N845 | 1N845 | | 3-5 | D4 |
| 1N846 | 1N4001 | 1N4001 | | D10 |
| 1N847 | 1N4002 | 1N4001 | | D10 |
| 1N848 | 1N4003 | 1N4001 | | D10 |
| 1N849 | 1N4004 | 1N4001 | | D10 |
| 1N850 | 1N4004 | 1N4001 | | D10 |
| 1N851 | 1N4005 | 1N4001 | | D10 |
| 1N852 | 1N4005 | 1N4001 | | D10 |
| 1N857 | 1N4001 | 1N4001 | | D10 |
| 1N858 | 1N4002 | 1N4001 | | D10 |
| 1N859 | 1N4003 | 1N4001 | | D10 |
| 1N860 | 1N4004 | 1N4001 | | D10 |
| 1N861 | 1N4004 | 1N4001 | | D10 |
| 1N862 | 1N4005 | 1N4001 | | D10 |
| 1N863 | 1N4005 | 1N4001 | | D10 |
| 1N868 | 1N4001 | 1N4001 | | D10 |
| 1N869 | 1N4002 | 1N4001 | | D10 |
| 1N870 | 1N4003 | 1N4001 | | D10 |
| 1N871 | 1N4004 | 1N4001 | | D10 |
| 1N872 | 1N4004 | 1N4001 | | D10 |
| 1N873 | 1N4005 | 1N4001 | | D10 |
| 1N874 | 1N4005 | 1N4001 | | D10 |
| 1N879 | 1N4001 | 1N4001 | | D10 |
| 1N880 | 1N4002 | 1N4001 | | D10 |
| 1N881 | 1N4003 | 1N4001 | | D10 |
| 1N882 | 1N4004 | 1N4001 | | D10 |
| 1N883 | 1N4004 | 1N4001 | | D10 |
| 1N884 | 1N4005 | 1N4001 | | D10 |

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|---|---|---|---|---|
| 1N885 | 1N4005 | 1N4001 | | D10 |
| 1N890 | 1N890 | | 3-8 | D5 |
| 1N891 | 1N891 | | 3-5 | D4 |
| 1N892 | 1N4148 | 1N914 | | D6 |
| 1N893 | 1N3070 | 1N3070 | | D4 |
| 1N897 | 1N4148 | 1N914 | | D6 |
| 1N898 | 1N914B | 1N914 | | D6 |
| 1N899 | 1N4148 | 1N914 | | D6 |
| 1N900 | 1N4148 | 1N914 | | D6 |
| 1N901 | 1N4148 | 1N914 | | D6 |
| 1N902 | 1N3070 | 1N3070 | | D4 |
| 1N903 | 1N903 | | 3-4 | D6 |
| 1N903A | 1N903A | | 3-4 | D6 |
| 1N904 | 1N904 | | 3-4 | D6 |
| 1N904A | 1N904A | | 3-4 | D6 |
| 1N905 | 1N905 | | 3-4 | D6 |
| 1N905A | 1N905A | | 3-4 | D6 |
| 1N906 | 1N906 | | 3-4 | D6 |
| 1N906A | 1N906A | | 3-4 | D6 |
| 1N907 | 1N907 | | 3-4 | D6 |
| 1N907A | 1N907A | | 3-4 | D6 |
| 1N908 | 1N908 | | 3-4 | D6 |
| 1N908A | 1N908A | | 3-4 | D6 |
| *1N914 | 1N914 | 1N914 | 3-3/3-12 | D6 |
| *1N914A | 1N914A | 1N914 | 3-3 | D6 |
| *1N914B | 1N914B | 1N914 | 3-3 | D6 |
| 1N915 | 1N914B | 1N914 | | D6 |
| *1N916 | 1N916 | 1N914 | 3-3 | D6 |
| *1N916A | 1N916A | 1N914 | 3-3 | D6 |
| *1N916B | 1N916B | 1N914 | 3-3 | D6 |
| 1N917 | 1N914 | 1N914 | | D6 |
| 1N919 | 1N3070 | 1N3070 | | D4 |
| 1N920 | 1N3069 | | | D6 |
| 1N921 | 1N662 | 1N662 | | D4 |
| 1N922 | 1N662 | 1N662 | | D4 |
| 1N923 | FDH444 | FD400 | | D4 |
| 1N925 | 1N925 | | 3-7 | D6 |
| 1N926 | 1N926 | | 3-7 | D4 |
| 1N927 | 1N927 | | 3-5 | D4 |
| 1N928 | 1N928 | | 3-5 | D6 |
| 1N929 | 1N914B | 1N914 | | D6 |
| 1N930 | FDH666 | FD600 | | D6 |
| 1N931 | 1N4148 | 1N914 | | D6 |
| 1N932 | 1N3070 | 1N3070 | | D4 |
| 1N934 | 1N3064 | 1N3062 | | D6 |
| 1N947 | 1N4005 | 1N4001 | | D10 |
| 1N948 | 1N662A | 1N662 | | D4 |
| *1N957 | 1N957 | 1N957 | 3-10 | D8 |
| *1N957A | 1N957A | 1N957 | 3-10 | D8 |
| *1N957B | 1N957B | 1N957 | 3-10 | D8 |
| *1N958 | 1N958 | 1N957 | 3-10 | D8 |
| *1N958A | 1N958A | 1N957 | 3-10 | D8 |
| *1N958B | 1N958B | 1N957 | 3-10 | D8 |
| *1N959 | 1N959 | 1N957 | 3-10 | D8 |
| *1N959A | 1N959A | 1N957 | 3-10 | D8 |
| *1N959B | 1N959B | 1N957 | 3-10 | D8 |
| *1N960 | 1N960 | 1N957 | 3-10 | D8 |
| *1N960A | 1N960A | 1N957 | 3-10 | D8 |
| *1N960B | 1N960B | 1N957 | 3-10 | D8 |
| *1N961 | 1N961 | 1N957 | 3-10 | D8 |
| *1N961A | 1N961A | 1N957 | 3-10 | D8 |
| *1N961B | 1N961B | 1N957 | 3-10 | D8 |
| *1N962 | 1N962 | 1N957 | 3-10 | D8 |
| *1N962A | 1N962A | 1N957 | 3-10 | D8 |
| *1N962B | 1N962B | 1N957 | 3-10 | D8 |
| *1N963 | 1N963 | 1N957 | 3-10 | D8 |
| *1N963A | 1N963A | 1N957 | 3-11 | D8 |
| *1N963B | 1N963B | 1N957 | 3-11 | D8 |
| *1N964 | 1N964 | 1N957 | 3-11 | D8 |
| *1N964A | 1N964A | 1N957 | 3-11 | D8 |
| *1N964B | 1N964B | 1N957 | 3-11 | D8 |
| *1N965 | 1N965 | 1N957 | 3-11 | D8 |
| *1N965A | 1N965A | 1N957 | 3-11 | D8 |
| *1N965B | 1N965B | 1N957 | 3-11 | D8 |
| *1N966 | 1N966 | 1N957 | 3-11 | D8 |
| *1N966A | 1N966A | 1N957 | 3-11 | D8 |
| *1N966B | 1N966B | 1N957 | 3-11 | D8 |
| *1N967 | 1N967 | 1N957 | 3-11 | D8 |
| *1N967A | 1N967A | 1N957 | 3-11 | D8 |
| *1N967B | 1N967B | 1N957 | 3-11 | D8 |
| *1N968 | 1N968 | 1N957 | 3-11 | D8 |
| *1N968A | 1N968A | 1N957 | 3-11 | D8 |
| *1N968B | 1N968B | 1N957 | 3-11 | D8 |
| *1N969 | 1N969 | 1N957 | 3-11 | D8 |
| *1N969A | 1N969A | 1N957 | 3-11 | D8 |
| *1N969B | 1N969B | 1N957 | 3-11 | D8 |
| *1N970 | 1N970 | 1N957 | 3-11 | D8 |
| *1N970A | 1N970A | 1N957 | 3-11 | D8 |
| *1N970B | 1N970B | 1N957 | 3-11 | D8 |
| *1N971 | 1N971 | 1N957 | 3-11 | D8 |
| *1N971A | 1N971A | 1N957 | 3-11 | D8 |
| *1N971B | 1N971B | 1N957 | 3-11 | D8 |
| *1N972 | 1N972 | 1N957 | 3-11 | D8 |
| *1N972A | 1N972A | 1N957 | 3-11 | D8 |
| *1N972B | 1N972B | 1N957 | 3-11 | D8 |
| *1N973 | 1N973 | 1N957 | 3-11 | D8 |
| *1N973A | 1N973A | 1N957 | 3-11 | D8 |
| *1N973B | 1N973B | 1N957 | 3-11 | D8 |
| 1N997 | 1N914 | 1N914 | | D6 |
| 1N998 | FD444 | FD400 | | D4 |
| 1N999 | 1N914 | 1N914 | | D6 |
| 1N1008 | 1N4004 | 1N4001 | | D10 |
| 1N1028 | 1N4001 | 1N4001 | | D10 |
| 1N1029 | 1N4002 | 1N4001 | | D10 |
| 1N1030 | 1N4003 | 1N4001 | | D10 |
| 1N1031 | 1N4003 | 1N4001 | | D10 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 1N1032 | 1N4004 | 1N4001 | | D10 |
| 1N1033 | 1N4004 | 1N4001 | | D10 |
| 1N1169 | 1N4004 | 1N4001 | | D10 |
| 1N1169A | 1N4004 | 1N4001 | | D10 |
| 1N1486 | 1N4005 | 1N4001 | | D10 |
| 1N1487 | 1N4002 | 1N4001 | | D10 |
| 1N1488 | 1N4003 | 1N4001 | | D10 |
| 1N1489 | 1N4004 | 1N4001 | | D10 |
| 1N1490 | 1N4004 | 1N4001 | | D10 |
| 1N1491 | 1N4005 | 1N4001 | | D10 |
| 1N1492 | 1N4005 | 1N4001 | | D10 |
| 1N1927 | 1N748 | 1N746 | | D8 |
| 1N1928 | 1N750 | 1N746 | | D8 |
| 1N1929 | 1N752 | 1N746 | | D8 |
| 1N1930 | 1N754 | 1N746 | | D8 |
| 1N1931 | 1N756 | 1N746 | | D8 |
| 1N1932 | 1N758 | 1N746 | | D8 |
| 1N1933 | 1N759 | 1N746 | | D8 |
| 1N1934 | 1N965A | 1N957 | | D8 |
| 1N1935 | 1N967A | 1N957 | | D8 |
| 1N1936 | 1N969A | 1N957 | | D8 |
| 1N1937 | 1N971A | 1N957 | | D8 |
| 1N1938 | 1N973A | 1N957 | | D8 |
| 1N1954 | 1N748 | 1N746 | | D8 |
| 1N1955 | 1N750 | 1N746 | | D8 |
| 1N1956 | 1N752 | 1N746 | | D8 |
| 1N1957 | 1N754 | 1N746 | | D8 |
| 1N1958 | 1N756 | 1N746 | | D8 |
| 1N1959 | 1N758 | 1N746 | | D8 |
| 1N1960 | 1N759 | 1N746 | | D8 |
| 1N1961 | 1N965A | 1N957 | | D8 |
| 1N1962 | 1N967A | 1N957 | | D8 |
| 1N1963 | 1N1969A | 1N957 | | D8 |
| 1N1964 | 1N971A | 1N957 | | D8 |
| 1N1965 | 1N973A | 1N957 | | D8 |
| 1N1981 | 1N748 | 1N746 | | D8 |
| 1N1982 | 1N750 | 1N746 | | D8 |
| 1N1983 | 1N752 | 1N746 | | D8 |
| 1N1984 | 1N754 | 1N746 | | D8 |
| 1N1985 | 1N756 | 1N746 | | D8 |
| 1N1986 | 1N758 | 1N746 | | D8 |
| 1N1987 | 1N759 | 1N746 | | D8 |
| 1N1988 | 1N965A | 1N957 | | D8 |
| 1N1989 | 1N967A | 1N957 | | D8 |
| 1N1990 | 1N969A | 1N957 | | D8 |
| 1N1991 | 1N971A | 1N957 | | D8 |
| 1N1992 | 1N973A | 1N957 | | D8 |
| 1N2069 | 1N4003 | 1N4001 | | D10 |
| 1N2069A | 1N4003 | 1N4001 | | D10 |
| 1N2070 | 1N4004 | 1N4001 | | D10 |
| 1N2070A | 1N4004 | 1N4001 | | D10 |
| 1N2071 | 1N4005 | 1N4001 | | D10 |
| 1N2071A | 1N4005 | 1N4001 | | D10 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 1N2072 | 1N4001 | 1N4001 | | D10 |
| 1N2073 | 1N4002 | 1N4001 | | D10 |
| 1N2074 | 1N4003 | 1N4001 | | D10 |
| 1N2075 | 1N4003 | 1N4001 | | D10 |
| 1N2076 | 1N4004 | 1N4001 | | D10 |
| 1N2077 | 1N4004 | 1N4001 | | D10 |
| 1N2078 | 1N4004 | 1N4001 | | D10 |
| 1N2079 | 1N4005 | 1N4001 | | D10 |
| 1N2080 | 1N4001 | 1N4001 | | D10 |
| 1N2081 | 1N4002 | 1N4001 | | D10 |
| 1N2082 | 1N4003 | 1N4001 | | D10 |
| 1N2083 | 1N4004 | 1N4001 | | D10 |
| 1N2084 | 1N4004 | 1N4001 | | D10 |
| 1N2085 | 1N4005 | 1N4001 | | D10 |
| 1N2086 | 1N4005 | 1N4001 | | D10 |
| 1N2088 | 1N4005 | 1N4001 | | D10 |
| 1N2089 | 1N4005 | 1N4001 | | D10 |
| 1N2090 | 1N4001 | 1N4001 | | D10 |
| 1N2091 | 1N4002 | 1N4001 | | D10 |
| 1N2092 | 1N4003 | 1N4001 | | D10 |
| 1N2093 | 1N4004 | 1N4001 | | D10 |
| 1N2094 | 1N4004 | 1N4001 | | D10 |
| 1N2095 | 1N4005 | 1N4001 | | D10 |
| 1N2096 | 1N4005 | 1N4001 | | D10 |
| 1N2103 | 1N4001 | 1N4001 | | D10 |
| 1N2104 | 1N4002 | 1N4001 | | D10 |
| 1N2105 | 1N4003 | 1N4001 | | D10 |
| 1N2106 | 1N4004 | 1N4001 | | D10 |
| 1N2107 | 1N4004 | 1N4001 | | D10 |
| 1N2108 | 1N4005 | 1N4001 | | D10 |
| 1N2110 | 1N4002 | 1N4001 | | D10 |
| 1N2111 | 1N4003 | 1N4001 | | D10 |
| 1N2112 | 1N4004 | 1N4001 | | D10 |
| 1N2113 | 1N4004 | 1N4001 | | D10 |
| 1N2114 | 1N4005 | 1N4001 | | D10 |
| 1N2115 | 1N4004 | 1N4001 | | D10 |
| 1N2116 | 1N4004 | 1N4001 | | D10 |
| 1N2482 | 1N4003 | 1N4001 | | D10 |
| 1N2483 | 1N4004 | 1N4001 | | D10 |
| 1N2484 | 1N4005 | 1N4001 | | D10 |
| 1N2485 | 1N4003 | 1N4001 | | D10 |
| 1N2486 | 1N4004 | 1N4001 | | D10 |
| 1N2487 | 1N4004 | 1N4001 | | D10 |
| 1N2488 | 1N4005 | 1N4001 | | D10 |
| 1N2489 | 1N4005 | 1N4001 | | D10 |
| 1N2609 | 1N4001 | 1N4001 | | D10 |
| 1N2610 | 1N4002 | 1N4001 | | D10 |
| 1N2611 | 1N4003 | 1N4001 | | D10 |
| 1N2612 | 1N4004 | 1N4001 | | D10 |
| 1N2613 | 1N4004 | 1N4001 | | D10 |
| 1N2614 | 1N4005 | 1N4001 | | D10 |
| 1N2615 | 1N4005 | 1N4001 | | D10 |
| 1N2765 | FCT1125 | FCT1021 | | D3 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 1N2765A | FCT1122 | FCT1021 | | D3 |
| *1N3062 | 1N3062 | 1N3062 | 3-3 | D6 |
| *1N3063 | 1N3063 | 1N3062 | 3-3 | D6 |
| *1N3064 | 1N3064 | 1N3062 | 3-3 | D6 |
| 1N3065 | 1N3065 | | 3-3 | D6 |
| 1N3066 | 1N3066 | | 3-3 | D6 |
| *1N3067 | 1N3067 | | 3-4 | D6 |
| 1N3068 | 1N3068 | | 3-6 | D4 |
| *1N3069 | 1N3069 | | 3-5 | D6 |
| *1N3070 | 1N3070 | 1N3070 | 3-5/3-12 | D4 |
| *1N3071 | 1N3071 | 1N3070 | 3-5 | D4 |
| 1N3072 | 1N4001 | 1N4001 | | D10 |
| 1N3073 | 1N4002 | 1N4001 | | D10 |
| 1N3074 | 1N4003 | 1N4001 | | D10 |
| 1N3075 | 1N4003 | 1N4001 | | D10 |
| 1N3076 | 1N4004 | 1N4001 | | D10 |
| 1N3077 | 1N4004 | 1N4001 | | D10 |
| 1N3078 | 1N4004 | 1N4001 | | D10 |
| 1N3079 | 1N4004 | 1N4001 | | D10 |
| 1N3080 | 1N4005 | 1N4001 | | D10 |
| 1N3081 | 1N4005 | 1N4001 | | D10 |
| 1N3082 | 1N4003 | 1N4001 | | D10 |
| 1N3083 | 1N4004 | 1N4001 | | D10 |
| 1N3084 | 1N4005 | 1N4001 | | D10 |
| 1N3147 | 1N662A | 1N662 | | D4 |
| 1N3189 | 1N4003 | 1N4001 | | D10 |
| 1N3190 | 1N4004 | 1N4001 | | D10 |
| 1N3191 | 1N4005 | 1N4001 | | D10 |
| 1N3192 | 1N3070 | 1N3070 | | D4 |
| 1N3193 | 1N4003 | 1N4001 | | D10 |
| 1N3194 | 1N4004 | 1N4001 | | D10 |
| 1N3195 | 1N4005 | 1N4001 | | D10 |
| 1N3206 | 1N662 | 1N662 | | D4 |
| 1N3207 | 1N662A | 1N662 | | D4 |
| 1N3215 | 1N662 | 1N662 | | D4 |
| 1N3223 | 1N628 | 1N625 | | D4 |
| 1N3253 | 1N4003 | 1N4001 | | D10 |
| 1N3254 | 1N4004 | 1N4001 | | D10 |
| 1N3255 | 1N4005 | 1N4001 | | D10 |
| 1N3257 | 1N662A | 1N662 | | D4 |
| 1N3258 | 1N662A | 1N662 | | D4 |
| 1N3277 | 1N4003 | 1N4001 | | D10 |
| 1N3278 | 1N4004 | 1N4001 | | D10 |
| 1N3279 | 1N4005 | 1N4001 | | D10 |
| 1N3411 | 1N753 | 1N746 | | D8 |
| 1N3412 | 1N754 | 1N746 | | D8 |
| 1N3413 | 1N755 | 1N746 | | D8 |
| 1N3414 | 1N756 | 1N746 | | D8 |
| 1N3415 | 1N758 | 1N746 | | D8 |
| 1N3416 | 1N759 | 1N746 | | D8 |
| 1N3417 | 1N965A | 1N957 | | D8 |
| 1N3418 | 1N967A | 1N957 | | D8 |
| 1N3419 | 1N969A | 1N957 | | D8 |
| 1N3420 | 1N971A | 1N957 | | D8 |
| 1N3421 | 1N972A | 1N957 | | D8 |
| 1N3422 | 1N973A | 1N957 | | D8 |
| 1N3471 | 1N482A | 1N482 | | D8 |
| 1N3485 | 1N485B | 1N482 | | D8 |
| 1N3506 | 1N746A | 1N746 | | D8 |
| 1N3507 | 1N747A | 1N746 | | D8 |
| 1N3508 | 1N748A | 1N746 | | D8 |
| 1N3509 | 1N749A | 1N746 | | D8 |
| 1N3510 | 1N750A | 1N746 | | D8 |
| 1N3511 | 1N751A | 1N746 | | D8 |
| 1N3512 | 1N752A | 1N746 | | D8 |
| 1N3513 | 1N753A | 1N746 | | D8 |
| 1N3514 | 1N754A | 1N746 | | D8 |
| 1N3515 | 1N755A | 1N746 | | D8 |
| 1N3516 | 1N756A | 1N746 | | D8 |
| 1N3517 | 1N757A | 1N746 | | D8 |
| 1N3518 | 1N758A | 1N746 | | D8 |
| 1N3519 | 1N962B | 1N957 | | D8 |
| 1N3520 | 1N963B | 1N957 | | D8 |
| 1N3521 | 1N964B | 1N957 | | D8 |
| 1N3522 | 1N965B | 1N957 | | D8 |
| 1N3523 | 1N966B | 1N957 | | D8 |
| 1N3524 | 1N967B | 1N957 | | D8 |
| 1N3525 | 1N968B | 1N957 | | D8 |
| 1N3526 | 1N969B | 1N957 | | D8 |
| 1N3527 | 1N970B | 1N957 | | D8 |
| 1N3528 | 1N971B | 1N957 | | D8 |
| 1N3529 | 1N972B | 1N957 | | D8 |
| 1N3530 | 1N973B | 1N957 | | D8 |
| 1N3544 | 1N4002 | 1N4001 | | D10 |
| 1N3545 | 1N4003 | 1N4001 | | D10 |
| 1N3546 | 1N4004 | 1N4001 | | D10 |
| 1N3547 | 1N4004 | 1N4001 | | D10 |
| 1N3548 | 1N4005 | 1N4001 | | D10 |
| 1N3549 | 1N4005 | 1N4001 | | D10 |
| 1N3550 | 1N3070 | 1N3070 | | D4 |
| 1N3567 | 1N483A | 1N482 | | D5 |
| 1N3568 | 1N483A | 1N482 | | D5 |
| 1N3593 | 1N4531 | 1N4531 | | D6 |
| 1N3594 | 1N4531 | 1N4531 | | D6 |
| *1N3595 | 1N3595 | 1N3595 | 3-8/3-12 | D5 |
| 1N3596 | 1N3596 | | 3-4 | D6 |
| *1N3597 | 1N3597 | 1N3597 | 3-5 | D4 |
| 1N3598 | 1N914 | 1N914 | | D6 |
| 1N3599 | 1N3070 | 1N3070 | | D4 |
| *1N3600 | 1N3600 | 1N3600 | 3-3 | D6 |
| 1N3601 | 1N3070 | 1N3070 | | D4 |
| 1N3602 | 1N3602 | | 3-4 | D6 |
| 1N3603 | 1N3603 | | 3-4 | D6 |
| 1N3604 | 1N3604 | | 3-3 | D6 |
| 1N3605 | 1N3605 | | 3-3 | D6 |
| 1N3606 | 1N3606 | | 3-3 | D6 |

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|---|---|---|---|---|
| 1N3607 | 1N4448 | 1N914 | | D6 |
| 1N3611 | 1N4003 | 1N4001 | | D10 |
| 1N3612 | 1N4004 | 1N4001 | | D10 |
| 1N3613 | 1N4005 | 1N4001 | | D10 |
| 1N3625 | 1N486 | 1N482 | | D10 |
| 1N3722 | 1N914B | 1N914 | | D6 |
| 1N3731 | 1N914B | 1N914 | | D6 |
| 1N3748 | 1N4003 | 1N4001 | | D10 |
| 1N3749 | 1N4004 | 1N4001 | | D10 |
| 1N3750 | 1N4005 | 1N4001 | | D10 |
| 1N3754 | 1N4002 | 1N4001 | | D10 |
| 1N3755 | 1N4003 | 1N4001 | | D10 |
| 1N3756 | 1N4004 | 1N4001 | | D10 |
| 1N3757 | 1N4003 | 1N4001 | | D10 |
| 1N3758 | 1N4004 | 1N4001 | | D10 |
| 1N3759 | 1N4005 | 1N4001 | | D10 |
| 1N3872 | 1N662A | 1N662 | | D4 |
| 1N3873 | 1N662A | 1N662 | | D4 |
| 1N3952 | 1N3595 | 1N3595 | | D5 |
| 1N3954 | FDH400 | FD400 | | D4 |
| 1N3956 | 1N914B | 1N914 | | D6 |
| *1N4001 | 1N4001 | 1N4001 | 3-16 | D10 |
| *1N4002 | 1N4002 | 1N4001 | 3-16 | D10 |
| *1N4003 | 1N4003 | 1N4001 | 3-16 | D10 |
| *1N4004 | 1N4004 | 1N4001 | 3-16 | D10 |
| *1N4005 | 1N4005 | 1N4005 | 3-16 | D10 |
| *1N4009 | 1N4009 | 1N4009 | 3-4 | D10 |
| 1N4043 | 1N914B | 1N914 | | D6 |
| *1N4086 | 1N4086 | 1N4086 | 3-3 | D6 |
| 1N4087 | 1N4087 | | 3-3 | D6 |
| 1N4092 | 1N4454 | 1N3062 | | D6 |
| 1N4093 | 1N4454 | 1N3062 | | D6 |
| 1N4095 | 1N751 | 1N746 | | D8 |
| 1N4099 | 1N957B | 1N957 | | D8 |
| 1N4100 | 1N958B | 1N957 | | D8 |
| 1N4101 | 1N959B | 1N957 | | D8 |
| 1N4102 | 1N960B | 1N957 | | D8 |
| 1N4103 | 1N960B | 1N957 | | D8 |
| 1N4104 | 1N961B | 1N957 | | D8 |
| 1N4105 | 1N962B | 1N957 | | D8 |
| 1N4106 | 1N963B | 1N957 | | D8 |
| 1N4107 | 1N964B | 1N957 | | D8 |
| 1N4108 | 1N965B | 1N957 | | D8 |
| 1N4109 | 1N965B | 1N957 | | D8 |
| 1N4110 | 1N966B | 1N957 | | D8 |
| 1N4111 | 1N967B | 1N957 | | D8 |
| 1N4112 | 1N967B | 1N957 | | D8 |
| 1N4113 | 1N968B | 1N957 | | D8 |
| 1N4114 | 1N968B | 1N957 | | D8 |
| 1N4115 | 1N969B | 1N957 | | D8 |
| 1N4116 | 1N970B | 1N957 | | D8 |
| 1N4117 | 1N970B | 1N957 | | D8 |
| 1N4118 | 1N971B | 1N957 | | D8 |
| 1N4119 | 1N971B | 1N957 | | D8 |
| 1N4120 | 1N972B | 1N957 | | D8 |
| 1N4121 | 1N972B | 1N957 | | D8 |
| 1N4147 | 1N914 | 1N914 | | D6 |
| *1N4148 | 1N4148 | 1N914 | 3-3 | D6 |
| *1N4149 | 1N4149 | 1N914 | 3-3 | D6 |
| *1N4150 | 1N4150 | 1N3600 | 3-3 | D6 |
| *1N4151 | 1N4151 | 1N4151 | 3-3 | D6 |
| *1N4152 | 1N4152 | 1N4151 | 3-3 | D6 |
| *1N4153 | 1N4153 | 1N4151 | 3-3 | D6 |
| *1N4154 | 1N4154 | 1N4151 | 3-4 | D6 |
| *1N4244 | 1N4244 | 1N4244 | 3-3 | D7 |
| 1N4245 | 1N4003 | 1N4001 | | D10 |
| 1N4246 | 1N4004 | 1N4001 | | D10 |
| 1N4247 | 1N4005 | 1N4001 | | D10 |
| *1N4305 | 1N4305 | 1N3062 | 3-3 | D6 |
| *1N4306 | 1N4306 | 1N4306 | 3-12 | D6 |
| *1N4307 | 1N4307 | 1N4306 | 3-12 | D6 |
| 1N4322 | 1N4322 | | 3-4 | D6 |
| 1N4363 | 1N4363 | | 3-5 | |
| 1N4364 | 1N4002 | 1N4001 | | D10 |
| 1N4365 | 1N4003 | 1N4001 | | D10 |
| 1N4366 | 1N4004 | 1N4001 | | D10 |
| 1N4367 | 1N4004 | 1N4001 | | D10 |
| 1N4368 | 1N4005 | 1N4001 | | D10 |
| 1N4369 | 1N4005 | 1N4001 | | D10 |
| 1N4375 | 1N914B | 1N914 | | D6 |
| *1N4376 | 1N4376 | 1N4376 | 3-3 | D7 |
| 1N4389 | FDH666 | FD600 | | D6 |
| 1N4390 | FDH666 | FD600 | | D6 |
| 1N4391 | FDH666 | FD600 | | D6 |
| 1N4392 | FDH666 | FD600 | | D6 |
| 1N4444 | 1N4148 | 1N914 | | D6 |
| 1N4445 | 1N4148 | 1N914 | | D6 |
| *1N4446 | 1N4446 | 1N914 | 3-3 | D6 |
| *1N4447 | 1N4447 | 1N914 | 3-3 | D6 |
| *1N4448 | 1N4448 | 1N914 | 3-3 | D6 |
| *1N4449 | 1N4449 | 1N914 | 3-3 | D6 |
| *1N4450 | 1N4450 | 1N3600 | 3-4 | D6 |
| 1N4451 | 1N914B | 1N914 | | D6 |
| 1N4453 | 1N4448 | 1N914 | | D6 |
| *1N4454 | 1N4454 | 1N3062 | 3-4 | D6 |
| *1N4531 | 1N4531 | 1N4531 | 3-3 | D6 |
| *1N4532 | 1N4532 | 1N4531 | 3-4 | D6 |
| *1N4533 | 1N4533 | 1N4533 | 3-3 | D6 |
| *1N4534 | 1N4534 | 1N4533 | 3-3 | D6 |
| *1N4536 | 1N4536 | 1N4009 | 3-4 | D6 |
| *1N4607 | 1N4607 | 1N4607 | | D6 |
| *1N4610 | 1N4610 | 1N3600 | 3-3 | D6 |
| 1N4620 | 1N746A | 1N746 | | D8 |
| 1N4621 | 1N747A | 1N746 | | D8 |
| 1N4622 | 1N748A | 1N746 | | D8 |
| 1N4623 | 1N749A | 1N746 | | D8 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 1N4624 | 1N750A | 1N746 | | D8 |
| 1N4625 | 1N751A | 1N746 | | D8 |
| 1N4626 | 1N752A | 1N746 | | D8 |
| 1N4627 | 1N753A | 1N746 | | D8 |
| 1N4726 | 1N4727 | 1N4727 | | D6 |
| *1N4727 | 1N4727 | 1N4727 | 3-4 | D6 |
| 1N4816 | 1N4001 | 1N4001 | | D10 |
| 1N4817 | 1N4002 | 1N4001 | | D10 |
| 1N4818 | 1N4003 | 1N4001 | | D10 |
| 1N4819 | 1N4004 | 1N4001 | | D10 |
| 1N4820 | 1N4004 | 1N4001 | | D10 |
| 1N4821 | 1N4005 | 1N4001 | | D10 |
| 1N4822 | 1N4005 | 1N4001 | | D10 |
| 1N4861 | 1N483 | 1N482 | | D5 |
| 1N4862 | 1N483 | 1N482 | | D5 |
| 1N4863 | 1N914B | 1N914 | | D6 |
| 1N4864 | 1N914B | 1N914 | | D6 |
| 1N4938 | 1N3070 | 1N3070 | | D6 |
| *1N4950 | 1N4950 | 1N4950 | 3-4 | D6 |
| 1N5004 | 1N4002 | 1N4001 | | D10 |
| 1N5005 | 1N4003 | 1N4001 | | D10 |
| 1N5006 | 1N4004 | 1N4001 | | D10 |
| 1N5007 | 1N4005 | 1N4001 | | D10 |
| 1N5219 | 1N4454 | 1N3062 | | D6 |
| 1N5220 | 1N4454 | 1N3062 | | D6 |
| 1N5234 | 1N753 | 1N746 | | D8 |
| 1N5234A | 1N753 | 1N746 | | D8 |
| 1N5234B | 1N753A | 1N746 | | D8 |
| 1N5235 | 1N754 | 1N746 | | D8 |
| 1N5235A | 1N754 | 1N746 | | D8 |
| 1N5235B | 1N754A | 1N746 | | D8 |
| 1N5236 | 1N755 | 1N746 | | D8 |
| 1N5236A | 1N755 | 1N746 | | D8 |
| 1N5236B | 1N755A | 1N746 | | D8 |
| 1N5237 | 1N756 | 1N746 | | D8 |
| 1N5237A | 1N756 | 1N746 | | D8 |
| 1N5237B | 1N756A | 1N746 | | D8 |
| 1N5238 | 1N757 | 1N746 | | D8 |
| 1N5238A | 1N757 | 1N746 | | D8 |
| 1N5238B | 1N757A | 1N746 | | D8 |
| 1N5239 | 1N757 | 1N746 | | D8 |
| 1N5239A | 1N757 | 1N746 | | D8 |
| 1N5239B | 1N957A | 1N746 | | D8 |
| 1N5240 | 1N758 | 1N746 | | D8 |
| 1N5240A | 1N758 | 1N746 | | D8 |
| 1N5240B | 1N758A | 1N746 | | D8 |
| 1N5241 | 1N759 | 1N746 | | D8 |
| 1N5241A | 1N759 | 1N746 | | D8 |
| 1N5241B | 1N759A | 1N746 | | D8 |
| 1N5242 | 1N759 | 1N746 | | D8 |
| 1N5242A | 1N759 | 1N746 | | D8 |
| 1N5242B | 1N759A | 1N746 | | D8 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 1N5243 | 1N964A | 1N957 | | D8 |
| 1N5243A | 1N964A | 1N957 | | D8 |
| 1N5243B | 1N964B | 1N957 | | D8 |
| 1N5244 | 1N965A | 1N957 | | D8 |
| 1N5244A | 1N965A | 1N957 | | D8 |
| 1N5244B | 1N965B | 1N957 | | D8 |
| 1N5245 | 1N965A | 1N957 | | D8 |
| 1N5245A | 1N965A | 1N957 | | D8 |
| 1N5245B | 1N965B | 1N957 | | D8 |
| 1N5246 | 1N966A | 1N957 | | D8 |
| 1N5246A | 1N966A | 1N957 | | D8 |
| 1N5246B | 1N966B | 1N957 | | D8 |
| 1N5247 | 1N967A | 1N957 | | D8 |
| 1N5247A | 1N967A | 1N957 | | D8 |
| 1N5247B | 1N967B | 1N957 | | D8 |
| 1N5248 | 1N967A | 1N957 | | D8 |
| 1N5248A | 1N967A | 1N957 | | D8 |
| 1N5248B | 1N967B | 1N957 | | D8 |
| 1N5249 | 1N968A | 1N957 | | D8 |
| 1N5249A | 1N968A | 1N957 | | D8 |
| 1N5249B | 1N968B | 1N957 | | D8 |
| 1N5250 | 1N968A | 1N957 | | D8 |
| 1N5250A | 1N968A | 1N957 | | D8 |
| 1N5250B | 1N968B | 1N957 | | D8 |
| 1N5251 | 1N969A | 1N957 | | D8 |
| 1N5251A | 1N969A | 1N957 | | D8 |
| 1N5251B | 1N969B | 1N957 | | D8 |
| 1N5252 | 1N970A | 1N957 | | D8 |
| 1N5252A | 1N970A | 1N957 | | D8 |
| 1N5252B | 1N970B | 1N957 | | D8 |
| 1N5253 | 1N970A | 1N957 | | D8 |
| 1N5253A | 1N970A | 1N957 | | D8 |
| 1N5253B | 1N970B | 1N957 | | D8 |
| 1N5254 | 1N971A | 1N957 | | D8 |
| 1N5254A | 1N971A | 1N957 | | D8 |
| 1N5254B | 1N971B | 1N957 | | D8 |
| 1N5255 | 1N971A | 1N957 | | D8 |
| 1N5255A | 1N971A | 1N957 | | D8 |
| 1N5255B | 1N971B | 1N957 | | D8 |
| 1N5256 | 1N972A | 1N957 | | D8 |
| 1N5256A | 1N972A | 1N957 | | D8 |
| 1N5256B | 1N972B | 1N957 | | D8 |
| 1N5257 | 1N973A | 1N957 | | D8 |
| 1N5257A | 1N973A | 1N957 | | D8 |
| 1N5257B | 1N973B | 1N957 | | D8 |
| *1N5282 | 1N5282 | 1N5282 | 3-3 | D6 |
| *1N5317 | 1N5317 | 1N5317 | 3-3 | D6 |
| *1N5318 | 1N5318 | 1N5317 | 3-4 | D6 |
| *1N5319 | 1N5319 | 1N5317 | 3-4 | D6 |
| *1N5390 | 1N5390 | FH1100 | 3-9 | D12 |
| 1N5412 | 1N4450 | 1N3600 | | D6 |
| 1N5413 | 1N4607 | 1N4607 | | D6 |
| 1N5414 | 1N4607 | 1N4607 | | D6 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 1N5518 | 1N746 | 1N746 | | D8 |
| 1N5518A | 1N746 | 1N746 | | D8 |
| 1N5518B | 1N746A | 1N746 | | D8 |
| 1N5519 | 1N747 | 1N746 | | D8 |
| 1N5519A | 1N747 | 1N746 | | D8 |
| 1N5519B | 1N747A | 1N746 | | D8 |
| 1N5520 | 1N748 | 1N746 | | D8 |
| 1N5520A | 1N748 | 1N746 | | D8 |
| 1N5520B | 1N748A | 1N746 | | D8 |
| 1N5521 | 1N749 | 1N746 | | D8 |
| 1N5521A | 1N749 | 1N746 | | D8 |
| 1N5521B | 1N749B | 1N746 | | D8 |
| 1N5522 | 1N750 | 1N746 | | D8 |
| 1N5522A | 1N750 | 1N746 | | D8 |
| 1N5522B | 1N750 | 1N746 | | D8 |
| 1N5523 | 1N751 | 1N746 | | D8 |
| 1N5523A | 1N751 | 1N746 | | D8 |
| 1N5523B | 1N751A | 1N746 | | D8 |
| 1N5524 | 1N752 | 1N746 | | D8 |
| 1N5524A | 1N752 | 1N746 | | D8 |
| 1N5524B | 1N752A | 1N746 | | D8 |
| 1N5525 | 1N753 | 1N746 | | D8 |
| 1N5525A | 1N753 | 1N746 | | D8 |
| 1N5525B | 1N753A | 1N746 | | D8 |
| 1N5526 | 1N957 | 1N957 | | D8 |
| 1N5526A | 1N957A | 1N957 | | D8 |
| 1N5526B | 1N957B | 1N957 | | D8 |
| 1N5527 | 1N958 | 1N957 | | D8 |
| 1N5527A | 1N958A | 1N957 | | D8 |
| 1N5527B | 1N958B | 1N957 | | D8 |
| 1N5528 | 1N959 | 1N957 | | D8 |
| 1N5528A | 1N959A | 1N957 | | D8 |
| 1N5528B | 1N959B | 1N957 | | D8 |
| 1N5529 | 1N960 | 1N957 | | D8 |
| 1N5529A | 1N960A | 1N957 | | D8 |
| 1N5529B | 1N960B | 1N957 | | D8 |
| 1N5530 | 1N961 | 1N957 | | D8 |
| 1N5530A | 1N961A | 1N957 | | D8 |
| 1N5530B | 1N961B | 1N957 | | D8 |
| 1N5531 | 1N962 | 1N957 | | D8 |
| 1N5531A | 1n962A | 1N957 | | D8 |
| 1N5531B | 1N962B | 1N957 | | D8 |
| 1N5532 | 1N963 | 1N957 | | D8 |
| 1N5532A | 1N963A | 1N957 | | D8 |
| 1N5532B | 1N963B | 1N957 | | D8 |
| 1N5533 | 1N964 | 1N957 | | D8 |
| 1N5533A | 1N964A | 1N957 | | D8 |
| 1N5533B | 1N964B | 1N957 | | D8 |
| 1N5534 | 1N965 | 1N957 | | D8 |
| 1N5534A | 1N965A | 1N957 | | D8 |
| 1N5534B | 1N965B | 1N957 | | D8 |
| 1N5535 | 1N965 | 1N957 | | D8 |
| 1N5535A | 1N965A | 1N957 | | D8 |
| 1N5535B | 1N965B | 1N957 | | D8 |
| 1N5536 | 1N966 | 1N957 | | D8 |
| 1N5536A | 1N966A | 1N957 | | D8 |
| 1N5536B | 1N966B | 1N957 | | D8 |
| 1N5537 | 1N967 | 1N957 | | D8 |
| 1N5537A | 1N967A | 1N957 | | D8 |
| 1N5537B | 1N967B | 1N957 | | D8 |
| 1N5538 | 1N967 | 1N957 | | D8 |
| 1N5538A | 1N967A | 1N957 | | D8 |
| 1N5538B | 1N967B | 1N957 | | D8 |
| 1N5539 | 1N968 | 1N957 | | D8 |
| 1N5539A | 1N968A | 1N957 | | D8 |
| 1N5539B | 1N968B | 1N957 | | D8 |
| 1N5540 | 1N968 | 1N957 | | D8 |
| 1N5540A | 1N968A | 1N957 | | D8 |
| 1N5540B | 1N968B | 1N957 | | D8 |
| 1N5541 | 1N969 | 1N957 | | D8 |
| 1N5541A | 1N969A | 1N957 | | D8 |
| 1N5541B | 1N969B | 1N957 | | D8 |
| 1N5542 | 1N970 | 1N957 | | D8 |
| 1N5542A | 1N970A | 1N957 | | D8 |
| 1N5542B | 1N970B | 1N957 | | D8 |
| 1N5543 | 1N971 | 1N957 | | D8 |
| 1N5543A | 1N971A | 1N957 | | D8 |
| 1N5543B | 1N971B | 1N957 | | D8 |
| 1N5544 | 1N971 | 1N957 | | D8 |
| 1N5544A | 1N971A | 1N957 | | D8 |
| 1N5544B | 1N971B | 1N957 | | D8 |
| 1N5545 | 1N972 | 1N957 | | D8 |
| 1N5545A | 1N972A | 1N957 | | D8 |
| 1N5545B | 1N972B | 1N957 | | D8 |
| 1N5546 | 1N973 | 1N957 | | D8 |
| 1N5546A | 1N973A | 1N957 | | D8 |
| 1N5546B | 1N973B | 1N957 | | D8 |
| 1N5605 | FDH333 | FD300 | | D5 |
| 1N5606 | FDH300 | FD300 | | D5 |
| 1N5607 | FDH300 | FD300 | | D5 |
| 1N5608 | FDH444 | FD400 | | D4 |
| 1N5609 | FDG444 | FD400 | | D4 |
| *1N5794 | 1N5794 | 1N5794 | 3-16 | D10 |
| *1N5795 | 1N5795 | 1N5794 | 3-16 | D10 |
| *1N5796 | 1N5796 | 1N5794 | 3-16 | D10 |
| *1N5797 | 1N5797 | 1N5794 | 3-16 | D10 |
| *1N5798 | 1N5798 | 1N5794 | 3-16 | D10 |
| *1S44 | 1S44 | 1S44 | 3-7 | D6 |
| *1S920 | 1S920 | 1S920 | 3-7 | D4 |
| 2N160 | 2N2218 | 2N2218 | | SS15 |
| 2N160A | 2N2218 | 2N2218 | | SS15 |
| 2N161 | 2N2218 | 2N2218 | | SS15 |
| 2N161A | 2N2218 | 2N2218 | | SS15 |
| 2N162 | 2N2221 | 2N2218 | | SS15 |
| 2N162A | 2N2221 | 2N2218 | | SS15 |
| 2N163 | 2N2221 | 2N2218 | | SS15 |
| 2N163A | 2N2221 | 2N2218 | | SS15 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 2N258 | 2N2906 | 2N2904 | | SS22 |
| 2N259 | 2N2906 | 2N2904 | | SS22 |
| 2N260 | 2N2906 | 2N2904 | | SS22 |
| 2N260A | 2N2906 | 2N2904 | | SS22 |
| 2N261 | 2N2906 | 2N2904 | | SS22 |
| 2N262 | 2N2906 | 2N2904 | | SS22 |
| 2N262A | 2N2906 | 2N2904 | | SS22 |
| 2N263 | 2N2907 | 2N2904 | | SS22 |
| 2N264 | 2N2906 | 2N2904 | | SS22 |
| 2N327 | 2N2906 | 2N2904 | | SS22 |
| 2N327A | 2N2906 | 2N2904 | | SS22 |
| 2N327B | 2N2906 | 2N2904 | | SS22 |
| 2N328 | 2N2906 | 2N2904 | | SS22 |
| 2N328A | 2N2906 | 2N2904 | | SS22 |
| 2N328B | 2N2906 | 2N2904 | | SS22 |
| 2N329 | 2N2906 | 2N2904 | | SS22 |
| 2N329A | 2N2906 | 2N2904 | | SS22 |
| 2N329B | 2N2906 | 2N2904 | | SS22 |
| 2N330 | 2N2906 | 2N2904 | | SS22 |
| 2N330A | 2N2906 | 2N2904 | | SS22 |
| 2N332 | 2N2221 | 2N2218 | | SS15 |
| 2N332A | 2N2218 | 2N2218 | | SS15 |
| 2N333 | 2N2221 | 2N2218 | | SS15 |
| 2N333A | 2N2218 | 2N2218 | | SS15 |
| 2N334 | 2N2221 | 2N2218 | | SS15 |
| 2N334A | 2N2218 | 2N2218 | | SS15 |
| 2N334B | 2N2218 | 2N2218 | | SS15 |
| 2N335 | 2N2221 | 2N2218 | | SS15 |
| 2N335A | 2N2218 | 2N2218 | | SS15 |
| 2N335B | 2N2218 | 2N2218 | | SS15 |
| 2N336 | 2N2221 | 2N2218 | | SS15 |
| 2N336A | 2N2218 | 2N2218 | | SS15 |
| 2N337 | 2N2221 | 2N2218 | | SS15 |
| 2N337A | 2N2218 | 2N2218 | | SS15 |
| 2N338 | 2N2221 | 2N2218 | | SS15 |
| 2N338A | 2N2218 | 2N2218 | | SS15 |
| 2N354 | 2N2906 | 2N2904 | | SS22 |
| 2N355 | 2N2906 | 2N2904 | | SS22 |
| 2N389 | 2N5068 | 2N5067 | | PWR6 |
| 2N389A | 2N5068 | 2N5067 | | PWR6 |
| 2N424 | 2N5069 | 2N5067 | | PWR6 |
| 2N424A | 2N5069 | 2N5067 | | PWR6 |
| 2N470 | 2N2221 | 2N2218 | | SS15 |
| 2N471 | 2N2221 | 2N2218 | | SS15 |
| 2N471A | 2N2221 | 2N2218 | | SS15 |
| 2N472 | 2N2221 | 2N2218 | | SS15 |
| 2N472A | 2N2221 | 2N2218 | | SS15 |
| 2N473 | 2N2221 | 2N2218 | | SS15 |
| 2N474 | 2N2221 | 2N2218 | | SS15 |
| 2N474A | 2N2221 | 2N2218 | | SS15 |
| 2N475 | 2N2221 | 2N2218 | | SS15 |
| 2N475A | 2N2221 | 2N2218 | | SS15 |
| 2N476 | 2N2221 | 2N2218 | | SS15 |
| 2N477 | 2N2221 | 2N2218 | | SS15 |
| 2N478 | 2N2221 | 2N2218 | | SS15 |
| 2N479 | 2N2221 | 2N2218 | | SS15 |
| 2N479A | 2N2221 | 2N2218 | | SS15 |
| 2N480 | 2N2221 | 2N2218 | | SS15 |
| 2N480A | 2N2221 | 2N2218 | | SS15 |
| 2N497 | 2N1893 | 2N1893 | | SS17 |
| 2N497A | 2N1893 | 2N1895 | | SS17 |
| 2N498 | 2N5681 | 2N5681 | | PWR3 |
| 2N498A | 2N5681 | 2N5681 | | PWR3 |
| 2N541 | 2N2221 | 2N2218 | | SS15 |
| 2N541A | 2N2221 | 2N2218 | | SS15 |
| 2N542 | 2N2221 | 2N2218 | | SS15 |
| 2N542A | 2N2221 | 2N2218 | | SS15 |
| 2N543 | 2N2221 | 2N2218 | | SS15 |
| 2N543A | 2N2221 | 2N2218 | | SS15 |
| 2N545 | 2N4238 | 2N4237 | | PWR5 |
| 2N546 | 2N4237 | 2N4237 | | PWR5 |
| 2N547 | 2N4238 | 2N4237 | | PWR5 |
| 2N548 | 2N4237 | 2N4237 | | PWR5 |
| 2N549 | 2N4238 | 2N4237 | | PWR5 |
| 2N550 | 2N4237 | 2N4237 | | PWR5 |
| 2N551 | 2N1893 | 2N1893 | | SS17 |
| 2N552 | 2N2218 | 2N2218 | | SS15 |
| 2N619 | 2N2221A | 2N2218A | | SS15 |
| 2N620 | 2N2221 | 2N2218 | | SS15 |
| 2N621 | 2N2221 | 2N2218 | | SS15 |
| 2N656 | 2N1893 | 2N1893 | | SS17 |
| 2N656A | 2N1893 | 2N1893 | | SS17 |
| 2N657 | 2N657 | | 3-33 | SS17 |
| 2N657A | 2N5681 | 2N5679 | | PWR13 |
| 2N696 | 2N2218 | 2N2218 | | SS15 |
| 2N696A | 2N2218 | 2N2218 | | SS15 |
| 2N697 | 2N697 | | 3-20 | SS15 |
| 2N697A | 2N2218 | 2N2218 | | SS15 |
| 2N698 | 2N1893 | 2N1893 | | SS17 |
| 2N699 | 2N699 | | 3-21 | SS17 |
| 2N699A | 2N1893 | 2N1893 | | SS17 |
| 2N699B | 2N1893 | 2N1893 | | SS17 |
| 2N702 | 2N3946 | 2N3946 | | SS14 |
| 2N703 | 2N3946 | 2N3946 | | SS14 |
| *2N706 | 2N706 | 2N706 | 3-17 | SS5 |
| *2N706A | 2N706A | 2N706 | 3-17 | SS28 |
| 2N706B | 2N706B | | 3-17 | SS28 |
| 2N706C | 2N2368 | | | SS28 |
| 2N707 | CF | | | |
| 2N707A | CF | | | |
| 2N708 | 2N708 | | 3-17 | SS5 |
| *2N709 | 2N709 | 2N709 | 3-17 | SS29 |
| 2N709A | FT709 | 2N709 | | SS29 |
| 2N715 | 2N2221 | 2N2218 | | SS15 |
| 2N716 | 2N2221 | 2N2218 | | SS15 |
| 2N717 | 2N2221 | 2N2218 | | SS15 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 2N718 | 2N718 | | 3-20 | SS15 |
| *2N718A | 2N718A | 2N718A | 3-20 | SS15 |
| 2N719 | 2N719 | | 3-21 | SS17 |
| 2N719A | 2N719A | | 3-21 | SS17 |
| 2N720 | 2N720 | | 3-21 | SS17 |
| 2N720A | 2N720A | | 3-21 | SS17 |
| 2N721 | 2N2906 | 2N2904 | | SS22 |
| 2N721A | 2N2906 | 2N2904 | | SS22 |
| 2N722 | 2N722 | | 3-25 | SS22 |
| 2N722A | 2N2906 | 2N2904 | | SS22 |
| 2N726 | 2N3250 | 2N3250 | | |
| 2N727 | 2N3250 | 2N3250 | | |
| 2N730 | 2N2218 | 2N2218 | | SS15 |
| 2N731 | 2N2221 | 2N2218 | | SS15 |
| 2N734 | 2N2484 | 2N2484 | | SS8 |
| 2N734A | 2N2484 | 2N2484 | | SS8 |
| 2N735 | 2N2484 | 2N2484 | | SS8 |
| 2N735A | 2N2484 | 2N2484 | | SS8 |
| 2N736 | 2N2484 | 2N2484 | | SS8 |
| 2N736A | 2N2484 | 2N2484 | | SS8 |
| 2N736B | 2N2484 | 2N2484 | | SS8 |
| 2N742 | 2N2484 | 2N2484 | | SS8 |
| 2N742A | 2N2484 | 2N2484 | | SS8 |
| 2N743 | 2N2368 | | | SS28 |
| 2N743A | 2N2368 | | | SS28 |
| 2N744 | 2N744 | | 3-17 | SS28 |
| 2N744A | 2N2369A | 2N2369 | | SS28 |
| 2N745 | 2N2221 | 2N2218 | | SS15 |
| 2N746 | 2N2221 | 2N2218 | | SS15 |
| 2N747 | 2N2221 | 2N2218 | | SS15 |
| 2N748 | 2N2221 | 2N2218 | | SS15 |
| 2N749 | 2N2221 | 2N2218 | | SS15 |
| 2N751 | 2N2221 | 2N2218 | | SS15 |
| 2N752 | 2N2221A | 2N2218A | | SS15 |
| 2N753 | 2N2369A | 2N2369 | 3-17 | SS28 |
| 2N754 | 2N720A | | | SS17 |
| 2N755 | 2N720A | | | SS17 |
| 2N756 | 2N930 | 2N930 | | SS8 |
| 2N756A | 2N2484 | 2N2484 | | SS8 |
| 2N757 | 2N930 | 2N930 | | SS8 |
| 2N757A | 2N2484 | 2N2484 | | SS8 |
| 2N758 | 2N930 | 2N930 | | SS8 |
| 2N758A | 2N2484 | 2N2484 | | SS8 |
| 2N758B | 2N2484 | 2N2484 | | SS8 |
| 2N759 | 2N930 | 2N930 | | SS8 |
| 2N759A | 2N2484 | 2N2484 | | SS8 |
| 2N759B | 2N2484 | 2N2484 | | SS8 |
| 2N760 | 2N930 | 2N930 | | SS8 |
| 2N760A | 2N2484 | 2N2484 | | SS8 |
| 2N760B | 2N2484 | 2N2484 | | SS8 |
| 2N761 | 2N930 | 2N930 | | SS8 |
| 2N762 | 2N930 | 2N930 | | SS8 |
| 2N770 | 2N3013 | 2N3009 | | SS5 |
| 2N771 | 2N3013 | 2N3009 | | SS5 |
| 2N772 | 2N3013 | 2N3009 | | SS5 |
| 2N773 | 2N3013 | 2N3009 | | SS5 |
| 2N774 | 2N3013 | 2N3009 | | SS5 |
| 2N775 | 2N3013 | 2N3009 | | SS5 |
| 2N776 | 2N3013 | 2N3009 | | SS5 |
| 2N777 | 2N3013 | 2N3009 | | SS5 |
| 2N778 | 2N3013 | 2N3009 | | SS5 |
| 2N780 | 2N930 | 2N930 | | SS8 |
| 2N783 | 2N834 | 2N834 | | SS28 |
| 2N784 | 2N834 | 2N834 | | SS28 |
| 2N784A | 2N834 | 2N834 | | SS28 |
| 2N789 | 2N3946 | 2N3946 | | SS14 |
| 2N790 | 2N3946 | 2N3946 | | SS14 |
| 2N791 | 2N3946 | 2N3946 | | SS14 |
| 2N792 | 2N3946 | 2N3946 | | SS14 |
| 2N793 | 2N3946 | 2N3946 | | SS14 |
| *2N834 | 2N834 | 2N834 | 3-17 | SS28 |
| 2N834A | 2N4137 | | | SS28 |
| 2N835 | 2N4137 | | | SS28 |
| 2N839 | 2N3946 | 2N3946 | | SS14 |
| 2N840 | 2N3946 | 2N3946 | | SS14 |
| 2N841 | 2N3947 | 2N3946 | | SS14 |
| 2N842 | 2N3946 | 2N3946 | | SS14 |
| 2N843 | 2N3946 | 2N3946 | | SS14 |
| 2N844 | 2N720A | | | SS17 |
| 2N845 | 2N720A | | | SS17 |
| 2N847 | 2N2369A | 2N2369 | | SS28 |
| 2N849 | 2N2368 | | | SS28 |
| 2N850 | 2N2369A | 2N2369 | | SS28 |
| 2N851 | 2N2368 | | | SS28 |
| 2N852 | 2N2369A | 2N2369 | | SS28 |
| 2N858 | 2N2906 | 2N2904 | | SS22 |
| 2N859 | 2N2906 | 2N2904 | | SS22 |
| 2N860 | 2N2906 | 2N2904 | | SS22 |
| 2N861 | 2N2906 | 2N2904 | | SS22 |
| 2N862 | 2N2906 | 2N2904 | | SS22 |
| 2N863 | 2N2906 | 2N2904 | | SS22 |
| 2N864 | 2N2906 | 2N2904 | | SS22 |
| 2N864A | 2N2906 | 2N2904 | | SS22 |
| 2N865 | 2N2906 | 2N2904 | | SS22 |
| 2N865A | 2N2906 | 2N2904 | | SS22 |
| 2N866 | 2N2906 | 2N2904 | | SS22 |
| 2N867 | 2N2906 | 2N2904 | | SS22 |
| 2N869 | 2N869 | | 3-25 | SS30 |
| 2N869A | 2N869A | | 3-25 | SS30 |
| 2N870 | 2N871 | | | SS17 |
| 2N871 | 2N871 | | 3-20 | SS17 |
| 2N902 | 2N2221 | 2N2218 | | SS15 |
| 2N903 | 2N2221 | 2N2218 | | SS15 |
| 2N904 | 2N2221 | 2N2218 | | SS15 |
| 2N905 | 2N2221 | 2N2218 | | SS15 |
| 2N906 | 2N2221 | 2N2218 | | SS15 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 2N907 | 2N2221 | 2N2218 | | SS15 |
| 2N908 | 2N2221 | 2N2218 | | SS15 |
| 2N909 | 2N2222 | 2N2218 | | SS15 |
| 2N910 | 2N2484 | 2N930 | | SS8 |
| 2N911 | 2N2484 | 2N930 | | SS8 |
| 2N912 | 2N2484 | 2N930 | | SS8 |
| 2N914 | 2N914 | | 3-17 | SS5 |
| 2N914A | 2N2369A | 2N2369 | | SS28 |
| 2N915 | 2N915 | | 3-20 | SS14 |
| 2N915A | 2N3946 | 2N3946 | | SS14 |
| 2N916 | 2N916 | | 3-20 | SS14 |
| 2N916A | 2N3946 | 2N3946 | | SS14 |
| 2N916B | 2N3946 | 2N3946 | | SS14 |
| 2N917 | 2N918 | 2N918 | | SS27 |
| 2N917A | 2N918 | 2N918 | | SS27 |
| *2N918 | 2N918 | 2N918 | 3-34 | SS27 |
| 2N919 | 2N834 | 2N834 | | SS28 |
| 2N920 | 2N834 | 2N834 | | SS28 |
| 2N921 | 2N834 | 2N834 | | SS28 |
| 2N922 | 2N834 | 2N834 | | SS28 |
| 2N923 | 2N2906 | 2N2904 | | SS22 |
| 2N924 | 2N2906 | 2N2904 | | SS22 |
| 2N925 | 2N2906 | 2N2904 | | SS22 |
| 2N926 | 2N2906 | 2N2904 | | SS22 |
| 2N927 | 2N2906 | 2N2904 | | SS22 |
| 2N928 | 2N2906 | 2N2904 | | SS22 |
| 2N929 | 2N930 | 2N930 | | SS8 |
| 2N929A | 2N2484 | 2N2484 | | SS8 |
| *2N930 | 2N930 | 2N930 | 3-29 | SS8 |
| 2N930A | 2N2484 | 2N2484 | | SS8 |
| 2N930B | 2N2484 | 2N2484 | | SS8 |
| 2N935 | 2N2906 | 2N2904 | | SS22 |
| 2N936 | 2N2906 | 2N2904 | | SS22 |
| 2N937 | 2N2906 | 2N2904 | | SS22 |
| 2N938 | 2N2906 | 2N2904 | | SS22 |
| 2N939 | 2N2906 | 2N2904 | | SS22 |
| 2N940 | 2N2906 | 2N2904 | | SS22 |
| 2N941 | 2N2906 | 2N2904 | | SS22 |
| 2N942 | 2N2906 | 2N2904 | | SS22 |
| 2N943 | 2N2906 | 2N2904 | | SS22 |
| 2N944 | 2N2906 | 2N2904 | | SS22 |
| 2N945 | 2N2906 | 2N2904 | | SS22 |
| 2N946 | 2N2906 | 2N2904 | | SS22 |
| 2N947 | 2N834 | 2N834 | | SS28 |
| *2N956 | 2N956 | 2N718A | 3-20 | |
| 2N957 | 2N3014 | 2N3009 | | SS5 |
| 2N958 | 2N2369A | 2N2369 | | SS28 |
| 2N959 | 2N2369A | 2N2369 | | SS28 |
| 2N978 | 2N2906 | 2N2904 | | SS22 |
| 2N981 | 2N720A | | | SS17 |
| 2N988 | 2N2221 | 2N2218 | | SS15 |
| 2N989 | 2N2221 | 2N2218 | | SS15 |
| 2N995 | 2N3250 | 2N3250 | | |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 2N955A | 2N3250 | 2N3250 | | |
| 2N996 | 2N3251 | 2N3250 | | |
| *2N997 | 2N997 | 2N997 | 3-44 | |
| *2N988 | 2N998 | 2N998 | 3-44 | |
| *2N999 | 2N999 | 2N999 | 3-44 | |
| 2N1005 | 2N3013 | 2N3009 | | SS5 |
| 2N1006 | 2N3013 | 2N3009 | | SS5 |
| 2N1047 | 2N4912 | 2N4910 | | PWR5 |
| 2N1047A | 2N4912 | 2N4910 | | PWR5 |
| 2N1047B | 2N4912 | 2N4910 | | PWR5 |
| 2N1047C | 2N4912 | 2N4910 | | PWR5 |
| 2N1049 | 2N4912 | 2N4910 | | PWR5 |
| 2N1049A | 2N4912 | 2N4910 | | PWR5 |
| 2N1049B | 2N4912 | 2N4910 | | PWR5 |
| 2N1049C | 2N4912 | 2N4910 | | PWR5 |
| 2N1051 | 2N2218 | 2N2218 | | SS15 |
| 2N1054 | 2N3923 | 2N3923 | | SS16 |
| 2N1055 | 2N3923 | 2N3923 | | SS16 |
| 2N1067 | 2N4237 | 2N4237 | | PWR5 |
| 2N1068 | 2N4237 | 2N4237 | | PWR5 |
| 2N1069 | 2N5067 | 2N5067 | | PWR6 |
| 2N1070 | 2N5067 | 2N5067 | | PWR6 |
| 2N1072 | 2N3766 | 2N3766 | | PWR18 |
| 2N1074 | 2N2218 | 2N2218 | | SS15 |
| 2N1075 | 2N2218 | 2N2218 | | SS15 |
| 2N1076 | 2N2218 | 2N2218 | | SS15 |
| 2N1077 | 2N2218 | 2N2218 | | SS15 |
| 2N1079 | 2N5068 | 2N5067 | | PWR6 |
| 2N1080 | 2N4914 | 2N4913 | | PWR6 |
| 2N1081 | 2N2221 | 2N2218 | | SS15 |
| 2N1082 | 2N2221 | 2N2218 | | SS15 |
| 2N1092 | 2N4237 | 2N4237 | | PWR5 |
| 2N1105 | 2N1893 | 2N1893 | | SS17 |
| 2N1106 | 2N5681 | 2N5679 | | PWR13 |
| 2N1116 | 2N3020 | 2N3019 | | SS17 |
| 2N1117 | 2N1893 | 2N1893 | | SS17 |
| 2N1118 | 2N3250 | 2N3250 | | |
| 2N1118A | 2N3250 | 2N3250 | | |
| 2N1131 | 2N1132 | | | SS22 |
| 2N1131A | 2N2904 | 2N2904 | | SS22 |
| 2N1132 | 2N1132 | | 3-25 | SS22 |
| 2N1132A | 2N2904 | 2N2904 | | SS22 |
| 2N1132B | 2N2904 | 2N2904 | | SS22 |
| 2N1135 | 2N2369A | 2N2369 | | SS28 |
| 2N1135A | 2N2369A | 2N2369 | | SS28 |
| 2N1139 | 2N3946 | 2N3946 | | SS14 |
| 2N1149 | 2N2221A | 2N2218A | | SS15 |
| 2N1150 | 2N2221A | 2N2218A | | SS15 |
| 2N1151 | 2N2221A | 2N2218A | | SS15 |
| 2N1152 | 2N2221A | 2N2218A | | SS15 |
| 2N1153 | 2N2221A | 2N2218A | | SS15 |
| 2N1199 | 2N2368 | | | SS28 |
| 2N1199A | 2N2368 | | | SS28 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 2N1206 | 2N3020 | 2N3019 | | SS17 |
| 2N1210 | 2N4232 | 2N4231 | | PWR5 |
| 2N1211 | 2N4233 | 2N4231 | | PWR5 |
| 2N1212 | 2N5477 | | | PWR4 |
| 2N1219 | 2N3250 | 2N3250 | | |
| 2N1220 | 2N3250 | 2N3250 | | |
| 2N1221 | 2N3250 | 2N3250 | | |
| 2N1222 | 2N3250 | 2N3250 | | |
| 2N1223 | 2N3250 | 2N3250 | | |
| 2N1228 | 2N2904 | 2N2904 | | SS22 |
| 2N1229 | 2N2904 | 2N2904 | | SS22 |
| 2N1230 | 2N2904 | 2N2904 | | SS22 |
| 2N1231 | 2N2904 | 2N2904 | | SS22 |
| 2N1232 | 2N2904A | 2N2904 | | SS22 |
| 2N1233 | 2N2904A | 2N2904 | | SS22 |
| 2N1234 | CF | | | |
| 2N1235 | CF | | | |
| 2N1238 | 2N3467 | 2N3467 | | SS7 |
| 2N1239 | 2N3467 | 2N3467 | | SS7 |
| 2N1240 | 2N3467 | 2N3467 | | SS7 |
| 2N1241 | 2N3467 | 2N3467 | | SS7 |
| 2N1250 | 2N4914 | 2N4913 | | PWR6 |
| 2N1252 | 2N3724 | 2N3724 | | SS13 |
| 2N1252A | 2N3724 | 2N3724 | | SS13 |
| 2N1253 | 2N3724 | 2N3724 | | SS13 |
| 2N1253A | 2N3724 | 2N3724 | | SS13 |
| 2N1260 | CF | | | |
| 2N1267 | 2N2369A | 2N2369 | | SS28 |
| 2N1268 | 2N2369A | 2N2369 | | SS28 |
| 2N1269 | 2N2369A | 2N2369 | | SS28 |
| 2N1270 | 2N2369A | 2N2369 | | SS28 |
| 2N1271 | 2N2369A | 2N2369 | | SS28 |
| 2N1272 | 2N2369A | 2N2369 | | SS28 |
| 2N1335 | 2N2218A | 2N2218A | | SS15 |
| 2N1336 | 2N2218A | 2N2218A | | SS15 |
| 2N1337 | 2N2218A | 2N2218A | | SS15 |
| 2N1338 | 2N2218A | 2N2218A | | SS15 |
| 2N1339 | 2N1893 | 2N1893 | | SS17 |
| 2N1340 | 2N1893 | 2N1893 | | SS17 |
| 2N1341 | 2N1893 | 2N1893 | | SS17 |
| 2N1342 | 2N1893 | 2N1893 | | SS17 |
| 2N1386 | 2N2222 | 2N2218 | | SS15 |
| 2N1387 | 2N2222 | 2N2218 | | SS15 |
| 2N1388 | 2N2222 | 2N2218 | | SS15 |
| 2N1389 | 2N2222A | 2N2218A | | SS15 |
| 2N1390 | 2N2222 | 2N2218 | | SS15 |
| 2N1420 | 2N2219 | 2N2218 | | SS15 |
| 2N1420A | 2N2219 | 2N2218 | | SS15 |
| 2N1439 | 2N2906A | 2N2904 | | SS22 |
| 2N1440 | 2N2906A | 2N2904 | | SS22 |
| 2N1441 | 2N2906 | 2N2904 | | SS22 |
| 2N1442 | 2N2906 | 2N2904 | | SS22 |
| 2N1443 | 2N2906 | 2N2904 | | SS22 |
| 2N1444 | 2N3724 | 2N3724 | | SS13 |
| 2N1445 | 2N5682 | 2N5679 | | PWR13 |
| 2N1469 | 2N2906 | 2N2904 | | SS22 |
| 2N1470 | 2N5068 | 2N5067 | | PWR6 |
| 2N1474 | 2N2906A | 2N2904 | | SS22 |
| 2N1474A | 2N2906A | 2N2904 | | SS22 |
| 2N1475 | 2N2906A | 2N2904 | | SS22 |
| 2N1476 | CF | | | |
| 2N1477 | CF | | | |
| 2N1479 | 2N4237 | 2N4237 | | PWR5 |
| 2N1480 | 2N4238 | 2N4237 | | PWR5 |
| 2N1481 | 2N4237 | 2N4237 | | PWR5 |
| 2N1482 | 2N4238 | 2N4237 | | PWR5 |
| 2N1483 | 2N4231 | 2N4231 | | PWR5 |
| 2N1484 | 2N4232 | 2N4231 | | PWR5 |
| 2N1485 | 2N4231 | 2N4231 | | PWR5 |
| 2N1486 | 2N4232 | 2N4231 | | PWR5 |
| 2N1487 | 2N4913 | 2N4913 | | PWR6 |
| 2N1488 | 2N4914 | 2N4913 | | PWR6 |
| 2N1489 | 2N4913 | 2N4913 | | PWR6 |
| 2N1490 | 2N4914 | 2N4913 | | PWR6 |
| 2N1491 | 2N2218 | 2N2218 | | SS15 |
| 2N1492 | 2N2218A | 2N2218A | | SS15 |
| 2N1493 | 2N3923 | 2N3923 | | SS16 |
| 2N1505 | 2N2218 | 2N2218 | | SS15 |
| 2N1506 | 2N2218 | 2N2218 | | SS15 |
| 2N1506A | 2N2218A | 2N2218A | | SS15 |
| 2N1507 | 2N2219 | 2N2218 | | SS15 |
| 2N1508 | 2N3020 | 2N3019 | | SS17 |
| 2N1509 | 2N3020 | 2N3019 | | SS17 |
| 2N1511 | 2N4913 | 2N4913 | | PWR6 |
| 2N1512 | 2N4914 | 2N4913 | | PWR6 |
| 2N1513 | 2N4913 | 2N4913 | | PWR6 |
| 2N1514 | 2N4914 | 2N4913 | | PWR6 |
| 2N1528 | 2N2218 | 2N2218 | | SS15 |
| 2N1564 | 2N1893 | 2N1893 | | SS17 |
| 2N1565 | 2N1893 | 2N1893 | | SS17 |
| 2N1566 | 2N1893 | 2N1893 | | SS17 |
| 2N1566A | 2N1893 | 2N1893 | | SS17 |
| 2N1572 | 2N1893 | 2N1893 | | SS17 |
| 2N1573 | 2N1893 | 2N1893 | | SS17 |
| 2N1574 | 2N1893 | 2N1893 | | SS17 |
| 2N1586 | 2N3946 | 2N3946 | | SS14 |
| 2N1587 | 2N3946 | 2N3946 | | SS14 |
| 2N1588 | 2N3946 | 2N3946 | | SS14 |
| 2N1589 | 2N3946 | 2N3946 | | SS14 |
| 2N1590 | 2N3946 | 2N3946 | | SS14 |
| 2N1591 | 2N3946 | 2N3946 | | SS14 |
| 2N1592 | 2N3946 | 2N3946 | | SS14 |
| 2N1593 | 2N3946 | 2N3946 | | SS14 |
| 2N1594 | 2N3946 | 2N3946 | | SS14 |
| *2N1613 | 2N1613 | 2N718A | 3-18 | |
| 2N1613A | 2N2218 | 2N2218 | | SS15 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 2N1613B | 2N3020 | 2N3019 | | SS17 |
| 2N1615 | 2N3923 | 2N3923 | | SS16 |
| 2N1623 | 2N2906 | 2N2904 | | SS22 |
| 2N1647 | 2N5477 | | | PWR4 |
| 2N1648 | 2N5479 | | | PWR4 |
| 2N1649 | 2N5477 | | | PWR4 |
| 2N1650 | 2N5477 | | | PWR4 |
| 2N1654 | 2N3923 | 2N3923 | | SS16 |
| 2N1655 | 2N3923 | 2N3923 | | SS16 |
| 2N1656 | 2N2923 | 2N3923 | | SS16 |
| 2N1657 | 2N5320 | 2N5320 | | PWR2 |
| 2N1679 | 2N5335 | 2N4895 | | PWR1 |
| 2N1680 | 2N5334 | 2N4895 | | PWR1 |
| 2N1690 | 2N4912 | 2N4231 | | PWR5 |
| 2N1691 | CF | | | |
| 2N1700 | 2N4237 | 2N4237 | | PWR5 |
| 2N1701 | 2N4910 | 2N4231 | | PWR5 |
| 2N1702 | 2N5067 | 2N5067 | | PWR6 |
| 2N1703 | 2N5067 | 2N5067 | | PWR6 |
| 2N1704 | 2N2218 | 2N2218 | | SS15 |
| 2N1708 | 2N3013 | 2N3009 | | SS5 |
| 2N1708A | 2N3013 | 2N3009 | | SS5 |
| *2N1711 | 2N1711 | 2N718A | 3-20 | |
| 2N1711A | 2N2219A | 2N2218A | | SS15 |
| 2N1711B | 2N2219A | 2N2218A | | SS15 |
| 2N1714 | 2N4237 | 2N4237 | | PWR5 |
| 2N1715 | 2N5681 | 2N5679 | | PWR13 |
| 2N1716 | 2N4237 | 2N4237 | | PWR5 |
| 2N1717 | 2N5681 | 2N5679 | | PWR13 |
| 2N1718 | 2N3766 | 2N3766 | | PWR18 |
| 2N1719 | 2N3767 | 2N3766 | | PWR18 |
| 2N1720 | 2N3766 | 2N3766 | | PWR18 |
| 2N1721 | 2N3767 | 2N3766 | | PWR18 |
| 2N1722 | CF | | | |
| 2N1722A | CF | | | |
| 2N1723 | CF | | | |
| 2N1764 | 2N2369A | 2N2369 | | SS28 |
| 2N1768 | 2N4231 | 2N4231 | | PWR5 |
| 2N1769 | 2N4232 | 2N4231 | | PWR5 |
| 2N1837 | 2N2218 | 2N2218 | | SS15 |
| 2N1837A | 2N2218 | 2N2218 | | SS15 |
| 2N1837B | 2N2218 | 2N2218 | | SS15 |
| 2N1838 | 2N2218 | 2N2218 | | SS15 |
| 2N1839 | 2N2218 | 2N2218 | | SS15 |
| 2N1840 | 2N2218 | 2N2218 | | SS15 |
| 2N1841 | 2N5320 | 2N5320 | | PWR2 |
| 2N1886 | 2N4911 | 2N4231 | | PWR5 |
| 2N1889 | 2N1893 | 2N1893 | | SS17 |
| 2N1890 | 2N3019 | 2N3019 | | SS17 |
| *2N1893 | 2N1893 | 2N1893 | 3-21 | SS17 |
| 2N1894 | 2N4238 | 2N4237 | | PWR5 |
| 2N1895 | 2N4239 | 2N4237 | | PWR5 |
| 2N1896 | 2N5336 | 2N5336 | | PWR4 |
| 2N1897 | 2N5336 | 2N5336 | | PWR4 |
| 2N1898 | 2N5338 | 2N5336 | | PWR4 |
| 2N1923 | 2N1893 | 2N1893 | | SS17 |
| 2N1941 | 2N2218 | 2N2218 | | SS15 |
| 2N1943 | 2N3020 | 2N3019 | | SS17 |
| 2N1944 | 2N2219 | 2N2218 | | SS15 |
| 2N1945 | 2N2219 | 2N2218 | | SS15 |
| 2N1946 | 2N2219A | 2N2218A | | SS15 |
| 2N1947 | CF | | | |
| 2N1948 | CF | | | |
| 2N1949 | CF | | | |
| 2N1950 | CF | | | |
| 2N1951 | CF | | | |
| 2N1952 | CF | | | |
| 2N1953 | 2N2218 | 2N2218 | | SS15 |
| 2N1958 | 2N3724 | 2N3724 | | SS13 |
| 2N1958A | 2N3724 | 2N3724 | | SS13 |
| 2N1959 | 2N3724 | 2N3724 | | SS13 |
| 2N1959A | 2N3724 | 2N3724 | | SS13 |
| 2N1972 | 2N2219 | 2N2218 | | SS15 |
| 2N1973 | 2N3019 | 2N3019 | | SS17 |
| 2N1974 | 2N1893 | 2N1893 | | SS17 |
| 2N1975 | 2N1893 | 2N1893 | | SS17 |
| 2N1983 | 2N2219 | 2N2218 | | SS15 |
| 2N1984 | 2N2218 | 2N2218 | | SS15 |
| 2N1985 | 2N2218 | 2N2218 | | SS15 |
| 2N1986 | 2N2218 | 2N2218 | | SS15 |
| 2N1987 | 2N2218 | 2N2218 | | SS15 |
| 2N1988 | 2N2218A | 2N2218A | | SS15 |
| 2N1989 | 2N2218A | 2N2218A | | SS15 |
| 2N1990 | 2N4410 | 2N4409 | | SS16 |
| 2N1991 | 2N2904 | 2N2904 | | SS15 |
| 2N1992 | 2N2221 | 2N2218 | | SS15 |
| 2N2008 | 2N3923 | 2N3923 | | SS16 |
| 2N2015 | 2N5881 | 2N5881 | | PWR7 |
| 2N2016 | 2N5882 | 2N5881 | | PWR7 |
| 2N2017 | 2N1893 | 2N1893 | | SS17 |
| 2N2018 | CF | | | |
| 2N2019 | CF | | | |
| 2N2020 | CF | | | |
| 2N2021 | CF | | | |
| 2N2032 | 2N4232 | 2N4231 | | PWR5 |
| 2N2033 | 2N3020 | 2N3019 | | SS17 |
| 2N2034 | 2N4238 | 2N4237 | | PWR5 |
| 2N2035 | 2N4232 | 2N4231 | | PWR5 |
| 2N2036 | 2N4232 | 2N4231 | | PWR5 |
| 2N2038 | 2N3053 | 2N3053 | | |
| 2N2039 | 2N1893 | 2N1893 | | SS17 |
| 2N2040 | 2N3053 | 2N3053 | | |
| 2N2041 | 2N1893 | 2N1893 | | SS17 |
| 2N2049 | 2N2219A | 2N2218A | | SS15 |
| 2N2086 | 2N3020 | 2N3019 | | SS17 |
| 2N2087 | 2N3020 | 2N3019 | | SS17 |
| 2N2106 | 2N1893 | 2N1893 | | SS17 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 2N2107 | 2N1893 | 2N1893 | | SS17 |
| 2N2108 | 2N1893 | 2N1893 | | SS17 |
| 2N2192 | 2N2219A | 2N2218A | | SS15 |
| 2N2192A | 2N2219A | 2N2218A | | SS15 |
| 2N2192B | 2N2219A | 2N2219A | | SS15 |
| 2N2193 | 2N2218A | 2N2218A | | SS15 |
| 2N2193A | 2N2218A | 2N2218A | | SS15 |
| 2N2193B | 2N2218A | 2N2218A | | SS15 |
| 2N2194 | 2N2218A | 2N2218A | | SS15 |
| 2N2194A | 2N2218A | 2N2218A | | SS15 |
| 2N2194B | 2N2218A | 2N2218A | | SS15 |
| 2N2195 | 2N2218 | 2N2218 | | SS15 |
| 2N2195A | 2N2218 | 2N2218 | | SS15 |
| 2N2195B | 2N2218 | 2N2218 | | SS15 |
| 2N2196 | 2N3766 | 2N3766 | | PWR18 |
| 2N2197 | 2N3766 | 2N3766 | | PWR18 |
| 2N2198 | 2N1893 | 2N1893 | | SS17 |
| 2N2201 | 2N5681 | 2N5679 | | PWR3 |
| 2N2202 | 2N5681 | 2N5679 | | PWR3 |
| 2N2203 | 2N5681 | 2N5679 | | PWR3 |
| 2N2204 | 2N5681 | 2N5679 | | PWR3 |
| 2N2205 | 2N2368 | | | SS28 |
| 2N2206 | 2N2369A | 2N2369 | | SS28 |
| 2N2214 | 2N2368 | | | SS28 |
| 2N2216 | 2N3923 | 2N3923 | | SS16 |
| 2N2217 | 2N2218 | 2N2218 | | SS15 |
| *2N2218 | 2N2218 | 2N2218 | 3-20 | SS15 |
| *2N2218A | 2N2218A | 2N2218A | 3-20 | SS15 |
| *2N2219 | 2N2219 | 2N2218 | 3-20 | SS15 |
| *2N2219A | 2N2219A | 2N2218A | 3-20 | SS15 |
| 2N2220 | 2N2221 | 2N2218 | | SS15 |
| *2N2221 | 2N2221 | 2N2218 | 3-20 | SS15 |
| *2N2221A | 2N2221A | 2N2218A | 3-20 | SS15 |
| *2N2222 | 2N2222 | 2N2218 | 3-20 | SS15 |
| *2N2222A | 2N2222A | 2N2218A | 3-20 | SS15 |
| 2N2222B | 2N2222A | 2N2218A | | SS15 |
| 2N2236 | 2N2218 | 2N2218 | | SS15 |
| 2N2237 | 2N2218 | 2N2218 | | SS15 |
| 2N2239 | 2N4232 | 2N4231 | | PWR5 |
| 2N2240 | 2N2218 | 2N2218 | | SS15 |
| 2N2241 | 2N2219 | 2N2218 | | SS15 |
| 2N2242 | 2N3013 | 2N3009 | | SS5 |
| 2N2243 | 2N3020 | 2N3019 | | SS17 |
| 2N2243A | 2N3020 | 2N3019 | | SS17 |
| 2N2270 | 2N2270 | | 3-20 | |
| 2N2272 | 2N2222 | 2N2218 | | SS15 |
| 2N2297 | 2N3020 | 2N3019 | | SS17 |
| 2N2303 | 2N2905 | 2N2904 | | SS22 |
| 2N2304 | 2N4910 | 2N4231 | | PWR5 |
| 2N2305 | 2N5068 | 2N5067 | | PWR6 |
| 2N2308 | 2N4912 | 2N4231 | | PWR5 |
| 2N2309 | 2N2218 | 2N2218 | | SS15 |
| 2N2310 | 2N1893 | 2N1893 | | SS17 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 2N2311 | 2N5681 | 2N5679 | | PWR3 |
| 2N2312 | 2N1893 | 2N1893 | | SS17 |
| 2N2313 | 2N5681 | 2N5679 | | PWR3 |
| 2N2314 | 2N2221A | 2N2218A | | SS15 |
| 2N2315 | 2N2221A | 2N2218A | | SS15 |
| 2N2316 | 2N1893 | 2N1893 | | SS17 |
| 2N2317 | 2N1613 | 2N1613 | | |
| 2N2318 | 2N930 | 2N930 | | SS8 |
| 2N2319 | 2N930 | 2N930 | | SS8 |
| 2N2320 | 2N930 | 2N930 | | SS8 |
| 2N2339 | 2N4910 | 2N4231 | | PWR5 |
| 2N2340 | 2N5320 | 2N5320 | | PWR2 |
| 2N2341 | 2N5320 | 2N5320 | | PWR2 |
| 2N2342 | 2N5320 | 2N5320 | | PWR2 |
| 2N2343 | 2N5320 | 2N5320 | | PWR2 |
| 2N2349 | 2N930 | 2N930 | | SS8 |
| 2N2350 | 2N2222A | 2N2218A | | SS15 |
| 2N2350A | 2N2222A | 2N2218A | | SS15 |
| 2N2351 | 2N2221A | 2N2218A | | SS15 |
| 2N2351A | 2N2221A | 2N2218A | | SS15 |
| 2N2352 | 2N2221A | 2N2218A | | SS15 |
| 2N2352A | 2N2221A | 2N2218A | | SS15 |
| 2N2353 | 2N2221 | 2N2218 | | SS15 |
| 2N2353A | 2N2221 | 2N2218 | | SS15 |
| 2N2364 | 2N3020 | 2N3019 | | SS17 |
| 2N2364A | 2N3020 | 2N3019 | | SS17 |
| 2N2368 | 2N2368 | | 3-17 | SS28 |
| *2N2369 | 2N2369 | 2N2369 | 3-17 | SS28 |
| *2N2369A | 2N2369A | 2N2369 | 3-17 | SS28 |
| 2N2377 | 2N3250 | 2N3250 | | |
| 2N2378 | 2N3250 | 2N3250 | | |
| 2N2380 | 2N2218A | 2N2218A | | SS15 |
| 2N2380A | 2N2218A | 2N2218A | | SS15 |
| 2N2383 | 2N4914 | 2N4913 | | PWR6 |
| 2N2384 | 2N4914 | 2N4913 | | PWR6 |
| 2N2389 | 2N1613 | 2N718A | | |
| 2N2390 | 2N1711 | 2N718A | | |
| 2N2391 | 2N3250 | 2N3250 | | |
| 2N2392 | 2N3250 | 2N3250 | | |
| 2N2393 | 2N2904 | 2N2904 | | SS22 |
| 2N2394 | 2N2904 | 2N2904 | | SS22 |
| 2N2395 | 2N2218 | 2N2218 | | SS15 |
| 2N2396 | 2N2218 | 2N2218 | | SS15 |
| 2N2397 | 2N2369A | 2N2369 | | SS28 |
| 2N2405 | 2N2405 | | 3-20 | SS13 |
| 2N2410 | 2N3724 | 2N3724 | | |
| 2N2411 | 2N2894 | 2N2894 | | |
| 2N2412 | 2N2894 | 2N2894 | | SS30 |
| 2N2413 | 2N2221 | 2N2218 | | SS15 |
| 2N2424 | 2N3250 | 2N3250 | | |
| 2N2425 | 2N3250 | 2N3250 | | |
| 2N2433 | 2N1613 | 2N1613 | | |
| 2N2434 | 2N1711 | 2N718A | | |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 2N2435 | 2N3020 | 2N3019 | | SS17 |
| 2N2436 | 2N3019 | 2N3019 | | SS17 |
| 2N2437 | 2N3020 | 2N3019 | | SS17 |
| 2N2438 | 2N3020 | 2N3019 | | SS17 |
| 2N2439 | 2N3019 | 2N3019 | | SS17 |
| 2N2440 | 2N3019 | 2N3019 | | SS17 |
| 2N2443 | 2N3923 | 2N3923 | | SS16 |
| 2N2475 | 2N709 | 2N709 | | SS29 |
| 2N2476 | 2N3724 | 2N3724 | | SS13 |
| 2N2477 | 2N3724 | 2N3724 | | SS13 |
| 2N2478 | 2N2218A | 2N2218 | | SS15 |
| 2N2479 | 2N2218A | 2N2218 | | SS15 |
| 2N2481 | 2N2481 | | 3-17 | SS28 |
| 2N2483 | 2N2484 | 2N2484 | | |
| *2N2484 | 2N2484 | 2N2484 | 3-29 | SS8 |
| 2N2501 | 2N3014 | 2N3009 | | SS8 |
| 2N2509 | 2N2484 | 2N2484 | | SS8 |
| 2N2510 | 2N2484 | 2N2484 | | SS8 |
| 2N2511 | 2N2484 | 2N2484 | | SS8 |
| 2N2529 | 2N930 | 2N930 | | SS8 |
| 2N2530 | 2N930 | 2N930 | | SS8 |
| 2N2531 | 2N930 | 2N930 | | SS8 |
| 2N2532 | 2N930 | 2N930 | | SS8 |
| 2N2533 | 2N930 | 2N930 | | SS8 |
| 2N2534 | 2N930 | 2N930 | | SS8 |
| 2N2537 | 2N3724 | 2N3724 | | SS13 |
| 2N2538 | 2N3724 | 2N3724 | | SS13 |
| 2N2539 | 2N3724 | 2N3724 | | SS13 |
| 2N2540 | 2N3724 | 2N3724 | | SS13 |
| 2N2551 | CF | | | |
| 2N2585 | 2N3117 | 2N2484 | | SS8 |
| 2N2594 | 2N5321 | 2N5320 | | PWR2 |
| 2N2595 | 2N2906A | 2N2904 | | SS22 |
| 2N2596 | 2N2906A | 2N2904 | | SS22 |
| 2N2597 | 2N2906A | 2N2904 | | SS22 |
| 2N2598 | CF | | | |
| 2N2599 | CF | | | |
| 2N2599A | CF | | | |
| 2N2600 | CF | | | |
| 2N2600A | CF | | | |
| 2N2601 | 2N2906A | 2N2904 | | SS22 |
| 2N2602 | 2N2906A | 2N2904 | | SS22 |
| 2N2603 | 2N2906A | 2N2904 | | SS22 |
| 2N2604 | 2N3962 | 2N3962 | | SS33 |
| 2N2605 | 2N3962 | 2N3962 | | SS33 |
| 2N2605A | 2N3962 | 2N3962 | | SS33 |
| 2N2610 | 2N930 | 2N930 | | SS8 |
| 2N2611 | 2N3766 | 2N3766 | | PWR18 |
| 2N2615 | 2N918 | 2N918 | | SS27 |
| 2N2616 | 2N918 | 2N918 | | SS27 |
| 2N2617 | 2N3250 | 2N3250 | | |
| 2N2618 | 2N2218 | 2N2218 | | SS15 |
| *2N2639 | 2N2639 | 2N2639 | 3-41 | SS8 |
| *2N2640 | 2N2640 | 2N2639 | 3-41 | SS8 |
| *2N2641 | 2N2641 | 2N2639 | 3-43 | SS8 |
| *2N2642 | 2N2642 | 2N2639 | 3-41 | SS8 |
| *2N2643 | 2N2643 | 2N2639 | 3-41 | SS8 |
| *2N2644 | 2N2644 | 2N2639 | 3-43 | SS8 |
| 2N2645 | 2N956 | 2N718A | | SS15 |
| 2N2651 | 2N3014 | 2N3009 | | SS5 |
| 2N2655 | 2N5681 | 2N5679 | | PWR3 |
| 2N2656 | 2N930 | 2N930 | | SS8 |
| 2N2657 | 2N5336 | 2N5336 | | PWR4 |
| 2N2658 | 2N5336 | 2N5336 | | PWR4 |
| 2N2673 | 2N930 | 2N930 | | SS8 |
| 2N2674 | 2N930 | 2N930 | | SS8 |
| 2N2675 | 2N930 | 2N930 | | SS8 |
| 2N2676 | 2N930 | 2N930 | | SS8 |
| 2N2677 | 2N930 | 2N930 | | SS8 |
| 2N2678 | 2N930 | 2N930 | | SS8 |
| 2N2692 | 2N930 | 2N930 | | SS8 |
| 2N2693 | 2N930 | 2N930 | | SS8 |
| 2N2694 | 2N930 | 2N930 | | SS8 |
| 2N2695 | 2N2906 | 2N2904 | | SS22 |
| 2N2696 | 2N2906 | 2N2904 | | SS22 |
| 2N2709 | 2N2906 | 2N2904 | | SS22 |
| 2N2710 | 2N3014 | 2N3009 | | SS5 |
| 2N2711 | MPS2711 | MPS2711 | | SS14 |
| 2N2712 | MPS2712 | MPS2711 | | SS14 |
| 2N2713 | MPS2713 | | | SS15 |
| 2N2714 | MPS2714 | | | SS15 |
| *2N2723 | 2N2723 | 2N2723 | 3-44 | |
| *2N2724 | 2N2724 | 2N2723 | 3-44 | |
| *2N2725 | 2N2725 | 2N2723 | 3-44 | |
| 2N2726 | 2N3440 | 2N3439 | | PWR8 |
| 2N2729 | 2N918 | 2N918 | | SS27 |
| 2N2785 | 2N999 | 2N999 | | |
| 2N2787 | 2N2218A | 2N2218A | | SS15 |
| 2N2788 | 2N2218A | 2N2218A | | SS15 |
| 2N2789 | 2N2219A | 2N2218A | | SS15 |
| 2N2790 | 2N2221A | 2N2218A | | SS15 |
| 2N2791 | 2N2221A | 2N2218A | | SS15 |
| 2N2792 | 2N2222A | 2N2218A | | SS15 |
| 2N2800 | 2N2904A | 2N2904 | | SS22 |
| 2N2801 | 2N2905A | 2N2904 | | SS22 |
| 2N2811 | 2N5002 | 2N5002 | | PWR19 |
| 2N2812 | 2N5002 | 2N5002 | | PWR19 |
| 2N2813 | 2N5002 | 2N5002 | | PWR19 |
| 2N2814 | 2N5002 | 2N5002 | | PWR19 |
| 2N2829 | 2N5002 | 2N5002 | | PWR19 |
| 2N2831 | 2N2221 | 2N2218 | | SS15 |
| 2N2837 | 2N2906A | 2N2904 | | SS22 |
| 2N2838 | 2N2907A | 2N2904 | | SS22 |
| 2N2849 | 2N5337 | 2N5336 | | PWR4 |
| 2N2850 | 2N5336 | 2N5336 | | PWR4 |
| 2N2851 | 2N5336 | 2N5336 | | PWR4 |
| 2N2852 | 2N5335 | 2N5336 | | PWR4 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 2N2853 | 2N5336 | 2N5336 | | PWR4 |
| 2N2854 | 2N5337 | 2N5336 | | PWR4 |
| 2N2855 | 2N5336 | 2N5336 | | PWR4 |
| 2N2856 | 2N5334 | 2N4895 | | PWR1 |
| 2N2858 | 2N5335 | 2N4895 | | PWR1 |
| 2N2859 | 2N5338 | 2N5336 | | PWR4 |
| 2N2861 | 2N3962 | 2N3962 | | SS33 |
| 2N2862 | 2N3962 | 2N3962 | | SS33 |
| 2N2863 | 2N2218 | 2N2218 | | SS15 |
| 2N2864 | 2N2218 | 2N2218 | | SS15 |
| 2N2866 | 2N5002 | 2N5002 | | PWR19 |
| 2N2867 | 2N5002 | 2N5002 | | PWR19 |
| 2N2868 | 2N2868 | | 3-20 | |
| 2N2875 | 2N5003 | 2N5002 | | PWR11 |
| 2N2877 | 2N5002 | 2N5002 | | PWR19 |
| 2N2878 | 2N5002 | 2N5002 | | PWR19 |
| 2N2879 | 2N5002 | 2N5002 | | PWR19 |
| 2N2880 | 2N5002 | 2N5002 | | PWR19 |
| 2N2881 | 2N4235 | 2N4234 | | PWR14 |
| 2N2882 | 2N4236 | 2N4234 | | PWR14 |
| 2N2886 | 2N2218A | 2N2218A | | SS15 |
| 2N2890 | 2N5335 | 2N4895 | | PWR4 |
| 2N2891 | 2N5335 | 2N4895 | | PWR4 |
| 2N2892 | 2N5002 | 2N5002 | | PWR19 |
| 2N2893 | 2N5002 | 2N5002 | | PWR19 |
| *2N2894 | 2N2894 | 2N2894 | 3-19 | SS30 |
| *2N2894A | 2N2894A | 2N2894 | 3-19 | SS32 |
| 2N2895 | CF | | | |
| 2N2896 | CF | | | |
| 2N2897 | CF | | | |
| 2N2902 | CF | | | |
| 2N2903 | 2N2920 | 2N2920 | | SS8 |
| 2N2903A | 2N2920 | 2N2920 | | SS8 |
| *2N2904 | 2N2904 | 2N2904 | | SS22 |
| *2N2904A | 2N2904A | 2N2904 | 3-25 | SS22 |
| *2N2905 | 2N2905 | 2N2904 | 3-25 | SS22 |
| *2N2905A | 2N2905A | 2N2904 | 3-25 | SS22 |
| *2N2906 | 2N2906 | 2N2904 | 3-25 | SS22 |
| *2N2906A | 2N2906A | 2N2904 | 3-26 | SS22 |
| *2N2907 | 2N2907 | 2N2904 | 3-25 | SS22 |
| *2N2907A | 2N2907A | 2N2904 | 3-25 | SS22 |
| 2N2908 | 2N5069 | 2N5067 | | |
| 2N2909 | 2N2221A | 2N2218A | | SS15 |
| 2N2911 | 2N3766 | 2N3766 | | |
| *2N2913 | 2N2913 | 2N2913 | 3-43 | SS8 |
| *2N2914 | 2N2914 | 2N2913 | 3-43 | SS8 |
| *2N2915 | 2N2915 | 2N2915 | 3-41 | SS8 |
| *2N2915A | 2N2915A | 2N2915 | 3-41 | SS8 |
| *2N2916 | 2N2916 | 2N2916 | 3-41 | SS8 |
| *2N2916A | 2N2916A | 2N2916 | 3-41 | SS8 |
| *2N2917 | 2N2917 | 2N2917 | 3-41 | SS8 |
| *2N2918 | 2N2918 | 2N2917 | 3-41 | SS8 |
| *2N2919 | 2N2919 | 2N2915 | 3-41 | SS8 |
| *2N2919A | 2N2919A | 2N2915 | 3-41 | SS8 |
| *2N2920 | 2N2920 | 2N2916 | 3-41 | SS8 |
| *2N2920A | 2N2920A | 2N2916 | 3-41 | SS8 |
| 2N2922 | MPS6512 | MPS6512 | | SS14 |
| 2N2923 | MPS2923 | MPS2923 | | |
| 2N2924 | MPS2924 | MPS2923 | | |
| 2N2925 | MPS2925 | MPS2923 | | |
| 2N2926 | MPS2926 | MPS2926 | | |
| 2N2927 | 2N2904 | 2N2904 | | SS22 |
| 2N2936 | 2N2919 | 2N2915 | | SS8 |
| 2N2937 | 2N2919 | 2N2915 | | SS8 |
| 2N2938 | 2N2369A | 2N2369 | | SS28 |
| 2N2939 | 2N3020 | 2N3019 | | SS17 |
| 2N2940 | 2N3019 | 2N3019 | | SS17 |
| 2N2941 | CF | | | |
| 2N2954 | 2N3014 | 2N3009 | | SS5 |
| 2N2960 | 2N2219 | 2N2218 | | SS15 |
| 2N2961 | 2N2219 | 2N2218 | | SS15 |
| 2N2968 | 2N3250 | 2N3250 | | |
| 2N2969 | 2N3250 | 2N3250 | | |
| 2N2970 | 2N3250 | 2N3250 | | |
| 2N2971 | 2N3250 | 2N3250 | | |
| *2N2972 | 2N2972 | 2N2913 | 3-43 | SS8 |
| *2N2973 | 2N2973 | 2N2913 | 3-43 | SS8 |
| *2N2974 | 2N2974 | 2N2915 | 3-41 | SS8 |
| *2N2975 | 2N2975 | 2N2916 | 3-41 | SS8 |
| *2N2976 | 2N2976 | 2N2917 | 3-41 | SS8 |
| *2N2977 | 2N2977 | 2N2917 | 3-41 | SS8 |
| *2N2978 | 2N2978 | 2N2915 | 3-41 | SS8 |
| *2N2979 | 2N2979 | 2N2915 | 3-41 | SS8 |
| 2N2983 | 2N5335 | 2N4895 | | PWR1 |
| 2N2984 | 2N5682 | 2N5679 | | |
| 2N2985 | 2N5338 | 2N5336 | | PWR4 |
| 2N2986 | 2N5682 | 2N5679 | | PWR3 |
| 2N2987 | 2N5335 | 2N4895 | | PWR1 |
| 2N2988 | 2N5681 | 2N5679 | | PWR3 |
| 2N2989 | 2N5681 | 2N5679 | | |
| 2N2990 | 2N5681 | 2N5679 | | PWR3 |
| *2N3009 | 2N3009 | 2N3009 | 3-17 | SS5 |
| *2N3010 | 2N3010 | 2N709 | 3-17 | SS29 |
| *2N3011 | 2N3011 | 2N3011 | 3-17 | SS28 |
| *2N3012 | 2N3012 | 2N2894 | 3-19 | SS30 |
| *2N3013 | 2N3013 | 2N3009 | 3-17 | SS5 |
| *2N3014 | 2N3014 | 2N3009 | 3-17 | SS5 |
| 2N3015 | 2N3015 | | 3-17 | |
| *2N3019 | 2N3019 | 2N3019 | 3-21 | SS17 |
| *2N3020 | 2N3020 | 2N3019 | 3-21 | SS17 |
| *2N3053 | 2N3053 | 2N3053 | 3-20 | |
| 2N3053A | 2N3020 | 2N3019 | | SS17 |
| *2N3054 | 2N3054 | 2N3054 | 3-36 | PWR5 |
| *2N3055 | 2N3055 | 2N3055 | 3-39 | PWR6 |
| 2N3056 | 2N3020 | 2N3019 | | SS17 |
| 2N3056A | 2N3020 | 2N3019 | | SS17 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 2N3057 | 2N3019 | 2N3019 | | SS17 |
| 2N3057A | 2N3019 | 2N3019 | | SS17 |
| 2N3072 | 2N3072 | | 3-25 | SS22 |
| 2N3073 | 2N3073 | | 3-25 | SS22 |
| 2N3077 | 2N2484 | 2N2484 | | SS8 |
| 2N3078 | 2N2483 | | | SS8 |
| 2N3081 | 2N3020 | 2N3019 | | SS17 |
| *2N3107 | 2N3107 | 2N3107 | 3-21 | SS17 |
| *2N3108 | 2N3108 | 2N3107 | 3-21 | SS17 |
| *2N3109 | 2N3109 | 2N3107 | 3-20 | SS17 |
| *2N3110 | 2N3110 | 2N3107 | 3-20 | SS17 |
| 2N3114 | 2N3114 | | 3-33 | |
| 2N3115 | 2N2221 | 2N2218 | | SS15 |
| 2N3116 | 2N2222 | 2N2218 | | SS15 |
| *2N3117 | 2N3117 | 2N2484 | 3-29 | SS8 |
| 2N3119 | 2N3020 | 2N3019 | | SS17 |
| 2N3120 | 2N2904 | 2N2904 | | SS22 |
| 2N3121 | 2N2906 | 2N2904 | | SS22 |
| 2N3122 | 2N2219 | 2N2218 | | SS15 |
| 2N3123 | 2N2219 | 2N2218 | | SS15 |
| 2N3133 | 2N2904 | 2N2904 | | SS22 |
| 2N3134 | 2N3134 | | 3-25 | SS22 |
| 2N3135 | 2N2906 | 2N2904 | | SS22 |
| 2N3136 | 2N2907 | 2N2904 | | SS22 |
| *2N3137 | 2N3137 | 2N3137 | 3-34 | SS2 |
| 2N3138 | 2N5002 | 2N5002 | | PWR19 |
| 2N3140 | 2N5002 | 2N5002 | | PWR19 |
| 2N3142 | 2N5002 | 2N5002 | | PWR19 |
| 2N3144 | 2N5002 | 2N5002 | | PWR19 |
| 2N3162 | 2N3411 | | | SS15 |
| 2N3171 | 2N4901 | 2N4901 | | PWR15 |
| 2N3172 | 2N4902 | 2N4901 | | PWR15 |
| 2N3173 | 2N4903 | 2N4901 | | PWR15 |
| 2N3175 | 2N5003 | 2N5002 | | PWR11 |
| 2N3176 | 2N5003 | 2N5002 | | PWR11 |
| 2N3177 | 2N5003 | 2N5002 | | PWR11 |
| 2N3183 | 2N4904 | 2N4901 | | PWR15 |
| 2N3184 | 2N4905 | 2N4901 | | PWR15 |
| 2N3185 | 2N4906 | 2N4901 | | PWR15 |
| 2N3195 | 2N4904 | 2N4901 | | PWR15 |
| 2N3196 | 2N4905 | 2N4901 | | PWR15 |
| 2N3197 | 2N4906 | 2N4901 | | PWR15 |
| 2N3199 | 2N5003 | 2N5002 | | PWR11 |
| 2N3200 | 2N5003 | 2N5002 | | PWR11 |
| 2N3201 | 2N5003 | 2N5002 | | PWR11 |
| 2N3202 | 2N4234 | 2N4234 | | PWR14 |
| 2N3203 | 2N4235 | 2N4235 | | PWR14 |
| 2N3204 | 2N4236 | 2N4234 | | PWR14 |
| 2N3205 | 2N5003 | 2N5002 | | PWR11 |
| 2N3206 | 2N5003 | 2N5002 | | PWR11 |
| 2N3207 | 2N5003 | 2N5002 | | PWR11 |
| 2N3208 | 2N4234 | 2N4234 | | PWR14 |
| *2N3209 | 2N3209 | 2N2894 | 3-19 | SS30 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 2N3210 | 2N3013 | 2N3009 | | SS5 |
| 2N3211 | 2N3013 | 2N3009 | | SS5 |
| 2N3220 | 2N5002 | 2N5002 | | PWR19 |
| 2N3221 | 2N5002 | 2N5002 | | PWR19 |
| 2N3222 | 2N5002 | 2N5002 | | PWR19 |
| 2N3223 | 2N5002 | 2N5002 | | PWR19 |
| 2N3224 | 2N3923 | 2N3923 | | SS16 |
| 2N3225 | 2N3923 | 2N3923 | | SS16 |
| 2N3226 | 2N4913 | 2N4913 | | PWR6 |
| 2N3227 | 2N4137 | | | SS28 |
| 2N3232 | 2N4914 | 2N4913 | | PWR6 |
| 2N3235 | 2N3055 | 2N3055 | | PWR7 |
| 2N3237 | 2N5882 | 2N5881 | | PWR7 |
| 2N3238 | 2N5882 | 2N5881 | | PWR7 |
| 2N3239 | 2N5882 | 2N5881 | | PWR7 |
| 2N3241 | 2N2222 | 2N2218 | | SS15 |
| 2N3241A | 2N2222 | 2N2218 | | SS15 |
| 2N3242 | 2N2222 | 2N2218 | | SS15 |
| 2N3242A | 2N2222 | 2N2218 | | SS15 |
| 2N3244 | 2N3467 | 2N3467 | | SS7 |
| 2N3245 | 2N3468 | 2N3467 | | SS7 |
| 2N3246 | 2N2484 | 2N2484 | | SS8 |
| 2N3247 | 2N2484 | 2N2484 | | SS8 |
| 2N3248 | 2N2894 | 2N2894 | | SS30 |
| 2N3249 | 2N2894 | 2N2894 | | SS30 |
| *2N3250 | 2N3250 | 2N3250 | 3-25 | |
| *2N3250A | 2N3250A | 2N3250 | 3-25 | |
| *2N3251 | 2N3251 | 2N3250 | 3-25 | |
| *2N3251A | 2N3251A | 2N3250 | 3-25 | |
| 2N3252 | 2N3252 | | 3-17 | SS13 |
| 2N3253 | 2N3253 | | 3-17 | SS13 |
| 2N3299 | 2N3299 | | 3-20 | SS15 |
| 2N3300 | 2N3300 | | 3-20 | SS15 |
| 2N3301 | 2N3301 | | 3-20 | SS15 |
| 2N3302 | 2N3302 | | 3-20 | SS15 |
| 2N3304 | 2N3304 | | 3-19 | SS31 |
| 2N3326 | 2N2218A | 2N2218A | | SS15 |
| 2N3337 | CF | | | |
| 2N3338 | CF | | | |
| 2N3339 | CF | | | |
| 2N3347 | 2N4024 | 2N4020 | | SS33 |
| 2N3348 | 2N4024 | 2N4020 | | SS33 |
| 2N3349 | 2N4021 | 2N4020 | | SS33 |
| 2N3350 | 2N4025 | 2N4020 | | SS33 |
| 2N3351 | 2N4022 | 2N4020 | | SS33 |
| 2N3352 | 2N4019 | 2N4017 | | SS33 |
| 2N3374 | 2N3020 | 2N3020 | | SS17 |
| 2N3390 | MPS6521 | MPS2520 | | SS14 |
| 2N3391 | MPS6515 | MPS6512 | | SS14 |
| 2N3391A | MPS6520 | MPS6520 | | SS14 |
| 2N3392 | MPS3392 | MPS3392 | | |
| 2N3393 | MPS3393 | MPS3392 | | |
| 2N3394 | MPS3394 | MPS3392 | | |
| 2N3395 | MPS3395 | MPS3392 | | |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 2N3396 | MPS3393 | MPS3392 | | |
| 2N3397 | MPS3395 | MPS3392 | | |
| 2N3398 | MPS3395 | MPS3392 | | |
| 2N3402 | MPS6513 | MPS6512 | | SS14 |
| 2N3403 | MPS6515 | MPS6512 | | SS14 |
| 2N3404 | MPS6565 | MPS6565 | | |
| 2N3405 | MPS6566 | MPS6565 | | |
| *2N3409 | 2N3409 | 2N3409 | 3-41 | SS15 |
| *2N3410 | 2N3410 | 2N3409 | 3-41 | SS15 |
| *2N3411 | 2N3411 | 2N3409 | 3-41 | SS15 |
| 2N3413 | CF | | | |
| 2N3414 | MPS6513 | MPS6512 | | |
| 2N3415 | MPS6515 | MPS6512 | | |
| 2N3416 | MPS6565 | MPS6565 | | |
| 2N3417 | MPS6566 | MPS6565 | | |
| 2N3418 | 2N5334 | 2N4895 | | PWR1 |
| 2N3419 | 2N5335 | 2N4895 | | PWR1 |
| 2N3420 | 2N5336 | 2N5336 | | PWR4 |
| 2N3421 | 2N5336 | 2N5336 | | PWR4 |
| *2N3423 | 2N3423 | 2N3423 | 3-41 | SS27 |
| *2N3424 | 2N3424 | 2N3424 | 3-41 | SS27 |
| 2N3425 | 2N3425 | | 3-43 | |
| *2N3439 | 2N3439 | 2N3439 | 3-36 | PWR8 |
| *2N3440 | 2N3440 | 2N3440 | 3-36 | PWR8 |
| 2N3444 | 2N3444 | | 3-17 | SS13 |
| 2N3451 | 2N4208 | 2N4208 | | SS31 |
| 2N3464 | 2N2219A | 2N2218A | | SS15 |
| *2N3467 | 2N3467 | 2N3467 | 3-19 | SS7 |
| *2N3468 | 2N3468 | 2N3467 | 3-19 | SS7 |
| 2N3469 | 2N5337 | 2N5337 | | PWR4 |
| 2N3485 | 2N2906 | 2N2904 | | SS22 |
| 2N3485A | 2N2906A | 2N2904 | | SS22 |
| 2N3486 | 2N2907 | 2N2904 | | SS22 |
| 2N3486A | 2N2907A | 2N2904 | | SS22 |
| 2N3494 | CF | | | |
| 2N3495 | CF | | | |
| 2N3496 | CF | | | |
| 2N3497 | CF | | | |
| 2N3498 | CF | | | |
| 2N3499 | CF | | | |
| 2N3500 | CF | | | |
| 2N3501 | CF | | | |
| 2N3502 | 2N3502 | | 3-25 | SS22 |
| 2N3503 | 2N3503 | | 3-25 | SS22 |
| 2N3504 | 2N3504 | | 3-25 | SS22 |
| 2N3505 | 2N3505 | | 3-25 | SS22 |
| 2N3508 | 2N2369A | 2N2369 | | SS28 |
| 2N3509 | 2N2369A | 2N2369 | | SS28 |
| 2N3510 | 2N3510 | | 3-17 | SS5 |
| 2N3511 | 2N3511 | | 3-17 | SS5 |
| 2N3512 | 2N3724 | 2N3724 | | SS13 |
| 2N3521 | 2N2919 | 2N2915 | | SS8 |
| 2N3522 | 2N2978 | 2N2915 | | SS8 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 2N3526 | 2N3114 | | | |
| 2N3545 | 2N3209 | 2N2894 | | |
| 2N3546 | 2N3546 | | 3-19 | |
| 2N3547 | 2N3962 | 2N3962 | | SS33 |
| 2N3548 | 2N3962 | 2N3962 | | SS33 |
| 2N3549 | 2N3962 | 2N3962 | | SS33 |
| 2N3550 | 2N3962 | 2N3962 | | SS33 |
| 2N3554 | 2N3724 | 2N3724 | | SS13 |
| *2N3563 | 2N3563 | 2N918 | 3-35 | SS27 |
| *2N3564 | 2N3564 | 2N3564 | 3-35 | SS2 |
| *2N3565 | 2N3565 | 2N3565 | 3-29 | SS8 |
| *2N3566 | 2N3566 | 2N3566 | 3-22 | SS15 |
| *2N3567 | 2N3567 | 2N3567 | 3-23 | |
| *2N3568 | 2N3568 | 2N3567 | 3-24 | |
| *2N3569 | 2N3569 | 2N3567 | 3-23 | |
| 2N3576 | 2N4209 | 2N4208 | | SS31 |
| 2N3579 | 2N3962 | 2N3962 | | SS33 |
| 2N3580 | 2N3962 | 2N3962 | | SS33 |
| 2N3581 | 2N3962 | 2N3962 | | SS33 |
| 2N3582 | 2N3962 | 2N3962 | | SS33 |
| 2N3583 | CF | | | |
| 2N3584 | CF | | | |
| 2N3585 | CF | | | |
| 2N3587 | 2N2917 | 2N2917 | | SS8 |
| 2N3605 | 2N5769 | 2N2369 | | SS28 |
| 2N3605A | 2N5769 | 2N2369 | | SS28 |
| 2N3606 | 2N5769 | 2N2369 | | SS28 |
| 2N3606A | 2N5769 | 2N2369 | | SS28 |
| 2N3607 | 2N5769 | 2N2369 | | SS28 |
| 2N3634 | CF | | | |
| 2N3635 | CF | | | |
| 2N3636 | CF | | | |
| 2N3637 | CF | | | |
| *2N3638 | 2N3638 | 2N3638 | 3-27 | SS22 |
| *2N3638A | 2N3638A | 2N3638 | 3-27 | SS22 |
| *2N3639 | 2N3639 | 2N3639 | 3-19 | SS31 |
| *2N3640 | 2N3640 | 2N3639 | 3-19 | SS31 |
| *2N3641 | 2N3641 | 2N3641 | 3-23 | SS15 |
| *2N3642 | 2N3642 | 2N3641 | 3-24 | SS15 |
| *2N3643 | 2N3643 | 2N3641 | 3-23 | SS15 |
| *2N3644 | 2N3644 | 2N3644 | 3-28 | SS22 |
| *2N3645 | 2N3645 | 2N3644 | 3-28 | SS22 |
| *2N3646 | 2N3646 | 2N3646 | 3-18 | SS5 |
| 2N3647 | 2N3013 | 2N3009 | | SS5 |
| 2N3648 | 2N3013 | 2N3009 | | SS5 |
| 2N3660 | 2N5023 | 2N3467 | | |
| 2N3661 | 2N5022 | 2N3467 | | |
| 2N3662 | 2N5770 | 2N918 | | SS27 |
| 2N3663 | 2N5770 | 2N918 | | SS27 |
| 2N3665 | 2N3665 | | 3-21 | |
| 2N3666 | 2N3666 | | 3-21 | |
| 2N3667 | 2N5881 | 2N5881 | | PWR7 |
| 2N3671 | 2N2905A | 2N2904 | | SS22 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 2N3672 | 2N2907A | 2N2904 | | SS22 |
| 2N3673 | 2N2907A | 2N2904 | | SS22 |
| 2N3675 | 2N4238 | 2N4237 | | PWR5 |
| 2N3676 | 2N4239 | 2N4237 | | PWR5 |
| 2N3678 | 2N3020 | 2N3019 | | SS17 |
| 2N3680 | 2N2920 | 2N2920 | | SS8 |
| *2N3688 | 2N3688 | 2N3688 | 3-35 | SS1 |
| *2N3689 | 2N3689 | 2N3688 | 3-35 | SS1 |
| *2N3690 | 2N3690 | 2N3688 | 3-35 | SS1 |
| 2N3691 | 2N3693 | 2N3693 | | |
| 2N3692 | 2N3694 | 2N3693 | | |
| *2N3693 | 2N3693 | 2N3693 | 3-24 | |
| *2N3694 | 2N3694 | 2N3693 | 3-23 | |
| *2N3700 | 2N3700 | 2N3700 | 3-21 | SS17 |
| *2N3701 | 2N3701 | 2N3701 | 3-21 | SS17 |
| 2N3702 | MPS3702 | MPS3702 | | |
| 2N3703 | MPS3703 | MPS3702 | | |
| 2N3704 | MPS3704 | MPS3704 | | |
| 2N3705 | MPS3705 | MPS3704 | | |
| 2N3706 | MPS3706 | MPS3704 | | |
| 2N3707 | MPS3707 | MPS3707 | | |
| 2N3708 | MPS3708 | MPS3708 | | |
| 2N3709 | MPS3709 | MPS3709 | | |
| 2N3710 | MPS3710 | MPS3710 | | |
| 2N3711 | MPS3711 | MPS3711 | | |
| 2N3712 | 2N3923 | 2N3923 | | SS16 |
| *2N3713 | 2N3713 | 2N3713 | 3-39 | PWR6 |
| *2N3714 | 2N3714 | 2N3713 | 3-39 | PWR6 |
| *2N3715 | 2N3715 | 2N3713 | 3-39 | PWR6 |
| *2N3716 | 2N3716 | 2N3713 | 3-39 | PWR6 |
| 2N3719 | 2N5679 | 2N5679 | | PWR13 |
| 2N3720 | 2N5679 | 2N5679 | | PWR13 |
| *2N3722 | 2N3722 | 2N3722 | 3-17 | SS9 |
| 2N3723 | FT3723 | 2N3722 | | SS9 |
| *2N3724 | 2N3724 | 2N3724 | 3-17 | SS13 |
| 2N3724A | CF | | | |
| *2N3725 | 2N3725 | 2N3724 | 3-17 | SS13 |
| 2N3725A | CF | | | |
| *2N3726 | 2N3726 | 2N3726 | 3-42 | SS22 |
| *2N3727 | 2N3727 | 2N3726 | 3-42 | SS22 |
| *2N3728 | 2N3728 | 2N3728 | 3-41 | SS15 |
| *2N3729 | 2N3729 | 2N3728 | 3-41 | SS15 |
| 2N3734 | 2N3734 | | 3-17 | |
| 2N3735 | 2N3725 | 2N3724 | | SS13 |
| 2N3736 | 2N4014 | 2N3724 | | |
| 2N3737 | 2N4014 | 2N3724 | | |
| 2N3738 | CF | | | |
| 2N3739 | CF | | | |
| *2N3740 | 2N3740 | 2N3740 | 3-37 | PWR14 |
| 2N3740A | 2N3740A | | | PWR14 |
| *2N3741 | 2N3741 | 2N3740 | 3-37 | PWR14 |
| 2N3741A | 2N3741A | | | PWR14 |
| 2N3742 | SE7056 | SE7055 | | SS11 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 2N3743 | CF | | | |
| 2N3744 | 2N5002 | 2N5002 | | PWR19 |
| 2N3745 | 2N5002 | 2N5002 | | PWR19 |
| 2N3746 | 2N5002 | 2N5002 | | PWR19 |
| 2N3747 | 2N5002 | 2N5002 | | PWR19 |
| 2N3748 | 2N5002 | 2N5002 | | PWR19 |
| 2N3749 | 2N5002 | 2N5002 | | PWR19 |
| 2N3750 | 2N5004 | 2N5002 | | PWR19 |
| 2N3751 | 2N5004 | 2N5002 | | PWR19 |
| 2N3752 | 2N5004 | 2N5002 | | PWR19 |
| 2N3762 | 2N5023 | 2N3467 | | SS7 |
| 2N3763 | 2N5022 | 2N3467 | | SS7 |
| 2N3764 | 2N5023 | 2N3467 | | SS7 |
| 2N3765 | 2N5022 | 2N3467 | | SS7 |
| *2N3766 | 2N3766 | 2N3766 | | PWR18 |
| *2N3767 | 2N3767 | 2N3766 | | PWR18 |
| 2N3771 | 2N3771 | | | PWR7 |
| 2N3772 | 2N3772 | | | PWR7 |
| 2N3774 | 2N4234 | 2N4234 | | PWR14 |
| 2N3775 | 2N4235 | 2N4235 | | PWR14 |
| 2N3776 | 2N4236 | 2N4234 | | PWR14 |
| 2N3777 | 2N5679 | 2N5679 | | PWR13 |
| 2N3778 | 2N4234 | 2N4234 | | PWR14 |
| 2N3779 | 2N4235 | 2N4234 | | PWR14 |
| 2N3780 | 2N4236 | 2N4234 | | PWR14 |
| 2N3781 | 2N5679 | 2N5679 | | PWR13 |
| 2N3782 | 2N4234 | 2N4234 | | PWR14 |
| *2N3789 | 2N3789 | 2N3789 | 3-39 | PWR15 |
| *2N3790 | 2N3790 | 2N3789 | 3-39 | PWR15 |
| *2N3791 | 2N3791 | 2N3789 | 3-39 | PWR15 |
| *2N3792 | 2N3792 | 2N3789 | 3-39 | PWR15 |
| 2N3793 | MPS6530 | MPS6530 | | SS15 |
| 2N3794 | MPS6531 | MPS6530 | | SS15 |
| 2N3798 | 2N3962 | 2N3962 | | SS33 |
| 2N3798A | 2N3962 | 2N3962 | | SS33 |
| 2N3799 | 2N3965 | 2N3962 | | SS33 |
| 2N3799A | 2N3965 | 2N3962 | | SS33 |
| *2N3800 | 2N3800 | 2N3800 | 3-43 | SS33 |
| *2N3801 | 2N3801 | 2N3800 | 3-43 | SS33 |
| *2N3802 | 2N3802 | 2N3800 | 3-42 | SS33 |
| *2N3803 | 2N3803 | 2N3800 | 3-42 | SS33 |
| *2N3804 | 2N3804 | 2N3804 | 3-42 | SS33 |
| *2N3804A | 2N3804A | 2N3804 | 3-42 | SS33 |
| *2N3805 | 2N3805 | 2N3804 | 3-42 | SS33 |
| *2N3805A | 2N3805A | 2N3804 | 3-42 | SS33 |
| *2N3806 | 2N3806 | 2N3800 | 3-43 | SS33 |
| *2N3807 | 2N3807 | 2N3800 | 3-43 | SS33 |
| *2N3808 | 2N3808 | 2N3800 | 3-42 | SS33 |
| *2N3809 | 2N3809 | 2N3800 | 3-42 | SS33 |
| *2N3810 | 2N3810 | 2N3804 | 3-42 | SS33 |
| *2N3810A | 2N3810A | 2N3804 | 3-42 | SS33 |
| *2N3811 | 2N3811 | 2N3804 | 3-42 | SS33 |
| *2N3811A | 2N3811A | 2N3804 | 4-42 | SS33 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 2N3819 | 2N5486 | 2N5484 | | |
| 2N3825 | 2N5220 | 2N5220 | | SS15 |
| 2N3826 | MPS6565 | MPS6565 | | |
| 2N3827 | MPS6566 | MPS6565 | | |
| 2N3828 | MPS6565 | MPS6565 | | |
| 2N3829 | 2N3250 | 2N3250 | | |
| 2N3830 | 2N2218A | 2N2218A | | SS15 |
| 2N3831 | 2N2218A | 2N2218A | | SS15 |
| 2N3843 | MPS6512 | MPS6512 | | SS14 |
| 2N3843A | MPS6512 | MPS6512 | | SS14 |
| 2N3844 | MPS6512 | MPS6512 | | SS14 |
| 2N3844A | MPS6512 | MPS6512 | | SS14 |
| 2N3845 | MPS6512 | MPS6512 | | SS14 |
| 2N3845A | MPS6513 | MPS6512 | | SS14 |
| 2N3850 | 2N5002 | 2N5002 | | PWR19 |
| 2N3851 | 2N5002 | 2N5002 | | PWR19 |
| 2N3852 | 2N5002 | 2N5002 | | PWR19 |
| 2N3853 | 2N5002 | 2N5002 | | PWR19 |
| 2N3854 | MPS6512 | MPS6512 | | SS14 |
| 2N3854A | MPS6512 | MPS6512 | | SS14 |
| 2N3855 | MPS6512 | MPS6512 | | SS14 |
| 2N3855A | MPS6512 | MPS6512 | | SS14 |
| 2N3856 | MPS6513 | MPS6512 | | SS14 |
| 2N3856A | MPS6513 | MPS6512 | | SS14 |
| 2N3858 | MPS6512 | MPS6512 | | SS14 |
| 2N3858A | 2N4409 | 2N4409 | | PWR15 |
| 2N3859 | MPS6513 | MPS6512 | | SS14 |
| 2N3859A | 2N4409 | 2N4409 | | SS16 |
| 2N3860 | MPS6514 | MPS6512 | | SS14 |
| 2N3862 | 2N3946 | 2N3946 | | SS14 |
| 2N3863 | 2N3715 | 2N3713 | | PWR6 |
| 2N3877 | 2N4410 | 2N4409 | | SS16 |
| 2N3877A | 2N4410 | 2N4409 | | SS16 |
| 2N3878 | CF | | | |
| 2N3879 | CF | | | |
| 2N3880 | 2N5770 | 2N918 | | SS27 |
| 2N3900 | 2N5210 | 2N5209 | | |
| 2N3900A | 2N5210 | 2N5209 | | |
| 2N3901 | 2N5088 | 2N5088 | | |
| 2N3902 | CF | | | |
| *2N3903 | 2N3903 | 2N3903 | 3-23 | SS14 |
| *2N3904 | 2N3904 | 2N3903 | 3-23 | SS14 |
| *2N3905 | 2N3905 | 2N3905 | 3-27 | SS23 |
| *2N3906 | 2N3906 | 2N3905 | 3-27 | SS23 |
| 2N3907 | 2N2915 | 2N2915 | | SS8 |
| 2N3908 | 2N2916 | 2N2916 | | SS8 |
| 2N3916 | CF | | | |
| *2N3923 | 2N3923 | 2N3923 | 3-33 | SS16 |
| 2N3930 | CF | | | |
| 2N3931 | CF | | | |
| 2N3932 | 2N5770 | 2N918 | | SS27 |
| 2N3933 | 2N5770 | 2N918 | | SS27 |
| 2N3941 | 2N2916 | 2N2916 | | SS8 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 2N3942 | 2N2918 | 2N2917 | | SS8 |
| 2N3943 | 2N2975 | 2N2916 | | SS8 |
| 2N3944 | 2N2977 | 2N2917 | | SS8 |
| 2N3945 | 2N2218A | 2N2218A | | SS15 |
| *2N3946 | 2N3946 | 2N3946 | 3-20 | SS14 |
| *2N3947 | 2N3947 | 2N3946 | 3-20 | SS14 |
| 2N3953 | 2N5770 | 2N918 | | SS27 |
| *2N3962 | 2N3962 | 2N3962 | 3-31 | SS33 |
| 2N3963 | 2N3962 | 2N3962 | | SS33 |
| *2N3964 | 2N3964 | 2N3962 | 3-31 | SS33 |
| *2N3965 | 2N3965 | 2N3962 | 3-31 | SS33 |
| 2N3973 | 2N4400 | 2N4400 | | SS15 |
| 2N3974 | 2N4401 | 2N4400 | | SS15 |
| 2N3975 | 2N4400 | 2N4400 | | SS15 |
| 2N3976 | 2N4401 | 2N4400 | | SS15 |
| 2N3981 | 2N2218 | 2N2218 | | SS15 |
| 2N3982 | 2N2218 | 2N2218 | | SS15 |
| 2N3983 | 2N5770 | 2N918 | | SS27 |
| 2N3984 | 2N5770 | 2N918 | | SS27 |
| 2N3985 | 2N5770 | 2N918 | | SS27 |
| 2N3996 | 2N5002 | 2N5002 | | PWR19 |
| 2N3997 | 2N5004 | 2N5002 | | PWR19 |
| 2N3998 | 2N5002 | 2N5002 | | PWR19 |
| 2N3999 | 2N5004 | 2N5002 | | PWR19 |
| 2N4000 | 2N3019 | 2N3019 | | SS17 |
| 2N4001 | 2N5681 | 2N5679 | | PWR3 |
| *2N4013 | 2N4013 | 2N3724 | 3-17 | SS13 |
| *2N4014 | 2N4014 | 2N3724 | 3-17 | SS13 |
| *2N4015 | 2N4015 | 2N3726 | 3-42 | SS22 |
| *2N4016 | 2N4016 | 2N3726 | 3-42 | SS22 |
| *2N4017 | 2N4017 | 2N4017 | 3-43 | SS33 |
| *2N4018 | 2N4018 | 2N4017 | 3-43 | SS33 |
| *2N4019 | 2N4019 | 2N4017 | 3-43 | SS33 |
| *2N4020 | 2N4020 | 2N4020 | 3-42 | SS33 |
| *2N4021 | 2N4021 | 2N4020 | 3-42 | SS33 |
| *2N4022 | 2N4022 | 2N4020 | 3-42 | SS33 |
| *2N4023 | 2N4023 | 2N4020 | 3-42 | SS33 |
| *2N4024 | 2N4024 | 2N4020 | 3-42 | SS33 |
| *2N4025 | 2N4025 | 2N4020 | 3-42 | SS33 |
| 2N4026 | CF | | | |
| 2N4027 | CF | | | |
| 2N4028 | CF | | | |
| 2N4029 | CF | | | |
| *2N4030 | 2N4030 | 2N4030 | 3-25 | SS24 |
| *2N4031 | 2N4031 | 2N4030 | 3-26 | SS24 |
| *2N4032 | 2N4032 | 2N4030 | 3-25 | SS24 |
| *2N4033 | 2N4033 | 2N4030 | 3-26 | SS24 |
| *2N4034 | 2N4034 | 2N4034 | 3-25 | |
| *2N4035 | 2N4035 | 2N4034 | 3-25 | |
| 2N4036 | 2N4036 | | 3-26 | |
| 2N4037 | 2N4037 | | 3-25 | |
| 2N4042 | 2N2920 | 2N2920 | | |
| 2N4043 | 2N2916 | 2N2916 | | SS8 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 2N4044 | 2N2920 | 2N2920 | | SS8 |
| 2N4045 | 2N2916 | 2N2916 | | SS8 |
| 2N4046 | 2N4046 | 2N3724 | 3-17 | |
| 2N4047 | 2N4047 | 2N3724 | 3-17 | |
| 2N4054 | CF | | | |
| 2N4056 | CF | | | |
| 2N4057 | CF | | | |
| 2N4058 | MPS6522 | MPS6522 | | SS23 |
| 2N4059 | MPS6516 | MPS6516 | | SS23 |
| 2N4060 | MPS6516 | MPS6516 | | SS23 |
| 2N4061 | MPS6517 | MPS6516 | | SS23 |
| 2N4062 | MPS6518 | MPS6516 | | SS23 |
| 2N4063 | 2N3439 | 2N3439 | | PWR8 |
| 2N4064 | 2N3440 | 2N3439 | | PWR8 |
| 2N4068 | CF | | | |
| 2N4069 | CF | | | |
| 2N4086 | MPS6514 | MPS6512 | | SS14 |
| 2N4087 | MPS6515 | MPS6512 | | SS14 |
| 2N4087A | MPS6515 | MPS6512 | | SS14 |
| 2N4099 | 2N2918 | 2N2917 | | SS8 |
| 2N4100 | 2N2920 | 2N2920 | | SS8 |
| 2N4115 | 2N4115 | | 3-38 | PWR19 |
| 2N4116 | 2N4116 | | 3-38 | PWR19 |
| *2N4121 | 2N4121 | 2N4121 | 3-27 | SS23 |
| *2N4122 | 2N4122 | 2N4121 | 3-27 | SS23 |
| *2N4123 | 2N4123 | 2N4123 | 3-22 | SS14 |
| *2N4124 | 2N4124 | 2N4123 | 3-22 | SS14 |
| *2N4125 | 2N4125 | 2N4125 | 3-27 | SS23 |
| *2N4126 | 2N4126 | 2N4125 | 3-27 | SS23 |
| 2N4134 | SE5020 | SE5020 | | SS3 |
| 2N4135 | SE5020 | SE5020 | | SS3 |
| 2N4137 | 2N4137 | | 3-17 | |
| 2N4140 | 2N4400 | 2N4400 | | SS15 |
| 2N4141 | 2N4401 | 2N4400 | | SS15 |
| 2N4142 | 2N4402 | 2N4402 | | SS22 |
| 2N4143 | 2N4403 | 2N4402 | | SS22 |
| 2N4150 | 2N5337 | 2N5336 | | PWR4 |
| *2N4208 | 2N4208 | 2N4208 | 3-19 | SS31 |
| *2N4209 | 2N4209 | 2N4208 | 3-19 | SS31 |
| 2N4225 | 2N5334 | 2N4895 | | PWR1 |
| 2N4226 | 2N5334 | 2N4895 | | PWR1 |
| 2N4227 | 2N4400 | 2N4400 | | SS15 |
| 2N4228 | 2N4402 | 2N4402 | | SS22 |
| *2N4231 | 2N4231 | 2N4910 | 3-36 | PWR5 |
| *2N4232 | 2N4232 | 2N4910 | 3-36 | PWR5 |
| *2N4233 | 2N4233 | 2N4910 | 3-36 | PWR5 |
| *2N4234 | 2N4234 | 2N4234 | 3-36 | PWR14 |
| *2N4235 | 2N4235 | 2N4234 | 3-36 | PWR14 |
| *2N4236 | 2N4236 | 2N4234 | 3-36 | PWR14 |
| *2N4237 | 2N4237 | 2N4237 | 3-36 | PWR5 |
| *2N4238 | 2N4238 | 2N4237 | 3-36 | PWR5 |
| *2N4239 | 2N4239 | 2N4237 | 3-36 | PWR5 |
| 2N4240 | CF | | | |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| *2N4248 | 2N4248 | 2N4248 | 3-32 | SS33 |
| *2N4249 | 2N4249 | 2N4248 | 3-32 | SS33 |
| *2N4250 | 2N4250 | 2N4248 | 3-32 | SS33 |
| *2N4250A | 2N4250A | 2N4248 | 3-32 | SS33 |
| 2N4252 | 2N918 | 2N918 | | SS27 |
| 2N4253 | 2N918 | 2N918 | | SS27 |
| 2N4254 | 2N918 | 2N918 | | SS27 |
| 2N4255 | 2N918 | 2N918 | | SS27 |
| 2N4256 | 2N3904 | 2N3903 | | SS14 |
| 2N4257 | 2N4258 | 2N4258 | | SS31 |
| 2N4257A | 2N4258A | 2N4258 | | SS31 |
| *2N4258 | 2N4258 | 2N4258 | 3-19 | SS31 |
| *2N4258A | 2N4258A | 2N4258 | 3-19 | SS31 |
| *2N4264 | 2N4264 | 2N4264 | 3-18 | SS5 |
| *2N4265 | 2N4265 | 2N4264 | 3-18 | SS5 |
| 2N4269 | CF | | | |
| 2N4270 | 2N3923 | 2N3923 | | SS16 |
| 2N4271 | CF | | | |
| 2N4272 | CF | | | |
| *2N4274 | 2N4274 | 2N4274 | 3-18 | SS28 |
| *2N4275 | 2N4275 | 2N4274 | 3-18 | SS28 |
| 2N4284 | 2N5086 | 2N5086 | | SS33 |
| 2N4285 | 2N5086 | 2N5086 | | SS33 |
| 2N4286 | MPS6515 | MPS6512 | | SS14 |
| 2N4287 | MPS6566 | MPS6565 | | |
| 2N4288 | MPS6518 | MPS6516 | | SS23 |
| 2N4289 | 2N5086 | 2N5086 | | SS33 |
| 2N4290 | MPS6533M | MPS6533M | | SS22 |
| 2N4291 | MPS6534M | MPS6533M | | SS22 |
| 2N4292 | 2N5770 | 2N918 | | SS27 |
| 2N4293 | 2N5770 | 2N918 | | SS27 |
| 2N4294 | 2N5769 | 2N2369 | | SS28 |
| 2N4295 | 2N5769 | 2N2369 | | SS28 |
| 2N4296 | CF | | | |
| 2N4297 | CF | | | |
| 2N4298 | CF | | | |
| 2N4299 | CF | | | |
| 2N4300 | 2N5336 | 2N5336 | | PWR4 |
| 2N4302 | 2N5486 | 2N5484 | | |
| 2N4303 | 2N5486 | 2N5484 | | |
| 2N4304 | 2N5486 | 2N5484 | | |
| 2N4305 | 2N4895 | 2N4895 | | PWR1 |
| 2N4307 | 2N4895 | 2N4895 | | PWR1 |
| 2N4309 | 2N4897 | 2N4895 | | PWR1 |
| 2N4311 | 2N4895 | 2N4895 | 3-19 | PWR1 |
| 2N4313 | 2N4313 | | | |
| *2N4342 | 2N4342 | 2N4342 | 3-40 | SS34 |
| *2N4343 | 2N4343 | 2N4342 | 3-40 | SS34 |
| 2N4347 | CF | | | |
| 2N4348 | CF | | | |
| *2N4354 | 2N4354 | 2N4354 | 3-28 | SS24 |
| *2N4355 | 2N4355 | 2N4354 | 3-28 | SS24 |
| *2N4356 | 2N4356 | 2N4354 | 3-28 | SS24 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 2N4357 | CF | | | |
| 2N4358 | CF | | | |
| 2N4359 | 2N3964 | 2N3962 | | SS33 |
| *2N4360 | 2N4360 | 2N4342 | 3-40 | SS34 |
| 2N4387 | 2N4898 | 2N3740 | | |
| 2N4388 | 2N4899 | 2N3740 | | |
| 2N4389 | 2N4258 | 2N4258 | | SS31 |
| 2N4395 | 2N3715 | 2N3713 | | PWR6 |
| 2N4396 | 2N3715 | 2N3713 | | PWR6 |
| *2N4398 | 2N4398 | 2N4398 | 3-39 | |
| *2N4399 | 2N4399 | 2N4398 | 3-39 | |
| *2N4400 | 2N4400 | 2N4400 | 3-23 | SS15 |
| *2N4401 | 2N4401 | 2N4400 | 3-23 | SS15 |
| *2N4402 | 2N4402 | 2N4402 | 3-28 | SS22 |
| *2N4403 | 2N4403 | 2N4402 | 3-28 | SS22 |
| 2N4404 | 2N4031 | 2N4030 | | SS24 |
| 2N4405 | 2N4033 | 2N4030 | | SS24 |
| 2N4406 | 2N4031 | 2N4030 | | SS24 |
| 2N4407 | 2N4033 | 2N4030 | | SS24 |
| *2N4409 | 2N4409 | 2N4409 | 3-24 | SS16 |
| *2N4410 | 2N4410 | 2N4409 | 3-24 | SS16 |
| 2N4412 | 2N3962 | 2N3962 | | SS33 |
| 2N4412A | 2N3962 | 2N3962 | | SS33 |
| 2N4413 | 2N3962 | 2N3962 | | SS33 |
| 2N4413A | 2N3962 | 2N3962 | | SS33 |
| 2N4414 | 2N3962 | 2N3962 | | SS33 |
| 2N4414A | 2N3962 | 2N3962 | | SS33 |
| 2N4415 | 2N3962 | 2N3962 | | SS33 |
| 2N4415A | 2N3962 | 2N3962 | | SS33 |
| 2N4418 | 2N5772 | 2N3646 | | SS5 |
| 2N4419 | 2N5772 | 2N3646 | | SS5 |
| 2N4420 | 2N5772 | 2N3646 | | SS5 |
| 2N4421 | 2N5772 | 2N3646 | | SS5 |
| 2N4422 | 2N5772 | 2N3646 | | SS5 |
| 2N4423 | 2N5772 | 2N3646 | | SS5 |
| 2N4424 | MPS3711 | MPS3707 | | |
| 2N4425 | MPS3711 | MPS3707 | | |
| 2N4436 | 2N4400 | 2N4400 | | SS15 |
| 2N4437 | 2N4401 | 2N4400 | | SS15 |
| 2N4438 | CF | | | |
| 2N4439 | CF | | | |
| 2N4440 | CF | | | |
| 2N4449 | 2N2369A | 2N2369 | | SS28 |
| 2N4450 | 2N2222 | 2N2218 | | SS15 |
| 2N4451 | 2N2894 | 2N2894 | | SS30 |
| 2N4452 | 2N2907 | 2N2904 | | SS22 |
| 2N4453 | 2N3209 | 2N2894 | | SS30 |
| 2N4872 | 2N4208 | 2N4208 | | SS31 |
| 2N4873 | 2N2369A | 2N2369 | | SS28 |
| 2N4878 | 2N2979 | 2N2915 | | SS8 |
| 2N4879 | 2N2979 | 2N2975 | | SS8 |
| 2N4880 | 2N2979 | 2N2915 | | SS8 |
| *2N4888 | 2N4888 | 2N4888 | 3-34 | |
| *2N4889 | 2N4889 | 2N4888 | 3-34 | |
| 2N4890 | 2N2904 | 2N2904 | | SS22 |
| *2N4895 | 2N4895 | 2N4895 | 3-36 | PWR1 |
| *2N4896 | 2N4896 | 2N4895 | 3-36 | PWR1 |
| *2N4897 | 2N4897 | 2N4895 | 3-36 | PWR1 |
| *2N4898 | 2N4898 | 2N3740 | 3-37 | |
| *2N4899 | 2N4899 | 2N3740 | 3-37 | |
| *2N4900 | 2N4900 | 2N3740 | 3-37 | |
| *2N4901 | 2N4901 | 2N4901 | 3-39 | PWR15 |
| *2N4902 | 2N4902 | 2N4901 | 3-39 | PWR15 |
| *2N4903 | 2N4903 | 2N4901 | 3-39 | PWR15 |
| *2N4904 | 2N4904 | 2N4901 | 3-39 | PWR15 |
| *2N4905 | 2N4905 | 2N4901 | 3-39 | PWR15 |
| *2N4906 | 2N4906 | 2N4901 | 3-39 | PWR15 |
| *2N4907 | 2N4907 | 2N4901 | 3-39 | PWR15 |
| *2N4908 | 2N4908 | 2N4901 | 3-39 | PWR15 |
| *2N4909 | 2N4909 | 2N4901 | 3-39 | PWR15 |
| *2N4910 | 2N4910 | 2N4231 | 3-36 | PWR5 |
| *2N4911 | 2N4911 | 2N4231 | 3-36 | PWR5 |
| *2N4912 | 2N4912 | 2N4231 | 3-36 | PWR5 |
| *2N4913 | 2N4913 | 2N4913 | 3-39 | PWR6 |
| *2N4914 | 2N4914 | 2N4913 | 3-39 | PWR6 |
| *2N4915 | 2N4915 | 2N4913 | 3-39 | PWR6 |
| *2N4916 | 2N4916 | 2N4916 | 3-27 | |
| *2N4917 | 2N4917 | 2N4916 | 3-27 | |
| 2N4918 | 2N6124 | 2N6124 | | PWR14 |
| 2N4919 | 2N6125 | 2N6124 | | PWR14 |
| 2N4920 | 2N6126 | 2N6124 | | PWR14 |
| 2N4921 | 2N6121 | 2N6121 | | PWR5 |
| 2N4922 | 2N6122 | 2N6121 | | PWR5 |
| 2N4923 | 2N6123 | 2N6121 | | PWR5 |
| 2N4924 | CF | | | |
| 2N4925 | CF | | | |
| 2N4926 | 2N4926 | | 3-33 | |
| 2N4927 | 2N4927 | | 3-33 | |
| 2N4928 | CF | | | |
| 2N4929 | CF | | | |
| 2N4930 | CF | | | |
| 2N4931 | CF | | | |
| 2N4937 | MD3250A | MD3250 | | |
| 2N4938 | MD3250A | MF3250 | | |
| 2N4939 | MF3250 | MF3250 | | |
| 2N4940 | MD3250A | MF3250 | | |
| 2N4941 | MF3250A | MD3250 | | |
| 2N4942 | MF3250 | MF3250 | | |
| 2N4943 | 2N3019 | 2N3019 | | SS17 |
| 2N4944 | PN3567 | 2N3567 | | SS15 |
| 2N4945 | PN3568 | 2N3567 | | SS17 |
| 2N4946 | PN3569 | 2N3567 | | SS17 |
| 2N4951 | 2N2221 | 2N2218 | | SS15 |
| 2N4952 | 2N2222 | 2N2218 | | SS15 |
| 2N4953 | 2N2222 | 2N2218 | | SS15 |
| 2N4954 | 2N2221 | 2N2218 | | SS15 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 2N4955 | 2N2913 | 2N2913 | | SS8 |
| 2N4956 | 2N2918 | 2N2917 | | SS8 |
| *2N4960 | 2N4960 | 2N4960 | 3-20 | SS17 |
| *2N4961 | 2N4961 | 2N4960 | 3-21 | SS17 |
| *2N4962 | 2N4962 | 2N4960 | 3-21 | SS17 |
| *2N4963 | 2N4963 | 2N4960 | 3-21 | SS17 |
| 2N4964 | 2N4248 | 2N4248 | | SS33 |
| 2N4965 | 2N4249 | 2N4248 | | SS33 |
| 2N4966 | SE4001 | | | |
| 2N4967 | 2N3565 | 2N3565 | | SS8 |
| 2N4968 | SE4001 | | | |
| 2N4969 | 2N4400 | 2N4400 | | SS15 |
| 2N4970 | 2N4401 | 2N4400 | | SS15 |
| 2N4971 | 2N4402 | 2N4402 | | SS22 |
| 2N4972 | 2N4403 | 2N4402 | | SS22 |
| 2N4994 | MPS3693 | 2N3693 | | |
| 2N4995 | MPS3694 | 2N3693 | | |
| 2N4996 | CF | | | |
| 2N4997 | CF | | | |
| 2N4998 | 2N5002 | 2N5002 | | PWR19 |
| 2N4999 | 2N5003 | 2N5002 | | PWR11 |
| 2N5000 | 2N5004 | 2N5002 | | PWR19 |
| 2N5001 | 2N5005 | 2N5002 | | PWR11 |
| *2N5002 | 2N5002 | 2N5002 | 3-38 | PWR19 |
| *2N5003 | 2N5003 | 2N5002 | | PWR11 |
| *2N5004 | 2N5004 | 2N5002 | 3-38 | PWR19 |
| *2N5005 | 2N5005 | 2N5002 | 3-38 | PWR11 |
| 2N5006 | CF | | | |
| 2N5007 | CF | | | |
| 2N5008 | CF | | | |
| 2N5009 | CF | | | |
| *2N5022 | 2N5022 | 2N5022 | 3-19 | SS7 |
| *2N5023 | 2N5023 | 2N5022 | 3-19 | SS7 |
| 2N5033 | 2N5033 | | 3-40 | |
| 2N5034 | 2N5877 | 2N5877 | | PWR6 |
| 2N5035 | 2N5877 | 2N5877 | | PWR6 |
| 2N5036 | 2N5877 | 2N5877 | | PWR6 |
| 2N5037 | 2N5877 | 2N5877 | | PWR6 |
| 2N5040 | 2N4354 | 2N4354 | | SS24 |
| 2N5041 | 2N4354 | 2N4354 | | SS24 |
| 2N5042 | 2N4030 | 2N4030 | | SS24 |
| 2N5050 | CF | | | |
| 2N5051 | CF | | | |
| 2N5052 | CF | | | |
| 2N5055 | 2N4258 | 2N4258 | | SS31 |
| 2N5056 | 2N5056 | | 3-19 | SS32 |
| 2N5057 | 2N5057 | | 3-19 | SS32 |
| *2N5058 | 2N5058 | 2N5058 | 3-33 | SS11 |
| 2N5059 | 2N5059 | 2N5058 | 3-33 | SS11 |
| *2N5067 | 2N5067 | 2N5067 | 3-39 | PWR6 |
| *2N5068 | 2N5068 | 2N5067 | 3-39 | PWR6 |
| *2N5069 | 2N5069 | 2N5067 | 3-39 | PWR6 |
| 2N5073 | 2N5682 | 2N5679 | | PWR3 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 2N5083 | CF | | | |
| 2N5084 | CF | | | |
| 2N5085 | CF | | | |
| *2N5086 | 2N5086 | 2N5086 | 3-32 | SS33 |
| *2N5087 | 2N5087 | 2N5086 | 3-32 | SS33 |
| *2N5088 | 2N5088 | 2N5088 | 3-29 | |
| *2N5089 | 2N5089 | 2N5088 | 3-29 | |
| 2N5092 | 2N3449 | 2N3439 | | PWR8 |
| 2N5106 | 2N2219 | 2N2218 | | SS15 |
| 2N5107 | 2N2222 | 2N2218 | | SS15 |
| 2N5110 | 2N4234 | 2N4234 | | PWR14 |
| 2N5111 | 2N4236 | 2N4234 | | PWR14 |
| 2N5112 | 2N4234 | 2N4234 | | PWR14 |
| 2N5113 | 2N4236 | 2N4234 | | PWR14 |
| *2N5126 | 2N5126 | 2N5126 | 3-35 | SS1 |
| 2N5127 | 2N5127 | 2N3564 | 3-35 | |
| *2N5128 | 2N5128 | 2N5128 | 3-22 | SS15 |
| *2N5129 | 2N5129 | 2N5128 | 3-22 | SS15 |
| *2N5130 | 2N5130 | 2N5130 | 3-35 | SS27 |
| *2N5131 | 2N5131 | 2N5131 | 3-22 | |
| *2N5132 | 2N5132 | 2N5131 | 3-22 | |
| *2N5133 | 2N5133 | 2N5133 | 3-29 | SS8 |
| *2N5134 | 2N5134 | 2N5134 | 3-18 | SS28 |
| *2N5135 | 2N5135 | 2N5135 | 3-22 | SS15 |
| *2N5136 | 2N5136 | 2N5135 | 3-22 | SS15 |
| *2N5137 | 2N5137 | 2N5135 | | SS15 |
| *2N5138 | 2N5138 | 2N5138 | 3-32 | SS33 |
| *2N5139 | 2N5139 | 2N5139 | 3-27 | |
| 2N5140 | 2N3639 | 2N3639 | | SS31 |
| 2N5141 | 2N3639 | 2N3639 | | SS31 |
| *2N5142 | 2N5142 | 2N5142 | 3-27 | SS22 |
| *2N5143 | 2N5143 | 2N5142 | 3-27 | SS22 |
| 2N5144 | 2N4013 | 2N3724 | | SS13 |
| 2N5145 | 2N3724 | 2N3724 | | SS13 |
| 2N5146 | FQ3467 | FQ3467 | | SS7 |
| 2N5147 | 2N5679 | 2N5679 | | PWR13 |
| 2N5148 | 2N5681 | 2N5679 | | PWR3 |
| 2N5149 | 2N5679 | 2N5679 | | PWR13 |
| 2N5150 | 2N5681 | 2N5679 | | PWR3 |
| 2N5151 | CF | | | |
| 2N5152 | 2N5336 | 2N5336 | | PWR4 |
| 2N5153 | CF | | | |
| 2N5154 | 2N5337 | 2N5336 | | PWR4 |
| 2N5172 | MPS5172 | MPS5172 | | |
| 2N5174 | 2N4410 | 2N4409 | | SS16 |
| 2N5175 | 2N5830 | 2N5830 | | SS16 |
| 2N5176 | 2N5832 | 2N5830 | | SS16 |
| 2N5190 | 2N6121 | 2N6121 | | PWR5 |
| 2N5191 | 2N6122 | 2N6121 | | PWR5 |
| 2N5192 | 2N6123 | 2N6121 | | PWR5 |
| 2N5193 | 2N6124 | 2N6124 | | PWR14 |
| 2N5194 | 2N6125 | 2N6124 | | PWR14 |
| 2N5195 | 2N6126 | 2N6124 | | PWR14 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 2N5200 | CF | | | |
| 2N5201 | CF | | | |
| 2N5202 | CF | | | |
| 2N5208 | PE5030B | PE5029 | | SS12 |
| *2N5209 | 2N5209 | 2N5209 | 3-30 | |
| *2N5210 | 2N5210 | 2N5209 | 3-30 | |
| *2N5219 | 2N5219 | 2N5219 | 3-22 | |
| *2N5220 | 2N5220 | 2N5220 | 3-22 | SS15 |
| *2N5221 | 2N5221 | 2N5220 | 3-27 | SS8 |
| 2N5222 | CF | | | |
| *2N5223 | 2N5223 | 2N5219 | 3-22 | |
| *2N5224 | 2N5224 | 2N5224 | 3-18 | SS5 |
| *2N5225 | 2N5225 | 2N5225 | 3-22 | SS15 |
| *2N5226 | 2N5226 | 2N5225 | 3-27 | SS22 |
| *2N5227 | 2N5227 | 2N5227 | 3-27 | |
| *2N5228 | 2N5228 | 2N5228 | 3-19 | SS31 |
| 2N5232 | 2N5210 | 2N5209 | | |
| 2N5232A | 2N5210 | 2N5209 | | |
| 2N5233 | 2N5961 | 2N5961 | | SS8 |
| 2N5234 | 2N5210 | 2N5209 | | |
| 2N5235 | 2N5962 | 2N5961 | | SS8 |
| 2N5236 | 2N3137 | 2N3137 | | SS2 |
| 2N5237 | 2N5337 | 2N5336 | | PWR4 |
| 2N5239 | CF | | | |
| 2N5240 | CF | | | |
| 2N5241 | CF | | | |
| 2N5244 | 2N4035 | 2N4034 | | |
| 2N5245 | 2N5485 | 2N5484 | | |
| 2N5246 | 2N5485 | 2N5484 | | |
| 2N5247 | 2N5486 | 2N5484 | | |
| 2N5249 | 2N5962 | 2N5961 | | SS8 |
| 2N5249A | 2N5962 | 2N5961 | | SS8 |
| 2N5252 | CF | | | |
| 2N5253 | CF | | | |
| 2N5254 | 2N4019 | 2N4017 | | SS33 |
| 2N5255 | 2N4020 | 2N4020 | | SS33 |
| 2N5256 | 2N4034 | 2N4020 | | SS33 |
| 2N5279 | 2N3439 | 2N3439 | | PWR8 |
| 2N5280 | CF | | | |
| 2N5292 | 2N2894A | 2N2894 | | SS32 |
| 2N5293 | 2N6122 | 2N6121 | | PWR5 |
| 2N5294 | 2N6122 | 2N6121 | | PWR5 |
| 2N5295 | 2N6122 | 2N6121 | | PWR5 |
| 2N5296 | 2N6122 | 2N6121 | | PWR5 |
| 2N5297 | 2N6123 | 2N6121 | | PWR5 |
| 2N5298 | 2N6123 | 2N6121 | | PWR5 |
| *2N5301 | 2N5301 | 2N5301 | 3-39 | PWR7 |
| *2N5302 | 2N5302 | 2N5301 | 3-39 | PWR7 |
| *2N5303 | 2N5303 | 2N5301 | 3-39 | PWR7 |
| 2N5305 | MPSA13 | MPSA13 | | |
| 2N5306 | MPSA14 | MPSA13 | | |
| 2N5306A | MPSA14 | MPSA13 | | |
| 2N5307 | MPSA13 | MPSA13 | | |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 2N5308 | MPSA14 | MPSA13 | | |
| 2N5308A | MPSA14 | MPSA13 | | |
| 2N5309 | 2N5209 | 2N5209 | | |
| 2N5310 | 2N5209 | 2N5209 | | |
| 2N5311 | 2N5210 | 2N5209 | | |
| *2N5320 | 2N5320 | 2N5320 | | PWR2 |
| *2N5321 | 2N5322 | 2N5320 | | PWR12 |
| *2N5322 | 2N5322 | 2N5320 | | PWR12 |
| *2N5323 | 2N5323 | 2N5320 | | PWR12 |
| 2N5333 | CF | | | |
| *2N5334 | 2N5335 | 2N4895 | | PWR1 |
| *2N5335 | 2N5335 | 2N4895 | | PWR1 |
| *2N5336 | 2N5336 | 2N5336 | | PWR4 |
| *2N5337 | 2N5337 | 2N5336 | | PWR4 |
| *2N5338 | 2N5338 | 2N5336 | | PWR4 |
| *2N5339 | 2N5339 | 2N5336 | | PWR4 |
| 2N5346 | 2N5002 | 2N5002 | | PWR19 |
| 2N5347 | 2N5002 | 2N5002 | | PWR19 |
| 2N5354 | MPS3638 | 2N3638 | | SS22 |
| 2N5355 | MPS3638A | 2N3638 | | SS22 |
| 2N5356 | CF | | | |
| 2N5365 | PN3644 | 2N3644 | | SS22 |
| 2N5366 | PN3644 | 2N3644 | | SS22 |
| 2N5367 | CF | | | |
| 2N5368 | 2N4400 | 2N4400 | | SS15 |
| 2N5369 | 2N4401 | 2N4401 | | SS15 |
| 2N5370 | PN3566 | 2N3566 | | SS15 |
| 2N5371 | 2N4400 | 2N4400 | | SS15 |
| 2N5372 | 2N4402 | 2N4402 | | SS22 |
| 2N5373 | 2N4403 | 2N4402 | | SS22 |
| 2N5374 | CF | | | |
| 2N5375 | 2N4402 | 2N4402 | | SS22 |
| 2N5376 | 2N5961 | 2N5961 | | SS8 |
| 2N5377 | 2N5961 | 2N5961 | | SS8 |
| 2N5378 | PN4249 | 2N4248 | | SS33 |
| 2N5379 | PN4248 | 2N4248 | | SS33 |
| 2N5380 | 2N3903 | 2N3903 | | SS14 |
| 2N5381 | 2N3904 | 2N3903 | | SS14 |
| 2N5382 | 2N3905 | 2N3905 | | SS23 |
| 2N5383 | 2N3906 | 2N3905 | | SS23 |
| 2N5384 | 2N5003 | 2N5002 | | PWR11 |
| 2N5385 | 2N5003 | 2N5002 | | PWR11 |
| 2N5390 | CF | | | |
| *2N5400 | 2N5400 | 2N5400 | 3-34 | SS25 |
| *2N5401 | 2N5401 | 2N5400 | 3-34 | SS25 |
| 2N5404 | CF | | | |
| 2N5405 | CF | | | |
| 2N5406 | CF | | | |
| 2N5407 | CF | | | |
| 2N5408 | 2N5003 | 2N5002 | | PWR11 |
| 2N5409 | 2N5003 | 2N5002 | | PWR11 |
| 2N5410 | 2N5003 | 2N5002 | | PWR11 |
| 2N5411 | 2N5003 | 2N5002 | | PWR11 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 2N5414 | CF | | | |
| 2N5418 | 2N4400 | 2N4400 | | SS15 |
| 2N5419 | 2N4401 | 2N4400 | | SS15 |
| 2N5420 | PN3566 | 2N3566 | | SS15 |
| 2N5425 | CF | | | |
| 2N5426 | CF | | | |
| 2N5427 | CF | | | |
| 2N5428 | CF | | | |
| 2N5429 | CF | | | |
| 2N5430 | CF | | | |
| 2N5447 | MPS3702 | MPS3702 | | |
| 2N5448 | MPS3703 | MPS3702 | | |
| 2N5449 | MPS3704 | MPS3704 | | |
| 2N5450 | MPS3705 | MPS3704 | | |
| 2N5451 | MPS3706 | MPS3704 | | |
| *2N5455 | 2N5455 | 2N5455 | 3-19 | SS21 |
| *2N5456 | 2N5456 | 2N5455 | 3-19 | SS21 |
| *2N5457 | 2N5457 | 2N5457 | 3-40 | |
| *2N5458 | 2N5458 | 2N5457 | 3-40 | |
| *2N5459 | 2N5459 | 2N5457 | 3-40 | |
| 2N5460 | CF | | | |
| 2N5461 | CF | | | |
| 2N5462 | CF | | | |
| 2N5463 | CF | | | |
| 2N5464 | CF | | | |
| 2N5465 | CF | | | |
| 2N5466 | CF | | | |
| 2N5467 | CF | | | |
| 2N5468 | SE9052 | 2N6233 | | PWR9 |
| 2N5469 | SE9052 | 2N6233 | | PWR9 |
| 2N5477 | 2N5002 | 2N5002 | | PWR19 |
| 2N5478 | 2N5004 | 2N5002 | | PWR19 |
| *2N5484 | 2N5484 | 2N5484 | 3-40 | |
| *2N5485 | 2N5485 | 2N5484 | 3-40 | |
| *2N5486 | 2N5486 | 2N5484 | 3-40 | |
| 2N5490 | 2N6122 | 2N6121 | | PWR5 |
| 2N5491 | 2N6122 | 2N6121 | | PWR5 |
| 2N5492 | 2N6130 | 2N6129 | | PWR10 |
| 2N5493 | 2N6130 | 2N6129 | | PWR10 |
| 2N5494 | 2N6129 | 2N6129 | | PWR10 |
| 2N5495 | 2N6129 | 2N6129 | | PWR10 |
| 2N5496 | 2N6131 | 2N6129 | | PWR10 |
| 2N5497 | 2N6131 | 2N6129 | | PWR10 |
| *2N5550 | 2N5550 | 2N5550 | | SS16 |
| 2N5551 | MPS5551M | 2N5550 | | SS16 |
| 2N5629 | CF | | | |
| 2N5630 | CF | | | |
| 2N5631 | CF | | | |
| 2N5632 | CF | | | |
| 2N5633 | CF | | | |
| 2N5634 | CF | | | |
| 2N5655 | CF | | | |
| 2N5656 | CF | | | |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 2N5657 | CF | | | |
| 2N5658 | 2N5004 | 2N5002 | | PWR19 |
| 2N5660 | 2N6233 | 2N6233 | | PWR9 |
| 2N5661 | 2N6234 | 2N6233 | | PWR9 |
| 2N5664 | 2N6233 | 2N6233 | | PWR9 |
| 2N5665 | 2N6234 | 2N6233 | | PWR9 |
| *2N5668 | 2N5668 | 2N5668 | | |
| *2N5669 | 2N5669 | 2N5668 | | |
| *2N5670 | 2N5670 | 2N5668 | | |
| 2N5675 | 2N5679 | 2N5679 | PWR13 | |
| *2N5679 | 2N5679 | 2N5679 | | PWR13 |
| *2N5680 | 2N5680 | 2N5679 | | PWR13 |
| *2N5681 | 2N5681 | 2N5679 | | PWR3 |
| *2N5682 | 2N5682 | 2N5679 | | PWR3 |
| 2N5729 | 2N5336 | 2N5336 | | PWR4 |
| 2N5730 | 2N5002 | 2N5002 | | PWR19 |
| 2N5737 | 2N3791 | 2N3789 | | PWR15 |
| 2N5738 | 2N3792 | 2N3789 | | PWR15 |
| 2N5741 | 2N4399 | 2N4398 | | PWR16 |
| 2N5745 | CF | | | |
| 2N5758 | CF | | | |
| 2N5759 | CF | | | |
| 2N5760 | CF | | | |
| 2N5763 | 2N2907A | 2N2904 | | SS22 |
| 2N5769 | 2N5769 | 2N2369 | 3-18 | SS28 |
| *2N5770 | 2N5770 | 2N918 | 3-35 | SS27 |
| *2N5771 | 2N5771 | 2N5771 | 3-19 | SS31 |
| *2N5772 | 2N5772 | 2N3646 | 3-18 | SS5 |
| 2N5781 | 2N4234 | 2N4234 | | PWR14 |
| 2N5782 | 2N4235 | 2N4235 | | PWR14 |
| 2N5783 | 2N4236 | 2N4234 | | PWR14 |
| 2N5784 | 2N4237 | 2N4237 | | PWR5 |
| 2N5785 | 2N4238 | 2N4237 | | PWR5 |
| 2N5786 | 2N4239 | 2N4237 | | PWR5 |
| 2N5793 | MD2218A | MD2218 | | |
| 2N5794 | MD2219A | MD2218 | | |
| 2N5795 | MD2904A | MD2904 | | |
| 2N5796 | MD2905A | MD2904 | | |
| 2N5804 | CF | | | |
| 2N5805 | CF | | | |
| 2N5810 | MPS6561 | MPS6560 | | SS15 |
| 2N5811 | MPS6563 | MPS6560 | | SS22 |
| 2N5812 | CF | | | |
| 2N5813 | CF | | | |
| 2N5814 | CF | | | |
| 2N5815 | CF | | | |
| 2N5816 | CF | | | |
| 2N5817 | CF | | | |
| 2N5818 | CF | | | |
| 2N5819 | CF | | | |
| 2N5820 | PN5856 | 2N5855 | | SS17 |
| 2N5821 | PN5855 | 2N5855 | | SS24 |
| 2N5822 | PE6020 | PE6020 | | SS17 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 2N5823 | MPS4355 | 2N4354 | | SS24 |
| 2N5824 | MPS6512 | MPS6512 | | SS14 |
| 2N5825 | MPS6513 | MPS6512 | | SS14 |
| 2N5826 | MPS6514 | MPS6512 | | SS14 |
| 2N5827 | MPS6515 | MPS6512 | | SS14 |
| 2N5828 | 2N5962 | 2N5961 | | SS8 |
| *2N5830 | 2N5830 | 2N5830 | 3-37 | SS16 |
| *2N5831 | 2N5831 | 2N5830 | 3-33 | SS16 |
| *2N5832 | 2N5832 | 2N5830 | 3-33 | SS16 |
| *2N5833 | 2N5833 | 2N5830 | 3-33 | SS16 |
| 2N5838 | CF | | | |
| 2N5839 | CF | | | |
| 2N5840 | CF | | | |
| *2N5845 | 2N5845 | 2N5845 | 3-18 | SS13 |
| *2N5845A | 2N5845A | 2N5845 | 3-18 | SS13 |
| *2N5855 | 2N5855 | 2N5855 | 3-28 | SS24 |
| *2N5856 | 2N5856 | 2N5855 | 3-24 | SS17 |
| *2N5857 | 2N5857 | 2N5855 | 3-28 | SS24 |
| *2N5858 | 2N5858 | 2N5855 | 3-24 | SS17 |
| 2N5859 | 2N3724 | 2N3724 | | SS13 |
| 2N5860 | 2N3724 | 2N3724 | | SS13 |
| 2N5861 | 2N3725 | 2N3724 | | SS13 |
| 2N5864 | 2N4031 | 2N4030 | | SS24 |
| 2N5865 | 2N4030 | 2N4030 | | SS24 |
| 2N5867 | 2N4908 | 2N4901 | | PWR15 |
| 2N5868 | 2N4909 | 2N4901 | | PWR15 |
| 2N5869 | 2N4914 | 2N4913 | | PWR6 |
| 2N5870 | 2N4915 | 2N4913 | | PWR6 |
| *2N5871 | 2N5871 | 2N5871 | | PWR15 |
| *2N5872 | 2N5872 | 2N5871 | | PWR15 |
| *2N5873 | 2N5873 | 2N5873 | | PWR6 |
| *2N5874 | 2N5874 | 2N5873 | | PWR6 |
| *2N5875 | 2N5875 | 2N5875 | | PWR15 |
| *2N5876 | 2N5876 | 2N5875 | | PWR15 |
| *2N5877 | 2N5877 | 2N5877 | | PWR6 |
| *2N5878 | 2N5878 | 2N5877 | | PWR6 |
| *2N5879 | 2N5879 | 2N5879 | | PWR16 |
| *2N5880 | 2N5880 | 2N5879 | | PWR16 |
| *2N5881 | 2N5881 | 2N5881 | | PWR7 |
| *2N5882 | 2N5882 | 2N5881 | | PWR7 |
| *2N5883 | 2N5883 | 2N5883 | | PWR16 |
| *2N5884 | 2N5884 | 2N5883 | | PWR16 |
| *2N5885 | 2N5885 | 2N5885 | | PWR7 |
| *2N5886 | 2N5886 | 2N5885 | | PWR7 |
| *2N5910 | 2N5910 | 2N5771 | 3-19 | SS31 |
| 2N5939 | 2N5004 | 2N5002 | | PWR19 |
| 2N5940 | 2N5004 | 2N5002 | | PWR19 |
| 2N5954 | 2N4900 | 2N3740 | | PWR14 |
| 2N5955 | 2N4899 | 2N3740 | | PWR14 |
| 2N5956 | 2N4898 | 2N3740 | | PWR14 |
| *2N5961 | 2N5961 | 2N5961 | 3-30 | SS8 |
| *2N5962 | 2N5962 | 2N5961 | 3-30 | SS8 |
| *2N5963 | 2N5963 | 2N5961 | 3-29 | SS8 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 2N5964 | PN5964 | PN5964 | | SS16 |
| 2N5965 | PN5965 | PN5965 | | SS16 |
| 2N5970 | 2N5302 | 2N5301 | | PWR7 |
| 2N5971 | 2N5302 | 2N5301 | | PWR7 |
| 2N5972 | 2N5302 | 2N5301 | | PWR7 |
| 2N5973 | 2N3714 | 2N3713 | | PWR6 |
| 2N5975 | 2N6132 | 2N6132 | | PWR17 |
| 2N5976 | 2N6132 | 2N6132 | | PWR17 |
| 2N5977 | 2N6129 | 2N6129 | | PWR10 |
| 2N5978 | 2N6129 | 2N6129 | | PWR10 |
| 2N5979 | 2N6129 | 2N6129 | | PWR10 |
| 2N5980 | CF | | | |
| 2N5981 | CF | | | |
| 2N5982 | CF | | | |
| 2N5983 | CF | | | |
| 2N5984 | CF | | | |
| 2N5985 | CF | | | |
| 2N5986 | CF | | | |
| 2N5987 | CF | | | |
| 2N5988 | CF | | | |
| 2N5989 | CF | | | |
| 2N5990 | CF | | | |
| 2N5991 | CF | | | |
| 2N5998 | 2N5961 | 2N5961 | | SS8 |
| 2N5999 | 2N5087 | 2N5086 | | SS33 |
| 2N6000 | 2N4401 | 2N4400 | | SS15 |
| 2N6001 | 2N4402 | 2N4402 | | SS22 |
| 2N6002 | CF | | | |
| 2N6003 | CF | | | |
| 2N6004 | 2N4401 | 2N4400 | | SS15 |
| 2N6005 | 2N4402 | 2N4402 | | SS22 |
| 2N6006 | CF | | | |
| 2N6007 | CF | | | |
| 2N6008 | 2N5961 | 2N5961 | | SS8 |
| 2N6009 | 2N5087 | 2N5086 | | SS33 |
| 2N6010 | 2N4401 | 2N4400 | | SS15 |
| 2N6011 | 2N4402 | 2N4402 | | SS22 |
| 2N6012 | CF | | | |
| 2N6013 | CF | | | |
| 2N6014 | CF | | | |
| 2N6015 | CF | | | |
| 2N6016 | CF | | | |
| 2N6017 | CF | | | |
| 2N6049 | 2N4899 | 2N3740 | | PWR14 |
| 2N6050 | CF | | | |
| 2N6051 | CF | | | |
| 2N6052 | CF | | | |
| 2N6053 | CF | | | |
| 2N6054 | CF | | | |
| 2N6055 | CF | | | |
| 2N6056 | CF | | | |
| 2N6057 | CF | | | |
| 2N6058 | CF | | | |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 2N6059 | CF | | | |
| 2N6067 | CF | | | |
| 2N6076 | MPS5172 | MPS5172 | | |
| 2N6077 | SE9051 | 2N6233 | | PWR9 |
| 2N6078 | SE9051 | 2N5133 | | PWR9 |
| 2N6079 | SE9052 | 2N6233 | | PWR9 |
| 2N6098 | CF | | | |
| 2N6099 | CF | | | |
| 2N6100 | CF | | | |
| 2N6101 | CF | | | |
| 2N6102 | CF | | | |
| 2N6103 | CF | | | |
| 2N6106 | 2N6126 | 2N6124 | | PWR14 |
| 2N6107 | 2N6126 | 2N6124 | | PWR14 |
| 2N6108 | 2N6132 | 2N6132 | | PWR17 |
| 2N6109 | 2N6132 | 2N6132 | | PWR17 |
| 2N6110 | 2N6132 | 2N6132 | | PWR17 |
| 2N6111 | 2N6132 | 2N6132 | | PWR17 |
| *2N6121 | 2N6121 | 2N6121 | 3-37 | PWR5 |
| *2N6122 | 2N6122 | 2N6121 | 3-37 | PWR5 |
| *2N6123 | 2N6123 | 2N6121 | 3-37 | PWR5 |
| *2N6124 | 2N6124 | 2N6124 | 3-37 | PWR14 |
| *2N6125 | 2N6125 | 2N6124 | 3-37 | PWR14 |
| *2N6126 | 2N6126 | 2N6124 | 3-37 | PWR14 |
| *2N6129 | 2N6129 | 2N6129 | 3-37 | PWR10 |
| *2N6130 | 2N6130 | 2N6130 | 3-37 | PWR10 |
| *2N6131 | 2N6131 | 2N6131 | 3-37 | PWR10 |
| *2N6132 | 2N6132 | 2N6132 | 3-37 | PWR17 |
| *2N6133 | 2N6133 | 2N6133 | 3-37 | PWR17 |
| *2N6134 | 2N6134 | 2N6134 | 3-37 | PWR17 |
| 2N6175 | 2N3440 | 2N3439 | | PWR8 |
| 2N6176 | 2N3439 | 2N3439 | | PWR8 |
| 2N6177 | 2N3439 | 2N3439 | | PWR8 |
| 2N6182 | 2N5003 | 2N5002 | | PWR11 |
| 2N6183 | 2N5005 | 2N5002 | | PWR11 |
| 2N6184 | 2N5003 | 2N5002 | | PWR11 |
| 2N6185 | 2N5005 | 2N5002 | | PWR11 |
| 2N6218 | CF | | | |
| 2N6219 | CF | | | |
| 2N6220 | CF | | | |
| 2N6221 | 2N5831 | 2N5830 | | SS16 |
| 2N6222 | PE6020 | PE6020 | | SS17 |
| 2N6223 | PN3645 | 2N3645 | | SS22 |
| 2N6224 | 2N5962 | 2N5961 | | SS8 |
| 2N6225 | PN4250A | 2N4248 | | SS33 |
| *2N6233 | 2N6233 | 2N6233 | 3-36 | PWR9 |
| *2N6234 | 2N6234 | 2N6233 | 3-36 | PWR9 |
| *2N6235 | 2N6235 | 2N6233 | 3-36 | PWR9 |

| Industry Type Number | Recommended Fairchild Device | Data Sheet | Short Form Data | Family Characteristics |
|---|---|---|---|---|
| 2N6246 | 2N3791 | 2N3789 | | PWR15 |
| 2N6247 | 2N3792 | 2N3789 | | PWR15 |
| 2N6249 | CF | | | |
| 2N6250 | CF | | | |
| 2N6251 | CF | | | |
| 2N6253 | CF | | | |
| 2N6254 | 2N5882 | 2N5881 | | PWR7 |
| 2N6257 | 2N5882 | 2N5881 | | PWR7 |
| 2N6258 | 2N5303 | 2N5301 | | PWR7 |
| 2N6260 | 2N4231 | 2N4231 | | |
| 2N6261 | 2N4233 | 2N4231 | | |
| 2N6263 | 2N6233 | 2N6233 | | PWR9 |
| 2N6264 | 2N6233 | 2N6233 | | PWR9 |
| 2N6282 | CF | | | |
| 2N6283 | CF | | | |
| 2N6284 | CF | | | |
| 2N6285 | CF | | | |
| 2N6286 | CF | | | |
| 2N6287 | CF | | | |
| 2N6294 | CF | | | |
| 2N6295 | CF | | | |
| 2N6296 | CF | | | |
| 2N6297 | CF | | | |
| 2N6298 | CF | | | |
| 2N6299 | CF | | | |
| 2N6300 | CF | | | |
| 2N6301 | CF | | | |
| 2N6303 | CF | | | |
| 2N6306 | CF | | | |
| 2N6307 | CF | | | |
| 2N6308 | CF | | | |
| 2N6312 | CF | | | |
| 2N6313 | CF | | | |
| 2N6314 | CF | | | |
| 2N6315 | CF | | | |
| 2N6316 | CF | | | |
| 2N6317 | CF | | | |
| 2N6318 | CF | | | |
| 2N6326 | 2N5881 | 2N5881 | | PWR7 |
| 2N6327 | 2N5882 | 2N5881 | | PWR7 |
| 2N6328 | CF | | | |
| 2N6329 | 2N3791 | 2N3789 | | PWR15 |
| 2N6330 | 2N3792 | 2N3789 | | PWR15 |
| 2N6331 | CF | | | |
| 2N6338 | CF | | | |
| 2N6339 | CF | | | |
| 2N6340 | CF | | | |
| 2N6341 | CF | | | |

2

# DISCRETE PRODUCTS

## CONTENTS AND SECTION SELECTOR

# INTRODUCTION

## SELECTION GUIDE BY APPLICATION AND SHORT FORM DATA LISTING

The arrangement of this section makes it more than a simple short form listing of Fairchild's Discrete semiconductor product line. Each major division is an application category and each subdivision is a secondary categorization of a key parametric value. In some instances, the crossover from one subdivision to another is somewhat arbitrary since definition varies with manufacturer. To aid the user in locating the desired device type, a short definition of each grouping is shown below and a cross reference statement has been included in some of the subsections.

There are two major groups of registered devices, those which have been registered in the U.S. with JEDEC, and those which have been registered in Europe with Association International PRO-ELECTRON. The JEDEC devices included are all devices which are prefixed 1N or 2N. The PRO-ELECTRON devices are all preceded by a two or three character alpha prefix. Since many of the device types contained in the data listing have multiple letter prefixes, the PRO-ELECTRON devices have been included in boldface type.

1. Diodes (Pages 3 through 16)

   All single and multiple diodes including assemblies, monolithic diode arrays, unencapsulated diodes (dice) and rectifiers.

2. Small Signal Transistors

   a. High Speed Saturated Switches (Pages 17 through 19)

      Logic Switches and Core Driver Transistors manufactured with specific diffusion processes to control majority carrier lifetimes. Storage times are generally less than 100 ns.

   b. General Purpose Amplifiers and Switches (Pages 20 through 28)

      Suitable for a wide variety of switching and amplifier applications. Collector to emitter voltages are less than 100 V, switching times are generally less than 1.0 μs and specification currents range from 100 μA to 1.0 A.

   c. Low Level, Low Noise Amplifiers (Pages 29 through 32)

      Designed to be used as front end Audio Amplifiers with operation in the 10 μA to 2.0 mA current range.

   d. High Voltage Amplifiers (Pages 33 and 34)

      Collector to emitter voltages greater than 100 V, current handling capabilities in the 10 mA area. There is a definite overlap between this section and the TO5 Power section.

   e. RF Amplifiers and Oscillators (Pages 34 and 35)

      Power gain, oscillator power out and/or noise figure specifications at frequencies above 25 MHz.

3. Power Transistors (Pages 36 through 39)

   Normal operating current ranges above 1.0 A and/or power dissipation capability of 1.0 W or more. There is a definite overlap with small signal transistors at 1.0 A and 1.0 W (see small Signal General Purpose Amplifiers and High Voltage sections).

4. Field Effect Transistors (Page 40)

   Junction and MOS Field Effect Transistors.

5. Multiple Transistors (Pages 41 through 44)

   Matched and unmatched dual transistors, including complementary duals, quad core driver transistors and Darlington transistors.

6. Unencapsulated Transistors (Page 45)

   Transistor dice.

NOTE:

Use of well specified devices, while normally somewhat higher in cost, can virtually eliminate the multiple sourcing technique, not only by Fairchild, but any manufacturer, since the more stringent the specifications, the less latitude permitted in the manufacturing process.

## COMPUTER DIODES (BY ASCENDING $t_{rr}$) GLASS PACKAGE

| TYPE | $t_{rr}$ ns MAX | $B_V$ VOLTS MIN | nA MAX | $I_R$ @ @ | $V_R$ VOLTS | VOLTS MAX | $V_F$ @ @ | $I_F$ mA | C pF MAX | Package | Package Equivalent DO7/DO35 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FD700 | 0.70 | 30 | 50 | @ | 15 | 1.1 | @ | 50 | 75 | DO7 | |
| **BAY82** | 0.75 | 12 | 100 | @ | 12 | 1.0 | @ | 20 | 1.3 | DO7 | |
| 1N4244 | 0.75 | 20 | 100 | @ | 10 | 1.0 | @ | 20 | 0.8 | DO7 | |
| 1N4376 | 0.75 | 20 | 100 | @ | 10 | 1.1 | @ | 50 | 1.0 | DO7 | |
| FD777 | 0.75 | 15 | 100 | @ | 8.0 | 1.0 | @ | 20 | 1.3 | DO7 | |
| 1N5282 | 2.0 | 80 | 100 | @ | 55 | 1.3 | @ | 500 | 2.5 | DO35 | |
| 1N5317 | 2.0 | 80 | 100 | @ | 55 | 0.90 | @ | 100 | 2.5 | DO34 | 1N5282 |
| 1N3606 | 2.0 | 75 | 50 | @ | 50 | 0.88 | @ | 20 | 2.0 | DO7 | 1N4153 |
| 1N4153 | 2.0 | 75 | 50 | @ | 50 | 0.88 | @ | 20 | 2.0 | DO35 | 1N3606 |
| 1N4534 | 2.0 | 75 | 50 | @ | 50 | 0.88 | @ | 20 | 2.0 | DO34 | 1N4153 |
| 1N3062 | 2.0 | 75 | 100 | @ | 50 | 1.0 | @ | 20 | 1.0 | DO7 | |
| 1N3066 | 2.0 | 75 | 100 | @ | 50 | 1.0 | @ | 10 | 1.0 | DO7 | |
| 1N3605 | 2.0 | 40 | 50 | @ | 30 | 0.88 | @ | 20 | 2.0 | DO7 | 1N4152 |
| 1N4152 | 2.0 | 40 | 50 | @ | 30 | 0.88 | @ | 20 | 2.0 | DO35 | 1N3605 |
| 1N4533 | 2.0 | 40 | 50 | @ | 30 | 0.88 | @ | 20 | 2.0 | DO34 | 1N4152 |
| 1N4087 | 2.5 | 50 | 90 | @ | 50 | 0.975 | @ | 30 | 1.8 | DO35 | |
| 1N3600 | 3.0 | 75 | 100 | @ | 50 | 1.0 | @ | 200 | 2.5 | DO7 | 1N4150 |
| **BAX13** | 4.0 | 50 | 200 | @ | 50 | 1.0 | @ | 20 | 3.0 | DO35 | |
| **BAY71** | 4.0 | 50 | 100 | @ | 35 | 1.0 | @ | 20 | 2.0 | DO35 | 1N3603 |
| **BAY74** | 4.0 | 50 | 100 | @ | 35 | 1.1 | @ | 300 | 3.0 | DO35 | 1N3600 |
| 1N914 | 4.0 | 100 | 25 | @ | 20 | 1.0 | @ | 10 | 4.0 | DO7 | 1N4148 |
| 1N914A | 4.0 | 100 | 25 | @ | 20 | 1.0 | @ | 20 | 4.0 | DO7 | 1N4446 |
| 1N914B | 4.0 | 100 | 25 | @ | 20 | 1.0 | @ | 100 | 4.0 | DO7 | 1N4448 |
| 1N916 | 4.0 | 100 | 25 | @ | 20 | 1.0 | @ | 10 | 2.0 | DO7 | 1N4149 |
| 1N916A | 4.0 | 100 | 25 | @ | 20 | 1.0 | @ | 20 | 2.0 | DO7 | 1N4447 |
| 1N916B | 4.0 | 100 | 25 | @ | 20 | 1.0 | @ | 30 | 2.0 | DO7 | 1N4449 |
| 1N4148 | 4.0 | 100 | 25 | @ | 20 | 1.0 | @ | 10 | 4.0 | DO35 | 1N914 |
| 1N4149 | 4.0 | 100 | 25 | @ | 20 | 1.0 | @ | 10 | 2.0 | DO35 | 1N916 |
| 1N4446 | 4.0 | 100 | 25 | @ | 20 | 1.0 | @ | 20 | 4.0 | DO35 | 1N914A |
| 1N4447 | 4.0 | 100 | 25 | @ | 20 | 1.0 | @ | 20 | 2.0 | DO35 | 1N916A |
| 1N4448 | 4.0 | 100 | 25 | @ | 20 | 1.0 | @ | 100 | 4.0 | DO35 | 1N914B |
| 1N4449 | 4.0 | 100 | 25 | @ | 20 | 1.0 | @ | 30 | 2.0 | DO35 | 1N916B |
| 1N4531 | 4.0 | 100 | 25 | @ | 20 | 1.0 | @ | 10 | 4.0 | DO34 | 1N4148 |
| 1N4606 | 4.0 | 85 | 250 | @ | 70 | 1.10 | @ | 250 | 2.5 | DO35 | |
| 1N4610 | 4.0 | 80 | 100 | @ | 55 | 1.0 | @ | 200 | 2.0 | DO7 | |
| 1N3604 | 4.0 | 75 | 50 | @ | 50 | 1.0 | @ | 50 | 2.0 | DO7 | 1N4151 |
| 1N4151 | 4.0 | 75 | 50 | @ | 50 | 1.0 | @ | 50 | 2.0 | DO35 | 1N3604 |
| FD600 | 4.0 | 75 | 100 | @ | 50 | 1.0 | @ | 200 | 2.5 | DO7 | FDH600 |
| FDH600 | 4.0 | 75 | 100 | @ | 50 | 1.0 | @ | 200 | 2.5 | DO35 | FD600 |
| FDN600 | 4.0 | 75 | 100 | @ | 50 | 1.0 | @ | 200 | 2.5 | DO34 | FDH600 |
| 1N3063 | 4.0 | 75 | 100 | @ | 50 | 0.85 | @ | 10 | 2.0 | DO7 | 1N4305 |
| **1N3064** | 4.0 | 75 | 100 | @ | 50 | 1.0 | @ | 10 | 2.0 | DO7 | 1N4454 |
| 1N3065 | 4.0 | 75 | 100 | @ | 50 | 1.0 | @ | 20 | 1.5 | DO7 | |
| 1N4086 | 4.0 | | 250 | @ | 70 | 1.0 | @ | 200 | 10 | DO7 | |
| 1N4150 | 4.0 | 75 | 100 | @ | 50 | 1.0 | @ | 200 | 2.5 | DO35 | 1N3600 |
| 1N4305 | 4.0 | 75 | 100 | @ | 50 | 0.85 | @ | 10 | 2.0 | DO35 | 1N3063 |

## COMPUTER DIODES (BY ASCENDING $t_{rr}$)
## GLASS PACKAGE (Cont'd)

| TYPE | $t_{rr}$ ns MAX | $B_V$ VOLTS MIN | nA MAX | $I_R$ @ | $V_R$ VOLTS | VOLTS MAX | $V_F$ @ | $I_F$ mA | C pF MAX | Package | Package Equivalent DO7/DO35 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1N4322 | 4.0 | 75 | 100 | @ | 50 | 1.0 | @ | 200 | 1.5 | DO7 | |
| 1N4454 | 4.0 | 75 | 100 | @ | 50 | 1.0 | @ | 10 | 2.0 | DO35 | 1N3064 |
| 1N4532 | 4.0 | 75 | 100 | @ | 50 | 1.0 | @ | 10 | 2.0 | DO34 | 1N4454 |
| 1N5318 | 4.0 | 75 | 100 | @ | 50 | 1.0 | @ | 200 | 2.5 | DO34 | FDH600 |
| 1N903 | 4.0 | 60 | 100 | @ | 40 | 1.0 | @ | 10 | 1.0 | DO7 | |
| 1N908 | 4.0 | 60 | 100 | @ | 40 | 1.0 | @ | 10 | 2.5 | DO7 | |
| 1N903A | 4.0 | 50 | 100 | @ | 40 | 1.0 | @ | 20 | 1.0 | DO7 | |
| 1N904 | 4.0 | 50 | 100 | @ | 30 | 1.0 | @ | 10 | 1.0 | DO7 | |
| 1N907 | 4.0 | 50 | 100 | @ | 30 | 1.0 | @ | 10 | 2.5 | DO7 | |
| 1N907A | 4.0 | 50 | 100 | @ | 30 | 1.0 | @ | 20 | 2.5 | DO7 | |
| 1N908A | 4.0 | 50 | 100 | @ | 40 | 1.0 | @ | 20 | 2.5 | DO7 | |
| FDH666 | 4.0 | 40 | 100 | @ | 25 | 1.0 | @ | 100 | 3.5 | DO35 | |
| FDN666 | 4.0 | 40 | 100 | @ | 25 | 1.0 | @ | 100 | 3.5 | DO34 | FDH666 |
| 1N905 | 4.0 | 40 | 100 | @ | 20 | 1.0 | @ | 10 | 1.0 | DO7 | |
| 1N906 | 4.0 | 40 | 100 | @ | 20 | 1.0 | @ | 10 | 2.5 | DO7 | |
| 1N4450 | 4.0 | 40 | 50 | @ | 30 | 1.0 | @ | 200 | 4.0 | DO35 | |
| 1N5319 | 4.0 | 40 | 100 | @ | 25 | 1.0 | @ | 100 | 3.5 | DO34 | FDH666 |
| 1N904A | 4.0 | 35 | 100 | @ | 30 | 1.0 | @ | 20 | 1.0 | DO7 | |
| 1N4009 | 4.0 | 35 | 100 | @ | 25 | 1.0 | @ | 30 | 4.0 | DO7 | 1N4154 |
| 1N4154 | 4.0 | 35 | 100 | @ | 25 | 1.0 | @ | 30 | 4.0 | DO35 | 1N4009 |
| 1N4536 | 4.0 | 35 | 100 | @ | 25 | 1.0 | @ | 30 | 4.0 | DO34 | 1N4154 |
| 1N905A | 4.0 | 30 | 100 | @ | 20 | 1.0 | @ | 20 | 1.0 | DO7 | |
| 1N906A | 4.0 | 30 | 100 | @ | 20 | 1.0 | @ | 20 | 2.5 | DO7 | |
| 1N3067 | 4.0 | 30 | 100 | @ | 20 | 1.0 | @ | 5 | 4.0 | DO7 | |
| 1N4727 | 4.0 | 30 | 100 | @ | 20 | 0.85 | @ | 10 | 4.0 | DO35 | |
| 1N4950 | 4.0 | 30 | 100 | @ | 25 | 1.0 | @ | 300 | 3.5 | DO7 | |
| 1N3596 | 4.0 | 20 | 100 | @ | 20 | 1.0 | @ | 30 | 1.0 | DO7 | |
| FD666 | 5.0 | 40 | 100 | @ | 25 | 1.0 | @ | 100 | 3.5 | DO7 | |
| 1N3602 | 5.0 | 75 | 100 | @ | 50 | 1.0 | @ | 20 | 3.0 | DO7 | |
| 1N3603 | 5.0 | 45 | 100 | @ | 35 | 1.0 | @ | 30 | 3.0 | DO7 | |
| 1N659 | 6.0 | 60 | 5 | @ | 50 | 1.0 | @ | 6 | | DO7 | |
| 1N814 | 25 | 50 | 100 | @ | 20 | 1.0 | @ | 5 | 1.0 | DO7 | |

## HIGH VOLTAGE SWITCHING DIODES (BY DESCENDING BV) GLASS PACKAGE

| TYPE | $B_V$ VOLTS MIN | nA MAX | $I_R$ @ @ | $V_R$ VOLTS | VOLTS MAX | $V_F$ @ @ | $I_F$ mA | C pF MAX | $t_{rr}$ ns MAX | Package |
|---|---|---|---|---|---|---|---|---|---|---|
| 1N843 | 250 | 100 | @ | 200 | 1.0 | @ | 150 | | 300 | DO7 |
| 1N809 | 220 | 1000 | @ | 200 | 1.0 | @ | 100 | | 300 | DO7 |
| FD400 | 200 | 100 | @ | 150 | 1.0 | @ | 400 | 2.0 | 50 | DO7 |
| FDH400 | 200 | 100 | @ | 150 | 1.0 | @ | 400 | 2.0 | 50 | DO35 |
| 1N629 | 200 | 1000 | @ | 175 | 1.5 | @ | 4.0 | | 50 | DO7 |
| 1N643 | 200 | 25 | @ | 10 | 1.0 | @ | 10 | 3.0 | 50 | DO7 |
| 1N804 | 200 | 1000 | @ | 40 | 1.0 | @ | 50 | | 50 | DO7 |
| 1N807 | 200 | 500 | @ | 175 | 1.0 | @ | 4.0 | | 300 | DO7 |
| 1N839 | 200 | 100 | @ | 175 | 1.0 | @ | 150 | 5.0 | 500 | DO7 |
| 1N842 | 200 | 100 | @ | 160 | 1.0 | @ | 150 | | 300 | DO7 |
| 1N845 | 200 | 100 | @ | 160 | 1.0 | @ | 200 | | 500 | DO7 |
| 1N3070 | 200 | 100 | @ | 175 | 1.0 | @ | 100 | 5.0 | 40 | DO7 |
| 1N3071 | 200 | 100 | @ | 150 | 1.0 | @ | 100 | 5.0 | 40 | DO7 |
| 1N3597 | 200 | 100 | @ | 150 | 1.2 | @ | 400 | 5.0 | 30 | DO7 |
| FD444 | 150 | 50 | @ | 100 | 1.0 | @ | 300 | 2.5 | 60 | DO7 |
| FDH444 | 150 | 50 | @ | 100 | 1.0 | @ | 300 | 2.5 | 60 | DO35 |
| 1N628 | 150 | 1000 | @ | 125 | 1.5 | @ | 4.0 | | 50 | DO7 |
| 1N801 | 150 | 100 | @ | 125 | 1.0 | @ | 10 | | 500 | DO7 |
| 1N838 | 150 | 100 | @ | 125 | 1.0 | @ | 150 | | 500 | DO7 |
| 1N841 | 150 | 100 | @ | 120 | 1.0 | @ | 150 | | 300 | DO7 |
| 1N4363 | 150 | 100 | @ | 120 | 1.0 | @ | 200 | 3.0 | 40 | DO7 |
| BAY72 | 125 | 100 | @ | 100 | 1.0 | @ | 100 | 5.0 | 50 | DO35 |
| 1N806 | 125 | 500 | @ | 100 | 1.0 | @ | 4.0 | | 50 | DO7 |
| 1N658 | 120 | 50 | @ | 50 | 1.0 | @ | 100 | | 300 | DO7 |
| 1N660 | 120 | 5000 | @ | 100 | 1.0 | @ | 7.0 | | 300 | DO7 |
| 1N928 | 120 | 100 | @ | 10 | 1.0 | @ | 10 | 4.0 | 150 | DO7 |
| 1N797 | 115 | 1000 | @ | 100 | 1.0 | @ | 10 | | 500 | DO7 |
| 1N808 | 110 | 1000 | @ | 100 | 1.0 | @ | 100 | | 300 | DO7 |
| 1N627 | 100 | 1000 | @ | 75 | 1.5 | @ | 4.0 | | 50 | DO7 |
| 1N662 | 100 | 100 | @ | 50 | 1.0 | @ | 10 | 3.0 | 50 | DO7 |
| 1N662A | 100 | 1000 | @ | 10 | 1.0 | @ | 100 | | 300 | DO7 |
| 1N663 | 100 | 5000 | @ | 75 | 1.0 | @ | 100 | | 500 | DO7 |
| 1N663A | 100 | 100 | @ | 75 | 1.0 | @ | 100 | | 300 | DO7 |
| 1N778 | 100 | 500 | @ | 100 | 1.0 | @ | 10 | | 300 | DO7 |
| 1N837 | 100 | 100 | @ | 75 | 1.0 | @ | 150 | | 500 | DO7 |
| 1N837A | 100 | 100 | @ | 80 | 1.0 | @ | 150 | | 300 | DO7 |
| 1N794 | 75 | 5000 | @ | 50 | 1.0 | @ | 10 | | 50 | DO7 |
| 1N818 | 75 | 200 | @ | 55 | 1.5 | @ | 30 | 5.0 | 50 | DO7 |
| 1N927 | 65 | 100 | @ | 10 | 1.0 | @ | 10 | 4.0 | 150 | DO7 |
| 1N3069 | 65 | 100 | @ | 60 | 1.0 | @ | 50 | 6.0 | 50 | DO7 |
| 1N793 | 60 | 1000 | @ | 50 | 1.0 | @ | 10 | | 50 | DO7 |
| 1N796 | 60 | 5000 | @ | 50 | 1.0 | @ | 100 | | 500 | DO7 |
| 1N891 | 60 | 100 | @ | 40 | 1.0 | @ | 50 | | 50 | DO7 |
| 1N626 | 50 | 1000 | @ | 35 | 1.5 | @ | 4.0 | | 50 | DO7 |
| 1N840 | 50 | 100 | @ | 40 | 1.0 | @ | 150 | | 300 | DO7 |
| 1N812 | 40 | 20 | @ | 10 | 1.0 | @ | 5.0 | | 250 | DO7 |

## HIGH VOLTAGE SWITCHING DIODES (BY DESCENDING BV)
## GLASS PACKAGE (Cont'd)

| TYPE | $B_V$ VOLTS MIN | nA MAX | $I_R$ @ @ | $V_R$ VOLTS | VOLTS MAX | $V_F$ @ @ | $I_F$ mA | C pF MAX | $t_{rr}$ ns MAX | Package |
|---|---|---|---|---|---|---|---|---|---|---|
| 1N625 | 30 | 1000 | @ | 20 | 1.5 | @ | 4.0 | | 4 | DO7 |
| 1N789 | 30 | 100 | @ | 20 | 1.0 | @ | 10 | | 500 | DO7 |
| 1N790 | 30 | 5000 | @ | 20 | 1.0 | @ | 10 | | 250 | DO7 |
| 1N791 | 30 | 5000 | @ | 20 | 1.0 | @ | 50 | | 500 | DO7 |
| 1N792 | 30 | 13 | @ | 20 | 1.0 | @ | 100 | | 500 | DO7 |
| 1N811 | 30 | 1000 | @ | 10 | 1.0 | @ | 1.0 | | 250 | DO7 |
| 1N3068 | 30 | 100 | @ | 20 | 1.0 | @ | 20 | 6.0 | 50 | DO7 |
| 1N815 | 25 | 500 | @ | 5.0 | 1.0 | @ | 30 | | 250 | DO7 |
| 1N813 | 20 | 500 | @ | 5.0 | 1.0 | @ | 5.0 | | 250 | DO7 |

| TYPE | $B_V$ VOLTS MIN | nA MAX | $I_R$ @ @ | $V_R$ VOLTS | VOLTS MAX | $V_F$ @ @ | $I_F$ mA | C pF MAX | $t_{rr}$ ns MAX | Package |
|---|---|---|---|---|---|---|---|---|---|---|
| 1N461 | 30 | 500 | @ | 25 | 1.0 | @ | 15 | 10 | | DO7 |
| 1N461A | 30 | 500 | @ | 25 | 1.0 | @ | 100 | | | DO7 |
| 1N462 | 70 | 500 | @ | 60 | 1.0 | @ | 5.0 | 8.0 | | DO7 |
| 1N462A | 70 | 500 | @ | 60 | 1.0 | @ | 100 | | | DO7 |
| 1N463 | 200 | 500 | @ | 175 | 1.0 | @ | 1.0 | | | DO7 |
| 1N463A | 200 | 500 | @ | 175 | 1.0 | @ | 100 | | | DO7 |
| 1N464 | 150 | 500 | @ | 125 | 1.0 | @ | 3.0 | 6.0 | | DO7 |
| 1N464A | 150 | 500 | @ | 125 | 1.0 | @ | 100 | | | DO7 |
| 1N482 | 40 | 100 | @ | 30 | 1.1 | @ | 100 | | | DO7 |
| 1N483 | 80 | 250 | @ | 60 | 1.1 | @ | 100 | | | DO7 |
| 1N484 | 150 | 250 | @ | 125 | 1.1 | @ | 100 | | | DO7 |
| 1N485 | 200 | 250 | @ | 175 | 1.0 | @ | 100 | | | DO7 |
| 1N661 | 240 | 350 | @ | 200 | 1.0 | @ | 7.0 | | | DO7 |
| 1N779 | 200 | 500 | @ | 175 | 1.0 | @ | 10 | | | DO7 |
| 1N795 | 75 | 5000 | @ | 50 | 1.0 | @ | 50 | | | DO7 |
| 1N799 | 150 | 5000 | @ | 100 | 1.0 | @ | 50 | | | DO7 |
| 1N816 | 6 | 100 | @ | 4 | 1.0 | @ | 100 | | | DO7 |
| 1N844 | 100 | 100 | @ | 80 | 1.0 | @ | 200 | | 500 | DO7 |
| 1N925 | 40 | 1000 | @ | 10 | 1.0 | @ | 5.0 | | 150 | DO7 |
| 1N926 | 40 | 100 | @ | 10 | 1.0 | @ | 5.0 | | 50 | DO7 |
| 1S44 | 40 | 50 | @ | 10 | 1.15 | @ | 10 | 6.0 | | DO35 |
| 1S920 | 50 | 100 | @ | 50 | 1.2 | @ | 200 | | | DO35 |
| 1S921 | 100 | 100 | @ | 100 | 1.2 | @ | 200 | | | DO35 |
| 1S922 | 150 | 100 | @ | 150 | 1.2 | @ | 200 | | | DO35 |
| 1S923 | 200 | 100 | @ | 200 | 1.2 | @ | 200 | | | DO35 |
| **BA100** | 60 | 1000 | @ | 60 | 1.0 | @ | 50 | | | DO35 |
| **BA128** | 75 | 100 | @ | 50 | 1.0 | @ | 50 | 5.0 | | DO35 |
| **BA129** | 200 | 10 | @ | 180 | 1.0 | @ | 10 | 6.0 | | DO35 |
| **BA130** | 30 | 500 | @ | 25 | 1.0 | @ | 15 | 2.0 | | DO35 |
| **BA136** | 50 | 100 | @ | 30 | 1.0 | @ | 100 | 2.0 | | DO35 |
| **BA155** | 150 | 1500 | @ | 100 | 1.2 | @ | 10 | 10 | | DO35 |
| **BA164** | 20 | 2000 | @ | 15 | 1.0 | @ | 10 | | | DO35 |
| **BA216** | 10 | 1500 | @ | 10 | 1.0 | @ | 15 | | | DO35 |
| **BA217** | 30 | 50 | @ | 10 | 1.0 | @ | 10 | 5.0 | | DO35 |
| **BA218** | 50 | 50 | @ | 25 | 1.0 | @ | 10 | 5.0 | | DO35 |
| **BA219** | 100 | 200 | @ | 50 | 0.85 | @ | 10 | 5.0 | | DO35 |
| **BAX16** | 150 | 100 | @ | 150 | 1.0 | @ | 1.0 | 10 | 120 | DO35 |
| FDH900 | 50 | 100 | @ | 30 | 1.0 | @ | 100 | 3.0 | 4.0 | DO35 |
| FDH999 | 30 | 1000 | @ | 20 | 1.0 | @ | 10 | 5.0 | 10 | DO35 |

# DIODES

## LOW LEAKAGE DIODES (BY DESCENDING BV)
## GLASS PACKAGE

| TYPE | $B_V$ VOLTS MIN | nA MAX | $I_R$ @ @ | $V_R$ VOLTS | VOLTS MAX | $V_F$ @ @ | $I_F$ mA | C pF MAX | $t_{rr}$ ns MAX | Package |
|---|---|---|---|---|---|---|---|---|---|---|
| 1N486 | 250 | 50 | @ | 225 | 1.1 | @ | 100 | | | DO7 |
| 1N486A | 250 | 25 | @ | 225 | 1.0 | @ | 100 | | | DO7 |
| 1N486B | 250 | 50 | @ | 225 | 1.0 | @ | 100 | | | DO7 |
| 1N459 | 200 | 25 | @ | 175 | 1.0 | @ | 3.0 | | | DO7 |
| 1N459A | 200 | 25 | @ | 175 | 1.0 | @ | 100 | | | DO7 |
| 1N485A | 200 | 25 | @ | 175 | 1.0 | @ | 100 | | | DO7 |
| 1N485B | 200 | 25 | @ | 175 | 1.0 | @ | 100 | | | DO7 |
| FD300 | 150 | 1.0 | @ | 125 | 1.0 | @ | 200 | 6.0 | | DO7 |
| FD333 | 150 | 3.0 | @ | 125 | 1.0 | @ | 200 | 10 | | DO7 |
| FDH300 | 150 | 1.0 | @ | 125 | 1.0 | @ | 200 | 6.0 | | DO35 |
| FDH333 | 150 | 3.0 | @ | 125 | 1.0 | @ | 200 | 10 | | DO35 |
| 1N458 | 150 | 25 | @ | 125 | 1.0 | @ | 7.0 | | | DO7 |
| 1N458A | 150 | 5.0 | @ | 125 | 1.0 | @ | 100 | | | DO7 |
| 1N484A | 150 | 25 | @ | 125 | 1.0 | @ | 100 | | | DO7 |
| 1N484B | 150 | 25 | @ | 125 | 1.0 | @ | 100 | | | DO7 |
| 1N3595 | 150 | 1.0 | @ | 125 | 1.0 | @ | 200 | 8.0 | | DO7 |
| BAY73 | 125 | 5.0 | @ | 100 | 1.0 | @ | 200 | 8.0 | | DO7 |
| 1N483A | 80 | 25 | @ | 60 | 1.0 | @ | 100 | | | DO7 |
| 1N483B | 80 | 25 | @ | 60 | 1.0 | @ | 100 | | | DO7 |
| 1N890 | 80 | 25 | @ | 60 | 1.0 | @ | 20 | | | DO7 |
| 1N457 | 70 | 25 | @ | 60 | 1.0 | @ | 20 | 8.0 | | DO7 |
| 1N457A | 70 | 25 | @ | 60 | 1.0 | @ | 100 | 5.0 | | DO7 |
| 1N482A | 40 | 25 | @ | 30 | 1.0 | @ | 100 | | | DO7 |
| 1N482B | 40 | 25 | @ | 30 | 1.0 | @ | 100 | | | DO7 |
| FJT1000 | 35 | 0.01 | @ | 20 | 1.0 | @ | 10 | 1.3 | | TO18-6 |
| FJT1100 | 35 | 0.01 | @ | 15 | 1.0 | @ | 10 | 1.3 | | DO7 |
| FJT2000 | 35 | 0.01 | @ | 20 | 1.0 | @ | 10 | 1.3 | | TO18-3 |
| 1N456 | 30 | 25 | @ | 25 | 1.0 | @ | 40 | 6.0 | | DO7 |
| 1N456A | 30 | 25 | @ | 25 | 1.0 | @ | 100 | 5.0 | | DO7 |

## HOT CARRIER DIODES
## GLASS PACKAGE

| TYPE | $B_V$ VOLTS MIN | nA MAX | $I_R$ @ @ | $V_R$ VOLTS | VOLTS MAX | $V_F$ @ @ | $I_F$ mA | C pF MAX | NF dB MAX | Package |
|---|---|---|---|---|---|---|---|---|---|---|
| FH1100 | 5.0 | 50 | @ | 1.0 | 0.55 | @ | 10 | 1.0 | 1.6 | DO7 |
| 1N5390 | 5.0 | 50 | @ | 1.0 | 0.55 | @ | 10 | 1.0 | 1.6 | DO7 |

## VOLTAGE VARIABLE CAPACITOR DIODES
## GLASS PACKAGE

| TYPE | $B_V$ VOLTS MIN | nA MAX | $I_R$ @ @ | $V_R$ VOLTS | C pF MAX | Figure Of Merit (Q) MIN | $C_1/C_4$ $V_{R1}$=0.1V $V_{R2}$=4.0V | $C_3/C_{20}$ $V_{R3}$=3V $V_{R20}$=20V | Package |
|---|---|---|---|---|---|---|---|---|---|
| RF400 | 35 | 30 | @ | 30 | 10 | 350 | 2.0 | 2.0 | DO34 |
| RF401 | 35 | 30 | @ | 30 | 7.0 | 350 | 2.0 | 2.0 | DO34 |

# DIODES

## ZENER DIODES (BY ASCENDING $V_Z$)
## GLASS PACKAGE

| TYPE | $V_Z$ @ $I_Z$ VOLTS NOMINAL | TOL $\pm V_Z$ % | $I_Z$ TEST CURRENT mA | $Z_Z$ @ $I_Z$ $\Omega$ MAX | $\mu$A MAX | $I_R$ @ @ | $V_R$ VOLTS | T C %/°C | Package |
|---|---|---|---|---|---|---|---|---|---|
| 1N746 | 3.3 | 10 | 20 | 28 | 10 | @ | 1.0 | -.070 | DO7 |
| 1N746A | 3.3 | 5.0 | 20 | 28 | 10 | @ | 1.0 | -.070 | DO7 |
| 1N747 | 3.6 | 10 | 20 | 24 | 10 | @ | 1.0 | -.065 | DO7 |
| 1N747A | 3.6 | 5.0 | 20 | 24 | 10 | @ | 1.0 | -.065 | DO7 |
| 1N748 | 3.9 | 10 | 20 | 23 | 10 | @ | 1.0 | -.060 | DO7 |
| 1N748A | 3.9 | 5.0 | 20 | 23 | 10 | @ | 1.0 | -.060 | DO7 |
| 1N749 | 4.3 | 10 | 20 | 22 | 2.0 | @ | 1.0 | -.055 | DO7 |
| 1N749A | 4.3 | 5.0 | 20 | 22 | 2.0 | @ | 1.0 | -.055 | DO7 |
| 1N750 | 4.7 | 10 | 20 | 19 | 2.0 | @ | 1.0 | -.043 | DO7 |
| 1N750A | 4.7 | 5.0 | 20 | 19 | 2.0 | @ | 1.0 | -.043 | DO7 |
| 1N751 | 5.1 | 10 | 20 | 17 | 1.0 | @ | 1.0 | ±.030 | DO7 |
| 1N751A | 5.1 | 5.0 | 20 | 17 | 1.0 | @ | 1.0 | ±.030 | DO7 |
| 1N752 | 5.6 | 10 | 20 | 11 | 1.0 | @ | 1.0 | ±.028 | DO7 |
| 1N752A | 5.6 | 5.0 | 20 | 11 | 1.0 | @ | 1.0 | ±.028 | DO7 |
| 1N753 | 6.2 | 10 | 20 | 7.0 | 0.1 | @ | 1.0 | +.045 | DO7 |
| 1N753A | 6.2 | 5.0 | 20 | 7.0 | 0.1 | @ | 1.0 | +.045 | DO7 |
| 1N957 | 6.8 | 20 | 18.5 | 4.5 | 10 | @ | 4.6 | +.050 | DO7 |
| 1N754 | 6.8 | 10 | 20 | 5.0 | 0.1 | @ | 1.0 | +.050 | DO7 |
| 1N957A | 6.8 | 10 | 18.5 | 4.5 | 10 | @ | 4.9 | +.050 | DO7 |
| 1N754A | 6.8 | 5.0 | 20 | 5.0 | 0.1 | @ | 1.0 | +.050 | DO7 |
| 1N957B | 6.8 | 5.0 | 18.5 | 4.5 | 10 | @ | 5.2 | +.050 | DO7 |
| 1N958 | 7.5 | 20 | 16.5 | 5.5 | 10 | @ | 5.1 | +.058 | DO7 |
| 1N755 | 7.5 | 10 | 20 | 6.0 | 0.1 | @ | 1.0 | +.058 | DO7 |
| 1N958A | 7.5 | 10 | 16.5 | 5.5 | 10 | @ | 5.4 | +.058 | DO7 |
| 1N755A | 7.5 | 5.0 | 20 | 6.0 | 0.1 | @ | 1.0 | +.058 | DO7 |
| 1N958B | 7.5 | 5.0 | 16.5 | 5.5 | 10 | @ | 5.7 | +.058 | DO7 |
| 1N959 | 8.2 | 20 | 15 | 6.5 | 5.0 | @ | 5.6 | +.062 | DO7 |
| 1N756 | 8.2 | 10 | 20 | 8.0 | 0.1 | @ | 1.0 | +.062 | DO7 |
| 1N959A | 8.2 | 10 | 15 | 6.5 | 5.0 | @ | 5.9 | +.062 | DO7 |
| 1N756A | 8.2 | 5.0 | 20 | 8.0 | 0.1 | @ | 1.0 | +.068 | DO7 |
| 1N959B | 8.2 | 5.0 | 15 | 6.5 | 5.0 | @ | 6.2 | +.062 | DO7 |
| 1N960 | 9.1 | 20 | 14 | 7.5 | 1.0 | @ | 6.3 | +.068 | DO7 |
| 1N757 | 9.1 | 10 | 20 | 16 | 0.1 | @ | 1.0 | +.068 | DO7 |
| 1N960A | 9.1 | 10 | 14 | 7.5 | 1.0 | @ | 6.6 | +.068 | DO7 |
| 1N757A | 9.1 | 5.0 | 20 | 16 | 0.1 | @ | 1.0 | +.068 | DO7 |
| 1N960B | 9.1 | 5.0 | 14 | 7.5 | 1.0 | @ | 6.9 | +.068 | DO7 |
| 1N961 | 10 | 20 | 12.5 | 8.5 | 1.0 | @ | 6.8 | +.072 | DO7 |
| 1N758 | 10 | 10 | 20 | 17 | 0.1 | @ | 1.0 | +.075 | DO7 |
| 1N961A | 10 | 10 | 12.5 | 8.5 | 1.0 | @ | 7.2 | +.072 | DO7 |
| 1N961B | 10 | 5.0 | 12.5 | 8.5 | 1.0 | @ | 7.6 | +.072 | DO7 |
| 1N758A | 10 | 5.0 | 20 | 17 | 0.1 | @ | 1.0 | +.075 | DO7 |
| 1N962 | 11 | 20 | 11.5 | 9.5 | 1.0 | @ | 7.6 | +.073 | DO7 |
| 1N962A | 11 | 10 | 11.5 | 9.5 | 1.0 | @ | 8.0 | +.073 | DO7 |
| 1N962B | 11 | 5.0 | 11.5 | 9.5 | 1.0 | @ | 8.4 | +.073 | DO7 |
| 1N963 | 12 | 20 | 10.5 | 11.5 | 1.0 | @ | 8.0 | +.076 | DO7 |
| 1N759 | 12 | 10 | 20 | 50 | 0.1 | @ | 1.0 | +.077 | DO7 |

## ZENER DIODES (BY ASCENDING $V_Z$)
(Cont'd) GLASS PACKAGE

| TYPE | $V_Z$ @ $I_Z$ VOLTS NOMINAL | TOL $\pm V_Z$ % | $I_Z$ TEST CURRENT mA | $Z_Z$ @ $I_Z$ $\Omega$ MAX | $\mu$A MAX | $I_R$ @ @ | $V_R$ VOLTS | T C %/°C | Package |
|---|---|---|---|---|---|---|---|---|---|
| 1N963A | 12 | 10 | 10.5 | 11.5 | 1.0 | @ | 8.6 | +.076 | DO7 |
| 1N759A | 12 | 5.0 | 20 | 50 | .10 | @ | 1.0 | +.077 | DO7 |
| 1N963B | 12 | 5.0 | 10.5 | 11.5 | 1.0 | @ | 9.1 | +.076 | DO7 |
| 1N964 | 13 | 20 | 9.5 | 13 | .10 | @ | 8.9 | +.079 | DO7 |
| 1N964A | 13 | 10 | 9.5 | 13 | .10 | @ | 9.4 | +.079 | DO7 |
| 1N964B | 13 | 5.0 | 9.5 | 13 | .10 | @ | 9.9 | +.079 | DO7 |
| 1N965 | 15 | 20 | 8.5 | 16 | .10 | @ | 10 | +.082 | DO7 |
| 1N965A | 15 | 10 | 8.5 | 16 | .10 | @ | 10.8 | +.082 | DO7 |
| 1N965B | 15 | 5.0 | 8.5 | 16 | .10 | @ | 11.4 | +.082 | DO7 |
| 1N966 | 16 | 20 | 7.8 | 17 | .10 | @ | 10.8 | +.083 | DO7 |
| 1N966A | 16 | 10 | 7.8 | 17 | .10 | @ | 11.5 | +.083 | DO7 |
| 1N966B | 16 | 5.0 | 7.8 | 17 | .10 | @ | 12.2 | +.083 | DO7 |
| 1N967 | 18 | 20 | 7.0 | 21 | .10 | @ | 12.3 | +.085 | DO7 |
| 1N967A | 18 | 10 | 7.0 | 21 | .10 | @ | 13 | +.085 | DO7 |
| 1N967B | 18 | 5.0 | 7.0 | 21 | .10 | @ | 13.7 | +.085 | DO7 |
| 1N968 | 20 | 20 | 6.2 | 25 | .10 | @ | 13.6 | +.086 | DO7 |
| 1N968A | 20 | 10 | 6.2 | 25 | .10 | @ | 14.4 | +.086 | DO7 |
| 1N968B | 20 | 5.0 | 6.2 | 25 | .10 | @ | 15.2 | +.086 | DO7 |
| 1N969 | 22 | 20 | 5.6 | 29 | .10 | @ | 14.9 | +.087 | DO7 |
| 1N969A | 22 | 10 | 5.6 | 29 | .10 | @ | 15.8 | +.087 | DO7 |
| 1N969B | 22 | 5.0 | 5.6 | 29 | .10 | @ | 16.7 | +.087 | DO7 |
| 1N970 | 24 | 20 | 5.2 | 33 | .10 | @ | 16.4 | +.088 | DO7 |
| 1N970A | 24 | 10 | 5.2 | 33 | .10 | @ | 17.3 | +.088 | DO7 |
| 1N970B | 24 | 5.0 | 5.2 | 33 | .10 | @ | 18.2 | +.088 | DO7 |
| 1N971 | 27 | 20 | 4.6 | 41 | .10 | @ | 18.2 | +.090 | DO7 |
| 1N971A | 27 | 10 | 4.6 | 41 | .10 | @ | 19.4 | +.090 | DO7 |
| 1N971B | 27 | 5.0 | 4.6 | 41 | .10 | @ | 20.6 | +.090 | DO7 |
| 1N972 | 30 | 20 | 4.2 | 49 | .10 | @ | 20.4 | +.091 | DO7 |
| 1N972A | 30 | 10 | 4.2 | 49 | .10 | @ | 21.6 | +.091 | DO7 |
| 1N972B | 30 | 5.0 | 4.2 | 49 | .10 | @ | 22.8 | +.091 | DO7 |
| 1N973 | 33 | 20 | 3.8 | 58 | .05 | @ | 22.5 | +.092 | DO7 |
| 1N973A | 33 | 10 | 3.8 | 58 | .05 | @ | 23.8 | +.092 | DO7 |
| 1N973B | 33 | 5.0 | 3.8 | 58 | .05 | @ | 25.1 | +.092 | DO7 |

# DIODES

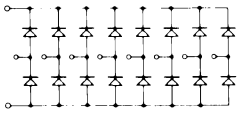
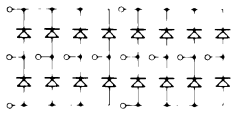
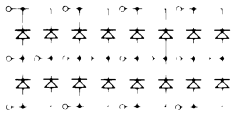
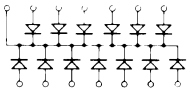
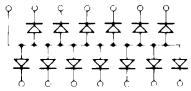
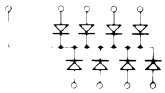
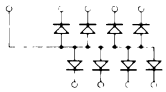
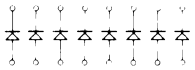
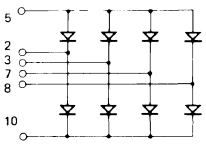
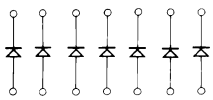
## VOLTAGE REFERENCE ZENER DIODES (NUMERIC LISTING)
## METAL PACKAGE

| TYPE | $V_Z$ @ $I_Z$ VOLTS ±5% | $I_Z$ mA (TEST) | TEMPERATURE COEFFICIENT TEMP. RANGE °C | TC %/°C | $Z_Z$ @ $I_Z$ Ω MAX | Package |
|---|---|---|---|---|---|---|
| FCT1021 | 6.7 | 0.1 | 0 to +100 | ±.001 | 750 | TO18 |
| FCT1022 | 6.7 | 0.1 | 0 to +100 | ±.002 | 750 | TO18 |
| FCT1025 | 6.7 | 0.1 | 0 to +100 | ±.005 | 750 | TO18 |
| FCT1121 | 6.7 | 0.1 | -55 to +100 | ±.001 | 750 | TO18 |
| FCT1122 | 6.7 | 0.1 | -55 to +100 | ±.002 | 750 | TO18 |
| FCT1125 | 6.7 | 0.1 | -55 to +100 | ±.005 | 750 | TO18 |

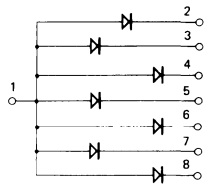
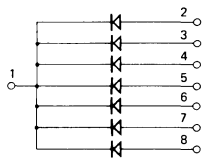
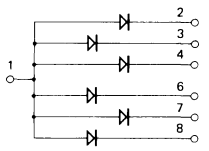
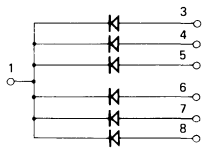
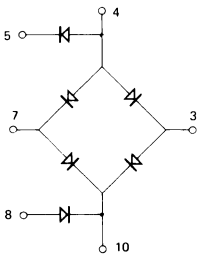
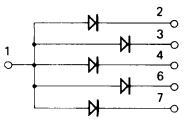
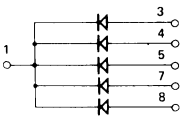
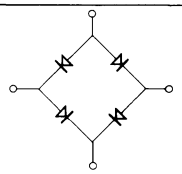
## MATCHED DIODE ASSEMBLIES (NUMERIC LISTING)
## GLASS AND PLASTIC

| NUMBER OF DIODES | | | | 2 | 2 | 4 | 4 | 4 |
|---|---|---|---|---|---|---|---|---|
| CONFIGURATION | | | | PAIR | PAIR | QUAD | QUAD | BRIDGE |
| PACKAGE | | | | (308) | DO7 or DO35 | (310) | DO7 or DO35 | (309) |
| | $V_F$ MATCHING (-55°C to +100°C) | | | | | | | |
| BASIC DIODE SPECIFICATION | $I_F$ RANGE mA | | $\Delta V_F$ mV | TYPE | TYPE | TYPE | TYPE | TYPE |
| 1N914 | 0.01 | – 1.0 | 3.0 | FA2310 E | FA2310 U | FA4310 E | FA4310 U | FA3310 |
| 1N914 | 0.01 | – 1.0 | 10 | FA2311 E | FA2311 U | FA4311 E | FA4311 U | FA3311 |
| 1N914 | 1.0 | – 10 | 5.0 | FA2312 E | FA2312 U | FA4312 E | FA4312 U | FA3312 |
| 1N914 | 1.0 | – 10 | 15 | FA2313 E | FA2313 U | FA4313 E | FA4313 U | FA3313 |
| 1N3070 | 0.01 | – 1.0 | 3.0 | FA2320 E | FA2320 U | FA4320 E | FA4320 U | FA3320 |
| 1N3070 | 0.01 | – 1.0 | 10 | FA2321 E | FA2321 U | FA4321 E | FA4321 U | FA3321 |
| 1N3070 | 1.0 | – 10 | 5.0 | FA2322 E | FA2322 U | FA4322 E | FA4322 U | FA3322 |
| 1N3070 | 1.0 | – 10 | 15 | FA2323 E | FA2323 U | FA4323 E | FA4323 U | FA3323 |
| 1N3070 | 10 | – 100 | 10 | FA2324 E | FA2324 U | FA4324 E | FA4324 U | FA3324 |
| 1N3070 | 10 | – 100 | 20 | FA2325 E | FA2325 U | FA5325 E | FA4325 U | FA3325 |
| 1N3070 | 10 | – 100 | 10 | FA2360 E | FA2360 U | FA4360 E | FA4360 U | FA3360 |
| 1N3070 | 10 | – 100 | 20 | FA2361 E | FA2361 U | FA4361 E | FA4361 U | FA3361 |
| 1N3595 | 0.01 | – 1.0 | 10 | FA2330 E | FA2330 U | FA4330 E | FA4330 U | FA3330 |
| 1N3595 | 1.0 | – 10 | 15 | FA2331 E | FA2331 U | FA4331 E | FA4331 U | FA3331 |
| 1N3595 | 10 | – 100 | 20 | FA2332 E | FA2332 U | FA4332 E | FA4332 U | FA3332 |
| 1N3595 | 0.01 | – 1.0 | 10 | FA2333 E | FA2333 U | FA4333 E | FA4333 U | FA3333 |
| 1N3595 | 1.0 | – 10 | 15 | FA2334 E | FA2334 U | FA4334 E | FA4334 U | FA3334 |
| 1N3595 | 10 | – 100 | 20 | FA2335 E | FA2335 U | FA4335 E | FA4335 U | FA3335 |
| 1N4306 | 0.1 | – 10 | 10 | 1N4306 | | | | |
| 1N4307 | 0.1 | – 10 | 10 | | | 1N4307 | | |

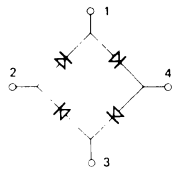
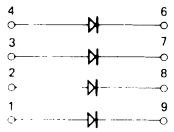
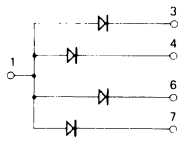
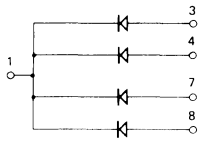
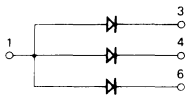
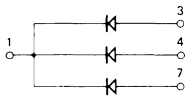
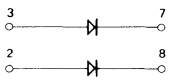
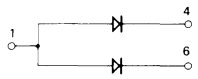
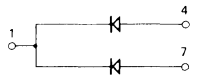
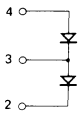
## MONOLITHIC DIODE ARRAYS (BY DESCENDING NUMBER OF JUNCTIONS) PLASTIC–METAL–CERAMIC PACKAGES

| CIRCUIT | TYPE | $B_V$ VOLTS MIN | $I_R$ nA MAX | @ $V_R$ VOLTS | $V_F$ VOLTS MAX | @ $I_F$ mA | C pF MAX | $t_{rr}$ ns MAX | PACKAGE OUTLINE | PACKAGE DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|
|  | FSA2500M | 60 | 100 | 50 | 1.5 | 500 | 7.0 | 50 | TO85-1 | Ceramic FP–10L |
| | FSA2501M | 60 | 100 | 50 | 1.5 | 500 | 7.0 | 50 | TO116-2 | Ceramic Dip–14L |
| | FSA2502M | 60 | 100 | 50 | 1.5 | 500 | 7.0 | 50 | TO5-11 | Metal Can–10L |
| | FSA2510M | 60 | 100 | 40 | 1.3 | 500 | 5.0 | 50 | TO116-1 | Plastic Dip–14L |
|  | FSA2503M | 60 | 100 | 50 | 1.5 | 500 | 7.0 | 50 | TO116-2 | Ceramic Dip–14L |
| | FSA2504M | 60 | 100 | 50 | 1.5 | 500 | 7.0 | 50 | TO86-1 | Ceramic FP–14L |
| | FSA2509M | 60 | 100 | 40 | 1.3 | 500 | 5.0 | 50 | TO116-1 | Plastic Dip–14L |
|  | FSA2508M | 60 | 100 | 40 | 1.3 | 500 | 5.0 | 50 | TO116-3 | Plastic Dip–16L |
|  | FSA2565M | 60 | 100 | 40 | 1.3 | 500 | 3.0 | 50 | TO116-1 | Plastic Dip–14L |
|  | FSA2566M | 60 | 100 | 40 | 1.3 | 500 | 3.0 | 50 | TO116-1 | Plastic Dip–14L |
|  | FSA1411M | 60 | 100 | 40 | 1.5 | 500 | 3.0 | 50 | TO5-11 | Metal Can–10L |
| | FSA2002M | 60 | 100 | 40 | 1.5 | 500 | 3.0 | 50 | TO85-1 | Ceramic FP–10L |
| | FSA2563M | 60 | 100 | 40 | 1.3 | 500 | 3.0 | 50 | TO116-1 | Plastic Dip–14L |
|  | FSA1410M | 60 | 100 | 40 | 1.5 | 500 | 3.0 | 50 | TO5-11 | Metal Can–10L |
| | FSA2003M | 60 | 100 | 40 | 1.5 | 500 | 3.0 | 50 | TO85-1 | Ceramic FP–10L |
| | FSA2564M | 60 | 100 | 40 | 1.3 | 500 | 3.0 | 50 | TO116-1 | Plastic Dip–14L |
|  | FSA2619M | 100 | 5.0 μA | 75 | 1.0 | 10 | 4.0 | 50 | TO116-3 | Plastic Dip–16L |
| | FSA2719M | 75 | 100 | 50 | 1.0 | 10 | 3.0 | 40 | TO116-3 | Plastic Dip–16L |
|   | FSA2788M | 60 | 100 | 50 | 1.1 | 200 | 7.0 | 10 | TO5-11 | Metal Can–10L |
|  | FSA2620M | 100 | 5.0 μA | 75 | 1.0 | 10 | 4.0 | 5.0 | TO116-1 | Plastic Dip–14L |
| | FSA2720M | 75 | 100 | 50 | 1.0 | 10 | 3.0 | 4.0 | TO116-1 | Plastic Dip–14L |
| | FSA2621M | 100 | 5.0 μA | 75 | 1.0 | 10 | 4.0 | 4.0 | TO86-1 | Ceramic FP–14L |
| | FSA2721M | 75 | 100 | 50 | 1.0 | 10 | 3.0 | 4.0 | TO86-1 | Ceramic FP–14L |

## MONOLITHIC DIODE ARRAYS (BY DESCENDING NUMBER OF JUNCTIONS)
## PLASTIC–METAL–CERAMIC PACKAGES (Cont'd)

| CIRCUIT | TYPE | $B_V$ VOLTS MIN | $I_R$ nA MAX | @ $V_R$ VOLTS | $V_F$ VOLTS MAX | @ $I_F$ mA | C pF MAX | $t_{rr}$ ns MAX | PACKAGE OUTLINE | PACKAGE DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|
|  | FSA2780M | 60 | 100 | 40 | 1.1 | 200 | 3.0 | 10 | TO5-11 | Metal Can–10L |
|  | FSA2786M | 60 | 100 | 40 | 1.1 | 200 | 3.0 | 10 | TO5-11 | Metal Can–10L |
|  | FSA2779M | 60 | 100 | 40 | 1.1 | 200 | 3.0 | 10 | TO5-11 | Metal Can–10L |
|  | FSA2785M | 60 | 100 | 40 | 1.0 | 200 | 3.0 | 10 | TO5-11 | Metal Can–10L |
|  | FSA2770M | 60 | 100 | 40 | 1.0 | 200 | 4.0 | 6 | TO5-11 | Metal Can–10L |
|  | FSA2778M | 60 | 100 | 40 | 1.1 | 200 | 3.0 | 10 | TO5-11 | Metal Can–10L |
|  | FSA2784M | 60 | 100 | 40 | 1.1 | 200 | 3.0 | 10 | TO5-11 | Metal Can–10L |
|  | FSA2702M | 60 | 100 | 40 | 1.0 | 200 | 3.0 | 8.0 | TO5-12 | Metal Can–4L |
| | FSA2703M | 60 | 100 | 40 | 1.0 | 200 | 3.0 | 8.0 | TO18-3 | Metal Can–4L |
| | FSA2704M | 60 | 100 | 40 | 1.0 | 200 | 3.0 | 8.0 | TO5-12 | Metal Can–4L |
| | FSA2705M | 60 | 100 | 40 | 1.0 | 200 | 3.0 | 8.0 | TO18-3 | Metal Can–4L |

## MONOLITHIC DIODE ARRAYS (BY DESCENDING NUMBER OF JUNCTIONS)
## (Cont'd) PLASTIC–METAL–CERAMIC PACKAGES

| CIRCUIT | TYPE | $B_V$ VOLTS MIN | $I_R$ nA MAX | @ $V_R$ VOLTS | $V_F$ VOLTS MAX | @ $I_F$ mA | C pF MAX | $t_{rr}$ ns MAX | PACKAGE OUTLINE | PACKAGE DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|
|  | FSA2773M | 60 | 100 | @ 40 | 1.0 | @ 100 | 3.0 | 6 | TO5-12 | Metal Can–4L |
| | FSA2774M | 60 | 100 | @ 40 | 1.0 | @ 100 | 3.0 | 6 | TO18-3 | Metal Can–4L |
|  | FSA2772M | 60 | 100 | @ 40 | 1.0 | @ 100 | 3.0 | 6 | TO5-11 | Metal Can–10L |
|  | FSA2777M | 60 | 100 | @ 40 | 1.1 | @ 200 | 3.0 | 10 | TO5-11 | Metal Can–10L |
|  | FSA2783M | 60 | 100 | @ 40 | 1.1 | @ 200 | 3.0 | 10 | TO5-11 | Metal Can–10L |
|  | FSA2776M | 60 | 100 | @ 40 | 1.1 | @ 200 | 3.0 | 10 | TO5-11 | Metal Can–10L |
|  | FSA2782M | 60 | 100 | @ 40 | 1.1 | @ 200 | 3.0 | 10 | TO5-11 | Metal Can–10L |
|  | FSA2771M | 60 | 100 | @ 40 | 1.0 | @ 100 | 3.0 | 6 | TO5-11 | Metal Can–10L |
|  | FSA2775M | 60 | 100 | @ 40 | 1.1 | @ 200 | 3.0 | 10 | TO5-11 | Metal Can–10L |
|  | FSA2781M | 60 | 100 | @ 40 | 1.1 | @ 200 | 3.0 | 10 | TO5-11 | Metal Can–10L |
|  | FSA2787M | 60 | 100 | @ 50 | 1.1 | @ 200 | 7.0 | 10 | TO18-3 | Metal Can–4L |

# DIODES/RECTIFIERS

## DIODE DICE
## (BY DESCENDING BV)

| TYPE | BASIC STANDARD DEVICE | $B_V$ VOLTS MIN | $I_R$ nA MAX | @ | $V_R$ VOLTS | $V_F$ VOLTS MAX | @ | $I_F$ mA | $t_{rr}$ ns MAX | @ | $I_f=I_r$ MAX | C pF MAX | CHIP SIZE MILS | BASIC APPLICATION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FDC3070 | 1N3070 | 200 | 100 | @ | 175 | 1.0 | @ | 100 | 50 | @ | 10 | 2.5 | 17.5 x 17.5 | High Voltage Switching |
| FDC485B | 1N485B | 200 | 25 | @ | 175 | 1.0 | @ | 100 | 500 | @ | 10 | 5.0 | 17.5 x 17.5 | High Voltage Low Leakage |
| FDC3600 | 1N3600 | 75 | 100 | @ | 50 | 1.0 | @ | 100 | 4.0 | @ | 10 | 2.5 | 17.5 x 17.5 | General Purpose Switching |
| FDC4376 | 1N4376 | 20 | 100 | @ | 10 | 1.1 | @ | 50 | 0.8 | @ | 10 | 1.2 | 17.5 x 17.5 | Ultra High Speed Switching |

# RECTIFIERS

## GENERAL PURPOSE RECTIFIERS (BY ASCENDING $V_R$)
## GLASS PACKAGE

| TYPE | $V_R$ VOLTS MIN | $I_R$ @ $V_R$ $\mu$A MAX | $V_F$ VOLTS MAX | @ | $I_F$ AMPS | $V_{FM}$ VOLTS MAX | @ | $I_O$ AMPS | Package |
|---|---|---|---|---|---|---|---|---|---|
| 1N4001 | 50 | 10 | 1.1 | @ | 1.0 | 1.6 | @ | 1.0 | DO41 |
| 1N5794 | 50 | 200 | 0.98 | @ | 1.0 | | | | DO41 |
| 1N4002 | 100 | 10 | 1.1 | @ | 1.0 | 1.6 | @ | 1.0 | DO41 |
| 1N5795 | 100 | 200 | 0.98 | @ | 1.0 | | | | DO41 |
| 1N4003 | 200 | 10 | 1.1 | @ | 1.0 | 1.6 | @ | 1.0 | DO41 |
| 1N5796 | 200 | 200 | 0.98 | @ | 1.0 | | | | DO41 |
| 1N4004 | 400 | 10 | 1.1 | @ | 1.0 | 1.6 | @ | 1.0 | DO41 |
| 1N5797 | 400 | 200 | 0.98 | @ | 1.0 | | | | DO41 |
| 1N4005 | 600 | 10 | 1.1 | @ | 1.0 | 1.6 | @ | 1.0 | DO41 |
| 1N5798 | 600 | 200 | 0.98 | @ | 1.0 | | | | DO41 |

## NPN HIGH SPEED SATURATED SWITCHING TRANSISTORS (BY ASCENDING $V_{CEO}$)

## METAL PACKAGE

(FOR MEDIUM SPEED – SEE GENERAL PURPOSE SECTION)

| TYPE | $V_{CEO}$ ($V_{CER}$) VOLTS MIN | $\tau_s$ ($t_{off}$) ns @ $I_C$ MAX mA | $h_{FE}$ $h_{FE}$ @ $I_C$ MIN - MAX mA | $V_{CE(sat)}$ VOLTS @ $I_C$ MAX mA | $f_T$ MHz MIN | $C_{ob}$ pF MAX | $P_D$ $T_A$ 25°C mW | $T_C$ 25°C W | Package | PNP Complement |
|---|---|---|---|---|---|---|---|---|---|---|
| 2N834 | 6 | 25 @ 10 | 25 @ 10 | 0.25 @ 10 | 350 | 4.0 | 300 | 1.0 | TO18-1 | 2N2894A |
| 2N709 | 6 | 6 @ 5 | 20 - 120 @ 10 | 0.30 @ 3 | 600 | 3.0 | 300 | 0.5 | TO18-1 | 2N4208 |
| FT709 | 6 | 6 @ 5 | 30 - 125 @ 10 | 0.25 @ 10 | 600 | 3.0 | 300 | 0.5 | TO18-1 | 2N4208 |
| 2N3010 | 6 | 6 @ 5 | 25 - 125 @ 10 | 0.25 @ 10 | 600 | 3.0 | 300 | | TO18-1 | 2N4208 |
| 2N3510 | 10 | (25) @ 150 | 25 - 150 @ 150 | 0.40 @ 150 | 350 | 4.0 | 360 | 1.2 | TO18-2 | 2N5455 |
| **BSX28** | 12 | 13 @ 10 | 30 - 120 @ 10 | 0.2 @ 10 | 400 | 4.0 | 360 | 1.2 | TO18-1 | 2N2894A |
| 2N3011 | 12 | 13 @ 10 | 30 - 120 @ 10 | 0.20 @ 10 | 400 | 4.0 | 360 | 1.2 | TO18-1 | 2N4208 |
| 2N744 | 12 | 18 @ 10 | 40 - 120 @ 10 | 0.35 @ 10 | 280 | 5.0 | 300 | 1.0 | TO18-1 | 2N2894A |
| 2N2368 | 15 | 10 @ 10 | 20 - 60 @ 10 | 0.25 @ 10 | 400 | 4.0 | 360 | 1.2 | TO18-1 | 2N5056 |
| 2N2369 | 15 | 13 @ 10 | 40 - 120 @ 10 | 0.25 @ 10 | 500 | 4.0 | 360 | 1.2 | TO18-1 | 2N5057 |
| 2N2369A | 15 | 13 @ 10 | 40 - 120 @ 10 | 0.20 @ 10 | 500 | 4.0 | 360 | 1.2 | TO18-1 | 2N5057 |
| 2N3009 | 15 | 18 @ 10 | 30 - 120 @ 30 | 0.18 @ 30 | 350 | 5.0 | 360 | 1.2 | TO18-2 | 2N5455 |
| 2N3013 | 15 | 18 @ 10 | 30 - 120 @ 30 | 0.18 @ 30 | 350 | 5.0 | 360 | 1.2 | TO18-2 | 2N5455 |
| 2N3511 | 15 | (18) @ 150 | 30 - 120 @ 150 | 0.40 @ 150 | 450 | 4.0 | 360 | 1.2 | TO18-2 | 2N5455 |
| 2N914 | 15 | 20 @ 20 | 30 - 120 @ 10 | 0.25 @ 20 | 300 | 6.0 | 360 | 1.2 | TO18-1 | 2N5455 |
| 2N2481 | 15 | 20 @ 10 | 40 - 120 @ 10 | 0.25 @ 10 | 300 | 5.0 | 360 | 1.2 | TO18-1 | 2N5057 |
| 2N706A | 15 | 25 @ 10 | 20 - 60 @ 10 | 0.60 @ 10 | 200 | 5.0 | 300 | 1.0 | TO18-1 | 2N5056 |
| 2N706B | 15 | 25 @ 10 | 20 - 60 @ 10 | 0.60 @ 10 | 200 | 5.0 | 300 | 1.0 | TO18-1 | 2N5056 |
| 2N708 | 15 | 25 @ 10 | 30 - 120 @ 10 | 0.40 @ 10 | 300 | 6.0 | 360 | 1.2 | TO18-1 | 2N5056 |
| 2N753 | 15 | 35 @ 10 | 40 - 120 @ 10 | 0.60 @ 10 | 200 | 5.0 | 300 | 1.0 | TO18-1 | 2N5057 |
| **BSX20** | 15 | 18 @ 10 | 30 - 120 @ 30 | 0.18 @ 30 | 350 | 5.0 | 360 | 1.2 | TO18-1 | BSX29 |
| **BSX26** | 15 | 13 @ 10 | 40 - 120 @ 10 | 0.25 @ 10 | 500 | 4.0 | 360 | 1.2 | TO18-1 | |
| 2N4137 | 20 | 13 @ 10 | 40 - 120 @ 10 | 0.30 @ 10 | 500 | 4.0 | 360 | 1.2 | TO18-1 | 2N3209 |
| **BSX39** | 20 | 18 @ 10 | 40 - 120 @ 30 | 0.18 @ 30 | 350 | 5.0 | 360 | 1.2 | TO18-1 | 2N3209 |
| 2N3014 | 20 | 18 @ 10 | 30 - 120 @ 30 | 0.18 @ 30 | 350 | 5.0 | 360 | 1.2 | TO18-2 | 2N5456 |
| 2N706 | (20) | 60 @ 10 | 20 @ 10 | 0.60 @ 10 | 200 | 6.0 | 300 | 1.0 | TO18-1 | 2N2894 |
| 2N3015 | 30 | (60) @ 300 | 30 - 120 @ 150 | 0.40 @ 150 | 250 | 8.0 | 800 | 3.0 | TO5-1 | |
| 2N4046 | 30 | (60) @ 500 | 40 - 150 @ 100 | 0.20 @ 100 | 250 | 12 | 800 | 3.5 | TO5-1 | 2N5023 |
| 2N3724 | 30 | (60) @ 500 | 60 - 150 @ 100 | 0.20 @ 100 | 300 | 12 | 800 | 3.5 | TO5-1 | 2N5023 |
| 2N4013 | 30 | (60) @ 500 | 60 - 150 @ 100 | 0.20 @ 100 | 300 | 12 | 360 | 1.2 | TO18-1 | |
| 2N3734 | 30 | (60) @1000 | 30 - 120 @1000 | 0.90 @1000 | 300 | 9.0 | 1000 | 4.0 | TO5-1 | 2N5023 |
| 2N3252 | 30 | (70) @ 500 | 30 - 90 @ 500 | 0.50 @ 500 | 200 | 12 | 1000 | 5.0 | TO5-1 | 2N5023 |
| **BSX32** | 40 | (60) @ 500 | 60 - 150 @ 100 | 0.25 @ 100 | 300 | 10 | 800 | 3.5 | TO5-1 | 2N5022 |
| 2N3253 | 40 | (70) @ 500 | 25 @ 150 | 0.35 @ 150 | 175 | 12 | 1000 | 5.0 | TO5-1 | 2N5022 |
| 2N4047 | 50 | (60) @ 500 | 40 - 150 @ 100 | 0.26 @ 100 | 250 | 10 | 800 | 3.5 | TO5-1 | 2N5022 |
| 2N3725 | 50 | (60) @ 500 | 60 - 150 @ 100 | 0.26 @ 100 | 300 | 10 | 800 | 3.5 | TO5-1 | 2N5022 |
| 2N4014 | 50 | (60) @ 500 | 60 - 150 @ 100 | 0.26 @ 100 | 300 | 10 | 360 | 1.2 | TO18-1 | |
| 2N3444 | 50 | (70) @ 500 | 20 - 60 @ 500 | 0.60 @ 500 | 150 | 12 | 1000 | 5.0 | TO5-1 | 2N5022 |
| 2N3722 | 60 | (100) @ 500 | 40 - 150 @ 100 | 0.22 @ 100 | 300 | 10 | 800 | 4.0 | TO5-1 | |
| FT3723 | 70 | (130) @ 500 | 40 - 150 @ 100 | 0.28 @ 100 | 300 | 9.0 | 800 | 4.0 | TO5-1 | |

# TRANSISTORS—SMALL SIGNAL

## NPN HIGH SPEED SATURATED SWITCHING TRANSISTORS (BY ASCENDING $V_{CEO}$)

### PLASTIC PACKAGE (Cont'd)

(FOR MEDIUM SPEED – SEE GENERAL PURPOSE SECTION)

| TYPE | $V_{CEO}$ ($V_{CER}$) VOLTS MIN | $\tau_s$ ($t_{off}$) ns @ $I_C$ MAX mA | $h_{FE}$ $h_{FE}$ @ $I_C$ MIN - MAX mA | $V_{CE(sat)}$ VOLTS@ $I_C$ MAX mA | $f_T$ MHz MIN | $C_{ob}$ pF MAX | $P_D$ $T_A$ 25°C mW | $T_C$ 25°C W | Package | PNP Complement |
|---|---|---|---|---|---|---|---|---|---|---|
| MPS834 | | 25 @ 10 | 25 @ 10 | 0.25 @ 10 | 350 | 4.0 | 625 | 1.0 | TO92-1 | MPSL08 |
| 2N5134 | 10 | 18 @ 10 | 20 - 150 @ 10 | 0.25 @ 10 | 250 | 4.0 | 200 | 0.5 | TO18-4 | 2N3639 |
| PN5134 | 10 | 18 @ 10 | 20 - 150 @ 10 | 0.25 @ 10 | 250 | 4.0 | 625 | 1.0 | TO92-1 | |
| EN3011 | 12 | 13 @ 10 | 30 - 120 @ 10 | 0.20 @ 10 | 400 | 4.0 | 200 | 0.5 | TO18-4 | EN2894A |
| 2N4274 | 12 | 13 @ 10 | 35 - 120 @ 10 | 0.20 @ 10 | 400 | 4.0 | 280 | 0.83 | TO18-4 | 2N2894A |
| EN744 | 12 | 18 @ 10 | 40 - 120 @ 10 | 0.30 @ 10 | 280 | 5.0 | 200 | 0.5 | TO18-4 | EN2984A |
| 2N4265 | 12 | 20 @ 10 | 100 - 400 @ 10 | 0.22 @ 10 | 300 | 4.0 | 625 | 1.0 | TO92-1 | MPSL08 |
| 2N5224 | 12 | (60) @ 10 | 40 - 400 @ 10 | 0.35 @ 10 | 250 | 4.0 | 625 | 1.0 | TO92-1 | MPSL08 |
| 2N4275 | 15 | 13 @ 10 | 35 - 120 @ 10 | 0.20 @ 10 | 400 | 4.0 | 280 | 0.83 | TO18-4 | 2N5910 |
| EN2369A | 15 | 13 @ 10 | 40 @ 10 | 0.20 @ 10 | 500 | 4.0 | 200 | 0.5 | TO18-4 | 2N5910 |
| MPS2369 | 15 | 13 @ 10 | 40 - 120 @ 10 | 0.25 @ 10 | 500 | 4.0 | 625 | 1.0 | TO92-1 | 2N5771 |
| 2N5769 | 15 | 13 @ 10 | 40 - 120 @ 10 | 0.20 @ 10 | 500 | 4.0 | 625 | 1.0 | TO92-1 | 2N5771 |
| EN3009 | 15 | 18 @ 10 | 30 - 120 @ 30 | 0.18 @ 30 | 350 | 5.0 | 200 | 0.5 | TO18-4 | |
| EN3013 | 15 | 20 @ 20 | 30 - 120 @ 10 | 0.40 @ 10 | 300 | 6.0 | 200 | 0.5 | TO18-4 | |
| MPS3646 | 15 | 18 @ 10 | 30 - 120 @ 30 | 0.20 @ 30 | 350 | 5.0 | 625 | 1.0 | TO92-1 | 2N5771 |
| 2N3646 | 15 | 18 @ 10 | 30 - 120 @ 30 | 0.20 @ 30 | 350 | 5.0 | 200 | 0.5 | TO18-4 | 2N4258A |
| 2N5772 | 15 | 18 @ 10 | 30 - 120 @ 30 | 0.20 @ 30 | 350 | 5.0 | 625 | 1.0 | TO92-1 | 2N5771 |
| EN708 | 15 | 20 @ 20 | 30 - 120 @ 10 | 0.40 @ 10 | 300 | 6.0 | 200 | 0.5 | TO18-4 | 2N5910 |
| EN914 | 15 | 20 @ 20 | 30 - 120 @ 10 | 0.25 @ 20 | 300 | 6.0 | 200 | 0.5 | TO18-4 | EN2894A |
| 2N4264 | 15 | 20 @ 10 | 40 - 160 @ 10 | 0.22 @ 10 | 300 | 4.0 | 625 | 1.0 | TO92-1 | 2N5771 |
| EN706 | 15 | 60 @ 10 | 20 @ 10 | 0.60 @ 10 | 200 | 6.0 | 200 | 0.5 | TO18-4 | 2N5910 |
| MPS2713 | 18 | | 30 - 90 @ 2.0 | 0.30 @ 2.0 | 250 | 2.5 | 625 | 1.0 | TO92-1 | |
| MPS2714 | 18 | | 75 - 225 @ 2.0 | 0.30 @ 2.0 | 250 | 2.5 | 625 | 1.0 | TO92-1 | |
| EN3014 | 20 | 18 @ 10 | 30 - 120 @ 30 | 0.18 @ 30 | 350 | 5.0 | 200 | 0.5 | TO18-4 | 2N5910 |
| MPS706A | (20) | 25 @ 10 | 20 - 60 @ 10 | 0.60 @ 10 | 200 | 6.0 | 625 | 1.0 | TO92-1 | MPS3640 |
| MPS706 | (20) | 60 @ 10 | 20 @ 10 | 0.60 @ 10 | 200 | 6.0 | 625 | 1.0 | TO92-1 | MPS3640 |
| 2N5845A | 40 | (50) @ 500 | 35 - 150 @ 500 | 0.50 @ 500 | 250 | 9.0 | 625 | 1.5 | TO92-1 | |
| 2N5845 | 40 | (60) @ 500 | 25 - 150 @ 500 | 0.60 @ 500 | 200 | 9.0 | 625 | 1.5 | TO92-1 | |

## PNP HIGH SPEED SATURATED SWITCHING TRANSISTORS (BY ASCENDING $V_{CEO}$)
## METAL PACKAGE

(FOR MEDIUM SPEED – SEE GENERAL PURPOSE SECTION)

| TYPE | $V_{CEO}$ ($V_{CER}$) VOLTS MIN | $\tau_s$ ($t_{off}$) ns MAX | @ $I_C$ mA | $h_{FE}$ $h_{FE}$ MIN - MAX | @ $I_C$ mA | $V_{CE(sat)}$ VOLTS MAX | @ $I_C$ mA | $f_T$ MHz MIN | $C_{ob}$ ($C_{cb}$) pF MAX | $P_D$ $T_A$ 25°C mW | $T_C$ 25°C W | Package | NPN Complement |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2N3304 | 6 | 30 | 10 | 30 - 120 | 10 | 0.16 | 10 | 500 | 3.5 | 300 | 0.5 | TO18-1 | 2N709 |
| **BSX29** | 12 | (90) | 30 | 30 - 120 | 30 | 0.20 | 30 | 400 | 6.0 | 360 | 1.2 | TO18-1 | BSX20 |
| 2N4208 | 12 | 20 | 10 | 30 - 120 | 10 | 0.15 | 10 | 700 | 3.0 | 350 | 0.7 | TO18-1 | 2N2369A |
| 2N2894A | 12 | 20 | 10 | 40 - 120 | 30 | 0.19 | 30 | 800 | 4.5 | 360 | 1.2 | TO18-1 | 2N2369A |
| 2N3546 | 12 | (30) | 50 | 30 - 120 | 10 | 0.15 | 10 | 700 | 6.0 | 360 | 1.2 | TO18-1 | 2N914 |
| 2N3012 | 12 | (75) | 30 | 30 - 120 | 30 | 0.20 | 30 | 400 | 6.0 | 360 | 1.2 | TO18-1 | 2N2369A |
| 2N2894 | 12 | (90) | 30 | 30 - 150 | 30 | 0.20 | 30 | 400 | 6.0 | 360 | 1.2 | TO18-1 | 2N2369A |
| 2N4209 | 15 | 20 | 10 | 50 - 120 | 10 | 0.18 | 10 | 850 | 3.0 | 350 | 0.7 | TO18-1 | 2N2369A |
| 2N5056 | 15 | 30 | 10 | 30 - 100 | 30 | 0.13 | 30 | 600 | 4.5 | 360 | 1.2 | TO18-1 | 2N2369A |
| 2N5057 | 15 | 30 | 10 | 40 - 100 | 30 | 0.19 | 30 | 800 | 4.5 | 360 | 1.2 | TO18-1 | 2N2369A |
| 2N5455 | 15 | 35 | 10 | 30 - 120 | 30 | 0.15 | 30 | 450 | (6.0) | 340 | 1.0 | TO18-2 | 2N3013 |
| 2N3209 | 20 | (90) | 30 | 30 - 120 | 30 | 0.20 | 30 | 400 | 5.0 | 360 | 1.2 | TO18-1 | 2N4137 |
| 2N5456 | 25 | 35 | 10 | 30 - 120 | 30 | 0.15 | 30 | 450 | (6.0) | 340 | 1.0 | TO18-2 | 2N3014 |
| 2N5023 | 30 | (90) | 500 | 40 - 100 | 500 | 0.35 | 500 | 200 | 25.0 | 1000 | 4.0 | TO5-1 | 2N3724 |
| 2N3467 | 40 | (90) | 500 | 40 - 120 | 500 | 0.50 | 500 | 175 | 25.0 | 1000 | 5.0 | TO5-1 | 2N3725 |
| 2N5022 | 50 | (90) | 500 | 25 - 100 | 500 | 0.40 | 500 | 170 | 25.0 | 1000 | 4.0 | TO5-1 | 2N3725 |
| 2N3468 | 50 | (90) | 500 | 25 - 75 | 500 | 0.60 | 500 | 150 | 25.0 | 1000 | 5.0 | TO5-1 | 2N3725 |

## PNP HIGH SPEED SATURATED SWITCHING TRANSISTORS (BY ASCENDING $V_{CEO}$)
## PLASTIC PACKAGE

(FOR MEDIUM SPEED – SEE GENERAL PURPOSE SECTION)

| TYPE | $V_{CEO}$ ($V_{CER}$) VOLTS MIN | $t_S$ ($t_{off}$) ns MAX | @ $I_C$ mA | $h_{FE}$ $h_{FE}$ MIN - MAX | @ $I_C$ mA | $V_{CE(sat)}$ VOLTS MAX | @ $I_C$ mA | $f_T$ MHz MIN | $C_{ob}$ pF MAX | $P_D$ $T_A$ 25°C mW | $T_C$ 25°C W | Package | NPN Complement |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2N5228 | 5 | (140) | 10 | 30 | 10 | 0.40 | 10 | 300 | 5.0 | 625 | 1.0 | TO92-1 | 2N5224 |
| MPSL07 | 6 | 15 | 10 | 30 - 120 | 10 | 0.15 | 10 | 500 | 3.0 | 625 | 1.0 | TO92-1 | MPS2369 |
| MPS3639 | 6 | (25) | 50 | 30 - 120 | 10 | 0.16 | 10 | 500 | 3.5 | 625 | 1.0 | TO92-1 | MPS2369 |
| 2N3639 | 6 | 30 | 10 | 30 - 120 | 10 | 0.16 | 10 | 500 | 3.5 | 200 | 0.5 | TO18-4 | 2N4274 |
| 2N4258A | 12 | 15 | 10 | 30 - 120 | 10 | 0.15 | 10 | 700 | 3.0 | 200 | 0.5 | TO18-4 | 2N4274 |
| PN4258A | 12 | 50 | 10 | 30 - 120 | 10 | 0.15 | 10 | 700 | 3.0 | 625 | 1.0 | TO92-1 | 2N5769 |
| 2N4258 | 12 | 20 | 10 | 30 - 120 | 10 | 0.15 | 10 | 700 | 3.0 | 200 | 0.5 | TO18-4 | 2N4274 |
| PN4258 | 12 | 20 | 10 | 30 - 120 | 10 | 0.15 | 10 | 700 | 3.0 | 625 | 1.0 | TO92-1 | 2N5769 |
| MPSL08 | 12 | 20 | 10 | 30 - 120 | 10 | 0.15 | 10 | 700 | 3.0 | 625 | 1.0 | TO92-1 | MPS2369 |
| 2N4313 | 12 | 20 | 10 | 30 - 120 | 30 | 0.19 | 30 | 700 | 4.5 | 200 | 0.5 | TO18-4 | 2N4274 |
| EN2894A | 12 | 20 | 10 | 40 - 120 | 30 | 0.19 | 30 | 800 | 4.5 | 200 | 0.5 | TO18-4 | EN2369A |
| MPS3640 | 12 | (35) | 50 | 30 - 120 | 10 | 0.20 | 10 | 500 | 3.5 | 625 | 1.0 | TO92-1 | 2N5772 |
| 2N3640 | 12 | 50 | 10 | 30 - 120 | 10 | 0.20 | 10 | 500 | 3.5 | 200 | 0.5 | TO18-4 | 2N4274 |
| 2N5771 | 15 | 20 | 10 | 50 - 120 | 10 | 0.15 | 10 | 850 | 3.0 | 625 | 1.0 | TO92-1 | 2N5772 |
| 2N5910 | 20 | 20 | 10 | 30 - 120 | 10 | 0.15 | 10 | 700 | 3.0 | 200 | 0.5 | TO18-4 | EN3014 |
| PN5910 | 20 | 20 | 10 | 30 - 120 | 10 | 0.15 | 10 | 700 | 3.0 | 625 | 1.0 | TO92-1 | 2N5769 |

# TRANSISTORS—SMALL SIGNAL

## NPN GENERAL PURPOSE AMPLIFIER AND SWITCHING TRANSISTORS (BY ASCENDING $V_{CEO}$) METAL PACKAGE

(ALSO SEE LOW LEVEL AND HIGH VOLTAGE SECTION)

| TYPE | $V_{CEO}$ ($V_{CER}$) VOLTS MIN | $h_{FE}$ $h_{FE}$ MIN - MAX | @ $I_C$ mA | $V_{CE(sat)}$ VOLTS MAX | @ $I_C$ mA | $C_{ob}$ pF MAX | $f_T$ MHz MIN | $t_{off}$ ns MAX | $P_D$ $T_A$ 25°C mW | $T_C$ 25°C W | Package | PNP Complement |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BFY52** | 20 | 60 | @ 150 | 0.35 | @ 150 | 12 | 200 | | 800 | 2.86 | TO5-1 | |
| 2N916 | 25 | 50 - 200 | @ 10 | 0.50 | @ 10 | 6.0 | 300 | | 360 | 1.2 | TO18-1 | 2N3250 |
| 2N718 | 28 | 40 - 120 | @ 150 | 1.50 | @ 150 | 35 | 50 | | 400 | 1.5 | TO18 | 2N2907 |
| **BC282** | 30 | 50 - 300 | @ 50 | 0.50 | @ 50 | 5.5(Typ) | | | 400 | 1.30 | TO18-1 | |
| 2N2219 | 30 | 100 - 300 | @ 150 | 0.40 | @ 150 | 8.0 | 250 | | 800 | 3.0 | TO5-1 | 2N2905 |
| 2N2222 | 30 | 100 - 300 | @ 150 | 0.40 | @ 150 | 8.0 | 250 | | 500 | 1.8 | TO18-1 | 2N2907 |
| 2N3300 | 30 | 100 - 300 | @ 150 | 0.22 | @ 150 | 8.0 | 250 | 150 | 800 | 3.0 | TO5-1 | 2N2905 |
| 2N3302 | 30 | 100 - 300 | @ 150 | 0.22 | @ 150 | 8.0 | 250 | 150 | 360 | 1.8 | TO18-1 | 2N2907 |
| 2N2218 | 30 | 40 - 120 | @ 150 | 0.40 | @ 150 | 8.0 | 250 | | 800 | 3.0 | TO5-1 | 2N2904 |
| 2N2221 | 30 | 40 - 120 | @ 150 | 0.40 | @ 150 | 8.0 | 250 | | 500 | 1.8 | TO18-1 | 2N2906 |
| 2N3299 | 30 | 40 - 120 | @ 150 | 0.22 | @ 150 | 8.0 | 250 | 150 | 800 | 3.0 | TO5-1 | 2N2904 |
| 2N3301 | 30 | 40 - 120 | @ 150 | 0.22 | @ 150 | 8.0 | 250 | 150 | 360 | 1.8 | TO18-1 | 2N2906 |
| **BC119** | 30 | 40 - 120 | @ 150 | 0.35 | @ 150 | 25 | 40 | | 800 | 5.0 | TO5-1 | BC139 |
| **BFY51** | 30 | 40 | @ 150 | 0.35 | @ 150 | 12 | 50 | | 800 | 2.86 | TO5-1 | |
| 2N2405 | 30 | 30 - 120 | @ 150 | 0.45 | @ 150 | 11 | 200 | | 800 | 2.4 | TO5-1 | 2N2904 |
| **BFY50** | 35 | 30 | @ 150 | 0.20 | @ 150 | 12 | 60 | | 800 | 2.86 | TO5 | |
| 2N3947 | 40 | 100 - 300 | @ 10 | 0.20 | @ 10 | 4.0 | 300 | 450 | 360 | 1.2 | TO18 | 2N3250 |
| 2N3946 | 40 | 50 - 150 | @ 10 | 0.20 | @ 10 | 4.0 | 250 | 375 | 360 | 1.2 | TO18 | FT3905 |
| **BC140** | 40 | 40 - 400 | @ 100 | 1.4 | @1000 | 25 | 50 | | 800 | 5.0 | TO5-1 | BC160 |
| **BC140-6** | 40 | 40 - 100 | @ 100 | 1.4 | @1000 | 25 | 50 | | 800 | 5.0 | TO5-1 | BC160-6 |
| **BC140-10** | 40 | 63 - 160 | @ 100 | 1.4 | @1000 | 25 | 50 | | 800 | 5.0 | TO5-1 | BC160-10 |
| **BC140-16** | 40 | 100 - 250 | @ 100 | 1.4 | @1000 | 25 | 50 | | 800 | 5.0 | TO5-1 | BC160-16 |
| **BC140-25** | 40 | 160 - 400 | @ 100 | 1.4 | @1000 | 25 | 50 | | 800 | 5.0 | TO5-1 | BC160-25 |
| 2N2219A | 40 | 100 - 300 | @ 150 | 0.30 | @ 150 | 8.0 | 300 | 285 | 800 | 3.0 | TO5-1 | 2N2905A |
| 2N2222A | 40 | 100 - 300 | @ 150 | 0.30 | @ 150 | 8.0 | 300 | 285 | 500 | 1.8 | TO18-1 | 2N2907A |
| 2N3109 | 40 | 100 - 300 | @ 150 | 0.25 | @ 150 | 25 | 70 | | 800 | 5.0 | TO5-1 | 2N2905 |
| 2N2218A | 40 | 40 - 120 | @ 150 | 0.30 | @ 150 | 8.0 | 250 | 285 | 800 | 3.0 | TO5-1 | 2N2904 |
| 2N2221A | 40 | 40 - 120 | @ 150 | 0.30 | @ 150 | 8.0 | 250 | 285 | 500 | 1.8 | TO18-1 | 2N2906 |
| 2N2868 | 40 | 40 - 120 | @ 150 | 0.25 | @ 150 | 20 | 50 | | 800 | 2.8 | TO5-1 | 2N2905 |
| 2N3110 | 40 | 40 - 120 | @ 150 | 0.25 | @ 150 | 25 | 60 | | 800 | 5.0 | TO5-1 | 2N2904 |
| 2N697 | (40) | 40 - 120 | @ 150 | 1.50 | @ 150 | 35 | 50 | | 600 | 2.0 | TO5-1 | 2N2904 |
| 2N2270 | 45 | 50 - 200 | @ 150 | 0.90 | @ 150 | 15 | 100 | | 1000 | 5.0 | TO5-1 | 2N2904A |
| **BFY56** | 45 | 30 - 150 | @ 150 | 0.30 | @ 150 | 2.5 | 40 | 625 | 800 | 5.0 | TO5-1 | BFX39 |
| 2N915 | 50 | 50 - 200 | @ 10 | 1.00 | @ 10 | 3.5 | 250 | | 360 | 1.2 | TO18-1 | 2N3250A |
| 2N956 | (50) | 100 - 300 | @ 150 | 1.50 | @ 150 | 25 | 70 | | 500 | 1.8 | TO18-1 | 2N2907 |
| 2N1711 | (50) | 100 - 300 | @ 150 | 1.50 | @ 150 | 25 | 70 | | 800 | 3.0 | TO5-1 | 2N2905 |
| 2N3053 | (50) | 50 - 250 | @ 150 | 1.40 | @ 150 | 15 | 100 | | | 5.0 | TO5-1 | 2N2905 |
| 2N718A | (50) | 40 - 120 | @ 150 | 1.50 | @ 150 | 25 | 60 | | 500 | 1.8 | TO18-1 | 2N2907 |
| 2N1613 | (50) | 40 - 120 | @ 150 | 1.50 | @ 150 | 25 | 80 | | 800 | 3.0 | TO5-1 | 2N2905A |
| **BC141** | 60 | 40 - 400 | @ 100 | 1.4 | @1000 | 25 | 50 | | 800 | 5.0 | TO5-1 | BC161 |
| **BC141-6** | 60 | 40 - 100 | @ 100 | 1.4 | @1000 | 25 | 50 | | 800 | 5.0 | TO5-1 | BC161-6 |
| **BC141-10** | 60 | 63 - 160 | @ 100 | 1.4 | @1000 | 25 | 50 | | 800 | 5.0 | TO5-1 | BC161-10 |
| **BC141-16** | 60 | 100 - 250 | @ 100 | 1.4 | @1000 | 25 | 50 | | 800 | 5.0 | TO5-1 | BC161-16 |
| **BC141-25** | 60 | 160 - 400 | @ 150 | 1.4 | @1000 | 25 | 50 | | 800 | 5.0 | TO5-1 | BC161-25 |
| 2N871 | 60 | 100 - 300 | @ 150 | 5.00 | @ 150 | 15 | 60 | | 500 | 1.8 | TO18-1 | 2N2907A |
| 2N4960 | 60 | 100 - 300 | @ 150 | 0.18 | @ 150 | 15 | 250 | 1000 | 800 | 3.5 | TO5-1 | 2N2905A |

## NPN GENERAL PURPOSE AMPLIFIER AND SWITCHING TRANSISTORS (Cont'd) (BY ASCENDING $V_{CEO}$) METAL PACKAGE

(ALSO SEE LOW LEVEL AND HIGH VOLTAGE SECTION)

| TYPE | $V_{CEO}$ ($V_{CER}$) VOLTS MIN | $h_{FE}$ $h_{FE}$ MIN - MAX | @ $I_C$ mA | $V_{CE(sat)}$ VOLTS MAX | @ $I_C$ mA | $C_{ob}$ pF MAX | $f_T$ MHz MIN | $t_{off}$ ns MAX | $P_D$ $T_A$ 25°C mW | $T_C$ 25°C W | Package | PNP Complement |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2N4962 | 60 | 100 - 300 | @ 150 | 0.18 | @ 150 | 15 | 250 | 1000 | 500 | 1.5 | TO18-1 | 2N2907A |
| 2N3107 | 60 | 100 - 300 | @ 150 | 0.25 | @ 150 | 20 | 70 | | 800 | 5.0 | TO18-1 | 2N4032 |
| 2N720 | 60 | 40 - 120 | @ 150 | 5.00 | @ 150 | 20 | 50 | | 500 | 1.8 | TO18-1 | 2N2906A |
| 2N3108 | 60 | 40 - 120 | @ 150 | 0.25 | @ 150 | 20 | 60 | | 800 | 5.0 | TO5-1 | 2N4030 |
| 2N719A | 60 | 20 - 60 | @ 150 | 5.00 | @ 150 | 15 | 40 | | 500 | 1.8 | TO18-1 | 2N2906A |
| 2N719 | 60 | 20 - 60 | @ 150 | 5.00 | @ 150 | 20 | 60 | | 500 | 1.8 | TO18-1 | 2N2906A |
| **BC142** | 60 | 20 | @ 200 | 0.4 | @ 200 | | | | 800 | 5.0 | TO5-1 | BC143 |
| **BC286** | 60 | 20 - 180 | @ 500 | 0.40 | @ 500 | 12 (Typ) | 100 (Typ) | | 800 | 4.0 | TO5-1 | BC287 |
| 2N3666 | 80 | 100 - 300 | @ 150 | 1.20 | @ 150 | 12 | 60 | | | 5.0 | TO5-1 | 2N4033 |
| 2N3019 | 80 | 100 - 300 | @ 150 | 0.20 | @ 150 | 12 | 100 | | 800 | 5.0 | TO5-1 | 2N4033 |
| 2N3700 | 80 | 100 - 300 | @ 150 | 0.20 | @ 150 | 12 | 100 | | 500 | 1.8 | TO18-1 | |
| 2N4961 | 80 | 100 - 300 | @ 150 | 0.18 | @ 150 | 15 | 250 | 1000 | 800 | 3.5 | TO5-1 | 2N4033 |
| 2N4963 | 80 | 100 - 300 | @ 150 | 0.18 | @ 150 | 15 | 250 | 1000 | 500 | 1.5 | TO18-1 | |
| 2N3665 | 80 | 40 - 120 | @ 150 | 1.20 | @ 150 | 12 | 60 | | | 5.0 | TO5-1 | 2N4031 |
| 2N3020 | 80 | 40 - 120 | @ 150 | 0.20 | @ 150 | 12 | 80 | | 800 | 5.0 | TO5-1 | 2N4031 |
| 2N3701 | 80 | 40 - 120 | @ 150 | 0.20 | @ 150 | 12 | 80 | | 500 | 1.8 | TO18-1 | |
| 2N720A | 80 | 40 - 120 | @ 150 | 5.00 | @ 150 | 15 | 50 | | 500 | 1.8 | TO18-1 | |
| 2N1893 | 80 | 40 - 120 | @ 150 | 5.00 | @ 150 | 15 | 50 | | 800 | 3.0 | TO5-1 | 2N4031 |
| 2N699 | (80) | 40 - 120 | @ 150 | 5.00 | @ 150 | 20 | 50 | | 600 | 2.0 | TO5-1 | 2N4030 |

# TRANSISTORS—SMALL SIGNAL

## NPN GENERAL PURPOSE AMPLIFIER AND SWITCHING TRANSISTORS (BY ASCENDING $V_{CEO}$) PLASTIC PACKAGE

(ALSO SEE LOW LEVEL AND HIGH VOLTAGE SECTION)

| TYPE | $V_{CEO}$ ($V_{CER}$) VOLTS MIN | $h_{FE}$ ($h_{fe}$) $h_{FE}$ MIN - MAX | @ $I_C$ mA | $V_{CE(sat)}$ VOLTS MAX | @ $I_C$ mA | $C_{ob}$ pF MAX | $f_T$ MHz MIN | $t_{off}$ ns MAX | $P_D$ $T_A$ 25°C mW | $T_C$ 25°C W | Package | PNP Complement |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2N5128 | 12 | 35 - 350 | @ 50 | 0.25 | @ 150 | 10 | 200 | | 300 | 0.7 | TO5-4 | 2N5142 |
| PN5128 | 12 | 35 - 350 | @ 50 | 0.25 | @ 150 | 10 | 200 | | 625 | 1.0 | TO92-1 | PN5142 |
| 2N5129 | 12 | 35 - 350 | @ 50 | 0.25 | @ 150 | 10 | 200 | | 200 | 0.5 | TO18-4 | 2N5143 |
| PN5129 | 12 | 35 - 350 | @ 50 | 0.25 | @ 150 | 10 | 200 | | 625 | 1.0 | TO92-1 | PN5143 |
| 2N5219 | 15 | 35 - 500 | @ 2.0 | 0.40 | @ 2.0 | 4.0 | 150 | | 625 | | TO92-1 | 2N3221 |
| 2N5131 | 15 | 30 - 500 | @ 10 | 1.00 | @ 10 | 6.0 | 100 | | 200 | 0.5 | TO18-4 | 2N5139 |
| PN5131 | 15 | 30 - 500 | @ 10 | 1.00 | @ 10 | 6.0 | 100 | | 625 | 1.0 | TO92-1 | PN5139 |
| 2N5220 | 15 | 30 - 600 | @ 50 | 0.50 | @ 50 | 10 | 100 | | 625 | | TO92-1 | 2N5226 |
| MPS2712 | 18 | 75 - 225 | @ 2.0 | | | 4.0 | | | 625 | 1.0 | TO92-1 | 2N4126 |
| MPS2711 | 18 | 30 - 90 | @ 2.0 | | | 4.0 | | | 625 | 1.0 | TO92-1 | 2N4125 |
| 2N5223 | 20 | 50 - 800 | @ 2.0 | 0.70 | @ 2.0 | 4.0 | 150 | | 625 | | TO92-1 | 2N5227 |
| SE2002 | 20 | 100 - 400 | @ 10 | 0.70 | @ 10 | 6.0 | 200 | | 200 | 0.5 | TO18-4 | 2N4122 |
| SE2001 | 20 | 40 - 160 | @ 10 | 0.70 | @ 10 | 6.0 | 200 | | 200 | 0.5 | TO18-4 | 2N4121 |
| 2N5132 | 20 | 30 - 400 | @ 10 | 2.00 | @ 10 | 3.5 | 200 | | 200 | 0.5 | TO18-4 | 2N4121 |
| PN5132 | 20 | 30 - 400 | @ 10 | 2.00 | @ 10 | 3.5 | 200 | | 625 | 1.0 | TO92-1 | PN4125 |
| MPS3706 | 20 | 30 - 600 | @ 50 | 1.00 | @ 50 | 12 | 100 | | 625 | 1.0 | TO92-1 | MPS3702 |
| 2N5136 | 20 | 20 - 400 | @ 150 | 0.25 | @ 150 | 35 | 40 | | 220 | 0.6 | TO5-4 | 2N5142 |
| PN5136 | 20 | 20 - 400 | @ 150 | 0.25 | @ 150 | 35 | 40 | | 625 | 1.0 | TO92-1 | 2N5142 |
| 2N5137 | 20 | 20 - 400 | @ 150 | 0.25 | @ 150 | 35 | 40 | | 220 | 0.6 | TO18-4 | 2N5143 |
| PN5137 | 20 | 20 - 400 | @ 150 | 0.25 | @ 150 | 35 | 40 | | 625 | 1.0 | TO92-1 | 2N5143 |
| MPS6561 | 20 | 50 - 200 | @ 350 | 0.50 | @ 150 | 30 | 60 | | 625 | 1.0 | TO92-1 | MPS6563 |
| MPS6515 | 25 | 250 - 500 | @ 2.0 | 0.50 | @ 2.0 | 3.5 | | | 625 | 1.0 | TO92-1 | MPS6519 |
| MPS2925 | 25 | (235 - 470) | @ 2.0 | | | 12 | | | 625 | 1.0 | TO92-1 | 2N4126 |
| MPS3392 | 25 | 150 - 300 | @ 2.0 | | | 3.5 | | | 625 | 1.0 | TO92-1 | 2N4126 |
| MPS6514 | 25 | 150 - 300 | @ 2.0 | 0.50 | @ 2.0 | 3.5 | | | 625 | 1.0 | TO92-1 | MPS6518 |
| MPS2924 | 25 | (150 - 300) | @ 2.0 | | | 12 | | | 625 | 1.0 | TO92-1 | 2N4126 |
| MPS3395 | 25 | 150 - 500 | @ 2.0 | | | 3.5 | | | 625 | 1.0 | TO92-1 | 2N4126 |
| 2N4124 | 25 | 120 - 360 | @ 2.0 | 0.30 | @ 2.0 | 4.0 | 300 | | 625 | | TO92-1 | 2N4126 |
| EN4124 | 25 | 120 - 360 | @ 2.0 | 0.30 | @ 2.0 | 4.0 | 300 | | 200 | | TO18-4 | EN4126 |
| MPS3393 | 25 | 90 - 180 | @ 2.0 | | | 3.5 | | | 625 | 1.0 | TO92-1 | 2N4126 |
| MPS2923 | 25 | (90 - 180) | @ 2.0 | | | 12 | | | 625 | 1.0 | TO92-1 | 2N4126 |
| MPS3721 | 25 | 60 - 660 | @ 2.0 | | | 3.5 | | | 625 | 1.0 | TO92-1 | 2N4125 |
| MPS3394 | 25 | 55 - 110 | @ 2.0 | | | 3.5 | | | 625 | 1.0 | TO92-1 | 2N4125 |
| MPS2926 | 25 | (35 - 470) | @ 2.0 | | | 3.5 | | | 625 | 1.0 | TO92-1 | 2N4125 |
| EN5172 | 25 | 100 - 500 | @ 10 | 0.25 | @ 10 | 12 | | | 200 | 0.5 | TO18-4 | 2N4122 |
| MPS5172 | 25 | 100 - 500 | @ 10 | 0.25 | @ 10 | 12 | | | 625 | 1.0 | TO92-1 | 2N4126 |
| EN916 | 25 | 50 - 200 | @ 10 | 0.50 | @ 10 | 6.0 | 300 | | 200 | 0.5 | TO18-4 | 2N4121 |
| 2N5135 | 25 | 50 - 600 | @ 10 | 1.00 | @ 100 | 25 | 40 | | 300 | 0.8 | TO5-4 | 2N5142 |
| PN5135 | 25 | 50 - 600 | @ 10 | 1.00 | @ 100 | 25 | 40 | | 625 | 1.0 | TO92-1 | PN5142 |
| 2N5225 | 25 | 30 - 600 | @ 50 | 0.80 | @ 50 | 20 | 50 | | 625 | | TO92-1 | 2N5226 |
| MPS6560 | 25 | 50 - 200 | @ 500 | 0.50 | @ 500 | 30 | 60 | | 625 | 1.0 | TO92-1 | MPS6562 |
| MPS6513 | 30 | 90 - 180 | @ 2.0 | 0.50 | @ 2.0 | 3.5 | | | 625 | 1.0 | TO92-1 | MPS6517 |
| MPS6512 | 30 | 50 - 100 | @ 2.0 | 0.50 | @ 2.0 | 3.5 | | | 625 | 1.0 | TO92-1 | MPS6516 |
| 2N4123 | 30 | 50 - 150 | @ 2.0 | 0.30 | @ 2.0 | 4.0 | 250 | | 625 | | TO92-1 | 2N4125 |
| EN4123 | 30 | 50 - 150 | @ 2.0 | 0.30 | @ 2.0 | 4.0 | 250 | | 200 | | TO18-4 | EN4125 |
| 2N3566 | 30 | 50 - 160 | @ 10 | 1.00 | @ 100 | 25 | 40 | | 300 | 0.8 | TO5-4 | 2N3638A |

## NPN GENERAL PURPOSE AMPLIFIER AND SWITCHING TRANSISTORS (BY ASCENDING $V_{CEO}$) PLASTIC PACKAGE

(ALSO SEE LOW LEVEL AND HIGH VOLTAGE SECTION)

| TYPE | $V_{CEO}$ ($V_{CER}$) VOLTS MIN | $h_{FE}$ ($h_{fe}$) $h_{FE}$ MIN - MAX | @ $I_C$ mA | $V_{CE(sat)}$ VOLTS MAX | @ $I_C$ mA | $C_{ob}$ pF MAX | $f_T$ MHz MIN | $t_{off}$ ns MAX | $P_D$ $T_A$ 25°C mW | $T_C$ 25°C W | Package | PNP Complement |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PN3566 | 30 | 50 - 160 | @ 10 | 1.00 | @ 100 | 25 | 40 | | 625 | 1.0 | TO92-1 | 2N3638A |
| MPS3704 | 30 | 100 - 300 | @ 50 | 0.60 | @ 50 | 12 | 100 | | 625 | 1.0 | TO92-1 | 2N4403 |
| MPS3705 | 30 | 50 - 150 | @ 50 | 0.80 | @ 50 | 12 | 100 | | 625 | 1.0 | TO92-1 | 2N4402 |
| MPS6532 | 30 | 30 | @ 100 | 0.50 | @ 100 | 5.0 | | | 625 | 1.0 | TO92-1 | MPS6535M |
| **BC125** | 30 | 30 | @ 150 | 25 | @ 150 | 25 | 40 | | 300 | 0.8 | TO5-4 | BC126 |
| 2N3643 | 30 | 100 - 300 | @ 150 | 0.22 | @ 150 | 8.0 | 250 | | 350 | 0.7 | TO5-4 | 2N3638A |
| PN3643 | 30 | 100 - 300 | @ 150 | 0.22 | @ 150 | 8.0 | 250 | | 625 | 1.0 | TO92-1 | MPS3638A |
| EN2219 | 30 | 100 - 300 | @ 150 | 0.40 | @ 150 | 8.0 | 250 | | 200 | 0.5 | TO5-4 | EN2905 |
| PN2219 | 30 | 100 - 300 | @ 150 | 0.40 | @ 150 | 8.0 | 250 | | 625 | 1.0 | TO92-1 | PN2905 |
| EN2222 | 30 | 100 - 300 | @ 150 | 0.40 | @ 150 | 8.0 | 250 | | 200 | 0.5 | TO18-4 | EN2907 |
| PN2222 | 30 | 100 - 300 | @ 150 | 0.40 | @ 150 | 8.0 | 250 | | 625 | 1.0 | TO92-1 | PN2907 |
| 2N3641 | 30 | 40 - 120 | @ 150 | 0.22 | @ 150 | 8.0 | 250 | | 350 | 0.7 | TO5-4 | 2N3638 |
| PN3641 | 30 | 40 - 120 | @ 150 | 0.22 | @ 150 | 8.0 | 250 | | 625 | 1.0 | TO92-1 | MPS3638 |
| PN2218 | 30 | 40 - 120 | @ 150 | 0.40 | @ 150 | 8.0 | 250 | | 625 | 1.0 | TO92-1 | PN2904 |
| EN697 | 30 | 40 - 120 | @ 150 | 1.50 | @ 150 | 35 | 50 | | 300 | 0.8 | TO5-4 | 2N3638 |
| MPSA10 | 40 | 40 - 400 | @ 5.0 | | | 4.0 | 50 | | 625 | 1.0 | TO92-1 | 2N3905 |
| MPSA20 | 40 | 40 - 400 | @ 5.0 | 0.25 | @ 5.0 | 4.0 | 125 | | 625 | 1.0 | TO92-1 | 2N3905 |
| 2N3904 | 40 | 100 - 300 | @ 10 | 0.20 | @ 10 | 4.0 | 300 | 225 | 625 | | TO92-1 | 2N3906 |
| EN3904 | 40 | 100 - 300 | @ 10 | 0.30 | @ 10 | 4.0 | 300 | 225 | 200 | 0.5 | TO18-4 | EN3906 |
| 2N3903 | 40 | 50 - 150 | @ 10 | 0.20 | @ 10 | 4.0 | 250 | 225 | 625 | | TO92-1 | 2N3905 |
| EN3903 | 40 | 50 - 150 | @ 10 | 0.20 | @ 10 | 4.0 | 250 | 225 | 200 | 0.5 | TO18-4 | EN3905 |
| MPS6531 | 40 | 90 - 270 | @ 100 | 0.30 | @ 100 | 5.0 | | | 625 | 1.0 | TO92-1 | MPS6534M |
| MPS6530 | 40 | 40 - 120 | @ 100 | 0.50 | @ 100 | 5.0 | | | 625 | 1.0 | TO92-1 | MPS6535M |
| 2N4401 | 40 | 100 - 300 | @ 150 | 0.40 | @ 150 | 6.5 | 250 | 225 | 625 | | TO92-1 | 2N4403 |
| 2N3569 | 40 | 100 - 300 | @ 150 | 0.25 | @ 150 | 20 | 60 | | 300 | 0.8 | TO5-4 | 2N4355 |
| PN3569 | 40 | 100 - 300 | @ 150 | 0.25 | @ 150 | 20 | 60 | | 625 | 1.0 | TO92-1 | MPS4355 |
| PN2219A | 40 | 100 - 300 | @ 150 | 0.30 | @ 150 | 8.0 | 300 | 285 | 625 | 1.0 | TO92-1 | PN2905A |
| PN2222A | 40 | 100 - 300 | @ 150 | 0.30 | @ 150 | 8.0 | 300 | 285 | 625 | 1.0 | TO92-1 | PN2907A |
| EN1711 | 40 | 100 - 300 | @ 150 | 1.50 | @ 150 | 25 | 70 | | 300 | 0.8 | TO5-4 | EN2905 |
| PN1711 | 40 | 100 - 300 | @ 150 | 1.50 | @ 150 | 25 | 70 | | 625 | 1.0 | TO92-1 | PN2905 |
| EN956 | 40 | 100 - 300 | @ 150 | 1.50 | @ 150 | 25 | 70 | | 220 | 0.6 | TO18-4 | EN2907 |
| 2N4400 | 40 | 50 - 150 | @ 150 | 0.40 | @ 150 | 6.5 | 200 | 255 | 625 | | TO92-1 | 2N4402 |
| 2N3567 | 40 | 40 - 120 | @ 150 | 0.25 | @ 150 | 20 | 60 | | 300 | 0.8 | TO5-4 | 2N4354 |
| PN3567 | 40 | 40 - 120 | @ 150 | 0.25 | @ 150 | 20 | 60 | | 625 | 1.0 | TO92-1 | MPS4354 |
| PN2218A | 40 | 40 - 120 | @ 150 | 0.30 | @ 150 | 8.0 | 250 | 285 | 625 | 1.0 | TO92-1 | PN2904A |
| PN2221A | 40 | 40 - 120 | @ 150 | 0.30 | @ 150 | 8.0 | 250 | 285 | 625 | 1.0 | TO92-1 | PN2906A |
| EN718A | 40 | 40 - 120 | @ 150 | 1.50 | @ 150 | 25 | 60 | | 220 | 0.6 | TO18-4 | EN2907 |
| EN1613 | 40 | 40 - 120 | @ 150 | 1.50 | @ 150 | 25 | 60 | | 300 | 0.8 | TO5-4 | EN2905 |
| PN1613 | 40 | 40 - 120 | @ 150 | 1.50 | @ 150 | 25 | 60 | | 625 | 1.0 | TO92-1 | PN2905 |
| 2N3694 | 45 | 100 - 400 | @ 10 | | | 3.5 | 200 | | 200 | 0.5 | TO18-4 | 2N4122 |
| MPS3694 | 45 | 100 - 400 | @ 10 | | | 3.5 | 200 | | 625 | 1.0 | TO92-1 | 2N3906 |
| SE1002 | 45 | 100 - 400 | @ 10 | 2.00 | @ 10 | 3.5 | 200 | | 200 | 0.5 | TO18-4 | 2N4122 |
| MPS6566 | 45 | 100 - 400 | @ 10 | 0.40 | @ 10 | 3.5 | 200 | | 625 | 1.0 | TO92-1 | 2N3906 |
| **BC134** | 45 | 150 - 400 | @ 10 | | | 3.5 | 200 | | 300 | 0.8 | TO18-4 | |
| MPS6565 | 45 | 40 - 160 | @ 10 | 0.40 | @ 10 | 3.5 | 200 | | 625 | 1.0 | TO92-1 | 2N3905 |

# TRANSISTORS—SMALL SIGNAL

## NPN GENERAL PURPOSE AMPLIFIER AND SWITCHING TRANSISTORS (BY ASCENDING $V_{CEO}$) PLASTIC PACKAGE (Cont'd)

(ALSO SEE LOW LEVEL AND HIGH VOLTAGE SECTION)

| TYPE | $V_{CEO}$ ($V_{CER}$) VOLTS MIN | $h_{FE}$ ($h_{fe}$) $h_{FE}$ MIN - MAX | @ $I_C$ mA | $V_{CE(sat)}$ VOLTS MAX | @ $I_C$ mA | $C_{ob}$ pF MAX | $f_T$ MHz MIN | $t_{off}$ ns MAX | $P_D$ $T_A$ 25°C mW | $T_C$ 25°C W | Package | PNP Complement |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BC118** | 45 | 40 - 160 | @ 10 | | | 3.5 | 200 | | 310 | 0.8 | TO18-4 | |
| 2N3693 | 45 | 40 - 160 | @ 10 | | | 3.5 | 200 | | 200 | 0.5 | TO18-4 | 2N4121 |
| MPS3693 | 45 | 40 - 160 | @ 10 | | | 3.5 | 200 | | 625 | 1.0 | TO92-1 | 2N3905 |
| SE1001 | 45 | 40 - 160 | @ 10 | 2.0 | @ 10 | 3.5 | 200 | | 200 | 0.5 | TO18-4 | 2N4121 |
| 2N3642 | 45 | 40 - 120 | @ 150 | 0.22 | @ 150 | 8.0 | 250 | | 350 | 0.7 | TO5-4 | 2N3644 |
| PN3642 | 45 | 40 - 120 | @ 150 | 0.22 | @ 150 | 8.0 | 250 | | 625 | 1.0 | TO92-1 | PN3644 |
| 2N4409 | 50 | 60 - 400 | @ 1.0 | 0.2 | @ 1.0 | 12 | 60 | | 625 | | TO92-1 | MPSA55 |
| EN915 | 50 | 50 - 200 | @ 10 | 1.0 | @ 10 | 3.5 | 250 | | 200 | 0.5 | TO18-4 | 2N4122 |
| MPSA05 | 60 | 50 | @ 100 | 0.25 | @ 100 | | 50 | | 625 | 1.0 | TO92-1 | MPSA55 |
| **BC537** | 60 | 40 - 400 | @ 100 | 0.5 | @1000 | 15 | 100 | | 625 | 1.0 | TO92-1 | BC527 |
| **BC537-6** | 60 | 40 - 100 | @ 100 | 0.5 | @1000 | 15 | 100 | | 625 | 1.0 | TO92-1 | BC527-6 |
| **BC537-10** | 60 | 63 - 160 | @ 100 | 0.5 | @1000 | 15 | 100 | | 625 | 1.0 | TO92-1 | BC527-10 |
| **BC537-16** | 60 | 100 - 250 | @ 100 | 0.5 | @1000 | 15 | 100 | | 625 | 1.0 | TO92-1 | BC527-16 |
| **BC537-25** | 60 | 160 - 400 | @ 100 | 0.5 | @1000 | 15 | 100 | | 625 | 1.0 | TO92-1 | BC527-25 |
| PE6020 | 60 | 100 - 300 | @ 150 | 0.18 | @ 150 | 15 | 250 | | 625 | 1.0 | TO92-1 | PN3645 |
| SE6020 | 60 | 100 - 300 | @ 150 | 0.18 | @ 150 | 15 | 250 | 1000 | 300 | 0.8 | TO5-4 | 2N3645 |
| EN871 | 60 | 100 - 300 | @ 150 | 5.0 | @ 150 | 20 | 60 | | 220 | 0.6 | TO18-4 | |
| 2N5856 | 60 | 50 - 300 | @ 150 | 0.4 | @ 150 | 12 | 12 | 200 | 750 | | TO5-4 | 2N5855 |
| EN870 | 60 | 40 - 120 | @ 150 | 5.0 | @ 150 | 20 | 50 | | 220 | 0.6 | TO18-4 | |
| 2N3568 | 60 | 40 - 120 | @ 150 | 0.25 | @ 150 | 20 | 60 | | 300 | 0.8 | TO5-4 | 2N4354 |
| PN3568 | 60 | 40 - 120 | @ 150 | 0.25 | @ 150 | 20 | 60 | | 625 | 1.0 | TO92-1 | MPS4354 |
| 2N4410 | 80 | 60 - 400 | @ 10 | 0.2 | @ 1.0 | 12 | 60 | | 625 | | TO92-1 | MPSA56 |
| **BC535** | 80 | 50 | @ 100 | 0.25 | @ 100 | | 50 | | 625 | 1.0 | TO92-1 | BC534 |
| MPSA06 | 80 | 50 | @ 100 | 0.25 | @ 100 | | 50 | | 625 | 1.0 | TO92-1 | MPSA56 |
| PE6021 | 80 | 100 - 300 | @ 150 | 0.18 | @ 150 | 15 | 250 | 1000 | 625 | 1.0 | TO92-1 | |
| SE6021 | 80 | 100 - 300 | @ 150 | 0.18 | @ 150 | 15 | 250 | 1000 | 300 | 0.8 | TO5-4 | 2N4356 |
| **BC538** | 80 | 40 - 400 | @ 100 | 0.5 | @1000 | 15 | 100 | | 625 | 1.0 | TO92-1 | BC528 |
| **BC538-6** | 80 | 40 - 100 | @ 100 | 0.5 | @1000 | 15 | 100 | | 625 | 1.0 | TO92-1 | BC528-6 |
| **BC538-10** | 80 | 63 - 160 | @ 100 | 0.5 | @1000 | 15 | 100 | | 625 | 1.0 | TO92-1 | BC528-10 |
| **BC538-16** | 80 | 100 - 250 | @ 100 | 0.5 | @1000 | 15 | 100 | | 625 | 1.0 | TO92-1 | BC528-16 |
| **BC538-25** | 80 | 160 - 400 | @ 100 | 0.5 | @1000 | 15 | 100 | | 625 | 1.0 | TO92-1 | BC528-25 |
| 2N5858 | 80 | 50 - 300 | @ 150 | 0.4 | @ 150 | 12 | 200 | | 750 | | TO105 | 2N5857 |
| PN1893 | 80 | 40 - 120 | @ 150 | 5.0 | @ 150 | 15 | 50 | | 625 | 1.0 | TO92-1 | MPSA56 |

## PNP GENERAL PURPOSE AMPLIFIER AND SWITCHING TRANSISTORS (BY ASCENDING $V_{CEO}$)

### METAL PACKAGE

(ALSO SEE LOW LEVEL AND HIGH VOLTAGE SECTION)

| TYPE | $V_{CEO}$ ($V_{CER}$) VOLTS MIN | $h_{FE}$ $h_{FE}$ MIN - MAX | @ $I_C$ mA | $V_{CE(sat)}$ VOLTS MAX | @ $I_C$ mA | $C_{ob}$ pF MAX | $f_T$ MHz MIN | $t_{off}$ ns MAX | $P_D$ $T_A$ 25°C mW | $T_C$ 25°C W | Package | NPN Complement |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2N869 | 18 | 20 | @ 10 | 1.0 | @ 10 | 9.0 | 100 | | 360 | 1.2 | TO18-1 | 2N916 |
| 2N869A | 18 | 40 - 120 | @ 30 | 0.2 | @ 30 | 6.0 | 400 | 80 | 360 | 1.2 | TO18-1 | 2N914 |
| **BCY72** | 25 | 50 | @ 10 | 0.25 | @ 10 | 6.0 | 200 | | 360 | 1.2 | TO18-1 | |
| **BFX48** | 30 | 90 | @ 10 | 0.3 | @ 50 | 3.5 | 400 | | 360 | 1.0 | TO18-1 | |
| **BC283** | 30 | 40 - 270 | @ 50 | 0.3 | @ 50 | 7.0 (Typ) | 200 (Typ) | | 400 | 1.3 | TO18-1 | |
| 2N3134 | 35 | 100 - 300 | @ 150 | 0.6 | @ 150 | 10 | 200 | 150 | 600 | 3.0 | TO5-1 | 2N2219 |
| 2N722 | 35 | 30 - 90 | @ 150 | 1.5 | @ 150 | 45 | 60 | | 400 | 1.5 | TO18-1 | 2N718 |
| 2N1132 | 35 | 30 - 90 | @ 150 | 1.5 | @ 150 | 45 | 60 | | 600 | 2.0 | TO5-1 | 2N1613 |
| 2N4035 | 40 | 150 - 300 | @ 10 | 0.14 | @ 10 | 3.5 | 450 | 150 | 360 | 1.0 | TO18-1 | 2N3947 |
| 2N3251 | 40 | 100 - 300 | @ 10 | 0.25 | @ 10 | 6.0 | 300 | 250 | 360 | 1.2 | TO18-1 | 2N3947 |
| **BFY64** | 40 | 80 | @ 10 | 0.3 | @ 50 | 10 | 200 | 120 | 700 | 3.0 | TO5-1 | |
| 2N4034 | 40 | 70 - 200 | @ 10 | 0.14 | @ 10 | 3.5 | 400 | 150 | 360 | 1.0 | TO18-1 | 2N3946 |
| **BCY70** | 40 | 50 - | @ 10 | 0.25 | @ 10 | 6.0 | 200 | | 360 | 1.2 | TO18-1 | |
| 2N3250 | 40 | 50 - 150 | @ 10 | 0.25 | @ 10 | 6.0 | 250 | 225 | 360 | 1.2 | TO18-1 | 2N3946 |
| **BC139** | 40 | 40 | @ 50 | 1.2 | @ 500 | 10 | 40 | | 700 | 3.0 | TO5-1 | BC119 |
| **BC160** | 40 | 40 - 400 | @ 100 | 1.4 | @1000 | 25 | 50 | | 800 | 5.0 | TO5-1 | BC140 |
| **BC160-6** | 40 | 40 - 100 | @ 100 | 1.4 | @1000 | 25 | 50 | | 800 | 5.0 | TO5-1 | BC140-6 |
| **BC160-10** | 40 | 63 - 160 | @ 100 | 1.4 | @1000 | 25 | 50 | | 800 | 5.0 | TO5-1 | BC140-10 |
| **BC160-16** | 40 | 100 - 250 | @ 100 | 1.4 | @1000 | 25 | 50 | | 800 | 5.0 | TO5-1 | BC140-16 |
| **BC160-25** | 40 | 160 - 400 | @ 100 | 1.4 | @1000 | 25 | 50 | | 800 | 5.0 | TO5-1 | BC140-25 |
| 2N2905 | 40 | 100 - 300 | @ 150 | 0.4 | @ 150 | 8.0 | 200 | 110 | 600 | 3.0 | TO5-1 | 2N2218A |
| 2N2907 | 40 | 100 - 300 | @ 150 | 0.4 | @ 150 | 8.0 | 200 | 110 | 400 | 1.8 | TO18-1 | 2N2222A |
| 2N4037 | 40 | 50 - 250 | @ 150 | 1.4 | @ 150 | | 60 | | 1000 | | TO5-2 | 2N3110 |
| 2N2904 | 40 | 40 - 120 | @ 150 | 0.4 | @ 150 | 8.0 | 200 | 110 | 600 | 3.0 | TO5-1 | 2N2218A |
| 2N2906 | 40 | 40 - 120 | @ 150 | 0.4 | @ 150 | 8.0 | 200 | 110 | 400 | 1.8 | TO18-1 | 2N2221A |
| **BCY71** | 45 | 100 - 600 | @ 10 | 0.25 | @ 10 | 6.0 | 200 | | 360 | 1.2 | TO18-1 | |
| 2N3502 | 45 | 115 - 300 | @ 50 | 0.25 | @ 50 | 8.0 | 200 | 100 | 700 | 3.0 | TO5-1 | 2N2219A |
| 2N3504 | 45 | 115 - 300 | @ 50 | 0.25 | @ 50 | 8.0 | 200 | 100 | 400 | 1.3 | TO18-1 | 2N2222A |
| **BFX38** | 55 | 85 | @ 100 | 0.5 | @ 500 | 20 | 100 | 400 | 800 | 4.0 | TO5-1 | |
| **BFX39** | 55 | 40 | @ 100 | 0.5 | @ 500 | 20 | 100 | 400 | 800 | 4.0 | TO5-1 | BFY56 |
| 2N3251A | 60 | 100 - 300 | @ 10 | 0.25 | @ 10 | 6.0 | 300 | 250 | 360 | 1.2 | TO18-1 | 2N871 |
| 2N3250A | 60 | 50 - 150 | @ 10 | 0.25 | @ 10 | 6.0 | 250 | 225 | 360 | 1.2 | TO18-1 | |
| 2N3503 | 60 | 115 - 300 | @ 50 | 0.25 | @ 50 | 8.0 | 200 | 100 | 700 | 3.0 | TO5-1 | 2N3107 |
| 2N3505 | 60 | 115 - 300 | @ 50 | 0.25 | @ 50 | 8.0 | 200 | 100 | 400 | 1.3 | TO18-1 | 2N871 |
| 2N3072 | 60 | 30 - 130 | @ 50 | 0.25 | @ 50 | 10 | 130 | 100 | 800 | 3.0 | TO5-1 | 2N3108 |
| 2N3073 | 60 | 30 - 130 | @ 50 | 0.25 | @ 50 | 10 | 130 | 100 | 360 | 1.2 | TO18-1 | |
| **BC161** | 60 | 40 - 400 | @ 100 | 1.4 | @1000 | 25 | 50 | | 800 | 5.0 | TO5-1 | BC141 |
| **BC161-6** | 60 | 40 - 100 | @ 100 | 1.4 | @1000 | 25 | 50 | | 800 | 5.0 | TO5-1 | BC141-6 |
| **BC161-10** | 60 | 63 - 160 | @ 100 | 1.4 | @1000 | 25 | 50 | | 800 | 5.0 | TO5-1 | BC141-10 |
| **BC161-16** | 60 | 100 - 250 | @ 100 | 1.4 | @1000 | 25 | 50 | | 800 | 5.0 | TO5-1 | BC141-16 |
| **BC161-25** | 60 | 150 - 400 | @ 100 | 1.4 | @1000 | 25 | 50 | | 800 | 5.0 | TO5-1 | BC141-25 |
| 2N4032 | 60 | 100 - 300 | @ 100 | 0.15 | @ 150 | 20 | 150 | | 800 | 4.0 | TO5 | 2N3107 |
| 2N4030 | 60 | 40 - 120 | @ 100 | 0.15 | @ 150 | 20 | 100 | | 800 | 4.0 | TO5-1 | 2N3108 |
| 2N2905A | 60 | 100 - 300 | @ 150 | 0.4 | @ 150 | 8.0 | 200 | 110 | 600 | 3.0 | TO5-1 | 2N3107 |
| 2N2907A | 60 | 100 - 300 | @ 150 | 0.4 | @ 150 | 8.0 | 200 | 110 | 400 | 1.8 | TO18-1 | 2N871 |
| 2N2904A | 60 | 40 - 120 | @ 150 | 0.4 | @ 150 | 8.0 | 200 | 110 | 600 | 3.0 | TO5-1 | 2N3108 |

## PNP GENERAL PURPOSE AMPLIFIER AND SWITCHING TRANSISTORS (BY ASCENDING $V_{CEO}$) METAL PACKAGE (Cont'd)

(ALSO SEE LOW LEVEL AND HIGH VOLTAGE SECTION)

| TYPE | $V_{CEO}$ ($V_{CER}$) VOLTS MIN | $h_{FE}$ $h_{FE}$ MIN - MAX | @ $I_C$ mA | $V_{CE(sat)}$ VOLTS MAX | @ $I_C$ mA | $C_{ob}$ pF MAX | $f_T$ MHz MIN | $t_{off}$ ns MAX | $P_D$ $T_A$ 25°C mW | $T_C$ 25°C W | Package | NPN Complement |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2N2906A | 60 | 40 - 120 | @ 150 | 0.4 | @ 150 | 8.0 | 200 | 110 | 400 | 1.8 | TO18-1 | |
| **BC143** | 60 | 20 | @ 200 | 0.6 | @ 200 | | | | 700 | 3.0 | TO5-1 | BC142 |
| **BC287** | 60 | 20 - 200 | @ 500 | 0.45 | @ 500 | 13(Typ) | 200(Typ) | | 800 | 4.0 | TO5-1 | BC286 |
| 2N4036 | 65 | 20 - 200 | @ 150 | 0.65 | @ 150 | | 60 | 700 | | 7.0 | TO5-1 | 2N3108 |
| **BFX40** | 75 | 60 | @ 500 | 0.5 | @ 500 | 20 | 150 | | 800 | 4.0 | TO5-1 | |
| **BFX41** | 75 | 40 | @ 100 | 0.5 | @ 500 | 20 | 100 | 400 | 800 | 4.0 | TO5-1 | |
| 2N4033 | 80 | 100 - 300 | @ 100 | 0.15 | @ 150 | 20 | 150 | | 800 | 4.0 | TO5-1 | 2N3020 |
| 2N4031 | 80 | 40 - 120 | @ 100 | 0.15 | @ 150 | 20 | 100 | | 800 | 4.0 | TO5-1 | 2N3019 |

## PNP GENERAL PURPOSE AMPLIFIER AND SWITCHING TRANSISTORS (BY ASCENDING $V_{CEO}$) PLASTIC PACKAGE

(ALSO SEE LOW LEVEL AND HIGH VOLTAGE SECTION)

| TYPE | $V_{CEO}$ ($V_{CER}$) VOLTS MIN | $h_{FE}$ $h_{FE}$ MIN - MAX | @ $I_C$ mA | $V_{CE(sat)}$ VOLTS MAX | @ $I_C$ mA | $C_{ob}$ pF MAX | $f_T$ MHz MIN | $t_{off}$ ns MAX | $P_D$ $T_A$ 25°C mW | $T_C$ 25°C W | Package | NPN Complement |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2N5221 | 15 | 30 - 600 | @ 50 | 0.50 | @ 50 | 15 | 100 | | 625 | | TO92-1 | 2N5227 |
| 2N5139 | 20 | 30 | @ 10 | 0.20 | @ 10 | 5.0 | 300 | | 200 | 0.5 | TO18-4 | 2N5137 |
| PN5139 | 20 | 30 | @ 10 | 0.20 | @ 10 | 5.0 | 300 | | 625 | 1.0 | TO92-1 | PN5137 |
| 2N5142 | 20 | 30 | @ 50 | 0.50 | @ 50 | 30 | 100 | 200 | 300 | 0.7 | TO5-4 | 2N5136 |
| PN5142 | 20 | 30 | @ 50 | 0.50 | @ 50 | 30 | 100 | 200 | 625 | 1.0 | TO92-1 | PN5136 |
| 2N5143 | 20 | 30 | @ 50 | 0.50 | @ 50 | 30 | 100 | 200 | 200 | 0.5 | TO18-4 | 2N5137 |
| PN5143 | 20 | 30 | @ 50 | 0.50 | @ 50 | 30 | 100 | 200 | 625 | 1.0 | TO92-1 | PN5137 |
| MPS6563 | 20 | 50 - 200 | @ 350 | 0.50 | @ 350 | 30 | 60 | | 625 | 1.0 | TO92-1 | MPS6561 |
| MPS6519 | 25 | 250 - 500 | @ 2.0 | 0.50 | @ 2.0 | 4.0 | | | 625 | 1.0 | TO92-1 | MPS6515 |
| 2N4126 | 25 | 120 - 360 | @ 2.0 | 0.40 | @ 2.0 | 4.5 | 250 | | 625 | | TO92-1 | 2N4124 |
| EN4126 | 25 | 120 - 360 | @ 2.0 | 0.40 | @ 2.0 | 4.5 | 250 | | 200 | 0.5 | TO18-4 | EN4124 |
| 2N3638A | 25 | 100 | @ 50 | 0.25 | @ 50 | 10 | 150 | 170 | 300 | 0.7 | TO5-4 | 2N3643 |
| MPS3638A | 25 | 100 | @ 50 | 0.25 | @ 50 | 10 | 150 | 170 | 625 | 1.0 | TO92-1 | 2N4401 |
| MPS3702 | 25 | 60 - 300 | @ 50 | 0.25 | @ 50 | 12 | 100 | | 625 | 1.0 | TO92-1 | MPS3706 |
| 2N3638 | 25 | 30 | @ 50 | 0.25 | @ 50 | 20 | 100 | 170 | 300 | 0.7 | TO5-4 | 2N3641 |
| MPS3638 | 25 | 30 | @ 50 | 0.25 | @ 50 | 20 | 100 | 170 | 625 | 1.0 | TO92-1 | PN3641 |
| 2N5226 | 25 | 30 - 600 | @ 50 | 0.80 | @ 50 | 20 | 50 | | 625 | | TO92-1 | 2N5225 |
| MPS6562 | 25 | 50 - 200 | @ 500 | 0.50 | @ 500 | 30 | 60 | | 625 | 1.0 | TO92-1 | MPS6560 |
| 2N4125 | 30 | 50 - 150 | @ 2.0 | 0.40 | @ 2.0 | 4.5 | 200 | | 625 | | TO92-1 | 2N4123 |
| EN4125 | 30 | 50 - 150 | @ 2.0 | 0.40 | @ 2.0 | 4.5 | 200 | | 200 | 0.5 | TO18-4 | EN4123 |
| 2N5227 | 30 | 50 - 700 | @ 2.0 | 0.40 | @ 2.0 | 5.0 | 100 | | 625 | | TO92-1 | 2N4123 |
| 2N4917 | 30 | 150 - 300 | @ 10 | 0.14 | @ 10 | 4.5 | 450 | 150 | 200 | 0.5 | TO18-4 | 2N3694 |
| PN4917 | 30 | 150 - 300 | @ 10 | 0.14 | @ 10 | 4.5 | 200 | 150 | 625 | 1.0 | TO92-1 | |
| 2N4916 | 30 | 70 - 200 | @ 10 | 0.14 | @ 10 | 4.5 | 400 | 150 | 200 | 0.5 | TO18-4 | 2N3693 |
| PN4916 | 30 | 70 - 200 | @ 10 | 0.14 | @ 10 | 4.5 | 400 | 150 | 625 | 1.0 | TO92-1 | |
| MPS3703 | 30 | 30 - 150 | @ 50 | 0.25 | @ 50 | 12 | 100 | | 625 | 1.0 | TO92-1 | 2N4123 |
| MPS6535M | 30 | 30 | @ 100 | 0.50 | @ 100 | 8.0 | | | 625 | 1.0 | TO92-1 | MPS6533 |
| **BC126** | 30 | 30 - 120 | @ 150 | 0.50 | @ 150 | | | | 300 | 0.8 | TO5-4 | BC125 |
| EN722 | 35 | 30 - 90 | @ 150 | 1.50 | @ 150 | 45 | 60 | | 200 | 0.5 | TO18-4 | EN718 |
| EN1132 | 35 | 30 - 90 | @ 150 | 1.50 | @ 150 | 45 | 60 | | 200 | 0.5 | TO5-4 | EN1613 |
| MPS6518 | 40 | 150 - 300 | @ 2.0 | 0.50 | @ 2.0 | 4.0 | | | 625 | 1.0 | TO92-1 | MPS6514 |
| MPS6517 | 40 | 90 - 180 | @ 2.0 | 0.50 | @ 2.0 | 4.0 | | | 625 | 1.0 | TO92-1 | MPS6513 |
| MPS6516 | 40 | 50 - 100 | @ 2.0 | 0.50 | @ 2.0 | 4.0 | | | 625 | 1.0 | TO92-1 | MPS6512 |
| MPSA70 | 40 | 40 - 400 | @ 5.0 | 0.25 | @ 5.0 | 4.0 | 125 | | 625 | 1.0 | TO92-1 | MPSA20 |
| 2N4122 | 40 | 150 - 300 | @ 10 | 0.14 | @ 10 | 4.5 | 450 | 150 | 200 | 0.5 | TO18-4 | |
| 2N3906 | 40 | 100 - 300 | @ 10 | 0.25 | @ 10 | 4.5 | 250 | 300 | 625 | | TO92-1 | 2N3904 |
| EN3906 | 40 | 100 - 300 | @ 10 | 0.25 | @ 10 | 4.5 | 250 | 300 | 200 | 0.5 | TO18-4 | EN3904 |
| PN3251 | 40 | 50 - 150 | @ 10 | 0.25 | @ 10 | 6.0 | 250 | 225 | 625 | 1.0 | TO92-1 | 2N3903 |
| 2N4121 | 40 | 70 - 200 | @ 10 | 0.14 | @ 10 | 4.5 | 400 | 150 | 200 | 0.5 | TO18-4 | |
| 2N3905 | 40 | 50 - 150 | @ 10 | 0.25 | @ 10 | 4.5 | 200 | 260 | 625 | | TO92-1 | 2N3903 |
| EN3905 | 40 | 50 - 150 | @ 10 | 0.25 | @ 10 | 4.5 | 200 | 260 | 200 | 0.5 | TO18-4 | EN3903 |
| EN3250 | 40 | 50 - 150 | @ 10 | 0.25 | @ 10 | 6.0 | 250 | 225 | 200 | 0.5 | TO18-4 | EN3903 |
| PN3250 | 40 | 50 - 150 | @ 10 | 0.25 | @ 10 | 6.0 | 250 | 225 | 625 | 1.0 | TO92-1 | |
| MPS6534M | 40 | 90 - 270 | @ 100 | 0.30 | @ 100 | 8.0 | | | 625 | 1.0 | TO92-1 | MPS6532 |
| MPS6533M | 40 | 40 - 120 | @ 100 | 0.50 | @ 100 | 8.0 | | | 625 | 1.0 | TO92-1 | MPS6531 |
| **BC116A** | 40 | 80 - 240 | @ 150 | 0.40 | @ 150 | 8.0 | 130 | | 300 | 0.8 | TO5-4 | 2N3569 |

## PNP GENERAL PURPOSE AMPLIFIER AND SWITCHING TRANSISTORS (BY ASCENDING $V_{CEO}$) PLASTIC PACKAGE (Cont'd)

(ALSO SEE LOW LEVEL AND HIGH VOLTAGE SECTION)

| TYPE | $V_{CEO}$ ($V_{CER}$) VOLTS MIN | $h_{FE}$ $h_{FE}$ MIN - MAX | @ $I_C$ mA | $V_{CE(sat)}$ VOLTS MAX | @ $I_C$ mA | $C_{ob}$ pF MAX | $f_T$ MHz MIN | $t_{off}$ ns MAX | $P_D$ $T_A$ 25°C mW | $T_C$ 25°C W | Package | NPN Complement |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EN2905 | 40 | 100 - 300 | @ 150 | 0.40 | @ 150 | 8.0 | 150 | 110 | 300 | 0.7 | TO5-4 | EN2219 |
| PN2905 | 40 | 100 - 300 | @ 150 | 0.40 | @ 150 | 8.0 | 150 | 110 | 625 | 1.0 | TO92-1 | PN2219 |
| EN2907 | 40 | 100 - 300 | @ 150 | 0.40 | @ 150 | 8.0 | 150 | 110 | 200 | 0.5 | TO18-4 | EN2222 |
| PN2907 | 40 | 100 - 300 | @ 150 | 0.40 | @ 150 | 8.0 | 150 | 110 | 625 | 1.0 | TO92-1 | PN2222 |
| 2N4403 | 40 | 100 - 300 | @ 150 | 0.40 | @ 150 | 8.5 | 200 | 255 | 625 | | TO92-1 | 2N4401 |
| 2N4402 | 40 | 50 - 150 | @ 150 | 0.40 | @ 150 | 8.5 | 150 | 255 | 625 | | TO92-1 | 2N4400 |
| PN2904 | 40 | 40 - 120 | @ 150 | 0.40 | @ 150 | 8.0 | 200 | 110 | 625 | 1.0 | TO92-1 | PN2218 |
| PN2906 | 40 | 40 - 120 | @ 150 | 0.40 | @ 150 | 8.0 | 200 | 110 | 625 | 1.0 | TO92-1 | PN2221 |
| 2N3644 | 45 | 115 - 300 | @ 50 | 0.25 | @ 50 | 8.0 | 200 | 100 | 300 | 0.7 | TO5-4 | 2N3569 |
| PN3644 | 45 | 115 - 300 | @ 50 | 0.25 | @ 50 | 8.0 | 200 | 100 | 625 | 1.0 | TO92-1 | PN3569 |
| EN3502 | 45 | 100 - 300 | @ 150 | 0.40 | @ 150 | 8.0 | 150 | 100 | 300 | 0.7 | TO5-4 | EN2219 |
| EN3504 | 45 | 100 - 300 | @ 150 | 0.40 | @ 150 | 8.0 | 150 | 100 | 200 | 0.5 | TO18-4 | EN2222 |
| 2N4355 | 60 | 100 - 400 | @ 10 | 0.15 | @ 150 | 30 | 100 | | 350 | 0.8 | TO5-4 | 2N3568 |
| MPS4355 | 60 | 100 - 400 | @ 10 | 0.15 | @ 150 | 30 | 100 | | 625 | 1.0 | TO92-1 | PN3568 |
| PN3251A | 60 | 100 - 300 | @ 10 | 0.25 | @ 10 | 6.0 | 300 | 250 | 625 | 1.0 | TO92-1 | |
| PN3250A | 60 | 50 - 150 | @ 10 | 0.25 | @ 10 | 6.0 | 250 | 225 | 625 | 1.0 | TO92-1 | |
| 2N4354 | 60 | 50 - 500 | @ 10 | 0.15 | @ 150 | 30 | 100 | | 350 | 0.8 | TO5-4 | SE6020 |
| MPS4354 | 60 | 50 - 500 | @ 10 | 0.15 | @ 150 | 30 | 100 | | 625 | 1.0 | TO92-1 | SE6020 |
| 2N3645 | 60 | 115 - 300 | @ 50 | 0.25 | @ 50 | 8.0 | 200 | 100 | 300 | 0.7 | TO5-4 | SE6020 |
| PN3645 | 60 | 115 - 300 | @ 50 | 0.25 | @ 50 | 8.0 | 200 | 100 | 300 | 0.7 | TO5-4 | SE6020 |
| MPSA55 | 60 | 50 | @ 100 | 0.25 | @ 100 | | 50 | | 625 | 1.0 | TO92-1 | MPSA05 |
| PN2905A | 60 | 100 - 300 | @ 150 | 0.40 | @ 150 | 8.0 | 150 | 110 | 625 | 1.0 | TO92-1 | PN2219A |
| PN2907A | 60 | 100 - 300 | @ 150 | 0.40 | @ 150 | 8.0 | 150 | 110 | 625 | 1.0 | TO92-1 | PN2222A |
| **BC527** | 60 | 40 - 400 | @ 100 | 0.50 | @1000 | 15 | 100 | | 625 | 1.0 | TO92-1 | BC537 |
| **BC527-6** | 60 | 40 - 100 | @ 100 | 0.50 | @1000 | 15 | 100 | | 625 | 1.0 | TO92-1 | BC537-6 |
| **BC527-10** | 60 | 63 - 160 | @ 100 | 0.50 | @1000 | 15 | 100 | | 625 | 1.0 | TO92-1 | BC537-10 |
| **BC527-16** | 60 | 100 - 250 | @ 100 | 0.50 | @1000 | 15 | 100 | | 625 | 1.0 | TO92-1 | BC537-16 |
| **BC527-25** | 60 | 160 - 400 | @ 100 | 0.50 | @1000 | 15 | 100 | | 625 | 1.0 | TO92-1 | BC537-25 |
| 2N5855 | 60 | 50 - 300 | @ 150 | 0.40 | @ 150 | | 15 | | 750 | | TO5-4 | 2N5856 |
| PN2904A | 60 | 40 - 120 | @ 150 | 0.40 | @ 150 | 8.0 | 150 | 110 | 625 | 1.0 | TO92-1 | PN2218A |
| PN2906A | 60 | 40 - 120 | @ 150 | 0.40 | @ 150 | 8.0 | 150 | 110 | 625 | 1.0 | TO92-1 | PN2221A |
| **BC534** | 80 | 50 | @ 10 | 0.25 | @ 100 | | 50 | | 625 | 1.0 | TO92-1 | BC535 |
| 2N4356 | 80 | 50 - 250 | @ 10 | 0.15 | @ 150 | 30 | 100 | | 350 | 0.8 | TO5-4 | SE6021 |
| MPS4356 | 80 | 50 - 250 | @ 10 | 0.15 | @ 150 | 30 | 100 | | 625 | 1.0 | TO92-1 | SE6021 |
| MPSA56 | 80 | 50 | @ 100 | 0.25 | @ 100 | | 50 | | 625 | 1.0 | TO92-1 | MPSA06 |
| **BC528** | 80 | 40 - 400 | @ 100 | 0.50 | @1000 | 15 | 100 | | 625 | 1.0 | TO92-1 | BC538 |
| **BC528-6** | 80 | 40 - 100 | @ 100 | 0.50 | @1000 | 15 | 100 | | 625 | 1.0 | TO92-1 | BC538-6 |
| **BC528-10** | 80 | 63 - 160 | @ 100 | 0.50 | @1000 | 15 | 100 | | 625 | 1.0 | TO92-1 | BC538-10 |
| **BC528-16** | 80 | 100 - 250 | @ 100 | 0.50 | @1000 | 15 | 100 | | 625 | 1.0 | TO92-1 | BC538-16 |
| **BC528-25** | 80 | 160 - 400 | @ 100 | 0.50 | @1000 | 15 | 100 | | 625 | 1.0 | TO92-1 | BC538-25 |
| 2N5857 | 80 | 50 - 300 | @ 150 | 0.40 | @ 150 | | 15 | | 750 | | TO5-1 | 2N5858 |

## TRANSISTORS—SMALL SIGNAL

### NPN LOW LEVEL, LOW NOISE AMPLIFIER TRANSISTORS (BY ASCENDING $V_{CEO}$) METAL PACKAGE

| TYPE | $V_{CEO}$ VOLTS MIN | $h_{FE}$ $h_{FE}$ ($h_{fe}$) MIN - MAX | @ | $I_C$ mA | $h_{FE}$ $h_{FE}$ ($h_{fe}$) MIN - MAX | @ | $I_C$ mA | NF dB MAX | @ | f kHz | NF dB MAX | @ | f kHz | Package |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2N930 | 45 | 100 - 300 | @ | 0.01 | 600 | @ | 10 | | | | 3.0 | @ | WIDEBAND | TO18 |
| 2N3117 | 60 | 250 - 500 | @ | 0.01 | 400 | @ | 1.0 | 1.0 | @ | 1.0 | 1.0 | @ | 10 | TO18 |
| 2N2484 | 60 | 100 - 500 | @ | 0.01 | 250 | @ | 1.0 | 2.0 | @ | 10 | 3.0 | @ | WIDEBAND | TO18 |

## TRANSISTORS—SMALL SIGNAL

### NPN LOW LEVEL, LOW NOISE AMPLIFIER TRANSISTORS (BY ASCENDING $V_{CEO}$) PLASTIC PACKAGE

| TYPE | $V_{CEO}$ VOLTS MIN | $h_{FE}$ $h_{FE}$ MIN - MAX | @ | $I_C$ mA | $h_{FE}$ $h_{FE}$ MIN - MAX | @ | $I_C$ mA | NF dB MAX | @ | f kHz | NF dB MAX | @ | f kHz | Package |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2N5133 | 18 | 60 - 1000 | @ | 1.0 | | | | | | | | | | TO18-4 |
| PN5133 | 18 | 60 - 1000 | @ | 1.0 | | | | | | | | | | TO92-1 |
| **BC208** | 20 | 90 (Typ) | @ | 0.01 | 110 - 800 | @ | 2.0 | 10 | @ | 1.0 | | | | TO18-4 |
| **BC208A** | 20 | 90 (Typ) | @ | 0.01 | 110 - 220 | @ | 2.0 | 10 | @ | 1.0 | | | | TO18-4 |
| **BC208B** | 20 | 150 (Typ) | @ | 0.01 | 200 - 450 | @ | 2.0 | 10 | @ | 1.0 | | | | TO18-4 |
| **BC208C** | 20 | 270 (Typ) | @ | 0.01 | 420 - 800 | @ | 2.0 | 10 | @ | 1.0 | | | | TO18-4 |
| **BC209** | 20 | 150 (Typ) | @ | 0.01 | 200 - 800 | @ | 2.0 | 4.0 | @ | 1.0 | 4.0 | @ | WIDE BAND | TO18-4 |
| **BC209B** | 20 | 150 (Typ) | @ | 0.01 | 200 - 450 | @ | 2.0 | 4.0 | @ | 1.0 | 4.0 | @ | WIDE BAND | TO18-4 |
| **BC209C** | 20 | 270 (Typ) | @ | 0.01 | 420 - 450 | @ | 2.0 | 4.0 | @ | 1.0 | 4.0 | @ | WIDE BAND | TO18-4 |
| **BC319** | 20 | 150 (Typ) | @ | 0.01 | 200 - 800 | @ | 2.0 | 4.0 | @ | 1.0 | 4.0 | @ | WIDE BAND | TO92-1 |
| **BC319B** | 20 | 150 (Typ) | @ | 0.01 | 200 - 450 | @ | 2.0 | 4.0 | @ | 1.0 | 4.0 | @ | WIDE BAND | TO92-1 |
| **BC319C** | 20 | 270 (Typ) | @ | 0.01 | 420 - 800 | @ | 2.0 | 4.0 | @ | 1.0 | 4.0 | @ | WIDE BAND | TO92-1 |
| MPS6571 | 20 | 250 - 1000 | @ | 0.1 | | | | | | | | | | TO92-1 |
| **BC113** | 20 | 120 | @ | 0.1 | 200 | @ | 1.0 | 2.5 (Typ) | @ | 1.0 | | | | TO18-4 |
| **BC114** | 25 | 120 | @ | 0.1 | 200 | @ | 10 | 3.0 | @ | 1.0 | | | | TO18-4 |
| 2N5089 | 25 | 400 - 1200 | @ | 0.1 | 400 | @ | 10.0 | | | | 2.0 | @ | WIDE BAND | TO92-1 |
| MPS6521 | 25 | 150 | @ | 0.1 | 300 - 600 | @ | 2.0 | | | | 3.0 | @ | WIDE BAND | TO92-1 |
| MPS6520 | 25 | 100 | @ | 0.1 | 200 - 400 | @ | 2.0 | | | | 3.0 | @ | WIDE BAND | TO92-1 |
| 2N3565 | 25 | .70 | @ | 0.1 | 150 - 600 | @ | 1.0 | | | | | | | TO18-4 |
| PN3565 | 25 | .70 | @ | 0.1 | 150 - 600 | @ | 1.0 | | | | | | | TO92-1 |
| SE4010 | 25 | 200 - 1000 | @ | 1.0 | | | | 3.0 | @ | 1.0 | | | | TO18-4 |
| SE4002 | 25 | 200 - 1000 | @ | 1.0 | | | | | | | | | | TO18-4 |
| SE4001 | 25 | 60 - 300 | @ | 1.0 | | | | | | | | | | TO18-4 |
| **BC115** | 30 | 50 | @ | 1.0 | 50 | @ | 100 | | | | | | | TO5-4 |
| **BC318** | 30 | 90 (Typ) | @ | 0.01 | 110 - 800 | @ | 2.0 | 6.0 | @ | 1.0 | | | | TO92-1 |
| **BC318A** | 30 | 90 (Typ) | @ | 0.01 | 110 - 220 | @ | 2.0 | 6.0 | @ | 1.0 | | | | TO92-1 |
| **BC318B** | 30 | 150 (Typ) | @ | 0.01 | 200 - 450 | @ | 2.0 | 6.0 | @ | 1.0 | | | | TO92-1 |
| **BC318C** | 30 | 270 (Typ) | @ | 0.01 | 420 - 800 | @ | 2.0 | 6.0 | @ | 1.0 | | | | TO92-1 |
| 2N5963 | 30 | 900 | @ | 0.01 | 1200 - 2200 | @ | 10 | 3.0 | @ | 1.0 | 8.0 | @ | 0.01 | TO92-1 |
| SE4023 | 30 | 900 | @ | 0.01 | 1200 - 2200 | @ | 10 | 3.0 | @ | 1.0 | 8.0 | @ | 0.01 | TO18-4 |
| 2N5088 | 30 | 300 - 900 | @ | 0.1 | 300 | @ | 10 | | | | 3.0 | @ | WIDE BAND | TO92-1 |
| MPS3707 | 30 | 100 - 400 | @ | 0.1 | | | | | | | 5.0 | @ | WIDE BAND | TO92-1 |
| MPS3711 | 30 | 180 - 660 | @ | 1.0 | | | | | | | | | | TO92-1 |

# TRANSISTORS—SMALL SIGNAL

## NPN LOW LEVEL, LOW NOISE AMPLIFIER TRANSISTORS (BY ASCENDING $V_{CEO}$) PLASTIC PACKAGE

| TYPE | $V_{CEO}$ VOLTS MIN | $h_{FE}$ $h_{FE}$ MIN - MAX | @ | $I_C$ mA | $h_{FE}$ $h_{FE}$ MIN - MAX | @ | $I_C$ mA | NF dB MAX | @ | f kHz | NF dB MAX | @ | f kHz | Package |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MPS3710 | 30 | 90 - 330 | @ | 1.0 | | | | | | | | | | TO92-1 |
| MPS3709 | 30 | 45 - 165 | @ | 1.0 | | | | | | | | | | TO92-1 |
| MPS3708 | 30 | 45 - 660 | @ | 1.0 | | | | | | | | | | TO92-1 |
| **BC207** | 45 | 90 (Typ) | @ | 0.01 | 110 - 450 | @ | 2.0 | 10 | @ | 1.0 | | | | TO18-4 |
| **BC207A** | 45 | 90 (Typ) | @ | 0.01 | 110 - 220 | @ | 2.0 | 10 | @ | 1.0 | | | | TO18-4 |
| **BC207B** | 45 | 150 (Typ) | @ | 0.01 | 200 - 450 | @ | 2.0 | 10 | @ | 1.0 | | | | TO18-4 |
| **BC317** | 45 | 90 (Typ) | @ | 0.01 | 110 - 450 | @ | 2.0 | 6.0 | @ | 1.0 | | | | TO92-1 |
| **BC317A** | 45 | 90 (Typ) | @ | 0.01 | 110 - 220 | @ | 2.0 | 6.0 | @ | 1.0 | | | | TO92-1 |
| **BC317B** | 45 | 150 (Typ) | @ | 0.01 | 200 - 450 | @ | 2.0 | 6.0 | @ | 1.0 | | | | TO92-1 |
| 2N5962 | 45 | 450 | @ | 0.01 | 600 - 1400 | @ | 10 | 3.0 | @ | 1.0 | 3.0 | @ | WIDE BAND | TO92-1 |
| SE4021 | 45 | 450 | @ | 0.01 | 600 - 1400 | @ | 10 | 3.0 | @ | 1.0 | 3.0 | @ | WIDE BAND | TO18-4 |
| EN930 | 45 | 100 - 300 | @ | 0.01 | 600 | @ | 10 | | | | 3.0 | @ | WIDE BAND | TO18-4 |
| **BC521** | 45 | 600 - 1400 | @ | 10 | 350 | @ | 0.01 | 3.0 | @ | 1.0 | | | | TO92-1 |
| 2N5210 | 50 | 200 - 600 | @ | 0.1 | 250 | @ | 10 | 3.0 | @ | 1.0 | 2.0 | @ | WIDE BAND | TO92-1 |
| 2N5209 | 50 | 100 - 300 | @ | 0.1 | 150 | @ | 10 | 4.0 | @ | 1.0 | 3.0 | @ | WIDE BAND | TO92-1 |
| MPSA09 | 50 | 100 - 600 | @ | 0.1 | | | | | | | | | | TO92-1 |
| 2N5961 | 60 | 100 | @ | 0.01 | 150 - 950 | @ | 10 | 6.0 | @ | 1.0 | | | | TO92-1 |
| SE4020 | 60 | 100 | @ | 0.01 | 150 - 950 | @ | 10 | 6.0 | @ | 1.0 | | | | TO18-4 |
| EN2484 | 60 | 100 - 500 | @ | 0.01 | 250 | @ | 1.0 | 2.0 | @ | 10 | 3.0 | @ | WIDE BAND | TO18-4 |
| PN2484 | 60 | 100 - 500 | @ | 0.01 | 250 | @ | 1.0 | 2.0 | @ | 10 | 3.0 | @ | WIDE BAND | TO92-1 |
| **BC520** | 60 | 150 - 700 | @ | 10 | 100 | @ | 0.01 | 3.0 | @ | 1.0 | 3.0 | @ | WIDE BAND | TO92-1 |
| **BC523** | 60 | 150 - 700 | @ | 10 | 100 | @ | 0.01 | | | | | | | TO92-1 |

## PNP LOW LEVEL, LOW NOISE AMPLIFIER TRANSISTORS (BY ASCENDING $V_{CEO}$) METAL PACKAGE

| TYPE | $V_{CEO}$ VOLTS MIN | $h_{FE}$ $h_{FE}$ MIN - MAX | @ | $I_C$ mA | $h_{FE}$ $h_{FE}$ MIN - MAX | @ | $I_C$ mA | NF dB MAX | @ | f kHz | NF dB MAX | @ | f kHz | Package |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BC179** | 20 | 120 - 460 | @ | 2.0 | | | | 4.0 | @ | 1.0 | 4.0 | @ | WIDE BAND | TO18-1 |
| **BC179A** | 20 | 120 - 220 | @ | 2.0 | | | | 4.0 | @ | 1.0 | 4.0 | @ | WIDE BAND | TO18-1 |
| **BC179B** | 20 | 180 - 460 | @ | 2.0 | | | | 4.0 | @ | 1.0 | 4.0 | @ | WIDE BAND | TO18-1 |
| **BC178** | 25 | 70 - 460 | @ | 2.0 | | | | 10 | @ | 1.0 | | | | TO18-1 |
| **BC178VI** | 25 | 70 - 140 | @ | 2.0 | | | | 10 | @ | 1.0 | | | | TO18-1 |
| **BC178A** | 25 | 120 - 220 | @ | 2.0 | | | | 10 | @ | 1.0 | | | | TO18-1 |
| **BC178B** | 25 | 180 - 460 | @ | 2.0 | | | | 10 | @ | 1.0 | | | | TO18-1 |
| **BC177** | 45 | 70 - 220 | @ | 2.0 | | | | 10 | @ | 1.0 | | | | TO18-1 |
| **BC177VI** | 45 | 70 - 140 | @ | 2.0 | | | | 10 | @ | 1.0 | | | | TO18-1 |
| **BC177A** | 45 | 120 - 220 | @ | 2.0 | | | | 10 | @ | 1.0 | | | | TO18-1 |
| **BC177B** | 45 | 180 - 460 | @ | 2.0 | | | | 10 | @ | 1.0 | | | | TO18-1 |
| 2N3964 | 45 | 180 | @ | 0.001 | 250 - 500 | @ | 0.01 | 2.0 | @ | 1.0 | 4.0 | @ | 0.1 | TO18-1 |
| 2N3965 | 60 | 180 | @ | 0.001 | 250 - 500 | @ | 0.01 | 2.0 | @ | 1.0 | 4.0 | @ | 0.1 | TO18-1 |
| **BFX37** | 60 | 70 - 300 | @ | 0.01 | 100 | @ | 1.0 | 3.0 | @ | 1.0 | 3.0 | @ | WIDE BAND | TO18-1 |
| 2N3962 | 60 | 60 | @ | 0.001 | 100 - 300 | @ | 0.01 | 3.0 | @ | 1.0 | 10 | @ | 0.1 | TO18-1 |

# TRANSISTORS—SMALL SIGNAL

## PNP LOW LEVEL, LOW NOISE AMPLIFIER TRANSISTORS (BY ASCENDING $V_{CEO}$) PLASTIC PACKAGE

| TYPE | $V_{CEO}$ VOLTS MIN | $h_{FE}(h_{fe})$ MIN - MAX | @ | $I_C$ mA | $h_{FE}(h_{fe})$ MIN - MAX | @ | $I_C$ mA | NF dB MAX | @ | f kHz | NF dB MAX | @ | f kHz | Package |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BC206** | 20 | 150 (Typ) | @ | 0.01 | 200 - 800 | @ | 2.0 | 4.0 | @ | 1.0 | 4.0 | @ | WIDE BAND | TO18-4 |
| **BC206B** | 20 | 150 (Typ) | @ | 0.01 | 200 - 450 | @ | 2.0 | 4.0 | @ | 1.0 | 4.0 | @ | WIDE BAND | TO18-4 |
| **BC206C** | 20 | 250 (Typ) | @ | 0.01 | 400 - 800 | @ | 2.0 | 4.0 | @ | 1.0 | 4.0 | @ | WIDE BAND | TO18-4 |
| **BC322** | 20 | 150 (Typ) | @ | 0.01 | 200 - 800 | @ | 2.0 | 4.0 | @ | 1.0 | 4.0 | @ | WIDE BAND | TO92-1 |
| **BC322B** | 20 | 150 (Typ) | @ | 0.01 | 200 - 450 | @ | 2.0 | 4.0 | @ | 1.0 | 4.0 | @ | WIDE BAND | TO92-1 |
| MPS6523 | 25 | 150 | @ | 0.10 | 300 - 600 | @ | 2.0 | | | | 3.0 | @ | WIDE BAND | TO92-1 |
| MPS6522 | 25 | 100 | @ | 0.10 | 200 - 400 | @ | 2.0 | | | | 3.0 | @ | WIDE BAND | TO92-1 |
| **BC205** | 20 | 80 (Typ) | @ | 0.01 | 110 - 500 | @ | 2.0 | 10 | @ | 1.0 | | | | TO18-4 |
| **BC205A** | 20 | 80 (Typ) | @ | 0.01 | 110 - 220 | @ | 2.0 | 10 | @ | 1.0 | | | | TO18-4 |
| **BC205B** | 20 | 150 (Typ) | @ | 0.01 | 200 - 450 | @ | 2.0 | 10 | @ | 1.0 | | | | TO18-4 |
| **BC321** | 30 | 80 (Typ) | @ | 0.01 | 110 - 800 | @ | 2.0 | 6.0 | @ | 1.0 | | | | TO92-1 |
| **BC321A** | 30 | 80 (Typ) | @ | 0.01 | 110 - 220 | @ | 2.0 | 6.0 | @ | 1.0 | | | | TO92-1 |
| **BC321B** | 30 | 150 (Typ) | @ | 0.01 | 200 - 450 | @ | 2.0 | 6.0 | @ | 1.0 | | | | TO92-1 |
| 2N5138 | 30 | 50 - 800 | @ | 0.10 | 50 | @ | 1.0 | | | | | | | TO18-4 |
| PN5138 | 30 | 50 - 800 | @ | 0.10 | 50 | @ | 1.0 | | | | | | | TO92-1 |
| **BC225** | 40 | 130 (Typ) | @ | 0.01 | 90 | @ | 1.0 | 1.0 (Typ) | @ | 1.0 | | | | TO18-4 |
| **BC153** | 40 | 50 | @ | 0.10 | 50 | @ | 10 | 1.0 | @ | 1.0 | | | | TO18-4 |
| **BC154** | 40 | 160 | @ | 0.10 | 160 | @ | 10 | 2.5 | @ | 1.0 | | | | TO18-4 |
| 2N4250 | 40 | 250 - 700 | @ | 0.10 | 250 | @ | 1.0 | 2.0 | @ | 1.0 | 2.0 | @ | WIDE BAND | TO18-4 |
| PN4250 | 40 | 250 - 700 | @ | 0.10 | 250 | @ | 1.0 | 2.0 | @ | 1.0 | 2.0 | @ | WIDE BAND | TO92-1 |
| 2N4248 | 40 | 50 | @ | 0.10 | 50 | @ | 1.0 | | | | | | | TO18-4 |
| PN4248 | 40 | 50 | @ | 0.10 | 50 | @ | 1.0 | | | | | | | TO92-1 |
| **BC204** | 45 | 80 (Typ) | @ | 0.01 | 50 - 450 | @ | 2.0 | 10 | @ | 1.0 | | | | TO18-4 |
| **BC204A** | 45 | 80 (Typ) | @ | 0.01 | 110 - 220 | @ | 2.0 | 10 | @ | 1.0 | | | | TO18-4 |
| **BC204B** | 45 | 150 (Typ) | @ | 0.01 | 200 - 450 | @ | 2.0 | 10 | @ | 1.0 | | | | TO18-4 |
| **BC320** | 45 | 80 (Typ) | @ | 0.01 | 110 - 450 | @ | 2.0 | 6.0 | @ | 1.0 | | | | TO92-1 |
| **BC320A** | 45 | 80 (Typ) | @ | 0.01 | 110 - 220 | @ | 2.0 | 6.0 | @ | 1.0 | | | | TO92-1 |
| **BC320B** | 45 | 150 (Typ) | @ | 0.01 | 200 - 450 | @ | 2.0 | 6.0 | @ | 1.0 | | | | TO92-1 |
| 2N5087 | 50 | 250 - 800 | @ | 0.10 | 250 | @ | 10 | 2.0 | @ | 1.0 | 2.0 | @ | WIDE BAND | TO92-1 |
| 2N5086 | 50 | 150 - 500 | @ | 0.10 | 150 | @ | 10 | 3.0 | @ | 1.0 | 3.0 | @ | WIDE BAND | TO92-1 |
| **BC526** | 50 | 40 | @ | 0.01 | (100 - 600) | @ | 2.0 | | | | | | | TO92-1 |
| **BC526A** | 50 | 40 | @ | 0.01 | (100 - 300) | @ | 2.0 | | | | 10 | | WIDE BAND | TO92-1 |
| **BC526B** | 50 | 40 | @ | 0.01 | (200 - 400) | @ | 2.0 | 4.0 | @ | 1.0 | 4.0 | @ | WIDE BAND | TO92-1 |
| **BC526C** | 50 | 40 | @ | 0.01 | (350 - 600) | @ | 2.0 | 4.0 | @ | 1.0 | 4.0 | @ | WIDE BAND | TO92-1 |
| EN3962 | 60 | 60 | @ | 0.001 | 100 - 300 | @ | 0.01 | 3.0 | @ | 1.0 | 10.0 | @ | 0.1 | TO18-4 |
| 2N4250A | 60 | 250 - 700 | @ | 0.10 | 250 | @ | 1.0 | 2.0 | @ | 1.0 | 2.0 | @ | WIDE BAND | TO18-4 |
| PN4250A | 60 | 250 - 700 | @ | 0.10 | 250 | @ | 1.0 | 2.0 | @ | 1.0 | 2.0 | @ | WIDE BAND | TO92-1 |
| 2N4249 | 60 | 100 - 300 | @ | 0.10 | 100 | @ | 1.0 | 3.0 | @ | 1.0 | 3.0 | @ | WIDE BAND | TO18-4 |
| PN4249 | 60 | 100 - 300 | @ | 0.10 | 100 | @ | 1.0 | 3.0 | @ | 1.0 | 3.0 | @ | WIDE BAND | TO92-1 |

## NPN HIGH VOLTAGE AMPLIFIER TRANSISTORS (BY ASCENDING $V_{CEO}$) METAL PACKAGE

(ALSO SEE TO5 POWER SECTION)

| TYPE | $V_{CEO}$ VOLTS MIN | $h_{FE}$ MIN - MAX | $h_{FE}$ @ | $I_C$ mA | $f_T$ MHz MIN | $C_{ob}$ ($C_{cb}$) pF MAX | $P_D$ $T_A$ 25°C mW | $P_D$ $T_C$ 25°C W | Package |
|---|---|---|---|---|---|---|---|---|---|
| 2N657 | 100 | 30 - 90 | @ | 200 | 70 | | 800 | 4.0 | TO5-1 |
| SE7002 | 120 | 30 | @ | 30 | 40 | 3.5 | 800 | 5.0 | TO5-1 |
| **BFY57** | 125 | 30 - 150 | @ | 30 | 40 | 12 | 800 | 5.0 | TO5-1 |
| SE7010 | 150 | 30 | @ | 25 | 40 | 3.5 | 800 | 3.0 | TO5-1 |
| 2N3923 | 150 | 30 - 120 | @ | 25 | 40 | 3.5 | 800 | 3.0 | TO5-1 |
| SE7001 | 150 | 30 | @ | 30 | 40 | 9.0 | 800 | 5.0 | TO5-1 |
| 2N3114 | 150 | 30 - 120 | @ | 30 | 40 | 9.0 | 800 | 5.0 | TO5-1 |
| **BF257** | 160 | 40 - 150 | @ | 10 | 40 | 3.5 | 1000 | 7.0 | TO5-2 |
| **BD115** | 180 | 22 | @ | 50 | | 3.5 | | 6.0 | TO5-1 |
| **BF336** | 180 | 20 | @ | 30 | 80 | (3.5) | 800 | | TO5-1 |
| 2N4926 | 200 | 20 - 200 | @ | 30 | 30 | (6.0) | 1000 | 7.0 | TO5-2 |
| **BF337** | 200 | 20 | @ | 30 | 80 | (3.5) | 800 | | TO5-1 |
| SE7055 | 220 | 40 - 150 | @ | 10 | 40 | (3.5) | 1000 | 7.0 | TO5-2 |
| **BF338** | 225 | 20 | @ | 30 | 80 | (3.5) | 800 | | TO5-1 |
| **BF258** | 250 | 40 - 150 | @ | 10 | 40 | 3.5 | 1000 | 7.0 | TO5-2 |
| 2N4927 | 250 | 20 - 200 | @ | 30 | 30 | (6.0) | 1000 | 7.0 | TO5-2 |
| 2N5059 | 250 | 30 - 150 | @ | 30 | 30 | 10 | 1000 | 5.0 | TO5-2 |
| 2N5058 | 300 | 35 - 150 | @ | 30 | 30 | 10 | 1000 | 5.0 | TO5-2 |
| SE7056 | 300 | 40 - 100 | @ | 10 | 40 | (3.0) | 1000 | 7.0 | TO5-2 |
| **BF259** | 300 | 25 | @ | 30 | 90 (Typ) | 4.2 | 1000 | 7.0 | TO5-2 |
| SE7057 | 450 | 30 - 70 | @ | 10 | 40 | (2.5) | 1000 | 7.0 | TO5-2 |

3

## NPN HIGH VOLTAGE AMPLIFIER TRANSISTORS (BY ASCENDING $V_{CEO}$) PLASTIC PACKAGE

| TYPE | $V_{CEO}$ VOLTS MIN | $h_{FE}$ MIN - MAX | $h_{FE}$ @ | $I_C$ mA | $f_T$ MHz MIN | $C_{ob}$ pF MAX | $P_D$ $T_A$ 25°C mW | $P_D$ $T_C$ 25°C W | Package | PNP Complement |
|---|---|---|---|---|---|---|---|---|---|---|
| MPSL01 | 120 | 50 - 300 | @ | 10 | 60 | 8.0 | 625 | 1.0 | TO92-1 | MPSL51 |
| 2N5830 | 120 | 80 - 500 | @ | 25 | 100 | 40 | 625 | | TO92-1 | |
| **BC117** | 120 | 30 | @ | 30 | 40 | | 300 | 0.8 | TO5-4 | |
| **BC532** | 140 | 60 - 250 | @ | 10 | 100 | 6.0 | 625 | 1.0 | TO92-1 | BC530 |
| 2N5550 | 140 | 60 - 250 | @ | 10 | 100 | 6.0 | 625 | | TO92-1 | 2N5400 |
| PN5964 | 150 | 50 - 250 | @ | 10 | 100 | 4.0 | 700 | 2.0 | TO5-4 | |
| **BC533** | 160 | 80 - 250 | @ | 10 | 100 | 6.0 | 625 | 1.0 | TO92-1 | BC531 |
| MPS5551M | 160 | 80 - 250 | @ | 10 | 100 | 6.0 | 625 | | TO92-1 | 2N5401 |
| 2N5831 | 160 | 80 - 250 | @ | 10 | 100 | 4.0 | 625 | | TO92-1 | |
| 2N5832 | 160 | 175 - 500 | @ | 10 | 100 | 4.0 | 625 | | TO92-1 | |
| PN5965 | 180 | 50 - 250 | @ | 10 | 100 | 4.0 | 700 | 2.0 | TO5-4 | |
| 2N5833 | 180 | 50 - 250 | @ | 10 | 100 | 4.0 | 625 | | TO92-1 | |
| MPSA43 | 200 | 50 - 200 | @ | 30 | 50 | 4.0 | 625 | 1.0 | TO92-1 | MPSA93 |
| MPSA42 | 300 | 40 - 200 | @ | 30 | 50 | 3.0 | 625 | 1.0 | TO92-1 | MPSA92 |

# TRANSISTORS—SMALL SIGNAL

## PNP HIGH VOLTAGE AMPLIFIER TRANSISTORS (BY ASCENDING $V_{CEO}$) PLASTIC PACKAGE

| TYPE | $V_{CEO}$ VOLTS MIN | $h_{FE}$ $h_{FE}$ MIN - MAX | @ | $I_C$ mA | $f_T$ MHz MIN | $C_{ob}$ pF MAX | $P_D$ $T_A$ 25°C mW | $P_D$ $T_C$ 25°C W | Package | NPN Complement |
|---|---|---|---|---|---|---|---|---|---|---|
| MPSL51 | 100 | 40 - 250 | @ | 50 | 60 | 8.0 | 625 | 1.0 | TO92-1 | MPSL01 |
| **BC530** | 120 | 40 - 180 | @ | 10 | 100 | 6.0 | 625 | 1.0 | TO92-1 | BC532 |
| 2N5400 | 120 | 40 - 180 | @ | 10 | 100 | 6.0 | 625 | 1.0 | TO92-1 | 2N5550 |
| **BC531** | 150 | 60 - 240 | @ | 10 | 100 | 6.0 | 625 | 1.0 | TO92-1 | BC533 |
| 2N4888 | 150 | 40 - 400 | @ | 10 | 30 | 4.0 | 300 | 0.8 | TO5-4 | |
| PN4888 | 150 | 40 - 400 | @ | 10 | 30 | 4.0 | 625 | 1.0 | TO92-1 | |
| 2N5401 | 150 | 60 - 240 | @ | 10 | 100 | 6.0 | 625 | 1.0 | TO92-1 | MPS5551M |
| 2N4889 | 150 | 80 - 300 | @ | 10 | 40 | 4.0 | 300 | 0.8 | TO5-4 | |
| PN4889 | 150 | 80 - 300 | @ | 10 | 40 | 4.0 | 625 | 1.0 | TO92-1 | |
| MPSA93 | 200 | 30 - 150 | @ | 30 | 50 | 8.0 | 625 | 1.0 | TO92-1 | MPSA43 |
| PN4357 | 240 | 80 - 300 | @ | 10 | 40 | 7.0 | 625 | 1.0 | TO92-1 | |
| MPSA92 | 300 | 25 | @ | 30 | 50 | 6.0 | 625 | 1.0 | TO92-1 | MPSA42 |

## NPN RF–IF AMPLIFIER AND OSCILLATOR TRANSISTORS (BY ASCENDING FREQUENCY) METAL PACKAGE

| TYPE | P.G. dB MIN | @ | f MHz | $V_{CEO}$ VOLTS MIN | $f_T$ MHz MIN | $C_{ob}$ pF MAX | NF dB MAX | @ | f MHz | $P_D$ $T_A$ 25°C mW | Package |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SE5023 | 22.5 | @ | 45 | 20 | 300 | 0.5 | 6.0 | @ | 45 | 175 | TO18-3 |
| SE5024 | 22.5 | @ | 45 | 20 | 300 | 0.5 | 6.0 | @ | 45 | 175 | TO18-3 |
| **BF167** | 27 | @ | 45 | 30 | 300 | 0.22 | 5.0 | @ | 45 | 175 | TO18-3 |
| SE5055 | 27 | @ | 45 | 20 | 300 | 0.22 | 5.0 | @ | 45 | 175 | TO18-3 |
| SE5040 | 27 | @ | 45 | 30 | 300 | 0.22 | 5.0 | @ | 45 | 175 | TO18-3 |
| SE5036 | 29 | @ | 45 | 30 | 500 | 0.3 | 5.0 | @ | 45 | 20 | TO18-3 |
| SE5050 | 20 | @ | 100 | 20 | 300 | 0.5 | 4.0 | @ | 100 | 175 | TO18-3 |
| SE5051 | 20 | @ | 100 | 20 | 300 | 0.5 | | | | 175 | TO18-3 |
| **BF222** | 20 (Typ ) | @ | 100 | 30 | 400 | 0.4 (Typ) | 5.0 | @ | 0.1 | 310 | TO18-3 |
| 2N918 | 15.0 | @ | 200 | 15 | 600 | 1.7 | 6.0 | @ | 60 | 200 | TO18-3 |
| SE5052 | 16 | @ | 200 | 20 | 375 | | 4.0 | @ | 200 | 175 | TO18-3 |
| SE5022 | 18 | @ | 200 | 20 | 300 | 0.5 | | | | 175 | TO18-3 |
| SE5020 | 20 | @ | 200 | 20 | 375 | 0.5 | 3.3 | @ | 200 | 175 | TO18-3 |
| SE5021 | 20 | @ | 200 | 20 | 375 | 0.5 | 4.0 | @ | 200 | 175 | TO18-3 |
| SE5035 | 22 | @ | 200 | 30 | 600 | 0.3 | | | | 200 | TO18-3 |
| 2N3137 | 6.0 | @ | 250 | 20 | 500 | 3.5 | | | | 600 | TO5-1 |

## NPN RF–IF AMPLIFIER AND OSCILLATOR TRANSISTORS (BY ASCENDING FREQUENCY) PLASTIC PACKAGE

| TYPE | PG (OSC. Po) dB @ f MIN MHz | $V_{CEO}$ VOLTS MIN | $f_T$ MHz MIN | $C_{ob}$ ($C_{cb}$) pF MAX | NF dB @ f MAX MHz | $P_D$ $T_A$ 25°C mW | Package |
|---|---|---|---|---|---|---|---|
| 2N5127 | | 12 | 150 | (3.5) | | 200 | TO18-4 |
| PE3100 | | 30 | 400 | (0.8) | | 425 (65°C) | TO92-1 |
| SE1010 | | 15 | 200 | 3.5 | 5.5 @ 1.0 | 200 | TO18-4 |
| **BF160** | | 12 | 400 | 2.0 | | 310 | TO18-4 |
| 2N3564 | 10 @ 30 | 15 | 400 | 3.5 | | 200 | TO18-4 |
| **BF152** | 28 @ 10.7 | 12 | 600 | 1.7 | | 310 | TO18-4 |
| **BF159** | 22 @ 40 | 20 | 600 | 1.2 | 3.5(Typ) @ 60 | 310 | TO18-4 |
| **BF163** | 22 @ 40 | 40 | 400 | 0.8 (Typ) | 3.0(Typ) @ 40 | 310 | TO18-4 |
| PE5025 | 25 @ 45 | 30 | 300 | (1.0) | | 425 (65°C) | TO92-1 |
| PE5013 | 25 @ 45 | 20 | 300 | (0.4) | 4.0 @ 45 | 300 (65°C) | TO92-1 |
| PE5029 | 28 @ 45 | 30 | 500 | (0.4) | 6.0 @ 45 | 425 (65°C) | TO92-1 |
| PE5030B | 28 @ 45 | 40 | 600 | (0.4) | | 425 (65°C) | TO92-1 |
| 2N3688 | 29 @ 45 | 40 | 400 | 1.6 | | 200 | TO18-4 |
| PN3688 | 29 @ 45 | 40 | 400 | 1.6 | | 200 | TO92-1 |
| 2N3689 | 29 @ 45 | 40 | 400 | 1.6 | | 200 | TO18-4 |
| PN3689 | 29 @ 45 | 40 | 400 | 1.6 | | 200 | TO92-1 |
| PE5015 | 20 @ 100 | 20 | 300 | (0.5) | 4.0 @ 100 | 300 (65°C) | TO92-1 |
| SE5006 | 20 @ 100 | 40 | 400 | 1.6 | | 200 | TO18-4 |
| 2N5126 | | 20 | 300 | (1.6) | | 200 | TO18-4 |
| PN5126 | | 20 | 300 | (1.6) | | 200 | TO92-1 |
| **BF162** | 15 @ 200 | 40 | 200 | 1.2 | 5.5 @ 200 | 310 | TO18-4 |
| EN918 | 14 @ 200 | 15 | 600 | 1.7 | 6.0 @ 60 | 200 | TO18-4 |
| 2N3563 | 14 @ 200 | 12 | 600 | 1.7 | | 200 | TO18-4 |
| 2N3690 | 15 @ 200 | 40 | 400 | 1.6 | 5.5 @ 200 | 200 | TO18-4 |
| PN3690 | 15 @ 200 | 40 | 400 | 1.6 | 5.5 @ 200 | 200 | TO92-1 |
| MPS918 | 15 @ 200 | 15 | 600 | 1.7 | 6.0 @ 60 | 625 | TO92-1 |
| 2N5130 | 17 @ 200 | 12 | 450 | (1.7) | | 200 | TO18-4 |
| PN5130 | 17 @ 200 | 12 | 450 | (1.7) | | 200 | TO92-1 |
| PE5031 | 19 @ 200 | 30 | 500 | 0.4 | 4.5 @ 200 | 425 (65°C) | TO92-1 |
| PE5010 | 20 @ 200 | 30 | 375 | (0.5) | 3.3 @ 200 | 300 (65°C) | TO92-1 |
| SE3001 | 12 @ 500 | 12 | 600 | 1.7 | | 200 | TO18-4 |
| SE3002 | 12 @ 500 | 12 | 600 | 1.7 | | 200 | TO18-4 |
| 2N5770 | 15 @ 500 | 15 | 900 | (1.7) | 6.0 @ 60 | 625 | TO92-1 |
| EN918 | (30) @ 500 | 15 | 600 | 1.7 | 6.0 @ 60 | 200 | TO18-4 |
| 2N5770 | (30) @ 500 | 15 | 900 | 1.7 | 6.0 @ 60 | 625 | TO92-1 |
| MPS3563 | (30) @ 500 | 12 | 600 | 1.7 | 6.0 @ 60 | 625 | TO92-1 |
| MPS918 | (30) @ 500 | 15 | 600 | 1.7 | 6.0 @ 60 | 625 | TO92-1 |
| SE3002 | (3.0) @ 930 | 12 | 600 | 1.7 | | 200 | TO18-4 |

# TRANSISTORS—POWER

## NPN
## TO5 PACKAGE

(ALSO SEE SMALL SIGNAL GENERAL PURPOSE AMPLIFIER AND HIGH VOLTAGE SECTIONS)

| TYPE | $V_{CEO}$ VOLTS MIN | $I_C$ AMPS MAX | $h_{FE}$ MIN - MAX | $h_{FE}$ @ | $I_C$ AMP | $V_{CE(sat)}$ VOLTS MAX | @ | $I_C$ AMP | $P_D$ $T_C = 25°C$ W | $f_T$ MHz MIN | PNP Complement |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2N4237 | 40 | 1.0 | 30 - 150 | @ | 0.25 | 0.6 | @ | 1.0 | 6.0 | 2.0 | 2N4234 |
| **BC323** | 60 | 5.0 | 50 - 250 | @ | 0.5 | 0.15 | @ | 0.5 | 7.0 | | |
| **BFX34** | 60 | 5.0 | 40 - 150 | @ | 2.0 | 1.0 | @ | 0.5 | 5.0 | 70 | |
| 2N4238 | 60 | 1.0 | 30 - 150 | @ | 0.25 | 0.6 | @ | 1.0 | 6.0 | 2.0 | 2N4235 |
| 2N4895 | 60 | 5.0 | 40 - 120 | @ | 2.0 | 1.0 | @ | 5.0 | 7.0 | 50 | |
| 2N4896 | 60 | 5.0 | 100 - 300 | @ | 2.0 | 1.0 | @ | 5.0 | 7.0 | 80 | |
| 2N4239 | 80 | 1.0 | 30 - 150 | @ | 0.25 | 0.6 | @ | 1.0 | 6.0 | 2.0 | 2N4236 |
| 2N4897 | 80 | 5.0 | 40 - 120 | @ | 2.0 | 1.0 | @ | 5.0 | 7.0 | 50 | |
| 2N3440 | 250 | 0.1 | 40 - 160 | @ | 0.02 | 0.5 | @ | 0.05 | 10 | 15 | |
| 2N3439 | 350 | 0.1 | 40 - 160 | @ | 0.02 | 0.5 | @ | 0.05 | 10 | 15 | |

## PNP
## TO5 PACKAGE

| TYPE | $V_{CEO}$ VOLTS MIN | $I_C$ AMPS MAX | $h_{FE}$ MIN - MAX | $h_{FE}$ @ | $I_C$ AMP | $V_{CE(sat)}$ VOLTS MAX | @ | $I_C$ AMP | $P_D$ $T_C = 25°C$ W | $f_T$ MHz MIN | NPN Complement |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2N4234 | 40 | 1.0 | 30 - 150 | @ | 0.25 | 0.6 | @ | 1.0 | 6.0 | 3.0 | 2N4237 |
| 2N4235 | 60 | 1.0 | 30 - 150 | @ | 0.25 | 0.6 | @ | 1.0 | 6.0 | 3.0 | 2N4238 |
| 2N4236 | 80 | 1.0 | 30 - 150 | @ | 0.25 | 0.5 | @ | 1.0 | 6.0 | 3.0 | 2N4239 |

## NPN
## TO66 PACKAGE

| TYPE | $V_{CEO}$ VOLTS MIN | $I_C$ AMPS MAX | $h_{FE}$ MIN - MAX | $h_{FE}$ @ | $I_C$ AMP | $V_{CE(sat)}$ VOLTS MAX | @ | $I_C$ AMP | $P_D$ $T_C = 25°C$ W | $f_T$ MHz MIN | PNP Complement |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2N4910 | 40 | 1.0 | 20 - 100 | @ | 0.5 | 0.6 | @ | 1.0 | 25 | 3.0 | 2N4898 |
| 2N4231 | 40 | 3.0 | 25 - 100 | @ | 1.5 | 0.7 | @ | 1.5 | 35 | 4.0 | |
| 2N3054 | 55 | 4.0 | 25 - 100 | @ | 0.5 | 1.0 | @ | 0.5 | 25 | 1.0 | |
| 2N4911 | 60 | 1.0 | 20 - 100 | @ | 0.5 | 0.5 | @ | 1.0 | 25 | 3.0 | 2N4899 |
| 2N4232 | 60 | 3.0 | 25 - 100 | @ | 1.5 | 0.7 | @ | 1.5 | 35 | 4.0 | |
| 2N4912 | 80 | 1.0 | 20 - 100 | @ | 0.5 | 0.6 | @ | 1.0 | 25 | 3.0 | 2N4900 |
| 2N4233 | 80 | 3.0 | 25 - 100 | @ | 1.5 | 0.7 | @ | 1.5 | 35 | 4.0 | |
| 2N6233 | 225 | 5.0 | 25 - 125 | @ | 1.0 | 0.5 | @ | 1.0 | 50 | 20 | |
| 2N6234 | 275 | 5.0 | 25 - 125 | @ | 1.0 | 0.5 | @ | 1.0 | 50 | 20 | |
| SE9051 | 275 | 10 | 20 - 100 | @ | 1.0 | 1.0 | @ | 5.0 | 50 | 20 | |
| SE9331 | 300 | 1.0 | 30 - 250 | @ | 0.1 | 2.5 | @ | 0.1 | 20 | 10 | |
| 2N6235 | 325 | 5.0 | 25 - 100 | @ | 1.0 | 0.5 | @ | 1.0 | 50 | 20 | |
| SE9052 | 325 | 10 | 20 - 100 | @ | 1.0 | 1.0 | @ | 5.0 | 50 | 20 | |

## PNP
## TO66 PACKAGE

| TYPE | $V_{CEO}$ VOLTS MIN | $I_C$ AMPS MAX | $h_{FE}$ MIN - MAX | $h_{FE}$ @ $I_C$ AMP | $V_{CE(sat)}$ VOLTS MAX | $V_{CE(sat)}$ @ $I_C$ AMP | $P_D$ $T_C = 25°C$ W | $f_T$ MHz MIN | PNP Complement |
|---|---|---|---|---|---|---|---|---|---|
| 2N4898 | 40 | 1.0 | 20 - 100 | @ .50 | 0.6 | @ 1.0 | 25 | 3.0 | 2N4910 |
| 2N4899 | 50 | 1.0 | 20 - 100 | @ .50 | 0.6 | @ 1.0 | 25 | 3.0 | 2N4911 |
| 2N3740 | 60 | 1.0 | 30 - 100 | @ .25 | 0.6 | @ 1.0 | 25 | 4.0 | |
| 2N4900 | 80 | 1.0 | 20 - 100 | @ .50 | 0.6 | @ 1.0 | 25 | 3.0 | 2N4912 |
| 2N3741 | 80 | 1.0 | 30 - 100 | @ .25 | 0.5 | @ 1.0 | 25 | 4.0 | |

## NPN
## TO220 (PLASTIC TO66) PACKAGE

| TYPE | $V_{CEO}$ VOLTS MIN | $I_C$ AMPS MAX | $h_{FE}$ MIN - MAX | $h_{FE}$ @ $I_C$ AMP | $V_{CE(sat)}$ VOLTS MAX | $V_{CE(sat)}$ @ $I_C$ AMP | $P_D$ $T_C = 25°C$ W | $f_T$ MHz MIN | PNP Complement |
|---|---|---|---|---|---|---|---|---|---|
| **BD221** | 40 | 4.0 | 30 - 120 | @ 1.0 | 1.0 | @ 1.0 | 36 | 0.8 | BD224 |
| 2N6129 | 40 | 7.0 | 20 - 100 | @ 2.5 | 1.4 | @ 7.0 | 50 | 2.5 | 2N6132 |
| 2N6121 | 45 | 4.0 | 25 - 100 | @ 1.5 | 0.6 | @ 1.5 | 40 | 2.5 | 2N6124 |
| **BD222** | 60 | 4.0 | 20 - 80 | @ 1.5 | 1.0 | @ 1.5 | 36 | 0.8 | BD225 |
| 2N6122 | 60 | 4.0 | 25 - 100 | @ 1.5 | 0.6 | @ 1.5 | 40 | 2.5 | 2N6125 |
| 2N6130 | 60 | 7.0 | 20 - 100 | @ 2.5 | 1.4 | @ 7.0 | 50 | 2.5 | 2N6133 |
| **BD220** | 70 | 4.0 | 30 - 120 | @ 0.5 | 1.0 | @ 0.5 | 36 | 0.8 | BD223 |
| 2N6123 | 80 | 4.0 | 20 - 80 | @ 1.5 | 0.6 | @ 1.5 | 40 | 2.5 | 2N6126 |
| 2N6131 | 80 | 7.0 | 20 - 100 | @ 2.5 | 2.0 | @ 7.0 | 50 | 2.5 | 2N6134 |

## PNP
## TO220 (PLASTIC TO66) PACKAGE

| TYPE | $V_{CEO}$ VOLTS MIN | $I_C$ AMPS MAX | $h_{FE}$ MIN - MAX | $h_{FE}$ @ $I_C$ AMP | $V_{CE(sat)}$ VOLTS MAX | $V_{CE(sat)}$ @ $I_C$ AMP | $P_D$ $T_C = 25°C$ W | $f_T$ MHz MIN | NPN Complement |
|---|---|---|---|---|---|---|---|---|---|
| **BD224** | 40 | 4.0 | 30 - 120 | @ 1.0 | 1.0 | @ 1.0 | 36 | 0.8 | BD221 |
| 2N6132 | 40 | 7.0 | 20 - 100 | @ 2.5 | 1.4 | @ 7.0 | 50 | 2.5 | 2N6129 |
| 2N6124 | 45 | 4.0 | 25 - 100 | @ 1.5 | 0.6 | @ 1.5 | 40 | 2.5 | 2N6121 |
| **BD225** | 60 | 4.0 | 20 - 80 | @ 1.5 | 1.0 | @ 1.5 | 36 | 0.8 | BD222 |
| 2N6125 | 60 | 4.0 | 25 - 100 | @ 1.5 | 0.6 | @ 1.5 | 40 | 2.5 | 2N6122 |
| 2N6133 | 60 | 7.0 | 20 - 100 | @ 2.5 | 1.4 | @ 7.0 | 50 | 2.5 | 2N6130 |
| **BD223** | 70 | 4.0 | 30 - 120 | @ 0.5 | 1.0 | @ 0.5 | 36 | 0.8 | BD220 |
| 2N6126 | 80 | 4.0 | 20 - 80 | @ 1.5 | 0.6 | @ 1.5 | 40 | 2.5 | 2N6123 |
| 2N6134 | 80 | 4.0 | 20 - 100 | @ 2.5 | 1.8 | @ 7.0 | 50 | 2.5 | 2N6131 |

# TRANSISTORS—POWER

## NPN
## TO59 (POWER STUD) PACKAGE

| TYPE | $V_{CEO}$ VOLTS MIN | $I_C$ AMPS MAX | $h_{FE}$ MIN - MAX | $h_{FE}$ @ $I_C$ AMP | $V_{CE(sat)}$ VOLTS MAX | $V_{CE(sat)}$ @ $I_C$ AMP | $P_D$ $T_C = 25°C$ W | $f_T$ MHz MIN | PNP Complement |
|---|---|---|---|---|---|---|---|---|---|
| 2N4116 | 80 | 5.0 | 100 - 300 | @ 2.0 | 1.5 | @ 5.0 | 37 | 70 | 2N5005 |
| 2N4115 | 80 | 5.0 | 40 - 120 | @ 2.0 | 1.5 | @ 5.0 | 37 | 70 | 2N5003 |
| 2N5004 | 80 | 5.0 | 70 - 200 | @ 2.5 | 1.5 | @ 5.0 | 50 | 70 | 2N5005 |
| 2N5002 | 80 | 5.0 | 30 - 90 | @ 2.5 | 1.5 | @ 5.0 | 50 | 60 | 2N5003 |

## PNP
## TO59 (POWER STUD) PACKAGE

| TYPE | $V_{CEO}$ VOLTS MIN | $I_C$ AMPS MAX | $h_{FE}$ MIN - MAX | $h_{FE}$ @ $I_C$ AMP | $V_{CE(sat)}$ VOLTS MAX | $V_{CE(sat)}$ @ $I_C$ AMP | $P_D$ $T_C = 25°C$ W | $f_T$ MHz MIN | NPN Complement |
|---|---|---|---|---|---|---|---|---|---|
| 2N5005 | 80 | 5.0 | 70 - 200 | @ 2.5 | 1.5 | @ 5.0 | 50 | 70 | 2N5004 |
| 2N5003 | 80 | 5.0 | 30 - 90 | @ 2.5 | 1.5 | @ 5.0 | 50 | 60 | 2N5002 |

## NPN
## TO3 PACKAGE

| TYPE | $V_{CEO}$ VOLTS MIN | $I_C$ AMPS MAX | $h_{FE}$ MIN - MAX | $h_{FE}$ @ $I_C$ AMP | $V_{CE(sat)}$ VOLTS MAX | $V_{CE(sat)}$ @ $I_C$ AMP | $P_D$ $T_C = 25°C$ W | $f_T$ MHz MIN | PNP Complement |
|---|---|---|---|---|---|---|---|---|---|
| 2N5067 | 40 | 5.0 | 20 - 80 | @ 1.0 | 1.5 | @ 5.0 | 87.5 | 4.0 | 2N4901 |
| 2N4913 | 40 | 5.0 | 25 - 100 | @ 2.5 | 1.5 | @ 5.0 | 87.5 | 4.0 | 2N4904 |
| 2N5301 | 40 | 30 | 15 - 60 | @ 15 | 2.0 | @ 20 | 200 | 2.0 | 2N4398 |
| 2N5068 | 60 | 5.0 | 20 - 80 | @ 1.0 | 1.5 | @ 5.0 | 87.5 | 4.0 | 2N4902 |
| 2N4914 | 60 | 5.0 | 25 - 100 | @ 2.5 | 1.5 | @ 5.0 | 87.5 | 4.0 | 2N4905 |
| 2N3713 | 60 | 10 | 25 - 90 | @ 1.0 | 1.0 | @ 5.0 | 150 | 2.5 | 2N3789 |
| 2N3715 | 60 | 10 | 50 - 150 | @ 1.0 | 0.8 | @ 5.0 | 150 | 2.5 | 2N3791 |
| 2N3055 | 60 | 15 | 20 - 70 | @ 4.0 | 1.1 | @ 4.0 | 117 | 0.8 | |
| 2N5302 | 60 | 30 | 15 - 60 | @ 15 | 2.0 | @ 20 | 200 | 2.0 | 2N4399 |
| 2N5069 | 80 | 5.0 | 20 - 80 | @ 1.0 | 1.5 | @ 5.0 | 87.5 | 4.0 | 2N4903 |
| 2N4915 | 80 | 5.0 | 25 - 100 | @ 2.5 | 1.5 | @ 5.0 | 87.5 | 4.0 | 2N4906 |
| 2N3714 | 80 | 10 | 25 - 90 | @ 1.0 | 1.0 | @ 5.0 | 150 | 2.5 | 2N3790 |
| 2N3716 | 80 | 10 | 50 - 150 | @ 1.0 | 0.8 | @ 5.0 | 150 | 2.5 | 2N3792 |
| 2N5303 | 80 | 20 | 15 - 60 | @ 10 | 2.0 | @ 20 | 200 | 2.0 | |

## PNP
## TO3 PACKAGE

| TYPE | $V_{CEO}$ VOLTS MIN | $I_C$ AMPS MAX | $h_{FE}$ MIN - MAX | $h_{FE}$ @ $I_C$ AMP | $V_{CE(sat)}$ VOLTS MAX | $V_{CE(sat)}$ @ $I_C$ AMP | $P_D$ $T_C = 25°C$ W | $f_T$ MHz MIN | NPN Complement |
|---|---|---|---|---|---|---|---|---|---|
| 2N4901 | 40 | 5.0 | 20 - 80 | @ 1.0 | 1.5 | @ 5.0 | 87.5 | 4.0 | 2N5067 |
| 2N4904 | 40 | 5.0 | 25 - 100 | @ 2.5 | 1.5 | @ 5.0 | 87.5 | 4.0 | 2N4913 |
| 2N4907 | 40 | 10 | 20 - 80 | @ 4.0 | 2.0 | @ 10 | 150 | 4.0 | |
| 2N4398 | 40 | 30 | 15 - 60 | @ 15 | 2.0 | @ 20 | 200 | 4.0 | 2N5301 |
| 2N4902 | 60 | 5.0 | 20 - 80 | @ 1.0 | 1.5 | @ 5.0 | 87.5 | 4.0 | 2N5068 |
| 2N4905 | 60 | 5.0 | 25 - 100 | @ 2.5 | 1.5 | @ 5.0 | 87.5 | 4.0 | 2N4914 |
| 2N3789 | 60 | 10 | 15 | @ 3.0 | 1.0 | @ 4.0 | 150 | 4.0 | 2N3713 |
| 2N4908 | 60 | 10 | 20 - 80 | @ 4.0 | 2.0 | @ 10 | 150 | 4.0 | |
| 2N3791 | 60 | 10 | 50 - 150 | @ 1.0 | 1.0 | @ 5.0 | 150 | 4.0 | 2N3715 |
| 2N4399 | 60 | 30 | 15 - 60 | @ 15 | 2.0 | @ 20 | 200 | 4.0 | 2N5302 |
| 2N4903 | 80 | 5.0 | 20 - 80 | @ 1.0 | 1.5 | @ 3.0 | 87.5 | 4.0 | 2N5069 |
| 2N4906 | 80 | 5.0 | 25 - 100 | @ 2.5 | 1.5 | @ 5.0 | 87.5 | 4.0 | 2N4915 |
| 2N3790 | 80 | 10 | 25 - 90 | @ 1.0 | 1.0 | @ 5.0 | 150 | 4.0 | 2N3714 |
| 2N4909 | 80 | 10 | 20 - 80 | @ 4.0 | 2.0 | @ 10 | 150 | 4.0 | |
| 2N3792 | 80 | 10 | 30 | @ 3.0 | 1.0 | @ 5.0 | 150 | 4.0 | 2N3716 |

# TRANSISTORS—FIELD EFFECT

## N–CHANNEL RF AMPLIFIER JUNCTION FIELD EFFECT TRANSISTORS (BY ASCENDING $V_{GSS}$) PLASTIC PACKAGE

| TYPE | $V_{GSS}$ VOLTS MIN | $I_{GSS}$ nA MAX | $I_{DSS}$ mA MIN - MAX | $V_{GS(OFF)}$ VOLTS MAX | $C_{ISS}$ pF MAX | $Y_{fs}$ μmho MIN | NF dB MAX | @ f kHz | NF dB MAX | @ f MHz | Package |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MPF111 | 20 | 100 | 0.5 - 20 | 10 | 4.5 | 500 | | | | | TO92-1 |
| MPF109 | 25 | 1.0 | 0.5 - 24 | 8.0 | 7.0 | 800 | 2.5 | @ 1.0 | | | TO92-1 |
| 2N5484 | 25 | 1.0 | 1.0 - 5.0 | 3.0 | 5.0 | 3000 | 2.5 | @ 1.0 | 3.0 | @ 100 | TO92-1 |
| 2N5457 | 25 | 1.0 | 1.0 - 5.0 | 6.0 | 7.0 | 1000 | | | | | TO92-1 |
| MPF108 | 25 | 1.0 | 0.5 - 24 | 8.0 | 7.0 | 2000 | 2.5 | @ 1.0 | 3.0 | @ 100 | TO92-1 |
| 2N5458 | 25 | 1.0 | 2.0 - 9.0 | 7.0 | 7.0 | 1500 | | | | | TO92-1 |
| 2N5485 | 25 | 1.0 | 4.0 - 10 | 4.0 | 5.0 | 3500 | 2.5 | @ 1.0 | 4.0 | @ 400 | TO92-1 |
| 2N5459 | 25 | 1.0 | 4.0 - 16 | 8.0 | 7.0 | 2000 | | | | | TO92-1 |
| 2N5486 | 25 | 1.0 | 8.0 - 20 | 6.0 | 5.0 | 4000 | 2.5 | @ 1.0 | 4.0 | @ 400 | TO92-1 |
| MPF102 | 25 | 2.0 | 2.0 - 20 | 8.0 | 7.0 | 1600 | | | | | TO92-1 |
| MPF112 | 25 | 100 | 1.0 - 25 | 10 | 8.0 (Typ) | 1000 | | | | | TO92-1 |

## P–CHANNEL GENERAL PURPOSE AMPLIFIER JUNCTION FIELD EFFECT TRANSISTORS (NUMERIC LISTING) PLASTIC PACKAGE

| TYPE | $V_{GSS}$ VOLTS MIN | $I_{GSS}$ nA MAX | $I_{DSS}$ mA MIN - MAX | $V_{GS(OFF)}$ VOLTS MAX | $C_{ISS}$ pF MAX | $Y_{fs}$ μmho MIN | NF dB MAX | @ f kHz | Package |
|---|---|---|---|---|---|---|---|---|---|
| 2N4342 | 25 | 10 | 4.0 - 12 | 5.5 | 2000 | 20 | 1.5 | @ 0.1 | TO18-4 |
| 2N4343 | 25 | 1.0 | 10 - 30 | 10 | 4000 | 20 | 1.5 | @ 0.1 | TO18-4 |
| 2N4360 | 20 | 10 | 3.0 - 30 | 10 | 2000 | 20 | 1.5 | @ 0.1 | TO18-4 |
| 2N5033 | 20 | 10 | 0.3 - 3.5 | 2.5 | 1000 | 25 | 2.0 | @ 1.0 | TO18-4 |

## N–CHANNEL RF DUAL GATE MOS FIELD EFFECT TRANSISTOR METAL PACKAGE

| TYPE | $V_{GSS}$ VOLTS MIN | $I_{GSS}$ nA MAX | $I_{DSX}$ mA MIN - MAX | $V_{GS(OFF)}$ VOLTS MAX | $Y_{fs}$ μmho TYP | $C_{ISS}$ pF MAX | $G_{ps}$ dB MIN | @ f MHz | NF dB MAX | Package |
|---|---|---|---|---|---|---|---|---|---|---|
| FT0601 | 6.0 | 20 | 5.0 - 30 | 4.0 | 13000 | 10 | 16 | @ 200 | 4.0 | TO18-3 |

| TYPE | $V_{CEO}$ VOLTS MIN | $h_{FE}$ MIN - MAX | $h_{FE}$ @ | $I_C$ mA | MATCHING $h_{FE}$ % | MATCHING $V_{BE}$ mV | Package |
|---|---|---|---|---|---|---|---|
| 2N2920A | 60 | 150 - 600 | @ | 0.01 | 10 | 1.5 | TO5-9 |
| 2N2920 | 60 | 150 - 600 | @ | 0.01 | 10 | 3.0 | TO5-9 |
| 2N2979 | 60 | 150 - 600 | @ | 0.01 | 10 | 3.0 | TO18-5 |
| 2N2919A | 60 | 60 - 240 | @ | 0.01 | 10 | 1.5 | TO5-9 |
| 2N2919 | 60 | 60 - 240 | @ | 0.01 | 10 | 3.0 | TO5-9 |
| 2N2978 | 60 | 60 - 240 | @ | 0.01 | 10 | 3.0 | TO18-5 |
| 2N2916 | 45 | 150 - 600 | @ | 0.01 | 10 | 5.0 | TO5-9 |
| 2N2916A | 45 | 150 - 600 | @ | 0.01 | 15 | 2.0 | TO5-9 |
| 2N2975 | 45 | 150 - 600 | @ | 0.01 | 20 | 3.0 | TO5-9 |
| 2N2977 | 45 | 150 - 600 | @ | 0.01 | 20 | 5.0 | TO18-5 |
| 2N2918 | 45 | 150 - 600 | @ | 0.01 | 20 | 5.0 | TO5-9 |
| 2N2642 | 45 | 100 - 300 | @ | 0.01 | 10 | 5.0 | TO5-9 |
| 2N2643 | 45 | 100 - 300 | @ | 0.01 | 20 | 10 | TO5-9 |
| 2N2915 | 45 | 60 - 240 | @ | 0.01 | 10 | 3.0 | TO5-9 |
| 2N2915A | 45 | 60 - 240 | @ | 0.01 | 15 | 2.0 | TO5-9 |
| 2N2974 | 45 | 60 - 240 | @ | 0.01 | 20 | 3.0 | TO18-5 |
| 2N2976 | 45 | 60 - 240 | @ | 0.01 | 20 | 5.0 | TO18-5 |
| 2N2917 | 45 | 60 - 240 | @ | 0.01 | 20 | 10 | TO5-9 |
| 2N2639 | 45 | 50 - 300 | @ | 0.01 | 10 | 5.0 | TO5-9 |
| 2N2640 | 45 | 50 - 300 | @ | 0.01 | 20 | 10 | TO5-9 |
| 2N3411 | 30 | 30 - 120 | @ | 0.1 | 10 | 5.0 | TO5-9 |
| 2N3410 | 30 | 30 - 120 | @ | 0.1 | 10 | 10 | TO5-9 |
| 2N3409 | 30 | 30 - 120 | @ | 0.1 | 20 | 10 | TO5-9 |
| 2N3729 | 30 | 45 - 180 | @ | 1.0 | 10 | 3.0 | TO5-9 |
| 2N3728 | 30 | 45 - 180 | @ | 1.0 | 20 | 5.0 | TO5-9 |
| MD918A | 15 | 50 | @ | 1.0 | 10 | 5.0 | TO5-9 |
| MD918B | 15 | 50 | @ | 1.0 | 20 | 10 | TO5-9 |
| 2N3424 | 15 | 20 - 200 | @ | 3.0 | 10 | 5.0 | TO5-9 |
| 2N3423 | 15 | 20 - 200 | @ | 3.0 | 20 | 10 | TO5-9 |
| MD2369A | 15 | 40 - 140 | @ | 10 | 10 | 5.0 | TO5-9 |
| MD2369B | 15 | 40 - 140 | @ | 10 | 20 | 10 | TO5-9 |

## PNP MATCHED DUAL TRANSISTORS

| TYPE | $V_{CEO}$ VOLTS MIN | $h_{FE}$ MIN - MAX | $h_{FE}$ @ | $I_C$ mA | MATCHING $h_{FE}$ % | MATCHING $V_{BE}$ mV | Package |
|---|---|---|---|---|---|---|---|
| 2N4021 | 60 | 100 - 350 | @ | .01 | 20 | 5.0 | TO5-9 |
| 2N4020 | 45 | 250 - 600 | @ | .01 | 20 | 5.0 | TO5-9 |
| 2N3811A | 60 | 300 - 900 | @ | 0.1 | 10 | 5.0 | TO5-9 |
| 2N3811 | 60 | 300 - 900 | @ | 0.1 | 10 | 5.0 | TO5-9 |
| 2N3805A | 60 | 300 - 900 | @ | 0.1 | 10 | 5.0 | TO18-5 |
| 2N3805 | 60 | 300 - 900 | @ | 0.1 | 10 | 5.0 | TO18-5 |
| 2N3809 | 60 | 300 - 900 | @ | 0.1 | 10 | 8.0 | TO5-9 |
| 2N3803 | 60 | 300 - 900 | @ | 0.1 | 10 | 8.0 | TO18-5 |
| 2N4025 | 60 | 250 - 600 | @ | 0.1 | 10 | 3.0 | TO5-9 |
| 2N4022 | 60 | 250 - 600 | @ | 0.1 | 20 | 5.0 | TO5-9 |
| 2N3810A | 60 | 150 - 450 | @ | 0.1 | 10 | 5.0 | TO5-9 |
| 2N3810 | 60 | 150 - 450 | @ | 0.1 | 10 | 5.0 | TO5-9 |
| 2N3804A | 60 | 150 - 450 | @ | 0.1 | 10 | 5.0 | TO18-5 |
| 2N3804 | 60 | 150 - 450 | @ | 0.1 | 10 | 5.0 | TO18-5 |
| 2N3808 | 60 | 150 - 450 | @ | 0.1 | 20 | 8.0 | TO5-9 |
| 2N3802 | 60 | 150 - 450 | @ | 0.1 | 20 | 8.0 | TO18-5 |
| 2N4024 | 60 | 100 - 350 | @ | 0.1 | 10 | 3.0 | TO5-9 |
| 2N4023 | 45 | 250 - 600 | @ | 0.1 | 10 | 3.0 | TO5-9 |
| MD3251A | 40 | 100 - 300 | @ | 0.1 | 10 | 5.0 | TO5-9 |
| MD3250A | 40 | 50 - 150 | @ | 0.1 | 10 | 5.0 | TO5-9 |
| 2N4016 | 60 | 135 - 350 | @ | 1.0 | 10 | 2.5 | TO5-9 |
| 2N4015 | 60 | 135 - 350 | @ | 1.0 | 10 | 5.0 | TO5-9 |
| 2N3727 | 45 | 135 - 350 | @ | 1.0 | 10 | 2.5 | TO5-9 |
| 2N3726 | 45 | 135 - 350 | @ | 1.0 | 10 | 5.0 | TO5-9 |

## NPN UNMATCHED DUAL TRANSISTORS

| TYPE | $V_{CEO}$ VOLTS MIN | $h_{FE}$ MIN - MAX | $h_{FE}$ @ | $I_C$ mA | MATCHING $h_{FE}$ % | MATCHING $V_{BE}$ mV | Package |
|---|---|---|---|---|---|---|---|
| 2N2914 | 45 | 150 - 600 | @ | 0.01 | | | TO5-9 |
| 2N2973 | 45 | 150 - 600 | @ | 0.01 | | | TO18-5 |
| 2N2644 | 45 | 100 - 300 | @ | 0.01 | | | TO5-9 |
| 2N2972 | 45 | 60 - 250 | @ | 0.01 | | | TO18-5 |
| 2N2913 | 45 | 60 - 240 | @ | 0.01 | | | TO5-9 |
| 2N2641 | 45 | 50 - 300 | @ | 0.01 | | | TO5-9 |
| MD918 | 15 | 50 | @ | 1.00 | | | TO5-9 |
| MD2369 | 15 | 40 - 140 | @ | 10 | | | TO5-9 |
| 2N3425 | 15 | 30 - 120 | @ | 100 | | | TO5-9 |
| MD2219A | 40 | 100 - 300 | @ | 150 | | | TO5-9 |
| MD2218A | 40 | 40 - 120 | @ | 150 | | | TO5-9 |
| MD2219 | 30 | 100 - 300 | @ | 150 | | | TO5-9 |
| MD2218 | 30 | 40 - 120 | @ | 150 | | | TO5-9 |

## PNP UNMATCHED DUAL TRANSISTORS

| TYPE | $V_{CEO}$ VOLTS MIN | $h_{FE}$ MIN - MAX | $h_{FE}$ @ | $I_C$ mA | MATCHING $h_{FE}$ % | MATCHING $V_{BE}$ mV | Package |
|---|---|---|---|---|---|---|---|
| 2N4017 | 80 | 100 - 350 | @ | 0.01 | | | TO5-9 |
| 2N4018 | 60 | 100 - 500 | @ | 0.01 | | | TO5-9 |
| 2N3807 | 60 | 300 - 900 | @ | 0.10 | | | TO5-9 |
| 2N3801 | 60 | 300 - 900 | @ | 0.10 | | | TO18-5 |
| 2N3806 | 60 | 150 - 450 | @ | 0.10 | | | TO5-9 |
| 2N3800 | 60 | 150 - 450 | @ | 0.10 | | | TO18-5 |
| 2N4019 | 45 | 250 - 500 | @ | 0.10 | | | TO5-9 |
| MD3251 | 40 | 100 - 300 | @ | 0.10 | | | TO5-9 |
| MD3250 | 40 | 50 - 150 | @ | 0.10 | | | TO5-9 |
| MD2905A | 60 | 100 - 300 | @ | 150 | | | TO5-9 |
| MD2904A | 60 | 40 - 120 | @ | 150 | | | TO5-9 |
| MD2905 | 40 | 100 - 300 | @ | 150 | | | TO5-9 |
| MD2904 | 40 | 40 - 120 | @ | 150 | | | TO5-9 |

## NPN UNMATCHED QUAD TRANSISTORS

| TYPE | $V_{CEO}$ VOLTS MIN | $h_{FE}$ MIN - MAX | $h_{FE}$ @ | $I_C$ mA | $V_{CE(sat)}$ VOLTS MAX | @ | $I_C$ mA | Package |
|---|---|---|---|---|---|---|---|---|
| FPQ3725 | 50 | 20 | | 500 | 0.5 | | 500 | TO116-1 |
| FQ3725 | 50 | 20 | | 500 | 0.5 | | 500 | TO86-1 |
| FPQ3724 | 40 | 30 | | 500 | 0.5 | | 500 | TO116-1 |
| FQ3724 | 40 | 30 | | 500 | 0.5 | | 500 | TO86-1 |

## PNP UNMATCHED QUAD TRANSISTORS

| TYPE | $V_{CEO}$ VOLTS MIN | $h_{FE}$ MIN - MAX | $h_{FE}$ @ | $I_C$ mA | $V_{CE(sat)}$ VOLTS MAX | @ | $I_C$ mA | Package |
|---|---|---|---|---|---|---|---|---|
| FPQ3468 | 50 | 20 | @ | 500 | 0.5 | | 500 | TO116-1 |
| FQ3468 | 50 | 20 | @ | 500 | 0.5 | | 500 | TO86-1 |
| FPQ3467 | 40 | 30 | @ | 500 | 0.5 | | 500 | TO116-1 |
| FQ3467 | 40 | 30 | @ | 500 | 0.5 | | 500 | TO86-1 |

## NPN DARLINGTON TRANSISTORS

| TYPE | $V_{CEO}$ VOLTS MIN | $h_{FE}$ MIN - MAX | $h_{FE}$ @ | $I_C$ mA | $V_{CE(sat)}$ VOLTS MAX | @ | $I_C$ mA | Package |
|---|---|---|---|---|---|---|---|---|
| MPSA12 | 20 | 20000 | @ | 10 | 1.0 | | 10 | TO92-1 |
| MPSA13 | 30 | 5000 | @ | 10 | 1.5 | | 100 | TO92-1 |
| MPSA14 | 30 | 10000 | @ | 10 | 1.5 | | 100 | TO92-1 |
| 2N997 | 40 | 7000 - 70000 | @ | 100 | 1.6 | | 100 | TO18-1 |
| 2N998 | 60 | 1600 - 8000 | @ | 10 | 1.2 | | 50 | TO18-3 |
| 2N999 | 60 | 7000 - 70000 | @ | 100 | 1.6 | | 100 | TO18-3 |
| 2N2723 | 60 | 2000 - 70000 | @ | 10 | 1.0 | | 10 | TO18-3 |
| 2N2724 | 60 | 7000 - 50000 | @ | 10 | 1.0 | | 10 | TO18-3 |
| 2N2725 | 45 | 2000 - 10000 | @ | 10 | 1.0 | | 10 | TO18-3 |

| TYPE | POL. | BASIC STANDARD DEVICE | $V_{CEO}$ VOLTS MIN | $I_{CBO}$ nA MAX | @ | $V_{CB}$ VOLTS | $h_{FE}$ MIN - MAX | @ | $I_C$ mA | CHIP SIZE MILS | BASIC APPLICATION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DN2484 | NPN | 2N2484 | 60 | 20 | @ | 45 | 250 | @ | 1 | 17.5 x 17.5 | Low Level, Low Noise Amplifier |
| DN3962 | PNP | 2N3962 | 60 | 20 | @ | 50 | 100 - 450 | @ | 1 | 13 x 26 | Low Level, Low Noise Amplifier |
| DN918 | NPN | 2N918 | 15 | 20 | @ | 15 | 20 | @ | 3 | 10 x 15 | R.F. Amplifier |
| DN3250 | PNP | 2N3250 | 40 | 20 | @ | 40 | 50 - 300 | @ | 10 | 11 x 18 | R.F. Amplifier |
| DN3904 | NPN | 2N3904 | 40 | 50 | @ | 30 | 100 - 300 | @ | 10 | 10 x 15 | General Purpose Amplifier |
| DN3906 | PNP | 2N3906 | 40 | 50 | @ | 30 | 100 - 300 | @ | 10 | 11 x 18 | General Purpose Amplifier |
| DN2222A | NPN | 2N2222A | 40 | 20 | @ | 60 | 100 - 300 | @ | 100 | 20 x 20 | G.P. Amplifier and Switch |
| DN2907 | PNP | 2N2907 | 40 | 20 | @ | 50 | 100 - 300 | @ | 100 | 22.5 x 22.5 | G.P. Amplifier and Switch |
| DN3019 | NPN | 2N3019 | 80 | 20 | @ | 90 | 100 - 300 | @ | 100 | 20 x 20 | G.P. Amplifier and Switch |
| DN4033 | PNP | 2N4033 | 80 | 50 | @ | 60 | 100 - 300 | @ | 100 | 27 x 33 | G.P. Amplifier and Switch |
| DN3923 | NPN | 2N3923 | 150 | 20 | @ | 100 | 30 - 120 | @ | 25 | 20 x 20 | High Voltage Amplifier and Switch |
| DN3930 | PNP | 2N3930 | 180 | 20 | @ | 100 | 80 - 300 | @ | 10 | 22.5 x 22.5 | High Voltage Amplifier and Switch |
| DN3742 | NPN | 2N3742 | 300 | 200 | @ | 200 | 20 - 200 | @ | 30 | 35 x 35 | High Voltage Amplifier and Switch |
| DN2369A | NPN | 2N2369A | 15 | 400 | @ | 20 | 40 - 120 | @ | 10 | 10 x 15 | High Speed Saturated Switch |
| DN2894A | PNP | 2N2894A | 12 | 50 | @ | 10 | 30 | @ | 10 | 10 x 15 | High Speed Saturated Switch |
| DN4209 | PNP | 2N4209 | 15 | 20 | @ | 8 | 35 | @ | 1 | 12 x 17 | High Speed Saturated Switch |
| DN3014 | NPN | 2N3014 | 20 | 300 | @ | 20 | 30 - 120 | @ | 30 | 15 x 15 | High Speed Saturated Switch |
| DN5455 | PNP | 2N5455 | 20 | 50 | @ | 15 | 30 - 120 | @ | 30 | 17.5 x 17.5 | High Speed Saturated Switch |
| DN3725 | NPN | 2N3725 | 50 | 1700 | @ | 60 | 60 - 150 | @ | 100 | 30 x 30 | High Speed Core Driver |
| DN3468 | PNP | 2N3468 | 50 | 100 | @ | 30 | 25 | @ | 100 | 27 x 33 | High Speed Core Driver |

# DISCRETE PRODUCTS

## CONTENTS AND SECTION SELECTOR

# INTRODUCTION

## DATA SHEETS

The data sheets are arranged in alphanumeric order, based on the first device designation appearing in the title. These data sheets contain only electrical and thermal data. Where applicable, references are made to family curves found in Section 5 and special test circuits in Section 6. On some data sheets, the package illustrations show pin numbers which refer to similar numbers in the package outline section.

# BA128

## GENERAL PURPOSE

DIFFUSED SILICON PLANAR* DIODE

- **BV . . . 75 V (MIN) @ 100 μA**
- **$I_R$ . . . 100 nA (MAX)**

**See DO35-1 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Junction Temperature | | 175°C |
| Lead Temperature (10 seconds) | | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Ambient Temperature | | 350 mW |
| at 100°C Ambient Temperature | | 175 mW |
| **Maximum Voltages and Currents** | | |
| WIV | Working Inverse Voltage | 50 V |
| $I_F$ | Forward Continuous DC Current | 110 mA |
| $I_O$ | Average Rectified Current | 75 mA |
| $i_f$ | Peak Repetitive Forward Current | 225 mA |
| $i_f$ | Peak Forward Surge Current | |
| | Pulse Width = 1.0 s | 500 mA |
| | Pulse Width = 1.0 μs | 2000 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | 0.73 | 1.0 | V | $I_F$ = 50 mA |
| | | 0.63 | 0.79 | V | $I_F$ = 10 mA |
| | | 0.51 | 0.64 | V | $I_F$ = 1.0 mA |
| | | 0.40 | 0.52 | V | $I_F$ = 0.1 mA |
| $I_R$ | Reverse Current | | 100 | nA | $V_R$ = 50 V |
| | | | 100 | μA | $V_R$ = 50 V, $T_A$ = 100°C |
| BV | Breakdown Voltage | 75 | | V | $I_R$ = 100 μA |
| C | Capacitance | | 5.0 | pF | $V_R$ = 0, f = 1.0 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 175°C and junction to ambient thermal resistance of 428°C/W (derating factor of 2.33 mW/°C).
4. For product family characteristic curves, refer to Section 5 – D6.

# BA129

## HIGH VOLTAGE GENERAL PURPOSE

DIFFUSED SILICON PLANAR* DIODE

- **BV . . . 200 V (MIN) @ 100 μA**
- **$I_R$ . . . 10 nA (MAX) @ 180 V**

**See DO7-2 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Junction Temperature | | 175°C |
| Lead Temperature (10 seconds) | | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Ambient Temperature | | 250 mW |
| at 100°C Ambient Temperature | | 125 mW |
| **Maximum Voltages and Currents** | | |
| WRV | Working Reverse Voltage | 180 V |
| $I_F$ | Forward Continuous Voltage | 225 mA |
| $I_O$ | Average Rectified Current | 150 mA |
| $i_f$ | Peak Repetitive Forward Current | 450 mA |
| $i_f$ | Peak Forward Surge Current | |
| | Pulse Width = 1.0 s | 500 mA |
| | Pulse Width = 1.0 μs | 2.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | 0.78 | 1.0 | V | $I_F$ = 50 mA |
| | | 0.69 | 0.83 | V | $I_F$ = 10 mA |
| | | 0.60 | 0.71 | V | $I_F$ = 1.0 mA |
| | | 0.51 | 0.60 | V | $I_F$ = 0.1 mA |
| $I_R$ | Reverse Current | | 10 | nA | $V_R$ = 180 V |
| | | | 5.0 | μA | $V_R$ = 180 V, $T_A$ = 100°C |
| BV | Breakdown Voltage | 200 | | V | $I_R$ = 100 μA |
| C | Capacitance | | 6.0 | pF | $V_R$ = 0, f = 1.0 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 175°C and jucntion to ambient thermal resistance of 600°C/W (derating factor of 1.67 mW/°C).
4. For product family characteristic curves, refer to Section 5-D5.

# BA130

## VIDEO DETECTOR FM DISCRIMINATOR

DIFFUSED SILICON PLANAR* DIODE

- $V_F$ . . . 1.0 V (MAX) @ 10 mA
- $I_R$ . . . 100 nA (MAX) @ 25 V

See DO7-2 Package Outline

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Junction Temperature | | 175°C |
| Lead Temperature (10 seconds) | | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Ambient Temperature | | 250 mW |
| at 100°C Ambient Temperature | | 125 mW |
| **Maximum Voltage and Currents** | | |
| WRV | Working Reverse Voltage | 25 V |
| $I_F$ | Forward Current (Continuous) | 75 mA |
| $I_O$ | Average Rectified Current | 50 mA |
| $i_f$ | Peak Repetitive Forward Current | 150 mA |
| $i_f$ | Peak Forward Surge Current | |
| | Pulse Width = 1.0 s | 500 mA |
| | Pulse Width = 1.0 μs | 2000 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | 0.69 | 1.0 | V | $I_F$ = 10 mA |
| | | 0.56 | 0.71 | V | $I_F$ = 1.0 mA |
| | | 0.45 | 0.58 | V | $I_F$ = 0.1 mA |
| | | 0.34 | 0.47 | V | $I_F$ = 0.01 mA |
| $I_R$ | Reverse Current | | 100 | nA | $V_R$ = 25 V |
| | | | 100 | μA | $V_R$ = 25 V, $T_A$ = 100°C |
| BV | Breakdown Voltage | 30 | | V | $I_R$ = 5.0 μA |
| C | Capacitance | | 2.0 | pF | $V_R$ = 0, f = 1.0 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 175°C and junction to ambient thermal resistance of 600°C/W (derating factor of 1.67 mW/°C).
4. For product family characteristic curves, refer to Section 5-D5.

# BA164

## TEMPERATURE COMPENSATING

DIFFUSED SILICON PLANAR* DIODE

- **$\Delta V_f$ / °C . . . 1.7 mV/°C @ 10 mA (TYP)**
- **$V_F$ . . . 1.0 V (MAX) @ 10 mA**

**See DO7-2 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Temperature | | 175°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Ambient Temperature | | 250 mW |
| at 45°C Ambient Temperature | | 225 mW |
| **Maximum Voltages and Currents** | | |
| WIV | Working Inverse Voltage | 15 V |
| $V_R$ | Reverse Voltage | 20 V |
| $I_F$ | Forward Continuous DC Current | 75 mA |
| $i_f$ | Peak Repetitive Forward Current | 150 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | TYP. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | | 0.85 | 1.0 | V | $I_F$ = 10 mA |
| $I_R$ | Reverse Current | | | 2.0 | μA | $V_R$ = 15 V |
| | | | | 50 | μA | $V_R$ = 15 V, $T_A$ = 65°C |
| BV | Breakdown Voltage | 20 | | | V | $I_R$ = 5.0 μA |
| $\Delta V_F$/°C | Forward Voltage Temperature Coefficient | | 2.2 | | mV/°C | $I_F$ = 1.0 mA |
| | | | 1.7 | | mV/°C | $I_F$ = 10 mA |
| | | | 1.35 | | mV/°C | $I_F$ = 30 mA |

*Planar is a patented Fairchild process.

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 175°C and junction to ambient thermal resistance of 600°C/W (derating factor of 1.67 mW/°C).
4. For product family characteristic curves, refer to Section 5 - D6.

# BA216

## OXIDE PASSIVATED

DIFFUSED SILICON PLANAR* DIODE

- **$V_F$ . . . 0.7 - 1.0 V @ 15 mA**
- **$V_F$ . . . 0.58 - 0.80 V @ 3.0 mA**

**See DO35-1 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | -65°C to +200°C |
| Operating Junction Temperature | | 175°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation | | 300 mW |
| Linear Derating Factor | | 2.0 mW/°C |
| **Maximum Voltage and Currents** | | |
| $V_R$ | Reverse Voltage | 30 V |
| $V_{RRM}$ | Repetitive Peak Reverse Voltage | 10 V |
| $I_{FAN}$ | Average Rectified Forward Current | 75 mA |
| $I_F$ | Forward Current | 75 mA |
| $I_{FRM}$ | Recurrent Peak Forward Current | 150 mA |
| $I_{FSM}$ | Peak Forward Surge Current | |
| | Pulse Width = 1.0 μs | 1000 mA |
| | Pulse Width = 1.0 s | 250 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | CONDITIONS |
|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | 0.5 | 0.62 | V | $I_F$ = 0.2 mA |
| | | 0.58 | 0.80 | V | $I_F$ = 3.0 mA |
| | | 0.70 | 1.0 | V | $I_F$ = 15 mA |
| $I_R$ | Reverse Current | | 1.5 | μA | $V_R$ = 10 V |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 175°C and junction to ambient thermal resistance of 500°C/W (derating factor of 2.0 mW/°C).
4. For product family characteristic curves, refer to Section 5 - D6.

# BA217

## OXIDE PASSIVATED

DIFFUSED SILICON PLANAR* DIODE

- **$V_F$ . . . 1.5 V (MAX) @ 50 mA**
- **$V_F$ . . . 1.0 V (MAX) @ 10 mA**

**See DO35-1 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Junction Temperature | | 175°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipations | | 300 mW |
| Linear Derating Factor | | 2.0 mW/°C |
| **Maximum Voltages and Currents** | | |
| $V_R$ | Reverse Voltage | 30 V |
| $V_{RRM}$ | Repetitive Peak Reverse Voltage | 10 V |
| $I_{FAV}$ | Average Rectified Forward Current | 75 mA |
| $I_F$ | Forward Current | 75 mA |
| $I_{FRM}$ | Recurrent Peak Forward Current | 150 mA |
| $I_{FSM}$ | Peak Forward Surge Current | |
| | Pulse Width = 1.0 μs | 2000 mA |
| | Pulse Width = 1.0 s | 500 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | | 0.7 | V | $I_F$ = 1.0 mA |
| | | | 1.0 | V | $I_F$ = 10 mA |
| | | | 1.5 | V | $I_F$ = 50 mA |
| $I_F$ | Reverse Current | | 50 | nA | $V_R$ = 10 V |
| | | | 200 | nA | $V_R$ = 30 V |
| C | Capacitance | | 5.0 | pF | $V_R$ = 0, f = 1.0 MHz |

*Planar is a patented Fairchild process.

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 175°C and junction to ambient thermal resistance of 500°C/W (derating factor of 2.0 mW/°C).
4. For product family characteristic curves, refer to Section 5 - D6.

# BAX13

## HIGH SPEED SWITCHING

DIFFUSED SILICON PLANAR* DIODE

- **C . . . 3.0 pF (MAX)**
- **$t_{rr}$ . . . 4.0 ns (MAX)**

**See DO35-1 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Junction Temperature | | 175°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation | | 300 mW |
| Linear Derating Factor | | 2.0 mW/°C |
| **Maximum Voltages and Currents** | | |
| $V_{RRM}$ | Repetitive Peak Reverse Voltage | 50 V |
| $V_R$ | Reverse Voltage | 50 V |
| $I_{FAV}$ | Average Rectified Forward Current | 75 mA |
| $I_F$ | Forward Current | 75 mA |
| $I_{FRM}$ | Recurrent Peak Forward Current | 150 mA |
| $I_{FSM}$ | Peak Forward Surge Current | |
| | Pulse Width = 1.0 μs | 2000 mA |
| | Pulse Width = 1.0 s | 500 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | | 0.7 | V | $I_F$ = 2.0 mA |
| | | | 0.8 | V | $I_F$ = 10 mA, $T_A$ = 100°C |
| | | | 1.0 | V | $I_F$ = 20 mA, (Note 4) |
| | | | 1.53 | V | $I_F$ = 75 mA, (Note 4) |
| $I_R$ | Reverse Current | | 25 | nA | $V_R$ = 10 V |
| | | | 10 | μA | $V_R$ = 10 V, $T_A$ = 150°C |
| | | | 50 | nA | $V_R$ = 25 V |
| | | | 200 | nA | $V_R$ = 50 V |
| | | | 25 | μA | $V_R$ = 50 V, $T_A$ = 150°C |
| C | Capacitance | | 3.0 | pF | $V_R$ = 0, f = 1.0 MHz |
| $t_{rr}$ | Reverse Recovery Time | | 4.0 | ns | $I_f$ = 10 mA, $V_r$ = 6.0 V, $R_L$ = 100Ω, $I_R$ = 1.0 mA |
| $Q_S$ | Recovered Charge | | 45 | pC | $I_f$ = 10 mA, $V_r$ = 5.0 V, $R_L$ = 500Ω |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 175°C and junction to ambient thermal resistance of 500°C/W (derating factor of 2.0 mW/°C).
4. Pulse conditions: length = 300 μs; duty cycle = 2%.
5. For product family characteristic curves, refer to Section 5-D6.

# BAY 71

## ULTRA FAST SWITCHING TYPE

### DIFFUSED SILICON PLANAR* DIODE

- $t_{rr}$ . . . 4.0 ns (MAX)
- C . . . 2.0 pF (MAX)

See DO35-1 Package Outline

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Temperature | | −65°C to +175°C |
| **Maximum Power Dissipation** | | |
| Total Dissipation at 25°C Ambient Temperature | | 250 mW |
| at 125°C Ambient Temperature | | 85 mW |
| **Maximum Voltage and Currents** | | |
| WIV | Working Inverse Voltage | 35 V |
| $I_O$ | Average Rectified Current | 75 mA |
| $I_F$ | Forward Current Steady State DC | 115 mA |
| $i_f$ | Recurrent Peak Forward Current | 225 mA |
| $i_{f(surge)}$ | Peak Forward Surge Current | |
| | Pulse Width = 1.0 s | 500 mA |
| | Pulse Width = 1.0 μs | 2000 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | 0.76 | 1.00 | V | $I_F$ = 20 mA |
| | | 0.69 | 0.88 | V | $I_F$ = 10 mA |
| | | 0.57 | 0.69 | V | $I_F$ = 1.0 mA |
| | | 0.46 | 0.56 | V | $I_F$ - 0.1 mA |
| $I_R$ | Reverse Current | | 100 | nA | $V_R$ = 35 V |
| | | | 100 | μA | $V_R$ = 35 V, $T_A$ = 125°C |
| BV | Breakdown Voltage | 50 | | V | $I_R$ = 5.0 μA |
| $t_{rr}$ | Reverse Recovery Time (Note 2) | | 2.0 | ns | $I_F$ = 10 mA, $I_R$ = 60 mA, $R_L$ = 100 Ω, $V_R$ = 6.0 V |
| $V_{fr}$ | Forward Recovery Peak Voltage (Note 3) | | 3.0 | V | $I_F$ = 100 mA (pulsed) |
| $t_{fr}$ | Forward Recovery Time (Note 3) | | 40 | ns | $I_F$ = 100 mA (pulsed) |
| $Q_S$ | Stored Charge (Note 4) | | 65 | pC | $I_F$ = 20 mA, $I_R$ = 2.0 mA |
| | | | 50 | pC | $I_F$ = 10 mA, $I_R$ = 1.0 mA |
| RE | Rectification Efficientcy (Note 6) | 45 | | % | f = 100 MHz |
| C | Capacitance (Note 5) | | 2.0 | pF | $V_R$ = 0, f = 1.0 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. Recovery to 1.0 mA.
3. The oscilloscope used as the response detector shall have a bandwidth of at least 10 MHz (3 dB down), and shall be calibrated using a deposited carbon resistor of 50 Ω in the diode test clips. $t_{fr}$ is defined as the difference between the 10% point of the pulse and the point where $V_F$ is to within 10% of the quiescent value.
4. Measured on the Tektronix "S" unit.
5. Capacitance as measured on Boonton Electronic Corporation Model No. 75-AS8 capacitance bridge or equivalent.
6. Rectification efficiency is defined as the ratio of dc load voltage to peak rf input voltage to the detector circuit, measured with 2.0 V rms input to the circuit. Load resistance 5.0 kΩ, load capacitance 20 pF.
7. For product family characteristic curves, refer to Section 5 — D6.

# BAY 72

## HIGH SPEED HIGH CONDUCTANCE TYPE

DIFFUSED SILICON PLANAR* DIODE

- **BV . . . 125 V (MIN)**
- **$V_F$ . . . 1.0 V @ 100 mA**

See DO35-1 Package Outline

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Junction Temperature | | 175°C |
| **Maximum Power Dissipation** | | |
| Total Dissipation at 25°C Ambient Temperature | | 500 mW |
| at 150°C Ambient Temperature | | 83 mW |
| **Maximum Voltage and Currents** | | |
| WIV | Working Inverse Voltage | 100 V |
| $I_O$ | Average Rectified Current | 225 mA |
| $I_F$ | Forward Current Steady State DC | 375 mA |
| $i_f$ | Recurrent Peak Forward Current | 725 mA |
| $i_{f(surge)}$ | Peak Forward Surge Current | |
| | Pulse Width = 1.0 s | 1.0 A |
| | Pulse Width = 1.0 μs | 4.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | 0.78 | 1.0 | V | $I_F$ = 100 mA |
| | | 0.73 | 0.92 | V | $I_F$ = 50 mA |
| | | 0.63 | 0.78 | V | $I_F$ = 10 mA |
| | | 0.51 | 0.64 | V | $I_F$ = 1.0 mA |
| $I_R$ | Reverse Current | | 100 | nA | $V_R$ = 100 V |
| | | | 100 | μA | $V_R$ = 100 V, $T_A$ = 125°C |
| BV | Breakdown Voltage | 125 | | V | $I_R$ = 100 μA |
| $t_{rr}$ | Reverse Recovery Time (Note 2) | | 50 | ns | $I_f$ = 30 mA, $I_r$ = 30 mA |
| $t_{rr}$ | Reverse Recovery Time (Note 3) | | 400 | ns | $I_f$ = 30 mA, $V_r$ = 35 V, $R_L$ = 2.0 kΩ, $C_L$ = 10 pF |
| $V_{fr}$ | Forward Recovery Peak Voltage (Note 4) | | 2.5 | V | $I_f$ = 100 mA (pulsed) |
| $t_{fr}$ | Forward Recovery Time (Note 4) | | 50 | ns | $I_f$ = 100 mA (pulsed) |
| $Q_S$ | Stored Charge (Note 5) | | 250 | pC | $I_f$ = 20 mA, $I_r$ = 1.0 mA |
| $C_{ob}$ | Capacitance (Note 6) | | 5.0 | pF | $V_R$ = 0, f = 1.0 MHz |
| RE | Rectification Efficiency (Note 7) | 35 | | % | f = 100 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. These maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. Recovery to 1.0 mA.
3. Recovery to 400 kΩ, JAN 256 circuit.
4. The oscilloscope used as the response detector shall have a bandwidth of at least 10 MHz (3 dB down), and shall be calibrated using a deposited carbon resistor of 50 Ω in the diode test clips. $t_{fr}$ is defined as the difference between the 10% point of the pulse and the point where $V_F$ is to be within 10% of the quiescent value. Pulse conditions shall be 0.1 μs wide at base, 20 ns maximum rise time, repetition rate = 100 kHz max.
5. Measured on the Tektronix "S" unit.
6. Capacitance as measured on Boonton Electronic Corporation Model No. 75-AS8 capacitance bridge or equivalent.
7. Rectification efficiency is defined as the ratio of dc load voltage to peak rf input to the circuit. Load resistance of 5.0 kΩ, load capacitance 20 pF.
8. For product family characteristic curves, refer to Section 5 — D4.

# BAY 73

## HIGH CONDUCTANCE LOW LEAKAGE TYPE

### DIFFUSED SILICON PLANAR* DIODE

- **$I_R$ . . . 5.0 nA (MAX) @ 100 V**
- **BV . . . 125 V (MIN)**

**See DO7-2 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Temperature | | 175°C |
| **Maximum Power Dissipation** | | |
| Total Dissipation at 25°C Ambient Temperature | | 500 mW |
| Linear Derating Factor | | 3.3 mW/°C |
| **Maximum Voltage and Currents** | | |
| WIV | Working Inverse Voltage | 100 V |
| $I_O$ | Average Rectified Current | 150 mA |
| $I_F$ | Forward Current Steady State DC | 225 mA |
| $i_f$ | Recurrent Peak Forward Current | 450 mA |
| $i_{f(surge)}$ | Peak Forward Surge Current | |
| | Pulse Width = 1.0 s | 500 mA |
| | Pulse Width = 1.0 μs | 4.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | 0.85 | 1.00 | V | $I_F$ = 200 mA |
| | | 0.81 | 0.94 | V | $I_F$ = 100 mA |
| | | 0.78 | 0.88 | V | $I_F$ = 50 mA |
| | | 0.69 | 0.80 | V | $I_F$ = 10 mA |
| | | 0.67 | 0.75 | V | $I_F$ = 5.0 mA |
| | | 0.60 | 0.68 | V | $I_F$ = 1.0 mA |
| $I_R$ | Reverse Current | | 5.0 | nA | $V_R$ = 100 V |
| | | | 500 | nA | $V_R$ = 20 V, $T_A$ = 125°C |
| | | | 1.0 | μA | $V_R$ = 100 V, $T_A$ = 125°C |
| $t_{rr}$ | Reverse Recovery Time | | 3.0 | μs | $I_f$ = 10 mA, $V_r$ = 35 V, $R_L$ = 1.0 kΩ to 100 kΩ, $C_L$ = 10 pF, JAN256 |
| C | Capacitance (Note 2) | | 8.0 | pF | $V_R$ = 0 V |
| BV | Breakdown Voltage | 125 | | V | $I_R$ = 100 μA |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. Capacitance as measured on Boonton Electronic Corporation Model No. 75-A58 capacitance bridge or equivalent.
3. For product family characteristic curves, refer to Section 5 — D5.

# BAY 74

## HIGH CONDUCTANCE ULTRA FAST TYPE

SILICON PLANAR* EPITAXIAL DIODE

- $t_{rr}$ . . . 4.0 ns (MAX)
- C . . . 3.0 pF (MAX)

See DO35-1 Package Outline

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Junction Temperature | | 175°C |
| **Maximum Power Dissipation** | | |
| Total Dissipation at 25°C Ambient Temperature | | 500 mW |
| at 125°C Ambient Temperature | | 190 mW |
| **Maximum Voltage and Currents** | | |
| WIV | Working Inverse Voltage | 35 V |
| $I_O$ | Average Rectified Current | 200 mA |
| $i_f$ | Recurrent Peak Forward Current | 600 mA |
| $i_{f(surge)}$ | Peak Forward Surge Current | |
| | Pulse Width = 1.0 s | 1.0 A |
| | Pulse Width = 1.0 μs | 4.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | 0.85 | 1.10 | V | $I_F$ = 300 mA |
| | | 0.82 | 1.00 | V | $I_F$ = 200 mA |
| | | 0.78 | 0.93 | V | $I_F$ = 100 mA |
| | | 0.73 | 0.88 | V | $I_F$ = 50 mA |
| | | 0.65 | 0.77 | V | $I_F$ = 10 mA |
| | | 0.54 | 0.65 | V | $I_F$ = 1.0 mA |
| $I_R$ | Reverse Current | | 100 | nA | $V_R$ = 35 V |
| | | | 100 | μA | $V_R$ = 35 V, $T_A$ = 125°C |
| BV | Breakdown Voltage | 50 | | V | $I_R$ = 5.0 μA |
| C | Capacitance | | 3.0 | pF | $V_R$ = 0, f = 1.0 MHz |
| $t_{rr}$ | Reverse Recovery Time (Note 2) | | 4.0 | ns | $I_f = I_r$ = 10 mA to 200 mA |
| | | | 6.0 | ns | $I_f = I_r$ = 200 mA to 400 mA |
| $t_{rr}$ | Reverse Recovery Time (Note 3) | | 6.0 | ns | $I_f$ = 10 mA, $I_r$ = 1.0 mA |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. Recovery to 10% of $I_f$.
3. Recovery to 0.1 mA.
4. For product family characteristic curves, refer to Section 5 — D6.

# BAY82

## PICOSECOND SWITCHING

DIFFUSED SILICON PLANAR* EPITAXIAL DIODE

- $V_F$ . . . 1.0 V (MAX) @ 20 mA
- $t_{rr}$ . . . 750 ps (MAX)

See DO7-2 Package Outline

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | –65°C to +200°C |
| Operating Junction Temperature | 175°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation | 250 mW |
| Linear Derating Factor | 1.67 mW/°C |

**Maximum Voltage and Currents**

| | | |
|---|---|---|
| WIV | Working Inverse Voltage | 12 V |
| $I_O$ | Average Rectified Current | 50 mA |
| $i_f$ | Recurrent Peak Forward Current | 150 mA |
| $i_{f(surge)}$ | Peak Forward Surge Current Pulse Width = 1.0 s | 150 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | 0.90 | 1.35 | V | $I_F$ = 50 mA |
| | | 0.8 | 1.0 | V | $I_F$ = 20 mA |
| | | 0.77 | 0.94 | V | $I_F$ = 10 mA |
| | | 0.64 | 0.79 | V | $I_F$ = 1.0 mA |
| | | 0.53 | 0.66 | V | $I_F$ = 0.1 mA |
| | | 0.41 | 0.53 | V | $I_F$ = 0.01 mA |
| $I_R$ | Reverse Current | | 100 | nA | $V_R$ = 12 V |
| | | | 50 | μA | $V_R$ = 12 V, $T_A$ = 100°C |
| $B_V$ | Breakdown Voltage | 15 | | V | $I_R$ = 5.0 μA |
| $t_{rr}$ | Reverse Recovery Time | | 750 | ps | $I_f$ = 10 mA, $I_r$ = 10 μA, $R_L$ = 100 Ω |
| C | Capacitance | | 1.3 | pF | $V_R$ = 0, f = 1.0 MHz |

*Planar is a patented Fiarchild process.

NOTES;

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 175°C and junction to ambient thermal resistance of 600°C/W (derating factor of 1.67 mW/°C).
4. For product family characteristic curves, refer to Section 5 - D7.

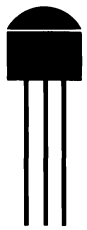
# BC113 • BC114

## NPN LOW LEVEL LOW NOISE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **SILICON NITRIDE PASSIVATED FOR IMPROVED STABILITY**
- **$V_{CEO}$ . . . 25 V (MIN)**
- **$h_{FE}$ . . . 200 (MIN) @ 1.0 mA**
- **NF . . . 2.5 dB (TYP) (BC113), 3.0 dB (MAX) (BC114) @ 1.0 kHz**

**See TO18-4 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −55°C to 125°C |
| Operating Junction Temperature | | 125°C |
| Lead Temperature (10 seconds) | | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Case Temperature | | 0.5 W |
| at 25°C Ambient Temperature | | 0.2 W |
| at 45°C Ambient Temperature | | 0.16 W |
| **Maximum Voltages and Current** | | |
| $V_{CBO}$ | Collector to Base Voltage | 30 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 25 V |
| $V_{EBO}$ | Emitter to Base Voltage | 6.0 V |
| $I_C$ | Collector Current | 50 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | TYP. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | | 170 | | | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V |
| | | 120 | 250 | | | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V |
| | | 200 | 350 | 1000 | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V |
| $h_{FE}$ | DC Current Gain (Note 5) | | 100 | | | $I_C$ = 50 mA, $V_{CE}$ = 5.0 V |
| $V_{BE}$ | Base to Emitter Voltage (Note 5) | | 0.64 | 0.70 | V | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation (Note 5) | | 0.15 | 0.35 | V | $I_C$ = 1.0 mA, $I_B$ = 0.1 mA |
| $I_{CES}$ | Collector Cutoff Current | | 0.5 | 50 | nA | $V_{CB}$ = 20 V, $I_E$ = 0 |
| | | | 0.1 | 5.0 | μA | $V_{CB}$ = 20 V, $I_E$ = 0, $T_A$ = 65°C |
| $I_{EBO}$ | Emitter Reverse Current | | 0.5 | 50 | nA | $V_{EB}$ = 5.0 V, $I_C$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 30 | | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 6.0 | | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $LV_{CEO}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | 30 | | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $h_{fe}$ | Small Signal Current Gain | | 400 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V, f = 1.0 kHz |
| $h_{ie}$ | Input Resistance | | 10 | | kΩ | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V, f = 1.0 kHz |
| $h_{oe}$ | Output Conductance | | 20 | | μΩ | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V, f = 1.0 kHz |
| $h_{re}$ | Voltage Fedback Ratio | | 4.2 | | $\times 10^{-4}$ | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V, f = 1.0 kHz |
| $C_{ob}$ | Output Capacitance | | 2.7 | 4.0 | pF | $I_E$ = 0, $V_{CB}$ = 5.0 V |

| SYMBOL | CHARACTERISTIC | BC113 MIN. | BC113 TYP. | BC113 MAX. | BC114 MIN. | BC114 TYP. | BC114 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain (Note 5) | | 400 | | 200 | 400 | | | $I_C$ = 10 mA, $V_{CE}$ = 5.0 V |
| $h_{fe}$ | High Frequency Gain | 3.0 | 5.0 | | 3.5 | 5.0 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V, f = 20 MHz |
| NF | Noise Figure | | 2.5 | | | 1.5 | 3.0 | dB | $I_C$ = 30 μA, $V_{CE}$ = 5.0 V, f = 1.0 kHz, $R_S$ = 10 kΩ, BW = 200 Hz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/W (derating factor of 2.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.

4

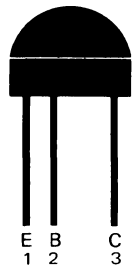
# BC115

## NPN GENERAL PURPOSE AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- **$V_{CEO}$ . . . 30 V (MIN)**
- **$h_{FE}$ . . . 100 - 400 @ 10 mA, 50 (MIN) @ 1.0 mA and 100 mA**

**See TO5-4 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +125°C |
| Operating Junction Temperature | 125°C |
| Lead Temperature (10 seconds) | 260°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 0.80 W |
| at 25°C Ambient Temperature | 0.30 W |
| at 45°C Ambient Temperature | 0.20 W |

**Maximum Voltages and Current**

| | | |
|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 40 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 30 V |
| $V_{EBO}$ | Emitter to Base Voltage | 5 V |
| $I_C$ | Collector Current | 200 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain (Note 5) | 50 | | | $V_{CE}$ = 10 V, $I_C$ = 1.0 mA |
| | | 100 | 400 | | $V_{CE}$ = 10 V, $I_C$ = 10 mA |
| | | 50 | | | $V_{CE}$ = 10 V, $I_C$ = 100 mA |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 5) | | 0.90 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | 1.0 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| $I_{CBO}$ | Collector Cutoff Current | | 100 | nA | $V_{CB}$ = 20 V, $I_E$ = 0 |
| | | | 5.0 | μA | $V_{CB}$ = 20 V, $I_E$ = 0, $T_A$ = 65°C |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 40 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $LV_{CEO}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | 30 | | V | $I_C$ = 30 mA, $I_B$ = 0 |
| $C_{ob}$ | Output Capacitance | | 25 | pF | $I_E$ = 0, $V_{CB}$ = 10 V |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on application involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 125°C, junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 333°C/W (derating factor of 3.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 - SS15.

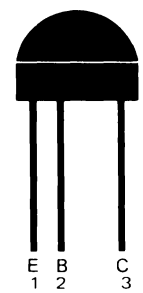
# BC116A

## PNP SMALL SIGNAL GENERAL PURPOSE AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- $V_{CEO}$ . . . 40 V (MIN)
- $h_{FE}$ . . . 80-240 @ 150 mA
- $V_{CE(sat)}$ . . . 0.4 V (MAX) @ 150 mA
- $f_T$ . . . 130 MHz (MIN)
- COMPLEMENTS . . . 2N3569

See TO5-4 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| **Maximum Temperatures** | |
| Storage Temperature | −55°C to +125°C |
| Operating Junction Temperature | 125°C |
| Lead Temperature (10 seconds) | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | |
| Total Dissipation at 25°C Case Temperature | 0.8 W |
| at 75°C Case Temperature | 0.4 W |
| at 25°C Ambient Temperature | 0.3 W |
| **Maximum Voltages** | |
| $V_{CBO}$ Collector to Base Voltage | −45 V |
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | −40 V |
| $V_{EBO}$ Emitter to Base Voltage | −5.0 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain (Note 5) | 70 | | | $I_C$ = 10 mA, $V_{CE}$ = −10 V |
| | | 80 | 240 | | $I_C$ = 150 mA, $V_{CE}$ = −10 V |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 5) | | −1.1 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| | | | −1.3 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 5) | | −1.0 | V | $I_C$ = 50 mA, $V_{CE}$ = −1.0 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | | −0.25 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| | (Note 5) | | −0.4 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| $I_{CBO}$ | Collector Reverse Current | | 50 | nA | $V_{CB}$ = −20 V, $I_E$ = 0 |
| | | | 10 | μA | $V_{CB}$ = −20 V, $I_E$ = 0, $T_A$ = 75°C |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −45 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −5.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $LV_{CEO}$ | Collector to Emitter Sustaining Voltage | −40 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| | (Notes 4 & 5) | | | | |
| $h_{fe}$ | Small Signal Current Gain | 70 | | | $I_C$ = 10 mA, $V_{CE}$ = −10 V, f = 1.0 kHz |
| $h_{fe}$ | High Frequency Current Gain | 1.3 | | | $I_C$ = 30 mA, $V_{CE}$ = −10 V, f = 100 MHz |
| $C_{TE}$ | Emitter Transition Capacitance | | 25 | pF | $I_C$ = 0, $V_{BE}$ = −0.5 V |
| $C_{ob}$ | Output Capacitance | | 10 | pF | $I_E$ = 0, $V_{CB}$ = −10 V |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
3. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 125°C/W (derating factor of 8 mW/°C; junction to ambient thermal resistance of 333°C/W (derating factor of 3 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 — SS15.

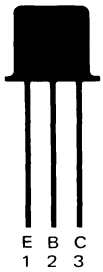
# BC119 • BC139

## NPN-PNP SMALL SIGNAL GENERAL PURPOSE COMPLEMENTARY AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$V_{CEO}$ . . . 30 V (MIN) (BC119), 40 V (MIN) (BC139)**
- **$h_{FE}$ . . . 40–120 @ 150 mA (BC119), 40 (MIN) @ 100 mA (BC139)**
- **COMPLEMENTS . . . BC119 (NPN) - BC139 (PNP)**

**See TO5-1 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | BC119 | BC139 |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | | −55°C to +200°C |
| Operating Junction Temperature | | | 200°C |
| Lead Temperature, (10 seconds) | | | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | **BC119** | **BC139** |
| Total Dissipation at 25°C Case Temperature | | 5.0 W | 3.0 W |
| at 75°C Case Temperature | | 3.5 W | 2.15 W |
| at 25°C Ambient Temperature | | 0.8 W | 0.7 W |
| **Maximum Voltages and Current** | | | |
| $V_{CBO}$ | Collector to Base Voltage | 60 V | −40 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 30 V | −40 V |
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V | −5.0 V |
| $I_C$ | Collector Current | | 500 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | BC119 MIN. | BC119 MAX. | BC139 MIN. | BC139 MAX. | UNITS | TEST CONDITIONS (Reverse Voltage Polarity for PNP) |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain (Note 5) | 40 | | | | | $I_C$ = 50 mA, $V_{CE}$ = 1.0 V |
| | | | | 40 | | | $I_C$ = 100 mA, $V_{CE}$ = 10 V |
| | | 40 | 120 | | | | $I_C$ = 150 mA, $V_{CE}$ = 1.0 V |
| | | | | 20 | | | $I_C$ = 300 mA, $V_{CE}$ = 1.0 V |
| | | 25 | | | | | $I_C$ = 500 mA, $V_{CE}$ = 10 V |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage | | 2.0 | | | V | $I_C$ = 1.0 A, $I_B$ = 100 mA |
| | (Note 5) | | 1.2 | | | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage | | 1.0 | | | V | $I_C$ = 150 mA, $V_{CE}$ = 1.0 V |
| | (Note 5) | | 1.8 | | | V | $I_C$ = 500 mA, $V_{CE}$ = 10 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | | 0.35 | | | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | (Note 5) | | 1.1 | | | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| | | | 1.5 | | | V | $I_C$ = 1.0 A, $I_B$ = 100 mA |
| | | | | | −0.8 | V | $I_C$ = 300 mA, $I_B$ = 30 mA |
| $I_{EBO}$ | Emitter Cutoff Current | | 100 | | | nA | $V_{EB}$ = 4.0 V, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | | | nA | $V_{CB}$ = 40 V, $I_E$ = 0 |
| | | | | | 50 | nA | $V_{CB}$ = 30 V, $I_E$ = 0 |
| | | | 20 | | | μA | $V_{CB}$ = 40 V, $I_E$ = 0, $T_A$ = 150°C |
| | | | | | 50 | μA | $V_{CB}$ = 30 V, $I_E$ = 0, $T_A$ = 75°C |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 60 | | | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| | | | | −40 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| | | | | −5.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $LV_{CEO}$ | Collector to Emitter Sustaining Voltage | 30 | | | | V | $I_C$ = 30 mA, $I_B$ = 0 |
| | (Note 5) | | | −40 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $h_{fe}$ | High Frequency Current Gain | 2.0 | | | | | $I_C$ = 50 mA, $V_{CE}$ = 10 V, f = 20 MHz |
| $C_{ob}$ | Output Capacitance | | 25 | | | pF | $I_E$ = 0, $V_{CB}$ = 10 V |
| | Two BC139 pair $h_{FE}$ ratio | | | 0.8 | 1.25 | | $I_C$ = 300 mA, $V_{CE}$ = 1.0 V |
| | BC139/BC119 pair $h_{FE}$ ratio | 0.8 | 1.25 | 0.8 | 1.25 | | $I_C$ = 300 mA, $V_{CE}$ = 1.0 V |
| | Two BC119 pair $h_{FE}$ ratio | 0.8 | 1.25 | | | | $I_C$ = 300 mA, $V_{CE}$ = 5.0 V |

*Planar is a patented Fairchild process.

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
3. These ratings give a maximum junction temperature of 200°C, junction to case thermal resistance of 35°C/W (derating factor of 28.6 mW/°C), and junction to ambient thermal resistance of 219°C/W (derating factor of 4.56 mW/°C) for BC119. These ratings give a maximum junction temperature of 200°C, junction to case thermal resistance of 58.3°C/W (derating factor of 17.1 mW/°C) and junction to ambient thermal resistance of 250°C/W (derating factor of 4 mW/°C) for BC139.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 - SS15 for BC119 and SS22 for BC139.

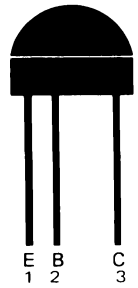
# BC125 • BC126

## NPN-PNP SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$V_{CEO}$ . . . 30 V (MIN)**
- **$h_{FE}$ . . . 30 (MIN) @ 150 mA, 1.0 V**
- **COMPLEMENTS . . . BC125 (NPN) - BC126 (PNP)**

**See TO5-4 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | | |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | | −55°C to +125°C |
| Operating Junction Temperature | | | 125°C |
| Lead Temperature, (10 seconds) | | | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | | |
| Total Dissipation at 25°C Case Temperature | | | 0.8 W |
| at 25°C Ambient Temperature | | | 0.3 W |
| at 45°C Ambient Temperature | | | 0.24 W |
| **Maximum Voltages and Current** | | **BC125** | **BC126** |
| $V_{CBO}$ | Collector to Base Voltage | 50 V | −35 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 30 V | −30 V |
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V | −5.0 V |
| $I_C$ | Collector Current | | 600 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | BC125 MIN. | BC125 MAX. | BC126 MIN. | BC126 MAX. | UNITS | TEST CONDITIONS (Reverse Voltage Polarity for PNP) |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain (Note 5) | 30 | | 30 | | | $I_C$ = 50 mA, $V_{CE}$ = 1.0 V |
| | | 30 | | 30 | 120 | | $I_C$ = 150 mA, $V_{CE}$ = 1.0 V |
| | | 25 | | 25 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V |
| | | 30 | | 30 | | | $I_C$ = 10 mA, $V_{CE}$ = 10 V |
| $V_{BE}$ (sat) | Base to Emitter Saturation Voltage (Note 5) | | 1.3 | | −1.3 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| $V_{BE}$ (On) | Base to Emitter "On" Voltage (Note 5) | | 1.0 | | −1.0 | V | $I_C$ = 50 mA, $V_{CE}$ = 1.0 V |
| $V_{CE}$ (sat) | Collector to Emitter Saturation | | | | −0.25 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| | Voltage (Note 5) | | 0.5 | | −0.5 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | | 50 | nA | $V_{CB}$ = 20 V, $I_E$ = 0 |
| | | | 20 | | 20 | μA | $V_{CB}$ = 20 V, $I_E$ = 0, $T_A$ = 75°C |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 50 | | −35 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| | | | | −5.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| | Collector to Emitter Sustaining | 30 | | | | V | $I_C$ = 30 mA, $I_B$ = 0 |
| | Voltage (Note 5) | | | −30 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $h_{fe}$ | High Frequency Current Gain | 2.0 | | | | | $I_C$ = 50 mA, $V_{CE}$ = 10 V, f = 20 MHz |
| $C_{ob}$ | Output Capacitance | | 25 | | | pF | $I_E$ = 0, $V_{CB}$ = 10 V |
| | BC125/BC126 pair $h_{FE}$ ratio | 0.8 | 1.25 | 0.8 | 1.25 | | $I_C$ = 50 mA, $V_{CE}$ = 1.0 V |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be imparied.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 125°C, junction to case thermal resistance of 125°C/W (derating factor of 8 mW/°C); junction to ambient thermal resistance of 333°C/W (derating factor of 3.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5-SS15 for BC125 and SS22 for BC126.

4

# BC140 • BC141 (NPN) • BC160 • BC161 (PNP)

## NPN-PNP SMALL SIGNAL COMPLEMENTARY GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $V_{CEO}$ . . . 40 V (BC140, BC160), 60 V (MIN) (BC141, BC161)
- $h_{FE}$ . . . 40–400 @ 100 mA
- FOUR $h_{FE}$ GROUPS
- COMPLEMENTS . . . BC140, BC141 (NPN) BC161 (PNP)

See TO5-1 Package Outline


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +175°C |
| Operating Junction Temperature | 175°C |

| **Maximum Power Dissipation** | **BC140** | **BC141** | **BC160, BC161** |
|---|---|---|---|
| Total Dissipation at 45°C Ambient Temperature | 650 mW | 650 mW | 650 mW |
| at 45°C Case Temperature, $V_{CE} \leq 7.0$ V | 3.7 W | | |
| at 45°C Case Temperature, $V_{CE} \leq 8.5$ V | | 3.7 W | |
| at 60°C Case Temperature, $V_{CE} \leq 8.0$ V | | | 3.2 W |

| **Maximum Voltages and Currents** | | **BC140** | **BC141** | **BC160** | **BC161** |
|---|---|---|---|---|---|
| $V_{CES}$ | Collector to Emitter Voltage | 80 V | 100 V | −40 V | −60 V |
| $V_{CEO}$ | Collector to Emitter Voltage | 40 V | 60 V | −40 V | −60 V |
| $V_{EBO}$ | Emitter to Base Voltage | 7.0 V | 7.0 V | −5.0 V | −5.0 V |
| $I_C$ | Collector Current | 1.0 A | 1.0 A | 1.0 A | 1.0 A |
| $I_B$ | Base Current | 100 mA | 100 mA | 100 mA | 100 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | BC140, BC141 MIN. | BC140, BC141 MAX. | BC160, BC161 MIN. | BC160, BC161 MAX. | UNITS | TEST CONDITIONS Reverse Voltage Polarity for PNP |
|---|---|---|---|---|---|---|---|
| $I_{CES}$ | Collector Current BC140/160 | | 100 | | 100 | nA | $V_{CE}$ = 40 V |
| | BC141/161 | | 100 | | 100 | nA | $V_{CE}$ = 60 V |
| | BC140/160 | | 100 | | 100 | μA | $V_{CE}$ = 40 V, $T_A$ = 150°C |
| | BC141/161 | | 100 | | 100 | μA | $V_{CE}$ = 60 V, $T_A$ = 150°C |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | | | | | | |
| | BC140 | 80 | | | | V | $I_C$ = 100 μA, $V_{CE}$ = 0 |
| | BC141 | 100 | | | | V | $I_C$ = 100 μA, $V_{CE}$ = 0 |
| | BC160 | | | −40 | | V | $I_C$ = 100 μA, $V_{CE}$ = 0 |
| | BC161 | | | −60 | | V | $I_C$ = 100 μA, $V_{CE}$ = 0 |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 4) | | | | | | |
| | BC140 | 40 | | | | V | $I_C$ = 30 mA |
| | BC141 | 60 | | | | V | $I_C$ = 30 mA |
| | BC160 | | | −40 | | V | $I_C$ = 50 mA |
| | BC161 | | | −60 | | V | $I_C$ = 50 mA |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage (Note 4) | 7.0 | | −5.0 | | V | $I_E$ = 100 μA |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 4) | | 1.0 | | −1.0 | V | $I_C$ = 1.0 A, $I_B$ = 100 mA |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 4) | | 1.8 | | −1.7 | V | $V_{CE}$ = 1.0 V, $I_C$ = 1.0 A |
| $h_{FE}$ | DC Pulse Current Gain | 40 | 400 | 40 | 400 | | $V_{CE}$ = 1.0 V, $I_C$ = 100 mA |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 175°C and junction to case thermal resistance of 35°C/W (derating factor of 28.6 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Pulse conditions: length = 300 μs; duty cycle = 1%.
5. For product family characteristic curves, refer to Section 5 - SS17 for BC140/41, and SS24 for BC160/61.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | BC140, BC141 MIN. | BC140, BC141 MAX. | BC160, BC161 MIN. | BC160, BC161 MAX. | UNITS | TEST CONDITIONS Reverse Voltage Polarity for PNP |
|---|---|---|---|---|---|---|---|
| $f_T$ | Current Gain Bandwidth Product | 50 | | 50 | | MHz | $V_{CE}$ = 10 V, $I_C$ = 50 mA, f = 20 MHz |
| $C_{cb}$ | Collector to Base Capacitance | | 25 | | 30 | pF | $V_{CB}$ = 10 V, f = 1.0 MHz |
| $C_{eb}$ | Emitter to Base Capacitance | | 80 | | 180 | pF | $V_{EB}$ = −0.5 V, f = 1.0 MHz |
| $t_{on}$ | Turn On Time (see test circuits no. 2011 for BC140/141 and No. 593 for BC160/161) | | 250 | | 500 | ns | $I_C$ = 100 mA, $I_{B1}$ = 5.0 mA |
| $t_{off}$ | Turn Off Time (see test circuits no. 2011 for BC140/141 and no. 593 for BC160/161) | | 850 | | 650 | ns | $I_C$ = 100 mA, $I_{B1}$ = $-I_{B2}$ = 5.0 mA |

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS Reverse Voltage Polarity for PNP |
|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain Gain Grouping − 6 | 40 | 100 | | $I_C$ = 100 mA, |
| | −10 | 63 | 160 | | $V_{CE}$ = 1.0 V |
| | −16 | 100 | 250 | | |
| | −25 | 160 | 400 | | |

4

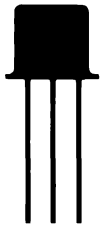
# BC142

## NPN SMALL SIGNAL GENERAL PURPOSE AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- **$V_{CEO}$ . . . 60 V (MIN)**
- **$h_{FE}$ . . . 20 (MIN) @ 200 mA**
- **COMPLEMENT . . . BC143**

**See TO5-1 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +200°C |
| Operating Junction Temperature | 200°C |
| Lead Temperature (10 seconds) | 260°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 5.0 W |
| at 75°C Case Temperature | 3.6 W |
| at 25°C Ambient Temperature | 0.8 W |
| at 45°C Ambient Temperature | 0.7 W |

**Maximum Voltages and Current**

| | | |
|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 80 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 60 V |
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V |
| $I_C$ | Collector Current | 1.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain (Note 5) | 20 | | | $I_C$ = 200 mA, $V_{CE}$ = 10 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | 0.4 | V | $I_C$ = 200 mA, $I_B$ = 20 mA |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | nA | $V_{CB}$ = 40 V, $I_E$ = 0 |
| | | | 50 | μA | $V_{CB}$ = 40 V, $I_E$ = 0, $T_A$ = 150°C |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 80 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $LV_{CEO}$ | Collector to Emitter Sustaining Voltage (Note 5) | 60 | | V | $I_C$ = 30 mA, $I_B$ = 0 |

*Planar is a patented Fairchild process.

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 35°C/W (derating factor of 28.6 mW/°C); junction to ambient thermal resistance of 219°C/W (derating factor of 4.56 mW/°C).
4. These ratings refer to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 - SS17.

# BC143

## PNP SMALL SIGNAL GENERAL PURPOSE AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- $V_{CEO}$ . . . 60 V (MIN)
- $h_{FE}$ . . . 20 (MIN) @ 300 mA
- COMPLEMENT . . . BC142

See TO5-1 Package Outline


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +200°C |
| Operating Junction Temperature | 200°C |
| Lead Temperature (10 seconds) | 260°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 4.0 W |
| at 75°C Case Temperature | 2.86 W |
| at 25°C Ambient Temperature | 0.8 W |
| at 45°C Ambient Temperature | 0.7 W |

**Maximum Voltages and Current**

| | | |
|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | −60 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | −60 V |
| $V_{EBO}$ | Emitter to Base Voltage | −5.0 V |
| $I_C$ | Collector Current | 1.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain (Note 5) | 20 | | | $I_C$ = 300 mA, $V_{CE}$ = −1.0 V |
| | | 15 | | | $I_C$ = 500 mA, $V_{CE}$ = −1.0 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | −0.5 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| | | | −1.0 | V | $I_C$ = 1.0 A, $I_B$ = 100 mA |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | nA | $V_{CB}$ = −30 V, $I_E$ = 0 |
| | | | 50 | μA | $V_{CB}$ = −30 V, $I_E$ = 0, $T_A$ = 75°C |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −60 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −5.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $LV_{CEO}$ | Collector to Emitter Sustaining Voltage (Note 5) | −60 | | V | $I_C$ = 10 mA, $I_B$ = 0 |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 43.7°C/W (derating factor of 23 mW/°C); junction to ambient thermal resistance of 219°C/W (derating factor of 4.56 mW/°C).
4. These ratings refer to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 - SS24.

4

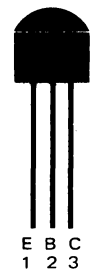
# BC153 • BC154 • BC225

## PNP LOW LEVEL LOW NOISE SMALL SIGNAL AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$V_{CEO}$ . . . 40 V (MIN)**
- **$h_{FE}$ . . . 160 (MIN) 100 μA, 10 mA (BC154)**
- **NF . . . 2.5 dB (MAX) @ 1.0 kHz (BC154)**

**See TO18-4 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −55°C to +125°C |
| Operating Junction Temperature | | 125°C |
| Lead Temperature (10 seconds) | | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Case Temperature | | 0.50 W |
| at 25°C Ambient Temperature | | 0.20 W |
| at 45°C Ambient Temperature | | 0.16 W |
| **Maximum Voltages and Current** | | |
| $V_{CBO}$ | Collector to Base Voltage | −40 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | −40 V |
| $V_{EBO}$ | Emitter to Base Voltage | −5.0 V |
| $I_C$ | Collector Current | 100 mA |

**ELECTRICAL CHARACTERISTIC** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | BC153 MIN. | BC153 MAX. | BC154 MIN. | BC154 MAX. | BC225 MIN. | BC225 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain (Note 5) | 50 | | 160 | | 90 | | | $I_C$ = 100 μA, $V_{CE}$ = −5.0 V |
| | | 50 | | 160 | | 90 | | | $I_C$ = 1.0 mA, $V_{CE}$ = −5.0 V |
| | | 50 | | 160 | | 90 | | | $I_C$ = 10 mA, $V_{CE}$ = −5.0 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | −0.25 | | −0.25 | | −0.25 | V | $I_C$ = 10 mA, $I_B$ = 0.5 mA |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | | 50 | | 50 | nA | $V_{CB}$ = −30 V, $I_E$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −40 | | −40 | | −40 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −5.0 | | −5.0 | | −5.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $LV_{CEO}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | −40 | | −40 | | −40 | | V | $I_C$ = 5.0 mA, $I_B$ = 0 |
| NF | Noise Figure | | | | 2.5 | | | dB | $I_C$ = 20 μA, $V_{CE}$ = −5.0 V, f = 1.0 kHz, $R_S$ = 10 kΩ, Power Bandwidth = 200 Hz |
| | | | | | 2.5 | | | dB | $I_C$ = 250 μA, $V_{CE}$ = −5.0 V, f = 1.0 kHz, $R_S$ = 1.0 kΩ, Power Bandwidth = 200 Hz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
3. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/W (derating factor of 2.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 — SS33.

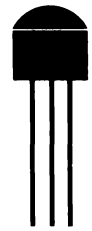
# BC204

## PNP LOW LEVEL LOW NOISE AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- $V_{CEO}$ . . . −45 V (MIN)
- $h_{FE}$ . . . 50–450 @ 2.0 mA

See TO18-4 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +125°C |
| Operating Junction Temperature | 125°C |
| Lead Temperature (10 seconds) | 260°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 0.5 W |
| at 25°C Ambient Temperature | 0.2 W |

**Maximum Voltages**

| | | |
|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | −50 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | −45 V |
| $V_{EBO}$ | Emitter to Base Voltage | −5.0 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 50 | 450 | | $I_C$ = 2.0 mA, $V_{CE}$ = −5.0 V |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage | −0.55 | −0.75 | V | $I_C$ = 2.0 mA, $V_{CE}$ = −5.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | −0.3 | V | $I_C$ = 10 mA, $I_B$ = 0.5 mA |
| $I_{CBO}$ | Collector Reverse Current | | 50 | nA | $V_{CB}$ = −45 V, $I_E$ = 0 |
| | | | 3.0 | μA | $V_{CB}$ = −45 V, $I_E$ = 0, $T_A$ = 65°C |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −50 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −5.0 | | V | $I_C$ = 0, $I_E$ = 10 μA |
| $LV_{CEO}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | −45 | | V | $I_C$ = 5.0 mA, $I_B$ = 0 |
| NF | Noise Figure | | 10 | dB | $I_C$ = 200 μA, $V_{CE}$ = −5.0 V, $R_S$ = 2.0 kΩ, f = 1.0 kHz, BW = 200 Hz |

| SYMBOL | CHARACTERISTIC | BC204VI | | BC204A | | BC204B | | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|
| | | MIN. | MAX. | MIN. | MAX. | MIN. | MAX. | |
| $h_{FE}$ | DC Current Gain (Note 5) | 50 | 120 | 110 | 220 | 200 | 450 | $I_C$ = 2.0 mA, $V_{CE}$ = −5.0 V |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/W (derating factor of 2.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.

4

# BC205

## PNP LOW LEVEL LOW NOISE AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- **$V_{CEO}$ . . . 20 V (MIN) @ 5.0 mA**
- **$h_{FE}$ . . . 110-450 @ 2.0 mA (BC205), 400-800 @ 2.0 mA (BC205C)**

**See TO18-4 Package Outline**


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −25°C to +125°C |
| Operating Junction Temperature | 125°C |
| Lead Temperature (10 seconds) | 260°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 0.5 W |
| at 25°C Ambient Temperature | 0.2 W |

**Maximum Voltages**

| | | |
|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | −25 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | −20 V |
| $V_{EBO}$ | Emitter to Base Voltage | −5.0 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 110 | 450 | | $I_C$ = 2.0 mA, $V_{CE}$ = −5.0 V |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage | −0.55 | −0.75 | V | $I_C$ = 2.0 mA, $V_{CE}$ = −5.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | −0.3 | V | $I_C$ = 10 mA, $I_B$ = 0.5 mA |
| $I_{CBO}$ | Collector Reverse Current | | 50 | nA | $V_{CB}$ = −20 V, $I_E$ = 0 |
| | | | 3.0 | μA | $V_{CB}$ = −20 V, $I_E$ = 0, $T_A$ = 65°C |
| $BV_{CBO}$ | Collector Base Breakdown Voltage | −25 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter Base Breakdown Voltage | −5.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $LV_{CEO}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | −20 | | V | $I_C$ = 5.0 mA, $I_B$ = 0 |
| NF | Noise Figure | | 10 | dB | $I_C$ = 200 μA, $V_{CE}$ = −5.0 V, f = 1.0 kHz, $R_S$ = 2.0 kΩ, BW = 200 Hz |

| SYMBOL | CHARACTERISTIC | BC205A MIN. | BC205A MAX. | BC205B MIN. | BC205B MAX. | BC205C MIN. | BC205C MAX. | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 110 | 220 | 200 | 450 | 400 | 800 | $I_C$ = 2.0 mA, $V_{CE}$ = −5.0 V |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse Conditions: length = 300 μs; duty cycle = 1%.

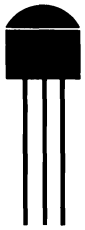
# BC206

## PNP LOW LEVEL LOW NOISE AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- **$V_{CEO}$ . . . −20 V (MIN)**
- **$h_{FE}$ . . . 200 (MIN) @ 2.0 mA (BC206)**
  **. . . 400–800 @ 2.0 mA, (BC206C)**

**See TO18-4 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +125°C |
| Operating Junction Temperature | 125°C |
| Lead Temperature (10 seconds) | 260°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 0.5 W |
| 25°C Ambient Temperature | 0.2 W |

**Maximum Voltages**

| | | |
|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | −25 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | −20 V |
| $V_{EBO}$ | Emitter to Base Voltage | −5.0 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 200 | 800 | | $I_C$ = 2.0 mA, $V_{CE}$ = −5.0 V |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage | −0.55 | −0.75 | | $I_C$ = 2.0 mA, $V_{CE}$ = −5.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | −0.3 | | $I_C$ = 10 mA, $I_B$ = 0.5 mA |
| $I_{CBO}$ | Collector Reverse Current | | 50 | nA | $V_{CB}$ = −20 V, $I_E$ = 0 |
| | | | 3.0 | μA | $V_{CB}$ = −20 V, $I_E$ = 0, $T_A$ = 65°C |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −25 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −5.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $LV_{CEO}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | −20 | | V | $I_C$ = 5.0 mA, $I_B$ = 0 |
| NF | Noise Figure | | 4.0 | dB | $I_C$ = 200 μA, $V_{CE}$ = −5.0 V, f = 1.0 kHz, $R_S$ = 2.0 kΩ, BW = 200 Hz |

| SYMBOL | CHARACTERISTIC | BC206B | | BC206C | | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| | | MIN. | MAX. | MIN. | MAX. | |
| $h_{FE}$ | DC Current Gain (Note 5) | 200 | 450 | 400 | 800 | $I_C$ = 2.0 mA, $V_{CE}$ = −5.0 V |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/W (derating factor of 2.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5-SS33.

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# BC207 • BC208 • BC209

## NPN LOW LEVEL LOW NOISE AMPLIFIERS

DIFFUSED SILICON PLANAR* TRANSISTORS

- **SILICON NITRIDE PASSIVATED FOR IMPROVED STABILITY**
- **NF . . . 4.0 dB (MAX) @ 1.0 kHz (BC209)**
- **$h_{FE}$ . . . 420–800 @ 2.0 mA (BC208C, BC209C)**
  **. . . 100 (MIN) @ 10 μA (BC208C, BC209C)**

**See TO18-4 Package Outline**


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +125°C |
| Operating Junction Temperature | 125°C |
| Lead Temperature (10 seconds) | 260°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Ambient Temperature | 200 mW |
| at 25°C Case Temperature | 500 mW |

**Maximum Voltages and Current**

| | | BC207 | BC208 BC209 |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 50 V | 25 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 45 V | 25 V |
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V | 5.0 V |
| $I_C$ | Collector Current | 100 mA | 100 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | BC207 MIN. | BC207 MAX. | BC208 MIN. | BC208 MAX. | BC209 MIN. | BC209 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 4) | | 0.25 | | 0.25 | | 0.25 | V | $I_C$ = 10 mA, $I_B$ = 0.5 mA |
| | | | 0.60 | | 0.60 | | 0.60 | V | $I_C$ = 100 mA, $I_B$ = 5.0 mA |
| $I_{CBO}$ | Collector Cutoff Current | | 15 | | | | | nA | $V_{CB}$ = 40 V, $I_E$ = 0 |
| | | | 15 | | | | | μA | $V_{CB}$ = 40 V, $I_E$ = 0, $T_A$ = 65°C |
| | | | | | 15 | | 15 | nA | $V_{CB}$ = 20 V, $I_E$ = 0 |
| | | | | | 15 | | 15 | μA | $V_{CB}$ = 20 V, $I_E$ = 0, $T_A$ = 65°C |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 50 | | 25 | | 25 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | 5.0 | | 5.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $LV_{CEO}$ | Collector to Emitter Sustaining Voltage (Note 4) | 45 | | 20 | | 20 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $C_{ob}$ | Output Capacitance | | 6.0 | | 6.0 | | 6.0 | pF | $V_{CB}$ = 10 V, $I_C$ = 0, f = 1.0 MHz |
| NF | Noise Figure | | 10 | | 10 | | | dB | $I_C$ = 0.2 mA, $V_{CE}$ = 5.0 V, f = 1.0 kHz, $R_S$ = 2.0 kΩ, Power Bandwidth of 200 Hz |
| | | | | | | | 4.0 | dB | $I_C$ = 0.2 mA, $V_{CE}$ = 5.0 V, $R_S$ = 2.0 kΩ, Power Bandwidth of 15.7 kHz with 3.0 dB points at 10 Hz and 10 kHz |
| $h_{FE}$ | DC Current Gain | 110 | 450 | 110 | 800 | 200 | 800 | | $I_C$ = 2.0 mA, $V_{CE}$ = 5.0 V |
| | | | | | | 70 | | | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V |

| SYMBOL | CHARACTERISTIC | BC207A BC208A MIN. | BC207A BC208A MAX. | BC207B BC208B BC209B MIN. | BC207B BC208B BC209B MAX. | BC208C BC209C MIN. | BC208C BC209C MAX. | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 110 | 220 | 200 | 450 | 420 | 800 | $I_C$ = 2.0 mA, $V_{CE}$ = 5.0 V |
| | | | | 40 | | 100 | | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
3. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/W (derating factor of 2.0 mW/°C).
4. Pulse conditions: length = 300 μs; duty cycle = 1%
5. For product family characteristic curves, refer to Section 5-SS18.

# BC286 • BC287

## NPN-PNP GENERAL PURPOSE SMALL SIGNAL COMPLEMENTARY AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$V_{CEO}$ . . . 60 V (MIN) @ 10 mA**
- **$h_{FE}$ . . . 20 (MIN) @ 500 mA**
- **COMPLEMENTS . . . BC286 (NPN), BC287 (PNP)**

**See TO5-1 Package Outline**


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +200°C |
| Operating Junction Temperature | 200°C |
| Lead Temperature (10 seconds) | 260°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 4.0 W |
| at 25°C Ambient Temperature | 0.8 W |
| at 45°C Ambient Temperature | 0.708 W |

**Maximum Voltages and Current**

| | | BC286 | BC287 |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 70 V | 60 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 60 V | 60 V |
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V | 5.0 V |
| $I_C$ | Collector Current | 1.0 A | 1.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | BC286 MIN. | BC286 TYP. | BC286 MAX. | BC287 MIN. | BC287 TYP. | BC287 MAX. | UNITS | TEST CONDITIONS Reverse Voltage Polarity for PNP |
|---|---|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | | 85 | | | 125 | | | $I_C$ = 10 mA, $V_{CE}$ = 2.0 V |
| | | | 120 | | | 125 | | | $I_C$ = 100 mA, $V_{CE}$ = 2.0 V |
| | | | 85 | | | 100 | | | $I_C$ = 250 mA, $V_{CE}$ = 2.0 V |
| | | 20 | 50 | 180 | 20 | 85 | 200 | | $I_C$ = 500 mA, $V_{CE}$ = 2.0 V |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage | | 0.92 | | | −0.95 | | V | $I_C$ = 500 mA, $V_{CE}$ = 2.0 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation | | 0.2 | | | −0.25 | | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| | Voltage (Note 5) | | 0.4 | 1.0 | | −0.45 | −1.0 | V | $I_C$ = 1.0 A, $I_B$ = 100 mA |
| $I_{CBO}$ | Collector Cutoff Current | | 0.1 | 20 | | 0.1 | 50 | nA | $V_{CB}$ = 30 V, $I_E$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 70 | | | | | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| | | | | | −60 | | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | | | | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| | | | | | −5.0 | | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | 60 | | | −60 | | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $h_{fe}$ | Small Signal Current Gain | | 25 | | | 75 | | | $I_C$ = 500 mA, $V_{CE}$ = 2.0 V, f = 1.0 kHz |
| | | | 120 | | | 110 | | | $I_C$ = 100 mA, $V_{CE}$ = 2.0 V, f = 1.0 kHz |
| $h_{fe}$ | High Frequency Current Gain | | 5.0 | | | | | | $I_C$ = 50 mA, $V_{CE}$ = 5.0 V, f = 20 MHz |
| | | | | | | 5.0 | | | $I_C$ = 50 mA, $V_{CE}$ = 5.0 V, f = 100 MHz |
| $C_{ob}$ | Output Capacitance | | 12 | | | 20 | | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 1.0 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 43.7°C/W (derating factor of 22.8 mW/°C); junction to ambient thermal resistance of 219°C/W (derating factor of 4.56 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.

4

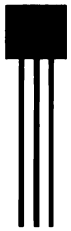
# BC317 • BC318 • BC319

## NPN LOW LEVEL LOW NOISE AMPLIFIERS

DIFFUSED SILICON PLANAR* TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C**
- **SILICON NITRIDE PASSIVATED FOR IMPROVED STABILITY**
- **$V_{CEO}$ . . . 20 V, 30 V AND 45 V (MIN)**
- **NF . . . 4.0 dB (MAX) @ 1.0 kHz (BC319)**
- **$h_{FE}$ . . . 110 (MIN) @ 2.0 mA**
  **. . . 420-800 @ 2.0 mA (BC318C, BC319C)**

**See TO92-1 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Ambient Temperature | 0.625 W |
| at 25°C Case Temperature | 1.0 W |

| **Maximum Voltages and Currents** | | **BC317** | **BC318** | **BC319** |
|---|---|---|---|---|
| $V_{CEO}$ | Collector to Emitter Voltage | 45 V | 30 V | 20 V |
| $V_{CBO}$ | Collector to Base Voltage | 50 V | 45 V | 30 V |
| $V_{EBO}$ | Emitter to Base Voltage | 6.0 V | 5.0 V | 5.0 V |
| $I_C$ | Collector Current | 150 mA | 150 mA | 150 mA |
| $I_{CM}$ | Collector Current | 300 mA | 300 mA | 300 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | BC317 MIN. | BC317 MAX. | BC318 MIN. | BC318 MAX. | BC319 MIN. | BC319 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $C_{ob}$ | Output Capacitance | | 4.0 | | 4.0 | | 4.0 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 1.0 MHz |
| NF | Noise Figure | | 6.0 | | 6.0 | | 4.0 | dB | $I_C$ = 200 μA, $V_{CE}$ = 5.0 V, $R_G$ = 2.0 kΩ f = 1.0 kHz, BW = 200 Hz |
| | | | | | | | 4.0 | dB | $I_C$ = 200 μA, $V_{CE}$ = 5.0 V, $R_G$ = 2.0 kΩ f = 30 Hz to 15 kHz |
| $I_{CBO}$ | Collector Cutoff Current | | 30 | | 30 | | 30 | nA | $V_{CB}$ = 20 V, $I_E$ = 0 |
| | | | 15 | | 15 | | 15 | μA | $V_{CB}$ = 20 V, $I_E$ = 0, $T_A$ = 100°C |
| $V_{CE(sat)}$ | Collector Saturation Voltage | | 0.20 | | 0.20 | | 0.20 | V | $I_C$ = 10 mA, $I_B$ = 0.5 mA |
| | | | 0.50 | | 0.50 | | 0.50 | V | $I_C$ = 100 mA, $I_B$ = 5.0 mA |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage | 0.57 | 0.72 | 0.57 | 0.72 | 0.57 | 0.72 | V | $I_C$ = 2.0 mA, $V_{CE}$ = 5.0 V |
| | | | 0.77 | | 0.77 | | 0.77 | V | $I_C$ = 10 mA, $V_{CE}$ = 5.0 V |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 50 | | 45 | | 30 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | 45 | | 30 | | 20 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 6.0 | | 5.0 | | 5.0 | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $h_{fe}$ | Small Signal Current Gain | 125 | 500 | 125 | 900 | 240 | 900 | V | $I_C$ = 2.0 mA, $V_{CE}$ = 5.0 V, f = 1.0 kHz |
| $h_{FE}$ | DC Current Gain | 110 | 450 | 100 | 800 | 200 | 800 | | $I_C$ = 2.0 mA, $V_{CE}$ = 5.0 V |

| SYMBOL | CHARACTERISTIC | BC317A BC318A MIN. | BC317A BC318A MAX | BC317B BC318B BC319B MIN. | BC317B BC318B BC319B MAX. | BC318C BC319C MIN. | BC318C BC319C MAX. | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|
| $h_{fe}$ | Small Signal Current Gain | 125 | 260 | 240 | 500 | 450 | 900 | $I_C$ = 2.0 mA, $V_{CE}$ = 5.0 V, f = 1.0 kHz |
| $h_{FE}$ | DC Current Gain | | | 40 | | 100 | | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V |
| | | 110 | 220 | 200 | 450 | 420 | 800 | $I_C$ = 2.0 mA, $V_{CE}$ = 5.0 V |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. For product family characteristic curves, refer to Section 5-SS18.

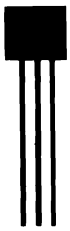
# BC320 • BC321 • BC322

## PNP LOW LEVEL LOW NOISE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- NF . . . 4.0 dB (MAX) (BC322)
- $h_{FE}$ . . . 110 (MIN) @ 2.0 mA (BC320, BC321)
  . . . 400-800 @ 2.0 mA (BC321C, BC322C)
- $V_{CEO}$ . . . −20 V, −30 V, AND −45 V (MIN)

See TO92-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperatures | −55°C to +150°C |
| Operating Junction Temperature | 150°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Ambient Temperature | 0.625 W |
| at 25°C Case Temperature | 1.0 W |

**Maximum Voltages and Current**

| | | BC320 | BC321 | BC322 |
|---|---|---|---|---|
| $V_{CEO}$ | Collector to Emitter Voltage | −45 V | −30 V | −20 V |
| $V_{CBO}$ | Collector to Base Voltage | −50 V | −45 V | −30 V |
| $V_{EBO}$ | Emitter to Base Voltage | −6.0 V | −5.0 V | −5.0 V |
| $I_C$ | Collector Current | 150 mA | 150 mA | 50 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | BC320 MIN. | BC320 MAX. | BC321 MIN. | BC321 MAX. | BC322 MIN. | BC322 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $C_{ob}$ | Output Capacitance | | 4.0 | | 4.0 | | 4.0 | pF | $V_{CB}$ = −10 V, $I_E$ = 0, f = 1.0 MHz |
| NF | Noise Figure | | 6.0 | | 6.0 | | 4.0 | dB | $I_C$ = 200 μA, $V_{CE}$ = −5.0 V, $R_G$ = 2.0 kΩ, f = 1.0 kHz, BW = 200 Hz |
| | | | | | | | 4.0 | dB | $I_C$ = 200 μA, $V_{CE}$ = −5.0 V, $R_G$ = 2.0 kΩ, f = 30 Hz−15 kHz |
| $I_{CBO}$ | Collector Cutoff Current | | 30 | | 30 | | 30 | nA | $V_{CB}$ = −20 V, $I_E$ = 0 |
| | | | 15 | | 15 | | 15 | μA | $V_{CB}$ = −20 V, $I_E$ = 0, $T_A$ = 100°C |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | −0.20 | | −0.20 | | −0.20 | V | $I_C$ = 10 mA, $I_B$ = 0.5 mA |
| $V_{BE(ON)}$ | Base Emitter "On" Voltage | −0.57 | −0.72 | −0.57 | −0.72 | −0.57 | −0.72 | V | $I_C$ = 2.0 mA, $V_{CE}$ = −5.0 V |
| | | | −0.77 | | −0.77 | | −0.77 | V | $I_C$ = 10 mA, $V_{CE}$ = −5.0 V |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −50 | | −45 | | | −30 | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $V_{CEO}$ | Collector to Emitter Sustaining Voltage | −45 | | −30 | | | −20 | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −6.0 | | −5.0 | | | −5.0 | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $h_{fe}$ | Small Signal Current Gain | 125 | 500 | 125 | 900 | 240 | 900 | | $I_C$ = 2.0 mA, $V_{CE}$ = −5.0 V, f = 1.0 kHz |
| $h_{FE}$ | DC Current Gain | 110 | 450 | 110 | 800 | 200 | 800 | | $I_C$ = 2.0 mA, $V_{CE}$ = −5.0 V |

| SYMBOL | CHARACTERISTIC | BC320A BC321A MIN. | BC320A BC321A MAX. | BC320B BC321B BC322B MIN. | BC320B BC321B BC322B MAX. | BC321C BC322C MIN. | BC321C BC322C MAX. | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|
| $h_{fe}$ | Small Signal Current Gain | 125 | 260 | 240 | 500 | 450 | 900 | $I_C$ = 2.0 mA, $V_{CE}$ = −5.0 V, f = 1.0 kHz |
| $h_{FE}$ | DC Current Gain | 110 | 220 | 200 | 450 | 400 | 800 | $I_C$ = 2.0 mA, $V_{CE}$ = −5.0 V |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5-SS33.

# BC323

## NPN GENERAL PURPOSE POWER

SILICON PLANAR* EPITAXIAL TRANSISTOR

- $V_{CEO}$ . . . 60 V (MIN) @ 50 mA
- $V_{CE(sat)}$ . . . 0.15 V (MAX) @ 500 mA

See TO5-2 Package Outline


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −55°C to +200°C |
| Operating Junction Temperature | | 200°C |
| Lead Temperature (10 seconds) | | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Case Temperature | | 7.0 W |
| at 25°C Ambient Temperature | | 0.8 W |
| at 45°C Ambient Temperature | | 0.7 W |
| **Maximum Voltages and Current** | | |
| $V_{CBO}$ | Collector to Base Voltage | 100 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 60 V |
| $V_{CES}$ | Collector to Emitter Voltage | 100 V |
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V |
| $I_C$ | Collector Current | 5.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | TYP. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain (Note 5) | 45 | 140 | 225 | | $I_C$ = 50 mA, $V_{CE}$ = 1.0 V |
| | | 50 | 160 | 250 | | $I_C$ = 500 mA, $V_{CE}$ = 1.0 V |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 5) | | 0.7 | 0.9 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | 0.07 | 0.15 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| $I_{EBO}$ | Emitter Reverse Current | | 0.01 | 10 | μA | $V_{EB}$ = 4.0 V, $I_C$ = 0 |
| $I_{CBO}$ | Collector Reverse Current | | | 100 | μA | $V_{CB}$ = 100 V, $I_E$ = 0 |
| | | | 0.02 | 10 | μA | $V_{CB}$ = 40 V, $I_E$ = 0 |
| | | | 0.35 | | μA | $V_{CB}$ = 40 V, $I_E$ = 0, $T_A$ = 75°C |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | 100 | | | V | $I_C$ = 1.0 mA, $V_{EB}$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | | V | $I_E$ = 1.0 mA, $I_C$ = 0 |
| $LV_{CEO}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | 60 | | | V | $I_C$ = 50 mA, $I_B$ = 0 |
| $h_{fe}$ | High Frequency Current Gain | | 5.0 | | | $I_C$ = 500 mA, $V_{CE}$ = 5.0 V, f = 20 MHz |
| $C_{TE}$ | Emitter Transition Capacitance | | | 500 | pF | $I_C$ = 0, $V_{EB}$ = 0.5 V |
| $C_{ob}$ | Output Capacitance | | | 80 | pF | $I_E$ = 0, $V_{CB}$ = 10 V |

*Planar is a patented Farichild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 25°C/W (derating factor of 40 mW/°C); junction to ambient thermal resistance of 219°C/W (derating factor of 4.56 mW/°C).
4. These ratings refer to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: pulse length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 - PWR1.

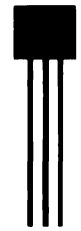
# BC520 • BC521

## NPN LOW LEVEL LOW NOISE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW (MIN) @ $T_A$ = 25°C**
- **SILICON NITRIDE PASSIVATED FOR IMPROVED STABILITY**
- **$V_{CEO}$ . . . 45 V (BC521), 60 V (MIN) (BC520)**
- **$h_{FE}$ . . . 600-1400 @ 10 mA (BC521)**

**See TO92-1 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | | |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | | −55°C to +150°C |
| Operating Junction Temperature | | | 150°C |
| Lead Temperature (10 seconds) | | | 260°C |
| **Maximum Power Dissiaption** (Notes 2 & 3) | | | |
| Total Dissipation at 25°C Case Temperature | | | 1.0 W |
| at 25°C Ambient Temperature | | | 0.625 W |
| at 70°C Ambient Temperature | | | 0.400 W |
| **Maximum Voltages and Current** | | **BC520** | **BC521** |
| $V_{CBO}$ | Collector to Base Voltage | 60 V | 45 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 60 V | 45 V |
| $V_{EBO}$ | Emitter to Base Voltage | 8.0 V | 8.0 V |
| $I_C$ | Collector Current | 50 mA | 50 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | BC520 MIN. | BC520 TYP. | BC520 MAX. | BC521 MIN. | BC521 TYP. | BC521 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 100 | 200 | | 350 | 735 | | | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V |
| | | 120 | 250 | | 400 | 840 | | | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V |
| | | 135 | 290 | | 500 | 960 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V |
| | | 150 | 310 | 700 | 600 | 950 | 1400 | | $I_C$ = 10 mA, (Note 5) $V_{CE}$ = 5.0 V |
| NF | Noise Figure | | 2.5 | 6.0 | | 3.5 | 6.0 | dB | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V, f = 1.0 kHz, $R_S$ = 1.0 kΩ, BW = 400 Hz |
| | | | 1.5 | | | 1.5 | 4.0 | dB | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V, f = 1.0 kHz, $R_S$ = 10 kΩ, BW = 400 Hz |
| | | | 4.0 | | | 2.5 | 8.0 | dB | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V, f = 1.0 kHz, $R_S$ = 100 kΩ, BW = 400 Hz |
| | | | 1.5 | 3.0 | | 1.5 | 3.0 | dB | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V, f = 1.0 kHz, $R_S$ = 10 kΩ, BW = 400 Hz |
| | | | 2.5 | | | 4.0 | | dB | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V, f = 1.0 kHz, $R_S$ = 1.0 kΩ, BW = 10 Hz |
| | | | 1.0 | 3.0 | | 1.0 | 3.0 | dB | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V, $R_S$ = 10 kΩ, BW = 15.7 kHz |
| $I_{CBO}$ | Collector Cutoff Current | | | 2.0 | | | | nA | $I_E$ = 0, $V_{CB}$ = 45 V |
| | | | | | | | 2.0 | nA | $I_E$ = 0, $V_{CB}$ = 30 V |
| | | | | 50 | | | | nA | $I_E$ = 0, $V_{CB}$ = 45 V, $T_A$ = 65°C |
| | | | | | | | 50 | nA | $I_E$ = 0, $V_{CB}$ = 30 V, $T_A$ = 65°C |
| $I_{EBO}$ | Emitter Cutoff Current | | | 1.0 | | | 1.0 | nA | $I_C$ = 0, $V_{EB}$ = 5.0 V |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | 60 | | | 45 | | | V | $I_C$ = 5.0 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 60 | | | 45 | | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 8.0 | | | 8.0 | | | V | $I_C$ = 0, $I_E$ = 10 μA |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5-SS8.

4

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd.)

| SYMBOL | CHARACTERISTIC | BC520 MIN. | BC520 TYP. | BC520 MAX. | BC521 MIN. | BC521 TYP. | BC521 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | | 0.2 | | | 0.2 | V | $I_C$ = 10 mA, $I_B$ = 0.5 mA |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage | 0.5 | | 0.7 | 0.5 | | 0.7 | V | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V |
| $h_{fe}$ | High Frequency Current Gain | 1.0 | | | 1.0 | | 1.5 | | $I_C$ = 10 mA, $V_{CE}$ = 5.0 V, f = 100 MHz |
| $C_{cb}$ | Collector to Base Capacitance | | | 2.5 | | | 3.0 | pF | $V_{CB}$ = 10 V, $I_E$ = 0 |
| $C_{eb}$ | Emitter to Base Capacitance | | | 6.0 | | | 6.0 | pF | $V_{EB}$ = 0.5 V, $I_C$ = 0 |
| $h_{fe}$ | Small Signal Current Gain | 150 | | 1000 | 600 | | 2000 | | $I_C$ = 10 mA, $V_{CE}$ = 5.0 V, f = 1.0 kHz |
| $h_{ie}$ | Input Resistance | | 8.5 | | | 28 | | kΩ | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $h_{oe}$ | Output Conductance | | 24 | | | 74 | | μmho | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $h_{re}$ | Voltage Feedback Ratio | | 7.0 | | | 23 | | $x10^{-4}$ | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |

| SYMBOL | CHARACTERISTIC | BC520 MIN. | BC520 MAX. | BC520B MIN. | BC520B MAX. | BC520C MIN. | BC520C MAX. | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 180 | 800 | 180 | 460 | 380 | 800 | $I_C$ = 2.0 mA, $V_{CE}$ = 5.0 V |

| SYMBOL | CHARACTERISTIC | BC521 MIN. | BC521 MAX. | BC521C MIN. | BC521C MAX. | BC521D MIN. | BC521D MAX. | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 380 | 1550 | 380 | 800 | 750 | 1550 | $I_C$ = 2.0 mA, $V_{CE}$ = 5.0 V |

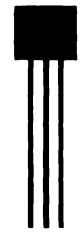
# BC522

## NPN LOW LEVEL LOW NOISE AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- SILICON NITRIDE PASSIVATED FOR IMPROVED STABILITY
- $V_{CEO}$ . . . 20 V (MIN)
- $h_{FE}$ . . . 400 - 2200 @ 2.0 mA

See TO92-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| **Maximum Temperatures** | |
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |
| Lead Temperature (10 seconds) | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | |
| Total Dissipation at 25°C Case Temperature | 1.0 W |
| at 25°C Ambient Temperature | 0.625 W |
| at 70°C Ambient Temperature | 0.400 W |
| **Maximum Voltages and Current** | |
| $V_{CBO}$ Collector to Base Voltage | 20 V |
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | 20 V |
| $V_{EBO}$ Emitter to Base Voltage | 6.0 V |
| $I_C$ Collector Current | 50 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | TYP. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 150 | | | | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V |
| | | 350 | 1580 | | | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V |
| | | 400 | | 2200 | | $I_C$ = 2.0 mA, $V_{CE}$ = 5.0 V |
| NF | Narrow Band Noise Figure | | 1.5 | 3.0 | dB | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V, $R_S$ = 10 kΩ, BW = 400 Hz, f = 1.0 kHz |
| NF | Wide Band Noise Figure | | 1.0 | 3.0 | dB | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V, $R_S$ = 10 kΩ, BW = 15.7 kHz, f = 10 Hz to 10 kHz |
| $I_{CBO}$ | Collector Cutoff Current | | | 10 | nA | $I_E$ = 0, $V_{CB}$ = 20 V |
| | | | | 50 | nA | $I_E$ = 0, $V_{CB}$ = 20 V, $T_A$ = 65°C |
| $I_{EBO}$ | Emitter Cutoff Current | | | 10 | nA | $I_C$ = 0, $V_{EB}$ = 5.0 V |
| | | | | 10 | μA | $I_C$ = 0, $V_{EB}$ = 6.0 V |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | 20 | | | V | $I_C$ = 5.0 mA, $I_B$ = 0 |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | | 0.2 | V | $I_C$ = 10 mA, $I_B$ = 0.5 mA |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage | 0.5 | | 0.75 | V | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V |
| $h_{fe}$ | High Frequency Gain | 1.0 | | | | $I_C$ = 10 mA, $V_{CE}$ = 5.0 V, f = 100 MHz |
| $C_{cb}$ | Collector to Base Capacitance | | | 4.0 | pF | $V_{CB}$ = 5.0 V, $I_E$ = 0 |

| SYMBOL | CHARACTERISTIC | BC522C MIN. | BC522C MAX. | BC522D MIN. | BC522D MAX. | BC522E MIN. | BC522E MAX. | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 400 | 800 | 750 | 1550 | 1200 | 2200 | $I_C$ = 2.0 mA, $V_{CE}$ = 5.0 V |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.

4

# BC523

## NPN LOW LEVEL LOW NOISE AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- SILICON NITRIDE PASSIVATED FOR IMPROVED STABILITY
- $V_{CEO}$ . . . 45 V (MIN)
- $h_{FE}$ . . . 100 (MIN) @ 10 μA
  . . . 150-170 @ 10 mA
- $V_{EBO}$ . . . 12 V (MIN)

See TO92-1 Package Outline


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| **Maximum Temperatures** | |
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |
| Lead Temperature (10 seconds) | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | |
| Total Dissipation at 25°C Case Temperature | 1.0 W |
| at 25°C Ambient Temperature | 0.625 W |
| **Maximum Voltages and Current** | |
| $V_{CBO}$ Collector to Base Voltage | 45 V |
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | 45 V |
| $V_{EBO}$ Emitter to Base Voltage | 12 V |
| $I_C$ Collector Current (Continuous) | 50 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 100 | | | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V |
| | | 120 | | | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V |
| | | 135 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V |
| $h_{fe}$ | DC Current Gain (Note 5) | 150 | 700 | | $I_C$ = 10 mA, $V_{CE}$ = 5.0 V |
| | | 180 | 800 | | $I_C$ = 2.0 mA, $V_{CE}$ = 5.0 V |
| $I_{CBO}$ | Collector Cutoff Current | | 2.0 | nA | $I_E$ = 0, $V_{CB}$ = 45 V |
| | | | 50 | nA | $I_E$ = 0, $V_{CB}$ = 45 V, $T_A$ = 65°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 1.0 | nA | $I_C$ = 0, $V_{EB}$ = 5.0 V |
| | | | 10 | μA | $I_C$ = 0, $V_{EB}$ = 12 V |
| $V_{CEO}$ | Collector to Emitter Breakdown Voltage | 45 | | V | $I_C$ = 5.0 mA, $I_B$ = 0 |
| $V_{CBO}$ | Collector to Base Breakdown Voltage | 45 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | 0.2 | V | $I_C$ = 10 mA, $I_B$ = 0.5 mA |
| $V_{BE(ON)}$ | Base to Emitter Voltage | 0.5 | 0.7 | V | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V |
| $h_{fe}$ | High Frequency Gain | 1.0 | | | $I_C$ = 10 mA, $V_{CE}$ = 5.0 V, f = 100 MHz |
| $C_{cb}$ | Collector to Base Capacitance | | 4.0 | pF | $V_{CB}$ = 5.0 V, $I_E$ = 0 |
| $C_{eb}$ | Emitter to Base Capacitance | | 6.0 | pF | $V_{EB}$ = 0.5 V, $I_C$ = 0 |
| $h_{fe}$ | Small Signal Current Gain | 100 | | | $I_C$ = 10 mA, $V_{CE}$ = 5.0 V, f = 1.0 kHz |

| SYMBOL | CHARACTERISTIC | BC523B MIN. | BC523B MAX. | BC523C MIN. | BC523C MAX. | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 180 | 400 | 380 | 800 | $I_C$ = 2.0 mA, $V_{CE}$ = 5.0 V |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150° and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5-SS8.

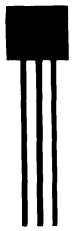
# BC526

## PNP LOW LEVEL LOW NOISE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- $V_{CEO}$ . . . −50 V (MIN)
- $h_{FE}$ . . . 60-800 (BC526) @ 2.0 mA
- $h_{fe}$ . . . 350-600 (BC526C) @ 2.0 mA
- NF . . . 4.0 dB (MAX) WIDE BAND (BC526B, BC526C)

See TO92-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| **Maximum Temperatures** | |
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |
| Lead Temperature (10 seconds) | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | |
| Total Dissipation at 25°C Case Temperature | 1.0 W |
| at 25°C Ambient Temperature | 0.625 W |
| at 70°C Ambient Temperature | 0.400 W |
| **Maximum Voltages and Current** | |
| $V_{CBO}$ Collector to Base Voltage | −60 V |
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | −50 V |
| $V_{EBO}$ Emitter to Base Voltage | −6.0 V |
| $I_C$ Collector Current | 200 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $I_{CBO}$ | Collector Cutoff Current | | 15 | nA | $V_{CB}$ = −30 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 15 | nA | $V_{EB}$ = −4.0 V, $I_C$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 5) | 40 | | | $I_C$ = 10 μA, $V_{CE}$ = −5.0 V |
| | | 60 | 800 | | $I_C$ = 2.0 mA, $V_{CE}$ = −5.0 V |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 5) | | −1.1 | V | $I_C$ = 100 mA, $I_B$ = 5.0 mA |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | −0.6 | V | $I_C$ = 100 mA, $I_B$ = −5.0 mA |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −60 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | −50 | | V | $I_C$ = 2.0 mA, $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −6.0 | | V | $I_C$ = 0, $I_E$ = 10 μA |
| $C_{ob}$ | Output Capacitance | | 5.0 | pF | $V_{CB}$ = −10 V, $I_E$ = 0, f = 1.0 MHz |
| $h_{fe}$ | Small Signal Current Gain | 100 | 600 | | $I_C$ = 2.0 mA, $V_{CE}$ = 5.0 V, f = 1.0 MHz |
| $f_T$ | Current Gain Bandwidth Product | 100 | | MHz | $I_C$ = 10 mA, $V_{CE}$ = −5.0 V |

| SYMBOL | CHARACTERISTIC | BC526A MIN. | BC526A MAX. | BC526B MIN. | BC526B MAX. | BC526C MIN. | BC526C MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $h_{fe}$ | Small Signal Current Gain | 100 | 300 | 200 | 400 | 350 | 600 | | $I_C$ = 2.0 mA, $V_{CE}$ = −5.0 V, f = 1.0 kHz |
| NF | Noise Figure | | 10 | | 4.0 | | 4.0 | dB | $V_{CE}$ = −5.0 V, $I_C$ = 200 μA $R_S$ = 2.0 kΩ, BW = 15.7 kHz |
| | | | | | 4.0 | | 4.0 | dB | $V_{CE}$ = −5.0 V, $I_C$ = 200 μA, $R_G$ = 2.0 kΩ, f = 1.0 kHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5-SS33.

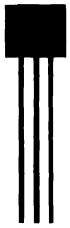
# BC527 • BC528 • BC537 • BC538

## PNP-NPN SMALL SIGNAL COMPLEMENTARY GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C**
- **$V_{CEO}$ . . . 60 V (MIN) (BC527, BC537), 80 V (MIN) (BC528, BC538)**
- **$h_{FE}$ . . . 50 (MIN) FROM 10 mA TO 500 mA, 15 (MIN) @ 1.0A, 40–400 @ 100 mA**
- **FOUR $h_{FE}$ GROUPS**
- **COMPLEMENTS . . . BC527, BC528 (PNP), BC537, BC538 (NPN)**

**See TO92-1 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |
| Lead Temperature (10 seconds) | 260°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 1.0 W |
| at 25°C Ambient Temperature | 0.625 W |
| at 70°C Ambient Temperature | 0.400 W |

**Maximum Voltages and Current** (Reverse Voltage Polarity for PNP)

| | | BC527 BC537 | BC528 BC538 |
|---|---|---|---|
| $V_{CBO}$ | Collector Base Voltage | 60 V | 80 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 60 V | 80 V |
| $V_{EBO}$ | Emitter to Base Voltage | 6.0 V | 6.0 V |
| $I_C$ | Collector Current | 1.0 A | 1.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | BC527 BC537 MIN. | BC527 BC537 MAX. | BC528 BC538 MIN. | BC528 BC538 MAX. | UNITS | TEST CONDITIONS (Reverse Voltage Polarity for PNP) |
|---|---|---|---|---|---|---|---|
| $I_{CBO}$ | Collector Cutoff Current | | 100 | | | nA | $V_{CB}$ = 40 V |
| | | | | | 10 | nA | $V_{CB}$ = 60 V |
| $I_{EBO}$ | Emitter Cutoff Current | | 100 | | 100 | nA | $V_{EB}$ = 4.0 V |
| $h_{FE}$ | DC Current Gain (Note 5) | 40 | 400 | 40 | 400 | | $V_{CE}$ = 1.0 V, $I_C$ = 100 mA |
| | | 50 | | 50 | | | $V_{CE}$ = 10 V, $I_C$ = 10 mA |
| | | 50 | | 50 | | | $V_{CE}$ = 10 V, $I_C$ = 150 mA |
| | | 50 | | 50 | | | $V_{CE}$ = 10 V, $I_C$ = 500 mA |
| | | 15 | | 15 | | | $V_{CE}$ = 10 V, $I_C$ = 1.0 A |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 5) | | 1.3 | | 1.3 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | 0.7 | | 0.7 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| | | | 1.2 | | 1.5 | V | $I_C$ = 1.0 A, $I_B$ = 100 mA |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 60 | | 80 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 6.0 | | 6.0 | | V | $I_C$ = 0, $I_E$ = 10 μA |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 5) | 60 | | 80 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $h_{fe}$ | High Frequency Current Gain | 1.0 | | 1.0 | | | $I_C$ = 50 mA, $V_{CE}$ = 10 V, f = 100 MHz |
| $C_{ob}$ | Output Capacitance | | 15 | | 15 | pF | $I_E$ = 0, $V_{CB}$ = 10 V, f = 1.0 MHz |

| SYMBOL | CHARACTERISTIC | | MIN. | MAX. | TEST CONDITIONS |
|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | Gain Grouping −6 | 40 | 100 | $I_C$ = 100 mA, $V_{CE}$ = 1.0 V |
| | | −10 | 63 | 160 | |
| | | −16 | 100 | 250 | |
| | | −25 | 160 | 400 | |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5-SS24 for BC527/8, SS17 for BC537/8.

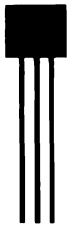
# BC530 • BC531

## PNP SMALL SIGNAL HIGH VOLTAGE GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- $V_{CEO}$ . . . −120 V (MIN) (BC530), 150 V (MIN) (BC531)
- $h_{FE}$ . . . 40-180 (BC530), 60-240 (BC531) @ 10 mA
- COMPLEMENTS . . . BC532, BC533

See TO92-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | | |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | | −55°C to 150°C |
| Operating Junction Temperature | | | 150°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | | |
| Total Dissipation at 25°C Ambient Temperature | | | 0.625 W |
| at 25°C Case Temperature | | | 1.0 W |
| **Maximum Voltages and Current** | | **BC530** | **BC531** |
| $V_{CBO}$ | Collector to Base Voltage | −130 V | −160 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | −120 V | −150 V |
| $V_{EBO}$ | Emitter to Base Voltage | −6.0 V | −6.0 V |
| $I_C$ | Collector Current | 100 mA | 100 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise stated)

| SYMBOL | CHARACTERISTIC | BC530 MIN. | BC530 MAX. | BC531 MIN. | BC531 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 5) | −120 | | −150 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −130 | | −160 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −6.0 | | −6.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 100 | | | nA | $V_{CB}$ = −100 V, $I_E$ = 0 |
| | | | | | 50 | nA | $V_{CB}$ = −120 V, $I_E$ = 0 |
| | | | 100 | | | μA | $V_{CB}$ = −100 V, $I_E$ = 0, $T_A$ = 100°C |
| | | | | | 50 | μA | $V_{CB}$ = −120 V, $I_E$ = 0, $T_A$ = 100°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 50 | | 50 | nA | $V_{EB}$ = −3.0 V, $I_C$ = 0 |
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 30 | | 50 | | | $I_C$ = 1.0 mA, $V_{CE}$ = −5.0 V |
| | | 40 | 180 | 60 | 240 | | $I_C$ = 10 mA, $V_{CE}$ = −5.0 V |
| | | 40 | | 50 | | | $I_C$ = 50 mA, $V_{CE}$ = −5.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | −0.20 | | −0.20 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | −0.25 | | −0.25 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 5) | | −1.0 | | −1.0 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | −1.0 | | −1.0 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $f_T$ | Current Gain Bandwidth Product | 50 | | 50 | | MHz | $I_C$ = 10 mA, $V_{CE}$ = −10 V, f = 100 MHz |
| $C_{ob}$ | Output Capacitance | | 6.0 | | 6.0 | pF | $V_{CB}$ = −10 V, $I_E$ = 0, f = 1.0 MHz |
| $h_{fe}$ | Small Signal Current Gain | 30 | 200 | 40 | 200 | | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V, f = 1.0 kHz |
| | | | 8.0 | | 8.0 | dB | $I_C$ = 250 μA, $V_{CE}$ = −5.0 V, $R_S$ = 1.0 kΩ, f = 10 Hz to 15.7 kHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5-SS25.

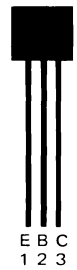
# BC532 • BC533

## NPN SMALL SIGNAL HIGH VOLTAGE GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C**
- **$V_{CEO}$ . . . 140 V (MIN) (BC532), 160 V (MIN) (BC533)**
- **$h_{FE}$ . . . 60-250 (BC532), 40-250 (BC533) @ 10 mA**
- **COMPLEMENTS . . . BC530, BC531**

**See TO92-1 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | | |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | | −55°C to +150°C |
| Operating Junction Temperature | | | 150°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | | |
| Total Dissipation at 25°C Ambient Temperature | | | 0.625 W |
| at 25°C Case Temperature | | | 1.0 W |
| **Maximum Voltages and Current** | | **BC532** | **BC533** |
| $V_{CBO}$ | Collector to Base Voltage | 160 V | 180 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 140 V | 160 V |
| $V_{EBO}$ | Emitter to Base Voltage | 6.0 V | 6.0 V |
| $I_C$ | Collector Current | 100 mA | 100 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | BC532 MIN. | BC532 MAX. | BC533 MIN. | BC533 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 5) | 140 | | 160 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 160 | | 180 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 6.0 | | 6.0 | | V | $I_C$ = 10 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 100 | | | nA | $V_{CB}$ = 100 V, $I_E$ = 0 |
| | | | | | 50 | nA | $V_{CB}$ = 120 V, $I_E$ = 0 |
| | | | 100 | | | μA | $V_{CB}$ = 100 V, $I_E$ = 0, $T_A$ = 100°C |
| | | | | | 50 | μA | $V_{CB}$ = 120 V, $I_E$ = 0, $T_A$ = 100°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 50 | | 50 | nA | $V_{EB}$ = 4.0 V, $I_C$ = 0 |
| $h_{FE}$ | DC Pulse Current Gain | 60 | | 40 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V |
| | (Note 5) | 60 | 250 | 40 | 250 | | $I_C$ = 10 mA, $V_{CE}$ = 5.0 V |
| | | 20 | | 25 | | | $I_C$ = 50 mA, $V_{CE}$ = 5.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage | | 0.15 | | 0.15 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | (Note 5) | | 0.25 | | 0.20 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage | | 1.0 | | 1.0 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | (Note 5) | | 1.2 | | 1.0 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $C_{ob}$ | Output Capacitance | | 6.0 | | 6.0 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 1.0 MHz |
| $C_{eb}$ | Emitter to Base Capacitance | | 30 | | 30 | pF | $V_{EB}$ = 0.5 V, $I_C$ = 0, f = 1.0 MHz |
| $f_T$ | Current Gain Bandwidth Product | 50 | | 50 | | MHz | $I_C$ = 10 mA, $V_{CE}$ = 10 V, f = 20 MHz |
| $h_{fe}$ | Small Signal Current Gain | 50 | 200 | 50 | 200 | | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| NF | Noise Figure | | 10 | | 8.0 | dB | $I_C$ = 250 μA, $V_{CE}$ = 5.0 V, $R_S$ = 1.0 kΩ, f = 10 Hz to 15.7 kHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.

# BC534 • BC535

## PNP-NPN SMALL SIGNAL GENERAL PURPOSE COMPLEMENTARY AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- $V_{CEO}$ . . . 80 V (MIN)
- $h_{FE}$ . . . 50 (MIN) @ 10 mA and 100 mA
- COMPLEMENTS . . . BC534 (PNP), BC535 (NPN)

See TO92-1 Package Outline


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperatures | | −55°C to +150°C |
| Operating Junction Temperature | | 150°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Case Temperature | | 1.0 W |
| at 25°C Ambient Temperature | | 0.625 W |
| at 70°C Ambient Temperature | | 0.400 W |
| **Maximum Voltages and Current** (Reverse Voltage Polarity for PNP) | | |
| $V_{CBO}$ | Collector to Base Voltage | 80 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 80 V |
| $V_{EBO}$ | Emitter to Base Voltage | 6.0 V |
| $I_C$ | Collector Current | 500 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless state otherwise) Reverse voltage polarity for PNP.

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | 80 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 6.0 | | V | $I_C$ = 100 μA, $I_C$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 80 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 100 | nA | $V_{CB}$ = 80 V, $I_E$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 5) | 50 | | | $I_C$ = 10 mA, $V_{CE}$ = 1.0 V |
| | | 50 | | | $I_C$ = 100 mA, $V_{CE}$ = 1.0 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | 0.25 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| $V_{BE(ON)}$ | Base to Emitter 'On'' Voltage (Note 5) | | 1.2 | V | $I_C$ = 100 mA, $V_{CE}$ = 1.0 V |
| $f_T$ | Current Gain Bandwidth Product | 50 | | MHz | $I_C$ = 100 mA, $V_{CE}$ = 1.0 V, f = 100 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5-SS24 for BC534 and SS17 for BC535.

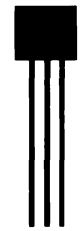
# BC727 • BC728 • BC737 • BC738

## PNP-NPN COMPLEMENTARY AUDIO FREQUENCY DRIVERS AND OUTPUT AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C**
- **$V_{CEO}$ . . . 40 V (MIN) BC727, BC737; 25 V (MIN), BC728, BC738**
- **$h_{FE}$ . . . 63-630 @ 100 mA, 63 (MIN) FROM 100 mA to 500 mA, 30 (MIN) @ 1.0 A BC728, BC738**
- **FOUR $h_{FE}$ GROUPS**
- **COMPLEMENTS . . . BC727, BC728 (PNP); BC737, BC738 (NPN)**

**See TO92-1 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | | |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | | −55°C to +150°C |
| Operating Junction Temperature | | | 150°C |
| Lead Temperature (10 seconds) | | | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | | |
| Total Dissipation at 25°C Case Temperature | | | 1.0 W |
| at 25°C Ambient Temperature | | | 0.625 W |
| at 70°C Ambient Temperature | | | 0.400 W |
| **Maximum Voltages and Current** | | **BC727, BC737** | **BC728, BC738** |
| $V_{CBO}$ | Collector to Base Voltage | 50 V | 30 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 40 V | 25 V |
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V | 5.0 V |
| $I_C$ | Collector Current | 1.0 A | 1.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | BC727, BC737 MIN. | BC727, BC737 MAX. | BC728, BC738 MIN. | BC728, BC738 MAX. | UNITS | TEST CONDITIONS Reverse Voltage Polarity for PNP |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain (Note 5) | 63 | 630 | 63 | 630 | | $V_{CE}$ = 1.0 V, $I_C$ = 100 mA |
| | | 63 | | 63 | | | $V_{CE}$ = 1.0 V, $I_C$ = 500 mA |
| | | 15 | | 30 | | | $V_{CE}$ = 1.0 V, $I_C$ = 1.0 A |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 5) | | 1.2 | | 1.2 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| | | | 1.3 | | 1.3 | V | $I_C$ = 1.0 A, $I_B$ = 100 mA |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | 0.7 | | 0.7 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 50 | | 30 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 5) | 40 | | 25 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $h_{fe}$ | High Frequency Current Gain | 2.0 | | 2.0 | | | $I_C$ = 50 mA, $V_{CE}$ = 10 V, f = 20 MHz |
| $C_{ob}$ | Output Capacitance | | 20 | | 20 | pF | $I_E$ = 0, $V_{CB}$ = 10 V, f = 1.0 MHz |
| $I_{CBO}$ | Collector Cutoff Current | | 100 | | | nA | $V_{CB}$ = 40 V |
| | | | | | 10 | nA | $V_{CB}$ = 25 V |
| $I_{EBO}$ | Emitter Cutoff Current | | 100 | | 100 | nA | $V_{EB}$ = 4.0 V |
| | | | 100 | | 100 | μA | $V_{EB}$ = 5.0 V |

| SYMBOL | CHARACTERISTIC | | MIN. | MAX. | TEST CONDITIONS Reverse Voltage Polarity for PNP |
|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | Gain Grouping −10 | 63 | 160 | $V_{CE}$ = 1.0 V, $I_C$ = 100 mA |
| | | −16 | 100 | 250 | $V_{CE}$ = 1.0 V, $I_C$ = 100 mA |
| | | −25 | 160 | 400 | $V_{CE}$ = 1.0 V, $I_C$ = 100 mA |
| | | −40 | 250 | 630 | $V_{CE}$ = 1.0 V, $I_C$ = 100 mA |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.

# BD115

## NPN HIGH VOLTAGE GENERAL PURPOSE AMPLIFIER

DIFFUSED SILICON PLANAR* TRANSISTOR

- $V_{CEO}$ . . . 180 V (MIN)
- $h_{FE}$ . . . 22 (MIN) @ 50 mA
- $r_b'C_c$ . . . 100 ps (MAX)

See TO5-1 Package Outline


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −55°C to +200°C |
| Operating Junction Temperature | | 200°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 50°C Ambient Temperature | | 6.0 W |
| (Mounted on a 1.5 mm Al blackened heat sink of at least 30 cm²) at 25°C Ambient Temperature | | 0.875 W |
| **Maximum Voltages and Currents** | | |
| $V_{CBO}$ | Collector to Base Voltage | 245 V |
| $V_{CEO}$ | Collector to Emitter Voltage | 180 V |
| $V_{CER}$ | Collector to Emitter Voltage | 245 V |
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V |
| $I_C$ | Collector Current | 150 mA |
| $I_{CM}$ | Collector Current (Peak) | 200 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $I_{EBO}$ | Emitter Cutoff Current | | 100 | μA | $I_C = 0$, $V_{EB} = 5.0$ V |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 4) | | 1.0 | V | $I_C = 50$ mA, $V_{CE} = 100$ V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 4) | | 9.0 | V | $I_C = 100$ mA, $I_B = 10$ mA |
| $h_{FE}$ | DC Current Gain (Note 4) | 22 | | | $I_C = 50$ mA, $V_{CE} = 100$ V |
| $r_b'C_c$ | Feedback Time Constant | | 100 | ps | $I_E = 10$ mA, $V_{CB} = 10$ V, f = 10 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 25°C/W (derating factor of 40 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Pulse conditions: length = 300 μs; duty cycle <2%.

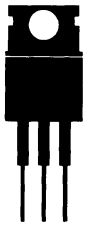
# BD220 • BD221 • BD222

## 36 WATT NPN SILICON POWER

MOLDED SILICON DIFFUSED BI-MESAR™ TRANSISTORS

- **$P_D$ . . . 36 W (MIN)**
- **$I_C$ . . . 4.0 A (MAX)**
- **COMPLEMENTS . . . BD223, BD224, BD225**

**See TO220-00 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +150°C |
| Operating Junction Temperature | 150°C |
| Lead Temperature (10 seconds) | 235°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation | 36 W |
| Linear Derating Factor | 288 mW/°C |

**Maximum Voltages and Currents**

| | | BD220 | BD221 | BD222 |
|---|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 80 V | 60 V | 80 V |
| $V_{EBO}$ | Emitter to Base Voltage | 7.0 V | 5.0 V | 5.0 V |
| $V_{CEV}$ | Collector to Emitter Voltage ($V_{EB}$ = 1.5 V) | 80 V | 60 V | 80 V |
| $V_{CER}$ | Collector to Emitter Voltage ($R_{BE}$ = 100 Ω) | 75 V | 50 V | 70 V |
| $V_{CEO}$ | Collector to Emitter Voltage | 70 V | 40 V | 60 V |
| $I_C$ | Collector Current (Continuous) | 4.0 A | 4.0 A | 4.0 A |
| $I_B$ | Base Current (Continuous) | 2.0 A | 2.0 A | 2.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | BD220 MIN. | BD220 MAX. | BD221 MIN. | BD221 MAX. | BD222 MIN. | BD222 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $I_{CEV}$ | Collector Cutoff Current | | 0.5 | | | | 0.5 | mA | $V_{CE}$ = 65 V, $V_{EB}$ = 1.5 V |
| | | | | | 2.0 | | | mA | $V_{CE}$ = 35 V, $V_{EB}$ = 1.5 V |
| | | | 10 | | | | 10 | mA | $V_{CE}$ = 80 V, $V_{BE}$ = 1.5 V |
| | | | | | 10 | | | mA | $V_{CE}$ = 60 V, $V_{BE}$ = 1.5 V |
| | | | 3.0 | | | | 3.0 | mA | $V_{CE}$ = 65 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| | | | | | 5.0 | | | mA | $V_{CE}$ = 35 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| $I_{CER}$ | Collector Cutoff Current | | 0.5 | | | | 0.5 | mA | $V_{CE}$ = 50 V, $R_{BE}$ = 100 Ω |
| | | | 10 | | | | | mA | $V_{CE}$ = 75 V, $R_{BE}$ = 100 Ω |
| | | | | | 10 | | | mA | $V_{CE}$ = 50 V, $R_{BE}$ = 100 Ω |
| | | | | | | | 10 | mA | $V_{CE}$ = 70 V, $R_{BE}$ = 100 Ω |
| | | | 2.0 | | | | 2.0 | mA | $V_{CE}$ = 50 V, $R_{BE}$ = 100 Ω, $T_C$ = 150°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 1.0 | | | | | mA | $V_{EB}$ = 7.0 V, $I_C$ = 0 |
| | | | | | 1.0 | | 1.0 | mA | $V_{EB}$ = 5.0 V, $I_C$ = 0 |
| $h_{FE}$ | DC Pulse Current Gain (Note 4) | 30 | 120 | | | | | | $I_C$ = 0.5 A, $V_{CE}$ = 4.0 V |
| | | | | 30 | 120 | | | | $I_C$ = 1.0 A, $V_{CE}$ = 4.0 V |
| | | | | | | 20 | 80 | | $I_C$ = 1.5 A, $V_{CE}$ = 4.0 V |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 4) | 70 | | 40 | | 60 | | V | $I_C$ = 100 mA, $I_B$ = 0 |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 4) | | 1.1 | | | | | V | $I_C$ = 0.5 A, $V_{CE}$ = 4.0 V |
| | | | | | 1.3 | | | V | $I_C$ = 1.0 A, $V_{CE}$ = 4.0 V |
| | | | | | | | 1.5 | V | $I_C$ = 1.5 A, $V_{CE}$ = 4.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 4) | | 1.0 | | | | | V | $I_C$ = 0.5 A, $I_B$ = 50 mA |
| | | | | | 1.0 | | | V | $I_C$ = 1.0 A, $I_B$ = 100 mA |
| | | | | | | | 1.0 | V | $I_C$ = 1.5 A, $I_B$ = 150 mA |

Additional Electrical Characteristics on following page.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 3.47°C/W (derating factor of 288 mW/°C).
4. Pulse conditions: length = 300 μs; duty cycle = 2%.
5. For product family characteristic curves, refer to Section 5 - PWR5.

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | BD220 MIN. | BD220 MAX. | BD221 MIN. | BD221 MAX. | BD222 MIN. | BD222 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $f_T$ | Current Gain Bandwidth Product | 0.8 | | 0.8 | | 0.8 | | MHz | $V_{CE}$ = 4.0 V, $I_C$ = 0.2 A, f = 100 kHz |
| $t_{on}$ | Saturated Turn On Time | | 5.0 | | | | | μs | $I_C$ = 0.5 A, $I_{B1}$ = 50 mA, $V_{CC}$ = 30 V |
| | | | | | 5.0 | | | μs | $I_C$ = 1.0 A, $I_{B1}$ = 100 mA, $V_{CC}$ = 30 V |
| | | | | | | | 5.0 | μs | $I_C$ = 1.5 A, $I_{B1}$ = 150 mA, $V_{CC}$ = 30 V |
| $t_{off}$ | Saturated Turn Off Time | | 15 | | | | | μs | $I_C$ = 0.5 A, $I_{B1}$ = $I_{B2}$ = 50 mA, $V_{CC}$ = 30 V |
| | | | | | 15 | | | μs | $I_C$ = 1.0 A, $I_{B1}$ = $I_{B2}$ = 100 mA, $V_{CC}$ = 30 V |
| | | | | | | | 15 | μs | $I_C$ = 1.5 A, $I_{B1}$ = $I_{B2}$ = 150 mA, $V_{CC}$ = 30 V |

4

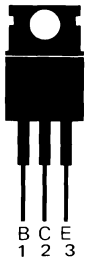
# BD223 • BD224 • BD225

## 36 WATT PNP SILICON POWER

MOLDED SILICON DIFFUSED BI-MESAR™ TRANSISTORS

- $P_D$ . . . 36 W (MIN)
- $I_C$ . . . 4.0 A (MAX)
- COMPLEMENTS . . . BD220, BD221, BD222

See TO220-00 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +150°C |
| Operating Junction Temperature | 150°C |
| Lead Temperature (10 seconds) | 235°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation | 36 W |
| Linear Derating Factor | 288 mW/°C |

**Maximum Voltages and Currents**

| | | BD223 | BD224 | BD225 |
|---|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | −80 V | −60 V | −80 V |
| $V_{EBO}$ | Emitter to Base Voltage | −7.0 V | −5.0 V | −5.0 V |
| $V_{CEV}$ | Collector to Emitter Voltage ($V_{EB}$ = 1.5 V) | −80 V | −60 V | −80 V |
| $V_{CER}$ | Collector to Emitter Voltage ($R_{BE}$ = 100 Ω) | −75 V | −50 V | −70 V |
| $V_{CEO}$ | Collector to Emitter Voltage | −70 V | −40 V | −60 V |
| $I_C$ | Collector Current (Continuous) | 4.0 A | 4.0 A | 4.0 A |
| $I_B$ | Base Current (Continuous) | 2.0 A | 2.0 A | 2.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | BD223 MIN. | BD223 MAX. | BD224 MIN. | BD224 MAX. | BD225 MIN. | BD225 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $I_{CEV}$ | Collector Cutoff Current | | 0.5 | | | | 0.5 | mA | $V_{CE}$ = −65 V, $V_{EB}$ = −1.5 V |
| | | | | | 2.0 | | | mA | $V_{CE}$ = −35 V, $V_{EB}$ = −1.5 V |
| | | | 10 | | | | 10 | mA | $V_{CE}$ = −80 V, $V_{BE}$ = −1.5 V |
| | | | | | 10 | | | mA | $V_{CE}$ = −60 V, $V_{BE}$ = −1.5 V |
| | | | 3.0 | | | | 3.0 | mA | $V_{CE}$ = −65 V, $V_{EB}$ = −1.5 V, $T_C$ = 150°C |
| | | | | | 5.0 | | | mA | $V_{CE}$ = −35 V, $V_{EB}$ = −1.5 V, $T_C$ = 150°C |
| $I_{CER}$ | Collector Cutoff Current | | 0.5 | | | | 0.5 | mA | $V_{CE}$ = −50 V, $R_{BE}$ = 100 Ω |
| | | | 10 | | | | | mA | $V_{CE}$ = −75 V, $R_{BE}$ = 100 Ω |
| | | | | | 10 | | | mA | $V_{CE}$ = −50 V, $R_{BE}$ = 100 Ω |
| | | | | | | | 10 | mA | $V_{CE}$ = −70 V, $R_{BE}$ = 100 Ω |
| | | | 2.0 | | | | 2.0 | mA | $V_{CE}$ = −50 V, $R_{BE}$ = 100 Ω, $T_A$ = 150°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 1.0 | | | | | mA | $V_{EB}$ = −7.0 V, $I_C$ = 0 |
| | | | | | 1.0 | | 1.0 | mA | $V_{EB}$ = −5.0 V, $I_C$ = 0 |
| $h_{FE}$ | DC Pulse Current Gain (Note 4) | 30 | 120 | | | | | | $I_C$ = 0.5 A, $V_{CE}$ = −4.0 V |
| | | | | 30 | 120 | | | | $I_C$ = 1.0 A, $V_{CE}$ = −4.0 V |
| | | | | | | 20 | 80 | | $I_C$ = 1.5 A, $V_{CE}$ = −4.0 V |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 4) | −70 | | −40 | | −60 | | V | $I_C$ = 100 mA, $I_B$ = 0 |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 4) | | −1.1 | | | | | V | $I_C$ = 0.5 A, $V_{CE}$ = −4.0 V |
| | | | | | −1.3 | | | V | $I_C$ = 1.0 A, $V_{CE}$ = −4.0 V |
| | | | | | | | 1.5 | V | $I_C$ = 1.5 A, $V_{CE}$ = −4.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 4) | | −1.0 | | | | | V | $I_C$ = 0.5 A, $I_B$ = 50 mA |
| | | | | | −1.0 | | | V | $I_C$ = 1.0 A, $I_B$ = 100 mA |
| | | | | | | | −1.0 | V | $I_C$ = 1.5 A, $I_B$ = 150 mA |

Additional Electrical Characteristics on following page.

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 3.47°C/W (derating factor of 288 mW/°C).
4. Pulse conditions: length = 300 μs; duty cycle = 2%.
5. For product family characteristic curves, refer to Section 5 - PWR14.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | BD223 MIN. | BD223 MAX. | BD224 MIN. | BD224 MAX. | BD225 MIN. | BD225 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $f_T$ | Current Gain Bandwidth Product | 0.8 | | 0.8 | | 0.8 | | MHz | $V_{CE}$ = −4.0 V, $I_C$ = 0.2 A, f = 100 kHz |
| $t_{on}$ | Saturated Turn On Time | | 5.0 | | | | | μs | $I_C$ = 0.5 A, $I_{B_1}$ = 50 mA, $V_{CC}$ = −30 V |
| | | | | | 5.0 | | | μs | $I_C$ = 1.0 A, $I_{B_1}$ = 100 mA, $V_{CC}$ = −30 V |
| | | | | | | | 5.0 | μs | $I_C$ = 1.5 A, $I_{B_1}$ = 150 mA, $V_{CC}$ = −30 V |
| $t_{off}$ | Saturated Turn Off Time | | 15 | | | | | μs | $I_C$ = 0.5 A, $I_{B1}$ = $I_{B2}$ = 50 mA, $V_{CC}$ = −30 V |
| | | | | | 15 | | | μs | $I_C$ = 1.0 A, $I_{B1}$ = $I_{B2}$ = 100 mA, $V_{CC}$ = −30 V |
| | | | | | | | 15 | μs | $I_C$ = 1.5 A, $I_{B_1}$ = $I_{B_2}$ = 150 mA, $V_{CC}$ = −30 V |

4

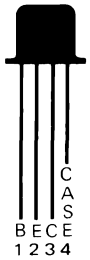
# BF167 • SE5040

## NPN RF-AGC AMPLIFIER

DIFFUSED SILICON PLANAR* TRANSISTOR

- **PG . . . 24 dB (MIN) @ 36 MHz**
- **NF . . . 3.0 dB (TYP) @ 36 MHz**
- **Forward AGC Capability Guaranteed @ –50 dB**

**See TO18-3 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | –55°C to +175°C |
| Operating Junction Temperature | | 175°C |
| Lead Temperature (10 seconds) | | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | **BF167** | **SE5040** |
| Total Dissipation at 25°C Ambient Temperature | 150 mW | 175 mW |
| at 45°C Ambient Temperature | 130 mW | |
| at 25°C Case Temperature | | 260 mW |
| **Maximum Voltages and Current** | | |
| $V_{CBO}$ Collector to Base Voltage | 40 V | 30 V |
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | 30 V | 30 V |
| $V_{EBO}$ Emitter to Base Voltage | 4.0 V | 3.0 V |
| $I_C$ Collector Current | 25 mA | 25 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | SE5040 MIN. | SE5040 TYP. | SE5040 MAX. | BF167 MIN. | BF167 TYP. | BF167 MAX. | UNITS | CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain (Note 5) | | | | | 35 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V |
| | | 20 | 80 | 220 | 30 | 60 | | | $I_C$ = 4.0 mA, $V_{CE}$ = 10 V |
| | | | | | | 20 | | | $I_C$ = 10 mA, $V_{CE}$ = 10 V |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage | | | | | 0.70 | | V | $I_C$ = 4.0 mA, $V_{CE}$ = 10 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | | 2.0 | | 0.7 | 0.95 | V | $I_C$ = 10 mA, $I_B$ = 5.0 mA |
| $I_{CES}$ | Collector Reverse Current | | | | | | 50 | nA | $V_{CE}$ = 10 V, $V_{EB}$ = 0 |
| | | | | | | | 5.0 | μA | $V_{CE}$ = 10 V, $V_{EB}$ = 0, $T_A$ = 100°C |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | | | | 40 | | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| | | 30 | | | | | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | | | | 40 | | | V | $I_C$ = 10 μA, $V_{EB}$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | | | | 4.0 | | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| | | 3.0 | | | | | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $h_{fe}$ | High Frequency Current Gain | 3.0 | 5.0 | | | 6.0 | | | $I_C$ = 4.0 mA, $V_{CE}$ = 10 V, f = 100 MHz |
| $C_{re}$ | Feedback Capacitance | | | | | 0.14 | | pF | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 MHz |
| NF | Narrow Band Noise Figure | | | | | 3.0 | | dB | $I_C$ = 4.0 mA, $V_{CE}$ = 10 V, f = 36 MHz, $R_S$ = 100 Ω |
| PG | Power Gain | | | | 24 | 31 | | dB | $I_E$ = 4.0 mA, $V_{EE}$ = –25 V, f = 36 MHz |
| | (see test circuit no. 422) | 27 | 29 | | | | | dB | $V_{BB}$ = 2.0 V, f = 45 MHz, $V_{CC}$ = 12 V |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | | | | 30 | | | V | $I_C$ = 5.0 mA, $I_B$ = 0 |
| | | 30 | | | | | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $V_{AGC}$ | AGC Voltage for 30 dB Gain Reduction (see test circuit no. 422) | 4.3 | 5.0 | 6.2 | | | | V | $V_{CC}$ = 12 V, f = 45 MHz |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 175°C, junction to ambient thermal resistance of 1000°C/W (derating factor of 1.0 mW/°C) for BF167. For SE5040, junction to case thermal resistance of 583°C/W (derating factor of 1.73 mW/°C); junction to ambient thermal resistance of 850°C/W (derating factor of 1.17 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | SE5040 MIN. | SE5040 TYP. | SE5040 MAX. | BF167 MIN. | BF167 TYP. | BF167 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $I_{AGC}$ | Collector Current for 30 dB Gain Reduction (see test circuit no. 422) | | 8.5 | | | | | mA | $V_{CC}$ = 12 V, f = 45 MHz |
| $V_{AGC}$ | AGC Voltage for 50 dB Gain Reduction (see test circuit no. 422) | | 7.50 | 9.0 | | | | V | $V_{CC}$ = 12 V, f = 45 MHz |
| NF | Noise Figure (see test circuit no. 422) | | 2.7 | 5.0 | | | | dB | $V_{BB}$ = 2.0 V, f = 45 MHz, $V_{CC}$ = 12V |
| $C_{cb}$ | Collector Base Capacitance | | 0.14 | 0.22 | | 0.14 | | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 1.0 MHz |
| $I_{CBO}$ | Collector Cutoff Current | | | 50 | | | | nA | $I_E$ = 0, $V_{CB}$ = 20 V |
| $R_{iep}$ | Input Resistance, Common Emitter | | 300 | | | 300 | | Ω | $I_C$ = 4.0 mA, $V_{CE}$ = 10 V, f = 45 MHz |
| $C_{iep}$ | Input Capacitance, Common Emitter | | 22 | | | 22 | | pF | $I_C$ = 4.0 mA, $V_{CE}$ = 10 V, f = 45 MHz |
| $R_{oep}$ | Output Resistance, Common Emitter | | 45 | | | 45 | | kΩ | $I_C$ = 4.0 mA, $V_{CE}$ = 10 V, f = 45 MHz |
| $C_{oep}$ | Output Capacitance, Common Emitter | | 1.3 | | | 1.3 | | pF | $I_C$ = 4.0 mA, $V_{CE}$ = 10 V, f = 45 MHz |

4

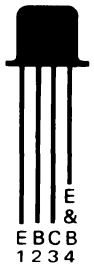
# BF222

## NPN RF-AGC AMPLIFIER

DIFFUSED SILICON PLANAR* TRANSISTOR

- **PG . . . 20 dB (TYP) @ 100 MHz**
- **NF . . . 2.0 dB (MAX) @ 100 MHz**
- **FORWARD AGC CAPABILITY**

**See TO18-3 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| **Maximum Temperatures** | |
| Storage Temperature | −55°C to +175°C |
| Operating Junction Temperature | 175°C |
| **Maximum Power Dissipation** (Note 2) | |
| Total Dissipation at 25°C Case Temperature | 0.260 W |
| at 25°C Ambient Temperature | 0.175 W |
| at 45°C Ambient Temperature | 0.152 W |
| **Maximum Voltages** | |
| $V_{CBO}$ Collector to Base Voltage | 50 V |
| $V_{CEO}$ Collector to Emitter Voltage | 50 V |
| $V_{EBO}$ Emitter to Base Voltage | 5.0 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | TYP. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| NF | Noise Figure | | | 2.0 | dB | $I_C$ = 4.0 mA, $V_{CE}$ = 5.0 V, f = 100 MHz, $R_S$ = 150 Ω |
| PG | Power Gain | | 20 | | dB | $I_C$ = 4.0 mA, $V_{CE}$ = 5.0 V, f = 100 MHz |
| $V_{AGC}$ | AGC Voltage for 30 dB Gain Reduction | | 6.0 | | V | f = 100 MHz |
| $C_{re}$ | Reverse Transfer Capacity, Common Emitter | | 0.37 | | pF | $I_C$ = 2.0 mA, $V_{CE}$ = 7.0 V, f = 1.0 MHz (Emitter and Can Guarded) |
| $h_{FE}$ | DC Pulse Current Gain (Note 4) | 20 | 60 | | | $I_C$ = 2.0 mA, $V_{CE}$ = 7.0 V |
| $I_{CBO}$ | Collector Cutoff Current | | 1.0 | | nA | $I_E$ = 0, $V_{CB}$ = 10 V |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 3 & 4) | 50 | | | V | $I_C$ = 5.0 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 50 | | | V | $I_C$ = 50 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | | V | $I_C$ = 0, $I_E$ = 50 μA |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage | | 0.74 | | V | $I_C$ = 2.0 mA, $V_{CE}$ = 7.0 V |
| $h_{fe}$ | High Frequency Current Gain | | 4.0 | | | $I_C$ = 2.0 mA, $V_{CE}$ = 7.0 V, f = 100 MHz |

*Planar is a patented Fairchild process

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These ratings give a maximum junction temperature of 175°C and junction to case thermal resistance of 583°C/W (derating factor of 1.73 mW/°C); junction to ambient thermal resistance of 850°C/W (derating factor of 1.17 mW/°C).
3. Rating refers to a high current point where collector to emitter voltage is lowest.
4. Pulse conditions: length = 300 μs; duty cycle = 1%.
5. For product family characteristic curves, refer to Section 5 - SS3.

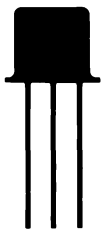
# BF257 • BF258 • BF259

## NPN SMALL SIGNAL HIGH VOLTAGE VIDEO DRIVERS

SILICON PLANAR* EPITAXIAL TRANSISTORS

- $V_{CEO}$ . . . 300 V (MIN) (BF259)
- $h_{FE}$ . . . 25 (MIN) @ 30 mA
- $f_T$ . . . 75 MHz (TYP)
- $C_{cb}$ . . . 2.5 pF (TYP) (BF259)

See TO5-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +175°C |
| Operating Junction Temperature | 175°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 7.0 W |
| at 25°C Ambient Temperature | 1.0 W |

**Maximum Voltages and Current**

| | | BF257 | BF258 | BF259 |
|---|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 160 V | 250 V | 300 V |
| $V_{CER}$ | Collector to Emitter Voltage ($R_{BE}$ = 1.0 kΩ) | 160 V | 250 V | 300 V |
| $V_{CEO}$ | Collector to Emitter Voltage | 160 V | 250 V | 300 V |
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V | 5.0 V | 5.0 V |
| $I_C$ | Collector Current | 100 mA | 100 mA | 100 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | BF257 MIN. | BF257 TYP. | BF257 MAX. | BF258 MIN. | BF258 TYP. | BF258 MAX. | BF259 MIN. | BF259 TYP. | BF259 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 160 | | | 250 | | | 300 | | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | 160 | | | 250 | | | 300 | | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | | 5.0 | | | 5.0 | | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | | 50 | | | | | | | nA | $V_{CB}$ = 100 V, $I_E$ = 0 |
| | | | | | | | 50 | | | | nA | $V_{CB}$ = 200 V, $I_E$ = 0 |
| | | | | | | | | | | 50 | nA | $V_{CB}$ = 250 V, $I_E$ = 0 |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | | | 1.0 | | | 1.0 | | | 1.0 | V | $I_C$ = 30 mA, $I_B$ = 6.0 mA |
| $h_{FE}$ | DC Current Gain | 25 | | | 25 | | | 25 | | | | $V_{CE}$ = 10 V, $I_C$ = 30 mA |
| $C_{cb}$ | Collector to Base Capacitance | | 3.5 | | | 3.0 | | | 2.5 | | pF | $V_{CB}$ = 30 V, $I_E$ = 0, f = 1.0 MHz |
| $f_T$ | Transition Frequency | | 75 | | | 75 | | | 75 | | MHz | $V_{CE}$ = 10 V, $I_C$ = 15 mA |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 25°C/W (derating factor of 40 mW/°C); junction to ambient thermal resistance of 175°C/W (derating factor of 5.71 mW/°C).

# BF336 • BF337 • BF338

## NPN SMALL SIGNAL HIGH VOLTAGE VIDEO DRIVERS

DIFFUSED SILICON PLANAR* TRANSISTORS

- **$V_{CEO}$ . . . 225 V (MIN) (BF338)**
- **$f_T$ . . . 50 MHz (MIN) @ 30 mA**
- **$C_{re}$ . . . 3.5 pF (MAX)**

**See TO5-1 Package Outline**


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Junction Temperature | 200°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Ambient Temperature | 1.0 W |
| at 40°C Case Temperature | 3.0 W |

| **Maximum Voltages and Current** | | **BF336** | **BF337** | **BF338** |
|---|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 185 V | 250 V | 300 V |
| $V_{CER}$ | Collector to Emitter Voltage ($R_{BE} \leq 1.0$ kΩ) | 185 V | 250 V | 300 V |
| $V_{CEO}$ | Collector to Emitter Voltage | 180 V | 200 V | 225 V |
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V | 5.0 V | 5.0 V |
| $I_C$ | Collector Current | 100 mA | 100 mA | 100 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | BF336 MIN. | BF336 MAX. | BF337 MIN. | BF337 MAX. | BF338 MIN. | BF338 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $I_{CER}$ | Collector Reverse Current | | 100 | | | | | μA | $V_{CE}$ = 150 V, $R_{BE}$ = 1.0 kΩ |
| | | | | | 100 | | | μA | $V_{CE}$ = 200 V, $R_{BE}$ = 1.0 kΩ |
| | | | | | | | 100 | μA | $V_{CE}$ = 250 V, $R_{BE}$ = 1.0 kΩ |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 185 | | 250 | | 300 | | V | $I_C$ = 1.0 mA, $I_E$ = 0 |
| $BV_{CER}$ | Collector to Emitter Breakdown Voltage | 185 | | 250 | | 300 | | V | $I_C$ = 1.0 mA, $R_{BE}$ = 1.0 kΩ, $T_A \leq 150°C$ |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | 180 | | 200 | | 225 | | V | $I_C$ = 4.0 mA, $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | 5.0 | | 5.0 | | V | $I_C$ - 0.1 mA, $I_C$ = 0 |
| $V_{BE(ON)}$ | Base to Emitter Voltage (Note 4) | | 1.2 | | 1.2 | | 1.2 | V | $V_{CE}$ = 10 V, $I_C$ = 30 mA |
| $h_{FE}$ | DC Current Gain (Note 4) | 20 | | 20 | | 20 | | | $V_{CE}$ = 10 V, $I_C$ = 30 mA |
| $f_T$ | Current Gain Bandwidth Product | 50 | | 50 | | 50 | | MHz | $V_{CE}$ = 20 V, $I_C$ = 30 mA, f = 20 MHz |
| $C_{re}$ | Common Emitter Reverse Transfer Capacitance | | 3.5 | | 3.5 | | 3.5 | pF | $V_{CE}$ = 20 V, $I_C$ = 10 mA, f = 500 kHz |
| $r_b'C_c$ | Collector to Base Time Constant | | 100 | | 100 | | 100 | ps | $V_{CB}$ = 20 V, $I_E$ = 30 mA, f = 10 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 20°C/W (derating factor of 50 mW/°C); junction to ambient thermal resistance of 175°C/W (derating factor of 5.71 mW/°C).
4. Pulse conditions: length = 300 μs; duty cycle <2%.

# BFX34

## NPN HIGH CURRENT GENERAL PURPOSE POWER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- $V_{CEO}$ . . . 60 V (MIN)
- $h_{FE}$ . . . 40-150 @ $I_C$ = 2.0 A

See TO5-1 Package Outline


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −55°C to +200°C |
| Operating Junction Temperature | | 200°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Case Temperature | | 5.0 W |
| at 25°C Ambient Temperature | | 0.87 W |
| **Maximum Voltages** | | |
| $V_{CBO}$ | Collector to Base Voltage | 120 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 60 V |
| $V_{EBO}$ | Emitter to Base Voltage | 6.0 V |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | TYP. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Pulse Current Gain | | 100 | | | $I_C$ = 1.0 A, $V_{CE}$ = 2.0 V |
| | (Note 5) | | 75 | | | $I_C$ = 1.5 A, $V_{CE}$ = 0.6 V |
| | | 40 | 80 | 150 | | $I_C$ = 2.0 A, $V_{CE}$ = 2.0 V |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 5) | | 1.3 | 1.6 | V | $I_C$ = 5.0 V, $I_B$ = 0.5 A |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | 0.4 | 1.0 | V | $I_C$ = 5.0 A, $I_B$ = 0.5 A |
| $I_{CES}$ | Collector Reverse Current | | 0.02 | 10 | μA | $V_{CE}$ = 60 V, $V_{BE}$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 0.05 | 10 | μA | $I_C$ = 0, $V_{EB}$ = 4.0 V |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 120 | | | V | $I_C$ = 5.0 mA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 6.0 | | | V | $I_E$ = 1.0 mA, $I_C$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | 60 | | | V | $I_C$ = 100 mA, $I_B$ = 0 |
| $h_{fe}$ | High Frequency Current Gain | 3.5 | 5.0 | | | $I_C$ = 0.5 A, $V_{CE}$ = 5.0 V, f = 20 MHz |
| $C_{ob}$ | Output Capacitance | | 40 | 100 | pF | $I_E$ = 0, $V_{CB}$ = 10 V |
| $C_{TE}$ | Emitter Transition Capacitance | | 300 | 400 | pF | $I_C$ = 0, $V_{EB}$ = 0.5 V |
| $t_{on}$ | Turn On Time | | 0.25 | 0.6 | μs | $I_C$ = 5.0 A, $I_{B1}$ = 5.0 A |
| $t_{off}$ | Turn Off Time | | 0.6 | 1.2 | μs | $I_C$ = 5.0 A, $I_{B1}$ = $I_{B2}$ = 0.5 A |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 35°C/W (derating factor of 28.6 mW/°C); junction to ambient thermal resistance of 201°C/W (derating factor of 4.97 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 - PWR1.

4

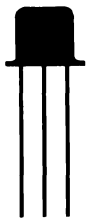
# BFX37

## PNP LOW LEVEL LOW NOISE AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- $V_{CEO}$ . . . –60 V (MIN)
- $h_{FE}$ . . . 70-300 @ 10 μA
- . . . 100 (MIN) @ 1.0 mA
- NF . . . 3.0 dB (MAX) @ 1.0 kHz, 10 kHz AND WIDE BAND

See TO18-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | –55°C to +200°C |
| Operating Junction Temperature | | 200°C |
| Lead Temperature (60 seconds) | | 300°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Case Temperature | | 1.2 W |
| at 25°C Ambient Temperature | | 0.36 W |
| **Maximum Voltages and Current** | | |
| $V_{CBO}$ | Collector to Base Voltage | –60 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | –60 V |
| $V_{EBO}$ | Emitter to Base Voltage | –6.0 V |
| $I_C$ | Collector Current | 50 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 70 | 300 | | $I_C$ = 10 μA, $V_{CE}$ = –5.0 V |
| | | 85 | | | $I_C$ = 100 μA, $V_{CE}$ = –5.0 V |
| | | 100 | | | $I_C$ = 1.0 mA, $V_{CE}$ = –5.0 V |
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 100 | | | $I_C$ = 10 mA, $V_{CE}$ = –5.0 V |
| | | 30 | | | $I_C$ = 10 μA, $V_{CE}$ = –5.0 V, $T_A$ = –55°C |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage | | –0.9 | V | $I_C$ = 10 mA, $I_B$ = 0.5 mA |
| | | | –1.0 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | | –0.25 | V | $I_C$ = 10 mA, $I_B$ = 0.5 mA |
| | | | –0.4 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $I_{CES}$ | Collector Cutoff Current | | 20 | nA | $V_{CE}$ = –50 V, $V_{EB}$ = 0 |
| | | | 20 | μA | $V_{CE}$ = –50 V, $V_{EB}$ = 0, $T_A$ = 125°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 10 | nA | $I_C$ = 0, $V_{EB}$ = –4.0 V |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | –60 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | –60 | | V | $I_C$ = 10 μA, $V_{BE}$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | –6.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | –60 | | V | $I_C$ = 5.0 mA, $I_B$ = 0 |
| $h_{fe}$ | High Frequency Current Gain | 2.0 | | | $I_C$ = 0.5 mA, $V_{CE}$ = –5.0 V, f = 20 MHz |
| $C_{ob}$ | Output Capacitance | | 6.0 | pF | $I_E$ = 0, $V_{CB}$ = –5.0 V |
| $C_{ib}$ | Input Capacitance | | 15 | pF | $I_C$ = 0, $V_{EB}$ = –0.5 V |
| NF | Narrow Band Noise Figure | | 3.0 | dB | $I_C$ = 20 μA, $V_{CE}$ = –5.0 V, $R_S$ = 10 kΩ, f = 1.0 kHz, Power Bandwidth of 200 Hz |
| | | | 3.0 | dB | $I_C$ = 20 μA, $V_{CE}$ = –5.0 V, f = 10 kHz, $R_S$ = 10 kΩ, Power Bandwidth of 2.0 kHz |
| NF | Wide Band Noise Figure | | 3.0 | dB | $I_C$ = 20 μA, $V_{CE}$ = –5.0 V, $R_S$ = 10 kΩ, Power Bandwidth of 15.7 kHz with 3.0 dB points at 10 Hz and 10 kHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 146°C/W (derating factor of 6.75 mW/°C); junction to ambient thermal resistance of 485°C/W (derating factor of 2.06 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 - SS33.

# BFX38 • BFX39 • BFX40 • BFX41

## PNP SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $V_{CEO}$ . . . 55 V (MIN) (BFX38/39), 75 V (MIN) (BFX40/41)
- $h_{FE}$ . . . 85 (MIN) (BFX38/40), 40 (MIN) (BFX39/41) @ 100 mA
  . . . 60 (MIN) (BFX38/40), 25 (MIN) (BFX39/41) @ 500 mA
  . . . GUARANTEED @ 1.0 A
- $t_{on}$ . . . 100 ns (MAX) @ 500 mA, $t_{off}$ . . . 400 ns (MAX) @ 500 mA
- COMPLEMENTS . . . BFY56, 2N3020

See TO5-1 Package Outline


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +200°C |
| Operating Junction Temperature | 200°C |
| Lead Temperature (10 seconds) | 260°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 4.0 W |
| at 25°C Ambient Temperature | 0.8 W |

**Maximum Voltages and Current**

| | | BFX38, BFX39 | BFX40, BFX41 |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | −55 V | −75 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | −55 V | −75 V |
| $V_{EBO}$ | Emitter to Base Voltage | −5.0 V | −5.0 V |
| $I_C$ | Collector Current | 1.0 A | 1.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −5.0 | | V | $I_C = 0$, $I_E = 10\ \mu A$ |
| $V_{BE\ (sat)}$ | Base to Emitter Saturation Voltage (Note 5) | | −0.9 | V | $I_C = 150$ mA, $I_B = 15$ mA |
| | | | −1.1 | V | $I_C = 500$ mA, $I_B = 50$ mA |
| $V_{CE\ (sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | −0.15 | V | $I_C = 150$ mA, $I_B = 15$ mA |
| | | | −0.5 | V | $I_C = 500$ mA, $I_B = 50$ mA |
| $h_{fe}$ | High Frequency Current Gain | 1.0 | | | $I_C = 50$ mA, $V_{CE} = -10$ V, f = 100 MHz |
| $C_{ob}$ | Output Capacitance | | 20 | pF | $I_E = 0$, $V_{CB} = -10$ V |
| $C_{TE}$ | Emitter Transistion Capacitance | | 120 | pF | $I_C = 0$, $V_{EB} = -0.5$ V |
| $t_{on}$ | Turn On Time (see test circuit no. 341) | | 100 | ns | $I_C = 500$ mA, $I_{B1} = 50$ mA, $V_{CC} = -30$ V |
| $t_s$ | Storage Time (see test circuit no. 341) | | 350 | ns | $I_C = 500$ mA, $I_{B1} = I_{B2} = 50$ mA, $V_{CC} = -30$ V |
| $t_f$ | Fall Time (see test circuit no. 341) | | 50 | ns | $I_C = 500$ mA, $I_{B1} = I_{B2} = 50$ mA, $V_{CC} = -30$ V |

| SYMBOL | CHARACTERISTIC | BFX38 MIN. | BFX38 MAX. | BFX39 MIN. | BFX39 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain (Note 5) | 60 | | 30 | | | $I_C = 100\ \mu A$, $V_{CE} = -5.0$ V |
| | | 85 | | 40 | | | $I_C = 100$ mA, $V_{CE} = -5.0$ V |
| | | 60 | | 25 | | | $I_C = 500$ mA, $V_{CE} = -5.0$ V |
| | | 30 | | 15 | | | $I_C = 1.0$ A, $V_{CE} = -5.0$ V |
| | | 30 | | 15 | | | $I_C = 100$ mA, $V_{CE} = -5.0$ V, $T_A = -55°C$ |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | | 50 | nA | $I_E = 0$, $V_{CB} = -40$ V |
| | | | 50 | | 50 | μA | $I_E = 0$, $V_{CB} = -40$ V, $T_A = 125°C$ |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −55 | | −55 | | V | $I_E = 0$, $I_C = 10\ \mu A$ |
| $LV_{CEO}$ | Collector to Emitter Sustaining Voltage (Note 5) | −55 | | −55 | | V | $I_C = 10$ mA, $I_B = 0$ |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 43.7°C/W (derating factor of 22.8 mW/°C); junction to ambient thermal resistance of 219°C/W (derating factor of 4.56 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 — SS24.

**ELECTRICAL CHARACTERISTICS** (25° C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | BFX40 MIN. | BFX40 MAX. | BFX41 MIN. | BFX41 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain (Note 5) | 60 | | 30 | | | $I_C$ = 100 μA, $V_{CE}$ = −5.0 V |
| | | 85 | | 40 | | | $I_C$ = 100 mA, $V_{CE}$ = −5.0 V |
| | | 60 | | 25 | | | $I_C$ = 500 mA, $V_{CE}$ = −5.0 V |
| | | 25 | | 10 | | | $I_C$ = 1.0 A, $V_{CE}$ = −5.0 V |
| | | 30 | | 15 | | | $I_C$ = 100 mA, $V_{CE}$ = −5.0 V $T_A$ = −55°C |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | | 50 | nA | $I_E$ = 0, $V_{CB}$ = −50 V |
| | | | 50 | | 50 | μA | $I_E$ = 0, $V_{CB}$ = −50 V, $T_A$ = 125°C |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −75 | | −75 | | V | $I_E$ = 0, $I_C$ = 10 μA |
| $LV_{CEO}$ | Collector to Emitter Sustaining Voltage (Note 5) | −75 | | −75 | | V | $I_C$ = 10 mA, $I_B$ = 0 |

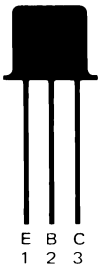
# BFY50 • BFY51 • BFY52

## NPN SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS AND SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $V_{CEO}$ . . . 35 V (MIN) (BFY50)
- $h_{FE}$ . . . 30 (MIN) @ 150 mA, 15 (MIN) @ 1.0 A (BFY50)

See TO5-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Junction Temperature | 200°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 50°C Case Temperature | 5.0 W |
| at 25°C Ambient Temperature | 0.8 W |

**Maximum Voltages and Currents**

| | | BFY50 | BFY51 | BFY52 |
|---|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 80 V | 60 V | 40 V |
| $V_{CEO}$ | Collector to Emitter Voltage | 35 V | 30 V | 20 V |
| $V_{EBO}$ | Emitter to Base Voltage | 6.0 V | 6.0 V | 6.0 V |
| $I_C$ | Collector Current | 1.0 A | 1.0 A | 1.0 A |
| $I_{CM}$ | Collector Current (Peak) | 1.0 A | 1.0 A | 1.0 A |
| $I_E$ | Emitter Current | 1.0 A | 1.0 A | 1.0 A |
| $I_{EM}$ | Emitter Current (Peak) | 1.0 A | 1.0 A | 1.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | BFY50 MIN. | BFY50 MAX. | BFY51 MIN. | BFY51 MAX. | BFY52 MIN. | BFY52 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $I_{CBO}$ | Collector Cutoff Current | | 50 | | | | | nA | $I_E = 0, V_{CB} = 60$ V |
| | | | | | 50 | | | nA | $I_E = 0, V_{CB} = 40$ V |
| | | | | | | | 50 | nA | $I_E = 0, V_{CB} = 30$ V |
| | | | 2.5 | | | | | μA | $I_E = 0, V_{CB} = 60$ V, $T_A = 100°C$ |
| | | | | | 2.5 | | | μA | $I_E = 0, V_{CB} = 40$ V, $T_A = 100°C$ |
| | | | | | | | 2.5 | μA | $I_E = 0, V_{CB} = 30$ V, $T_A = 100°C$ |
| $I_{EBO}$ | Emitter Cutoff Current | | 50 | | 50 | | 50 | nA | $I_C = 0, V_{EB} = 5.0$ V |
| | | | 2.8 | | 2.8 | | 2.8 | μA | $I_C = 0, V_{EB} = 5.0$ V, $T_A = 100°C$ |
| $I_B$ | Base Current | | 4.85 | | 3.65 | | 2.45 | mA | $I_E = 150$ mA, $V_{CB} = 6.0$ V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | | 0.20 | | 0.35 | | 0.35 | V | $I_C = 150$ mA, $I_B = 15$ mA |
| | (Note 4) | | 1.0 | | 1.6 | | 1.6 | V | $I_C = 1.0$ A, $I_B = 100$ mA |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 4) | | 2.0 | | 2.0 | | 2.0 | V | $I_C = 1.0$ A, $I_B = 100$ mA |
| $h_{fe}$ | Small Signal Current Gain | 10 | | 30 | | 30 | | | $I_C = 1.0$ mA, $V_{CE} = 6.0$ V, f = 1.0 kHz |
| $h_{FE}$ | DC Current Gain (Note 4) | 20 | | 30 | | 30 | | | $I_C = 10$ mA, $V_{CE} = 10$ V |
| | | 30 | | 40 | | 60 | | | $I_C = 150$ mA, $V_{CE} = 10$ V |
| | | 15 | | 15 | | 15 | | | $I_C = 1.0$ A, $V_{CE} = 10$ V |
| | | 20 | | 25 | | 30 | | | $I_C = 500$ mA, $V_{CE} = 10$ V |
| $C_{cb}$ | Collector to Base Capacitance | | 12 | | 12 | | 12 | pF | $I_E = 0, V_{CB} = 12$ V |
| $f_T$ | Transistion Frequency | 60 | | 50 | | 50 | | MHz | $I_C = 50$ mA, $V_{CE} = 6.0$ V |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 35°C/W (derating factor of 28.6 mW/°C); junction to ambient thermal resistance of 220°C/W (derating factor of 4.54 mW/°C).
4. Measured under pulsed conditions to avoid excess dissipation with a lead length of 1 cm.
5. For product family characteristic curves, refer to Section 5 - SS17.

# BFY56

## NPN SMALL SIGNAL GENERAL PURPOSE AMPLIFIER AND SWITCH

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- $V_{CEO}$ . . . 45 V (MIN)
- $h_{FE}$ . . . 30-150 @ 150 mA
  . . . 20 (MIN) @ 500 mA
- $t_{on}$ . . . 225 ns (MAX) @ 150 mA
- $t_{off}$ . . . 625 ns (MAX) @ 150 mA
- COMPLEMENTS . . . BFX39

See TO5-1 Package Outline


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| **Maximum Temperatures** | |
| Storage Temperature | −65°C to +200°C |
| Operating Junction Temperature | 200°C |
| Lead Temperature (60 seconds) | 300°C |
| **Maximum Power Dissipations** (Notes 2 & 3) | |
| Total Dissipation at 25°C Case Temperature | 5.0 W |
| at 25°C Ambient Temperature | 0.8 W |
| **Maximum Voltages** | |
| $V_{CBO}$ Collector to Base Voltage | 80 V |
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | 45 V |
| $V_{EBO}$ Emitter to Base Voltage | 5.0 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 15 | | | $I_C$ = 0.1 mA, $V_{CE}$ = 10 V |
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 20 | | | $I_C$ = 500 mA, $V_{CE}$ = 10 V |
| | | 30 | 150 | | $I_C$ = 150 mA, $V_{CE}$ = 1.0 V |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 5) | | 1.5 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | | | 2.3 | V | $I_C$ = 1.0 A, $I_B$ = 100 mA |
| $V_{CE(sat)}$ | Collector Saturation Voltage | | 0.3 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | (Note 5 & 6) | | 1.2 | V | $I_C$ = 1.0 A, $I_B$ = 100 mA |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | nA | $I_E$ = 0, $V_{CB}$ = 50 V |
| $I_{EBO}$ | Emitter Cutoff Current | | 100 | nA | $I_C$ = 0, $V_{EB}$ = 4.0 V |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 80 | | V | $I_E$ = 0, $I_C$ = 100 μA |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | V | $I_C$ = 0, $I_E$ = 100 μA |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage | 45 | | V | $I_B$ = 0, $I_C$ = 30 mA |
| | (Note 5) | | | | |
| $h_{fe}$ | High Frequency Current Gain | 2.0 | | | $I_C$ = 50 mA, $V_{CE}$ = 10 V, f = 20 MHz |
| $C_{ob}$ | Output Capacitance | | 25 | pF | $I_E$ = 0, $V_{CB}$ = 10 V, f = 1.0 MHz |
| $C_{TE}$ | Emitter Transition Capacitance | | 80 | pF | $I_C$ = 0, $V_{EB}$ = 0.5 V, f = 1.0 MHz |
| $t_{on}$ | Turn On Time (see test circuit no. 288) | | 225 | ns | $I_C$ = 150 mA, $I_{B1}$ = 7.5 mA |
| $t_{off}$ | Turn Off Time (see test circuit no. 288) | | 625 | ns | $I_C$ = 150 mA, $I_{B1}$ = 7.5 mA, $I_{B2}$ = −7.5 mA |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 35°C/W (derating factor of 28.6 mW/°C); junction to ambient thermal resistance of 219°C/W (derating factor of 4.56 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. Saturation voltage measured with 6.35 mm lead length (0.25 inch).
7. For product family characteristic curves, refer to Section 5-SS17.

# BFY64

## PNP SMALL SIGNAL GENERAL PURPOSE AMPLIFIER AND SWITCH

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- $V_{CEO}$ . . . −40 V (MIN)
- $h_{FE}$ . . . 80 (MIN) @ 10 mA
- $t_{on}$ . . . 50 ns (MAX) @ 300 mA
- $t_{off}$ . . . 120 ns (MAX) @ 300 mA

See TO5-1 Package Outline


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Junction Temperature | 200°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 3.0 W |
| at 25°C Ambient Temperature | 0.7 W |

**Maximum Voltages**

| | | |
|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | −40 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | −40 V |
| $V_{EBO}$ | Emitter to Base Voltage | −5.0 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 80 | | | $I_C$ = 10 mA, $V_{CE}$ = −10 V |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 5) | | −1.1 | V | $I_C$ = 50 mA, $I_B$ = 2.5 mA |
| | | | −1.4 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | | | −2.2 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| $V_{CE(sat)}$ | Collector Saturation Voltage | | −0.3 | V | $I_C$ = 50 mA, $I_B$ = 2.5 mA |
| | (Note 5) | | −0.5 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | | | −1.8 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| $I_{CES}$ | Collector Cutoff Current | | 30 | nA | $V_{CE}$ = −25 V, $V_{BE}$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −40 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −5.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $V_{CEO}$ | Collector to Emitter Sustaining Voltage | −40 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| | (Notes 4 & 5) | | | | |
| $h_{fe}$ | High Frequency Current Gain | 2.0 | | | $I_C$ = 50 mA, $V_{CE}$ = −20 V, f = 100 MHz |
| $C_{ob}$ | Output Capacitance | | 10 | pF | $I_E$ = 0, $V_{CB}$ = −10 V, f = 1.0 MHz |
| $C_{TE}$ | Emitter Transistion Capacitance | | 25 | pF | $I_C$ = 0, $V_{EB}$ = −0.5 V, f = 1.0 MHz |
| $t_{on}$ | Turn On Time (see test circuit no. 222) | | 50 | ns | $I_C$ = 300 mA, $I_{B1}$ = 30 mA |
| $t_{off}$ | Turn Off Time (see test circuit no. 222) | | 120 | ns | $I_C$ = 300 mA, $I_{B1}$ = 30 mA, $I_{B2}$ = −30 mA |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 58.3°C/W (derating factor of 17.2 mW/°C); junction to ambient thermal resistance of 250°C/W (derating factor of 4.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 - SS22.

# BSX32

## NPN SMALL SIGNAL, HIGH VOLTAGE HIGH CURRENT SATURATED SWITCH

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- **$V_{CEO}$ . . . 40 V (MIN)**
- **$h_{FE}$ . . . 60-150 @ 100 mA**
- **. . . 25 (MIN) @ 500 mA**
- **$t_{on}$ . . . 60 ns (MAX) @ 500 mA**
- **$t_{off}$ . . . 60 ns (MAX) @ 500 mA**
- **Complements . . . 2N5022**

**See TO5-1 Package Outline**

E B C
1 2 3

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| **Maximum Temperatures** | |
| Storage Temperature | −55°C to +200°C |
| Operating Junction Temperature | 200°C |
| Lead Temperature (10 seconds) | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | |
| Total Dissipation at 25°C Case Temperature | 3.5 W |
| at 25°C Ambient Temperature | 0.8W |
| **Maximum Voltages and Current** | |
| $V_{CBO}$ Collector to Base Voltage | 65 V |
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | 40 V |
| $V_{EBO}$ Emitter to Base Voltage | 6.0 V |
| $I_C$ DC Collector Current | 1.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 30 | | | $I_C$ = 10 mA, $V_{CE}$ = 1.0 V |
| | | 60 | 150 | | $I_C$ = 100 mA, $V_{CE}$ = 1.0 V |
| | | 25 | | | $I_C$ = 500 mA, $V_{CE}$ = 1.0 V |
| | | 20 | | | $I_C$ = 1.0 A, $V_{CE}$ = 5.0 V |
| | | 30 | | | $I_C$ = 100 mA, $V_{CE}$ = 1.0 V, $T_A$ = −55°C |
| | | 15 | | | $I_C$ = 500 mA, $V_{CE}$ = 1.0 V, $T_A$ = −55°C |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 5) | | 0.9 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| | | | 1.5 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| | | | 2.0 | V | $I_C$ = 1.0 A, $I_B$ = 100 mA |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | | 0.25 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| | (Note 5) | | 0.50 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| | | | 0.85 | V | $I_C$ = 1.0 A, $I_B$ = 100 mA |
| $I_{CBO}$ | Collector Cutoff Current | | 4.0 | μA | $V_{CB}$ = 50 V, $I_E$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 65 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 6.0 | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage | 40 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| | (Notes 4 & 5) | | | | |
| $h_{fe}$ | High Frequency Current Gain | 3.0 | | | $I_C$ = 50 mA, $V_{CE}$ = 10 V, f = 100 MHz |
| $C_{ob}$ | Output Capacitance | | 10 | pF | $V_{CB}$ = 10 V, f = 1.0 MHz |
| $C_{TE}$ | Emitter Transition Capacitance | | 55 | pF | $V_{EB}$ = 0.5 V, f = 1.0 MHz |
| $t_{on}$ | Turn On Time (see test circuit no. 265) | | 60 | ns | $I_C$ = 500 mA, $I_{B1}$ = 50 mA |
| $t_{off}$ | Turn Off Time (see test circuit no. 265) | | 60 | ns | $I_C$ = 500 mA, $I_{B1}$ = $I_{B2}$ = 50 mA |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 50°C/W (derating factor of 20 mW/°C); junction to ambient thermal resistance of 219°C/W (derating factor of 4.56 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 - SS13.

# MATCHED DIODE ASSEMBLIES EPOXY ENCAPSULATED

**GENERAL DESCRIPTION** — Customers' requirements and inquiries constitute the basis for the types of assemblies offered as off the shelf items, and influence our efforts to obtain and publish technical information. For this reason, we encourage requests for assemblies not currently offered as standard items or requests for additional information.

The specifications contained on the succeeding pages are a condensed revision of the most popular circuit configurations used. Custom assemblies tailored to individual circuit requirements are available on request.

Normal delivery is two to four weeks for types listed in this brochure. For custom assemblies, an additional one to two weeks is required.

**MAXIMUM RATINGS** (25°C Ambient Temperature unless otherwise noted)

| | | FD1389 | FD2389 | FD3389 | FD6389 |
|---|---|---|---|---|---|
| $V_R$ | Reverse Voltage | 75 V | 150 V | 125 V | 50 V |
| $I_O$ | Average Rectified Current | 75 mA | 100 mA | 150 mA | 200 mA |
| $I_F$ | Forward Current DC | 115 mA | 150 mA | 225 mA | 300 mA |
| $i_f$ | Recurrent Peak Forward Current | 225 mA | 300 mA | 450 mA | 600 mA |
| $I_{f\ (surge)}$ | 1.0 s Pulse Width | 0.5 A | 1.0 A | 1.0 A | 1.0 A |
| $i_{f\ (surge)}$ | 1.0 μs Pulse Width | 2.0 A | 4.0 A | 4.0 A | 4.0 A |
| $P_D$ | Power Dissipation | 250 mW | 500 mW | 500 mW | 500 mW |
| $T_A$ | Operating Temperature | — — — — — — — — | −65°C to +175°C | — — — — | |
| $T_{stg}$ | Storage Temperature, Ambient | — — — — | −65°C to +200°C | — — — — | |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| | | | | | |
|---|---|---|---|---|---|
| BV (min) | Breakdown Voltage at 5.0 μA | 100 V | — | — | — |
| | at 100 μA | — | 200 V | 150 V | 75 V |
| $I_R$ (max) | Reverse Leakage at $V_R$ | 100 nA | 100 nA | 1.0 nA | 100 nA |
| | at $V_R$, 150°C | 100 μA | 100 μA | 3.0 μA | 100 μA |
| C (max) | Capacitance at 0 V | 1.5 pF | 5.0 pF | 6.0 pF | 3.0 pF |
| $V_F$ (max) | Forward Voltage at 200 mA | — | 1.0 V | 1.0 V | 1.0 V |
| | at 100 mA | — | .925 V | .930 V | .920 V |
| | at 50 mA | — | .860 V | .880 V | .860 V |
| | at 20 mA | 1.0 V | .790 V | .840 V | .790 V |
| | at 10 mA | .875 V | .740 V | .810 V | .750 V |
| | at 5.0 mA | .800 V | .700 V | .770 V | .710 V |
| | at 2.0 mA | .725 V | .620 V | .730 V | .670 V |
| | at 1.0 mA | .670 V | .610 V | .710 V | .630 V |
| $t_{rr}$ (max) | $I_f = I_r$ = 10 mA, Recover to 1.0 mA | 4.0 ns | — | — | 4.0 ns |
| $t_{rr}$ (max) | $I_f = I_r$ = 30 mA, Recover to 1.0 mA | — | 50 ns | — | — |
| $t_{rr}$ (max) | $I_f = I_r$ = 200 mA, Recover to 20 mA | — | — | — | 4.0 ns |

4

# MATCHED DIODE ASSEMBLIES EPOXY ENCAPSULATED

**MATCHING CHARACTERISTICS** (Apply over temperature range of −55°C to +100°C)

FORWARD VOLTAGE MATCHED ASSEMBLIES

| Basic Diode Specification | Forward Current Matching Range | Maximum Forward Voltage Difference ($\Delta V_F$) Between Diodes | Assembly Type Number: Encapsulated Pair | Unencapsulated Pair | Encapsulated Quad | Unencapsulated Quad | Bridge | Family Reference (See Sec. 5) |
|---|---|---|---|---|---|---|---|---|
| FD1389 | 10 μA to 1.0 mA | 3.0 mV | FA2310E | FA2310U | FA4310E | FA4310U | FA3310 | D6 |
| FD1389 | 10 μA to 1.0 mA | 10 mV | FA2311E | FA2311U | FA4311E | FA4311U | FA3311 | D6 |
| FD1389 | 1.0 mA to 10 mA | 5.0 mV | FA2312E | FA2312U | FA4312E | FA4312U | FA3312 | D6 |
| FD1389 | 1.0 mA to 10 mA | 15 mV | FA2313E | FA2313U | FA4313E | FA4313U | FA3313 | D6 |
| FD2389 | 10 μA to 1.0 mA | 3.0 mV | FA2320E | FA2320U | FA4320E | FA4320U | FA3320 | D4 |
| FD2389 | 10 μA to 1.0 mA | 10 mV | FA2321E | FA4321U | FA4321E | FA4321U | FA3321 | D4 |
| FD2389 | 1.0 mA to 10 mA | 5.0 mV | FA2322E | FA2322U | FA4322E | FA4322U | FA3322 | D4 |
| FD2389 | 1.0 mA to 10 mA | 15 mV | FA2323E | FA2323U | FA4323E | FA4323U | FA3323 | D4 |
| FD2389 | 10 mA to 100 mA (pulse only) | 10 mV | FA2324E | FA2324U | FA4324E | FA4324U | FA3324 | D4 |
| FD2389 | 10 mA to 100 mA (pulse only) | 20 mV | FA2325E | FA2325U | FA4325E | FA4325U | FA3325 | D4 |
| FD6389 | 10 mA to 100 mA (pulse only) | 10 mV | FA2360E | FA2360U | FA4360E | FA4360U | FA3360 | D6 |
| FD6389 | 10 mA to 100 mA (pulse only) | 20 mV | FA2361E | FA2361U | FA4361E | FA4361U | FA3361 | D6 |

REVERSE CURRENT – FORWARD VOLTAGE MATCHED ASSEMBLIES (Basic Diode Specifications: FD3389)

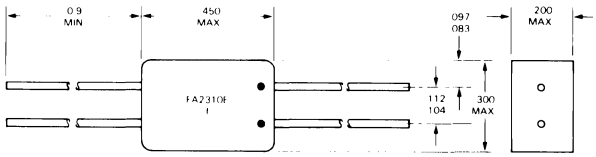
| Maximum Reverse Current Difference ($\Delta I_R$) Between Diodes | Forward Current Matching Range | Maximum Forward Voltage Difference ($\Delta V_F$) Between Diodes | Assembly Type Number: Encapsulated Pair | Unencapsulated Pair | Encapsulated Quad | Unencapsulated Quad | Bridge | Family Reference (See Sec. 5) |
|---|---|---|---|---|---|---|---|---|
| 2.0 nA + 0.064 · $V_R$ | 10 μA to 1.0 mA | 10 mV | FA2330E | FA2330U | FA4330E | FA4330U | FA3330 | D5 |
| 2.0 nA + 0.064 · $V_R$ | 1.0 mA to 10 mA | 15 mV | FA2331E | FA2331U | FA4331E | FA4331U | FA3331 | D5 |
| 2.0 nA + 0.064 · $V_R$ | 10 mA to 100 mA (pulse only) | 20 mV | FA2332E | FA2332U | FA4332E | FA4332U | FA3332 | D5 |
| 4.0 nA + 0.128 · $V_R$ | 10 μA to 1.0 mA | 10 mV | FA2333E | FA2333U | FA4333E | FA4333U | FA3333 | D5 |
| 4.0 nA + 0.128 · $V_R$ | 1.0 mA to 10 mA | 15 mV | FA2334E | FA2334U | FA4334E | FA4334U | FA3334 | D5 |
| 4.0 nA + 0.128 · $V_R$ | 10 mA to 100 mA (pulse only) | 20 mV | FA2335E | FA2335U | FA4335E | FA4335U | FA3335 | D5 |

NOTES:

1. The "Basic Diode Specification" column refers to the specifications listed in the table on the preceding page. These specifications are guaranteed for each individual diode of the assembly.
2. The "Maximum Reverse Current Difference ($\Delta I_R$) Between Diodes" means that the difference in reverse current between the diode having the highest $I_R$ and the diode having the lowest $I_R$ in an assembly will not exceed the specified limit. "$V_R$" is the reverse voltage bias in volts at which the test is performed and may be any value between 0 and 125 V as the user desires. As an example, the specification limit for an FA2330E at a reverse bias of 10 V would be 2.0 nA + 0.064·10 = 2.6 nA. See Figure 6 for $\Delta I_R$ test circuit.
3. The "Forward Current Matching" ranges of 10 μA to 10 mA may be applied either as a dc current or pulse input current. For the 10 mA to 100 mA current range, the $\Delta V_F$ is guaranteed only for short duty cycle (1% or less) input current pulses. Conditions of test in both cases are defined by Figure 5.
4. All specifications are available in five basic configurations as listed under the "Assembly Type Number" column. Encapsulated pairs, quads, and bridges are supplied in the configurations illustrated in Figures 1, 2, and 3 respectively. Unencapsulated pairs and quads meet the dimensional requirements of Figure 4 and are taped securely together for shipment.
5. Capacitance (C) cannot be monitored independently on each diode in a bridge configuration. In measuring this parameter on bridge configurations, the capacitance limit is 4/3 the limit listed in the basic diode specifications table.
6. For matched bridges, the forward current range specified is "per leg." That is, twice the current specified is applied to the assembly.

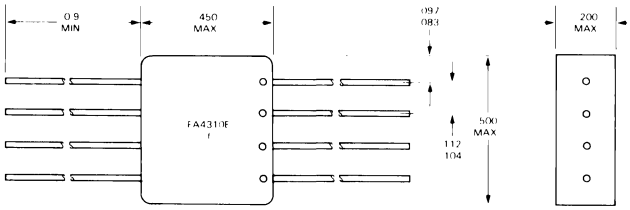
# MATCHED DIODE ASSEMBLIES EPOXY ENCAPSULATED

**FIG. 1 ENCAPSULATED MATCHED PAIR PACKAGE DIMENSIONS.**



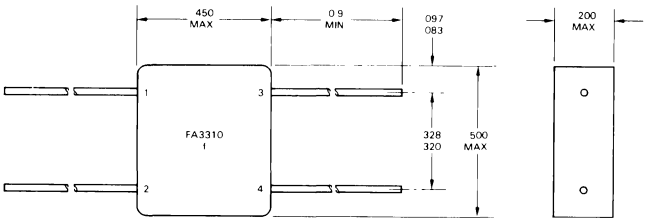

NOTES:
1. Dots denote cathode ends of diodes.
2. All dimensions in inches.

**FIG. 2 ENCAPSULATED MATCHED QUAD PACKAGE DIMENSIONS.**



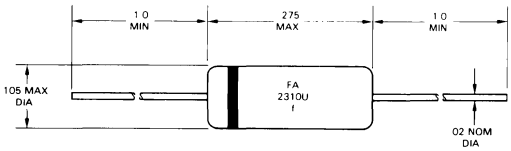

NOTES:
1. Dots denote cathode ends of diodes.
2. All dimensions in inches.

**FIG. 3 BRIDGE PACKAGE DIMENSIONS.**




NOTES:
1. Numbers 1 and 2 denote the common anode and common cathode terminals of the bridge, respectively. Terminals 3 and 4 denote the two cathode anode terminals.
2. All dimensions in inches.

**FIG. 4 INDIVIDUAL DIODE DIMENSIONS FOR UNENCAPSULATED MATCHED PAIRS AND QUADS.**



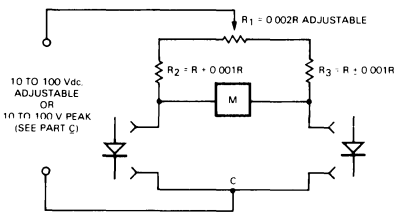

NOTES:
1. Band denotes cathode end of diode.
2. All dimensions in inches.

4

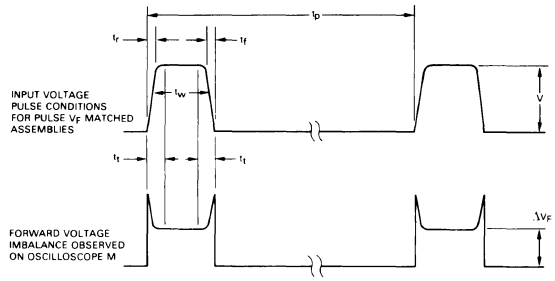
# MATCHED DIODE ASSEMBLIES EPOXY ENCAPSULATED

**FIG. 5 $\Delta V_F$ DIODE MATCHING CIRCUITS.**

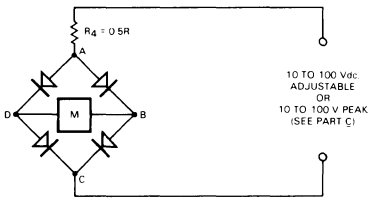
**a.**




**b.**




**c.**




| | | |
|---|---|---|
| $t_r$ | Pulse Rise Time (10 to 90% Amplitude) | = 1.0 $\mu$s Max. |
| $t_f$ | Pulse Fall Time (90 to 10% Amplitude) | = 1.0 $\mu$s Max. |
| $t_w$ | Pulse Width (50% Amplitude) | = 10 ± 2.0 $\mu$s |
| $t_t$ | Transient Time | = 1.0 $\mu$s Min. |
| $t_p$ | Period | = 1.0 ms |
| V | Voltage Input to Circuit "A or B" | = 10 to 100 V Adjustable |
| $\Delta V_F$ | Forward Voltage Difference Between Diodes (Measured Between Transient Times) | = As Specified |

NOTES:

1. R varies depending on the current range. For the most often used current ranges, R is as follows:

| Current Range (amperes) | R (ohms) |
|---|---|
| $10^{-5}$ to $10^{-4}$ | $10^6$ |
| $10^{-4}$ to $10^{-3}$ | $10^5$ |
| $10^{-3}$ to $10^{-2}$ | $10^4$ |
| or $10^{-n}$ to $10^{-n+1}$ | $10^{n+1}$ |

2. The input voltage pulse conditions illustrated in part C are employed at Fairchild in testing. The user may deviate from the specific conditions above with no variation in results providing the following general conditions are met:

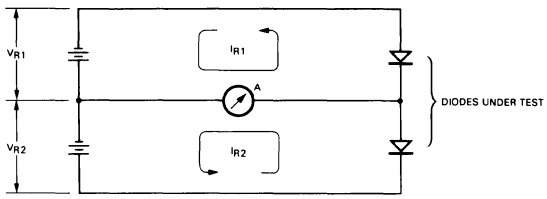
   a. $\frac{tw}{tp} \leqslant 0.01$

   b. $tw < 10$ ms

   c. Transients occuring during pulse rise and fall times are ignored in observing $\Delta V_F$.

---

**FIG. 6 $\Delta I_R$ DIODE MATCHING CIRCUIT**




NOTES:

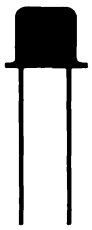
1. $V_{R2} = -V_{R1} \pm 1\%$.
2. $I_{R2} - I_{R1} = \Delta I_R$ (difference in $I_R$ between two diodes under test).
3. A is a center reading $\mu\mu$ ammeter.

# FCT REFERENCE SERIES

DIFFUSED SILICON PLANAR* DIODES

- **TC @ 0.1 mA AND SINGLE CHIP CONSTRUCTION**
- **$V_Z$ . . . 6.7 NOMINAL**
- **VOLTAGE TOLERANCE . . . ±5.0% (Note 1)**
- **$I_R$ . . . 100 nA (MAX) @ 5.0 V**
- **$T_J$ (MAX) . . . 175°C**

**See TO18-1 Package Outline**



(Center Lead is Clipped)

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| TYPE | TEMPERATURE COEFFICIENT @ 100 μA | TEMPERATURE RANGE |
|---|---|---|
| FCT 1021 | ± .001%/°C | 0 to +100°C |
| FCT 1022 | ± .002%/°C | |
| FCT 1025 | ± .005%/°C | |
| FCT 1121 | ± .001%/°C | −55°C to +100°C |
| FCT 1122 | ± .002%/°C | |
| FCT 1125 | ± .005%/°C | |

*Planar is a patented Fairchild process.

NOTES:
1. Voltage tolerances tighter than ±5% are available upon request.
2. Temperature coefficient is determined by measuring $V_Z$ at the two temperature extremes and using the following formula:

$$TC = \frac{(V_{T1} - V_{T2})\,100}{V(T_1 - T_2)} \quad \text{where} \quad V = \frac{V_{T1} + V_{T2}}{2}$$

3. Devices are mounted in two-leaded TO18 packages and with a black dot opposite cathode lead on side of case.
4. For product family characteristic curves, refer to Section 5 - D3.

# FD300 • FD333 • FDH300 • FDH333

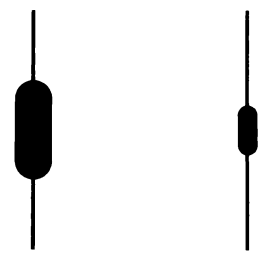
## HIGH CONDUCTANCE LOW LEAKAGE

DIFFUSED SILICON PLANAR* DIODES

- **BV . . . 150 V (MIN) @ 100 μA**
- **$I_R$ . . . 1.0 nA (MAX) @ 125 V (FD300), 3.0 nA (MAX) @ 125 V (FD333)**

**See Package Outlines**

**DO7-1** **DO35-1**



**FD300** **FDH300**
**FD333** **FDH333**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | | |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | | −65°C to +200°C |
| Operating Temperature | | | 175°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | **FD300, FD333** | **FDH300, FDH333** |
| Total Dissipation at 25°C Ambient Temperature | | 400 mW | 500 mW |
| Linear Derating Factor | | 2.67 mW/°C | 3.33 mW/°C |
| **Maximum Voltages and Currents** | | | |
| WIV | Working Inverse Voltage | 125 V | 125 V |
| $I_O$ | Average Rectified Current | 150 mA | 200 mA |
| $I_F$ | Forward Current Steady State | 375 mA | 500 mA |
| $i_f$ | Recurrent Peak Forward Current | 450 mA | 600 mA |
| $i_{f(surge)}$ | Peak Forward Surge Current | | |
| | Pulse Width = 1.0 s | 500 mA | 1000 mA |
| | Pulse Width = 1.0 μs | 4000 mA | 4000 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | FD300, FDH300 MIN. | FD300, FDH300 MAX. | FD333, FDH333 MIN. | FD333, FDH333 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | | | 0.9 | 1.15 | V | $I_F$ = 300 mA |
| | | | | 0.88 | 1.08 | V | $I_F$ = 250 mA |
| | | | 1.0 | 0.87 | 1.05 | V | $I_F$ = 200 mA |
| | | | | 0.86 | 0.97 | V | $I_F$ = 150 mA |
| | | | 0.92 | 0.83 | 0.94 | V | $I_F$ = 100 mA |
| | | | 0.88 | 0.80 | 0.89 | V | $I_F$ = 50 mA |
| | | | 0.8 | | | V | $I_F$ = 10 mA |
| | | | 0.75 | | | V | $I_F$ = 5.0 mA |
| | | | 0.68 | | | V | $I_F$ = 1.0 mA |
| $I_R$ | Reverse Current | | 1.0 | | 3.0 | nA | $V_R$ = −125 V |
| | | | 3.0 | | | μA | $V_R$ = −125 V, $T_A$ = 150°C |
| | | | | | 500 | nA | $V_R$ = −125 V, $T_A$ = 100°C |
| C | Capacitance | | 6.0 | | 6.0 | pF | $V_R$ = 0 |
| BV | Breakdown Voltage | 150 | | 150 | | V | $I_R$ = 100 μA |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 175°C and junction to ambient thermal resistance of 375°C/W (derating factor of 2.67 mW/°C) for FD300 and FD333; junction to ambient thermal resistance of 300°C/W (derating factor of 3.33 mW/°C) for FDH300 and FDH333.
4. Leads are tinned. Gold-plate with nickel strike may be obtained when specified.
5. For family characteristic curves, refer to Section 5 - D5.

# FD400 • FD444 • FDH400 • FDH444

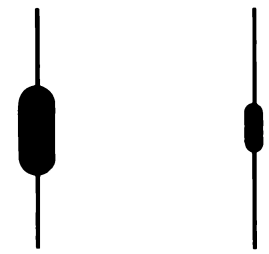
## HIGH VOLTAGE GENERAL PURPOSE

DIFFUSED SILICON PLANAR* DIODES

- **BV . . . 200 V (MIN)-FD400, FDH400**
  **. . . 150 V (MIN)-FD444, FDH444**
- **$V_F$ . . . 1.1 V (MAX) @ 300 mA - FD400, FDH400**
  **@ 200 mA - FD444, FDH444**

**See Package Outlines**

**DO7-1** **DO35-1**



**FD400** **FDH400**
**FD444** **FDH444**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Temperature | 175°C |

| **Maximum Power Dissipation** (Notes 2 & 3) | **FD400, FD444** | **FDH400, FDH444** |
|---|---|---|
| Total Dissipation at 25°C Ambient Temperature | 400 mW | 500 mW |
| Linear Derating Factor | 2.67 mW/°C | 3.33 mW/°C |

| **Maximum Voltage and Currents** | | **FD400** | **FD444** | **FDH400** | **FDH444** |
|---|---|---|---|---|---|
| WIV | Working Inverse Voltage | 175 V | 125 V | 175 V | 125 V |
| $I_O$ | Average Rectified Current | 175 mA | 175 mA | 200 mA | 200 mA |
| $I_F$ | Forward Current Steady State | 400 mA | 400 mA | 500 mA | 500 mA |
| $i_f$ | Recurrent Peak Forward Current | 600 mA | 600 mA | 600 mA | 600 mA |
| $i_{f\ (surge)}$ | Peak Forward Surge Current | | | | |
| | Pulse width = 1.0 s | 1.0 A | 1.0 A | 1.0 A | 1.0 A |
| | Pulse width = 1.0 μs | 4.0 A | 4.0 A | 4.0 A | 4.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | FD400, FDH400 MIN. | FD400, FDH400 MAX. | FD444, FDH400 MIN. | FD444, FDH400 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_F$ | Pulsed Forward Voltage (Note 4) | | 1.1 | | 1.2 | V | $I_F$ = 300 mA |
| $V_F$ | Forward Voltage | | 1.0 | | 1.1 | V | $I_F$ = 200 mA |
| BV | Breakdown Voltage | 200 | | 150 | | V | $I_R$ = 100 μA |
| $I_R$ | Reverse Current | | 100 | | | nA | $V_R$ = 150 V |
| | | | | | 50 | nA | $V_R$ = 100 V |
| | | | 100 | | | μA | $V_R$ = 150 V, $T_A$ = 150°C |
| | | | | | 100 | μA | $V_R$ = 100 V, $T_A$ = 150°C |
| C | Capacitance | | 2.0 | | 2.5 | pF | $V_R$ = 0, f = 1.0 MHz |
| $t_{rr}$ | Reverse Recovery Time | | 50 | | 60 | ns | $I_f$ = 30 mA, $I_r$ = 30 mA, $R_L$ = 100Ω, $I_{rr}$ = 3.0 mA |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 175°C and junction to ambient thermal resistance of 375°C/W (derating factor of 2.67 mW/°C) for FD400 and FD444, junction to ambient thermal resistance of 300°C/W (derating factor of 3.33 mW/°C).
4. Pulse conditions: length = 300 μs; duty cycle ≤2%.
5. For product family characteristic curves, refer to Section 5-D4.

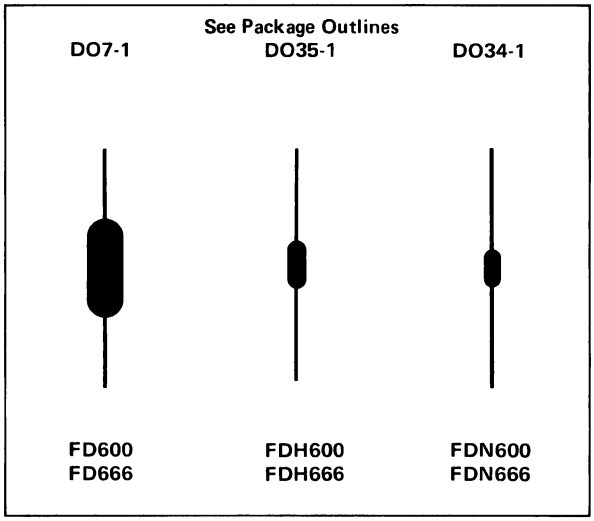
4

# FD/FDH/FDN600 • FD/FDH/FDN666

## ULTRA FAST

DIFFUSED SILICON PLANAR* EPITAXIAL DIODES

- **C . . . 2.5 pF (MAX) FD/FDH/FDN600, 3.5 pF (MAX) FD/FDH/FDN666**
- **$V_F$ . . . 1.0 V (MAX) @ 100 mA (FD/FDH/FDN666)**
  **. . . 1.0 V (MAX) @ 200 mA (FD/FDH/FDN600)**
- **$t_{rr}$ . . . 4.0 ns (MAX) @ $I_f = I_r$ = 10 mA**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | | |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | −65°C to +200°C | |
| Operating Temperature | | 175°C | |
| **Maximum Power Dissipation** | | **FD600 FD666** | **FDH/FDN600 FDH/FDN666** |
| Total Dissipation | | 400 mW | 500 mW |
| Linear Derating Factor | | 2.67 mW/°C | 3.33 mW/°C |
| **Maximum Voltage and Currents** | | **FD/FDH/ FDN600** | **FD/FDH/ FDN666** |
| WIV | Working Inverse Voltage | 50 V | 25 V |
| $I_O$ | Average Rectified Current | 200 mA | 200 mA |
| $i_f$ | Recurrent Peak Forward Current | 600 mA | 600 mA |
| $i_{f(surge)}$ | Peak Forward Surge Current | | |
| | Pulse Width = 1.0 s | 1.0 A | 1.0 A |
| | Pulse Width = 1.0 μs | 4.0 A | 4.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | FD/FDH/FDN600 MIN. | FD/FDH/FDN600 MAX. | FD/FDH/FDN666 MIN. | FD/FDH/FDN666 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | | 1.0 | | | V | $I_F$ = 200 mA |
| | | | 0.92 | | 1.0 | V | $I_F$ = 100 mA |
| | | | 0.86 | | 0.86 | V | $I_F$ = 50 mA |
| | | | 0.79 | | 0.79 | V | $I_F$ = 10 mA |
| | | | 0.65 | | 0.65 | V | $I_F$ = 1.0 mA |
| $I_R$ | Reverse Current | | 0.1 | | | μA | $V_R$ = −50 V |
| | | | | | 0.1 | μA | $V_R$ = −25 V |
| | | | 100 | | | μA | $V_R$ = −50 V, $T_A$ = 150°C |
| | | | | | 100 | μA | $V_R$ = −25 V, $T_A$ = 150°C |
| BV | Breakdown Voltage | 75 | | 40 | | V | $I_R$ = 5.0 μA |
| $t_{rr}$ | Reverse Recovery Time (Note 2) | | 4.0 | | 4.0 | ns | $I_f = I_r$ = 10 mA, $R_L$ = 100 Ω |
| | | | 6.0 | | 6.0 | ns | $I_f = I_r$ = 200 mA, $R_L$ = 100 Ω |
| C | Capacitance (Note 3) | | 2.5 | | 3.5 | pF | $V_R$ = 0, f = 1.0 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. Recovery to 0.1 $I_R$.
3. Capacitance as measured on Boonton Electronic Corporation Model No. 75-AS8 capacitance bridge or equivalent.
4. Leads are tinned. Gold-plate with nickel strike may be obtained when specified.
5. For product family characteristic curves, refer to Section 5-D6.

# FD700 • FD777 • FDN700 • FDN777

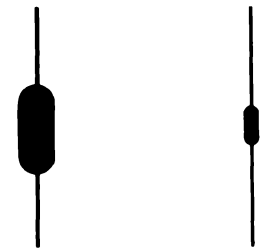
## PICOSECOND COMPUTER

DIFFUSED SILICON PLANAR* DIODES

- **C . . . 1.0 pF (MAX) @ $V_R$ = 0, f = 1.0 MHz (FD700, FDN700)**
- **$t_{rr}$ . . . 700 ps (MAX) @ $I_f = I_r$ = 10 mA, $R_L$ = 100 Ω (FD700, FDN700)**
- **CONTROLLED FORWARD CONDUCTANCE**

See Package Outlines

DO7-1 DO34-1



FD700 FD777 FDN700 FDN777

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | FD/FDN700 | FD/FDN777 |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | -65°C to +200°C | -65°C to +200°C |
| Operating Temperature | | 175°C | 175°C |
| **Maximum Power Dissipation** | | | |
| Total Dissipation | | 1.67 mW/°C | 1.67 mW/°C |
| Linear Derating Factor | | 2.0 mW/°C | 2.0 mW/°C |
| **Maximum Voltages and Currents** | | | |
| WIV | Working Inverse Voltage | 20 V | 8.0 V |
| $I_O$ | Average Rectified Current | 50 mA | 50 mA |
| $I_F$ | Forward Current Steady State dc | 150 mA | 150 mA |
| $i_f$ | Recurrent Peak Forward Current | 150 mA | 150 mA |
| $i_{f(surge)}$ | Peak Forward Surge Current Pulse Width = 1.0 s | 250 mA | 250 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | FD/FDN700 MIN. | FD/FDN700 MAX. | FD/FDN777 MIN. | FD/FDN777 MAX | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | 0.89 | 1.10 | 0.89 | 1.35 | V | $I_F$ = 50 mA |
| | | 0.81 | 0.95 | 0.81 | 1.00 | V | $I_F$ = 20 mA |
| | | 0.76 | 0.88 | 0.76 | 0.94 | V | $I_F$ = 10 mA |
| | | 0.64 | 0.74 | 0.64 | 0.79 | V | $I_F$ = 1.0 mA |
| | | 0.52 | 0.61 | 0.52 | 0.64 | V | $I_F$ = 0.1 mA |
| | | 0.42 | 0.50 | 0.42 | 0.53 | V | $I_F$ = 0.01 mA |
| BV | Breakdown Voltage | 30 | | 15 | | V | $I_R$ = 5.0 μA |
| $I_R$ | Reverse Current | | 50 | | | nA | $V_R$ = 20 V |
| | | | | | 100 | nA | $V_R$ = 8.0 V |
| | | | 50 | | | μA | $V_R$ = 20 V, $T_A$ = 150°C |
| | | | | | 50 | μA | $V_R$ = 8.0 V, $T_A$ = 150°C |
| $\tau$ | Minority Carrier Lifetime | | 450 | | 450 | ps | (see Note 2) |
| $t_{rr}$ | Reverse Recovery Time (Note 3) | | 700 | | 750 | ps | $I_f = I_r$ = 10 mA, $R_L$ = 100 Ω |
| C | Capacitance | | 1.0 | | 1.3 | pF | $V_R$ = 0, f = 1.0 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. Measured as suggested by S. M. Krakauer, IRE Proceedings, Volume 60, July 1962, pp. 1674 - 1675.
3. Recovery to 0.1 $I_R$.
4. Leads are tinned. Gold plate with nickel strike may be obtained when specified.
5. For product family characteristic curves, refer to Section 5 - D7.

4

# FDH900 • FDH999

## HIGH SPEED SWITCHING

DIFFUSED SILICON PLANAR* DIODES

- **BV . . . 45 V (FDH900), 35 V (FDH999)**
- **$t_{rr}$ . . . 4.0 ns (FDH900), 5.0 ns (FDH999)**

**See DO35-1 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +175°C |
| Operating Temperature | | 150°C |
| **Maximum Power Dissipation** | | |
| Total Dissipation at 25°C Ambient Temperature | | 400 mW |
| at 125°C Ambient Temperature | | 170 mW |
| **Maximum Voltage and Currents** | | |
| WIV | Working Inverse Voltage | 25 V |
| $I_O$ | Average Rectified Current | 200 mA |
| $i_f$ | Recurrent Peak Forward Current | 600 mA |
| $i_{f(surge)}$ | Peak Forward Surge Current | |
| | Pulse Width = 1.0s | 1.0A |
| | Pulse Width = 1.0 μs | 4.0A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | FDH900 MIN. | FDH900 MAX. | FDH999 MIN. | FDH999 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| BV | Breakdown Voltage | 45 | | 35 | | V | $I_R$ = 5.0 μA |
| $I_R$ | Reverse Current | | | | 1.0 | μA | $V_R$ = 25 V |
| | | | 500 | | | nA | $V_R$ = 40 V |
| $V_F$ | Forward Voltage | | | | 1.0 | V | $I_F$ = 10 mA |
| | | | 1.1 | | | | $I_F$ = 100 mA |
| C | Capacitance | | 3.0 | | 5.0 | pF | $V_R$ = 0, f = 1.0 MHz |
| $t_{rr}$ | Reverse Recovery Time | | 4.0 | | 5.0 | ns | $I_f$ = 10 mA, $I_r$ = 10 mA, $R_L$ = 100Ω, $I_{rr}$ = 1.0 mA |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. For product family characteristic curves, refer to Section 5-D6.

# FH1100 • 1N5390

## HOT CARRIER

DIFFUSED SILICON DIODE

- **$Q_S$ . . . 1.6 pC (TYP)**
- **C . . . 1.0 pF (MAX)**
- **NF . . . 10 dB (MAX) @ f = 890 MHz**

**See DO7-2 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** ($T_A$ = 25°C) (Note 2)

| | FH1100 | 1N5390 |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | −55°C to +150°C | −65°C to +150°C |
| Operating Temperature | 125°C | 125°C |
| **Maximum Power Dissipation** | | |
| Total Dissipation | 100 mW | 100 mW |
| Linear Derating Factor | 1.0 mW/°C | 1.0 mW/°C |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | | MIN. | TYP. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | | | | 0.55 | V | $I_F$ = 10 mA |
| $I_R$ | Leakage Current | FH1100 | | | 1.0 | μA | $V_R$ = 1.0 V |
| | | 1N5390 | | | 50 | nA | $V_R$ = 1.0 V |
| BV | Breakdown Voltage | | 5.0 | | | V | $I_R$ = 100 μA |
| C | Capacitance | | | | 1.0 | pF | $V_R$ = 0, f = 1.0 MHz |
| NF | Noise Figure | | | | 10 | dB | f = 890 MHz |
| $Q_S$ | Stored Charge (Note 1) | FH1100 | | 1.6 | | pC | $I_f$ = 10 mA |
| | | 1N5390 | | | 3.0 | pC | $I_f$ = 10 mA |

*Planar is a patented Fairchild process.

NOTES:
1. Measured on B-Line Electronics QS-3 stored charge meter.
2. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
3. For product family characteristic curves, refer to Section 5 — D12.

# FJT1100 • FJT1101 • FJT2000

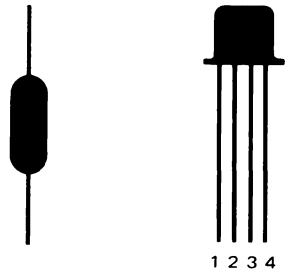
## PICOAMPERE

DIFFUSED SILICON PLANAR* EPITAXIAL DIODES

- **$I_R$ . . . 1.0 pA @ 5.0 V (FJT1100)**
  **. . . 5.0 pF @ 5.0 V (FJT1101, FJT2000)**

**See Package Outlines**

**DO7-1** **TO18-3**




**FJT1100**
**FJT1101** **FJT2000**

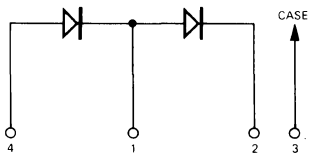
**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | FJT1100, FJT1101 | FJT2000 |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | –55°C to +200°C | –55°C to +125°C |
| Operating Temperature | 175°C | 125°C |
| **Maximum Power Dissipation** | | |
| Total Dissipation at 25°C Ambient Temperature | 250 mW | 125 mW |
| **Maximum Current** | | |
| $I_F$ DC Forward Current | 150 mA | 100 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | FJT1100 MIN. | FJT1100 MAX. | FJT1101 MIN. | FJT1101 MAX. | FJT2000 MIN. | FJT2000 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| BV | Breakdown Voltage | 30 | | 20 | | | | V | $I_R$ = 5.0 μA |
| | | | | | | 35 | | V | $I_R$ = 1.0 μA |
| $I_R$ | Reverse Current | | 1.0 | | 5.0 | | 5.0 | pA | $V_R$ = 5.0 V |
| | | | 10 | | 15 | | | pA | $V_R$ = 15 V |
| | | | | | | | 500 | pA | $V_R$ = 5.0 V, $T_A$ = 80°C |
| | | | | | | | 10 | pA | $V_R$ = 20 V |
| $V_F$ | Forward Voltage | | 1.05 | | 1.10 | | | V | $I_F$ = 50 mA |
| | | | | | | | 1.0 | V | $I_F$ = 10 mA |
| C | Capacitance | | 1.5 | | 1.8 | | 1.3 | pF | $V_R$ = 0, f = 1.0 MHz |
| $t_{rr}$ | Reverse Recovery Time (Note 2) | | | | | | 250 | ns | $I_f = I_r$ = 10 mA, $I_{rr}$ = 1.0 mA |

**LEAD CONNECTION**




**FJT2000**

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life of satisfactory performance may be impaired.
2. For product family characteristic curves and test circuits, refer to Section 5 - D2.

# FQ3467 • FQ3468 • FPQ3467 • FPQ3468

## PNP QUAD CORE DRIVERS

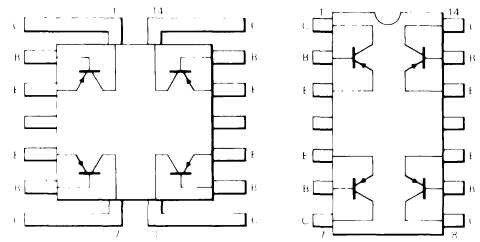
DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $V_{CEO}$ . . . 50 V (MIN)
- $t_{on}$ . . . 25 ns (TYP)
- $t_{off}$ . . . 65 ns (TYP)
- COMPACT PACKAGING . . . FOUR TRANSISTORS PER PACKAGE

**CONNECTION DIAGRAMS**

See Package Outlines

TO86-1 TO116-1



FQ3467 FQ3468 FPQ3467 FPQ3468

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | FQ3467 FQ3468 | FPQ3467 FPQ3468 |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | −65°C to +200°C | −65°C to +150°C |
| Operating Junction Temperature | 200°C | 150°C |
| Lead Temperature (60 seconds) | 300°C | 300°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Ambient Temperature | 0.5 W | 2.0 W |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | FQ/FPQ3467 MIN. | FQ/FPQ3467 MAX. | FQ/FPQ3468 MIN. | FQ/FPQ3468 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 4) | −40 | | −50 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −40 | | −50 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{CES}$ | Collector to Base Breakdown Voltage | −40 | | −50 | | V | $I_C$ = 10 μA, $V_{BE}$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −5.0 | | −5.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 1.0 | | 1.0 | μA | $V_{CB}$ = −25 V, $I_E$ = 0 |
| | | | 120 | | 120 | μA | $V_{CB}$ = −25 V, $I_E$ = 0, $T_A$ = 100°C |
| $V_{BE(sat)}$ | Pulsed Base Saturation Voltage (Note 4) | | −1.2 | | −1.5 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| $V_{CE(sat)}$ | Pulsed Collector Saturation Voltage (Note 4) | | −0.5 | | −0.5 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| | | | −0.5 | | −0.5 | V | $I_C$ = 500 mA, $I_B$ = 50 mA, $T_A$ = 55 C |
| | | | −0.6 | | −0.6 | V | $I_C$ = 500 mA, $I_B$ = 50 mA, $T_A$ = 100°C |
| $h_{FE}$ | DC Pulse Current Gain (Note 4) | 40 | | 25 | | | $I_C$ = 150 mA, $V_{CE}$ = −1.0 V |
| | | 30 | | 20 | | | $I_C$ = 500 mA, $V_{CE}$ = −1.0 V |
| $h_{fe}$ | High Frequency Current Gain | 2.0 | | 2.0 | | | $I_C$ = 50 mA, $V_{CE}$ = −10 V, f = 100 MHz |
| $t_{on}$ | Turn On Time (Note 5) | | 40 | | 40 | ns | $I_C \approx$ 500 mA, $I_{B1} \approx$ 50 mA |
| $t_{off}$ | Turn Off Time (Note 5) | | 90 | | 90 | ns | $I_C \approx$ 500 mA, $I_{B1} \approx -I_{B2} \approx$ 50 mA |
| $t_s$ | Storage Time (Note 5) | | 60 | | 60 | ns | $I_C \approx$ 500 mA, $I_{B1} \approx -I_{B2} \approx$ 50 mA |
| $C_{cb}$ | Collector to Base Capacitance | | 25 | | 25 | pF | $V_{CB}$ = −10 V, $I_E$ = 0, f = 1.0 MHz |
| $C_{eb}$ | Emitter to Base Capacitance | | 100 | | 100 | pF | $V_{EB}$ = −0.5 V, $I_C$ = 0, f = 1.0 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. This rating gives a maximum junction temperature of 150°C and junction to ambient thermal resistance of 62.5°C/W (derating factor of 16 mW/°C), for FPQ3467 and FPQ3468. This rating gives a maximum junction temperature of 200°C and junction to ambient thermal resistance of 350°C/W (derating factor of 28.6 mW/°C), for FQ3467 and FQ3468.
4. Pulse conditions: length = 300 μs; duty cycle = 1%.
5. For product family characteristic curves, refer to Section 5 - SS7.

# FPQ3724 • FPQ3725 • FQ3724 • FQ3725

## NPN QUAD CORE DRIVER

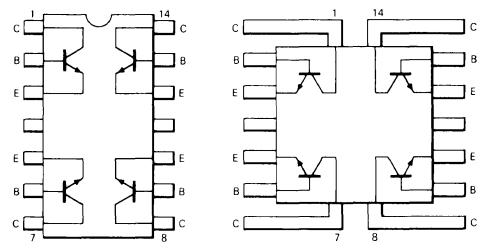
DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$V_{CEO(sus)}$ . . . 50 V (FQ/FPQ3725)**
- **HIGH CURRENT . . . 500 mA**
- **$t_{on}$ . . . 25 ns (TYP)**
- **$t_{off}$ . . . 45 ns (TYP)**
- **COMPLEMENTS . . . FPQ/FQ3467 AND FPQ/FQ3468**

**CONNECTION DIAGRAMS**

**See Package Outlines**

**TO116-1** **TO86-1**




**FPQ3724** **FQ3724**
**FPQ3725** **FQ3725**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | FPQ3724/5 | FQ3724/5 |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | −65°C to +150°C | −65°C to +200°C |
| Operating Junction Temperature | 150°C | 200°C |
| Lead Temperature (60 seconds) | 300°C | 300°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Ambient Temperature | 2.0 W | 0.5 W |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | FQ/FPQ3724 MIN. | FQ/FPQ3724 MAX. | FQ/FPQ3725 MIN. | FQ/FPQ3725 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 4) | 40 | | 50 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 70 | | 80 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | 70 | | 80 | | V | $I_C$ = 10 μA, $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 6.0 | | 6.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 1.7 | | 1.7 | μA | $V_{CB}$ = 40 V, $I_E$ = 0 |
| | | | 120 | | 120 | μA | $V_{CB}$ = 40 V, $I_E$ = 0, $T_A$ = 100°C |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 4) | | 1.2 | | 1.2 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 4) | | 0.5 | | 0.5 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| | | | 0.5 | | 0.5 | V | $I_C$ = 500 mA, $I_B$ = 50 mA, $T_A$ = −55°C |
| | | | 0.6 | | 0.6 | V | $I_C$ = 500 mA, $I_B$ = 50 mA, $T_A$ = 100°C |
| $h_{FE}$ | DC Pulse Current Gain (Note 4) | 50 | | 50 | | | $I_C$ = 100 mA, $V_{CE}$ = 1.0 V |
| | | 30 | | 20 | | | $I_C$ = 500 mA, $V_{CE}$ = 1.0 V |
| $h_{fe}$ | High Frequency Current Gain | 2.0 | | 2.0 | | | $I_C$ = 50 mA, $V_{CE}$ = 10 V, f = 100 MHz |
| $t_{on}$ | Turn On Time (see test circuit no. 265) | | 35 | | 35 | ns | $I_C$ = 500 mA, $I_{B1}$ = 50 mA |
| $t_{off}$ | Turn Off Time (see test circuit no. 265) | | 60 | | 60 | ns | $I_C$ = 500 mA, $I_{B1}$ = $I_{B2}$ = 50 mA |
| $t_s$ | Storage Time (see test circuit no. 265) | | 50 | | 50 | ns | $I_C$ = 500 mA, $I_{B1}$ = $I_{B2}$ = 50 mA |
| $C_{eb}$ | Emitter to Base Capacitance | | 60 | | 60 | pF | $I_C$ = 0, $V_{EB}$ = 0.5 V |
| $C_{cb}$ | Collector to Base Capacitance | | 12 | | 12 | pF | $I_E$ = 0, $V_{CB}$ = 10 V |

*Planar is a patented Fairchild process

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to ambient thermal resistance of 62.5°C/W (derating factor of 16 mW/°C) for FPQ3724 and FPQ3725.
   These ratings give a maximum junction temperature of 200°C and junction to ambient thermal resistance of 350°C/W (derating factor of 2.86 mW/°C) for FQ3724 and FQ3725.
4. Pulse conditions: length = 300 μs; duty cycle = 1%.
5. For product family characteristic curves, refer to Section 5-SS13.

# FSA1410M • FSA1411M • FSA2002M • FSA2003M

## AIR ISOLATED MONOLITHIC ARRAYS 8 COMMON CATHODE 8 COMMON ANODE

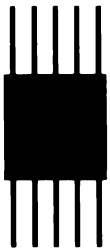
DIFFUSED SILICON PLANAR* DIODES

- **C . . . 4.0 pF MAX**
- **$\Delta V_F$ . . . 15 mV (MAX) @ 10 mA**

See Package Outlines

**TO5-11 (10-LEAD)** — **FSA1410M, FSA1411M**

**TO85-1** — **FSA2002M, FSA2003M**



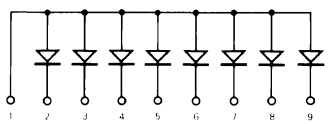
**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| **Maximum Temperatures** | |
| Storage Temperature | −55°C to +150°C |
| Operating Temperature | 200°C |
| **Maximum Power Dissipation** | |
| Dissipation per Junction | 400 mW |
| per Package | 600 mW |
| **Maximum Voltage and Currents** | |
| WIV Working Inverse Voltage | 55 V |
| $I_F$ Forward Current Steady State DC | 350 mA |
| $i_f$ Peak Forward Surge Current | |
| Pulse Width = 1.0 s | 1.0 A |
| Pulse Width = 1.0 μs | 2.0 A |

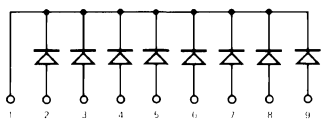
**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| BV | Breakdown Voltage | 60 | | V | $I_R$ = 10 μA |
| $V_F$ | Forward Voltage (Note 2) | | 1.5 | V | $I_F$ = 500 mA |
| | | | 1.1 | V | $I_F$ = 200 mA |
| | | | 1.0 | V | $I_F$ = 100 mA |
| $I_R$ | Reverse Current | | 100 | nA | $V_R$ = 40 V |
| | | | 100 | μA | $V_R$ = 40 V, $T_A$ = 150°C |
| C | Capacitance | | 4.0 | pF | $V_R$ = 0, f = 1.0 MHz |
| $V_{FM}$ | Peak Forward Voltage (Note 3) | | 4.0 | V | $I_F$ = 500 mA, $t_r$ < 10 ns |
| $t_{fr}$ | Forward Recovery Time (Note 3) | | 40 | ns | $I_f$ = 500 mA, $t_r$ < 10 ns |
| $t_{rr}$ | Reverse Recovery Time (Note 3) | | 10 | ns | $I_f$ = $I_r$ = 10-200 mA |
| | | | | | $R_L$ = 100 Ω, Rec. to $I_R$ |
| | | | 50 | ns | $I_f$ = 500 mA, $I_r$ = 50 mA |
| | | | | | $R_L$ = 100 Ω, Rec. to 5.0 mA |
| $\Delta V_F$ | Forward Voltage Match (Note 3) | | 15 | mV | $I_F$ = 10 mA |

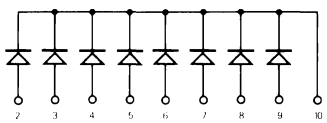
### CIRCUIT DIAGRAMS



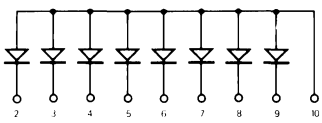
**FSA1410M**



**FSA1411M**



**FSA2002M**



**FSA2003M**

*Planar is a patented Fairchild process.

NOTES:
1. Ratings apply to individual diodes. For multiple diode operations, total power must not exceed power dissipation rating listed.
2. These values apply for a single 8 ms pulse.
3. For product family characteristic curves and test circuits, refer to Section 5 - D11.

# FSA2500M • FSA2501M • FSA2502M

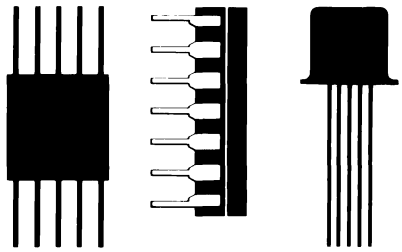
## AIR ISOLATED MONOLITHIC CORE DRIVERS

DIFFUSED SILICON PLANAR* DIODES

- **C . . . 5.0 pF MAX**
- **$V_F$ . . . 1.5 V (MAX) @ 500 mA**
- **$t_{rr}$ . . . 50 ns (MAX)**

See Package Outlines

TO85-1 TO116-2 TO5-11 10-LEAD



FSA2500M FSA2501M FSA2502M

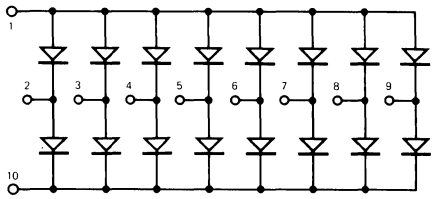
**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| **Maximum Temperatures** | |
| Storage Temperature | −55°C to +200°C |
| Operating Temperature | 150°C |
| **Maximum Power Dissipation** (Note 3) | |
| Dissipation per Junction | 400 mW |
| per Package | 650 mW |
| **Maximum Voltage and Currents** (Note 2) | |
| PIV Peak Inverse Voltage | 55 V |
| $I_F$ DC Forward Current | 350 mA |
| $i_f$ Peak Forward Surge Current | |
| Pulse Width = 1.0 s | 1.0 A |
| Pulse Width = 1.0 μs | 2.0 A |

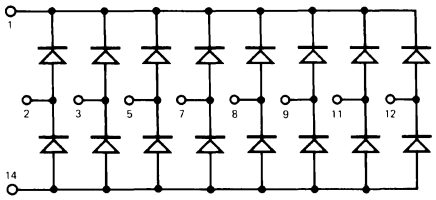
**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature) (Note 4)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| BV | Breakdown Voltage | 60 | | V | $I_R$ = 10 μA |
| $V_F$ | Forward Voltage (Note 5) | | 1.0 | V | $I_F$ = 100 mA |
| | | | 1.1 | V | $I_F$ = 200 mA |
| | | | 1.5 | V | $I_F$ = 500 mA |
| $\Delta V_F$ | Forward Voltage Match (Note 8) | | 15 | mV | $I_F$ = 10 mA |
| $I_R$ | Reverse Current (Note 6) | | 100 | nA | $V_R$ = 40 V |
| | | | 200 | μA | $V_R$ = 40 V, $T_A$ = 150°C |
| C | Capacitance (Note 7) | | 5.0 | pF | $V_R$ = 0, f = 1.0 MHz |
| $t_{fr}$ | Forward Recovery Time (Note 8) | | 40 | ns | $I_f$ = 500 mA |
| $t_{rr}$ | Reverse Recovery Time (Note 8) | | 10 | ns | $I_f$ = $I_r$ = 10 mA to 200 mA, $R_L$ = 100 Ω, $I_{rr}$ = 0.1 $I_R$ |
| | | | 50 | ns | $I_f$ = 500 mA, $I_r$ = 50 mA, $R_L$ = 100 Ω, $I_{rr}$ = 5.0 mA |

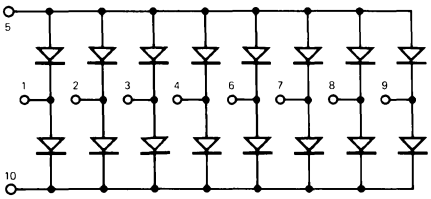
**CIRCUIT DIAGRAMS**




FSA2500M




FSA2501M




FSA2502M

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which satisfactory performance may be impaired.
2. These values apply for a single 50 ms pulse.
3. These are steady state limits. The factory should be consulted in applications involving pulsed or low duty cycle operation.
4. Limits and typical electrical characteristics apply to single diode operation only. The diodes not under test are open circuited, except for $I_R$.
5. These values apply for a single 8 ms pulse.
6. To measure reverse current of an individual diode, see test circuits, Note 8.
7. The capacitance is measured from pin to pin across any one of the diodes. The interaction of other diodes is therefore included in the measured value.
8. For product family characteristic curves and test circuits refer to Section 5-D11.

# FSA2503M • FSA2504M

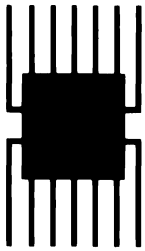
## AIR ISOLATED MONOLITHIC CORE DRIVERS

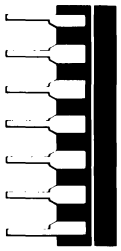
DIFFUSED SILICON PLANAR* DIODES

- **C . . . 5.0 pF (MAX)**
- **$V_F$ . . . 1.5 V (MAX) @ 500 mA**
- **$t_{rr}$ . . . 50 ns (MAX)**

**See Package Outlines**

**TO86-1** **TO116-2**





**FSA2504M** **FSA2503M**

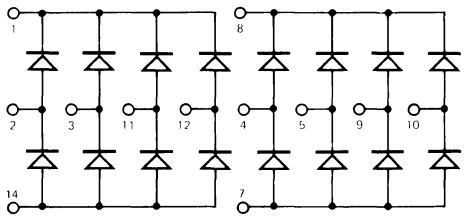
**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| **Maximum Temperatures** | |
| Storage Temperature | −55°C to +200°C |
| Operating Temperature | 150°C |
| **Maximum Power Dissipation** (Note 3) | |
| Dissipation per Junction | 400 mW |
| per Package | 650 mW |
| **Maximum Voltage and Currents** (Note 2) | |
| PIV Peak Inverse Voltage | 55 V |
| $I_F$ DC Forward Current | 350 mA |
| $i_f$ Peak Forward Surge Current | |
| Pulse Width = 1.0 s | 1.0 A |
| Pulse Width = 1.0 μs | 2.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature) (Note 4)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| BV | Breakdown Voltage | 60 | | V | $I_R$ = 10 μA |
| $V_F$ | Forward Voltage (Note 5) | | 1.0 | V | $I_F$ = 100 mA |
| | | | 1.1 | V | $I_F$ = 200 mA |
| | | | 1.5 | V | $I_F$ = 500 mA |
| $\Delta V_F$ | Forward Voltage Match (Note 8) | | 15 | mV | $I_F$ = 10 mA |
| $I_R$ | Reverse Current (Note 6) | | 100 | nA | $V_R$ = 40 V |
| | | | 200 | μA | $V_R$ = 40 V, $T_A$ = 150°C |
| C | Capacitance (Note 7) | | 5.0 | pF | $V_R$ = 0, f = 1.0 MHz |
| $t_{fr}$ | Forward Recovery Time (Note 8) | | 40 | ns | $I_f$ = 500 mA |
| $t_{rr}$ | Reverse Recovery Time (Note 8) | | 10 | ns | $I_f$ = $I_r$ = 10 mA to 200 mA, $R_L$ = 100 Ω, $I_{rr}$ = 0.1 $I_R$ |
| | | | 50 | ns | $I_f$ = 500 mA, $I_r$ = 50 mA, $R_L$ = 100 Ω, $I_{rr}$ = 5.0 mA |

### CIRCUIT DIAGRAMS




**FSA2503M**
**FSA2504M**
**Dual 8 Diode Array**

NOTES:

*Planar is a patented Fairchild process.

1. The maximum ratings are limiting values above which satisfactory performance may be impaired.
2. These values apply for a single 50 ms pulse.
3. These are steady state limits. The factory should be consulted in applications involving pulsed or low duty cycle operation.
4. Limits and typical electrical characteristics apply to single diode operation only. The diodes not under test are open circuited, except for $I_R$.
5. These values apply for a single 8 ms pulse.
6. To measure reverse current of an individual diode, see test circuits, Note 8.
7. The capacitance is measured from pin to pin across any one of the diodes. The interaction of other diodes is therefore included in the measured value.
8. For product family characteristic curves and circuits, refer to Section 5 - D11.

# FSA2508M • FSA2509M • FSA2510M

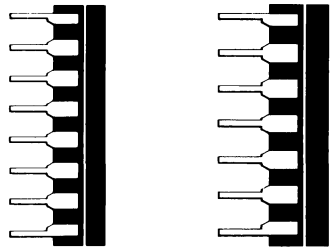
## AIR ISOLATED MONOLITHIC CORE DRIVERS

DIFFUSED SILICON PLANAR* DIODES

- **C . . . 5.0 pF MAX**
- **$V_F$ . . . 1.3 V (MAX) @ 500 mA**
- **$t_{rr}$ . . . 50 ns (MAX)**

**See Package Outlines**

**TO116-3** **TO116-1**



**FSA2508M** **FSA2509M FSA2510M**

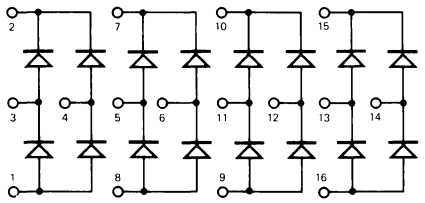
**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| **Maximum Temperatures** | |
| Storage Temperature | –55°C to +150°C |
| Operating Temperature | 150°C |
| **Maximum Power Dissipation** (Note 3) | |
| Dissipation per Junction | 400 mW |
| per Package | 650 mW |
| **Maximum Voltage and Currents** (Note 2) | |
| PIV Peak Inverse Voltage | 55 V |
| $I_F$ DC Forward Current | 350 mA |
| $i_f$ Peak Forward Surge Current | |
| Pulse Width = 1.0 s | 1.0 A |
| Pulse Width = 1.0 μs | 2.0 A |

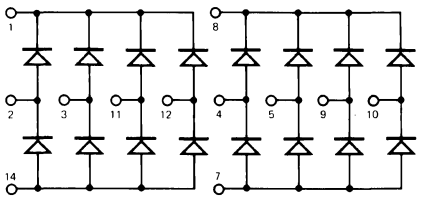
**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature) (Note 4)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| BV | Breakdown Voltage | 60 | | V | $I_R$ = 10 μA |
| $V_F$ | Forward Voltage (Note 5) | | 1.0 | V | $I_F$ = 100 mA |
| | | | 1.1 | V | $I_F$ = 200 mA |
| | | | 1.3 | V | $I_F$ = 500 mA |
| $\Delta V_F$ | Forward Voltage Match (Note 8) | | 15 | mV | $I_F$ = 10 mA |
| $I_R$ | Reverse Current (Note 6) | | 100 | nA | $V_R$ = 40 V |
| | | | 200 | μA | $V_R$ = 40 V, $T_A$ = 150°C |
| C | Capacitance (Note 7) | | 5.0 | pF | $V_R$ = 0, f = 1.0 MHz |
| $t_{fr}$ | Forward Recovery Time (Note 8) | | 40 | ns | $I_f$ = 500 mA |
| $t_{rr}$ | Reverse Recovery Time (Note 8) | | 10 | ns | $I_f = I_r$ = 10 mA to 200 mA |
| | | | | | $R_L$ = 100 Ω, $I_{rr}$ = 0.1 $I_R$ |
| | | | 50 | ns | $I_f$ = 500 mA, $I_r$ = 50 mA |
| | | | | | $R_L$ = 100 Ω, $I_{rr}$ = 5.0 mA |

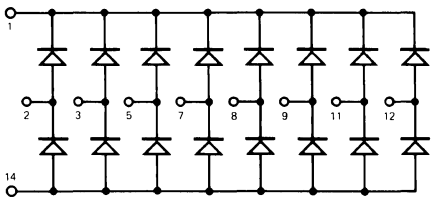
### CIRCUIT DIAGRAMS




**FSA2508M**
4 Quad Diode Array




**FSA2509M**
Dual 8 Diode Array




**FSA2510M**
16 Diode Array

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which satisfactory performance may be impaired.
2. These values apply for a single 50 ms pulse.
3. These are steady state limits. The factory should be consulted in applications involving pulsed or low duty cycle operation.
4. Limits and typical electrical characteristics apply to single diode operation only. The diodes not under test are open circuited, except for $I_R$.
5. These values apply for a single 8 ms pulse.
6. To measure reverse current of an individual diode see test circuits, Note 8.
7. The capacitance is measured from pin to pin across any one of the diodes. The interaction of other diodes is therefore included in the measured value.
8. For product family characteristic curves and test circuits, refer to Section 5 - D11.

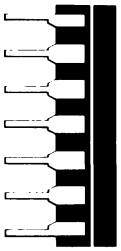
# FSA2563M • FSA2564M • FSA2565M • FSA2566M

## COMMON CATHODE COMMON ANODE

DIFFUSED SILICON PLANAR* AIR ISOLATED MONOLITHIC DIODE ARRAYS

- **C . . . 5.0 pF (MAX)**
- **$V_F$ . . . 1.3 V (MAX) @ 500 mA**
- **$\Delta V_F$ . . . 15 mV (MAX)**

**See TO116-1 Package Outline**



**ABSOLUTE MAXIMUM RATINGS** (Note 1)

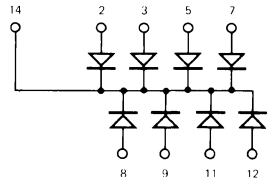
| | |
|---|---|
| **Maximum Temperatures** | |
| Storage Temperature | −55°C to +150°C |
| Operating Temperature | +150°C |
| **Maximum Power Dissipation** (Note 3) | |
| Total Dissipation per Junction | 400 mW |
| per Package | 600 mW |
| **Maximum Voltage and Currents** (Note 2) | |
| PIV Peak Inverse Voltage | 55 V |
| $I_F$ DC Forward Current | 350 mA |
| $i_f$ Peak Forward Surge Current | |
| Pulse Width = 1.0 s | 1.0 A |
| Pulse Width = 10 μs | 2.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Note 4)

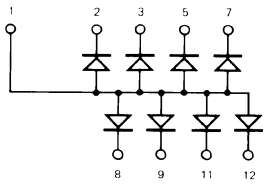
| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| BV | Breakdown Voltage | 60 | | V | $I_R$ = 10 μA |
| $V_F$ | Forward Voltage (Note 5) | | 1.0 | V | $I_F$ = 100 mA |
| | | | 1.1 | V | $I_F$ = 200 mA |
| | | | 1.3 | V | $I_F$ = 500 mA |
| $I_R$ | Reverse Current (Note 6) | | 100 | nA | $V_R$ = 40 V |
| | | | 100 | μA | $V_R$ = 40 V, $T_A$ = 125°C |
| C | Capacitance (Note 7) | | 5.0 | pF | $V_R$ = 0 V, f = 1.0 MHz |
| $V_{FM}$ | Peak Forward Voltage (Note 6) | | 4.0 | V | $I_F$ = 500 mA |
| $t_{fr}$ | Forward Recovery Time (Note 6) | | 40 | ns | $I_F$ = 500 mA |
| $t_{rr}$ | Reverse Recovery Time (Note 6) | | 10 | ns | $I_f = I_r$ = 10 mA to 200 mA |
| | | | | | $R_L$ = 100 Ω, $I_{rr}$ = 0.1 $I_r$ |
| | | | 50 | ns | $I_f$ = 500 mA, $I_r$ = 50 mA |
| | | | | | $R_L$ = 100 Ω, $I_{rr}$ = 5.0 mA |
| $\Delta V_F$ | Forward Voltage Match (Note 6) | | 15 | mV | $I_f$ = 10 mA |

4

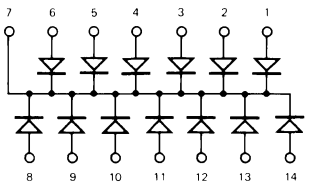
**CIRCUIT DIAGRAMS**



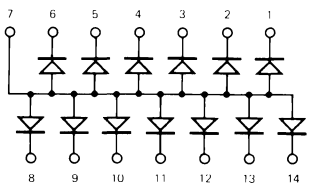

**FSA2563M**




**FSA2564M**




**FSA2565M**




**FSA2566M**

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which satisfactory performance may be impaired.
2. These values apply for a single 50 ms pulse.
3. These are steady state limits. The factory should be consulted in applications involving pulsed or low duty cycle operation.
4. Limits and typical electrical characteristics apply to single diode operation only. The diodes not under test are open circuited, except for $I_R$.
5. These values apply for a single 8 ms pulse.
6. For product family characteristic curves and test circuits, refer to Section 5 - D11.
7. The capacitance is measured from pin to pin across any one of the diodes. The interaction of other diodes is therefore included in the measured value.
8. To measure reverse current of an individual diode, see test circuits. (Note 6)

# FSA2619M/20M/21M • FSA2719M/20M/21M

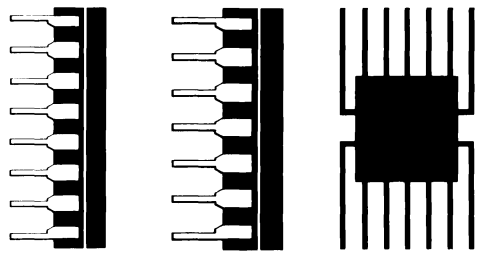
## AIR ISOLATED MONOLITHIC ARRAYS

DIFFUSED SILICON PLANAR* DIODES

- **C . . . 4.0 pF MAX**
- **$\Delta V_F$ . . . 15 mV MAX @ 10 mA**

**See Package Outlines**

**TO116-3** **TO116-1** **TO86-1**



**FSA2619M** **FSA2620M** **FSA2621M**
**FSA2719M** **FSA2720M** **FSA2721M**

**ABSOLUTE MAXIMUM RATINGS** ($T_A$ = 25°C) (Notes 1 & 7)

**Maximum Temperatures**

| | | |
|---|---|---|
| Storage Temperature | **FSA2621M, FSA2721M** | −55°C to +150°C |
| | **FSA2619M, FSA2620M, FSA2719M, FSA2720M** | −55°C to +200°C |
| Operating Temperature | | 150°C |

**Maximum Power Dissipation**

| | |
|---|---|
| Total Dissipation per Junction | 400 mW |
| per Package | 600 mW |

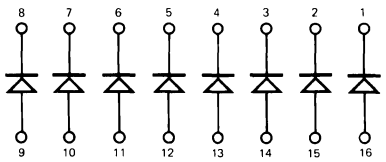
**Maximum Voltage and Currents** (Note 2)

| | | | |
|---|---|---|---|
| $V_R$ | Reverse Voltage at −65°C to +150°C | **FSA2619M** | 75 V |
| | | **FSA2719M** | 65 V |
| $I_O$ | Average Rectified Forward Current | | 200 mA |
| $I_O$ | Average Rectified Forward Current at 150°C | | 10 mA |
| $I_F$ | Recurrent Peak Forward Current | | 350 mA |
| $i_{f(surge)}$ | Surge Current, Pulse Width = 1.0 s | | 1.0 A |
| RE | Minimum Rectification Efficiency @ 100 MHz @ 2.0 V rms | | 45% |

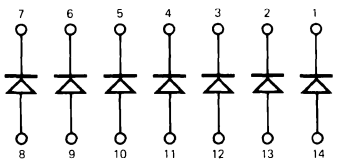
**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Note 4)

| SYMBOL | CHARACTERISTIC | | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| BV | Breakdown Voltage | FSA2719M | 75 | | V | $I_R$ = 5.0 μA |
| | | FSA2619M | 100 | | V | $I_R$ = 100 μA |
| $I_R$ | Reverse Current (Note 6) | FSA2619M | | 5.0 | μA | $V_R$ = 75 V |
| | | | | 0.025 | μA | $V_R$ = −20 V |
| | | | | 50 | μA | $V_R$ = −20 V, $T_A$ = 150°C |
| | | FSA2719M | | 100 | nA | $V_R$ = −50 V |
| | | | | 100 | μA | $V_R$ = −50 V, $T_A$ = 150°C |
| $V_F$ | Forward Voltage (Note 5) | | | 1.0 | V | $I_F$ = 10 mA |
| $t_{rr}$ | Reverse Recovery Time (Note 7) | FSA2619M | | 5.0 | ns | $I_f = I_r$ = 10 mA, $I_{rr}$ = 1.0 mA |
| | | FSA2719M | | 6.0 | ns | $I_f = I_r$ = 10 mA, $I_{rr}$ = 1.0 mA |
| C | Capacitance (Note 7) | FSA2619M | | 4.0 | pF | $V_R$ = 0 |
| | | FSA2719M | | 3.0 | pF | $V_R$ = 0 |
| $\Delta V_F$ | Forward Voltage Match (Note 7) | | | 15 | mV | $I_F$ = 10 mA |
| $t_{fr}$ | Forward Recovery Time (Note 7) | FSA2619M | | 2.5 | ns | 50 mA Peak square wave, 0.1 μs Pulse Width, 5.0 kHz - 100 kHz |
| $V_{FM}$ | Peak Forward Voltage | FSA2719M | | 3.0 | V | $I_F$ = 100 mA, $t_r \leq$ 10 ns |

### CIRCUIT DIAGRAMS




**FSA2619M**
**FSA2719M**
8 Diodes




**FSA2720M • FSA2721M**
**FSA2620M • FSA2621M**
7 Diodes

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which satisfactory performance may be impaired.
2. These values apply for a single 50 ms pulse.
3. These are steady state limits. The factory should be consulted in applications involving pulsed or low duty cycle operation.
4. Limits and typical electrical characteristics apply to single diode operation only. The diodes not under test are open circuited.
5. These values apply for a single 8 ms pulse.
6. To measure reverse current of an individual diode see test circuit note 7.
7. For product family characteristic curves and circuits refer to Section 5 - D11.
8. FSA2719M denotes series FSA2719M, FSA2720M, FSA2721M; FSA2619M denotes series FSA2619M, FSA2620M, FSA2621M.

# FSA2702M/3M/4M/5M • FSA2770M

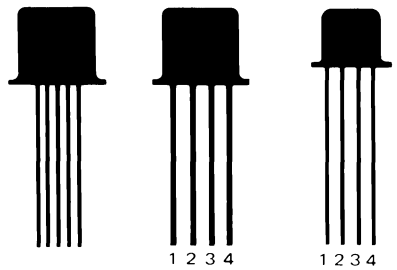
## AIR ISOLATED MONOLITHIC ARRAYS

DIFFUSED SILICON PLANAR* DIODES

- **BV . . . 60 V (MIN) @ 10 μA**
- **$t_{rr}$ . . . 6.0 ns (MAX) @ $I_f = I_r$ = 10 mA**

**See Package Outlines**

**TO5-11** (10-LEAD) **TO5-12** **TO18-3**




**FSA2770M** **FSA2702M** **FSA2704M** **FSA2703M** **FSA2705M**

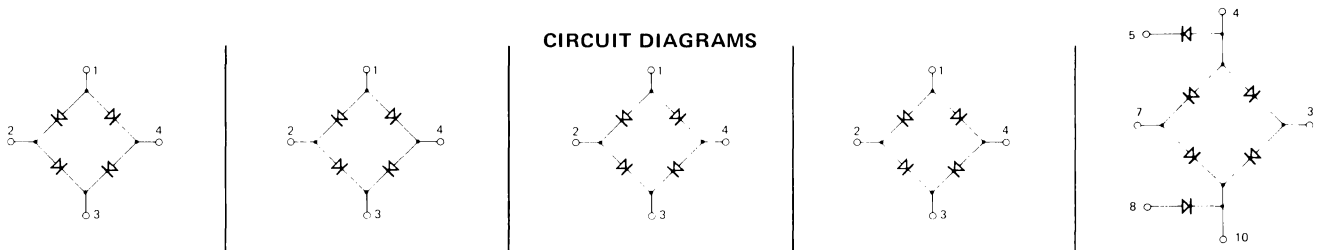
**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −55°C to +200°C |
| Operating Temperature | | 150°C |
| **Maximum Power Dissipation** (Note 2) | | |
| Total Dissipation | | 500 mW |
| **Maximum Voltages and Currents** (Note 3) | | |
| PIV | Peak Inverse Voltage | 55 V |
| $I_F$ | DC Forward Current | 350 mA |
| $I_f$ | Peak Forward Surge Current | |
| | Pulse Width = 1.0 s | 1.0 A |
| | Pulse Width = 1.0 μs | 4.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Note 4)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| BV | Breakdown Voltage | 60 | | V | $I_R$ = 100 μA |
| $I_R$ | Reverse Current (Note 6) | | 100 | nA | $V_R$ = 40 V |
| | | | 100 | μA | $V_R$ = 40 V, $T_A$ = 150°C |
| C | Capacitance (Note 7) | | 4.0 | pF | $V_R$ = 0 |
| $V_F$ | Forward Voltage (Note 5) | | 1.000 | V | $I_F$ = 200 mA |
| | | | .920 | V | $I_F$ = 100 mA |
| | | | .850 | V | $I_F$ = 50 mA |
| | | | .780 | V | $I_F$ = 20 mA |
| | | | .740 | V | $I_F$ = 10 mA |
| | | | .700 | V | $I_F$ = 5.0 mA |
| | | | .650 | V | $I_F$ = 2.0 mA |
| | | | .620 | V | $I_F$ = 1.0 mA |
| $t_{rr}$ | Reverse Recovery Time (Note 8) | | 6.0 | ns | $I_f = I_r$ = 10 mA, $I_{rr}$ = 1.0 mA |
| | | | 8.0 | ns | $I_f = I_r$ = 200 mA, $I_{rr}$ = 20 mA |
| $\Delta V_F$ | Forward Voltage Match (Note 8) FSA2702, FSA2703, FSA2770 | | 3.0 | mV | $I_F$ = 10 μA to 10 mA, $T_A$ = −55°C to +100°C |
| $\Delta I_R$ | Reverse Current Match (Note 8) FSA2702, FSA2703, FSA2770 | | 1.0 | μA | $V_R$ = 10 V, $T_A$ = −55°C to +100°C |

**CIRCUIT DIAGRAMS**




**FSA2702M** **FSA2703M** **FSA2704M** **FSA2705M** **FSA2770M**

See additional circuit diagrams and test circuits on following page.

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which satisfactory performance may be impaired.
2. These values apply for a single 50 ms pulse.
3. These are steady state limits. The factory should be consulted in applications involving pulsed or low duty cycle operation.
4. Limits and typical electrical characteristics apply to single diode operation only. The diodes not under test are open circuited, except for $I_R$, $\Delta I_R$ and $\Delta V_F$. (Note 6)
5. These values apply for a single 8 ms pulse.
6. To measure reverse current of an individual diode, see test circuits, Note 8.
7. The capacitance is measured from pin to pin across any one of the diodes. The interaction of other diodes is therefore included in the measured value.
8. For product family characteristic curves and test circuits, refer to Section 5-D11.

# FSA2771M through FSA2774M

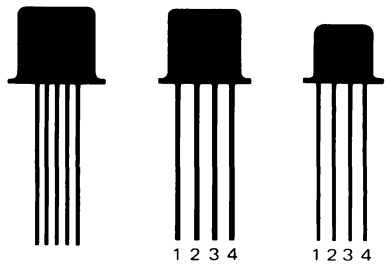
## AIR ISOLATED MONOLITHIC ARRAYS

DIFFUSED SILICON PLANAR* DIODES

- **BV . . . 60 V (MIN) @ 10 $\mu$A**
- **$t_{rr}$ . . . 6.0 ns (MAX) @ $I_f = I_r = 10$ mA**

See Package Outlines

TO5-11 (10-LEAD) TO5-12 TO18-3




FSA2771M
FSA2772M FSA2773M FSA2774M

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | –55°C to +200°C |
| Operating Temperature | 150°C |

**Maximum Power Dissipation** (Note 2)

| | |
|---|---|
| Total Dissipation | 500 mW |

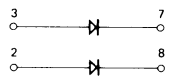
**Maximum Voltage and Currents** (Note 3)

| | | |
|---|---|---|
| PIV | Peak Inverse Voltage | 55 V |
| $I_F$ | DC Forward Current | 350 mA |
| $I_f$ | Peak Forward Surge Current | |
| | Pulse Width = 1.0 s | 1.0 A |
| | Pulse Width = 1.0 $\mu$s | 4.0 A |

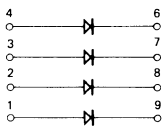
**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Note 4)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| BV | Breakdown Voltage | 60 | | V | $I_R = 100\ \mu A$ |
| $I_R$ | Reverse Current (Note 6) | | 100 | nA | $V_R = 40$ V |
| | | | 100 | $\mu$A | $V_R = 40$ V, $T_A = 150°C$ |
| $V_F$ | Forward Voltage (Note 5) | | 1.0 | V | $I_F = 100$ mA |
| C | Capacitance (Note 7) | | 3.0 | pF | $V_R = 0$ V |
| $t_{rr}$ | Reverse Recovery Time (Note 8) | | 6.0 | ns | $I_f = I_r = 10$ mA, $I_{rr} = 1.0$ mA |
| $\Delta V_F$ | Forward Voltage Match (Note 8) | | 3.0 | mV | $I_f = 20\ \mu A - 2.0$ mA<br>$T_A = -55°C$ to $+100°C$ |

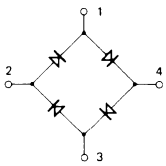
**CIRCUIT DIAGRAMS**



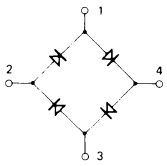

FSA2771M




FSA2772M




FSA2773M




FSA2774M

See test circuits on following page.

NOTES:

*Planar is a patented Fairchild process.

1. The maximum ratings are limiting values above which satisfactory performance may be impaired.
2. These values apply for a single 50 ms pulse.
3. These are steady state limits. The factory should be consulted in applications involving pulsed or low duty cycle operation.
4. Limits and typical electrical characteristics apply to single diode operation only. The diodes not under test are open circuited, except for $I_R$, $\Delta I_R$ and $\Delta V_F$. (Note 6)
5. These values apply for a single 8 ms pulse.
6. To measure reverse current of an individual diode, see test circuits, Note 8.
7. The capacitance is measured from pin to pin across any one of the diodes. The interaction of other diodes is therefore included in the measured value.
8. For product family characteristic curves and test circuits, refer to Section 5-D11.

# FSA2775M through FSA2786M

## AIR ISOLATED MONOLITHIC ARRAYS

DIFFUSED SILICON PLANAR* DIODES

- **BV . . . 60 V (MIN) @ 10 $\mu$A**
- **$t_{rr}$ . . . 6.0 ns (MAX) @ $I_f = I_r$ = 10 mA**

**See TO5-11 Package Outline (10-LEAD)**

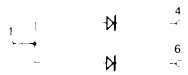
**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −55°C to +200°C |
| Operating Temperature | | 150°C |
| **Maximum Power Dissipation** (Note 2) | | |
| Total Dissipation | | 500 mW |
| **Maximum Voltage and Currents** (Note 3) | | |
| PIV | Peak Inverse Voltage | 55 V |
| $I_F$ | DC Forward Current | 350 mA |
| $I_f$ | Peak Forward Surge Current | |
| | Pulse Width = 1.0 s | 1.0 A |
| | Pulse Width = 1.0 $\mu$s | 4.0 A |

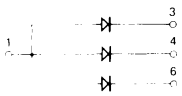
**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Note 4)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| BV | Breakdown Voltage | 60 | | V | $I_R$ = 10 $\mu$A |
| $V_F$ | Forward Voltage (Note 5) | | 1.5 | V | $I_F$ = 500 mA |
| | | | 1.1 | V | $I_F$ = 200 mA |
| | | | 1.0 | V | $I_F$ = 100 mA |
| $I_R$ | Reverse Current (Note 6) | | 100 | nA | $V_R$ = 40 V |
| | | | 100 | $\mu$A | $V_R$ = 40 V, $T_A$ = 150°C |
| C | Capacitance (Note 7) | | 3.0 | pF | $V_R$ = 0, f = 1.0 MHz |
| $V_{FM}$ | Peak Forward Voltage (Note 8) | | 4.0 | V | $I_f$ = 500 mA, $t_r$ < 10 ns |
| $t_{fr}$ | Forward Recovery Time (Note 8) | | 40 | ns | $I_f$ = 500 mA, $t_r$ < 10 ns |
| $t_{rr}$ | Reverse Recovery Time (Note 8) | | 10 | ns | $I_f = I_r$ = 10–200 mA<br>$R_L$ = 100 Ω, Rec. to $I_R$ |
| | | | 50 | ns | $I_f$ = 500 mA, $I_r$ = 50 mA<br>$R_L$ = 100 Ω, Rec. to 5.0 mA |
| $\Delta V_F$ | Forward Voltage Match (Fig. 3) | | 15 | mV | $I_F$ = 10 mA |

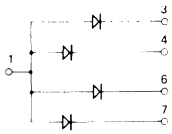
**CIRCUIT DIAGRAMS**



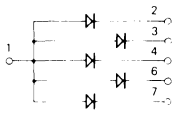
**FSA2775M**



**FSA2776M**



**FSA2777M**



**FSA2778M**

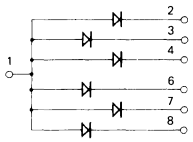
See additional circuit diagrams on following page.

NOTES:

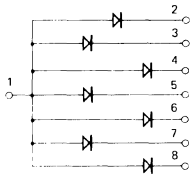
*Planar is a patented Fairchild process.

1. The maximum ratings are limiting values above which satisfactory performance may be impaired.
2. These values apply for a single 50 ms pulse.
3. These are steady state limits. The factory should be consulted in applications involving pulsed or low duty cycle operation.
4. Limits and typical electrical characteristics apply to single diode operation only. The diodes not under test are open circuited, except for $I_R$, $\Delta I_R$ and $\Delta V_F$. (Note 6)
5. These values apply for a single 8 ms pulse.
6. To measure reverse current of an individual diode, see test circuits, Note 8.
7. The capacitance is measured from pin to pin across any one of the diodes. The interaction of other diodes is therefore included in the measured value.
8. For product family characteristic curves and test circuits refer to Section 5-D11.

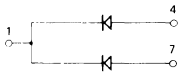
## CIRCUIT DIAGRAMS



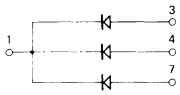

FSA2779M



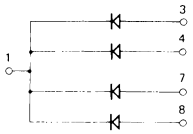

FSA2780M



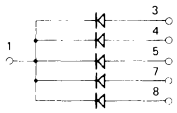

FSA2781M



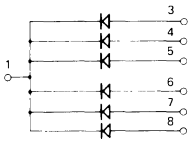

FSA2782M



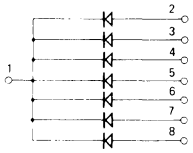

FSA2783M




FSA2784M




FSA2785M




FSA2786M

# FSA2787M • FSA2788M

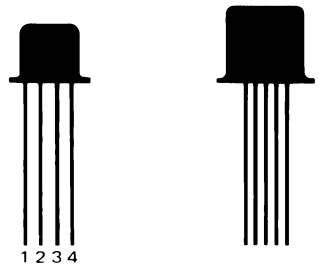
## AIR ISOLATED MONOLITHIC ARRAYS

DIFFUSED SILICON PLANAR* DIODES

- **BV . . . 60 V (MIN) @ 10 μA**
- **$t_{rr}$ . . . 6.0 ns (MAX) @ $I_f = I_r$ = 10 mA**

See Package Outlines

TO18-3 TO5-11 (10-LEAD)



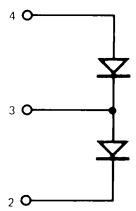

FSA2787M FSA2788M

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

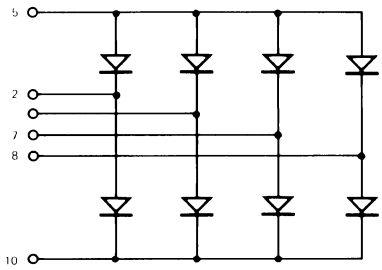
| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −55°C to +200°C |
| Operating Temperature | | 150°C |
| **Maximum Power Dissipation** (Note 2) | | |
| Total Dissipation | | 500 mW |
| **Maximum Voltage and Currents** (Note 3) | | |
| PIV | Peak Inverse Voltage | 55 V |
| $I_F$ | DC Forward Current | 350 mA |
| $I_f$ | Peak Forward Surge Current | |
| | Pulse Width = 1.0 s | 1.0 A |
| | Pulse Width = 1.0 μs | 4.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Note 4)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| BV | Breakdown Voltage | 60 | | V | $I_R$ = 10 μA |
| $V_F$ | Forward Voltage (Note 5) | | 1.0 | V | $I_F$ = 100 mA |
| | | | 1.1 | V | $I_F$ = 200 mA |
| | | | 1.5 | V | $I_F$ = 500 mA |
| $I_R$ | Reverse Current (Note 6) | | 100 | nA | $V_R$ = 50 V |
| | | | 200 | μA | $V_R$ = 50 V, $T_A$ = 150°C |
| C | Capacitance (Note 7) | | 7.0 | pF | $V_R$ = 0 V, f = 1.0 MHz |
| $V_{FM}$ | Peak Forward Voltage (Note 8) | | 4.0 | V | $I_f$ = 500 mA |
| $t_{fr}$ | Forward Recovery Time (Note 8) | | 40 | ns | $I_f$ = 500 mA |
| $t_{rr}$ | Reverse Recovery Time (Note 8) | | 10 | ns | $I_f = I_r$ = 10 mA to 200 mA, $R_L$ = 100 Ω, $I_{rr}$ = 0.1 $I_R$ |
| | | | 50 | ns | $I_f$ = 500 mA, $I_r$ = 50 mA, $R_L$ = 100 Ω, $I_{rr}$ = 5.0 mA |




FSA2787M




FSA2788M

See test circuits on following page.

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which satisfactory performance may be impaired.
2. These values apply for a single 50 ms pulse.
3. These are steady state limits. The factory should be consulted in applications involving pulsed or low duty cycle operation.
4. Limits and typical electrical characteristics apply to single diode operation only. The diodes not under test are open circuited, except for $I_R$, $\Delta I_R$ and $\Delta V_F$. (Note 6)
5. These values apply for a single 8 ms pulse.
6. To measure reverse current of an individual diode, see test circuits, Note 8.
7. The capacitance is measured from pin to pin across any one of the diodes. The interaction of other diodes is therefore included in the measured value.
8. For product family characteristic curves and test circuits refer to Section 5-D11.

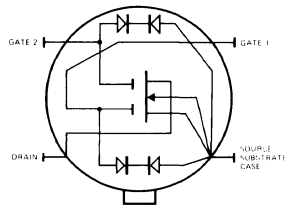
# FT0601 • SE5315

## GATE PROTECTED MOS CASCODE N-CHANNEL FIELD EFFECT RF AMPLIFIERS

DIFFUSED SILICON PLANAR* TRANSISTORS

- **$G_{ps}$ . . . 16 dB (MIN), 19 dB (TYP) @ 200 MHz (FT0601); 20 dB (MIN), 25 dB (TYP) @ 100 MHz (SE5315)**
- **NF . . . 4.0 dB (MAX), 2.5 dB (TYP) @ 200 MHz (FT0601); 4.0 dB (MAX), 2.0 dB (TYP) @ 100 MHz (SE5315)**
- **$C_{rs}$ . . . .05 pF (MAX), 0.025 pF (TYP)**
- **IMPROVED CROSS MODULATION REJECTION CAPABILITY**
- **WIDE DYNAMIC OPERATING RANGE**
- **AGC CAPABILITY TO 50 dB (TYP)**

**INTERNAL CONNECTIONS**
(BOTTOM)




**See TO18-3 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Junction Temperature | 175°C |

**Maximum Power Dissipation** (Note 2)

| | |
|---|---|
| Total Dissipation at 25°C Ambient Temperature | 0.33 W |
| Linear Derating Factor | 2.2 mW/°C |

**Maximum Voltages and Current**

| | | |
|---|---|---|
| $V_{DS}$ | Drain to Source Voltage | 25 V |
| $V_{G1S}$(dc) | Gate No. 1 Source Voltage | −6.0 V to +1.0 V |
| $V_{G1S}$(ac) | Gate No. 1 Source Voltage | −6.0 V to +6.0 V |
| $V_{G2S}$(dc and ac) | Gate No. 2 Source Voltage | −6.0 V to +6.0 V |
| $I_D$ | Drain Current | 50 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | SE5315 MIN. | SE5315 TYP. | SE5315 MAX. | FT0601 MIN. | FT0601 TYP. | FT0601 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $G_{ps}$ | Power Gain (unneutralized) (see test circuit no. 580) | 20 | 25 | | | | | dB | $V_{DD}$ = +15 V, $I_D \cong$ 10 mA $V_{G2S}$ = +4.0 V, f = 100 MHz |
| | (see test circuit no. 564) | | | | 16 | 19 | | dB | $V_{DD}$ = +15 V, $I_D \cong$ 8.0 mA $V_{G2S}$ = +4.0 V, f = 200 MHz |
| NF | Noise Figure (see test circuit no. 580) | | 2.0 | 4.0 | | | | | $V_{DD}$ = +15 V, $I_D \cong$ 10 mA $V_{G2S}$ = +4.0 V, f = 100 MHz |
| | (see test circuit no. 564) | | | | | 2.5 | 4.0 | dB | $V_{DS}$ = +15 V, $I_D \cong$ 8.0 mA $V_{G2S}$ = +4.0 V, f = 200 MHz |
| $C_{rss}$ | Small Signal Short Circuit Reverse Transfer Capacitance | | 0.025 | 0.05 | | 0.025 | 0.05 | pF | $V_{DS}$ = +15 V, $I_D$ = 10 mA $V_{G2S}$ = +4.0 V, f = 1.0 MHz |
| $I_{DSX}$ | Biased Drain Current | 5.0 | 15 | 30 | 5.0 | 15 | 30 | mA | $V_{DS}$ = +15 V, $V_{G2S}$ = 4.0 V, $V_{G1S}$ = 0 |
| $g_{fs}$ | Forward Transconductance | 7.0 | 11 | | 7.0 | 11 | | mmho | $V_{DS}$ = +15 V, $I_D$ = 10 mA $V_{G2S}$ = +4.0 V, f = 1.0 kHz |
| $V_{G1S(OFF)}$ | Gate no. 1 to Source Cutoff Voltage | | −1.5 | −4.0 | | −1.5 | −4.0 | V | $V_{DS}$ = +15 V, $I_D$ = 0.2 mA $V_{G2S}$ = +4.0 V |
| $V_{G2S(OFF)}$ | Gate no. 2 to Source Cutoff Voltage | | −1.5 | −4.0 | | −1.5 | −4.0 | V | $V_{DS}$ = +15 V, $I_D$ = 0.2 mA $V_{G1S}$ = 0 |
| $BV_{G1SS}$ | Gate no. 1 to Source Breakdown Voltage (Note 3) | ±6.0 | ±13 | ±25 | ±6.0 | ±13 | ±25 | V | $I_{G1S}$ = ±100 μA, $V_{DS}$ = 0, $V_{G2S}$ = 0 |
| $BV_{G2SS}$ | Gate no. 2 to Source Breakdown Voltage (Note 3) | ±6.0 | ±13 | ±25 | ±6.0 | ±13 | ±25 | V | $I_{G2S}$ = ±100 μA, $V_{DS}$ = 0, $V_{G1S}$ = 0 |
| $BV_{DSX}$ | Breakdown Voltage, Drain to Source, Substrate | 25 | | | 25 | | | V | $V_{G1S}$ = $V_{G2S}$ = −4.0 V, $I_D$ = 10 μA |
| $I_{G1SS}$ | Gate no. 1 to Source Leakage Current | | ±0.003 | ±20 | | ±0.003 | ±20 | nA | $V_{G1S}$ = +1.0 V or −6.0 V, $V_{DS}$ = 0, $V_{G2S}$ = 0 |
| $I_{G2SS}$ | Gate no. 2 Source Leakage Current | | ±0.003 | ±20 | | ±0.003 | ±20 | nA | $V_{G2S}$ = ±6.0 V, $V_{DS}$ = 0, $V_{G1S}$ = 0 |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. This is the breakdown voltage of the protection diodes. The diodes prevent voltage transients from exceeding this range.
4. For product family characteristic curves, refer to Section 5 - SS26.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | SE5315 MIN. | SE5315 TYP. | SE5315 MAX. | FT0601 MIN. | FT0601 TYP. | FT0601 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $C_{iss}$ | Small Signal Short Circuit Input Capacitance | | | | | 7.0 | 10 | pF | $V_{DS}$ = +15 V, $I_D$ = 10 mA<br>$V_{G2S}$ = +4.0 V, f = 1.0 MHz |
| $C_{oss}$ | Small Signal Short Circuit Output Capacitance | | | | | 2.6 | 3.5 | pF | $V_{DS}$ = +15 V, $I_D$ = 10 mA<br>$V_{G2S}$ = +4.0 V, f = 1.0 MHz |
| $y_{fs}$ | Magnitude of Forward Transfer Admittance | | | | | 13 | | mmho | $V_{DS}$ = +15 V, $I_D$ = 10 mA,<br>$V_{G2S}$ = +4.0 V, f = 200 MHz |
| $\Theta$ | Phase Angle of Forward Transfer Admittance | | | | | −40 | | degree | $V_{DS}$ = +15 V, $I_D$ = 10 mA,<br>$V_{G2S}$ = +4.0 V, f = 200 MHz |
| $R_{iss}$ | Input Resistance | | | | | 600 | | Ω | $V_{DS}$ = +15 V, $I_D$ = 10 mA<br>$V_{G2S}$ = +4.0 V, f = 200 MHz |
| $R_{oss}$ | Output Resistance | | | | | 4.5 | | kΩ | $V_{DS}$ = +15 V, $I_D$ = 10 mA<br>$V_{G2S}$ = +4.0 V, f = 200 MHz |

4

# MD918 • MD918A • MD918B

## DUAL NPN ULTRA HIGH FREQUENCY OSCILLATORS AND AMPLIFIERS

DIFFUSED SILICON PLANAR* TRANSISTORS

- $f_T$ . . . 600 MHz (MIN)
- $C_{ob}$ . . . 1.7 pF (MAX) @ 10 V
- ELECTRICALLY SIMILAR TO 2N918

See TO5-9 Package Outline

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**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | One Side | Both Sides |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | | −65°C to +200°C |
| Operating Junction Temperature | | | 200°C |
| **Maximum Power Dissipation** (Note 2) | | | |
| Total Dissipation at 25°C Ambient Temperature | | 300 mW | 400 mW |
| Linear Derating Factor | | 1.7 mW/°C | 2.3 mW/°C |
| **Maximum Voltages and Current** | | | |
| $V_{CEO}$ | Collector to Emitter Voltage | | 15 V |
| $V_{EBO}$ | Emitter to Base Voltage | | 5.0 V |
| $V_{CBO}$ | Collector to Base Voltage | | 30 V |
| $I_C$ | Collector Current | | 50 mA |

**MATCHING CHARACTERISTICS FOR EACH SIDE** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | | MIN | MAX | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| $\frac{h_{FE1}}{h_{FE2}}$ | DC Current Gain Ratio (Note 3) | MD918A | 0.9 | 1.0 | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V |
| | | MD918B | 0.8 | 1.0 | | |
| $\lvert V_{BE1}-V_{BE2}\rvert$ | Base Voltage Differential | MD918A | | 5.0 | mV | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V |
| | | MD918B | | 10 | | |
| $\frac{\Delta(V_{BE1}-V_{BE2})}{\Delta T_A}$ | Base Voltage Differential Change | MD918A | | 10 | μV/°C | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V, $T_A$ = −55°C to +125°C |
| | | MD918B | | 20 | | |

**ELECTRICAL CHARACTERISTICS FOR EACH SIDE** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | 15 | | V | $I_B$ = 0, $I_C$ = 3.0 mA |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 30 | | V | $I_C$ = 1.0 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 0.01 | μA | $V_{CB}$ = 15 V, $I_E$ = 0 |
| | | | 1.0 | μA | $V_{CB}$ = 15 V, $I_E$ = 0, $T_A$ = 150°C |
| $h_{FE}$ | DC Current Gain | 50 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | | 0.2 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage | | 0.9 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $f_T$ | Current Gain Bandwidth Product | 600 | | MHz | $I_C$ = 4.0 mA, $V_{CE}$ = 10 V, f = 100 MHz |
| $C_{ob}$ | Output Capacitance | | 1.7 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 140 kHz |
| | | | 3.0 | pF | $V_{CB}$ = 0, $I_E$ = 0, f = 140 kHz |
| $C_{ib}$ | Input Capacitance | | 2.0 | pF | $V_{EB}$ = 0.5 V, $I_C$ = 0, f = 140 kHz |
| NF | Noise Figure | | 6.0 | dB | $I_C$ = 1.0 mA, $V_{CE}$ = 6.0 V, f = 60 MHz, $R_S$ = 400 Ω |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. Lowest of two $h_{FE}$ ratings is taken as $h_{FE1}$ for purposes of this ratio.
4. For product family characteristic curves, refer to Section 5-SS27.

# MD2218 • MD2218A • MD2219 • MD2219A

## DUAL NPN SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS AND SWITCHES

DIFFUSED SILICON* PLANAR EPITAXIAL TRANSISTORS

- **ELECTRICALLY SIMILAR TO THE CORRESPONDING 2N NUMBER**

See TO5-9 Package Outline

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**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Operating and Storage Junction Temperature | −65°C to +200°C |

| **Maximum Power Dissipation** (Note 2) | **One Side** | **Both Sides** |
|---|---|---|
| Total Dissipation at 25°C Ambient Temperature | 500 mW | 600 mW |
| Linear Derating Factor | 2.9 mW/°C | 3.4 mW/°C |
| Total Dissipation at 25°C Case Temperature | 1.2 W | 2.0 W |
| Linear Dearting Factor | 6.83 mW/°C | 11.43 mW/°C |

| **Maximum Voltages and Current** | | **MD2218 MD2219** | **MD2218A MD2219A** |
|---|---|---|---|
| $V_{CEO}$ | Collector to Emitter Voltage | 30 V | 40 V |
| $V_{CBO}$ | Collector to Base Voltage | 60 V | 75 V |
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V | 6.0 V |
| $I_C$ | Collector Current | 600 mA | 600 mA |

**ELECTRICAL CHARACTERISTICS** (each side) (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MD2218 MD2219 MIN. | MD2218 MD2219 MAX. | MD2218A MD2219A MIN. | MD2218A MD2219A MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 2) | 30 | | 40 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 60 | | 75 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | 6.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $I_{CEX}$ | Collector Cutoff Current | | 20 | | 15 | nA | $V_{CE}$ = 50 V, $V_{EB}$ = 3.0 V |
| | | | 25 | | 25 | μA | $V_{CE}$ = 50 V, $V_{EB}$ = 3.0 V, $T_A$ = 150°C |
| $I_{BL}$ | Base Cutoff Current | | 30 | | 30 | nA | $V_{CE}$ = 50 V, $V_{EB}$ = 3.0 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 3) | | 0.4 | | 0.3 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | | | 1.2 | | 0.9 | V | $I_C$ = 300 mA, $I_B$ = 30 mA |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 3) | 0.6 | 1.3 | 0.6 | 1.2 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | | | 2.0 | | 1.8 | V | $I_C$ = 300 mA, $I_B$ = 30 mA |
| $f_T$ | Current Gain Bandwidth Product | 200 (MD2218) 250 (MD2219) | | 250 (MD2218A) 300 (MD2219A) | | | $I_C$ = 20 mA, $V_{CE}$ = 20 V, f = 100 MHz |
| $C_{ob}$ | Output Capacitance | | 8.0 | | 8.0 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 100 kHz |
| $C_{ib}$ | Input Capacitance | | 30 | | 25 | pF | $V_{BE}$ = 0.5 V, $I_C$ = 0, f = 100 kHz |
| $t_d$ | Delay Time | | 20 | | 15 | ns | $V_{CC}$ = 30 V, $V_{EB(off)}$ = 0.5 V, $I_C$ = 150 mA, $I_{B1}$ = 15 mA |
| $t_r$ | Rise Time | | 40 | | 30 | ns | $V_{CC}$ = 30 V, $V_{EB(off)}$ = 0.5 V, $I_C$ = 150 mA, $I_{B1}$ = 15 mA |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor may be impaired.
2. Pulse Conditions: length ≤ 300 μs; duty cycle = ≤ 2%.
3. For product family characteristic curves, refer to Section 5 - SS15.

**ELECTRICAL CHARACTERISTICS** (each side) (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | MD2218 MD2219 MIN. | MD2218 MD2219 MAX. | MD2218A MD2219A MIN. | MD2218A MD2219A MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $t_s$ | Storage Time | | 280 | | 250 | ns | $V_{CC}$ = 30 V, $I_C$ = 150 mA, $I_{B1}$ = $I_{B2}$ = 15 mA |
| $t_f$ | Fall Time | | 70 | | 60 | ns | $V_{CC}$ = 30 V, $I_C$ = 150 mA $I_{B1}$ = $I_{B2}$ = 15 mA |

| SYMBOL | CHARACTERISTIC | MD2218 MD2218A MIN. | MD2218 MD2218A MAX. | MD2219 MD2219A MIN. | MD2219 MD2219A MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain (Note 3) | 20 | | 35 | | | $I_C$ = 0.1 mA, $V_{CE}$ = 10 V |
| | | 25 | | 50 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V |
| | | 35 | | 75 | | | $I_C$ = 10 mA, $V_{CE}$ = 10 V |
| | | 40 | 120 | 100 | 300 | | $I_C$ = 150 mA, $V_{CE}$ = 10 V |
| | | 20 | | 50 | | | $I_C$ = 150 mA, $V_{CE}$ = 1.0 V |
| | | 20 (MD2218) | | 30 (MD2219) | | | $I_C$ = 300 mA, $V_{CE}$ = 10 V |
| | | 25 (MD2218A) | | 40 (MD2219A) | | | $I_C$ = 300 mA, $V_{CE}$ = 10 V |

# MD2369 • MD2369A • MD2369B

## DUAL NPN HIGH FREQUENCY SATURATED SWITCHING TYPE

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $t_{on}$ . . . 15 ns (MAX) @ 10 mA
- $t_{off}$ . . . 20 ns (MAX) @ 10 mA
- ELECTRICALLY SIMILAR TO 2N2369A

See TO5-9 Package Outline

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**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Junction Temperature | | 200°C |
| **Maximum Power Dissipation** | **One Side** | **Both Sides** |
| Total Dissipation at 25°C Ambient Temperature | 500 mW | 600 mW |
| Linear Derating Factor | 1.5 mW/°C | 2.0 mW/°C |
| **Maximum Voltages and Currents** | | |
| $V_{CEO}$ Collector to Emitter Voltage | | 15 V |
| $V_{CBO}$ Collector to Base Voltage | | 40 V |
| $V_{EBO}$ Emitter to Base Voltage | | 5.0 V |
| $I_C$ Collector Current Pulse Width = 10 μs | | 500 mA |

**MATCHING CHARACTERISTICS FOR EACH SIDE** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| $h_{FE1}/h_{FE2}$ | DC Current Gain Ratio (Note 3) | MD2369A | 0.9 | 1.0 | | $I_C$ = 3.0 mA, $V_{CE}$ = 1.0 V |
| | | MD2369B | 0.8 | 1.0 | | |
| $\lvert V_{BE1}-V_{BE2}\rvert$ | Base Voltage Differential | MD2369A | | 5.0 | mV | $I_C$ = 3.0 mA, $V_{CE}$ = 1.0 V |
| | | MD2369B | | 10 | | |
| $\Delta(V_{BE1}-V_{BE2})/\Delta T_A$ | Base Voltage Differential Gradient | MD2369A | | 10 | μV/°C | $I_C$ = 3.0 mA, $V_{CE}$ = 1.0 V, $T_A$ = −55°C to +125°C |
| | | MD2369B | | 20 | | |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 4) | 15 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 40 | | V | $I_C$ = 10 mA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 30 | nA | $V_{CB}$ = 20 V, $I_E$ = 0 |
| | | | 30 | μA | $V_{CB}$ = 20 V, $I_E$ = 0, $T_A$ = 150°C |
| $h_{FE}$ | DC Current Gain (Note 4) | 40 | 140 | | $I_C$ = 10 mA, $V_{CE}$ = 1.0 V |
| | | 20 | | | $I_C$ = 10 mA, $V_{CE}$ = 1.0 V, $T_A$ = −55°C |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | | 0.25 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage | 0.7 | 0.85 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $f_T$ | Current Gain Bandwidth Product | 500 | | MHz | $I_C$ = 10 mA, $V_{CE}$ = 10 V, f = 100 MHz |
| $C_{ob}$ | Output Capacitance | | 4.0 | pF | $V_{CB}$ = 5.0 V, $I_E$ = 0, f = 140 kHz |
| $C_{ib}$ | Input Capacitance | | 4.0 | pF | $V_{BE}$ = 1.0 V, $I_C$ = 0, f = 140 MHz |
| $\tau_s$ | Charge Storage Time Constant | | 13 | ns | $I_C$ = 10 mA, $I_{B1}$ = $I_{B2}$ = 2.5 mA |
| $t_{on}$ | Turn On Time | | 15 | ns | $I_C$ = 10 mA, $I_{B1}$ = 3.0 mA, $V_{BB}$ = −1.5 V, $V_{IN}$ = +12.1 V |
| $t_{off}$ | Turn Off Time | | 20 | ns | $I_C$ = 10 mA, $I_{B1}$ = $I_{B2}$ = 3.0 mA, $V_{BB}$ = −9.15 V, $V_{IN}$ = +19.9 V |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. Lowest of two $h_{FE}$ ratings is taken as $h_{FE1}$ for purposes of this ratio.
4. Pulse conditions: length = 300 μs; duty cycle = 2%.
5. For product family characteristic curves, refer to Section 5 - SS28

# MD2904 • MD2904A • MD2905 • MD2905A

## DUAL PNP HIGH SPEED SWITCHES AND CORE DRIVERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$BV_{CBO}$ . . . 60 V (MIN)**
- **ELECTRICALLY SIMILAR TO THE CORRESPONDING 2N NUMBER**
- **COMPLEMENTS . . . MD2218, MD2218A, MD2219, MD2219A**

**See TO5-9 Package Outline**

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**ABSOLUTE MAXIMUM RATINGS** (Each Side) (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Junction Temperature | | 200°C |
| **Maximum Power Dissipation** | **One Side** | **Both Sides** |
| Total Dissipation at 25°C Ambient Temperature | 500 mW | 600 mW |
| Linear Derating Factor | 2.9 mW/°C | 3.4 mW/°C |
| at 25°C Case Temperature | 1.2 W | 2.0 W |
| Linear Derating Factor | 6.83 mW/°C | 11.43 mW/°C |
| **Maximum Voltages and Current** | **MD2904 MD2905** | **MD2904A MD2905A** |
| $V_{CEO}$ Collector to Emitter Voltage | −40 V | −60 V |
| $V_{CBO}$ Collector to Base Voltage | −60 V | −60 V |
| $V_{EBO}$ Emitter to Base Voltage | −5.0 V | −5.0 V |
| $I_C$ Collector Current | 600 mA | 600 mA |

**ELECTRICAL CHARACTERISTICS FOR EACH SIDE** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MD2904 MIN. | MD2904 MAX. | MD2904A MIN. | MD2904A MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 2) | −40 | | −60 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −60 | | −60 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −5.0 | | −5.0 | | V | $I_B$ = 10 μA, $I_C$ = 0 |
| $I_{CEX}$ | Collector Cutoff Current | | 20 | | 20 | nA | $V_{CE}$ = −50 V, $V_{EB}$ = −3.0 V |
| | | | 30 | | 30 | μA | $V_{CE}$ = −50 V, $V_{EB}$ = −3.0 V, $T_A$ = 150°C |
| $I_{BL}$ | Base Cutoff Current | | 30 | | 30 | nA | $V_{CE}$ = −50 V, $V_{EB}$ = 3.0 V |
| $h_{FE}$ | DC Current Gain (Note 2) | 20 | | 40 | | | $I_C$ = 0.1 mA, $V_{CE}$ = −10 V |
| | | 25 | | 40 | | | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V |
| | | 35 | | 40 | | | $I_C$ = 10 mA, $V_{CE}$ = −10 V |
| | | 40 | 120 | 40 | 120 | | $I_C$ = 150 mA, $V_{CE}$ = −10 V |
| | | 20 | | 40 | | | $I_C$ = 500 mA, $V_{CE}$ = −10 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | | −0.4 | | −0.4 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | | | −1.6 | | −1.6 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| $V_{BE(sat)}$ | Base Emitter Saturation | | −1.3 | | −1.3 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | | | −2.6 | | −2.6 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| $f_T$ | Current Gain Bandwidth Product | 200 | | 200 | | MHz | $I_C$ = 50 mA, $V_{CE}$ = −20 V, f = 100 MHz |
| $C_{ob}$ | Output Capacitance | | 8.0 | | 8.0 | pF | $V_{CB}$ = −10 V, $I_E$ = 0, f = 100 kHz |
| $C_{ib}$ | Input Capacitance | | 30 | | 30 | pF | $V_{EB}$ = −2.0 V, $I_C$ = 0, f = 100 kHz |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. Pulse conditions: length ≤ 300 μs; duty cycle ≤ 2%.
3. For product family characteristic curves, refer to Section 5 - SS22.

**ELECTRICAL CHARACTERISTICS FOR EACH SIDE** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | MD2904 MIN. | MD2904 MAX. | MD2904A MIN. | MD2904A MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $t_{on}$ | Turn On Time (see test circuit no. 558) | | 45 | | 45 | ns | $V_{CC}$ = −30 V, $V_{BE(OFF)}$ = −0.5 V, $V_{DD}$ = 0, $V_{BB}$ = +27.9 V, $I_C$ = 150 mA, $I_{B1}$ = 15 mA |
| $t_d$ | Delay Time (see test circuit no. 558) | | 12 | | 12 | ns | $V_{CC}$ = −30 V, $V_{BE(OFF)}$ = −0.5 V, $V_{DD}$ = 0, $V_{BB}$ = 27.9 V, $I_C$ = 150 mA, $I_{B1}$ = 15 mA |
| $t_r$ | Rise Time (see test circuit no. 558) | | 35 | | 35 | ns | $V_{CC}$ = −30 V, $V_{BE(OFF)}$ = −0.5 V, $V_{DD}$ = 0, $V_{BB}$ = 27.9 V, $I_C$ = 150 mA, $I_{B1}$ = 15 mA |
| $t_{off}$ | Turn Off Time (see test circuit no. 558) | | 130 | | 130 | ns | $V_{CC}$ = −30 V, $I_C$ = 150 mA, $V_{DD}$ = 0, $V_{BB}$ = 27.9 V, $I_{B1}$ = $I_{B2}$ = 15 mA |
| $t_s$ | Storage Time (see test circuit no. 558) | | 100 | | 100 | ns | $V_{CC}$ = −30 V, $I_C$ = 150 mA, $V_{DD}$ = 0 $V_{BB}$ = 27.9 V, $I_{B1}$ = $I_{B2}$ = 15 mA |
| $t_f$ | Fall Time (see test circuit no. 558) | | 40 | | 40 | ns | $V_{CC}$ = −30 V, $I_C$ = 150 mA, $V_{DD}$ = 0, $V_{BB}$ = 27.9 V, $I_{B1}$ = $I_{B2}$ = 15 mA |

| SYMBOL | CHARACTERISTIC | MD2905 MIN. | MD2905 MAX. | MD2905A MIN. | MD2905A MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 2) | −40 | | −60 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −60 | | −60 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −5.0 | | −5.0 | | V | $I_B$ = 10 μA, $I_C$ = 0 |
| $I_{CEX}$ | Collector Cutoff Current | | 20 | | 20 | nA | $V_{CE}$ = −50 V, $V_{EB}$ = −3.0 V |
| | | | 30 | | 30 | μA | $V_{CE}$ = −50 V, $V_{EB}$ = −3.0 V, $T_A$ = 150°C |
| $I_{BL}$ | Base Cutoff Current | | 30 | | 30 | nA | $V_{CE}$ = −50 V, $V_{EB}$ = 3.0 V |
| $h_{FE}$ | DC Current Gain (Note 2) | 35 | | 75 | | | $I_C$ = 0.1 mA, $V_{CE}$ = −10 V |
| | | 50 | | 100 | | | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V |
| | | 75 | | 100 | | | $I_C$ = 10 mA, $V_{CE}$ = −10 V |
| | | 100 | 300 | 100 | 300 | | $I_C$ = 150 mA, $V_{CE}$ = −10 V |
| | | 30 | | 50 | | | $I_C$ = 500 mA, $V_{CE}$ = −10 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 2) | | −0.4 | | −0.4 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | | | −1.6 | | −1.6 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| $V_{BE(sat)}$ | Base Emitter Saturation Voltage (Note 2) | | −1.3 | | −1.3 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | | | −2.6 | | −2.6 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| $f_T$ | Current Gain Bandwidth Product | 200 | | 200 | | MHz | $I_C$ = 50 mA, $V_{CE}$ = −20 V, f = 100 MHz |
| $C_{ob}$ | Output Capacitance | | 8.0 | | 8.0 | pF | $V_{CB}$ = −10 V, $I_E$ = 0, f = 100 kHz |
| $C_{ib}$ | Input Capacitance | | 30 | | 30 | pF | $V_{EB}$ = −2.0 V, $I_C$ = 0, f = 100 kHz |
| $t_{on}$ | Turn On Time (see test circuit no. 558) | | 45 | | 45 | ns | $V_{CC}$ = −30 V, $V_{BE(OFF)}$ = −0.5 V, $V_{DD}$ = 0, $V_{BB}$ = +27.9 V, $I_C$ = 150 mA, $I_{B1}$ = 15 mA |
| $t_d$ | Delay Time (see test circuit no. 558) | | 12 | | 12 | ns | $V_{CC}$ = −30 V, $V_{BE(OFF)}$ = −0.5 V, $V_{DD}$ = 0, $V_{BB}$ = +27.9 V, $I_C$ = 150 mA, $I_{B1}$ = 15 mA |
| $t_r$ | Rise Time (see test circuit no. 558) | | 35 | | 35 | ns | $V_{CC}$ = −30 V, $V_{BE(OFF)}$ = −0.5 V, $V_{DD}$ = 0, $V_{BB}$ = +27.9 V, $I_C$ = 150 mA, $I_{B1}$ = 15 mA |
| $t_{off}$ | Turn Off Time (see test circuit no. 558) | | 130 | | 130 | ns | $V_{CC}$ = −30 V, $I_C$ = 150 mA, $V_{DD}$ = 0, $V_{BB}$ = +27.9 V, $I_{B1}$ = $I_{B2}$ = 15 mA |
| $t_s$ | Storage Time (see test circuit no. 558) | | 100 | | 100 | ns | $V_{CC}$ = −30 V, $I_C$ = 150 mA, $V_{DD}$ = 0, $V_{BB}$ = +27.9 V, $I_{B1}$ = $I_{B2}$ = 15 mA |
| $t_f$ | Fall Time (see test circuit no. 558) | | 40 | | 40 | ns | $V_{CC}$ = −30 V, $I_C$ = 150 mA, $V_{DD}$ = 0, $V_{BB}$ = +27.9 V, $I_{B1}$ = $I_{B2}$ = 15 mA |

4

# MD3250 • MD3250A • MD3251 • MD3251A

## DUAL PNP SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS AND SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $V_{CEO}$ . . . −40 V (MIN)
- ELECTRICALLY SIMILAR TO 2N3250

See TO5-9 Package Outline

CBEEBC
123456

**ABSOLUTE MAXIMUM RATINGS** (Each Side) (Note 1)

| | One Side | Both Sides |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Junction Temperature | | 200°C |
| **Maximum Power Dissipation** | | |
| Total Dissipation at 25°C Ambient Temperature | 500 mW | 600 mW |
| Linear Derating Factor | 2.9 mW/°C | 3.4 mW/°C |
| Total Dissipation at 25°C Case Temperature | 1.2 W | 2.0 W |
| Linear Derating Factor | 6.85 mW/°C | 11.42 mW/°C |
| **Maximum Voltages and Current** | | |
| $V_{CBO}$ Collector to Base Voltage | | −50 V |
| $V_{CEO}$ Collector to Emitter Voltage | | −40 V |
| $V_{EBO}$ Emitter to Base Voltage | | −5.0 V |
| $I_C$ DC Collector Current | | 50 mA |

**MATCHING CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MD3250A, MD3251A MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $\frac{h_{FE1}}{h_{FE2}}$ | DC Current Gain Ratio (Note 2) | 0.9 | 1.0 | | $I_C$ = 100 μA to 1.0 mA, $V_{CE}$ = −5.0 V |
| $\lvert V_{BE1}-V_{BE2}\rvert$ | Base Voltage Differential | | 5.0 | mV | $I_C$ = 10 μA to 10 mA, $V_{CE}$ = −5.0 V |
| | | | 3.0 | mV | $I_C$ = 100 μA, $V_{CE}$ = −5.0 V |
| $\frac{\Delta(V_{BE1}-V_{BE2})}{\Delta T_A}$ | Base Voltage Differential Change | | 10 | mV/°C | $I_C$ = 100 μA, $V_{CE}$ = −5.0 V, $T_A$ = −55°C to +25°C |
| | | | 10 | mV/°C | $I_C$ = 100 μA, $V_{CE}$ = −5.0 V, $T_A$ = +25°C to +125°C |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MD3250 MD3250A MIN. | MAX. | MD3251 MD3251A MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −50 | | −50 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 3) | −40 | | −40 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −5.0 | | −5.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 10 | | 10 | nA | $V_{CB}$ = −50 V, $I_E$ = 0 |
| | | | 10 | | 10 | μA | $V_{CB}$ = −50 V, $I_E$ = 0, $T_A$ = 150°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 20 | | 20 | nA | $V_{EB}$ = −3.0 V, $I_C$ = 0 |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor may be impaired.
2. Lowest of two $h_{FE}$ ratings is taken as $h_{FE1}$ for purposes of this ratio.
3. Pulse conditions: length ≤ 300 μs; duty cycle ≤ 2%.
4. For product family characteristic curves, refer to Section 5-SS23.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | MD3250 MD3250A MIN. | MD3250 MD3250A MAX. | MD3251 MD3251A MIN. | MD3251 MD3251A MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Forward Current | 25 | | 50 | | | $I_C$ = 10 μA, $V_{CE}$ = −5.0 V |
| | Transfer Ratio (Note 3) | 50 | 150 | 100 | 300 | | $I_C$ = 100 μA, $V_{CE}$ = −5.0 V |
| | | 25 | | 50 | | | $I_C$ = 100 μA, $V_{CE}$ = −5.0 V, $T_A$ = −55°C |
| | | 50 | 150 | 100 | 300 | | $I_C$ = 1.0 mA, $V_{CE}$ = −5.0 V |
| | | 50 | | 100 | | | $I_C$ = 10 mA, $V_{CE}$ = −5.0 V |
| | | 15 | | 30 | | | $I_C$ = 50 mA, $V_{CE}$ = −5.0 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation | | −0.25 | | −0.25 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | Voltage (Note 3) | | −0.50 | | −0.50 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $V_{BE(sat)}$ | Base to Emitter Saturation | −0.6 | −0.9 | −0.6 | −0.9 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | Voltage (Note 3) | | −1.2 | | −1.2 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $f_T$ | Current Gain Bandwidth Product | 200 | | 250 | | MHz | $I_C$ = 10 mA, $V_{CE}$ = −20 V, f = 100 MHz |
| $C_{ob}$ | Output Capacitance | | 6.0 | | 6.0 | pF | $V_{CB}$ = −5.0 V, $I_E$ = 0, f = 100 kHz |
| $C_{ib}$ | Input Capacitance | | 8.0 | | 8.0 | pF | $V_{EB}$ = −0.5 V, $I_C$ = 0, f = 100 kHz |
| $h_{fe}$ | Small Signal Current Gain | 50 | 200 | 100 | 400 | | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V, f = 1.0 kHz |
| $h_{re}$ | Voltage Feedback Ratio | | 10 | | 20 | $\times 10^{-4}$ | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V, f = 1.0 kHz |
| $h_{ie}$ | Input Impedance | 1.0 | 6.0 | 2.0 | 12 | kΩ | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V, f = 1.0 kHz |
| $h_{oe}$ | Output Admittance | 4.0 | 40 | 10 | 60 | μmhos | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V, f = 1.0 kHz |
| NF | Wide Band Noise Figure | | 4.0 | | 3.0 | dB | $I_C$ = 100 μA, $V_{CE}$ = −10 V, $R_G$ = 3.0 kΩ, BW = 10 Hz to 15.7 kHz |

4

# MPF102 • MPF108 • MPF109

## N-CHANNEL JUNCTION FIELD EFFECT

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **VHF AMPLIFIER . . . MPF102, MPF108**
- **DRAIN AND SOURCE INTERCHANGEABLE**
- **$C_{rss}$ . . . 3.0 pF (MAX) @ 15 V (MPF102, MPF109)**

**See TO92-1 Package Outline**

D S G
1 2 3

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −55°C to +150°C |
| Operating Junction Temperature | | 150°C |
| Lead Temperature (10 seconds) | | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Case Temperature | | 1.0 W |
| at 25°C Ambient Temperature | | 0.625 W |
| **Maximum Voltages and Currents** | | |
| $V_{DS}$ | Drain to Source Voltage | 25 V |
| $V_{DG}$ | Drain to Gate Voltage | 25 V |
| $V_{GS}$ | Gate to Source Voltage | −25 V |
| $I_G$ | Gate Current | 10 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MPF102 MIN. | MPF102 MAX. | MPF108 MIN. | MPF108 MAX. | MPF109 MIN. | MPF109 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $BV_{GSS}$ | Gate to Source Breakdown Voltage | −25 | | −25 | | −25 | | V | $I_G = 10\,\mu A$, $V_{DS} = 0$ |
| $I_{GSS}$ | Gate Reverse Current | | 2.0 | | | | | nA | $V_{GS} = -15$ V, $V_{DS} = 0$ |
| | | | 2.0 | | | | | μA | $V_{GS} = -15$ V, $V_{DS} = 0$, $T_A = 100°C$ |
| | | | | | 1.0 | | −1.0 | nA | $V_{GS} = -15$ V, $V_{DS} = 0$ |
| | | | | | −1.0 | | | μA | $V_{GS} = -15$ V, $V_{DS} = 0$, $T_A = 100°C$ |
| $V_{GS(OFF)}$ | Gate to Source Cutoff Voltage | | 8.0 | | | | | V | $V_{DS} = 15$ V, $I_D = 2.0$ nA |
| | | | | 0.5 | 8.0 | 0.2 | 8.0 | V | $V_{DS} = 15$ V, $I_D = 10\,\mu A$ |
| $V_{GS}$ | Gate Source Voltage | 0.5 | 7.5 | | | | | V | $V_{DS} = 15$ V, $I_D = 0.2$ mA |
| $I_{DSS}$ | Zero Gate Voltage Drain Current (Note 4) | 2.0 | 20 | 1.5 | 24 | 0.5 | 24 | mA | $V_{DS} = 15$ V, $V_{GS} = 0$ |
| $y_{fs}$ | Forward Transfer Admittance (Note 4) | 2.0 | 7.5 | 2.0 | 7.5 | 0.8 | 6.0 | mmhos | $V_{DS} = 15$ V, $V_{GS} = 0$, f = 1.0 kHz |
| | | 1.6 | | 1.6 | | | | mmhos | $V_{DS} = 15$ V, $V_{GS} = 0$, f = 100 MHz |
| $C_{iss}$ | Input Capacitance | | 7.0 | | 6.5 | | 7.0 | pF | $V_{DS} = 15$ V, $V_{GS} = 0$, f = 1.0 MHz |
| $C_{rss}$ | Reverse Transfer Capacitance | | 3.0 | | 2.5 | | 3.0 | pF | $V_{DS} = 15$ V, $V_{GS} = 0$, f = 1.0 MHz |
| Re $y_{is}$ | Input Conductance | | 0.8 | | 0.8 | | | mmhos | $V_{DS} = 15$ V, $V_{GS} = 0$, f = 100 MHz |
| Re $y_{os}$ | Output Conductance | | 0.2 | | 0.2 | | | mmhos | $V_{DS} = 15$ V, $V_{GS} = 0$, f = 100 MHz |
| $y_{os}$ | Output Admittance | | | | 75 | | 75 | μmhos | $V_{DS} = 15$ V, $V_{GS} = 0$, f = 1.0 kHz |
| NF | Noise Figure | | | | 2.5 | | 2.5 | dB | $V_{DS} = 15$ V, $V_{GS} = 0$, $R_G = 1\,M\Omega$, f = 1.0 kHz |
| | | | | | 3.0 | | | dB | $V_{DS} = 15$ V, $V_{GS} = 0$, $R_G = 1.0\,k\Omega$, f = 100 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Pulse conditions: length ≤ 630 ms; duty cycle ≤ 10%.

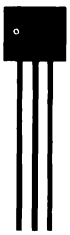
# MPF111 • MPF112

## N-CHANNEL JUNCTION FIELD EFFECT

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$C_{rss}$ . . . 1.5 pF (TYP) @ 10 V**
- **DRAIN AND SOURCE INTERCHANGEABLE**
- **$C_{iss}$ . . . 4.5 pF (TYP) @ 10 V**

See TO92-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +150°C |
| Operating Junction Temperature | 150°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 1.0 W |
| at 25°C Ambient Temperature | 0.625 W |

**Maximum Voltages and Current**

| | | MPF111 | MPF112 |
|---|---|---|---|
| $V_{DS}$ | Drain to Source Voltage | 20 V | 25 V |
| $V_{DE}$ | Drain to Gate Voltage | 20 V | 25 V |
| $V_{ES}$ | Gate to Source Voltage | −20 V | −25 V |
| $I_E$ | Gate Current | 10 mA | 10 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MPF111 MIN. | MPF111 MAX. | MPF112 MIN. | MPF112 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{GSS}$ | Gate to Source Breakdown Voltage | −20 | | −25 | | V | $I_G = -10\ \mu A$, $V_{DS} = 0$ |
| $I_{GSS}$ | Gate Reverse Current | | 100 | | 100 | nA | $V_{GS} = -10$ V, $V_{DS} = 0$ |
| $V_{GS(OFF)}$ | Gate to Source Cutoff Voltage | −0.5 | −10 | −0.5 | −10 | V | $V_{DS} = 10$ V, $I_D = 1.0\ \mu A$ |
| $I_{DSS}$ | Zero Gate Voltage Drain Current (Note 4) | 0.5 | 20 | 1.0 | 25 | mA | $V_{DS} = 10$ V, $V_{GS} = 0$ |
| $y_{fs}$ | Forward Transfer Admittance (Note 4) | 0.5 | | 1.0 | 7.5 | mmhos | $V_{DS} = 10$ V, $V_{GS} = 0$, f = 1.0 kHz |
| | | | | 0.8 | | mmhos | $V_{DS} = 10$ V, $V_{GS} = 0$, f = 100 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Pulse conditions: length ≤ 630 ms; duty cycle ≤ 10%.

# MPS2711 • MPS2712

## NPN LOW POWER SMALL SIGNAL

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C**
- **$V_{CEO}$ . . . 18 V (MIN)**
- **$h_{FE}$ . . . 75-225 @ 2.0 mA (MPS2712)**
- **$C_{ob}$ . . . 4.0 pF (MAX)**
- **COMPLEMENTS . . . 2N4125, 2N4126**

**See TO92-1 Package Outline**


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| **Maximum Temperatures** | |
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | |
| Total Dissipation at 25°C Case Temperature | 1.0 W |
| at 25°C Ambient Temperature | 0.625 W |
| at 70°C Ambient Temperature | 0.400 W |
| **Maximum Voltages and Current** | |
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | 18 V |
| $V_{CBO}$ Collector to Base Voltage | 18 V |
| $V_{EBO}$ Emitter to Base Voltage | 5.0 V |
| $I_C$ Collector Current | 100 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MPS2711 MIN. | MPS2711 MAX. | MPS2712 MIN. | MPS2712 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain (Note 5) | 30 | 90 | 75 | 225 | | $V_{CE}$ = 4.5 V, $I_C$ = 2.0 mA |
| $I_{CBO}$ | Collector Cutoff Current | | 500 | | 500 | nA | $V_{CB}$ = 18 V, $I_E$ = 0, |
| | | | 1.5 | | 1.5 | μA | $V_{CB}$ = 18 V, $I_E$ = 0, $T_A$ = 100°C |
| $I_{EBO}$ | Emitter to Base Cutoff Current | | 500 | | 500 | nA | $V_{EB}$ = 5.0 V, $I_C$ = 0 |
| $C_{ob}$ | Output Capacitance | | 4.0 | | 4.0 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 1.0 MHz |
| $h_{fe}$ | Small Signal Current Gain | 30 | 120 | 80 | 200 | | $V_{CE}$ = 10 V, $I_C$ = 2.0 mA, f = 1.0 kHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semicondutor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 — SS14.

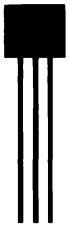
# MPS2923 • MPS2924 • MPS2925

## NPN SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C**
- **$V_{CEO}$ . . . 25 V (MIN)**
- **$h_{fe}$ . . . 235-470 @ 2.0 mA (MPS2925)**
- **COMPLEMENTS . . . 2N4125, 2N4126**

**See TO92-1 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |
| Lead Temperature (10 seconds) | 260°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 1.0 W |
| at 25°C Ambient Temperature | 0.625 W |
| at 70°C Ambient Temperature | 0.400 W |

**Maximum Voltages and Currents**

| | | |
|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 25 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 25 V |
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V |
| $I_C$ | Collector Current | 100 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MPS2923 MIN. | MPS2923 MAX. | MPS2924 MIN. | MPS2924 MAX. | MPS2925 MIN. | MPS2925 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $I_{CBO}$ | Collector Cutoff Current | | 500 | | 500 | | 500 | nA | $V_{CB}$ = 25 V, $I_E$ = 0 |
| | | | 15 | | 15 | | 15 | μA | $V_{CB}$ = 25 V, $I_E$ = 0, $T_A$ = 100°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 500 | | 500 | | 500 | nA | $V_{EB}$ = 5.0 V, $I_C$ = 0 |
| $h_{fe}$ | Small Signal Current | 90 | 180 | 150 | 300 | 235 | 470 | | $V_{CE}$ = 10 V, $I_C$ = 2.0 mA, f = 1.0 kHz |
| $C_{ob}$ | Output Capacitance | | 12 | | 12 | | 12 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 1.0 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.

4

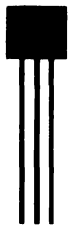
# MPS2926 • MPS3721

## NPN SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- $V_{CEO}$ . . . 18 V (MIN)
- $h_{fe}$ . . . 35-470 @ 2.0 mA MPS2926
- . . . 60-660 @ 2.0 mA MPS3721
- COMPLEMENTS . . . 2N4125

See TO92-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| **Maximum Temperatures** | |
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | |
| Total Dissipation at 25°C Ambient Temperature | 0.625 W |
| at 70°C Ambient Temperature | 0.400 W |
| at 25°C Case Temperature | 1.0 W |
| **Maximum Voltages and Current** | |
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | 18 V |
| $V_{CBO}$ Collector to Base Voltage | 18 V |
| $V_{EBO}$ Emitter to Base Voltage | 5.0 V |
| $I_C$ Collector Current | 100 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MPS2926 MIN. | MPS2926 MAX. | MPS3721 MIN. | MPS3721 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $I_{CBO}$ | Collector Cutoff Current | | 0.5 | | 0.5 | μA | $V_{CB}$ = 18 V, $I_E$ = 0 |
| | | | 15 | | 15 | μA | $V_{CB}$ = 18 V, $I_E$ = 0, $T_A$ = 100°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 0.5 | | 0.5 | μA | $V_{EB}$ = 5.0 V, $I_C$ = 0 |
| $C_{ob}$ | Output Capacitance | | 3.5 | | 3.5 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 1.0 MHz |
| $h_{fe}$ | Small Signal Current Gain | 35 | 470 | 60 | 660 | | $V_{CE}$ = 10 V, $I_C$ = 2.0 mA, f = 1.0 kHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.

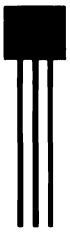
# MPS3392 through MPS3395

## NPN SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- $V_{CEO}$ . . . 25 V (MIN)
- $h_{FE}$ . . . 150-300 (MPS3392), 90-180 (MPS3393) @ 2.0 mA
  . . . 55-110 (MPS3394), 150-500 (MPS3395) @ 2.0 mA
- COMPLEMENTS . . . 2N4125, 2N4126

See TO92-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| **Maximum Temperatures** | |
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | |
| Total Dissipation at 25°C Ambient Temperature | 0.625 W |
| at 70°C Ambient Temperature | 0.400 W |
| at 25°C Case Temperature | 1.0 W |
| **Maximum Voltages and Current** | |
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | 25 V |
| $V_{CBO}$ Collector to Base Voltage | 25 V |
| $V_{EBO}$ Emitter to Base Voltage | 5.0 V |
| $I_C$ Collector Current | 100 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MPS3392 MIN. | MPS3392 MAX. | MPS3393 MIN. | MPS3393 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage Voltage | 25 | | 25 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 100 | | 100 | nA | $V_{CB}$ = 18 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 100 | | 100 | nA | $V_{EB}$ = 5.0 V, $I_C$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 5) | 150 | 300 | 90 | 180 | | $V_{CE}$ = 4.5 V, $I_C$ = 2.0 mA |
| $C_{ob}$ | Output Capacitance | | 3.5 | | 3.5 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 1.0 MHz |
| $h_{fe}$ | Small Signal Current Gain | 150 | 500 | 90 | 400 | | $V_{CE}$ = 4.5 V, $I_C$ = 2.0 mA, f = 1.0 kHz |

| SYMBOL | CHARACTERISTIC | MPS3394 MIN. | MPS3394 MAX. | MPS3395 MIN. | MPS3395 MAX | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | 25 | | 25 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 100 | | 100 | nA | $V_{CB}$ = 18 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 100 | | 100 | nA | $V_{EB}$ = 5.0 V, $I_C$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 5) | 55 | 110 | 150 | 500 | | $V_{CE}$ = 4.5 V, $I_C$ = 2.0 mA |
| $C_{ob}$ | Output Capacitance | | 3.5 | | 3.5 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 1.0 MHz |
| $h_{fe}$ | Small Signal Current Gain | 55 | 300 | 150 | 800 | | $V_{CE}$ = 4.5 V, $I_C$ = 2.0 mA, f = 1.0 kHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.

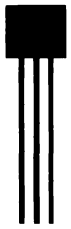
# MPS3702 • MPS3703

## PNP SMALL SIGNAL GENERAL PURPOSE AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- $V_{CEO}$ . . . −30 V (MIN) (MPS3703)
- $h_{FE}$ . . . 60-300 @ 50 mA (MPS3702)
- $V_{CE(sat)}$ . . . −0.25 V (MAX) @ 50 mA
- COMPLEMENTS . . . MPS3704 through MPS3706

See TO92-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to 150°C |
| Operating Junction Temperature | 150°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Ambient Temperature | 0.625 W |
| at 70°C Ambient Temperature | 0.400 W |
| at 25°C Case Temperature | 1.0 W |

**Maximum Voltages and Current**

| | | MPS3702 | MPS3703 |
|---|---|---|---|
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | −25 V | −30 V |
| $V_{CBO}$ | Collector to Base Voltage | −40 V | −50 V |
| $V_{EBO}$ | Emitter to Base Voltage | −5.0 V | −5.0 V |
| $I_C$ | Collector Current | 200 mA | 200 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MPS3702 MIN. | MPS3702 MAX. | MPS3703 MIN. | MPS3703 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 5) | −25 | | −30 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −40 | | −50 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −5.0 | | −5.0 | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 100 | | 100 | nA | $V_{CB}$ = −20 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 100 | | 100 | nA | $V_{EB}$ = −3.0 V, $I_C$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 5) | 60 | 300 | 30 | 150 | | $I_C$ = 50 mA, $V_{CE}$ = −5.0 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | −0.25 | | −0.25 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 5) | −0.6 | −1.0 | −0.6 | −1.0 | V | $I_C$ = 50 mA, $V_{CE}$ = −5.0 V |
| $f_T$ | Current Gain Bandwidth Product | 100 | | 100 | | MHz | $I_C$ = 50 mA, $V_{CE}$ = −5.0 V, f = 20 MHz |
| $C_{ob}$ | Output Capacitance | | 12 | | 12 | pF | $V_{CB}$ = −10 V, f = 1.0 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.

# MPS3704 • MPS3705 • MPS3706

## NPN SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW (MIN) @ $T_A$ = 25°C
- $V_{CEO}$ . . . 30 V (MIN) (MPS3704/5)
- $h_{FE}$ . . . 100-300 @ 50 mA (MPS3704)
- $V_{CE(sat)}$ . . . 0.6 V (MAX) @ 100 mA (MPS3704)
- COMPLEMENTS . . . MPS3702, MPS3703

See TO92-1 Package Outline


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Ambient Temperature | 0.625 W |
| at 70°C Ambient Temperature | 0.400 W |
| at 25°C Case Temperature | 1.0 W |

**Maximum Voltages and Current**

| | | MPS3704, MPS3705 | MPS3706 |
|---|---|---|---|
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 30 V | 20 V |
| $V_{CBO}$ | Collector to Base Voltage | 50 V | 40 V |
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V | 5.0 V |
| $I_C$ | Collector Current | 600 mA | 600 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MPS3704 MIN. | MPS3704 MAX. | MPS3705 MIN. | MPS3705 MAX. | MPS3706 MIN. | MPS3706 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 5) | 30 | | 30 | | 20 | | V | $I_C$ = 10 mA, $I_E$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 50 | | 50 | | 40 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | 5.0 | | 5.0 | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 100 | | 100 | | 100 | nA | $V_{CB}$ = 20 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 100 | | 100 | | 100 | nA | $V_{EB}$ = 3.0 V, $I_C$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 5) | 100 | 300 | 50 | 150 | 30 | 600 | | $I_C$ = 50 mA, $V_{CE}$ = 2.0 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | 0.6 | | 0.8 | | 1.0 | V | $I_C$ = 100 mA, $I_B$ = 5.0 mA |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 5) | 0.5 | 1.0 | 0.5 | 1.0 | 0.5 | 1.0 | V | $I_C$ = 100 mA, $V_{CE}$ = 2.0 V |
| $f_T$ | Current Gain Bandwidth Product | 100 | | 100 | | 100 | | MHz | $I_C$ = 50 mA, $V_{CE}$ = 2.0 V, f = 20 MHz |
| $C_{ob}$ | Output Capacitance | | 12 | | 12 | | 12 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 1.0 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.

# MPS3707 through MPS3711

## NPN SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- $V_{CEO}$ . . . 30 V (MIN)
- $h_{FE}$ . . . 100-400 @ 100 μA (MPS3707)
- NF . . . 5.0 dB (MAX) (MPS3707)

See TO92-1 Package Outline


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| **Maximum Temperatures** | |
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | |
| Total Dissipation at 25°C Case Temperature | 1.0 W |
| at 25°C Ambient Temperature | 0.625 W |
| at 70°C Ambient Temperature | 0.400 W |
| **Maximum Voltages and Current** | |
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | 30 V |
| $V_{CBO}$ Collector to Base Voltage | 30 V |
| $V_{EBO}$ Emitter to Base Voltage | 6.0 V |
| $I_C$ Collector Current | 30 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MPS3707 MIN. | MPS3707 MAX. | MPS3708 MIN. | MPS3708 MAX. | MPS3709 MIN. | MPS3709 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | 30 | | 30 | | 30 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 100 | | 100 | | 100 | nA | $V_{CB}$ = 20 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 100 | | 100 | | 100 | nA | $V_{EB}$ = 6.0 V, $I_C$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 5) | 100 | 400 | | | | | | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V |
| | | | | 45 | 660 | 45 | 165 | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V |
| NF | Noise Figure | | 5.0 | | | | | dB | $V_{CE}$ = 5.0 V, $I_C$ = 100 μA |
| | | | | | | | | | $R_G$ = 5.0 kΩ, BW = 15.7 kHz |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | 1.0 | | 1.0 | | 1.0 | V | $I_C$ = 10 mA, $I_B$ = 0.5 mA |
| $V_{BE(ON)}$ | Base to Emitter Voltage | 0.5 | 1.0 | 0.5 | 1.0 | 0.5 | 1.0 | V | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V |
| $h_{fe}$ | Small Signal Current Gain | 100 | 550 | | | | | | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V, f = 1.0 kHz |
| | | | | 45 | 800 | 45 | 250 | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V, f = 1.0 kHz |

| SYMBOL | CHARACTERISTIC | MPS3710 MIN. | MPS3710 MAX. | MPS3711 MIN. | MPS3711 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | 30 | | 30 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 100 | | 100 | nA | $V_{CB}$ = 20 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 100 | | 100 | nA | $V_{EB}$ = 6.0 V, $I_C$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 5) | | | | | | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V |
| | | 90 | 330 | 180 | 660 | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | 1.0 | | 1.0 | V | $I_C$ = 10 mA, $I_B$ = 0.5 mA |
| $V_{BE(ON)}$ | Base to Emitter Voltage | 0.5 | 1.0 | 0.5 | 1.0 | V | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V |
| $h_{fe}$ | Small Signal Current Gain | 90 | 450 | 180 | 800 | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V, f = 1.0 kHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.

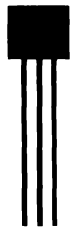
# MPS5172

## NPN SMALL SIGNAL GENERAL PURPOSE AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- $h_{FE}$ . . . 100-500 @ $I_C$ = 10 mA
- $V_{CE(sat)}$ . . . 0.25 V (MAX) @ $I_C$ = 10 mA
- COMPLEMENTS . . . 2N4126

See TO92-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| **Maximum Temperatures** | |
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |
| Lead Temperature (10 seconds) | 260°C |
| **Maximum Power Dissiaption** (Notes 2 & 3) | |
| Total Dissipation at 25°C Case Temperature | 1.0 W |
| at 25°C Ambient Temperature | 0.625 W |
| at 70°C Ambient Temperature | 0.400 W |
| **Maximum Voltages and Current** | |
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | 25 V |
| $V_{CBO}$ Collector to Base Voltage | 25 V |
| $V_{EBO}$ Emitter to Base Voltage | 5.0 V |
| $I_C$ Collector Current | 100 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | 25 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $I_{CES}$ | Collector Cutoff Current | | 100 | nA | $V_{CE}$ = 25 V, $V_{BE}$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 100 | nA | $V_{CB}$ = 25 V, $I_E$ = 0 |
| | | | 10 | μA | $V_{CB}$ = 25 V, $I_E$ = 0, $T_A$ = 100°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 100 | nA | $V_{BE}$ = 5.0 V, $I_C$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 5) | 100 | 500 | | $I_C$ = 10 mA, $V_{CE}$ = 10 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | 0.25 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage | 0.5 | 1.2 | V | $I_C$ = 10 mA, $V_{CE}$ = 10 V |
| $C_{cb}$ | Collector to Base Capacitance | 1.6 | 10 | pF | $V_{CB}$ = 0, $I_E$ = 0, f = 1.0 MHz |
| $h_{fe}$ | Small Signal Current Gain | 100 | 750 | | $I_C$ = 10 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These ratings are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.

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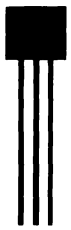
# MPS6512 through MPS6515

## NPN SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- $V_{CEO}$ . . . 30 V (MIN) (MPS6512/13), 25 V (MIN) (MPS6514/15)
- $h_{FE}$ . . . 150-300 (MPS6514), 250-500 (MPS6515) @ 2.0 mA
  . . . 90 (MIN) (MPS6514), 150 (MIN) (MPS6515) @ 100 mA
- COMPLEMENTS . . . MPS6516 THROUGH MPS6519

See TO92-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 70°C Ambient Temperature | 0.400 W |
| at 25°C Ambient Temperature | 0.625 W |
| at 25°C Case Temperature | 1.0 W |

**Maximum Voltages and Current**

| | | MPS6512 MPS6513 | MPS6514 MPS6515 |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 40 V | 40 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 30 V | 25 V |
| $V_{EBO}$ | Emitter to Base Voltage | 4.0 V | 4.0 V |
| $I_C$ | Collector Current | 100 mA | 100 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MPS6512 MIN. | MPS6512 MAX. | MPS6513 MIN. | MPS6513 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | 30 | | 30 | | V | $I_C$ = 0.5 mA, $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 4.0 | | 4.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | | 50 | nA | $V_{CB}$ = 30 V, $I_E$ = 0 |
| | | | 1.0 | | 1.0 | μA | $V_{CB}$ = 30 V, $I_E$ = 0, $T_A$ = 60°C |
| $h_{FE}$ | DC Current Gain (Note 5) | 50 | 100 | 90 | 180 | | $I_C$ = 2.0 mA, $V_{CE}$ = 10 V |
| | | 30 | | 60 | | | $I_C$ = 100 mA, $V_{CE}$ = 10 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | 0.5 | | 0.5 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $C_{ob}$ | Output Capacitance | | 3.5 | | 3.5 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 100 kHz |

| SYMBOL | CHARACTERISTIC | MPS6514 MIN. | MPS6514 MAX. | MPS6515 MIN. | MPS6515 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | 25 | | 25 | | V | $I_C$ = 0.5 mA, $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 4.0 | | 4.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | | 50 | nA | $V_{CB}$ = 30 V, $I_E$ = 0 |
| | | | 1.0 | | 1.0 | μA | $V_{CB}$ = 30 V, $I_E$ = 0, $T_A$ = 60°C |
| $h_{FE}$ | DC Current Gain (Note 5) | 150 | 300 | 250 | 500 | | $I_C$ = 2.0 mA, $V_{CE}$ = 10 V |
| | | 90 | | 150 | | | $I_C$ = 100 mA, $V_{CE}$ = 10 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | 0.5 | | 0.5 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $C_{ob}$ | Output Capacitance | | 3.5 | | 3.5 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 100 kHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 — SS14.

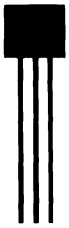
# MPS6516 through MPS6519

## PNP SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- $V_{CEO}$ . . . 40 V (MIN) (MPS6516-MPS6518), 25 V (MIN) (MPS6519)
- $h_{FE}$ . . . 150-300 (MPS6518) 250-500 (MPS6519) @ 2.0 mA
  . . . 90 (MIN) (MPS6518) 150 (MIN) (MPS6519) @ 100 mA
- COMPLEMENTS . . . MPS6512 THROUGH MPS6515

See TO92-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −55°C to +150°C |
| Junction Temperature | | 150°C |
| **Maximum Power Dissipation** | | |
| Total Dissipation at 70°C Ambient Temperature | | 0.400 W |
| at 25°C Ambient Temperature | | 0.625 W |
| at 25°C Case Temperature | | 1.0 W |
| **Maximum Voltages and Current** | **MPS6516/17/18** | **MPS6519** |
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | −40 V | −25 V |
| $V_{CBO}$ Collector to Base Voltage | −40 V | −25 V |
| $V_{EBO}$ Emitter to Base Voltage | −4.0 V | −4.0 V |
| $I_C$ Collector Current | 100 mA | 100 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MPS6516 MIN. | MPS6516 MAX. | MPS6517 MIN. | MPS6517 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter | −40 | | −40 | | V | $I_C$ = 0.5 mA, $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −4.0 | | −4.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | | 50 | nA | $V_{CB}$ = −30 V, $I_E$ = 0 |
| | | | 1.0 | | 1.0 | μA | $V_{CB}$ = −30 V, $I_E$ = 0, $T_A$ = 60°C |
| $h_{FE}$ | DC Current Gain (Note 5) | 50 | 100 | 90 | 180 | | $I_C$ = 2.0 mA, $V_{CE}$ = −10 V |
| | | 30 | | 60 | | | $I_C$ = 100 mA, $V_{CE}$ = −10 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | −0.5 | | −0.5 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $C_{ob}$ | Output Capacitance | | 4.0 | | 4.0 | pF | $V_{CB}$ = −10 V, $I_E$ = 0, f = 100 kHz |

| SYMBOL | CHARACTERISTIC | MPS6518 MIN. | MPS6518 MAX. | MPS6519 MIN. | MPS6519 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | −40 | | −25 | | V | $I_C$ = 0.5 mA, $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −4.0 | | −4.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | | | nA | $V_{CB}$ = −30 V, $I_E$ = 0 |
| | | | | | 50 | nA | $V_{CB}$ = −20 V, $I_E$ = 0 |
| | | | 1.0 | | | μA | $V_{CB}$ = −30 V, $I_E$ = 0, $T_A$ = 60°C |
| | | | | | 1.0 | μA | $V_{CB}$ = −20 V, $I_E$ = 0, $T_A$ = 60°C |
| $h_{FE}$ | DC Current Gain (Note 5) | 150 | 300 | 250 | 500 | | $I_C$ = 2.0 mA, $V_{CE}$ = −10 V |
| | | 90 | | 150 | | | $I_C$ = 100 mA, $V_{CE}$ = −10 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | −0.5 | | −0.5 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $C_{ob}$ | Output Capacitance | | 4.0 | | 4.0 | pF | $V_{CB}$ = −10 V, $I_E$ = 0, f = 100 kHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 – SS23.

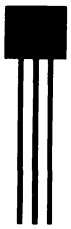
# MPS6520 • MPS6521

## NPN SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C**
- **$V_{CEO}$ . . . 25 V (MIN)**
- **$h_{FE}$ . . . 100 (MIN) (MPS6520), 150 (MIN) (MPS6521) @ 100 μA**
- **. . . 200-400 (MPS6520), 300-600 (MPS6521) @ 2.0 mA**
- **NF . . . 3.0 dB (MAX) @ $I_C$ = 10 μA, WIDE BAND**
- **COMPLEMENTS . . . MPS6522, MPS6523**

**See TO92-1 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −55°C to +150°C |
| Operating Junction Temperature | | 150°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 70°C Ambient Temperature | | 0.400 W |
| at 25°C Ambient Temperature | | 0.625 W |
| at 25°C Case Temperature | | 1.0 W |
| **Maximum Voltages and Current** | | |
| $V_{CBO}$ | Collector to Base Current | 40 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 25 V |
| $V_{EBO}$ | Emitter to Base Voltage | 4.0 V |
| $I_C$ | Collector Current | 100 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MPS6520 MIN. | MPS6520 MAX. | MPS6521 MIN. | MPS6521 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | 25 | | 25 | | V | $I_C$ = 0.5 mA, $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 4.0 | | 4.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | | 50 | nA | $V_{CB}$ = 30 V, $I_E$ = 0 |
| | | | 1.0 | | 1.0 | μA | $V_{CB}$ = 30 V, $I_E$ = 0, $T_A$ = 60°C |
| $h_{FE}$ | DC Current Gain | 100 | | 150 | | | $I_C$ = 100 μA, $V_{CE}$ = 10 V |
| | | 200 | 400 | 300 | 600 | | $I_C$ = 2.0 mA, $V_{CE}$ = 10 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | 0.5 | | 0.5 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $C_{ob}$ | Output Capacitance | | 3.5 | | 3.5 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 100 kHz |
| NF | Noise Figure | | 3.0 | | 3.0 | dB | $V_{CE}$ = 5.0 V, $I_C$ = 10 μA, Rg = 10 kΩ<br>Power Bandwidth = 15.7 kHz<br>3.0 dB points @ 10 Hz and 10 kHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 — SS14.

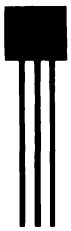
# MPS6522 • MPS6523

## PNP SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C**
- **$h_{FE}$ . . . 150 (MIN) @ 100 μA (MPS6523)**
  **. . . 300-600 @ 2.0 mA (MPS6523)**
- **NF . . . 3.0 dB (MAX) @ 10 μA, WIDE BAND**
- **$V_{CEO}$ . . . 25 V (MIN)**
- **COMPLEMENTS . . . MPS6520, MPS6521**

**See TO92-1 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| **Maximum Temperatures** | |
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | |
| Total Dissipation at 25°C Case Temperature | 1.0 W |
| at 25°C Ambient Temperature | 0.625 W |
| at 70°C Ambient Temperature | 0.400 W |
| **Maximum Voltages and Current** | |
| $V_{CEO}$ Collector to Emitter Voltage | −25 V |
| $V_{CBO}$ Collector to Base Voltage | −25 V |
| $V_{EBO}$ Emitter to Base Voltage | −4.0 V |
| $I_C$ Collector Current | 100 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MPS6522 MIN. | MPS6522 MAX. | MPS6523 MIN. | MPS6523 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | −25 | | −25 | | V | $I_C$ = 0.5 mA, $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −4.0 | | −4.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | | 50 | nA | $V_{CB}$ = −20 V, $I_E$ = 0, $T_A$ = 60°C |
| | | | 1.0 | | 1.0 | μA | $V_{CB}$ = −20 V, $I_E$ = 0, $T_A$ = 60°C |
| $h_{FE}$ | DC Current Gain | 100 | | 150 | | | $I_C$ = 100 μA, $V_{CE}$ = −10 V |
| | | 200 | 400 | 300 | 600 | | $I_C$ = 2.0 mA, $V_{CE}$ = −10 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | −0.5 | | −0.5 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $C_{ob}$ | Output Capacitance | | 3.5 | | 3.5 | pF | $V_{CB}$ = −10 V, $I_E$ = 0, f = 100 kHz |
| NF | Noise Figure | | 3.0 | | 3.0 | dB | $I_E$ = 10 μA, $V_{CE}$ = −5.0 V, $R_S$ = 10 kΩ, P B W = 15.7 kHz 3.0 dB points @ 10 Hz and 10 kHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 — SS23.

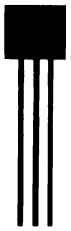
# MPS6530 • MPS6531 • MPS6532

## NPN SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C**
- **$V_{CEO}$ . . . 40 V (MIN)**
- **$h_{FE}$ . . . 90-270 @ 100 mA (MPS6531)**
- **COMPLEMENTS . . . MPS6533M, MPS6534, MPS6535M**

See TO92-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | MPS6530 | MPS6531 | MPS6532 |
|---|---|---|---|---|
| **Maximum Temperatures** | | | | |
| Storage Temperature | | | | −55°C to +150°C |
| Operating Junction Temperature | | | | 150°C |
| Lead Temperature (10 seconds) | | | | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | | | |
| Total Dissipation at 25°C Case Temperature | | | | 1.0 W |
| at 25°C Ambient Temperature | | | | 0.625 W |
| at 70°C Ambient Temperature | | | | 0.400 W |
| **Maximum Voltages and Current** | | **MPS6530** | **MPS6531** | **MPS6532** |
| $V_{CBO}$ | Collector to Base Voltage | 60 V | 60 V | 50 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 40 V | 40 V | 30 V |
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V | 5.0 V | 5.0 V |
| $I_C$ | Collector Current | 600 mA | 600 mA | 600 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MPS6530 MIN. | MPS6530 MAX. | MPS6531 MIN. | MPS6531 MAX. | MPS6532 MIN. | MPS6532 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 60 | | 60 | | 50 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | 40 | | 40 | | 30 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | 5.0 | | 5.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | | 50 | | | nA | $V_{CB}$ = 40 V, $I_E$ = 0 |
| | | | | | | | 100 | nA | $V_{CB}$ = 30 V, $I_E$ = 0 |
| | | | 2.0 | | 2.0 | | | μA | $V_{CB}$ = 40 V, $I_E$ = 0, $T_A$ = 60°C |
| | | | | | | | 5.0 | μA | $V_{CB}$ = 30 V, $I_E$ = 0, $T_A$ = 60°C |
| $h_{FE}$ | DC Current Gain (Note 5) | 30 | | 60 | | | | | $I_C$ = 10 mA, $V_{CE}$ = 1.0 V |
| | | 40 | 120 | 90 | 270 | 30 | | | $I_C$ = 100 mA, $V_{CE}$ = 1.0 V |
| | | 25 | | 50 | | | | | $I_C$ = 500 mA, $V_{CE}$ = 10 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | 0.5 | | 0.3 | | 0.5 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 5) | | 1.0 | | 1.0 | | 1.2 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| $C_{ob}$ | Output Capacitance | | 5.0 | | 5.0 | | 5.0 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 100 kHz |

*Planar is a patented Fairchild process.

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 2%.
6. For product family characteristic curves, refer to Section 5-SS15.

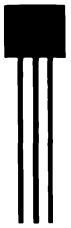
# MPS6533M • MPS6534M • MPS6535M

## PNP SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C**
- **$V_{CEO}$ . . . 40 V (MIN) (MPS6533M/4M)**
- **$h_{FE}$ . . . 90-270 @ 100 mA (MPS6534M)**
- **COMPLEMENTS . . . MPS6530, MPS6531, MPS6532**

**See TO92-1 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | | |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | | −55°C to +150°C |
| Operating Junction Temperature | | | 150°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | | |
| Total Dissipation at 25°C Case Temperature | | | 1.0 W |
| at 25°C Ambient Temperature | | | 0.625 W |
| at 70°C Ambient Temperature | | | 0.400 W |
| **Maximum Voltages and Current** | **MPS6533M** | **MPS6534M** | **MPS6535M** |
| $V_{CBO}$ Collector to Base Voltage | −40 V | −40 V | −30 V |
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | −40 V | −40 V | −30 V |
| $V_{EBO}$ Emitter to Base Voltage | −4.0 V | −4.0 V | −4.0 V |
| $I_C$ Collector Current | 600 mA | 600 mA | 600 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MPS6533M MIN. | MPS6533M MAX. | MPS6534M MIN. | MPS6534M MAX. | MPS6535M MIN. | MPS6535M MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −40 | | −40 | | −30 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | −40 | | −40 | | −30 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −4.0 | | −4.0 | | −4.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | | 50 | | | nA | $V_{CB}$ = −30 V, $I_E$ = 0 |
| | | | | | | | 100 | nA | $V_{CB}$ = −20 V, $I_E$ = 0 |
| | | | 2.0 | | 2.0 | | | μA | $V_{CB}$ = −30 V, $I_E$ = 0, $T_A$ = 60°C |
| | | | | | | | 5.0 | μA | $V_{CB}$ = −20 V, $I_E$ = 0, $T_A$ = 60°C |
| $h_{FE}$ | DC Current Gain (Note 5) | 30 | | 60 | | | | | $I_C$ = 10 mA, $V_{CE}$ = −1.0 V |
| | | 40 | 120 | 90 | 270 | 30 | | | $I_C$ = 100 mA, $V_{CE}$ = −1.0 V |
| | | 25 | | 50 | | | | | $I_C$ = 500 mA, $V_{CE}$ = −10 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | −0.5 | | −0.3 | | −0.5 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 5) | | −1.0 | | −1.0 | | −1.2 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| $C_{ob}$ | Output Capacitance | | 8.0 | | 8.0 | | 8.0 | pF | $V_{CB}$ = −10 V, $I_E$ = 0, f = 100 kHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C; junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 2%.
6. For product family characteristic curves, refer to Section 5-SS22.

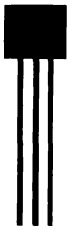
# MPS6560 • MPS6561 • MPS6562 • MPS6563

## NPN-PNP SMALL SIGNAL GENERAL PURPOSE COMPLEMENTARY AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C**
- **$V_{CEO}$ . . . 25 V (MPS6560/2), 20 V (MPS6561/3)**
- **$h_{FE}$ . . . 50-200 @ 500 mA (MPS6560/2), @ 350 mA (MPS6561/3)**
- **$V_{CE(sat)}$ . . . 0.5 V (MAX) @ 500 mA (MPS6560/2), @ 350 mA (MPS6561/3)**
- **COMPLEMENTS . . . MPS6560, MPS6561 (NPN)-MPS6562, MPS6563 (PNP)**

**See TO92-1 Package Outline**



E B C
1 2 3

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Ambient Temperature | 0.625 W |
| at 25°C Case Temperature | 1.0 W |
| at 70°C Ambient Temperature | 0.400 W |

**Maximum Voltages and Current**

| | | **MPS6560 MPS6562** | **MPS6561 MPS6563** |
|---|---|---|---|
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 25 V | 20 V |
| $V_{CBO}$ | Collector to Base Voltage | 25 V | 20 V |
| $V_{EBO}$ | Emitter to Base Voltage | 4.0 V | 4.0 V |
| $I_C$ | Collector Current | 600 mA | 600 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted.) Note: Negative Voltage for PNP

| SYMBOL | CHARACTERISTIC | MPS6560 MPS6562 MIN. | MPS6560 MPS6562 MAX. | MPS6561 MPS6563 MIN. | MPS6561 MPS6563 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | −5.0 | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $I_{CEO}$ | Collector Cutoff Current | | 100 | | | nA | $V_{CE}$ = 25 V, $I_B$ = 0 |
| | | | | | 100 | nA | $V_{CE}$ = 20 V, $I_B$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 100 | | 100 | nA | $V_{CB}$ = 20 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 100 | | 100 | nA | $V_{EB}$ = 4.0 V, $I_C$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 5) | 35 | | 35 | | | $I_C$ = 10 mA, $V_{CE}$ = 1.0 V |
| | | 50 | | 50 | | | $I_C$ = 100 mA, $V_{CE}$ = 1.0 V |
| | | 50 | 200 | | | | $I_C$ = 500 mA, $V_{CE}$ = 1.0 V |
| | | | | 50 | 200 | | $I_C$ = 350 mA, $V_{CE}$ = 1.0 V |
| $V_{CE(sat)}$ | Collector Emitter Saturation Voltage | | 0.5 | | | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| | (Note 5) | | | | −0.5 | V | $I_C$ = 350 mA, $I_B$ = 35 mA |
| $V_{BE(On)}$ | Base Emitter "On" Voltage (Note 5) | | 1.2 | | | V | $I_C$ = 500 mA, $V_{CE}$ = 1.0 V |
| | | | | | −1.2 | V | $I_C$ = 350 mA, $V_{CE}$ = 1.0 V |
| $f_T$ | Current Gain Bandwidth Product | 60 | | 60 | | MHz | $I_C$ = 10 mA, $V_{CE}$ = 10 V, f = 30 MHz |
| $C_{ob}$ | Output Capacitance | | 30 | | 30 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 100 kHz |

*Planar is a patented Fairchild process.

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5-SS15 for MPS6560, MPS6561; for SS22 for MPS6563; and SS24 for MPS6562.

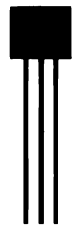
# MPS6565 • MPS6566

## NPN SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- $V_{CEO}$ . . . 45 V (MIN)
- $h_{FE}$ . . . 100 – 400 @ 10 mA (MPS6566)
- COMPLEMENTS . . . 2N3905, 2N3906

See TO92-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| **Maximum Temperatures** | |
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | |
| Total Dissipation at 25°C Case Temperature | 1.0 W |
| at 70°C Ambient Temperature | 0.400 W |
| at 25°C Ambient Temperature | 0.625 W |
| **Maximum Voltages and Current** | |
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | 45 V |
| $V_{CBO}$ Collector to Base Voltage | 60 V |
| $V_{EBO}$ Emitter to Base Voltage | 4.0 V |
| $I_C$ Collector Current | 200 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MPS6565 MIN. | MPS6565 MAX. | MPS6566 MIN. | MPS6566 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | 45 | | 45 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 60 | | 60 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 4.0 | | 4.0 | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 100 | | 100 | nA | $V_{CB}$ = 30 V, $I_E$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 5) | 40 | 160 | 100 | 400 | | $I_C$ = 10 mA, $V_{CE}$ = 10 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | 0.4 | | 0.4 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $C_{ob}$ | Output Capacitance | | 3.5 | | 3.5 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 100 kHz |
| $h_{fe}$ | High Frequency Current Gain | 2.0 | | 2.0 | | | $I_C$ = 10 mA, $V_{CE}$ = 10 V, f = 100 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.

4

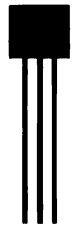
# MPS6571

## NPN LOW LEVEL HIGH GAIN AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- $V_{CEO}$ . . . 20 V (MIN)
- $h_{FE}$ . . . 250-1000 @ 100 μA

See TO92-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperature** | | |
| Storage Temperature | | −55°C to +150°C |
| Operating Junction Temperature | | 150°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Case Temperature | | 1.0 W |
| at 25°C Ambient Temperature | | 0.625 W |
| at 70°C Ambient Temperature | | 0.400 W |
| **Maximum Voltages and Current** | | |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 20 V |
| $V_{CBO}$ | Collector to Base Voltage | 20 V |
| $V_{EBO}$ | Emitter to Base Voltage | 3.0 V |
| $I_C$ | Collector Current (Continuous) | 50 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | 20 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 25 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | nA | $V_{CB}$ = 20 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 50 | nA | $V_{EB(OFF)}$ = 3.0 V, $I_C$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 5) | 250 | 1000 | | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | 0.5 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 5) | | 0.8 | V | $I_C$ = 10 mA, $V_{CE}$ = 5.0 V |
| $f_T$ | Current Gain Bandwidth Product | 50 | | MHz | $I_C$ = 500 μA, $V_{CE}$ = 5.0 V, f = 20 MHz |
| $C_{ob}$ | Output Capacitance | | 4.5 | pF | $V_{CB}$ = 5.0 V, $I_E$ = 0, f = 100 kHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.

# MPSA05 • MPSA06

## NPN SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C**
- **$V_{CEO}$ . . . 60 V (MIN) (MPSA05), 80 V (MIN) (MPSA06)**
- **$h_{FE}$ . . . 50 (MIN) @ 10 mA AND 100 mA**
- **$V_{CE\ (sat)}$ . . . 0.25 V (MAX) @ 100 mA**
- **COMPLEMENTS . . . MPSA55, MPSA56 (PNP)**

**See TO92-1 Package Outline**


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −55°C to +150°C |
| Operating Junction Temperature | | 150°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Case Temperature | | 1.0 W |
| at 25°C Ambient Temperature | | 0.625 W |
| at 70°C Ambient Temperature | | 0.400 W |
| **Maximum Voltages and Current** | **MPSA05** | **MPSA06** |
| $V_{CBO}$ Collector to Base Voltage | 60 V | 80 V |
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | 60 V | 80 V |
| $V_{EBO}$ Emitter to Base Voltage | 4.0 V | 4.0 V |
| $I_C$ Collector Current | 500 mA | 500 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MPSA05 MIN. | MPSA05 MAX. | MPSA06 MIN. | MPSA06 MAX | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | 60 | | 80 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 4.0 | | 4.0 | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 100 | | | nA | $V_{CB}$ = 60 V, $I_E$ = 0 |
| | | | | | 100 | nA | $V_{CB}$ = 80 V, $I_E$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 5) | 50 | | 50 | | | $I_C$ = 10 mA, $V_{CE}$ = 1.0 V |
| | | 50 | | 50 | | | $I_C$ = 100 mA, $V_{CE}$ = 1.0 V |
| $V_{CE\ (sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | 0.25 | | 0.25 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| $V_{BE\ (ON)}$ | Base to Emitter "On" Voltage | | 1.2 | | 1.2 | V | $I_C$ = 100 mA, $V_{CE}$ = 1.0 V |
| $f_T$ | Current Gain Bandwidth Product | 50 | | 50 | | MHz | $I_C$ = 100 mA, $V_{CE}$ = 1.0 V, f = 100 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5-SS17.

4

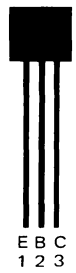
# MPSA09

## NPN LOW LEVEL LOW NOISE AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- $V_{CEO}$ . . . 50 V (MIN)
- $h_{FE}$ . . . 100-600 @ 100 μA
- NF . . . 1.4 dB (TYP) @ 1.0 kHz

See TO92-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 1.0 W |
| at 25°C Ambient Temperature | 0.625 W |
| at 70°C Ambient Temperature | 0.400 W |

**Maximum Voltages and Current**

| | | |
|---|---|---|
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 50 V |
| $V_{CBO}$ | Collector to Base Voltage | 50 V |
| $I_C$ | Collector Current (Peak) | 100 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | 50 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 50 | | V | $I_C$ = 0.1 mA, $I_E$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 100 | nA | $V_{CB}$ = 25 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 100 | nA | $V_{EB}$ = 3.0 V, $I_C$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 5) | 100 | 600 | | $I_C$ = 0.1 mA, $V_{CE}$ = 5.0 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | 0.9 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage | | 1.0 | V | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V |
| $f_T$ | Current Gain Bandwidth Product | 30 | | MHz | $I_C$ = 0.5 mA, $V_{CE}$ = 5.0 V, f = 20 MHz |
| $C_{ob}$ | Output Capacitance | | 5.0 | pF | $V_{CB}$ = 5.0 V, $I_E$ = 0, f = 100 kHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.

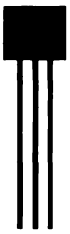
# MPSA12

## NPN MONOLITHIC DARLINGTON AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $h_{FE}$ . . . 20,000 (MIN) @ 10 mA
- $V_{CEO}$ . . . 20 V (MIN)

See TO92-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 1.0 W |
| at 25°C Ambient Temperature | 0.625 W |
| at 70°C Ambient Temperature | 0.400 W |

**Maximum Voltages**

| | | |
|---|---|---|
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 20 V |
| $V_{EBO}$ | Emitter to Base Voltage | 10 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | TYP. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 20,000 | | | | $I_C$ = 10 mA, $V_{CE}$ = 5.0 V |
| $I_{CES}$ | Collector Reverse Current | | | 100 | nA | $V_{CE}$ = 15 V, $V_{BE}$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | | 100 | nA | $V_{CB}$ = 15 V, $I_C$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | | 100 | nA | $V_{EB}$ = 10 V, $I_C$ = 0 |
| $h_{fe}$ | Small Signal Current Gain | | 35 | | | $I_C$ = 10 mA, $V_{CE}$ = 5.0 V, f = 1.0 kHz |
| $V_{CE(sat)}$ | Collector Saturation Voltage | | | 1.0 | V | $I_C$ = 10 mA, $I_B$ = 0.01 mA |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage | | | 1.4 | V | $I_C$ = 10 mA, $V_{CE}$ = 5.0 V |
| $C_{ob}$ | Output Capacitance | | 8.0 | | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 100 kHz |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | 20 | | | V | $I_C$ = 100 μA, $I_B$ = 0 |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 - SS20.

# MPSA13 • MPSA14

## NPN MONOLITHIC DARLINGTON AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$h_{FE}$ . . . 20,000 (MIN) @ 10.0 mA (MPSA14)**
- **$V_{CEO}$ . . . 30 V (MIN)**

**See TO92-1 Package Outline**


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −55°C to +150°C |
| Operating Junction Temperature | | 150°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Case Temperature | | 1.0 W |
| at 25°C Ambient Temperature | | 0.625 W |
| at 70°C Ambient Temperature | | 0.400 W |
| **Maximum Voltages and Current** | | |
| $V_{CES}$ | Collector to Emitter Voltage | 30 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 30 V |
| $V_{CBO}$ | Collector to Base Voltage | 30 V |
| $V_{EBO}$ | Emitter to Base Voltage | 10 V |
| $I_C$ | Collector Current | 300 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MPSA13 MIN. | MPSA13 TYP. | MPSA13 MAX. | MPSA14 MIN. | MPSA14 TYP. | MPSA14 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | 30 | | | 30 | | | V | $I_C$ = 100 μA, $I_B$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | | 100 | | | 100 | nA | $V_{CB}$ = 30 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | | 100 | | | 100 | nA | $V_{EB}$ = 10 V, $I_C$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 5) | 5,000 | | | 10,000 | | | | $I_C$ = 10 mA, $V_{CE}$ = 5.0 V |
| | | 10,000 | | | 20,000 | | | | $I_C$ = 100 mA, $V_{CE}$ = 5.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | 0.8 | 1.5 | | 0.8 | 1.5 | V | $I_C$ = 100 mA, $I_B$ = 0.1 mA |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 5) | | 1.25 | 2.0 | | 1.25 | 2.0 | V | $I_C$ = 100 mA, $V_{CE}$ = 5.0 V |
| $f_T$ | Current Gain Bandwidth Product | 125 | 200 | | 125 | 200 | | MHz | $I_C$ = 10 mA, $V_{CE}$ = 5.0 V, f = 100 MHz |
| $C_{ob}$ | Output Capacitance | | 5.0 | | | 5.0 | | pF | $V_{CB}$ = 10 V, $I_E$ = 0 |
| NF | Noise Figure | | 2.0 | | | 2.0 | | dB | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V, $R_S$ = 100 kΩ, f = 1.0 kHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest
5. Pulse conditions: length = 300 μs; duty cycle = 2%.

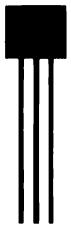
# MPSA20 • MPSA70

## NPN-PNP SMALL SIGNAL GENERAL PURPOSE COMPLEMENTARY AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- $V_{CEO}$ . . . 40 V (MIN)
- $h_{FE}$ . . . 40-400 @ 5.0 mA
- $V_{CE(sat)}$ . . . 0.25 V (MAX) @ 10 mA
- $C_{ob}$ . . . 4.0 pF (MAX) 10 V
- COMPLEMENTS . . . MPSA20 (NPN), MPSA70 (PNP)

See TO92-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| **Maximum Temperatures** | |
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | |
| Total Dissipation at 25°C Case Temperature | 1.0 W |
| at 25°C Ambient Temperature | 0.625 W |
| at 70°C Ambient Temperature | 0.400 W |
| **Maximum Voltages and Current** | |
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | 40 V |
| $V_{EBO}$ Emitter to Base Voltage | 4.0 V |
| $I_C$ Collector Current (Continuous) | 100 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS (Reverse Voltage Polarity for PNP) |
|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | 40 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 4.0 | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 100 | nA | $V_{CB}$ = 30 V, $I_E$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 5) | 40 | 400 | | $I_C$ = 5.0 mA, $V_{CE}$ = 10 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | 0.25 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $f_T$ | Current Gain Bandwidth Product | 125 | | MHz | $I_C$ = 5.0 mA, $V_{CE}$ = 10 V, f = 100 MHz |
| $C_{ob}$ | Output Capacitance | | 4.0 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 100 kHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.

4

# MPSA42 • MPSA43

## NPN SMALL SIGNAL HIGH VOLTAGE GENERAL PURPOSE AMPLIFIERS

SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- $V_{CEO}$ . . . 300 V (MIN) (MPSA42), 200 V (MIN) (MPSA43)
- $h_{FE}$ . . . 40 (MIN) @ 10 mA
- $f_T$ . . . 50 MHz (MIN)
- COMPLEMENTS . . . MPSA92, MPSA93

See TO92-1 Package Outline


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 1.0 W |
| at 25°C Ambient Temperature | 0.625 W |

**Maximum Voltages and Currents**

| | | MPSA42 | MPSA43 |
|---|---|---|---|
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 300 V | 200 V |
| $V_{CBO}$ | Collector to Base Voltage | 300 V | 200 V |
| $V_{EBO}$ | Emitter to Base Voltage | 8.0 V | 6.0 V |
| $I_C$ | Collector Current (Continuous) | 500 mA | 500 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MPSA42 MIN. | MPSA42 MAX. | MPSA43 MIN. | MPSA43 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 4) | 300 | | 200 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 300 | | 200 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 8.0 | | 6.0 | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 0.1 | | | μA | $V_{CB}$ = 200 V, $I_E$ = 0 |
| | | | | | 0.1 | μA | $V_{CB}$ = 160 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 0.1 | | | μA | $V_{EB}$ = 6.0 V, $I_C$ = 0 |
| | | | | | 0.1 | μA | $V_{EB}$ = 4.0 V, $I_C$ = 0 |
| $h_{FE}$ | DC Current Gain | 25 | | 25 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V |
| | | 40 | | 40 | | | $I_C$ = 10 mA, $V_{CE}$ = 10 V |
| | | 40 | | 50 | 200 | | $I_C$ = 30 mA, $V_{CE}$ = 10 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | | 0.5 | | 0.4 | V | $I_C$ = 20 mA, $I_B$ = 2.0 mA |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage | | 0.9 | | 0.9 | V | $I_C$ = 20 mA, $I_B$ = 2.0 mA |
| $f_T$ | Current Gain Bandwidth Product | 50 | | 50 | | MHz | $I_C$ = 10 mA, $V_{CE}$ = 20 V, f = 100 MHz |
| $C_{cb}$ | Collector to Base Capacitance | | 3.0 | | 4.0 | pF | $V_{CB}$ = 20 V, $I_E$ = 0, f = 1.0 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Pulse conditions: length = 300 μs; duty cycle = ≤2%.

# MPSA55 • MPSA56

## PNP SMALL SIGNAL GENERAL PURPOSE COMPLEMENTARY AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C**
- **$V_{CEO}$ . . . −60 V (MIN) (MPSA55), 80 V (MIN) (MPSA56)**
- **$h_{FE}$ . . . 50 (MIN) @ 10 mA AND 100 mA**
- **$V_{CE(sat)}$ . . . −0.25 V (MAX) @ 100 mA**
- **COMPLEMENTS . . . MPSA05, MPSA06 (NPN)**

**See TO92-1 Package Outline**

E B C
1 2 3

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −55°C to +150°C |
| Operating Junction Temperature | | 150°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Case Temperature | | 1.0 W |
| at 25°C Ambient Temperature | | 0.625 W |
| at 70°C Ambient Temperature | | 0.400 W |
| **Maximum Voltages and Current** | **MPSA55** | **MPSA56** |
| $V_{CBO}$ Collector to Base Voltage | −60 V | −80 V |
| $V_{CEO}$ Collector to Emitter Voltage | −60 V | −80 V |
| $V_{EBO}$ Emitter to Base Voltage | −4.0 V | −4.0 V |
| $I_C$ Collector Current | 500 mA | 500 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MPSA55 MIN. | MPSA55 MAX. | MPSA56 MIN. | MPSA56 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | −60 | | −80 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −4.0 | | −4.0 | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 100 | | | nA | $V_{CB}$ = −60 V, $I_E$ = 0 |
| | | | | | 100 | nA | $V_{CB}$ = −80 V, $I_E$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 5) | 50 | | 50 | | | $I_C$ = 10 mA, $V_{CE}$ = −1.0 V |
| | | 50 | | 50 | | | $I_C$ = 100 mA, $V_{CE}$ = −1.0 V |
| $V_{CE\ (sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | −0.25 | | −0.25 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage | | −1.2 | | −1.2 | V | $I_C$ = 100 mA, $V_{CE}$ = −1.0 V |
| $f_T$ | Current Gain Bandwidth Product | 50 | | 50 | | MHz | $I_C$ = 100 mA, $V_{CE}$ = −1.0 V, f = 100 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5-SS24.

# MPSA92 • MPSA93

## PNP SMALL SIGNAL HIGH VOLTAGE GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C**
- **$BV_{CEO}$ . . . 300 V (MIN) (MPSA92), 200 V (MIN) (MPSA93)**
- **$h_{FE}$ . . . 40 (MIN) @ 10 mA**
- **$f_T$ . . . 50 MHz (MIN)**
- **COMPLEMENTS . . . MPSA42, MPSA43**

**See TO92-1 Package Outlines**


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 1.0 W |
| at 25°C Ambient Temperature | 0.625 W |

**Maximum Voltages and Current**

| | | MPSA92 | MPSA93 |
|---|---|---|---|
| $V_{CEO}$ | Collector to Emitter Voltage | −300 V | −200 V |
| $V_{CBO}$ | Collector to Base Voltage | −300 V | −200 V |
| $V_{EBO}$ | Emitter to Base Voltage | −5.0 V | −5.0 V |
| $I_C$ | Collector Current (Continuous) | 500 mA | 500 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MPSA92 MIN. | MPSA92 MAX. | MPSA93 MIN. | MPSA93 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 4) | −300 | | −200 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −300 | | −200 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −5.0 | | −5.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 0.25 | | | μA | $V_{CB}$ = −200 V, $I_E$ = 0 |
| | | | | | 0.25 | μA | $V_{CB}$ = −160 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 0.1 | | 0.1 | μA | $V_{EB}$ = −3.0 V, $I_C$ = 0 |
| $h_{FE}$ | DC Current Gain | 25 | | 25 | | | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V |
| | | 40 | | 40 | | | $I_C$ = 10 mA, $V_{CE}$ = −10 V |
| | | 25 | | 30 | 150 | | $I_C$ = 30 mA, $V_{CE}$ = −10 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | | −0.5 | | −0.4 | V | $I_C$ = 20 mA, $I_B$ = 2.0 mA |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage | | −0.9 | | −0.9 | V | $I_C$ = 20 mA, $I_B$ = 2.0 mA |
| $f_T$ | Current Gain Bandwidth Product | 50 | | 50 | | MHz | $I_C$ = 10 mA, $V_{CE}$ = −20 V, f = 100 MHz |
| $C_{cb}$ | Collector to Base Capacitance | | 6.0 | | 8.0 | pF | $V_{CB}$ = −20 V, $I_E$ = 0, f = 1.0 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Pulse conditions: length = 300 μs; duty cycle = 1%.
5. For product family characteristic curves, refer to Section 5 - SS4.

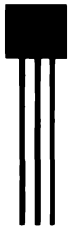
# MPSL01 • MPSL51

## NPN-PNP HIGH VOLTAGE COMPLEMENTARY SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C**
- **$V_{CE\,(sat)}$ . . . 0.30 V (MAX) @ 50 mA**
- **$V_{CEO}$ . . . 120 V (MIN) (MPSL01), 100 V (MIN) (MPSL51)**
- **COMPLEMENTS . . . MPSL01 (NPN) - MPSL51 (PNP)**

**See TO92-1 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | | |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | | −55°C to +150°C |
| Operating Junction Temperature | | | 150°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | | |
| Total Dissipation at 25°C Case Temperature | | | 1.0 W |
| at 25°C Ambient Temperature | | | 0.625 W |
| at 70°C Ambient Temperature | | | 0.400 W |
| **Maximum Voltages and Current** | | **MPSL01** | **MPSL51** |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 120 V | −100 V |
| $V_{CBO}$ | Collector to Base Voltage | 140 V | −100 V |
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V | −4.0 V |
| $I_C$ | Collector Current (Continuous) | 600 mA | 600 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MPSL01 MIN. | MPSL01 MAX. | MPSL51 MIN. | MPSL51 MAX. | UNITS | TEST CONDITIONS (Reverse Voltage Polarity for PNP) |
|---|---|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Voltage (Note 3) | 120 | | −100 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 140 | | −100 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | −4.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 1.0 | | | μA | $V_{CB}$ = 75 V, $I_E$ = 0 |
| | | | | | 1.0 | μA | $V_{CB}$ = 50 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 100 | | | nA | $V_{EB}$ = 4.0 V, $I_C$ = 0 |
| | | | | | 100 | nA | $V_{EB}$ = 3.0 V, $I_C$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 5) | 50 | 300 | | | | $V_{CE}$ = 5.0 V, $I_C$ = 10 mA |
| | | | | 40 | 250 | | $V_{CE}$ = 5.0 V, $I_C$ = 50 mA |
| $V_{CE\,(sat)}$ | Collector to Emitter Saturation Voltage | | 0.20 | | −0.25 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | (Note 5) | | 0.30 | | −0.30 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $V_{BE\,(sat)}$ | Base to Emitter Saturation Voltage | | 1.2 | | −1.2 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | (Note 5) | | 1.4 | | −1.2 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $f_T$ | Current Gain Bandwidth Product | 60 | | 60 | | MHz | $I_C$ = 10 mA, $V_{CE}$ = 10 V, f = 100 MHz |
| $C_{ob}$ | Output Capacitance | | 8.0 | | 8.0 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 1.0 MHz |
| $h_{fe}$ | Small Signal Current Gain | 30 | | 20 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |

*Planar is a patented Fairchild process

NOTES:
1. The maximum ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic, refer to Section 5-SS16 for MPSL01; SS25 for MPSL51.

4

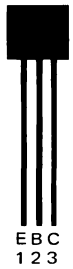
# MPSL07 • MPSL08

## PNP SMALL SIGNAL HIGH SPEED LOGIC SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- $t_{on}$ . . . 20 ns (MAX) @ 10 mA
- $t_{off}$ . . . 40 ns (MAX) @ 10 mA
- $\tau_s$ . . . 15 ns (MAX) (MPSL07), 20 ns (MAX) (MPSL08) @ 10 mA
- $V_{CE(sat)}$ . . . 0.15 V (MAX) @ 10 mA
- $f_T$ . . . 500 MHz (MIN) (MPSL07), 700 MHz (MIN) (MPSL08) @ 10 mA
- COMPLEMENTS . . . MPS2369

See TO92-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperature**

| | |
|---|---|
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 1.0 W |
| at 25°C Ambient Temperature | 0.625 W |
| at 70°C Ambient Temperature | 0.400 W |

**Maximum Voltages and Current**

| | | MPSL07 | MPSL08 |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | −6.0 V | −12 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | −6.0 V | −12 V |
| $V_{EBO}$ | Emitter to Base Voltage | −4.5 V | −4.5 V |
| $I_C$ | Collector Current | 80 mA | 80 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MPSL07 MIN. | MPSL07 MAX. | MPSL08 MIN. | MPSL08 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage | −6.0 | | −12 | | V | $I_C$ = 3.0 mA, $I_B$ = 0 |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | −6.0 | | −12 | | V | $I_C$ = 100 μA, $V_{BE}$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −6.0 | | −12 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −4.5 | | −4.5 | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $I_{CES}$ | Collector Cutoff Current | | 10 | | | nA | $V_{CE}$ = −3.0 V, $V_{BE}$ = 0 |
| | | | | | 10 | nA | $V_{CE}$ = −6.0 V, $V_{BE}$ = 0 |
| $I_{CES}$ | Collector Cutoff Current | | 5.0 | | | μA | $V_{CE}$ = −3.0 V, $V_{BE}$ = 0, $T_A$ = 65°C |
| | | | | | 5.0 | μA | $V_{CE}$ = −6.0 V, $V_{BE}$ = 0, $T_A$ = 65°C |
| $I_B$ | Base Current | | 10 | | | nA | $V_{CE}$ = −3.0 V, $V_{BE}$ = 0 |
| | | | | | 10 | nA | $V_{CE}$ = −6.0 V, $V_{BE}$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 5) | 15 | | 15 | | | $I_C$ = 1.0 mA, $V_{CE}$ = −0.5 V |
| | | 30 | 120 | 30 | 120 | | $I_C$ = 10 mA, $V_{CE}$ = −3.0 V |
| | | 30 | | 30 | | | $I_C$ = 50 mA, $V_{CE}$ = −1.0 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation | | −0.15 | | −0.15 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | Voltage (Note 5) | | −0.5 | | −0.5 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage | −0.73 | −0.88 | −0.73 | −0.88 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | (Note 5) | | −1.5 | | −1.5 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $f_T$ | Current Gain Bandwidth Product | 500 | | | | MHz | $I_C$ = 10 mA, $V_{CE}$ = −5.0 V, f = 100 MHz |
| | | | | 700 | | MHz | $I_C$ = 10 mA, $V_{CE}$ = −10 V, f = 100 MHz |
| $C_{ob}$ | Output Capacitance | | 3.0 | | 3.0 | pF | $V_{CB}$ = −5.0 V, $I_E$ = 0, f = 140 kHz |
| $C_{ib}$ | Input Capacitance | | 5.0 | | 5.0 | pF | $V_{EB}$ = −0.5 V, $I_C$ = 0, f = 140 kHz |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For additional product family characteristic curves, refer to Section 5 — SS31.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | MPSL07 MIN. | MPSL07 MAX. | MPSL08 MIN. | MPSL08 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $t_{on}$ | Turn On Time (see test circuit no. 348) | | 20 | | 20 | ns | $I_C$ = 10 mA, $I_{B1}$ = 1.0 mA |
| $t_{off}$ | Turn Off Time (see test circuit no. 348) | | 40 | | 40 | ns | $I_C$ = 10 mA, $I_{B1}$ = $I_{B2}$ = 1.0 mA |
| $\tau_s$ | Charge Storage Time (see test circuit no. 234) | | 15 | | 20 | ns | $I_C$ = 10 mA, $I_{B1}$ = $I_{B2}$ = 10 mA |

4

# PE3100

## NPN RF-VHF OSCILLATOR

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- $f_T$ . . . 500 MHz (MIN), 800 MHz (TYP)
- $r_b'C_c$ . . . 6.5 ps (TYP) 15 ps (MAX)
- SUFFICIENT VOLTAGE OUTPUT TO DRIVE MOS FET VHF MIXERS

See TO92-1 Package Outline


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |

**Maximum Power Dissipation**

| | |
|---|---|
| Total Dissipation at or below 65°C Ambient Temperature (Note 2) | 0.425 W |

**Maximum Voltages**

| | | |
|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 30 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 3) | 30 V |
| $V_{EBO}$ | Emitter to Base Voltage | 3.0 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $C_{cb}$ | Collector to Base Capacitance | | 0.8 | pF | $I_E = 0$, $V_{CB} = 10$ V, f = 1.0 MHz |
| $r_b' C_c$ | Collector to Base Time Constant | | 15 | ps | $I_C = 8.0$ mA, $V_{CE} = 10$ V, f = 80 MHz |
| $C_{ce}$ | Collector to Emitter Capacitance | 0.6 | 1.2 | pF | $I_B = 0$, $V_{CE} = 10$ V |
| $h_{FE}$ | DC Current Gain | 30 | 225 | | $I_C = 5.0$ mA, $V_{CE} = 10$ V |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage | 30 | | V | $I_C = 1.0$ mA, $I_B = 0$ |
| $I_{CBO}$ | Collector to Cutoff Current | | 200 | nA | $I_E = 0$, $V_{CB} = 30$ V |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | 30 | | V | $I_C = 100\ \mu A$, $I_E = 0$ |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 3.0 | | V | $I_C = 0$, $I_E = 100\ \mu A$ |
| $h_{fe}$ | High Frequency Current Gain | 5.0 | | | $I_C = 5.0$ mA, $V_{CE} = 10$ V, f = 100 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These ratings give a maximum junction temperature of 150°C and junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
3. Rating refers to a high current point where collector to emitter voltage is lowest.
4. For product family characteristic curves, refer to Section 5-SS12.

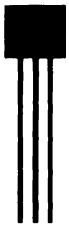
# PE5010 • PE5013 • PE5015

## NPN RF-AGC AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- **PG . . . 20 dB (MIN) @ 200 MHz (PE5010)**
- **NF . . . 3.3 dB (MAX) @ 200 MHz (PE5010)**
- **$C_{cb}$ . . . 0.5 pF (MAX) (PE5010)**
- **FORWARD AGC CAPABILITY**

**See TO92-1 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at or below 65°C Ambient Temperature | 300 mW |

**Maximum Voltages**

| | | PE5010 | PE5013 PE5015 |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 30 V | 20 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Notes 4 & 5) | 30 V | 20 V |
| $V_{EBO}$ | Emitter to Base Voltage | 3.0 V | 3.0 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | PE5010 MIN. | PE5010 MAX. | PE5013 MIN. | PE5013 MAX. | PE5015 MIN. | PE5015 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| NF | Noise Figure (Note 5) (see test circuit no. 257) | | 3.3 | | | | | dB | $V_{CC}$ = 12 V, f = 200 MHz |
| | (see test circuit no. 2003) | | | | 4.0 | | | dB | $V_{CC}$ = 12 V, $V_{AGC}$ = 2.75 V, f = 45 MHz |
| | (see test circuit no. 2009) | | | | | | 4.0 | dB | $V_{CC}$ = 12 V, $V_{AGC}$ = 2.0 V, f = 100 MHz |
| PG | Power Gain (see test circuit no. 257) | 20 | 27 | | | | | dB | $V_{AGC}$ = 1.4 V, f = 200 MHz |
| | (see test circuit no. 2003) | | | 25 | | | | dB | $V_{AGC}$ = 2.75 V, $V_{CC}$ = 12 V, f = 45 MHz |
| | (see test circuit no. 2009) | | | | | 20 | | dB | $V_{CC}$ = 12 V, f = 100 MHz |
| $V_{AGC(30)}$ | AGC Voltage for 30 dB Gain Reduction (see test circuit no. 257) | 4.0 | 5.0 | | | | | V | $V_{CC}$ = 12 V, f = 200 MHz |
| | (see test circuit no. 2003) | | | 4.4 | 5.8 | | | V | $V_{CC}$ = 12 V, f = 45 MHz |
| $V_{AGC(50)}$ | AGC Voltage for 50 dB Gain Reduction (see test circuit no. 2003) | | | | 8.0 | | | V | $V_{CC}$ = 12 V, f = 45 MHz |
| $C_{cb}$ | Collector to Base Capacitance | 0.25 | 0.5 | | 0.40 | 0.25 | 0.5 | pF | $I_E$ = 0, $V_{CB}$ = 10 V, f = 1.0 MHz |
| $h_{FE}$ | DC Pulse Current Gain | 25 | 200 | 20 | 200 | 20 | 200 | | $I_C$ = 4.0 mA, $V_{CE}$ = 5.0 V |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 5) | 30 | | 20 | | 20 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | | 50 | | 50 | nA | $I_E$ = 0, $V_{CB}$ = 10 V |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 30 | | 20 | | 20 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 3.0 | | 3.0 | | 3.0 | | V | $I_C$ = 0, $I_E$ = 100 μA |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | 3.0 | | 3.0 | | 3.0 | V | $I_C$ = 10 mA, $I_B$ = 5.0 mA |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 5) | | 0.95 | | 0.95 | | 0.95 | V | $I_C$ = 10 mA, $I_B$ = 5.0 mA |
| $h_{fe}$ | High Frequency Current Gain | 3.75 | | 3.0 | | 3.0 | | | $I_C$ = 4.0 mA, $V_{CE}$ = 10 V, f = 100 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to ambient thermal resistance of 283°C/W (derating factor of 3.53 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5-SS19.

# PE5025

## NPN IF AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C**
- **OPTIMIZED FOR FINAL VIDEO IF AMPLIFIER**
- **$C_{re}$ . . . 1.0 pF (MAX)**
- **$g_{oe}$ . . . 200 μmho (MAX)**
- **$G_{pe}$ . . . 25 dB (MIN) @ f = 45 MHz**
- **$V_{CEO}$ . . . 30 V (MIN)**

**See TO92-1 Package Outline**


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | –55°C to +150°C |
| Operating Junction Temperature | 150°C |

**Maximum Power Dissipation** (Notes 2 & 5)

| | |
|---|---|
| Total Dissipation at or below 65°C Ambient Temperature | 0.425 W |

**Maximum Voltages**

| | | |
|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 30 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 3) | 30 V |
| $V_{EBO}$ | Emitter to Base Voltage | 3.0 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $G_{pe}$ | Power Gain, Fixed Neutralization (see test circuit no. 320) | 25 | | dB | $I_C$ = 10 mA, $V_{CE}$ = 10 V, f = 45 MHz |
| $C_{re}$ | Reverse Transfer Capacitance | 0.6 | 1.1 | pF | $I_E$ = 0, $V_{CB}$ = 10 V, f ≤ 1.0 MHz |
| $g_{oe}$ | Output Admittance, Input Short Circuit | 30 | 200 | μmho | $I_C$ = 10 mA, $V_{CE}$ = 10 V, f = 45 MHz |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 4) | 30 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 30 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 3.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $h_{FE}$ | DC Pulse Current Gain (Note 4) | 20 | 100 | | $I_C$ = 10 mA, $V_{CE}$ = 10 V |
| $h_{fe}$ | High Frequency Current | 3.0 | 7.0 | | $I_C$ = 10 mA, $V_{CE}$ = 10 V, f = 100 MHz |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 4) | | 0.6 | V | $I_C$ = 20 mA, $I_B$ = 1.0 mA, |
| $I_{CEO}$ | Collector Cutoff Current | | 1.0 | μA | $I_B$ = 0, $V_{CE}$ = 30 V |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | nA | $I_E$ = 0, $V_{CB}$ = 30 V |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.
2. These ratings give a maximum junction temperature of 150°C and junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
3. Rating refers to a high current point where collector to emitter voltage is lowest.
4. Pulse conditions: length = 300 μs; duty cycle = 1%.
5. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
6. For product family characteristic curves, refer to Section 5 - SS6.

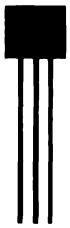
# PE5029 • PE5030B • PE5031

## NPN RF-IF AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **PE5031 . . . VHF AMPLIFIER AND MIXER**
- **PE5030B . . . THIRD VIDEO IF**
- **PE5029 . . . RF IF AMPLIFIER**
- **$C_{cb}$ . . . 0.4 pF (MAX)**
- **PG . . . 22 dB (MIN) @ 200 MHz (PE5031)**
- **NF . . . 4.5 dB (MAX) @ 200 MHz (PE5031)**

**See TO92-1 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |
| Lead Temperature (60 seconds) | 260°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at or below 65°C Ambient Temperature | 0.425 W |

| **Maximum Voltages** | | **PE5029** | **PE5030B** | **PE5031** |
|---|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 35 V | 45 V | 40 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 30 V | 40 V | 30 V |
| $V_{EBO}$ | Emitter to Base Voltage | 3.0 V | 4.5 V | 4.0 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | PE5029 MIN. | PE5029 MAX. | PE5030B MIN. | PE5030B MAX. | PE5031 MIN. | PE5031 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $G_{PE}$ | Power Gain | | | | | | | | |
| | (see test circuit no. 592) | 28 | | | | | | dB | $V_{CC}$ = 12 V, $V_{BB}$ = 2.5 V, f = 45 MHz |
| | (see test circuit no. 573) | | | | | 22 | | dB | $V_{CC}$ = 12 V, f = 200 MHz |
| | (see test circuit no. 596) | | | 27 | | | | dB | $V_{CE}$ = 10 V, $I_C$ = 10 mA, f = 45 MHz |
| NF | Noise Figure | | | | | | | | |
| | (see test circuit no. 592) | | 6.0 | | | | | dB | $V_{CC}$ = 12 V, f = 45 MHz |
| | (see test circuit no. 573) | | | | | | 4.5 | dB | $V_{CC}$ = 12 V, f = 200 MHz |
| $C_{cb}$ | Collector to Base Capacitance | | 0.40 | 0.25 | 0.40 | | 0.40 | pF | $V_{CB}$ = 15 V, $I_E$ = 0, f = 1.0 MHz |
| $h_{FE}$ | DC Current Gain | 30 | 225 | | | 30 | 180 | | $V_{CE}$ = 10 V, $I_C$ = 5.0 mA |
| | (Note 5) | | | 45 | 150 | | | | $V_{CE}$ = 15 V, $I_C$ = 7.0 mA |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | 30 | | 40 | | 30 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 200 | | 100 | | 100 | nA | $V_{CB}$ = 30 V, $I_E$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 30 | | 45 | | 40 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 3.0 | | | | 4.0 | | V | $I_C$ = 0, $I_E$ = 100 μA |
| | | | | 4.5 | | | | V | $I_C$ = 0, $I_E$ = 10 μA |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage | | 0.85 | | | | 0.85 | V | $I_C$ = 5.0 mA, $V_{CE}$ = 10 V |
| $h_{fe}$ | High Frequency Current Gain | 5.0 | | | | 6.0 | | | $V_{CE}$ = 10 V, $I_C$ = 5.0 mA, f = 100 MHz |
| | | | | 6.0 | | | | | $V_{CE}$ = 15 V, $I_C$ = 7.0 mA f = 100 MHz |

NOTES:

*Planar is a patented Fairchild process.

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C; junction to ambient thermal resistance of 200°C/W derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. $GMS = 10 \log \frac{Y_{fe}}{Y_{re}}$
7. For product family characteristic curves, refer to Section 5-SS12.

4

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) **(Cont'd)**

| SYMBOL | CHARACTERISTIC | PE5029 MIN. | PE5029 MAX. | PE5030B MIN. | PE5030B MAX. | PE5031 MIN. | PE5031 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $V_{BE(sat)}$ | Pulsed Base Saturation Voltage (Note 5) | | | | 0.92 | | | V | $I_C$ = 10 mA, $I_B$ = 5.0 mA |
| $V_{CE(sat)}$ | Pulsed Collector Saturation Voltage (Note 5) | | | | 3.0 | | | V | $I_C$ = 20 mA, $I_B$ = 1.0 mA |
| | | | | | | | 1.0 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $G_{VE}$ | Voltage Gain (see test circuit no. 595) | | | 38 | 46 | | | dB | Fixed Tuned Test Circuit Unneutralized, f = 45 MHz |
| GMS | Gain Maximum Stable (Note 6) | | | 27 | | | | dB | $V_{CE}$ = 15 V, $I_C$ = 7.0 mA f = 45 MHz |

# PE6020 • PE6021 • SE6020 • SE6021

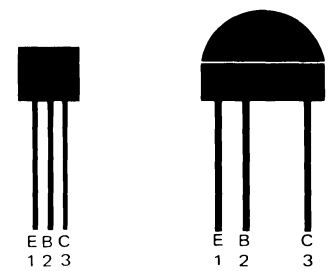
## NPN SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS AND SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C (PE6020, PE6021)**
- **$V_{CEO}$ . . . 80 V (MIN) (PE6021)**
- **$h_{FE}$ . . . 100-300 @ 150 mA**
- **$V_{CE(sat)}$ . . . 0.5 V (MAX) @ 500 mA; 0.18 V (MAX) @ 150 mA**
- **$f_T$ . . . 250 MHz (MIN) @ 50 mA**
- **COMPLEMENTS . . . 2N/MPS4355, 2N/MPS4356**

See Package Outlines

TO92-1 TO5-4




PE6020 PE6021 SE6020 SE6021

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | PE6020, PE6021 | SE6020, SE6021 |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | −55°C to +150°C | −55°C to +125°C |
| Operating Junction Temperature | 150°C | 125°C |
| Lead Temperature (10 seconds) | 260°C | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Case Temperature | 1.0 W | 0.8 W |
| at 25°C Ambient Temperature | 0.625 W | 0.3 W |
| **Maximum Voltages and Current** | **PE6020, SE6020** | **PE6021, SE6021** |
| $V_{CBO}$ Collector to Base Voltage | 60 V | 80 V |
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | 60 V | 80 V |
| $V_{EBO}$ Emitter to Base Voltage | 6.5 V | 6.5 V |
| $I_C$ Collector Current | 1.0 A | 1.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | PE6020, SE6020 MIN. | PE6020, SE6020 MAX. | PE6021, SE6021 MIN. | PE6021, SE6021 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 30 | | 30 | | | $I_C$ = 100 μA, $V_{CE}$ = 10 V |
| | | 60 | | 60 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V |
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 90 | | 90 | | | $I_C$ = 10 mA, $V_{CE}$ = 10 V |
| | | 100 | | 100 | | | $I_C$ = 50 mA, $V_{CE}$ = 1.0 V |
| | | 40 | 300 | 40 | | | $I_C$ = 150 mA, $V_{CE}$ = 1.0 V |
| | | 100 | 300 | 100 | 300 | | $I_C$ = 150 mA, $V_{CE}$ = 10 V |
| | | 70 | | 70 | | | $I_C$ = 300 mA, $V_{CE}$ = 10 V |
| | | 45 | | 45 | | | $I_C$ = 500 mA, $V_{CE}$ = 10 V |
| | | 10 | | 10 | | | $I_C$ = 150 mA, $V_{CE}$ = 1.0 V, $T_A$ = −55°C |
| | | 25 | | 25 | | | $I_C$ = 150 mA, $V_{CE}$ = 10 V, $T_A$ = −55°C |
| | | | 340 | | 340 | | $I_C$ = 150 mA, $V_{CE}$ = 1.0 V, $T_A$ = 65°C |
| | | | 380 | | 380 | | $I_C$ = 150 mA, $V_{CE}$ = 10 V, $T_A$ = 65°C |
| $h_{fe}$ | High Frequency Current Gain | 2.5 | 6.0 | 2.5 | 6.0 | | $I_C$ = 50 mA, $V_{CE}$ = 5.0 V, f = 100 MHz |
| $V_{CE(sat)}$ | Pulsed Collector Saturation Voltage (Note 5) | | 0.07 | | 0.07 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | 0.18 | | 0.18 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | | | 0.31 | | 0.31 | V | $I_C$ = 300 mA, $I_B$ = 30 mA |
| | | | 0.50 | | 0.50 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| | | | 0.28 | | 0.28 | V | $I_C$ = 150 mA, $I_B$ = 15 mA, $T_A$ = 65°C |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C) for PE6020 and PE6021. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 167°C/W (derating factor of 6.0 mW/°C) for SE6020 and SE6021.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 - SS17.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | PE6020, SE6020 MIN. | PE6020, SE6020 MAX. | PE6021, SE6021 MIN. | PE6021, SE6021 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_{BE(sat)}$ | Pulsed Base Saturation Voltage (Note 5) | | 0.72 | | 0.72 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | 0.78 | 0.90 | 0.78 | 0.90 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | | | 1.05 | | 1.05 | V | $I_C$ = 300 mA, $I_B$ = 30 mA |
| | | | 1.30 | | 1.30 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| | | | 1.10 | | 1.10 | V | $I_C$ = 150 mA, $I_B$ = 15 mA, $T_A$ = −55°C |
| | | 0.72 | | 0.72 | | V | $I_C$ = 150 mA, $I_B$ = 15 mA, $T_A$ = 65°C |
| $V_{BE(ON)}$ | Pulsed Base Emitter "On" Voltage (Note 5) | | 0.88 | | 0.88 | V | $I_C$ = 150 mA, $V_{CE}$ = 10 V |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | 60 | | 80 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | 60 | | 80 | | V | $I_C$ = 10 μA, $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 6.5 | | 6.5 | | V | $I_C$ = 0, $I_E$ = 10 μA |
| $I_{CBO}$ | Collector Cutoff Current | | 100 | | 100 | nA | $I_E$ = 0, $V_{CB}$ = 50 V |
| | | | 10 | | 10 | μA | $I_E$ = 0, $V_{CB}$ = 50 V, $T_A$ = 65°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 100 | | 100 | nA | $I_C$ = 0, $V_{EB}$ = 4.0 V |
| $C_{cb}$ | Collector to Base Capacitance | | 15 | | 15 | pF | $I_E$ = 0, $V_{CB}$ = 10 V, f = 1.0 MHz |
| $C_{eb}$ | Emitter to Base Capacitance | | 75 | | 75 | pF | $I_C$ = 0, $V_{EB}$ = 0.5 V, f= 1.0 MHz |
| $t_{on}$ | Turn On Time (see test circuit no. 417) | | 150 | | 150 | ns | $I_C$ = 150 mA, $I_{B1}$ = 15 mA |
| $t_{off}$ | Turn Off Time (see test circuit no. 417) | | 1.0 | | 1.0 | μs | $I_C$ = 150 mA, $I_{B1}$ = $I_{B2}$ = 15 mA |

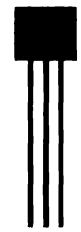
# PN4357

## PNP SMALL SIGNAL HIGH VOLTAGE GENERAL PURPOSE AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- $V_{CEO}$ . . . −240 V (MIN)
- NF . . . 3.0 dB (MAX) @ 1.0 kHz
- $h_{FE}$ . . . 80-300 @ 10 mA
- EXCELLENT BETA LINEARITY FROM 10 μA TO 50 mA

See TO92-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −55°C to +150°C |
| Operating Junction Temperature | | 150°C |
| Soldering Temperature (10 seconds) | | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 5) | | |
| Total Dissipation at 25°C Case Temperature | | 1.0 W |
| at 25°C Ambient Temperature | | 0.625 W |
| **Maximum Voltages** | | |
| $V_{CBO}$ | Collector to Base Voltage | −240 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 3) | −240 V |
| $V_{EBO}$ | Emitter to Base Voltage | −6.0 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $V_{CEO}$ | Collector to Emitter Sustaining Voltage | −240 | | V | $I_C$ = 2.0 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −240 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| NF | Narrow Band Noise Figure | | 10 | dB | $I_C$ = 10 μA, $V_{CE}$ = −5.0 V, $R_S$ = 10 kΩ, BW = 15 Hz, f = 100 Hz |
| | | | 3.0 | dB | $I_C$ = 10 μA, $V_{CE}$ = −5.0 V, $R_S$ = 10 kΩ, BW = 150 Hz, f = 1.0 kHz |
| | | | 3.0 | dB | $I_C$ = 10 μA, $V_{CE}$ = −5.0 V $R_S$ = 10 kΩ, BW = 1.5 kHz, f = 10 kHz |
| $h_{FE}$ | DC Pulse Current Gain (Note 4) | 80 | 300 | | $I_C$ = 10 mA, $V_{CE}$ = −10 V |
| $h_{FE}$ | DC Current Gain | 60 | | | $I_C$ = 10 μA, $V_{CE}$ = −10 V |
| | | 80 | | | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V |
| | | 15 | | | $I_C$ = 10 μA, $V_{CE}$ = −10 V, $T_A$ = −55°C |
| $C_{ob}$ | Output Capacitance | | 7.0 | pF | $I_E$ = 0, $V_{CB}$ = −5.0 V, f = 1.0 MHz |
| $C_{ib}$ | Input Capacitance | | 25 | pF | $V_{EB}$ = −0.5 V, $I_C$ = 0, f = 1.0 MHz |
| $I_{CBO}$ | Collector Reverse Current | | 20 | nA | $V_{CB}$ = −200 V, $I_E$ = 0 |
| | | | 20 | μA | $V_{CB}$ = −200 V, $I_E$ = 0, $T_A$ = 150°C |
| $V_{CE(sat)}$ | Pulsed Collector Saturation Voltage (Note 4) | | −0.5 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −6.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 10 | nA | $V_{EB}$ = −4.0 V, $I_C$ = 0 |
| $V_{BE(sat)}$ | Pulsed Base Saturation Voltage (Note 4) | | −0.9 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $h_{fe}$ | High Frequency Current Gain | −2.0 | −8.0 | V | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V, f = 20 MHz |
| $h_{fe}$ | Small Signal Current Gain | 100 | 400 | | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V, f = 1.0 kHz |
| $h_{oe}$ | Output Conductance | 5.0 | 25 | μmhos | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V, f = 1.0 kHz |
| $h_{ie}$ | Input Resistance | 2.5 | 12 | kΩ | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V, f = 1.0 kHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
3. Rating refers to a high current point where collector to emitter voltage is lowest.
4. Pulse conditions: length = 300 μs; duty cycle = 1%.
5. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
6. For product family characteristic curves, refer to Section 5 - SS4.

# PN5964 • PN5965

## LOW POWER AUDIO FREQUENCY

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- $V_{CEO}$ . . . 150 V (MIN) (PN5964), 180 V (MIN) (PN5965)
- $h_{FE}$ . . . 50-250 @ 10 mA
  . . . 50 (MIN) @ 1.0 mA AND 50 mA
- $C_{cb}$ . . . 4.0 pF (MAX) @ 10 V
- COMPLEMENTS . . . PN4888

See TO92-1 Package Outline


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |
| Lead Temperature (10 seconds) | 260°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 1.0 W |
| at 25°C Ambient Temperature | 0.625 W |

| **Maximum Voltages and Current** | | **PN5964** | **PN5965** |
|---|---|---|---|
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V | 5.0 V |
| $V_{CBO}$ | Collector to Base Voltage | 160 V | 200 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 150 V | 180 V |
| $I_C$ | DC Collector Current | 600 mA | 600 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | PN5964 MIN. | PN5964 MAX. | PN5965 MIN. | PN5965 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $I_{CBO}$ | Collector Cutoff Current | | 50 | | | nA | $V_{CB}$ = 120 V, $I_E$ = 0 |
| | | | | | 50 | nA | $V_{CB}$ = 160 V, $I_E$ = 0 |
| | | | 25 | | | μA | $V_{CB}$ = 120 V, $I_E$ = 0, $T_A$ = 100°C |
| | | | | | 25 | μA | $V_{CB}$ = 160 V, $I_E$ = 0, $T_A$ = 100°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 50 | | 50 | nA | $V_{EB}$ = 4.0 V, $I_C$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 160 | | 200 | | V | $I_E$ = 0, $I_C$ = 100 μA |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | 5.0 | | V | $I_C$ = 0, $I_E$ = 10 μA |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | 150 | | 180 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $h_{FE}$ | DC Current Gain | 50 | | 50 | | | $V_{CE}$ = 5.0 V, $I_C$ = 1.0 mA |
| | (Note 5) | 50 | 250 | 50 | 250 | | $V_{CE}$ = 5.0 V, $I_C$ = 10 mA |
| | (Note 5) | 50 | | 50 | | | $V_{CE}$ = 5.0 V, $I_C$ = 50 mA |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage | | 0.8 | | 0.8 | V | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V |
| $V_{BE(sat)}$ | Base to Emitter Saturation | | 0.8 | | 0.8 | V | $I_C$ = 1.0 mA, $I_B$ = 0.1 mA |
| | Voltage (Note 5) | | 1.0 | | 1.0 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | (Note 5) | | 1.0 | | 1.0 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $V_{CE(sat)}$ | Collector to Emitter Saturation | | 0.15 | | 0.15 | V | $I_C$ = 1.0 mA, $I_B$ = 0.1 mA |
| | Voltage (Note 5) | | 0.20 | | 0.20 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | (Note 5) | | 0.25 | | 0.25 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |

Additional Electrical Characteristics on following page.

*Planar ia a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Applicable from 1.0 mA to 20 mA.
5. Pulse conditions: length ≤ 300 μs; duty cycle = 1%.
6. $C_{cb}$ measurement employs a three terminal capacitance bridge incorporating a guard circuit. The emitter terminal shall be connected to the guard terminal of the bridge.
7. For product family characteristic curves, refer to Section 5 - SS16.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd.)

| SYMBOL | CHARACTERISTIC | PN5964 MIN. | PN5964 MAX. | PN5965 MIN. | PN5965 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{ie}$ | Small Signal Short Circuit Input Impedance | | 6.0 | | 6.0 | kΩ | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $h_{oe}$ | Small Signal Open Circuit Output Conductance | | 40 | | 40 | μmho | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $h_{fe}$ | Small Signal Current Gain | 50 | | 50 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $C_{cb}$ | Collector Base Capacitance (Note 6) | | 4.0 | | 4.0 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 1.0 MHz |
| $\|h_{fe}\|$ | Magnitude of Common Emitter Small Signal Current Gain | 1.0 | 5.0 | 1.0 | 5.0 | | $I_C$ = 10 mA, $V_{CE}$ = 10 V, f = 100 MHz |

4

# RF400 • RF401

## AFC

DIFFUSED SILICON PLANAR* EPITAXIAL DIODES

- **Q . . . 400 (TYP) @ 50 MHz**
- **C3/C20 . . . 2.0 MIN**

**See DO35-1 Package Outline**

**ABSOLUTE MAXIMUM RATINGS**

| | | |
|---|---|---|
| **Maximum Temperature** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Temperature | | 175°C |
| **Maximum Power Dissipation** | | |
| Total Dissipation | | 350 mW |
| **Maximum Voltage and Current** | | |
| WIV | Maximum Working Voltage | 30 V |
| $I_F$ | Forward Current | 250 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| BV | Breakdown Voltage | 35 | | V | $I_R$ = 10 μA |
| $I_R$ | Reverse Leakage Current | | 30 | nA | $V_R$ = 30 V |
| $I_R$ | Reverse Leakage Current | | 50 | μA | $V_R$ = 30 V, $T_A$ = 150°C |
| Q | Figure of Merit | 350 | | | $V_R$ = 4.0 V, f = 50 MHz |
| | | **RF400** | **RF401** | | |
| | Nominal Capacitance | 10 | 7.0 | pF | $V_R$ = 4.0 V, f = 1.0 MHz |
| | Minimum Capacitance | 2.0 | 2.0 | | $V_R$ = 0.1 V, f = 1.0 MHz (C0.1) |
| | Ratio $\frac{C0.1}{C4}$ | | | | $V_R$ = 4.0 V, f = 1.0 MHz (C4) |
| | Minimum Capacitance | 2.0 | 2.0 | | $V_R$ = 3.0 V, f = 1.0 MHz (C3) |
| | Ratio $\frac{C3}{C20}$ | | | | $V_R$ = 20 V, f = 1.0 MHz (C20) |

*Planar is a patented Fairchild process.

NOTE:
1. For product family characteristic curves, refer to Section 5 — D1.

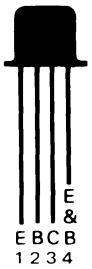
# SE5020 • SE5021 • SE5022 • SE5023 • SE5024

## NPN SMALL SIGNAL RF-AGC AMPLIFIERS

DIFFUSED SILICON PLANAR* TRANSISTORS

- $V_{CEO}$ . . . 20 V
- **PERFORMANCE CHARACTERIZED @ 45 MHz & 200 MHz**
- $V_{AGC}$ **GUARANTEED FOR −30 dB @ 45 MHz & 200 MHz**
- $C_{re}$ . . . 0.25–0.5 pF @ 10 V
- **NF . . . 3.3 dB (MAX) (SE5020)**

**See TO18-3 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| **Maximum Temperatures** | |
| Storage Temperature | −55°C to +175°C |
| Operating Junction Temperature | 175°C |
| **Maximum Power Dissipation** (Note 2) | |
| Total Dissipation at 25°C Case Temperature | 0.260 W |
| at 25°C Ambient Temperature | 0.175 W |
| **Maximum Voltages** | |
| $V_{CBO}$ Collector to Base Voltage | 20 V |
| $V_{CEO}$ Collector to Emitter Voltage (Note 3) | 20 V |
| $V_{EBO}$ Emitter to Base Voltage | 3.0 V |

**ELECTRICAL CHARACTERISTICS:** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | SE5020/1/2 MIN. | SE5020/1/2 MAX. | SE5023/4 MIN. | SE5023/4 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| NF | Noise Figure (see test circuit no. 257) | | | | | | |
| | SE5020 | | 3.3 | | | dB | $V_{AGC}$ = 1.4 V, $R_S$ = 75Ω, f = 200 MHz |
| | SE5021 | | 4.0 | | | dB | |
| NF | Noise Figure (see test circuit no. 211) | | | | 6.0 | dB | $V_{AGC}$ = 2.75 V, $R_S$ = 50Ω, f = 45 MHz |
| PG | Power Gain (see test circuit no. 257) | | | | | | |
| | SE5020, SE5021 | 20 | 27 | | | dB | $V_{AGC}$ = 1.4 V, $R_S$ = 75Ω, f = 200 MHz |
| | SE5022 | 18 | | | | | |
| PG | Power Gain (see test circuit no. 211) | | | 22.5 | 28.5 | dB | $V_{AGC}$ = 2.75 V, $R_S$ = 50Ω, f = 45 MHz |
| $V_{AGC}$ | AGC Voltage for 30 dB Gain Reduction (see test circuit no. 257) SE5020 | 4.0 | 5.0 | | | V | $R_S$ = 75 Ω, f = 200 MHz |
| $V_{AGC}$ | AGC Voltage for 30 dB Gain Reduction (see test circuit no. 211) SE5023 | | | 4.4 | 5.4 | V | $R_S$ = 50Ω, f = 45 MHz |
| | SE5024 | | | 5.2 | 6.2 | V | |
| $C_{re}$ | Reverse Transfer Capacity, Common Emitter | 0.25 | 0.5 | 0.25 | 0.5 | pF | $I_E$ = 0, $V_{CB}$ = 10 V, f = 1.0 MHz (Emitter & can guarded) |
| $h_{FE}$ | DC Pulse Current Gain | 20 | 200 | 20 | 200 | | $I_C$ = 4.0 mA, $V_{CE}$ = 5.0 V |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | | 50 | nA | $I_E$ = 0, $V_{CB}$ = 10 V |
| $V_{CEO(sus)}$ | Collector Emitter Sustaining Voltage (Note 4) | 20 | | 20 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown | 20 | | 20 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 3.0 | | 3.0 | | V | $I_C$ = 0, $I_E$ = 100 μA |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 4) | | 3.0 | | 3.0 | V | $I_C$ = 10 mA, $I_B$ = 5.0 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 4) | | 0.96 | | 0.96 | V | $I_C$ = 10 mA, $I_B$ = 5.0 mA |
| $h_{fe}$ | High Frequency Current Gain | | | | | | |
| | SE5020, SE5021 | 3.75 | 8.0 | 3.0 | 8.0 | | $I_C$ = 4.0 mA, $V_{CE}$ = 10 V, f = 100 MHz |
| | SE5022 | 3.0 | 8.0 | | | | |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These ratings give a maximum junction temperature of 175°C and junction to case thermal resistance of 583°C/W (derating factor of 1.75 mW/°C); junction to ambient thermal resistance of 850°C/W (derating factor of 1.17 mW/°C).
3. Rating refers to a high current point where collector to emitter voltage is lowest.
4. Pulse conditions: length = 300 μs; duty cycle = 1%.
5. For additional product family characteristic curves, refer to Section 5-SS3.

# SE5035 • SE5036

## NPN RF-VHF AMPLIFIERS AND MIXERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$C_{cb}$ . . . 0.3 pF (MAX), 0.22 pF (TYP)**
- **$f_T$ . . . 600 MHz (MIN)**
- **$P_G$ . . . 22 dB (MIN) @ 200 MHz, 29 dB (MIN) @ 45 MHz**
- **$C_{GE}$ . . . 25 dB (TYP)**

**See TO18-3 Package Outline**


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +175°C |
| Operating Temperature | 175°C |

**Maximum Power Dissipation** (Note 2)

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 0.300 W |
| at 25°C Ambient Temperature | 0.200 W |

**Maximum Voltages**

| | | SE5035 | SE5036 |
|---|---|---|---|
| $V_{CES}$ | Collector to Emitter Voltage | 40 V | 35 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 3) | 30 V | 30 V |
| $V_{EBO}$ | Emitter to Base Voltage | 4.0 V | 3.0 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | SE5035 MIN. | SE5035 TYP. | SE5035 MAX. | SE5036 MIN. | SE5036 TYP. | SE5036 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| PG | Neutralized Gain | | | | | | | | |
| | (see test circuit no. 520) | 22 | 27 | | | | | dB | $V_{CC}$ = 12 V, f = 200 MHz |
| | (see test circuit no. 422) | | | | 29 | 33 | | dB | $V_{CC}$ = 12 V, f = 45 MHz |
| $C_{GE}$ | Conversion Gain, Unneutralized | | | | | | | | |
| | (see test circuit no. 520-45) | | 25 | | | | | dB | $V_{CC}$ = 12 V, $I_C \approx$ 4.0 mA, $f_{in}$ = 213 MHz, $f_{out}$ = 45 MHz |
| $G_{PE}$ | Unneutralized Gain (see test circuit no. 520-200) | | 19.5 | | | | | dB | $V_{CC}$ = 12 V, f = 200 MHz |
| NF | Noise Figure | | | | | | | | |
| | (see test circuit no. 520-200) | | 2.5 | | | | | dB | f = 200 MHz |
| | (see test circuit no. 422) | | | | | 3.3 | 5.0 | dB | f = 45 MHz |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage | | 0.75 | 0.85 | | 0.75 | 0.85 | V | $I_C$ = 5.0 mA, $V_{CE}$ = 10 V |
| $h_{fe}$ | High Frequency Current Gain | 6.0 | 10 | | 5.0 | 8.0 | | | $I_C$ = 5.0 mA, $V_{CE}$ = 10 V, f = 100 MHz |
| $C_{cb}$ | Collector to Base Capacitance | | 0.22 | 0.3 | | 0.22 | 0.3 | pF | $I_E$ = 0, $V_{CB}$ = 10 V |
| $h_{FE}$ | DC Current Gain | 40 | 80 | 180 | 30 | 70 | 225 | | $I_C$ = 5.0 mA, $V_{CE}$ = 10 V |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage | 30 | | | 30 | | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | | 50 | | | 50 | nA | $I_E$ = 0, $V_{CB}$ = 30 V |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage (Shorted Base) | 40 | | | 35 | | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 4.0 | | | 3.0 | | | V | $I_C$ = 0, $I_E$ = 100 μA |
| $R_{iep}$ | Input Resistance, Common Emitter | | | | | 300 | | Ω | $I_C$ = 5.0 mA, $V_{CE}$ = 10 V, f = 45 MHz |
| $C_{iep}$ | Input Capacitance Common Emitter | | | | | 17 | | pF | $I_C$ = 5.0 mA, $V_{CE}$ = 10 V, f = 45 MHz |
| $R_{oep}$ | Output Resistance, Common Emitter | | | | | 25 | | kΩ | $I_C$ = 5.0 mA, $V_{CE}$ = 10 V, f = 45 MHz |
| $C_{oep}$ | Output Capacitance, Common Emitter | | | | | 1.4 | | pF | $I_C$ = 5.0 mA, $V_{CE}$ = 10 V, f = 45 MHz |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These ratings give a maximum junction temperature of 175°C and junction to case thermal resistance of 503°C/W (derating factor of 1.98 mW/°C); junction to ambient thermal resistance of 770°C/W (derating factor of 1.33 mW/°C).
3. Rating refers to a high current point where collector to emitter voltage is lowest.
4. For product family characteristic curves, refer to Section 5 - SS12.

**TYPICAL COMMON EMITTER "Y" PARAMETERS FOR SE5035** ($T_A$ = 25°C, $V_{CE}$ = 10 V) (Cont'd)

| SYMBOL | PARAMETER | MAGNITUDE | | |
|---|---|---|---|---|
| | | $I_C$ = 2.0 mA, f = 200 MHz | $I_C$ = 5.0 mA, f = 200 MHz | $I_C$ = 5.0 mA, f = 45 MHz |
| $\|Y_{ie}\|$ | Input Admittance<br>Output Short Circuit | 8.0 + j11.0 mmhos | 13.0 + j12.0 mmhos | 3.5 + j5.5 mmhos |
| $\|Y_{re}\|$ | Reverse Transadmittance<br>Input Short Circuit | −0.02 − 0.28 mmhos | −0.03 − j0.28 mmhos | 0.00 − j0.06 mmhos |
| $\|Y_{fe}\|$ | Forward Transadmittance<br>Output Short Circuit | 39.0 − j42.0 mmhos | 48.0 − 79.0 mmhos | 120 − j42.0 mmhos |
| $\|Y_{oe}\|$ | Output Admittance<br>Input Short Circuit | 0.10 + j1.80 mmhos | 0.18 + j1.80 mmhos | 0.04 + j0.40 mmhos |

4

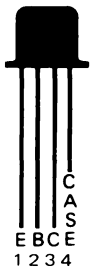
# SE5050 • SE5051

## NPN SMALL SIGNAL RF AMPLIFIERS

DIFFUSED SILICON PLANAR* TRANSISTORS

- **$C_{re}$ . . . 0.25 (MIN) TO 0.50 (MAX) pF**
- **NF . . . 4.0 dB (MAX) @ 100 MHz**
- **PG . . . 20 dB (MIN) @ 100 MHz**

**See TO18-3 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −55°C to +175°C |
| Operating Junction Temperature | | 175°C |
| **Maximum Power Dissipation** | | |
| Total Dissipation at 25°C Case Temperature | | 0.260 W |
| at 25°C Ambient Temperature | | 0.175 W |
| **Maximum Voltages** | | |
| $V_{CBO}$ | Collector to Base Voltage | 20 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 3) | 20 V |
| $V_{EBO}$ | Emitter to Base Voltage | 3.0 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| NF | Noise Figure SE5050 (see test circuit no. 334) | | 4.0 | dB | $V_{AGC}$ = 2.0 V, $R_G$ = 75 Ω, f = 100 MHz |
| PG | Power Gain (see test circuit no. 334) | 20 | | dB | $V_{AGC}$ = 2.0 V, $R_G$ = 75 Ω, f = 100 MHz |
| $C_{re}$ | Reverse Transfer Capacity Common Emitter | 0.25 | 0.50 | pF | $I_E$ = 0, $V_{CB}$ = 10 V |
| $h_{fe}$ | DC Pulse Current Gain (Note 4) | 20 | 200 | | $V_{CE}$ = 5.0 V, $I_C$ = 4.0 mA |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 3 & 4) | 20 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | nA | $I_E$ = 0, $V_{CB}$ = 10 V |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 20 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 3.0 | | V | $I_C$ = 0, $I_E$ = 100 μA |
| $V_{CE(sat)}$ | Collector Saturation Voltage | | 3.0 | V | $I_C$ = 10 mA, $I_B$ = 5.0 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage | | 0.96 | V | $I_C$ = 10 mA, $I_B$ = 5.0 mA |
| $h_{fe}$ | High Frequency Current Gain | 3.0 | | | $I_C$ = 4.0 mA, $V_{CE}$ = 10 V, f = 100 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These ratings give a maximum junction temperature of 175°C and junction to case thermal resistance of 583°C/W (derating factor of 1.73 mW/°C); junction to ambient thermal resistance of 850°C/W (derating factor of 1.17 mW/°C).
3. Rating refers to a high current point where collector to emitter voltage is lowest.
4. Pulse conditions: length = 300 μs; duty cycle = 1%.
5. For product family characteristic curves, refer to Section 5 — SS3.

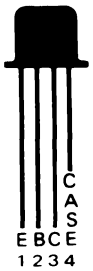
# SE5055

## NPN RF-AGC AMPLIFIER

DIFFUSED SILICON PLANAR* TRANSISTOR

- **$C_{cb}$ . . . 0.13 pF (TYP), 0.22 pF (MAX)**
- **PG . . . 27 dB (MIN) AT 45 MHz**
- **$V_{AGC}$ . . . GUARANTEED FOR −30 dB AND −50 dB AT 45 MHz**

**See TO18-3 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +175°C |
| Operating Junction Temperature | 175°C |

**Maximum Power Dissipation** (Note 2)

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 0.260 W |
| at 25°C Ambient Temperature | 0.175 W |

**Maximum Voltages**

| | | |
|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 20 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 3) | 20 V |
| $V_{EBO}$ | Emitter to Base Voltage | 3.0 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | TYP. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| PG | Power Gain (see test circuit no. 422) | 27 | 29 | | dB | $V_{BE}$ = 2.0 V, f = 45 MHz |
| NF | Noise Figure (see test circuit no. 422) | | 2.7 | 5.0 | dB | $V_{BE}$ = 2.0 V, f = 45 MHz |
| $V_{AGC}$ | AGC Voltage for 30 dB Gain Reduction (see test circuit no. 422) | 3.3 | 4.15 | 5.0 | V | $V_{CC}$ = 12 V, f = 45 MHz |
| $I_{AGC}$ | Collector Current for 30 dB Gain Reduction (see test circuit no. 422) | | 7.2 | | mA | $V_{CC}$ = 12 V, f = 45 MHz |
| $V_{AGC}$ | AGC Voltage for 50 dB Gain Reduction (see test circuit no. 422) | | 6.15 | 7.5 | V | $V_{CC}$ = 12 V, f = 45 MHz |
| $C_{cb}$ | Collector to Base Capacitance | | 0.13 | 0.22 | pF | $I_E$ = 0, $V_{CB}$ = 10 V, f = 1.0 MHz |
| $h_{FE}$ | DC Current Gain | 20 | 80 | 220 | | $I_C$ = 2.0 mA, $V_{CE}$ = 10 V |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage | 20 | | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | | 50 | nA | $I_E$ = 0, $V_{CB}$ = 20 V |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 20 | | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 3.0 | | | V | $I_C$ = 0, $I_E$ = 100 μA |
| $V_{CE(sat)}$ | Collector Saturation Voltage | | | 2.75 | V | $I_C$ = 10 mA, $I_B$ = 5.0 mA |
| $h_{fe}$ | High Frequency Current Gain | 3.0 | 5.0 | | | $I_C$ = 2.0 mA, $V_{CE}$ = 10 V, f = 100 MHz |
| $R_{iep}$ | Input Resistance, Common Emitter | | 400 | | Ω | $I_C$ = 2.0 mA, $V_{CE}$ = 10 V, f = 45 MHz |
| $C_{iep}$ | Input Capacitance, Common Emitter | | 16 | | pF | $I_C$ = 2.0 mA, $V_{CE}$ = 10 V, f = 45 MHz |
| $R_{oep}$ | Output Resistance, Common Emitter | | 67 | | kΩ | $I_C$ = 2.0 mA, $V_{CE}$ = 10 V, f = 45 MHz |
| $C_{oep}$ | Output Capacitance, Common Emitter | | 1.2 | | pF | $I_C$ = 2.0 mA, $V_{CE}$ = 10 V, f = 45 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These ratings give a maximum junction temperature of 175°C and junction to case thermal resistance of 583°C/W (derating factor of 1.73 mW/°C); junction to ambient thermal resistance of 850°C/W (derating factor of 1.17 mW/°C).
3. Rating refers to a high current point where collector to emitter voltage is lowest.
4. For product family characteristic curves, refer to Section 5-SS10.

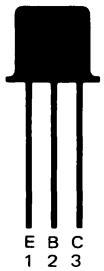
# SE7055 • SE7056 • SE7057

## NPN HIGH VOLTAGE VIDEO OUTPUT

DIFFUSED SILICON PLANAR* TRANSISTORS

- $V_{CEO}$ . . . 220 V TO 450 V (MIN) @ 5.0 mA
- $C_{cb}$ . . . 2.5 pF TO 3.5 pF (MAX) @ 20 V
- $f_T$ . . . 40 TO 50 MHz (MIN), 80 MHz (TYP) @ 15 mA
- $P_D$ . . . 7.0 W @ $T_C$ = 25°C, 1.0 W @ $T_A$ = 25°C

See TO5-2 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Junction Temperature | 200°C |
| Lead Temperature (60 seconds) | 300°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 7.0 W |
| at 25°C Ambient Temperature | 1.0 W |

**Maximum Voltages**

| | | SE7055 | SE7056 | SE7057 |
|---|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 220 V | 300 V | 450 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 220 V | 300 V | 450 V |
| $V_{EBO}$ | Emitter to Base Voltage | 7.0 V | 7.0 V | 7.0 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | SE7055 MIN. | SE7055 MAX. | SE7056 MIN. | SE7056 MAX. | SE7057 MIN. | SE7057 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $C_{cb}$ | Collector to Base Capacitance | | 3.5 | | 3.0 | | 2.5 | pF | $I_E = 0$, $V_{CB} = 20$ V |
| $h_{fe}$ | High Frequency Current Gain | 2.0 | | | | | | | $I_C = 3.0$ mA, $V_{CE} = 200$ V, f = 20 MHz, $R_L = 6.7$ kΩ |
| | | 2.0 | | | | | | | $I_C = 30$ mA, $V_{CE} = 20$ V, f = 20 MHz, $R_L = 6.7$ kΩ |
| | | | | 2.0 | | | | | $I_C = 3.0$ mA, $V_{CE} = 270$ V, f = 20 MHz, $R_L = 9.0$ kΩ |
| | | | | 2.0 | | | | | $I_C = 30$ mA, $V_{CE} = 30$ V, f = 20 MHz, $R_L = 9.0$ kΩ |
| | | | | | | 1.5 | | | $I_C = 3.0$ mA, $V_{CE} = 405$ V, f = 20 MHz, $R_L = 13.5$ kΩ |
| | | | | | | 1.5 | | | $I_C = 30$ mA, $V_{CE} = 40$ V, f = 20 MHz, $R_L = 13.5$ kΩ |
| | | 2.5 | | | | | | | $I_C = 15$ mA, $V_{CE} = 100$ V, f = 20 MHz |
| | | | | 2.5 | | | | | $I_C = 15$ mA, $V_{CE} = 150$ V, f = 20 MHz |
| | | | | | | 2.0 | | | $I_C = 15$ mA, $V_{CE} = 200$ V, f = 20 MHz |
| $h_{FE}$ | DC Pulse Current Gain | 40 | | 40 | | 30 | | | $I_C = 30$ mA, $V_{CE} = 20$ V |
| | | 40 | | 40 | | 30 | | | $I_C = 10$ mA, $V_{CE} = 20$ V |
| $h_{FE}$ | DC Current Gain | 20 | | 20 | | 15 | | | $I_C = 1.0$ mA, $V_{CE} = 20$ V |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 4 & 5) | 220 | | 300 | | 450 | | V | $I_C = 5.0$ mA, $I_B = 0$ |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 220 | | 300 | | 450 | | V | $I_C = 100$ μA, $I_E = 0$ |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 7.0 | | 7.0 | | 7.0 | | V | $I_E = 100$ μA, $I_C = 0$ |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 25°C/W (derating factor of 40 mW/°C); junction to ambient thermal resistance of 175°C/W (derating factor of 5.71 mW/°C.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse Conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5-SS11.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | SE7055 MIN. | SE7055 MAX. | SE7056 MIN. | SE7056 MAX. | SE7057 MIN. | SE7057 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $I_{CBO}$ | Collector Cutoff Current | | 100 | | | | | nA | $I_E = 0, V_{CB} = 150$ V |
| | | | 5.0 | | | | | μA | $I_E = 0, V_{CB} = 150$ V, $T_A = 125°C$ |
| | | | | | 100 | | | nA | $I_E = 0, V_{CB} = 200$ V |
| | | | | | 5.0 | | | μA | $I_E = 0, V_{CB} = 200$ V, $T_A = 125°C$ |
| | | | | | | | 100 | nA | $I_E = 0, V_{CB} = 300$ V |
| | | | | | | | 5.0 | μA | $I_E = 0, V_{CB} = 300$ V, $T_A = 125°C$ |
| $I_{EBO}$ | Emitter Cutoff Current | | 100 | | 100 | | 100 | nA | $I_C = 0, V_{EB} = 6.0$ V |
| $C_{eb}$ | Emitter to Base Capacitance | | 70 | | 70 | | 70 | pF | $I_C = 0, V_{EB} = 0.5$ V |
| $V_{BE(sat)}$ | Pulsed Base Saturation Voltage (Note 5) | | 0.85 | | 0.85 | | 0.85 | V | $I_C = 20$ mA, $I_B = 2.0$ mA |
| $V_{CE(sat)}$ | Pulsed Collector Saturation Voltage (Note 5) | | 1.0 | | 1.0 | | 1.0 | V | $I_C = 20$ mA, $I_B = 2.0$ mA |

4

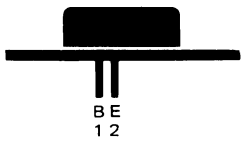
# SE9331

## HIGH VOLTAGE POWER

### DIFFUSED SILICON PLANAR* TRANSISTOR

- $V_{CEO}$ . . . 300 V (MIN)
- $h_{FE}$ . . . 30–250 @ 100 mA
- $f_T$ . . . 10 MHz (MIN) @ 50 mA

See TO66-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +175°C |
| Operating Junction Temperature | | 175°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Case Temperature | | 20 W |
| **Maximum Voltages and Currents** | | |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 300 V |
| $V_{CBO}$ | Collector to Base Voltage | 300 V |
| $V_{EBO}$ | Emitter to Base Voltage | 6.0 V |
| $I_B$ | Base Current | 250 mA |
| $I_C$ | Collector Current | 1.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $I_{CBO}$ | Collector to Cutoff Current | | 10 | μA | $V_{CB}$ = 300 V |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | 300 | | V | $I_C$ = 5.0 mA |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 6.0 | | V | $I_E$ = 10 μA |
| $I_{CBO}$ | Collector Cutoff Current | | 500 | nA | $V_{CB}$ = 250 V |
| $I_{CEO}$ | Collector to Emitter Cutoff Current | | 100 | μA | $V_{CE}$ = 300 V |
| $h_{FE}$ | DC Current Gain (Note 4) | 30 | | | $I_C$ = 50 mA, $V_{CE}$ = 10 V |
| | | 30 | 250 | | $I_C$ = 100 mA, $V_{CE}$ = 10 V |
| $f_T$ | Current to Gain Bandwidth Product | 10 | | MHz | $I_C$ = 50 mA, $V_{CE}$ = 10 V, f = 10 MHz |
| $C_{ob}$ | Output Capacitance | | 20 | pF | $V_{CB}$ = 100 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 4) | | 2.5 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 4) | | 1.5 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 4) | | 1.5 | V | $I_C$ = 100 mA, $V_{CE}$ = 10 V |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 175°C and junction to case thermal resistance of 7.5°C/W (derating factor of 133 mW/°C).
4. Pulse conditions: length = 300 μs; duty cycle < 2%.
5. For product family characteristic curves, refer to Section 5-PWR8.

# 1N456 • 1N456A

## HIGH CONDUCTANCE LOW LEAKAGE

DIFFUSED SILICON PLANAR* DIODES

- **BV . . . 30 V (MIN) @ 100 μA**
- **$I_R$ . . . 25 nA (MAX) @ 25 V**

**See DO7-2 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Temperature | | 175°C |
| **Maximum Power Dissipation** | | |
| Total Dissipation at 25°C Ambient Temperature | | 200 mW |
| Linear Derating Factor | | 1.33 mW/°C |
| **Maximum Voltage and Currents** | | |
| WIV | Working Inverse Voltage | 25 V |
| $I_O$ | Average Rectified Current | 90 mA |
| $I_F$ | DC Forward Current | 135 mA |
| $i_f$ | Recurrent Peak Forward Current | 450 mA |
| $i_f$ (surge) | Peak Forward Surge Current | |
| | Pulse Width of 1.0 s | 700 mA |
| | Pulse Width of 2.0 μs | 1200 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 1N456 MIN. | 1N456 MAX. | 1N456A MIN. | 1N456A MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $B_V$ | Breakdown Voltage | 30 | | | | V | $I_R$ = 100 μA |
| | | | | 30 | | V | $I_R$ = 5.0 μA |
| $I_R$ | Reverse Current | | 25 | | 25 | nA | $V_R$ = 25 V |
| | | | 5.0 | | 5.0 | μA | $V_R$ = 25 V, $T_A$ = 150°C |
| $V_F$ | Forward Voltage | | 1.0 | | | V | $I_F$ = 40 mA |
| | | | | | 1.0 | V | $I_F$ = 100 mA |
| C | Capacitance | | 10 | | | pF | $V_R$ = 0, f = 1.0 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. Leads are tinned. Gold plate with nickel strike may be obtained when specified.
3. For product family characteristic curves, refer to Section 5-D5.

# 1N457 • 1N457A

## LOW LEAKAGE

DIFFUSED SILICON PLANAR* DIODES

- **BV . . . 70 V (MIN) @ 100 μA**
- **$I_R$ . . . 25 nA (MAX) @ 60 V**

**See DO7-2 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Temperature | 175°C |

**Maximum Power Dissipation**

| | |
|---|---|
| Total Dissipation at 25°C Ambient Temperature | 400 mW |

**Maximum Voltage and Currents**

| | | |
|---|---|---|
| WIV | Working Inverse Voltage | 60 V |
| $I_O$ | Average Rectified Current | 75 mA |
| $I_F$ | Forward Current Steady State DC | 140 mA |
| $i_f$ | Recurrent Peak Forward Current | 225 mA |
| $i_f$(surge) | Peak Forward Surge Current | |
| | Pulse Width = 1.0 s | 500 mA |
| | Pulse Width = 1.0 μs | 2.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 1N457 MIN. | 1N457 MAX. | 1N457A MIN. | 1N457A MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | | 1.0 | | | V | $I_F$ = 20 mA |
| | | | | | 1.0 | V | $I_F$ = 100 mA |
| $I_R$ | Reverse Current | | 25 | | 25 | nA | $V_R$ = 60 V |
| | | | 5.0 | | 5.0 | μA | $V_R$ = 60 V, $T_A$ = 150°C |
| BV | Breakdown Voltage | 70 | | 70 | | V | $I_R$ = 100 μA |
| C | Capacitance (Note 2) | | 6.0 | | | pF | $V_R$ = 0, f = 1.0 MHz |

*Planar is a patented Fairchild process.

NOTES:

1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. Capacitance as measured on Boonton Electronic Corporation Model No. 75-AS8 capacitance bridge or equivalent.
3. For product family characteristic curves, refer to Section 5-D5.

# 1N458 • 1N458A

## LOW LEAKAGE

DIFFUSED SILICON PLANAR* DIODES

- **BV . . . 150 V (MIN) @ 100 μA**
- **$I_R$ . . . 25 nA (MAX) @ 125 V 1N458**

**See DO7-2 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Temperature | | 175°C |
| **Maximum Power Dissipation** | | |
| Total Dissipation at 25°C Ambient Temperature | | 400 mW |
| **Maximum Voltage and Currents** | | |
| WIV | Working Inverse Voltage | 125 V |
| $I_O$ | Average Rectified Current | 55 mA |
| $I_F$ | Forward Current Steady State DC | 115 mA |
| $I_f$ | Recurrent Peak Forward Current | 175 mA |
| $i_f$ (surge) | Peak Forward Surge Current | |
| | Pulse Width = 1.0 s | 500 mA |
| | Pulse Width = 1.0 μs | 2.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 1N458 MIN. | 1N458 MAX. | 1N458A MIN. | 1N458A MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | | 1.0 | | | V | $I_F$ = 7.0 mA |
| | | | | | 1.0 | V | $I_F$ = 100 mA |
| $I_R$ | Reverse Current | | 25 | | | nA | $V_R$ = 125 V |
| | | | | | 5.0 | nA | $V_R$ = 125 V |
| | | | 5.0 | | 5.0 | μA | $V_R$ = 125 V, $T_A$ = 150°C |
| BV | Breakdown Voltage | 150 | | 150 | | V | $I_R$ = 100 μA |
| C | Capacitance (Note 2) | | 6.0 | | | pF | $V_R$ = 0, f = 1.0 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. Capacitance as measured on Boonton Electronic Corporation Model No. 75-AS8 capacitance bridge or equivalent.
3. For product family characteristic curves, refer to Section 5-D5.

# 1N459 • 1N459A

## LOW LEAKAGE

### DIFFUSED SILICON PLANAR* DIODES

- **BV . . . 200 V (MIN) @ 100 μA**
- **$I_R$ . . . 25 nA (MAX) @ 175 V**

**See DO7-2 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Temperature | | 175°C |
| **Maximum Power Dissipation** | | |
| Total Dissipation at 25°C Ambient Temperature | | 400 W |
| **Maximum Voltages and Currents** | | |
| WIV | Working Inverse Voltage | 175 V |
| $I_O$ | Average Rectified Current | 40 mA |
| $I_F$ | Forward Current Steady State DC | 100 mA |
| $i_f$ | Recurrent Peak Forward Current | 125 mA |
| $i_{f(surge)}$ | Peak Forward Surge Current | |
| | Pulse Width = 1.0 s | 500 mA |
| | Pulse Width = 1.0 μs | 2.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 1N459 MIN. | 1N459 MAX. | 1N459A MIN. | 1N459A MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | | 1.0 | | | V | $I_F$ = 3.0 mA |
| | | | | | 1.0 | V | $I_F$ = 100 mA |
| $I_R$ | Reverse Current | | 25 | | 25 | nA | $V_R$ = 175 V |
| | | | 5.0 | | 5.0 | μA | $V_R$ = 175 V, $T_A$ = 150°C |
| BV | Breakdown Voltage | 200 | | 200 | | V | $I_R$ = 100 μA |
| C | Capacitance (Note 2) | | 6.0 | | | pF | $V_R$ = 0, f = 1.0 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. Capacitance as measured on Boonton Electronic Corporation Model No. 75-AS8 capacitance bridge or equivalent.
3. For product family characteristic curves, refer to Section 5 — D5.

# 1N461 • 1N461A

## GENERAL PURPOSE

DIFFUSED SILICON PLANAR* DIODES

- **BV . . . 30 V (MIN) @ 100 μA**
- **$I_R$ . . . 500 nA (MAX) @ 25 V**

See DO7-2 Package Outline

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Temperature | | 175°C |
| **Maximum Power Dissipation** | | |
| Total Dissipation at 25°C Ambient Temperature | | 200 mW |
| **Maximum Voltage and Currents** | | |
| WIV | Working Inverse Voltage | 25 V |
| $I_O$ | Average Rectified Current | 60 mA |
| $I_F$ | Forward Current Steady State DC | 90 mA |
| $I_f$ | Recurrent Peak Forward Current | 180 mA |
| $i_{f(surge)}$ | Peak Forward Surge Current | |
| | Pulse Width = 1.0 s | 550 mA |
| | Pulse Width = 2.0 μs | 900 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 1N461 MIN. | 1N461 MAX. | 1N461A MIN. | 1N461A MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | | 1.0 | | | V | $I_F$ = 15 mA |
| | | | | | 1.0 | V | $I_F$ = 100 mA |
| $I_R$ | Reverse Current | | 500 | | 500 | nA | $V_R$ = 25 V |
| | | | 30 | | 30 | μA | $V_R$ = 25 V, $T_A$ = 150°C |
| C | Capacitance | | 10 | | 10 | pF | $V_R$ = 0, f = 1.0 MHz |
| BV | Breakdown Voltage | 30 | | 30 | | V | $I_R$ = 100 μA |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. For product family characteristic curves, refer to Section 5 — D6.

# 1N462 • 1N462A

## GENERAL PURPOSE

DIFFUSED SILICON PLANAR* DIODES

- **BV . . . 70 V (MIN) @ 100 μA**
- **$I_R$ . . . 500 nA (MAX) @ 60 V**

**See DO7-2 Package Outline**

**ABSOLUTE MAXIMUM RATINGS**

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Temperature | | 175°C |
| **Maximum Power Dissipation** | | |
| Total Dissipation at 25°C Ambient Temperature | | 200 mW |
| **Maximum Voltage and Currents** | | |
| WIV | Working Inverse Voltage | 60 V |
| $I_O$ | Average Rectified Current | 50 mA |
| $I_R$ | Forward Current Steady State DC | 75 mA |
| $I_f$ | Recurrent Peak Forward Current | 150 mA |
| $i_{f(surge)}$ | Peak Forward Surge Current | |
| | Pulse Width = 1.0 s | 500 mA |
| | Pulse Width = 2.0 μs | 800 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 1N462 MIN. | 1N462 MAX. | 1N462A MIN. | 1N462A MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | | 1.0 | | | V | $I_F$ = 5.0 mA |
| | | | | | 1.0 | V | $I_F$ = 100 mA |
| BV | Breakdown Voltage | 70 | | 70 | | V | $I_R$ = 100 μA |
| $I_R$ | Reverse Current | | 500 | | 500 | nA | $V_R$ = 60 V |
| | | | 30 | | 30 | μA | $V_R$ = 60 V, $T_A$ = 150°C |
| C | Capacitance | | 8.0 | | | pF | $V_R$ = 0, f = 1.0 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. For product family characteristic curves, refer to Section 5 — D5.

# 1N463 • 1N463A

## GENERAL PURPOSE

DIFFUSED SILICON PLANAR* DIODES

- **BV . . . 200 V (MIN) @ 100 μA**
- **$I_R$ . . . 500 nA (MAX) @ 175 V**

**See DO7-2 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Temperature | | 175°C |
| **Maximum Power Dissipation** | | |
| Total Dissipation at 25°C Ambient Temperature | | 200 mW |
| **Maximum Voltage and Currents** | | |
| WIV | Working Inverse Voltage | 175 V |
| $I_O$ | Average Rectified Current | 30 mA |
| $I_F$ | Forward Current Steady State DC | 50 mA |
| $I_f$ | Recurrent Peak Forward Current | 100 mA |
| $i_{f(surge)}$ | Peak Forward Surge Current | |
| | Pulse Width = 1.0 s | 400 mA |
| | Pulse Width = 2.0 μs | 700 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 1N463 MIN. | 1N463 MAX. | 1N463A MIN. | 1N463A MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | | 1.0 | | | V | $I_F$ = 1.0 mA |
| | | | | | 1.0 | V | $I_F$ = 100 mA |
| BV | Breakdown Voltage | 200 | | 200 | | V | $I_R$ = 100 μA |
| $I_R$ | Reverse Current | | 500 | | 500 | nA | $V_R$ = 175 V |
| | | | 30 | | 30 | μA | $V_R$ = 175 V, $T_A$ = 150°C |
| C | Capacitance | | 4.0 | | | pF | $V_R$ = 0, f = 1.0 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. For product family characteristic curves, refer to Section 5 – D5.

# 1N464 • 1N464A

## GENERAL PURPOSE

DIFFUSED SILICON PLANAR* DIODES

- **BV . . . 150 V (MIN) @ 100 μA**
- **$I_R$ . . . 500 nA (MAX) @ 125 V**

**See DO7-2 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Temperature | | 175°C |
| **Maximum Power Dissipation** | | |
| Total Dissipation at 25°C Ambient Temperature | | 200 mW |
| **Maximum Voltage and Currents** | | |
| WIV | Working Inverse Voltage | 125 V |
| $I_O$ | Average Rectified Current | 40 mA |
| $I_F$ | Forward Current Steady State DC | 60 mA |
| $I_f$ | Recurrent Peak Forward Current | 120 mA |
| $i_{f(surge)}$ | Peak Forward Surge Current | |
| | Pulse Width = 1.0 s | 400 mA |
| | Pulse Width = 2.0 μs | 700 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 1N464 MIN. | 1N464 MAX. | 1N464A MIN. | 1N464A MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | | 1.0 | | | V | $I_F$ = 3.0 mA |
| | | | | | 1.0 | V | $I_F$ = 100 mA |
| $I_R$ | Reverse Current | | 500 | | 500 | nA | $V_R$ = 125 V |
| | | | 30 | | 30 | μA | $V_R$ = 125 V, $T_A$ = 150°C |
| BV | Breakdown Voltage | 150 | | 150 | | V | $I_R$ = 100 μA |
| C | Capacitance | | 6.0 | | | pF | $V_R$ = 0, f = 1.0 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. For product family characteristic curves, refer to Section 5 — D5.

# 1N482 through 1N486 • 1N482A/B through 1N486A/B

## GENERAL PURPOSE

DIFFUSED SILICON PLANAR* DIODES

- **$V_F$ . . . 1.0 @ 100 mA (1N482A/B THROUGH 1N486A/B)**
- **$I_R$ . . . 0.25 μA, 0.025 μA, 0.05 μA**

See DO7-2 Package Outline

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Temperature | 200°C |

**Maximum Power Dissipation**

| | |
|---|---|
| Total Dissipation at 25°C Ambient Temperature | 250 mW |

**Maximum Voltage**

| | | | |
|---|---|---|---|
| WIV | Working Inverse Voltage | 1N482/A/B | 36 V |
| | | 1N483/A/B | 70 V |
| | | 1N484/A/B | 130 V |
| | | 1N485/A/B | 180 V |
| | | 1N486/A/B | 225 V |

| **Maximum Currents** | | **1N482 Through 1N486** | **1N482A/B Through 1N486A/B** |
|---|---|---|---|
| $I_F$ | Average Forward Current | 100 mA | 200 mA |
| $I_F$ | Average Forward Current @ $T_A$ = 150°C | 25 mA | 50 mA |
| $i_f$ | Recurrent Peak Forward Current | 400 mA | 650 mA |
| $i_{f(surge)}$ | Surge Current | 1.0 A | 2.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | 1N482 through 1N486 | | 1.1 | V | $V_R$ = 100 mA |
| | | 1N482A through 1N486A | | 1.0 | V | |
| | | 1N482B through 1N486B | | 1.0 | V | |
| $I_R$ | Reverse Current | 1N482 through 1N486 | | 0.25 | μA | $V_R$ = rated WIV |
| | | 1N482A through 1N485A | | 0.025 | μA | |
| | | 1N482B through 1N485B | | 0.025 | μA | |
| | | 1N486A and 1N486B | | 0.050 | μA | |
| | | 1N482 through 1N485 | | 30 | μA | $V_R$ = rated WIV, $T_A$ = 150°C |
| | | 1N486 | | 50 | μA | |
| | | 1N482A through 1N485A | | 15 | μA | |
| | | 1N486A | | 25 | μA | |
| | | 1N482B through 1N485B | | 5.0 | μA | |
| | | 1N486B | | 10 | μA | |
| BV | Breakdown Voltage | 1N482/A/B | 40 | | V | $I_R$ = 100 μA |
| | | 1N483/A/B | 80 | | V | |
| | | 1N484/A/B | 150 | | V | |
| | | 1N485/A/B | 200 | | V | |
| | | 1N486/A/B | 250 | | V | |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. For product family characteristic curves, refer to Section 5 - D5.

# 1N625 through 1N629

## GENERAL PURPOSE

### DIFFUSED SILICON PLANAR* DIODES

- $V_F$ . . . 1.5 V (MAX) @ 4.0 mA
- $I_R$ . . . 1.0 μA (MAX) @ WIV

See DO7-2 Package Outline

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Junction Temperature | 175°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Ambient Temperature | 400 mW |
| Linear Derating Factor | 2.67 mW/°C |

| **Maximum Voltage and Currents** | | **1N625** | **1N626** | **1N627** | **1N628** | **1N629** |
|---|---|---|---|---|---|---|
| WIV | Working Inverse Voltage | 20 V | 35 V | 75 V | 125 V | 175 V |
| $I_O$ | Average Rectified Current | 175 mA | 175 mA | 175 mA | 175 mA | 175 mA |
| $I_F$ | Forward Current Steady State | 400 mA | 400 mA | 400 mA | 400 mA | 400 mA |
| $i_{f(surge)}$ | Peak Forward Surge Current | | | | | |
| | Pulse Width = 1.0 s | 500 mA | 500 mA | 500 mA | 500 mA | 500 mA |
| | Pulse Width = 1.0 μs | 4.0 A | 4.0 A | 4.0 A | 4.0 A | 4.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | | | 1.5 | V | $I_F$ = 4.0 mA |
| $I_R$ | Reverse Current | | | 1.0 | μA | $V_R$ = rated WIV |
| | | | | 30 | μA | $V_R$ = rated WIV, $T_A$ = 100°C |
| BV | Breakdown Voltage | 1N625 | 30 | | V | $I_R$ = 100 μA |
| | | 1N626 | 50 | | V | $I_R$ = 100 μA |
| | | 1N627 | 100 | | V | $I_R$ = 100 μA |
| | | 1N628 | 150 | | V | $I_R$ = 100 μA |
| | | 1N629 | 200 | | V | $I_R$ = 100 μA |
| $t_{rr}$ | Reverse Recovery Time | | | 1.0 | μs | $I_F$ = 30 mA, $V_r$ = 35 V, Recovery to 400 kΩ |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 175°C and junction to ambient thermal resistance 375°C/W (derating factor of 2.67 mW/°C).
4. For product family characteristic curves, refer to Section 5 - D4.

# 1N643 • 1N643A

## GENERAL PURPOSE

DIFFUSED SILICON PLANAR* DIODE

- **BV . . . 200 V (MIN) @ 100 μA**
- **$I_R$ . . . 1.0 μA (MAX) @ 100 V**

**See DO7-2 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Junction Temperature | | 175°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Ambient Temperature | | 400 mW |
| Linear Power Derating Factor | | 2.67 mW/°C |
| **Maximum Voltage and Currents** | | |
| WIV | Working Inverse Voltage | 175 V |
| $I_O$ | Average Rectified Current | 175 mA |
| $I_F$ | Forward Current Steady State | 400 mA |
| $i_{f(surge)}$ | Peak Forward Surge Current | |
| | Pulse Width = 1.0s | 500 mA |
| | Pulse Width = 1.0 μs | 4.0A |

**ELECTRICAL CHARACTERISTICS:** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 1N643 MIN. | 1N643 MAX. | 1N643A MIN. | 1N643A MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | | 1.0 | | | V | $I_F$ = 10 mA |
| | | | | | 1.0 | V | $I_F$ = 100 mA |
| $I_R$ | Reverse Current | | 25 | | 25 | nA | $V_R$ = 10 V |
| | | | 5.0 | | 5.0 | μA | $V_R$ = 10 V, $T_A$ = 100°C |
| | | | 1.0 | | 1.0 | μA | $V_R$ = 100 V |
| | | | 15 | | 15 | μA | $V_R$ = 100 V, $T_A$ = 100°C |
| BV | Breakdown Voltage | 200 | | 200 | | V | $I_R$ = 100 μA |
| $t_{rr}$ | Reverse Recovery Time | | 300 | | 300 | ns | $V_r$ = 40 V, $I_f$ = 5.0 mA, $R_L$ = 2.3 kΩ, $C_L$ = 40 pF, Recovery to 200 kΩ |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 175°C and junction to ambient thermal resistance of 375°C/W (derating factor of 2.67 mW/°C).
4. For product family characteristic curves, refer to Section 5-D4.

# 1N658

## GENERAL PURPOSE

DIFFUSED SILICON PLANAR*EPITAXIAL DIODE

- **BV . . . 120 V (MIN) @ 100 μA**
- **$V_F$ . . . 1.0 V (MAX) @ 100 mA**

**See DO 7-2 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Junction Temperature | | 175°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Ambient Temperature | | 400 mW |
| Linear Derating Factor | | 2.67 mW/°C |
| **Maximum Voltage and Currents** | | |
| WIV | Working Inverse Voltage | 100 V |
| $I_O$ | Average Rectified Current | 200 mA |
| $I_F$ | Forward Current Steady State | 400 mA |
| $i_{f(surge)}$ | Peak Forward Surge Current | |
| | Pulse Width = 1.0s | 500 mA |
| | Pulse Width = 1.0μs | 4.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | | 1.0 | V | $I_F$ = 100 mA |
| $I_R$ | Reverse Current | | 50 | nA | $V_R$ = 50 V |
| | | | 25 | μA | $V_R$ = 50 V, $T_A$ = 150°C |
| BV | Breakdown Voltage | 120 | | V | $I_R$ = 100 μA |
| $t_{rr}$ | Reverse Recovery Time | | 300 | ns | $V_R$ = 40 V, $I_F$ = 5.0 mA, $R_L$ = 2.0 kΩ, $C_L$ = 10 pF, Recovery to 80 kΩ |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 175°C and junction to ambient thermal resistance of 375°C/W (derating factor of 2.67 mW/°C).
4. For product family characteristic curves, refer to Section 5 – D4.

# 1N659 • 1N660 • 1N661

## GENERAL PURPOSE

DIFFUSED SILICON PLANAR* DIODES

- $V_F$ . . . 1.0 V (MAX) @ 6.0 mA
- $t_{rr}$ . . . 300 ns (MAX)

See DO7-2 Package Outline

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Junction Temperature | 175°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Ambient Temperature | 400 mW |
| Linear Derating Factor | 2.67 mW/°C |

**Maximum Voltage and Currents**

| | | 1N659 | 1N660 | 1N661 |
|---|---|---|---|---|
| WIV | Working Inverse Voltage | 50 V | 100 V | 200 V |
| $I_O$ | Average Rectified Current | 175 mA | 175 mA | 175 mA |
| $I_F$ | Forward Current Steady State | 400 mA | 400 mA | 400 mA |
| $i_{f(surge)}$ | Peak Forward Surge Current | | | |
| | Pulse Width = 1.0s | 500 mA | 500 mA | 500 mA |
| | Pulse Width = 1.0 μs | 4.0A | 4.0A | 4.0A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 1N659 | | 1N660 | | 1N661 | | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| | | MIN. | MAX. | MIN. | MAX. | MIN. | MAX. | | |
| $V_F$ | Forward Voltage | | 1.0 | | 1.0 | | 1.0 | V | $I_F$ = 6.0 mA |
| $I_R$ | Reverse Current | | 5.0 | | | | | μA | $V_R$ = 50 V |
| | | | | | 5.0 | | | μA | $V_R$ = 100 V |
| | | | | | | | 10 | μA | $V_R$ = 200 V |
| | | | 25 | | | | | μA | $V_R$ = 50 V, $T_A$ = 100°C |
| | | | | | 50 | | | μA | $V_R$ = 100 V, $T_A$ = 100°C |
| | | | | | | | 100 | μA | $V_R$ = 200 V, $T_A$ = 100°C |
| BV | Breakdown Voltage | 60 | | 120 | | 240 | | V | $I_R$ = 100 μA |
| $t_{rr}$ | Reverse Recovery Time | | 300 | | 300 | | 300 | ns | $V_r$ = 35 V, $I_f$ = 30 mA, $R_L$ = 2.0 kΩ, $C_L$ = 10 pF, Recovery to 400 kΩ |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 175°C and junction to ambient thermal resistance of 375°C/W (derating factor of 2.67 mW/°C).
4. For product family characteristic curves, refer to Section 5-D6 for 1N659, D4 for 1N660 and 1N661.

# 1N662 • 1N662A • 1N663 • 1N663A

## GENERAL PURPOSE

### DIFFUSED SILICON PLANAR* DIODES

- **BV . . . 100 V (MIN) @ 100 μA**

See DO7-2 Package Outline

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Junction Temperature | | 175°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Ambient Temperature | | 400 mW |
| Linear Derating Factor | | 2.67 mW/°C |
| **Maximum Voltage and Currents** | | |
| WIV | Working Inverse Voltage | 80 V |
| $I_O$ | Average Rectified Current | 175 mA |
| $I_F$ | Forward Current Steady State | 400 mA |
| $i_{f(surge)}$ | Peak Forward Surge Current | |
| | Pulse Width = 1.0 s | 500 mA |
| | Pulse Width = 1.0 μs | 4.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 1N662 MIN. | 1N662 MAX. | 1N662A MIN. | 1N662A MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | | 1.0 | | | V | $I_F$ = 10 mA |
| | | | | | 1.0 | V | $I_F$ = 100 mA |
| $I_R$ | Reverse Current | | 1.0 | | 1.0 | μA | $V_R$ = 10 V |
| | | | 20 | | 20 | μA | $V_R$ = 10 V, $T_A$ = 100°C |
| | | | 20 | | 20 | μA | $V_R$ = 50 V |
| | | | 100 | | 100 | μA | $V_R$ = 50 V, $T_A$ = 100°C |
| BV | Breakdown Voltage | 100 | | 100 | | V | $I_R$ = 100 μA |
| $t_{rr}$ | Reverse Recovery Time | | 500 | | 300 | ns | $V_r$ = 40 V, $I_f$ = 5.0 mA, $R_L$ = 2.3 kΩ, $C_L$ = 40 pF, Recovery to 100 kΩ |

| SYMBOL | CHARACTERISTIC | 1N663 MIN. | 1N663 MAX. | 1N663A MIN. | 1N663A MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | | 1.0 | | 1.0 | V | $I_F$ = 100 mA |
| $I_R$ | Reverse Current | | 5.0 | | 1.0 | μA | $V_R$ = 75 V |
| | | | 50 | | 15 | μA | $V_R$ = 75 V, $T_A$ = 100°C |
| BV | Breakdown Voltage | 100 | | 100 | | V | $I_R$ = 100 μA |
| $t_{rr}$ | Reverse Recovery Time | | 500 | | 300 | ns | $V_r$ = 40 V, $I_f$ = 5.0 mA, $R_L$ = 2.3 kΩ, $C_L$ = 40 pF, Recovery to 200 kΩ |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 175°C and junction to ambient thermal resistance of 375°C/W (derating factor of 2.67 mW/°C).
4. For product family characteristic curves, refer to Section 5 - D4.

# 1N746/A through 1N759/A

## 400 MILLIWATT VOLTAGE REGULATORS

SILICON PLANAR* ZENER DIODES

- **EXTREME LEAKAGE STABILITY**
- **VERY LOW DYNAMIC RESISTANCE**
- **SHARP ZENER KNEES**

**See DO7-2 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 4)

| | |
|---|---|
| **Maximum Temperatures** | |
| Storage Temperature | −65°C to +175°C |
| Operating Temperature | 175°C |
| **Maximum Power Dissipation** | |
| Power Dissipation | 400 mW |
| Linear Derating Factor | 2.67 mW/°C |

| JEDEC TYPE NO. (Note 1) | $V_Z$ ZENER VOLTAGE NOMINAL | $I_{ZT}$ TEST CURRENT | $Z_Z$ MAX. ZENER IMPEDANCE $Z_{ZT}$ @ $I_{ZT}$ (Note 3) | REVERSE VOLTAGE | IR MAX. REVERSE CURRENT @ $V_R$ 25°C | 150°C | TEMPERATURE COEFFICIENT (TYPICAL) |
|---|---|---|---|---|---|---|---|
| | V | mA | Ω | V | μA | | %/°C |
| 1N746 | 3.3 | 20 | 28 | 1.0 | 10 | 30 | −.062 |
| 1N747 | 3.6 | 20 | 24 | 1.0 | 10 | 30 | −.055 |
| 1N748 | 3.9 | 20 | 23 | 1.0 | 10 | 30 | −.049 |
| 1N749 | 4.3 | 20 | 22 | 1.0 | 2.0 | 30 | −.036 |
| 1N750 | 4.7 | 20 | 19 | 1.0 | 2.0 | 30 | −.018 |
| 1N751 | 5.1 | 20 | 17 | 1.0 | 1.0 | 20 | −.008 |
| 1N752 | 5.6 | 20 | 11 | 1.0 | 1.0 | 20 | +.006 |
| 1N753 | 6.2 | 20 | 7.0 | 1.0 | 0.10 | 20 | +.022 |
| 1N754 | 6.8 | 20 | 5.0 | 1.0 | 0.10 | 20 | +.035 |
| 1N755 | 7.5 | 20 | 6.0 | 1.0 | 0.10 | 20 | +.045 |
| 1N756 | 8.2 | 20 | 8.0 | 1.0 | 0.10 | 20 | +.052 |
| 1N757 | 9.1 | 20 | 10 | 1.0 | 0.10 | 20 | +.056 |
| 1N758 | 10 | 20 | 17 | 1.0 | 0.10 | 20 | +.060 |
| 1N759 | 12 | 20 | 30 | 1.0 | 0.10 | 20 | +.060 |

*Planar is a patented Fairchild process.

NOTES:
1. The 1N746-1N759 series has a standard Zener Voltage tolerance of ±10%. A tolerance of ±5.0% is also available by suffixing A to the JEDEC type number.
2. For family characteristic curves, refer to Section 5 - D8.
3. The zener impedance $Z_{ZT}$ is derived by superimposing a 60 cycle ac signal, having an rms value equal to 10% of the dc Zener current, on $I_{ZT}$.
4. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.

# 1N914/A/B • 1N916/A/B • 1N4148/9 • 1N4446-1N4449

## HIGH CONDUCTANCE ULTRA FAST SWITCHES

DIFFUSED SILICON PLANAR* DIODES

- $t_{rr}$ . . . 4.0 ns (MAX)
- BV . . . 100 V (MIN)

See DO35-1 Package Outline & Note 1

**ABSOLUTE MAXIMUM RATINGS** (Note 2)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Temperature | | 175°C |
| **Maximum Power Dissipation** | | |
| Total Dissipation | | 500 mW |
| **Maximum Voltage and Currents** | | |
| WIV | Working Inverse Voltage | 75 V |
| $I_O$ | Average Rectified Current | 200 mA |
| $I_F$ | DC Forward Current | 400 mA |
| $I_f$ | Recurrent Peak Forward Current | 600 mA |
| $I_{f(surge)}$ | Peak Forward Surge Current | |
| | Pulse Width = 1.0 s | 1.0 A |
| | Pulse Width = 1.0 μs | 4.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| BV | Breakdown Voltage | | 100 | | V | $I_R$ = 100 μA |
| | | | 75 | | V | $I_R$ = 5.0 μA |
| $I_R$ | Reverse Current | | | 25 | nA | $V_R$ = 20 V |
| | | | | 50 | μA | $V_R$ = 20 V, $T_A$ = 150°C |
| | | | | 5.0 | μA | $V_R$ = 75 V |
| $V_F$ | Forward Voltage Drop | 1N914B, 1N4448 | 0.62 | 0.72 | V | $I_F$ = 5.0 mA |
| | | 1N916B, 1N4449 | 0.63 | 0.73 | V | |
| | | 1N914, 1N916<br>1N4148, 1N4149 | | 1.0 | V | $I_F$ = 10 mA |
| | | 1N914A, 1N916A<br>1N4446, 1N4447 | | 1.0 | V | $I_F$ = 20 mA |
| | | 1N916B, 1N4449 | | 1.0 | V | $I_F$ = 30 mA |
| | | 1N914B, 1N4448 | | 1.0 | V | $I_F$ = 100 mA |
| $t_{rr}$ | Reverse Recovery Time | | | 4.0 | ns | $I_f$ = 10 mA, $V_r$ = 6.0 V, $R_L$ = 100 Ω Rec. to 1.0 mA |
| C | Capacitance | 1N914, 1N914A<br>1N914B, 1N4148<br>1N4446, 1N4447 | | 4.0 | pF | $V_R$ = 0 V (Note 3) |
| | | 1N916, 1N916A<br>1N916B, 1N4149<br>1N4448, 1N4449 | | 2.0 | pF | |
| $V_{fr}$ | Peak Forward Recovery Voltage | 1N914, 1N916<br>1N914B, 1N916B<br>1N4448, 1N4449 | | 2.5 | V | 50 mA Peak Square Wave, 0.1 μs pulse width, 5 kHz - 100 kHz rep. rate |
| RE | Rectification Efficiency | 1N914A, 1N914B<br>1N916A, 1N916B | 45 | | % | 2.0 V rms , f = 100 MHz |

*Planar is a patented Fairchild process.

NOTES:

1. Fairchild retains the option of supplying the 1N914, 1N914A, 1N914B, 1N916, 1N916A and 1N916B in the DO7 package. The 1N914JAN and 1N914JAN TX will be supplied only in the DO7 package.
2. Maximum ratings are limiting values above which life or satisfactory performance may be impaired.
3. Capacitance as measured on Boonton Model 75A Capacitance Bridge or equivalent.
4. For family characteristic curves, refer to Section 5 - D6.

# 1N957 through 1N973 • 1N957A/B • 1N973A/B

## 400 MILLIWATT VOLTAGE REGULATORS

SILICON PLANAR* ZENER DIODES

- **EXTREME LEAKAGE STABILITY**
- **VERY LOW DYNAMIC RESISTANCE**
- **SHARP ZENER KNEES**
- **PLANAR CONSTRUCTION**

**See DO7-2 Package Outline & Note 6**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| Operating Temperature | −65°C to +150°C |
| Storage Temperature | 175°C |
| Power Dissipation | 400 mW |
| Power Derating Factor | 3.2 mW/°C |

| JEDEC TYPE NO. (Note 2) | $V_Z$ ZENER VOLTAGE NOMINAL V | $I_{ZT}$ TEST CURRENT mA | $Z_Z$ MAX. ZENER IMPEDANCE (Note 3) $Z_{ZT}$ @ $I_{ZT}$ Ω | $Z_{ZK}$ Ω | $I_{ZK}$ mA | REVERSE VOLTAGE (Note 5) V A | B | $I_R$ MAX. REVERSE CURRENT @ $V_R$ 25°C μA | 25°C μA | T.C. TEMPERATURE COEFFICIENT (MAX.) %/°C | $I_{ZM}$ MAX. CURRENT (Note 4) mA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1N957 | 6.8 | 18.5 | 4.5 | 700 | 1.0 | 4.9 | 5.2 | 10 | 50 | +.050 | 47 |
| 1N958 | 7.5 | 16.5 | 5.5 | 700 | 0.5 | 5.4 | 5.7 | 10 | 50 | +.058 | 42 |
| 1N959 | 8.2 | 15 | 6.5 | 700 | 0.5 | 5.9 | 6.2 | 5.0 | 50 | +.062 | 38 |
| 1N960 | 9.0 | 14 | 7.5 | 700 | 0.5 | 6.6 | 6.9 | 1.0 | 10 | +.068 | 35 |
| 1N961 | 10 | 12.5 | 8.5 | 700 | 0.25 | 7.2 | 7.6 | 1.0 | 10 | +.072 | 32 |
| 1N962 | 11 | 11.5 | 9.5 | 700 | 0.25 | 8.0 | 8.4 | 1.0 | 5.0 | +.073 | 28 |
| 1N963 | 12 | 10.5 | 11.5 | 700 | 0.25 | 8.6 | 9.1 | 1.0 | 5.0 | +.076 | 26 |
| 1N964 | 13 | 9.5 | 13 | 700 | 0.25 | 9.4 | 9.9 | 0.10 | 5.0 | +.079 | 24 |
| 1N965 | 15 | 8.5 | 16 | 700 | 0.25 | 10.8 | 11.4 | 0.10 | 5.0 | +.082 | 21 |
| 1N966 | 16 | 7.8 | 17 | 700 | 0.25 | 11.5 | 12.2 | 0.10 | 5.0 | +.083 | 19 |
| 1N967 | 18 | 7.0 | 21 | 750 | 0.25 | 13 | 13.7 | 0.10 | 5.0 | +.085 | 17 |
| 1N968 | 20 | 6.2 | 25 | 750 | 0.25 | 14.4 | 15.2 | 0.10 | 5.0 | +.086 | 15 |
| 1N969 | 22 | 5.6 | 29 | 750 | 0.25 | 15.8 | 16.7 | 0.10 | 1.0 | +.087 | 14 |
| 1N970 | 24 | 5.2 | 33 | 750 | 0.25 | 17.3 | 18.2 | 0.10 | 1.0 | +.088 | 13 |
| 1N971 | 27 | 4.6 | 41 | 750 | 0.25 | 19.4 | 20.6 | 0.10 | 1.0 | +.090 | 11 |
| 1N972 | 30 | 4.2 | 49 | 1000 | 0.25 | 21.6 | 22.8 | 0.10 | 1.0 | +.091 | 10 |
| 1N973 | 33 | 3.8 | 58 | 1000 | 0.25 | 23.8 | 25.1 | 0.05 | 1.0 | +.092 | 9.2 |

NOTES:

*Planar is a patented Fairchild process.

1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. The 1N957 −1N973 series has a 20% tolerance. Add suffix "A" for 10% tolerance, and suffix "B" for 5.0% tolerance.
3. The zener impedances $Z_{ZT}$ and $Z_{ZK}$ are derived by superimposing a 60 cycle ac signal, having an rms value equal to 10% of the dc zener current, on $I_{ZT}$ or $I_{ZK}$.
4. Maximum zener current ratings ($I_{ZM}$) are based on the maximum voltage of a 20% tolerance unit. For closer tolerance units or units where the actual zener ($V_Z$) is known at the operating point, the maximum zener current may be increased according to the operating curve.
5. $V_R$ value for 20% tolerance = 80% lowest $V_Z$ value for each type.
6. When not specified, Fairchild reserves the option of supplying in the DO35 package.
7. For product family characteristic curves, refer to Section 5-D8.

4

# 1N3062 • 1N3063 • 1N3064 • 1N4305 • 1N4454

## ULTRA FAST LOW CAPACITANCE

### DIFFUSED SILICON PLANAR* DIODES

- **C . . . 2.0 pF @ $V_R$ = 0, f = 1.0 MHz**
- **$t_{rr}$ . . . 4.0 ns @ $I_f$ = 10 mA, $R_r$ = 10 mA, $V_r$ = 1.0 V**
- **BV . . . 75 V (MIN)**

**See DO7-2 Package Outline & Note 5**

**ABSOLUTE MAXIMUM RATINGS** ($T_A$ = 25°C) (Note 1)

| | | 1N3062 1N3063 | 1N3064 | 1N4454 | 1N4305 |
|---|---|---|---|---|---|
| **Maximum Temperatures** | | | | | |
| Storage Temperature | | −65°C to +200°C | −65°C to +175°C | | −65°C to +200°C |
| Operating Temperature | | −65°C to +175°C | −65° C to +150°C | | |
| **Maximum Power Dissipation** | | | | | |
| Total Dissipation | | 250 mW | 250 mW | 500 mW | 500 mW |
| Linear Derating Factor | | 1.67 mW/°C | 2.0 mW/°C | 4.0 mW/°C | 2.85 mW/°C |
| **Maximum Voltages and Currents** | | | | | |
| WIV | Working Inverse Voltage | 50 V | 50 V | 40 V | 75 V |
| $I_O$ | Average Rectified Current | 75 mA | 75 mA | 200 mA | |
| $I_F$ | Forward Current Steady State dc | 115 mA | 115 mA | 400 mA | |
| $i_f$ | Recurrent Peak Forward Current | 225 mA | 225 mA | 600 mA | |
| $i_f$ (surge) | Peak Forward Surge Current | | | | |
| | Pulse Width = 1.0 s | 500 mA | 500 mA | 1.0 A | |
| | Pulse Width = 1.0 μs | 2.0 A | 2.0 A | 4.0 A | |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | 1N3062 | | 1.0 | V | $I_F$ = 20 mA |
| | | 1N3063, 1N4305 | 0.700 | 0.850 | V | $I_F$ = 10 mA |
| | | | 0.610 | 0.710 | V | $I_F$ = 2.0 mA |
| | | | 0.550 | 0.650 | V | $I_F$ = 1.0 mA |
| | | | 0.505 | 0.575 | V | $I_F$ = 250 μA |
| | | 1N3064, 1N4454 | | 1.0 | V | $I_F$ = 10 mA |
| $I_R$ | Reverse Current | | | 0.1 | μA | $V_R$ = 50 V |
| $I_R$ | | | | 100 | μA | $V_R$ = 50 V, $T_A$ = 150°C |
| BV | Breakdown Voltage | | 75 | | V | $I_R$ = 5.0 μA |
| $t_{rr}$ | Reverse Recovery Time (Note 2) | 1N4305, 1N3062 | | 2.0 | ns | $I_f$ = 10 mA, $V_r$ = 6.0 V, $R_L$ = 100 Ω |
| | | 1N3063, 1N3064, 1N4454, 1N4305 | | 4.0 | ns | $I_f$ = $I_r$ = 10 mA, $R_L$ = 100 Ω, $V_r$ = 1.0 V |
| C | Capacitance (Note 4) | 1N3062 | | 1.0 | pF | $V_R$ = 0, f = 1.0 MHz |
| | | 1N3063, 1N3064, 1N4454, 1N4305 | | 2.0 | pF | $V_R$ = 0, f = 1.0 MHz |
| RE | Rectification Efficiency | | 45 | | % | f = 1.0 MHz |
| $\Delta V_F/°C$ | Forward Voltage Temperature Coefficient (Note 8) | 1N3062, 1N3063, 1N3064 | | 1.8 | | mV/°C |
| | | 1N4454, 1N4305 | | 3.0 | | mV/°C |

NOTES:

1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. Recovery to 1.0 mA.
3. Capacitance as measured on Boonton Electronic Corporation Model No. 75-AS8 capacitance bridge or equivalent.
4. Rectification efficiency is defined as the ratio of dc load voltage to peak rf input voltage to the detector circuit, measured with 2.0 V rms input to the circuit. Load resistance 5.0 Ω, load capacitance 20 pF
5. When not specified, Fairchild reserves the right to ship 1N3062, 1N3063, 1N3064 in DO7 package.
6. This value for $\Delta V_F/°C$ is a typical value not a minimum or maximum.
7. For product family characteristic curves, refer to Section 5 - D6.

*Planar is a patented Fairchild process.

# 1N3067

## GENERAL PURPOSE

DIFFUSED SILICON DIODE

- **C . . . 4.0 pF @ $V_R$ = 0**
- **$t_{rr}$ . . . 2.0 ns @ $I_f$ = 10 mA, $I_r$ = 60 mA**

**See DO7-2 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| **Maximum Temperatures** | |
| Storage Temperature | −65°C to +200°C |
| Lead Temperature (2 seconds) | 250°C |
| **Maximum Power Dissipation** | |
| Total Dissipation | 250 mW |
| Linear Derating Factor | 1.5 mW/°C |
| **Maximum Voltage** | |
| $V_R$ Reverse Voltage | 30 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | | 1.0 | V | $I_F$ = 5.0 mA |
| $I_R$ | Reverse Current | | 0.1 | μA | $V_R$ = 20 V |
| | | | 100 | μA | $V_R$ = 20 V, $T_A$ = 150°C |
| BV | Breakdown Voltage | 30 | | V | $I_R$ = 5.0 μA |
| $t_{rr}$ | Reverse Recovery Time (Note 2) | | 2.0 | ns | $I_f$ = 10 mA, $I_r$ = 60 mA, $R_L$ = 100 Ω, $V_r$ = −6.0 V |
| | | | 4.0 | ns | $I_f$ = 10 mA, $I_r$ = 10 mA, $V_r$ = −1.0 V, $R_L$ = 100 Ω |
| C | Capacitance (Note 3) | | 4.0 | pF | $V_R$ = 0 V, f = 1.0 MHz |
| RE | Rectification Efficiency (Note 4) | 35 | | % | $V_{AC}$ = 2.0 V, $C_L$ = 20 pF, $R_L$ = 5.0 Ω, f = 100 MHz, Z source = 50 Ω |
| ΔV/°C | Thermal Coefficient | | 3.0 | mV/°C | |

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. Recovery to 1.0 mA.
3. Capacitance as measured on Boonton Electronic Corporation Model No. 75-AS8 capacitance bridge or equivalent.
4. Rectification efficiency is defined as the ratio of dc load voltage to peak rf input voltage to the detector circuit, measured with 2.0 V rms input to the circuit. Load resistance 5.0 kΩ, load capacitance 20 pF.
5. For product family characteristic curves, refer to Section 5 – D6.

# 1N3069

## HIGH CONDUCTANCE HIGH SPEED

DIFFUSED SILICON PLANAR* DIODE

- **BV . . . 65 V (MIN) @ $I_R$ = 5.0 μA**
- **$t_{rr}$ . . . 50 ns (MAX) @ $I_f$ = $I_r$ = 30 mA**

**See DO7-2 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| **Maximum Temperatures** | |
| Storage Temperature | −65°C to +200°C |
| Operating Temperature | 175°C |
| Lead Temperature (2 seconds) | 250°C |
| **Maximum Power Dissipation** | |
| Total Dissipation at 25°C Ambient Temperature | 250 mW |
| Linear Derating Factor | 1.5 mW/°C |
| **Maximum Voltage** | |
| WIV Working Inverse Voltage | 65 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | | 1.0 | V | $I_F$ = 50 mA |
| $I_R$ | Reverse Current | | 100 | nA | $V_R$ = 50 V |
| | | | 100 | μA | $V_R$ = 50 V, $T_A$ = 150°C |
| BV | Breakdown Voltage | 65 | | V | $I_R$ = 5.0 μA |
| $t_{rr}$ | Reverse Recovery Time | | 50 | ns | $I_f$ = $I_r$ = 30 mA, $R_L$ = 100 Ω, $C_L$ = 10 pF, Recovery to 1.0 mA |
| C | Capacitance | | 6.0 | pF | $V_R$ = 0, f = 1.0 MHz |
| RE | Rectification Efficiency (Note 2) | 30 | | % | f = 100 MHz |
| $\Delta V_F/°C$ | Thermal Coefficient | | 3.0 | mV/°C | |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. Rectification efficiency is defined as the ratio of dc load voltage to peak rf input voltage to the detector circuit, measured with 2.0 V rms input to the circuit. Load resistance: 5.0 kΩ, load capacitance 20 pF.
3. For product family characteristic curves, refer to Section 5 — D6.

# 1N3070 • 1N3071

## HIGH SPEED HIGH CONDUCTANCE

DIFFUSED SILICON PLANAR* DIODES

- **BV . . . 200 V (MIN)**
- **$I_R$ . . . 100 nA (MAX)**

**See DO7-2 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Temperature | | −65°C to +175°C |
| **Maximum Power Dissipation** | | |
| Total Dissipation at 25°C Ambient Temperature | | 250 mW |
| at 125°C Ambient Temperature | | 85 mW |
| **Maximum Voltage and Currents** | | |
| WIV | Working Inverse Voltage | 175 V |
| $I_O$ | Average Rectified Current | 100 mA |
| $I_F$ | Forward Current Steady State DC | 220 mA |
| $I_f$ | Recurrent Peak Forward Current | 300 mA |
| $i_{f(surge)}$ | Peak Forward Surge Current | |
| | Pulse Width = 1.0 s | 1.0A |
| | Pulse Width = 1.0 μs | 4.0A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 1N3070 MIN. | 1N3070 MAX. | 1N3071 MIN. | 1N3071 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $I_R$ | Reverse Current | | 100 | | | nA | $V_R$ = 175 V |
| | | | 100 | | | μA | $V_R$ = 175 V, $T_A$ = 150°C |
| | | | | | 100 | nA | $V_R$ = 150 V |
| | | | | | 100 | μA | $V_R$ = 150 V, $T_A$ = 150°C |
| BV | Breakdown Voltage | 200 | | 200 | | V | $I_R$ = 100 μA |
| $V_F$ | Forward Voltage | | 1.0 | 0.80 | 1.0 | V | $I_F$ = 100 mA |
| | | | | 0.53 | 0.63 | V | $I_F$ = 1.0 mA |
| | | | | 0.76 | 0.92 | V | $I_F$ = 50 mA |
| | | | | 0.64 | 0.74 | V | $I_F$ = 10 mA |
| C | Capacitance | | 5.0 | | 5.0 | pF | $V_R$ = 0, f = 1.0 MHz |
| $t_{rr}$ | Reverse Recovery Time (Note 2) | | 50 | | | ns | $I_f = I_r$ = 30 mA, $R_L$ = 100Ω |
| | | | | | 40 | ns | $I_f = I_r$ = 30 mA, $R_L$ = 100Ω |
| | | | | | 50 | ns | $I_f = I_r$ = 30 mA, $R_L$ = 150Ω |
| | | | | | 400 | ns | $I_f$ = 30 mA, $V_r$ = 35 V, $R_L$ = 2.0 kΩ, $C_L$ = 10 pF, Recover to 400 kΩ |
| $Q_S$ | Stored Charge | | | | 250 | pC | $I_f$ = 20 mA, $I_r$ = 1.0 mA |
| RE | Rectification Efficiency | 35 | | 35 | | % | f = 100 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. Recovery to 1.0 mA.
3. Rectification efficiency is defined as the ratio of dc load voltage to peak rf input voltage to the detector circuit, measured with 2.0 V rms input to the circuit. Load resistance: 5.0 kΩ, load capacitance 20 pF.
4. Leads are tinned. Gold-plate with nickel strike may be obtained when specified.
5. For product family characteristic curves, refer to Section 5-D4.

# 1N3595

## HIGH CONDUCTANCE LOW LEAKAGE

### DIFFUSED SILICON PLANAR* DIODE

- **BV . . . 150 V (MIN) @ 100 μA**
- **$V_F$ . . . 1.0 V @ 200 mA**

**See DO7-2 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +175°C |
| Operating Temperature | | 150°C |
| **Maximum Power Dissipation** | | |
| Total Dissipation | | 500 mW |
| Linear Derating Factor | | 4.0 mW/°C |
| **Maximum Voltage and Currents** | | |
| WIV | Working Inverse Voltage | 125 V |
| $I_O$ | Average Rectified Current | 150 mA |
| $I_F$ | Forward Current Steady State | 225 mA |
| $i_{f(surge)}$ | Peak Forward Surge Current | |
| | Pulse Width = 1.0 s | 500 mA |
| | Pulse Width = 1.0 μs | 4.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | 0.83 | 1.0 | V | $I_F$ = 200 mA |
| | | 0.79 | 0.92 | V | $I_F$ = 100 mA |
| | | 0.75 | 0.88 | V | $I_F$ = 50 mA |
| | | 0.65 | 0.80 | V | $I_F$ = 10 mA |
| | | 0.60 | 0.75 | V | $I_F$ = 5.0 mA |
| | | 0.52 | 0.68 | V | $I_F$ = 1.0 mA |
| $I_R$ | Reverse Current | | 1.0 | nA | $V_R$ = 125 V |
| | | | 300 | nA | $V_R$ = 30 V, $T_A$ = 125°C |
| | | | 500 | nA | $V_R$ = 125 V |
| | | | 3.0 | μA | $V_R$ = 125 V, $T_A$ = 150°C |
| $t_{rr}$ | Reverse Recovery Time | | 3.0 | μs | $I_f$ = 10 mA, $V_r$ = 3.5 V, $R_L$ = 1.0 kΩ |
| C | Capacitance (Note 3) | | 8.0 | pF | $V_R$ = 0, f = 1.0 MHz |
| BV | Breakdown Voltage | 150 | | V | $I_R$ = 100 μA |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. Leads are tinned. Gold plate with nickel strike may be obtained when specified.
3. Capacitance as measured on Boonton Electronics Corporation Model No. 75A-S8 capacitance bridge or equivalent.
4. For product family characteristic curves, refer to Section 5 — D5.

# 1N3597

## HIGH CONDUCTANCE LOW LEAKAGE

DIFFUSED SILICON PLANAR* DIODE

- **BV . . . 150 V (MIN) @ 100 μA**
- **$V_F$ . . . 1.2 V (MAX) @ 400 mA**

**See DO7-2 Package Outline and Note 4**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperature** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Temperature | | 175°C |
| **Maximum Power Dissipation** | | |
| Total Dissipation | | 500 mW |
| Linear Derating Factor | | 3.3 mW/°C |
| **Maximum Voltage and Currents** | | |
| WIV | Working Inverse Voltage | 150 V |
| $I_O$ | Average Rectified Current | 275 mA |
| $I_F$ | Forward Current Steady State | 425 mA |
| $i_{f(surge)}$ | Peak Forward Surge Current | |
| | Pulse Width = 1.0 s | 1.0 A |
| | Pulse Width = 1.0 μs | 4.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | | 1.2 | V | $I_F$ = 400 mA |
| $I_R$ | Reverse Current | | 0.1 | μA | $V_R$ = 150 V |
| | | | 100 | μA | $V_R$ = 150 V, $T_A$ = 150°C |
| $t_{rr}$ | Reverse Recovery Time | | 0.3 | μs | $I_f$ = 500 mA, $V_r$ = 50 V |
| C | Capacitance (Note 3) | | 5.0 | pF | $V_R$ = 0, f = 1.0 MHz |
| $B_V$ | Breakdown Voltage | 150 | | V | $I_R$ = 100 μA |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. Leads are tinned. Gold plate with nickel strike may be obtained when specified.
3. Capacitance as measured on Boonton Electronics Corporation Model No. 75-AS8 capacitance bridge or equivalent.
4. When not specified, Fairchild reserves the right to supply in DO35 package.
5. For product family characteristic curves, refer to Section 5 — D4.

# 1N3600 • 1N4150 • 1N4450 • 1N4610

## HIGH CONDUCTANCE ULTRA FAST

### DIFFUSED SILICON PLANAR* EPITAXIAL DIODES

- $t_{rr}$ . . . 4.0 ns (MAX)
- $V_F$ . . . 1.0 V (MAX) @ 200 mA

See DO7-2 Package Outline & Note 1

**ABSOLUTE MAXIMUM RATINGS** (Note 2)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +175°C |
| Operating Temperature | 165°C |

**Maximum Power Dissipation**

| | |
|---|---|
| Total Power Dissipation | 500 mW |

| **Maximum Voltages and Currents** | | **1N3600** | **1N4150** | **1N4450** | **1N4610** |
|---|---|---|---|---|---|
| WIV | Working Inverse Voltage | 50 V | 50 V | 30 V | 55 V |
| $I_O$ | Average Rectified Current | 200 mA | 200 mA | 200 mA | 200 mA |
| $I_F$ | DC Forward Current | 400 mA | 400 mA | 400 mA | 400 mA |
| $i_f$ | Recurrent Peak Forward Current | 900 mA | 600 mA | 600 mA | 600 mA |
| $i_{f(surge)}$ | Peak Forward Surge Current | | | | |
| | Pulse Width = 1.0 s | 1.0 A | 1.0 A | 1.0 A | 1.0 A |
| | Pulse Width = 1.0 μs | 4.0 A | 4.0 A | 4.0 A | 4.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 1N3600 1N4150 MIN. | 1N3600 1N4150 MAX. | 1N4450 MIN. | 1N4450 MAX. | 1N4610 MIN. | 1N4610 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| BV | Breakdown Voltage | | | | | | | | |
| | 1N3600 | 75 | | | | | | V | $I_R$ = 5.0 μA |
| | 1N4150 | 50 | | | | | | V | $I_R$ = 100 μA |
| | | | | 40 | | 80 | | V | $I_R$ = 5.0 μA |
| $I_R$ | Reverse Current | | 100 | | | | | nA | $V_R$ = 50 V |
| | | | | | 50 | | | nA | $V_R$ = 30 V |
| | | | | | | | 100 | nA | $V_R$ = 55 V |
| | | | 100 | | | | | μA | $V_R$ = 50 V, $T_A$ = 150°C |
| | | | | | 50 | | | μA | $V_R$ = 30 V, $T_A$ = 150°C |
| | | | | | | | 100 | μA | $V_R$ = 55 V, $T_A$ = 150°C |
| $V_F$ | Forward Voltage | | | 0.42 | 0.54 | 0.455 | 0.505 | V | $I_F$ = 0.1 mA |
| | | | | | | 0.53 | 0.59 | V | $I_F$ = 0.5 mA |
| | | 0.54 | 0.62 | 0.52 | 0.64 | 0.56 | 0.62 | V | $I_F$ = 1.0 mA |
| | | | | | | 0.640 | 0.705 | V | $I_F$ = 5.0 mA |
| | | 0.66 | 0.74 | 0.64 | 0.76 | 0.67 | 0.74 | V | $I_F$ = 10 mA |
| | | 0.76 | 0.86 | | | 0.76 | 0.84 | V | $I_F$ = 50 mA |
| | | 0.82 | 0.92 | 0.80 | 0.92 | 0.80 | 0.90 | V | $I_F$ = 100 mA |
| | | 0.87 | 1.0 | | 1.0 | 0.85 | 1.0 | V | $I_F$ = 200 mA |
| | | | | | | 0.875 | 1.10 | V | $I_F$ = 300 mA |
| C | Capacitance (Note 3) | | 2.5 | | 4.0 | | 2.0 | pF | $V_R$ = 0, f = 1.0 MHz |
| $t_{rr}$ | Reverse Recovery Time | | 4.0 | | | | 4.0 | ns | $I_f$ = $I_r$ = 10 mA to 200 mA, $R_L$ = 100 Ω |
| | | | | | 4.0 | | | ns | $I_f$ = $I_r$ = 10 mA, $R_L$ = 100 Ω |
| | | | | | | | 2.0 | ns | $I_f$ = 10 mA, $V_r$ = 6.0 V, $R_L$ = 100 Ω |
| | | | 6.0 | | | | | ns | $I_f$ = $I_r$ = 200 mA to 400 mA, $R_L$ = 100 Ω |
| $t_{fr}$ | Forward Recovery Time | | | | | | | | |
| | 1N4150,1N4610 | | 10 | | | | 10 | ns | $I_f$ = 200 mA, $t_r$ = 0.4 ns, $V_{fr}$ = 1.0 V |

*Planar is a patented Fairchild process.

NOTES:
1. Fairchild retains the option of supplying the 1N4610 in the DO-7 package.
2. Maximum ratings are limiting values above which life or satisfactory performance may be impaired.
3. Capacitance as measured on Boonton Model 75-AS8 capacitance bridge or equivalent.
4. Recovery to 0.1 $I_F$.
5. For family characteristic curves, refer to Section 5 - D6.

# 1N4001 through 1N4005

## NITRIDE PASSIVATED GLASS RECTIFIER

DIFFUSED SILICON PLANAR* DIODES

- **GLASS PACKAGE . . . NON-FLAMMABLE, HERMETIC**
- **NITRIDE PASSIVATED . . . FOR JUNCTION STABILITY**

**See DO41-1 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Junction Temperature | 175°C |

**Maximum Voltages and Current**

| | | 1N4001 | 1N4002 | 1N4003 | 1N4004 | 1N4005 |
|---|---|---|---|---|---|---|
| $V_{RM(rep)}$ | Peak Repetitive Reverse Voltage | 50 V | 100 V | 200 V | 400 V | 600 V |
| $V_{RM(wkg)}$ | Working Peak Reverse Voltage | 50 V | 100 V | 200 V | 400 V | 600 V |
| $V_R$ | DC Blocking Voltage | 50 V | 100 V | 200 V | 400 V | 600 V |
| $V_{RM(non\text{-}rep)}$ | Non-Repetitive Peak Reverse Voltage (half/wave, single phase, 60 Hz Peak) | 50 V | 100 V | 200 V | 400 V | 600 V |
| $V_{RM}$ | rms Input Voltage | 35 V | 70 V | 140 V | 280 V | 420 V |
| $I_O$ | Average Rectified Forward Current | 1.0 A | 1.0 A | 1.0 A | 1.0 A | 1.0 A |
| $I_{FM(surge)}$ | Non-Repetitive Peak Surge Current | 30 A | 30 A | 30 A | 30 A | 30 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | TYP. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $V_F$ | Maximum Instantaneous Forward Voltage Drop | 0.95 | 1.10 | V | $I_F$ = 1.0 A |
| $V_F$ (AV) | Maximum Full Cycle Average Forward Voltage Drop | 0.75 | 0.80 | V | $I_O$ = 1.0 A, $T_A$ = 75°C |
| $I_R$ | Maximum Reverse Current | 0.01 | 10 | μA | (Rated dc Voltage) |
| | | 0.50 | 50 | μA | $T_A$ = 100°C |
| $I_R$ (AV) | Maximum Full Cycle Average Reverse Current | 1.0 | 30 | μA | (Rated Reverse Voltage and $I_O$) |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. For product family characteristic curves, refer to Section 5-D10.

# 1N4009 • 1N4536

## ULTRA HIGH SPEED

### DIFFUSED SILICON PLANAR* DIODES

- **BV . . . 35 V (MIN) @ 5.0 μA**
- **C . . . 4.0 pF (MAX) @ $V_R$ = 0, f = 1.0 MHz**
- **$t_{rr}$ . . . 4.0 ns (MAX) @ $I_f$ = $I_r$ = 10 mA**

**See DO35-1 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Lead Temperature | 300°C |

**Maximum Power Dissipation** (Note 2)

| | **1N4009** | **1N4536** |
|---|---|---|
| Total Dissipation | 250 mW | 500 mW |
| Linear Derating Factor | 1.5 mW/°C | 2.85 mW/°C |

**Maximum Voltage**

| | | |
|---|---|---|
| WIV Working Inverse Voltage | 25 V | 25 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | | 1.0 | V | $I_F$ = 30 mA |
| $I_R$ | Reverse Current | | 0.1 | μA | $V_R$ = 50 V |
| | | | 100 | μA | $V_R$ = 50 V, $T_A$ = 150°C |
| BV | Breakdown Voltage | 35 | | V | $I_F$ = 5.0 μA |
| $t_{rr}$ | Reverse Recovery (Note 5) | | 4.0 | ns | $I_f$ = $I_r$ = 10 mA |
| | | | 2.0 | ns | $I_f$ = 10 mA, $V_r$ = 6.0 V, $R_L$ = 100Ω |
| C | Capacitance (Note 3) | | 4.0 | pF | $V_R$ = 0, f = 1.0 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. This power rating is based on a maximum junction temperature of 200°C.
3. Capacitance as measured on Boonton Electronic Corporation Model No. 75-AS8 capacitance bridge or equivalent.
4. Rectification efficiency is defined as the ratio of dc load voltage to peak rf input voltage to the detector circuit, measured with 2.0 V rms input to the circuit. Load resistance 5 kΩ, load capacitance 20 pF.
5. Recovery to 1.0 mA.
6. For additional product family characteristic curves, refer to Section 5-D6.

# 1N4086

## GENERAL PURPOSE

DIFFUSED SILICON PLANAR* EPITAXIAL DIODE

- **$V_F$ . . . 1.0 V (MAX) @ 100 mA**
- **$I_R$ . . . 250 nA (MAX) @ 70 V**

**See DO7-2 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| **Maximum Temperatures** | |
| Storage Temperature | −65°C to +200°C |
| Lead Temperature (2 seconds) | 250°C |
| **Maximum Power Dissipation** | |
| Total Dissipation | 400 mW |
| Linear Derating Factor | 2.7 mW/°C |
| **Maximum Voltage** | |
| WIV Working Inverse Voltage | 70 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | | 1.0 | V | $I_F$ = 200 mA |
| $I_R$ | Reverse Current | | 0.25 | μA | $V_R$ = 70 V |
| $t_{rr}$ | Reverse Recovery | | 200 | ns | $V_r$ = 10 V |
| $t_{fr}$ | Forward Recovery | | 75 | ns | $I_f$ = 300 mA |
| C | Capacitance (Note 2) | | 10 | pF | $V_R$ = 10 V, f = 1.0 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. Capacitance as measured on Boonton Electronic Corporation's Model No. 75-AS8 capacitance bridge or equivalent.
3. For product family characteristic curves, refer to Section 5 - D6.

# 1N4151 • 1N4152 • 1N4153 • 1N4154

## ULTRA HIGH SPEED

SILICON PLANAR* EPITAXIAL DIODES

- **C . . . 4 pF @ $V_R$ = 0, f = 1.0 MHz**
- **$t_{rr}$ . . . 2.0 ns @ $I_F$ = 10 mA, $V_R$ = −6.0 V, $R_L$ = 100 Ω**

**See DO35-1 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperature**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Lead Temperature (20 seconds) | 300°C |

**Maximum Power Dissipation** (Note 2)

| | 1N4151 | 1N4152 | 1N4153 | 1N4154 |
|---|---|---|---|---|
| Total Dissipation at 25°C Ambient Temperature | 500 mW | 500 mW | 500 mW | 500 mW |
| Linear Derating Factor | 2.85 mW/°C | 2.85 mW/°C | 2.85 mW/°C | 2.85 mW/°C |

**Maximum Voltage**

| | | | | |
|---|---|---|---|---|
| $V_R$ Reverse Voltage | 75 V | 40 V | 75 V | 35 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | 1N4154 | | 1.0 | V | $I_F$ = 30 mA |
| | | 1N4151 | | 1.0 | V | $I_F$ = 50 mA |
| | | 1N4152 & 1N4153 | 0.49 | 0.55 | V | $I_F$ = 0.1 mA |
| | | | 0.53 | 0.59 | V | $I_F$ = 0.25 mA |
| | | | 0.59 | 0.67 | V | $I_F$ = 1.0 mA |
| | | | 0.62 | 0.70 | V | $I_F$ = 2.0 mA |
| | | | 0.70 | 0.81 | V | $I_F$ = 10 mA |
| | | | 0.74 | 0.88 | V | $I_F$ = 20 mA |
| $I_R$ | Reverse Current | 1N4154 | | 0.1 | μA | $V_R$ = 25 V |
| | | | | 100 | μA | $V_R$ = 25 V, $T_A$ = 150°C |
| | | 1N4153, 1N4151 | | 0.05 | μA | $V_R$ = 50 V |
| | | | | 50 | μA | $V_R$ = 50 V, $T_A$ = 150°C |
| | | 1N4152 | | 0.05 | μA | $V_R$ = 30 V |
| | | | | 50 | μA | $V_R$ = 30 V, $T_A$ = 150°C |
| BV | Breakdown Voltage | 1N4154 | 35 | | V | $I_R$ = 5.0 μA |
| | | 1N4153, 1N4151 | 75 | | V | $I_R$ = 5.0 μA |
| | | 1N4152 | 40 | | V | $I_R$ = 5.0 μA |
| $t_{rr}$ | Reverse Recovery Time | | | 4.0 | ns | $I_f$ = 10 mA, $I_r$ = 10 mA (Note 3) |
| | | | | 2.0 | ns | $I_f$ = 10 mA, $V_r$ = −6.0 V, $R_L$ = 100Ω |
| C | Capacitance | | | 4.0 | pF | $V_R$ = 0, f = 1.0 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which satisfactory performance may be impaired.
2. These are steady state limits. The factory should be consulted in applications involving pulsed or low duty cycle operation.
3. Recovery to 1.0 mA.
4. For product family characteristic curves, refer to Section 5-D6.

# 1N4244

## PICOSECOND COMPUTER

DIFFUSED SILICON PLANAR* DIODE

- **C . . . 0.8 pF @ $V_R$ = 0 V**
- **$t_{rr}$ . . . 0.75 ns @ $I_f$ = $I_r$ = 10 mA,**

**See DO7-2 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +150°C |
| Operating Temperature | | 150°C |
| **Maximum Power Dissipation** | | |
| Total Dissipation | | 250 mW |
| Linear Derating Factor | | 2.0 mW/°C |
| **Maximum Voltages and Currents** | | |
| WIV | Working Inverse Voltage | 10 V |
| $I_O$ | Average Rectified Current | 50 mA |
| $i_f$ | Recurrent Peak Forward Current | 150 mA |
| $i_{f(surge)}$ | Peak Forward Surge Current Pulse Width = 1.0 s | 150 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| BV | Breakdown Voltage | 20 | | V | $I_R$ = 5.0 μA |
| $V_F$ | Forward Voltage | | 1.0 | V | $I_F$ = 20 mA |
| $I_{R1}$ | Reverse Current | | 100 | nA | $V_R$ = 10 V |
| $I_{R2}$ | Reverse Current | | 250 | nA | $V_R$ = 15 V |
| $I_{R3}$ | Reverse Current | | 100 | μA | $V_R$ = 10 V, $T_A$ = 150°C |
| C | Capacitance (Note 3) | | 0.8 | pF | $V_R$ = 0 V, f = 1.0 MHz |
| $t_{rr}$ | Reverse Recovery Time (Note 2) | | 0.75 | ns | $I_f$ = $I_r$ = 10 mA, $R_L$ = 100 Ω |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. Recovery to 0.1 $I_R$.
3. Capacitance as measured on Boonton Electronic Corporation Model No. 75-AS8 capacitance bridge or equivalent.
4. Leads are tinned. Gold plate with nickel strike may be obtained when specified.
5. For product family characteristic curves, refer to Section 5 — D7.

# 1N4306 • 1N4307

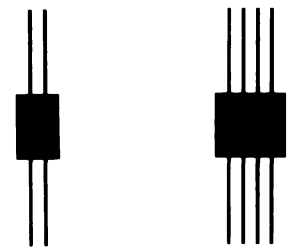
## HIGH CONDUCTANCE ULTRA FAST

DIFFUSED SILICON PLANAR* EPITAXIAL DIODES

- **$\Delta V_F$ . . . 10-20 mV (MAX)**
- **C . . . 2.0 pF @ $V_R$ = 0, f = 1.0 MHz**
- **$t_{rr}$ . . . 4.0 ns (MAX) @ $I_f = I_r$ = 10 mA**
- **MATCHED PAIR (1N4306)**
- **MATCHED QUAD (1N4307)**

**See Package Outlines**

**TO308-1** **TO310-1**



**1N4306** **1N4307**

**ABSOLUTE MAXIMUM RATINGS**

**Maximum Temperatures**

| | | |
|---|---|---|
| Storage Temperature | | –65°C to +150°C |
| Operating Temperature | | 150°C |

**Maximum Power Dissipation**

| | | |
|---|---|---|
| Total Dissipation at 25°C Ambient Temperature | | 500 mW |
| at 125°C Ambient Temperature | 1N4306 | 100 mW |
| | 1N4307 | 170 mW |

**Maximum Voltage and Currents**

| | | |
|---|---|---|
| WIV | Working Inverse Voltage | 50 V |
| $I_O$ | Average Rectified Current | 200 mA |
| $i_f$ | Recurrent Peak Forward Current | 600 mA |
| $i_{f(surge)}$ | Peak Forward Surge Current | |
| | Pulse Width = 1.0 s | 1.0 A |
| | Pulse Width = 1 μs | 4.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $V_{F1}$ | Forward Voltage | 0.440 | 0.550 | V | $I_F$ = 100 μA |
| $V_{F2}$ | Forward Voltage | 0.560 | 0.670 | V | $I_F$ = 1.0 mA |
| $V_{F3}$ | Forward Voltage | 0.670 | 0.810 | V | $I_F$ = 10 mA |
| $V_{F4}$ | Forward Voltage | 0.750 | 1.0 | V | $I_F$ = 50 mA |
| $I_{R1}$ | Reverse Current | | 50 | nA | $V_R$ = 50 V |
| $I_{R2}$ | Reverse Current | | 5.0 | μA | $V_R$ = 75 V |
| $I_{R3}$ | Reverse Current | | 50 | μA | $V_R$ = 50 V, $T_A$ = 150°C |
| C | Capacitance | | 2.0 | pF | $V_R$ = 0, f = 1.0 MHz |
| $t_{rr}$ | Reverse Recovery Time (Note 2) | | 4.0 | ns | $I_f = I_r$ = 10 mA, $R_L$ = 100 Ω |
| $\Delta V_{F1}$ | Forward Voltage Match | | 10 | mV | $I_F$ = 0.1 to 10 mA, $T_A$ = –55°C to +125°C |
| $\Delta V_{F2}$ | Forward Voltage Match | | 20 | mV | $I_F$ = 10 to 50 mA, $T_A$ = –55°C to +125°C |

*Planar is a patented Fairchild process

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. Recovery to 10% of $I_F$.
3. For product family characteristic curves, refer to Section 5 - D6.

# 1N4376

## PICOSECOND COMPUTER

DIFFUSED SILICON PLANAR* DIODE

- **BV . . . 20 V (MIN) @ 5.0 μA**
- **$t_{rr}$ . . . = 750 ps @ $I_f = I_r$ = 10 mA,**
- **C . . . 1.0 pF (MAX) @ $V_R$ = 0**

**See DO7-2 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +175°C |
| Operating Temperature | | 150°C |
| **Maximum Power Dissipation** | | |
| Total Dissipation | | 250 mW |
| Linear Derating Factor | | 2.0 mW/°C |
| **Maximum Voltage and Currents** | | |
| WIV | Working Inverse Voltage | 10 V |
| $I_O$ | Average Rectified Current | 50 mA |
| $i_f$ | Recurrent Peak Forward Current | 150 mA |
| $i_f$ (surge) | Peak Forward Surge Current Pulse Width = 1.0 s | 150 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTICS | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $B_V$ | Breakdown Voltage | 20 | | V | $I_R$ = 5.0 μA |
| $I_R$ | Reverse Current | | 100 | nA | $V_R$ = 10 V |
| | | | 100 | μA | $V_R$ = 10 V, $T_A$ = 150°C |
| $V_{F1}$ | Forward Voltage | 0.89 | 1.10 | V | $I_F$ = 50 mA |
| $V_{F2}$ | Forward Voltage | 0.81 | 0.95 | V | $I_F$ = 20 mA |
| $V_{F3}$ | Forward Voltage | 0.76 | 0.88 | V | $I_F$ = 10 mA |
| $V_{F4}$ | Forward Voltage | 0.64 | 0.74 | V | $I_F$ = 1.0 mA |
| $V_{F5}$ | Forward Voltage | 0.52 | 0.61 | V | $I_F$ = 0.1 mA |
| $V_{F6}$ | Forward Voltage | 0.42 | 0.50 | V | $I_F$ = 0.01 mA |
| $t_{rr}$ | Reverse Recovery Time (Note 2) | | 750 | ps | $I_f = I_r$ = 10 mA, $R_L$ = 100 Ω |
| C | Capacitance (Note 3) | | 1.0 | pF | $V_R$ = 0 V, f = 1.0 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. Recovery to 0.1 $I_R$.
3. Capacitance as measured on Boonton Electronic Corporation Model No. 75-AS8 capacitance bridge or equivalent.
4. Leads are tinned. Gold plate with nickel strike may be obtained when specified.
5. For product family characteristic curves, refer to Section 5-D7.

# 1N4531 • 1N4532

## ULTRA COMPACT HIGH CONDUCTANCE ULTRA FAST

DIFFUSED SILICON PLANAR* EPITAXIAL DIODES

- **$V_F$ . . . 1.0 V (MAX) @ 10 mA**
- **C . . . 2.0 pF (MAX) (1N4532), 4.0 pF (MAX) 1N4531**

**See DO34-1 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| **Maximum Temperatures** | |
| Storage Temperatures | −65°C to +200°C |
| Operating Temperature | 150°C |
| **Maximum Power Dissipation** (Package) | |
| Total Dissipation | 350 mW |
| Linear Derating Factor | 2.8 mW/°C |
| **Maximum Voltage** | |
| WIV Working Inverse Voltage | 75 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | | | 1.0 | V | $I_F$ = 10 mA |
| $I_R$ | Reverse Current | 1N4531 | | 25 | nA | $V_R$ = 20 V |
| | | 1N4532 | | 0.1 | μA | $V_R$ = 50 V |
| | | 1N4531 | | 50 | μA | $V_R$ = 20 V, $T_A$ = 150°C |
| | | 1N4532 | | 100 | μA | $V_R$ = 50 V, $T_A$ = 150°C |
| BV | Breakdown Voltage | 1N4531 | 100 | | V | $I_R$ = 100 μA |
| | | 1N4532 | 75 | | V | $I_R$ = 5.0 μA |
| $t_{rr}$ | Reverse Recovery Time (Note 2) | 1N4531 | | 4.0 | ns | $I_f$ = 10 mA, $V_r$ = 6.0 V |
| | | 1N4532 | | 2.0 | ns | $I_f$ = 10 mA, $V_r$ = 6.0 V |
| | | 1N4532 | | 4.0 | ns | $I_f$ = $I_r$ = 10 mA |
| $V_{fr}$ | Forward Recovery Peak Voltage (Note 3) | 1N4532 | | 3.0 | V | $I_f$ = 100 mA (pulsed) |
| C | Capacitance (Note 4) | 1N4531 | | 4.0 | pF | $V_R$ = 0, f = 1.0 MHz |
| | | 1N4532 | | 2.0 | pF | $V_R$ = 0, f = 1.0 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. Recovery to 1.0 mA. $R_L$ = 100 Ω.
3. $I_F$ = 100 mA peak square wave; 0.1 μs pulse width; $R_L$ = 50 Ω; $T_R \leqslant$ 30 ns; Rep. Rate = 5-100 kHz.
4. Capacitance as measured on Boonton Electronic Corporation Model No. 75 — AS8 capacitance bridge or equivalent.
5. Leads are tinned. Gold plate with nickel strike may be obtained when specified.
6. For product family characteristic curves, refer to Section 5 — D6.

# 1N4533 • 1N4534

## ULTRA HIGH SPEED

DIFFUSED SILICON PLANAR* DIODES

- **C . . . 2.0 pF @ $V_R$ = 0, f = 1.0 MHz**
- **$t_{rr}$ . . . 4.0 ns @ $I_f$ = $I_r$ = 10 mA**

**See DO34-1 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | −65°C to +200°C | |
| Lead Temperature (10 seconds) | 300°C | |
| **Maximum Power Dissipation** | | |
| Total Dissipation | 500 mW | |
| Linear Derating Factor | 2.85 mW/°C | |
| **Maximum Voltage** | **1N4533** | **1N4534** |
| WIV Working Inverse Voltage | 40 V | 50 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | | 0.490 | 0.550 | V | $I_F$ = 0.1 mA |
| | | | 0.530 | 0.590 | V | $I_F$ = 0.25 mA |
| | | | 0.590 | 0.670 | V | $I_F$ = 1.0 mA |
| | | | 0.620 | 0.700 | V | $I_F$ = 2.0 mA |
| | | | 0.700 | 0.810 | V | $I_F$ = 10 mA |
| | | | 0.740 | 0.880 | V | $I_F$ = 20 mA |
| $I_R$ | Reverse Current | 1N4533 | | 0.05 | μA | $V_R$ = 30 V |
| | | 1N4534 | | 0.05 | μA | $V_R$ = 50 V |
| | | 1N4533 | | 50 | μA | $V_R$ = 30 V, $T_A$ = 150°C |
| | | 1N4534 | | 50 | μA | $V_R$ = 50 V, $T_A$ = 150°C |
| BV | Breakdown Voltage | 1N4533 | 40 | | V | $I_R$ = 5.0 μA |
| | | 1N4534 | 75 | | V | $I_R$ = 5.0 μA |
| $t_{rr}$ | Reverse Recovery Time (Note 2) | | | 4.0 | ns | $I_f$ = $I_r$ = 10 mA |
| | | | | 2.0 | ns | $I_f$ = 10 mA, $V_r$ = −6.0 V, $R_L$ = 100 Ω |
| C | Capacitance (Note 3) | | | 2.0 | pF | $V_R$ = 0 V, f = 1.0 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. Recovery to 1.0 mA.
3. Capacitance as measured on Boonton Electronic Corporation Model No. 75 — AS8 capacitance bridge or equivalent.
4. For product family characteristic curves, refer to Section 5 — D6.

# 1N4607

## MINIATURE SIZE HIGH CONDUCTANCE ULTRA FAST

DIFFUSED SILICON PLANAR* EPITAXIAL DIODE

- **$t_{rr}$ . . . 4 ns (MAX) @ $I_f = I_r = 500$ mA**
- **BV . . . 85 V (MIN) @ 100 μA**
- **C . . . 4.0 pF (MAX) @ $V_R = 0$**

**See DO35-1 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Temperature | | 175°C |
| **Maximum Power Dissipation** | | |
| Total Dissipation | | 500 mW |
| **Maximum Voltage and Currents** | | |
| WIV | Working Inverse Voltage | 70 V |
| $I_O$ | Average Rectified Current | 200 mA |
| $I_F$ | DC Forward Current | 400 mA |
| $i_f$ | Recurrent Peak Forward Current | 600 mA |
| $I_{f(surge)}$ | Peak Forward Surge Current | |
| | Pulse Width = 1.0 s | 1.0 A |
| | Pulse Width = 1.0 μs | 4.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| BV | Breakdown Voltage | 85 | | V | $I_R = 100$ μA |
| $I_R$ | Reverse Current | | 100 | nA | $V_R = 50$ V |
| | | | 25 | μA | $V_R = 50$ V, $T_A = 100$°C |
| | | | 250 | nA | $V_R = 70$ V |
| $V_F$ | Forward Voltage Drop | 0.39 | 0.50 | V | $I_F = 0.1$ mA |
| | | 0.50 | 0.61 | V | $I_F = 1.0$ mA |
| | | 0.61 | 0.72 | V | $I_F = 10$ mA |
| | (Note 4) | 0.74 | 0.87 | V | $I_F = 100$ mA |
| | (Note 4) | 0.81 | 0.95 | V | $I_F = 250$ mA |
| | (Note 4) | | 1.0 | V | $I_F = 350$ mA |
| | (Note 4) | | 1.1 | V | $I_F = 400$ mA |
| C | Capacitance (Note 2) | | 4.0 | pF | $V_R = 0$ |
| $t_{rr}$ | Reverse Recovery Time (Note 3) | | 10 | ns | $I_f = I_r = 10$ mA, $R_L = 100\ \Omega$ |
| | | | 15 | ns | $I_f = I_r = 500$ mA, $R_L = 100\ \Omega$ |

*Planar is a patented Fairchild process.

NOTES:
1. Maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. Capacitance as measured on Boonton Model 75-AS8 capacitance bridge or equivalent.
3. Recovery to 0.1 $I_R$.
4. Pulse conditions: length ≤ 300 μs; duty cycle ≤ 2%.
5. For family characteristic curves, refer to Section 5 - D6.

# 1N4727

## MINIATURE SIZE HIGH CONDUCTANCE

ULTRA FAST SILICON PLANAR* EPITAXIAL DIODE

- **BV . . . 30 V (MIN) @ 5.0 μA**
- **C . . . 4.0 pF (MAX) $V_R$ = 0 V**

**See DO35-1 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +175°C |
| Operating Temperature | | 150°C |
| **Maximum Power Dissipation** | | |
| Total Dissipation at 25°C Ambient Temperature | | 500 mW |
| Total Dissipation at 125°C Ambient Temperature | | 100 mW |
| **Maximum Voltage and Currents** | | |
| WIV | Working Inverse Voltage | 20 V |
| $I_O$ | Average Rectified Current | 200 mA |
| $I_F$ | DC Forward Current | 400 mA |
| $i_f$ | Recurrent Peak Forward Current | 600 mA |
| $i_f$ (surge) | Peak Forward Surge Current | |
| | Pulse Width = 1.0 s | 1.0 A |
| | Pulse Width = 1.0 μs | 4.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | | 0.85 | V | $I_F$ = 10 mA |
| $I_{R1}$ | Reverse Current | | 100 | nA | $V_R$ = 20 V |
| $I_{R2}$ | Reverse Current | | 10 | μA | $V_R$ = 20 V, $T_A$ = 100°C |
| BV | Breakdown Voltage | 30 | | V | $I_R$ = 5.0 μA |
| $Q_S$ | Stored Charge (Note 2) | | 40 | pC | $I_f$ = 10 mA |
| C | Capacitance (Note 3) | | 4.0 | pF | $V_R$ = 0 V |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. Stored charge as measured on B-Line Corporation Model No. QS-3 stored charge meter or equivalent.
3. Capacitance as measured on Boonton Electronic Corporation Model No. 75 — AS8 capacitance bridge or equivalent.
4. Leads are tinned, gold plate with nickel strike may be obtained when specified.
5. For product family characteristic curves, refer to Section 5 — D6.

# 1N4950

## HIGH CONDUCTANCE ULTRA FAST

DIFFUSED SILICON PLANAR* EPITAXIAL DIODE

- **BV . . . 30 V (MIN) @ 5.0 μA**
- **$t_{rr}$ . . . 4.0 ns (MAX) @ $I_f = I_r$ = 10 mA to 200 mA**

**See DO7-2 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Temperature | | 175°C |
| **Maximum Power Dissipation** | | |
| Total Dissipation at 25°C Ambient Temperature | | 500 mW |
| at 125°C Ambient Temperature | | 170 mW |
| **Maximum Voltage and Currents** | | |
| WIV | Working Inverse Voltage | 25 V |
| $I_O$ | Average Rectified Current | 200 mA |
| $i_f$ | Recurrent Peak Forward Current | 900 mA |
| $i_{f(surge)}$ | Peak Forward Surge Current | |
| | Pulse Width = 1.0 s | 1.0 A |
| | Pulse Width = 1.0 μs | 4.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | 0.87 | 1.0 | V | $I_F$ = 300 mA |
| | | 0.53 | 0.61 | V | $I_F$ = 1.0 mA |
| | | 0.64 | 0.72 | V | $I_F$ = 10 mA |
| | | 0.72 | 0.82 | V | $I_F$ = 50 mA |
| | | 0.77 | 0.87 | V | $I_F$ = 100 mA |
| | | 0.83 | 0.93 | V | $I_F$ = 200 mA |
| $I_R$ | Reverse Current | | 100 | nA | $V_R$ = 25 V |
| | | | 100 | μA | $V_R$ = 25 V, $T_A$ = 150°C |
| BV | Breakdown Voltage | 30 | | V | $I_R$ = 5.0 μA |
| C | Capacitance (Note 3) | | 3.3 | pF | $V_R$ = 0 |
| $t_{rr}$ | Reverse Recovery Time (Note 2) | | 4.0 | ns | $I_f = I_r$ = 10 mA to 200 mA, $R_L$ = 100 Ω |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. Recovery to 0.1 $I_R$.
3. Capacitance as measured on Boonton Electronic Corporation Model No. 75 – AS8 capacitance bridge or equivalent.
4. Leads are tinned. Gold plate with nickel strike may be obtained when specified.
5. For product family characteristic curves, refer to Section – 5D6.

# 1N5282

## HIGH CONDUCTANCE ULTRA FAST

DIFFUSED SILICON PLANAR* EPITAXIAL DIODE

- **BV . . . 80 V (MIN) @ 5.0 μA**
- **C . . . 2.5 pF @ $V_R$ = 0 V, f = 1.0 MHz**
- **$t_{rr}$ . . . 4.0 ns @ $I_f$ = $I_r$ = 10 mA to 200 mA**

**See DO35-1 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperatures | | −65°C to +175°C |
| Operating Temperature | | 150°C |
| **Maximum Power Dissipation** | | |
| Total Dissipation | | 500 mW |
| Linear Derating Factor | | 4.0 mW/°C |
| **Maximum Voltages and Currents** | | |
| WIV | Working Inverse Voltage | 55 V |
| $I_O$ | Average Rectified Current | 200 mA |
| $i_{f(surge)}$ | Peak Forward Surge Current | |
| | Pulse Width = 1.0 s | 1.0 A |
| | Pulse Width = 1.0 μs | 4.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | 1.05 | 1.30 | V | $I_F$ = 500 mA (Note 5) |
| | | 0.92 | 1.10 | V | $I_F$ = 300 mA |
| | | 0.80 | 0.90 | V | $I_F$ = 100 mA |
| | | 0.67 | 0.725 | V | $I_F$ = 10 mA |
| | | 0.55 | 0.60 | V | $I_F$ = 1.0 mA |
| | | 0.45 | 0.49 | V | $I_F$ = 0.1 mA |
| $I_R$ | Reverse Current | | 100 | nA | $V_R$ = 55 V |
| | | | 100 | μA | $V_R$ = 55 V, $T_A$ = 150°C |
| BV | Breakdown Voltage | 80 | | V | $I_R$ = 5.0 μA |
| $t_{rr}$ | Reverse Recovery Time (Note 2) | | 4.0 | ns | $I_f$ = $I_r$ = 10 mA to 200 mA<br>$R_L$ = 100 Ω |
| $t_{rr}$ | Reverse Recovery Time | | 2.0 | ns | $I_f$ = 10 mA, $V_r$ = 6.0 V<br>$R_L$ = 100 Ω |
| $t_{fr}$ | Forward Recovery Time | | 10 | ns | $I_f$ = 200 mA (Note 7) |
| $V_{pk}$ | Peak Forward Voltage | | 2.0 | V | $I_f$ = 500 mA (Note 8) |
| C | Capacitance (Note 3) | | 2.5 | pF | $V_R$ = 0, f = 1.0 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. Recovery to 0.1 $I_F$.
3. Capacitance as measured on Boonton Electronic Corporation Model No. 75 – AS8 capacitance bridge or equivalent.
4. Leads are tinned. Gold plate with nickel strike may be obtained when specified.
5. Pulse conditions: length = 300 μs; duty cycle ≤ 1%.
6. For product family characteristic curves, refer to Section 5 – D6.
7. $t_r$ = 0.4 ns, $V_{fr}$ = 1.0 V, pulse width = 100 ns; duty cycle ≤ 1%.
8. $t_r$ = 8.0 ns, pulse width = 1.0 μs; duty cycle ≤ 1%.

# 1N5317 • 1N5318 • 1N5319

## ULTRA COMPACT HIGH CONDUCTANCE ULTRA FAST

DIFFUSED SILICON PLANAR* EPITAXIAL DIODES

- **C . . . 2.5 pF @ $V_R$ = 0, f = 1.0 MHz**
- **$I_R$ . . . 100 μA (MAX)**
- **$t_{rr}$ . . . 2.0 ns @ $I_F$ = 10 mA, $V_R$ = 6.0 V, $R_L$ = 100 Ω**

**See DO34-1 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +175°C |
| Operating Junction Temperature | 150°C |

**Maximum Power Dissipation** (Package) (Note 2)

| | |
|---|---|
| Total Dissipation | 350 mW |
| Linear Derating Factor | 2.8 mW/°C |

| **Maximum Voltages and Currents** | | **1N5317** | **1N5318** | **1N5319** |
|---|---|---|---|---|
| WIV | Working Inverse Voltage | 55 V | 50 V | 25 V |
| $I_O$ | Average Rectified Current | 125 mA | 125 mA | 100 mA |
| $i_f$ | Recurrent Peak Forward Current | 400 mA | 400 mA | 400 mA |
| $i_{f(surge)}$ | Peak Forward Surge Current | | | |
| | Pulse Width = 1.0 s | 500 mA | 500 mA | 500 mA |
| | Pulse Width = 1.0 μs | 2.0 A | 2.0 A | 2.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 1N5317 MIN. | 1N5317 MAX. | 1N5318 MIN. | 1N5318 MAX. | 1N5319 MIN. | 1N5319 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $V_F$ | Forward Voltage (Note 3) | 1.05 | 1.30 | | | | | V | $I_F$ = 500 mA |
| | | 0.92 | 1.10 | | | | | V | $I_F$ = 300 mA |
| | | | | 0.87 | 1.0 | | | V | $I_F$ = 200 mA |
| | | 0.80 | 0.90 | 0.82 | 0.92 | | 1.0 | V | $I_F$ = 100 mA |
| | | | | 0.76 | 0.86 | | | | $I_F$ = 50 mA |
| | | 0.67 | 0.725 | 0.66 | 0.74 | | | | $I_F$ = 10 mA |
| | | 0.55 | 0.60 | 0.54 | 0.62 | | | | $I_F$ = 1.0 mA |
| | | 0.45 | 0.49 | | | | | | $I_F$ = 0.1 mA |
| $I_R$ | Reverse Current | | 0.1 | | | | | μA | $V_R$ = 55 V |
| | | | | | 0.1 | | | μA | $V_R$ = 50 V |
| | | | | | | | 0.1 | μA | $V_R$ = 25 V |
| | | | 100 | | | | | μA | $V_R$ = 55 V, $T_A$ = 150°C |
| | | | | | 100 | | | μA | $V_R$ = 50 V, $T_A$ = 150°C |
| | | | | | | | 100 | μA | $V_R$ = 25 V, $T_A$ = 150°C |
| BV | Breakdown Voltage | 80 | | 75 | | 40 | | V | $I_R$ = 5.0 μA |
| $t_{rr1}$ | Reverse Recovery Time (Note 4) | | 4.0 | | 4.0 | | 4.0 | ns | $I_f = I_r$ = 10 mA to 200 mA, $R_L$ = 100 Ω |
| $t_{rr2}$ | Reverse Recovery Time (Note 4) | | 2.0 | | | | | ns | $I_f$ = 10 mA, $V_r$ = 6.0 V, $R_L$ = 100 Ω |
| | | | | | 6.0 | | 6.0 | ns | $I_f = I_r$ = 200 mA to 400 mA, $R_L$ = 100 Ω |
| C | Capacitance (Note 5) | | 2.5 | | 2.5 | | 3.5 | pF | $V_R$ = 0, f = 1.0 MHz |
| $t_{fr}$ | Forward Recovery Time (Note 6) | | 10 | | | | | ns | $I_f$ = 200 mA |
| $V_{pk}$ | Peak Forward Voltage (Note 7) | | 2.0 | | | | | V | $I_f$ = 500 mA |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. Heat sink in copper block 1/4" from diode body.
3. Pulse conditions: length = 300 μs; duty cycle ≤ 1%.
4. Recovery to 0.1 $I_r$.
5. Capacitance as measured on Boonton Electronic Corporation Model No. 75-AS8 capacitance bridge or equivalent.
6. $t_r$ = 0.4 ns, $V_{fr}$ = 1.0 V; Pulse width = 100 ns, duty cycle ≤ 1%.
7. $t_r$ = 8.0 ns; Pulse width = 1.0 μs; duty cycle ≤1%.
8. For product family characteristic curves, refer to Section 5 - D6.

# 1N5794 • 1N5795 • 1N5796 • 1N5797 • 1N5798

## 1 AMP GLASS ENCAPSULATED RECTIFIER

DIFFUSED SILICON PLANAR* DIODES

- **HERMETIC (Glass) PACKAGE**
- **NITRIDE PASSIVATION FOR JUNCTION STABILITY**
- **DOUBLE STUD CONSTRUCTION**

**See DO41-1 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Temperature | 175°C |
| Lead Temperature | 300°C |

**Maximum Voltages and Currents**

| | | 1N5794 | 1N5795 | 1N5796 | 1N5797 | 1N5798 |
|---|---|---|---|---|---|---|
| $V_{RM(wkg)}$ | Working Peak Reverse Voltage | 50 V | 100 V | 200 V | 400 V | 600 V |
| $V_{RM(rep)}$ | Repetitive Peak Reverse Voltage | 50 V | 100 V | 200 V | 400 V | 600 V |
| $V_{RM(non\text{-}rep)}$ | Non-Repetitive Peak Reverse Voltage | 60 V | 120 V | 240 V | 480 V | 720 V |
| $V_R$ | DC Blocking Voltage | 50 V | 100 V | 200 V | 400 V | 600 V |
| | | | | **ALL DEVICES** | | |
| $I_O$ | Average dc Forward Current (Note 2) | | | 1.0 A | | |
| $i_{f(surge)}$ | Surge Current @ $T_A$ = 100°C | | | 0.75 A | | |
| | @ $T_A$ = 75°C | | | 30 A | | |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $I_{RO}$ | Reverse Current | | 30 | μA | $T_A$ = 75°C, $V_R$ = Rated $V_{RM(wkg)}$ |
| $I_R$ | DC Reverse Current | | 200 | μA | $T_A$ = 175°C, Rated $V_R$ |
| $V_F$ | Forward Voltage | | 0.98 | V | $T_A$ = 75°C, $I_F$ = 1.0 A |

*Planar is a patented Fairchild process.

NOTES:
1. The maximum ratings are limiting values above which life or satisfactory performance may be impaired.
2. $T_A$ = −20°C to +75°C.
3. For product family characteristics, refer to Section 5 - D10.

# 1S44

## GENERAL PURPOSE SWITCHING

DIFFUSED SILICON PLANAR* DIODES

- **BV . . . 50 V (MIN) @ 100 μA**
- **$V_F$ . . . 1.15 V (MAX) @ 10 mA**

**See DO35-1 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Temperature | | 175°C |
| **Maximum Power Dissipation** | | |
| Total Dissipation at 25°C Ambient Temperature | | 500 mW |
| Linear Derating Factor | | 3.33 mW/°C |
| **Maximum Currents and Voltage** | | |
| $i_f$ | Recurrent Peak Forward Current | 225 mA |
| $i_{f(surge)}$ | Surge Current (1.0 s pulse) | 500 mA |
| $I_O$ | Average Forward Current (−65°C to +25°C) (derates at 1.0 mA/°C above 25°C) | 75 mA |
| PIV | Peak Inverse Voltage | 40 V |

**ELECTRICAL CHARACTERISTICS:** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $I_R$ | Inverse Current | | 50 | nA | $V_R$ = 10 V |
| $V_F$ | Forward Voltage | | 1.15 | V | $I_F$ = 10 mA |
| $B_V$ | Reverse Voltage | 50 | | V | $I_R$ = 100 μA |
| C | Capacitance | | 6.0 | pF | $V_R$ = 0 |
| $Q_S$ | Stored Charge | | 120 | pC | $I_F$ = 10 mA, $V_R$ = 10 V |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. For product family characteristic curves, refer to Section 5 - D6.

# 1S920 • 1S921 • 1S922 • 1S923

## GENERAL PURPOSE

DIFFUSED SILICON PLANAR* DIODES

- **$V_F$ . . . 1.2 (MAX) @ 200 mA**
- **$I_R$ . . . 100 nA (MAX) @ RATED WIV**

**See DO35-1 Package Outline**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Temperature | 200°C |
| Lead Temperature (2 seconds) | 300°C |

**Maximum Power Dissipation**

| | |
|---|---|
| Total Dissipation at 25°C Ambient Temperature | 250 mW |
| Linear Derating Factor | 2.0 mW/° C |

**Maximum Voltage and Currents**

| | | 1S920 | 1S921 | 1S922 | 1S923 |
|---|---|---|---|---|---|
| WIV | Working Inverse Voltage (−65°C to +100°C) | 50 V | 100 V | 150 V | 200 V |
| $I_O$ | Average Forward Current | 200 mA | 200 mA | 200 mA | 200 mA |
| $i_f$ | Recurrent Peak Forward Current | 2.0 A | 2.0 A | 2.0 A | 2.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTICS | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $I_R$ | Inverse Current | | 100 | nA | $V_R$ = rated WIV |
| | | | 10 | μA | $V_R$ = rated WIV, $T_A$ = 100°C |
| $V_F$ | Forward Voltage (Note 2) | | 1.2 | V | $I_F$ = 200 mA |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. Pulse conditions: length = 300 μs; duty cycle ≤ 2%.
3. For product family characteristic curves, refer to Section 5-D4.

# 2N706 • 2N706A • MPS706 • MPS706A

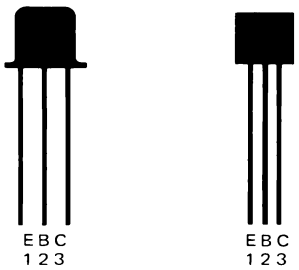
## NPN HIGH SPEED LOGIC SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C (MPS706, MPS706A)
- $V_{CER}$ . . . 20 V (MIN) @ 10 mA
- $h_{FE}$ . . . 20 (MIN) @ 10 mA
- $\tau_s$ . . . 60 ns (MAX) (2N/MPS706), 25 ns (MAX) (2N/MPS706A)
- COMPLEMENTS . . . 2N3012 (TO18), MPS3640 (TO92)

See Package Outlines

TO18-1 TO92-1




2N706 2N706A MPS706 MPS706A

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| **Maximum Temperatures** | **2N706/706A** | **MPS706/706A** |
|---|---|---|
| Storage Temperature | −65°C to +175°C | −55°C to +150°C |
| Operating Junction Temperature | 175°C | 150°C |
| Lead Temperature (10 seconds) | 300°C | 300°C |

| **Maximum Power Dissipation** | **2N706/706A** | **MPS706/706A** |
|---|---|---|
| Total Dissipation at 25°C Ambient Temperature | 0.3 W | 0.625 W |
| at 25°C Case Temperature | 1.0 W | 1.0 W |

| **Maximum Voltages** | | **2N/MPS706** | **2N/MPS706A** |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 25 V | 25 V |
| $V_{CER}$ | Collector to Emitter Voltage ($R_{BE} \leq 10\Omega$) (Note 4) | 20 V | 20 V |
| $V_{EBO}$ | Emitter to Base Voltage | 3.0 V | 5.0 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOLS | CHARACTERISTIC | MPS706 MIN. | MPS706 MAX. | MPS706A MIN. | MPS706A MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain (Note 5) | 20 | | 20 | 60 | | $V_{CE}$ = 1.0 V, $I_C$ = 10 mA |
| $V_{BE}$ (sat) | Base to Emitter Saturation Voltage (Note 5) | | 0.9 | 0.7 | 0.9 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $V_{CE}$ (sat) | Collector to Emitter Saturation Voltage (Note 5) | | 0.6 | | 0.6 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $h_{fe}$ | High Frequency Current Gain | 2.0 | | 2.0 | | | $I_C$ = 10 mA, $V_{CE}$ = 15 V, f = 100 MHz |
| $C_{ob}$ | Output Capacitance | | 6.0 | | 6.0 | pF | $V_{CB}$ = 10 V, $I_E$ = 0. f = 100 kHz |
| $I_{CBO}$ | Collector Cutoff Current | | 500 | | 500 | nA | $V_{CB}$ = 15 V, $I_E$ = 0 |
| $\tau_s$ | Charge Storage Time Constant (see test circuit no. 588) | | 60 | | 25 | ns | $I_C$ = 10 mA, $V_{CC}$ = 10 V, $I_{B1}$ = $I_{B2}$ = 10 mA |
| $I_{EBO}$ | Emitter Cutoff Current | | 10 | | 10 | μA | $V_{EB}$ = 3.0 V, $I_C$ = 0 |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 5) | 15 | | 15 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $BV_{CER}$ | Collector to Emitter Breakdown Voltage | 20 | | 20 | | V | $I_C$ = 10 mA, $R_{BE}$ = 10 Ω |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 25 | | 25 | | | $I_C$ = 10 μA, $I_E$ = 0 |
| $r_b'$ | Base Resistance | | 50 | | 50 | Ω | $I_E$ = 10 mA, $V_{CE}$ = 15 V, f = 300 MHz |
| $t_{on}$ | Turn On Time (see test circuit no. 589) | | 40 | | 40 | ns | $I_C$ = 10 mA, $I_{B1}$ = 3.0 mA, $V_{CC}$ = 3.0 V |
| $t_{off}$ | Turn Off Time (see test circuit no. 589) | | 75 | | 75 | ns | $I_C$ = 10 mA, $I_{B1}$ = 3.0 mA, $I_{B2}$ = 1.5 mA, $V_{CC}$ = 3.0 V |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 175°C and junction to case thermal resistance of 150°C/W (derating factor of 6.7 mW/°C); for 2N706 and 2N706A. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C) for MPS706, MPS706A.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length ≤ 12 μs; duty cycle = 1% for MPS706/A; length = 300 μs; duty cycle = 1% for 2N706/A.
6. For product family characteristic curves, refer to Section 5 - SS5 for 2N706, MPS706 and MPS706A; Section 5 - SS28 for 2N706A.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N706 MIN. | 2N706 MAX. | 2N706A MIN. | 2N706A MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain (Note 5) | 20 | | 20 | 60 | | $V_{CE}$ = 1.0 V, $I_C$ = 10 mA |
| $V_{BE\,(sat)}$ | Base to Emitter Saturation Voltage (Note 5) | | 0.9 | 0.7 | 0.9 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | 0.6 | | 0.6 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $h_{fe}$ | High Frequency Current Gain | 2.0 | | | | | $I_C$ = 10 mA, $V_{CE}$ = 15 V, f = 100 MHz |
| | | | | 2.0 | | | $I_C$ = 10 mA, $V_{CE}$ = 10 V, f = 100 MHz |
| $C_{ob}$ | Output Capacitance | | 6.0 | | | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 100 kHz |
| | | | | | 5.0 | pF | $V_{CB}$ = 5.0 V, $I_E$ = 0, f = 1.0 MHz |
| $I_{CBO}$ | Collector Cutoff Current | | 300 | | 500 | nA | $V_{CB}$ = 15 V, $I_E$ = 0 |
| | | | 30 | | 30 | μA | $V_{CB}$ = 15 V, $I_E$ = 0, $T_A$ = 150°C |
| $\tau_s$ | Charge Storage Time Constant (see test circuit no. 3111) | | 60 | | 25 | ns | $I_C$ = 10 mA, $V_{CC}$ = 10 V, $I_{B1}$ = $I_{B2}$ = 10 mA |
| $I_{EBO}$ | Emitter Cutoff Current | | | | 10 | μA | $V_{EB}$ = 5.0 V, $I_C$ = 0 |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 5) | 15 | | 15 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $BV_{CER}$ | Collector to Emitter Breakdown Voltage | 20 | | 20 | | V | $I_C$ = 10 mA, $R_{BE}$ = 10 Ω |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 25 | | 25 | | | $I_C$ = 10 μA, $I_E$ = 0 |
| $t_{on}$ | Turn On Time (see test circuit no. 215) | | | 40 | | ns | $I_C$ = 10 mA, $I_{B1}$ = 3.0 mA, $V_{CC}$ = 3.0 V |
| $t_{off}$ | Turn Off Time (see test circuit no. 215) | | | | 75 | ns | $I_C$ = 10 mA, $I_{B1}$ = 3.0 mA, $I_{B2}$ = 1.0 mA, $V_{CC}$ = 3.0 V |

4

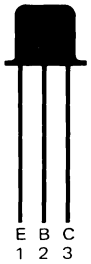
# 2N709 • FT709 • 2N3010

## NPN ULTRA HIGH SPEED SATURATED LOGIC SWITCHES

DIFFUSED SILICON PLANAR* TRANSISTORS

- **$V_{CEO}$ . . . 6.0 V (MIN)**
- **$\tau_s$ . . . 6.0 ns (MAX) @ 5.0 mA**
- **$t_{on}$ & $t_{off}$ . . . 12 ns (MAX) @ 10 mA (FT709, 2N3010)**

**See TO18-1 Package Outline**




FT709 is also available in TO18-2 package

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Junction Temperature | 200°C |
| Lead Temperature (60 seconds) | 300°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 100°C Case Temperature | 0.5 W |
| at 25°C Ambient Temperature | 0.3 W |

**Maximum Voltages**

| | | 2N709, FT709 | 2N3010 |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 15 V | 15 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 6.0V | 6.0 V |
| $V_{EBO}$ | Emitter to Base Voltage | 4.0 V | 4.0 V |
| $V_{CES}$ | Collector to Emitter Voltage | | 11 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N709 MIN. | 2N709 MAX. | FT709 MIN. | FT709 MAX. | 2N3010 MIN. | 2N3010 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain (Note 5) | | | 30 | 125 | 25 | 125 | | $I_C$ = 10 mA, $V_{CE}$ = 0.4 V |
| | | 20 | 120 | | | | | | $I_C$ = 10 mA, $V_{CE}$ = 0.5 V |
| | | | | 20 | | 15 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 0.4 V |
| | | | | 20 | | 15 | | | $I_C$ = 30 mA, $V_{CE}$ = 0.4 V |
| | | 15 | | | | | | | $I_C$ = 30 mA, $V_{CE}$ = 1.0 V |
| | | | | 12 | | | | | $I_C$ = 10 mA, $V_{CE}$ = 0.4 V, $T_A$ = −55°C |
| | | 10 | | | | | | | $I_C$ = 10 mA, $V_{CE}$ = 0.5 V, $T_A$ = −55°C |
| $V_{BE(sat)}$ | Base Saturation Voltage | 0.70 | 0.85 | | | | | V | $I_C$ = 3.0 mA, $I_B$ = 0.15 mA |
| | (Note 5) | | | 0.68 | 0.85 | 0.68 | 0.85 | V | $I_C$ = 1.0 mA, $I_B$ = 0.1 mA |
| | | | | 0.75 | 0.95 | 0.75 | 0.95 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | | | 1.3 | | 1.3 | V | $I_C$ = 30 mA, $I_B$ = 3.0 mA |
| $V_{CE(sat)}$ | Collector Saturation Voltage | | | | 0.25 | | 0.25 | V | $I_C$ = 1.0 mA, $I_B$ = 0.1 mA |
| | (Note 5) | | | | 0.25 | | 0.25 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | 0.30 | | | | | V | $I_C$ = 3.0 mA, $I_B$ = 0.15 mA |
| | | | | | 0.32 | | | V | $I_C$ = 1.0 mA, $I_B$ = 0.1 mA, $T_A$ = 125°C |
| | | | | | 0.38 | | 0.38 | V | $I_C$ = 30 mA, $I_B$ = 3.0 mA |
| | | | | | 0.42 | | | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA, $T_A$ = 125°C |
| | | | | | 0.45 | | | V | $I_C$ = 30 mA, $I_B$ = 3.0 mA, $T_A$ = 125°C |
| | | | | | | | 0.4 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA, $T_A$ = 85°C |
| $C_{ob}$ | Output Capacitance | | 3.0 | | 3.0 | | 3.0 | pF | $I_E$ = 0, $V_{CE}$ = 5.0 V |
| $C_{ib}$ | Input Capacitance | | 2.0 | | 2.0 | | 2.0 | pF | $I_C$ = 0, $V_{EB}$ = 0.5 V |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 200°C/W (derating factor of 5.0 mW/°C), at temperatures above 100°C. Power rating is constant at temperatures below 100°C; junction to ambient thermal resistance of 583°C/W (derating factor of 1.71 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 - SS29.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N709 MIN. | 2N709 MAX. | FT709 MIN. | FT709 MAX. | 2N3010 MIN. | 2N3010 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $I_{CBO}$ | Collector Cutoff Current | | 50 | | 50 | | | nA | $I_E = 0, V_{CB} = 5.0$ V |
| | | | 5.0 | | 5.0 | | | μA | $I_E = 0, V_{CB} = 5.0$ V, $T_A = 125°C$ |
| $I_{CES}$ | Collector Reverse Current | | | | | | 100 | nA | $V_{CE} = 5.0$ V, $V_{EB} = 0$ |
| | | | | | | | 10 | μA | $V_{CE} = 11$ V, $V_{EB} = 0$ |
| | | | | | | | 5.0 | μA | $V_{CE} = 5.0$ V, $V_{EB} = 0$, $T_A = 85°C$ |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 15 | | 15 | | 15 | | V | $I_C = 10$ μA, $I_E = 0$ |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | 6.0 | | 6.0 | | 6.0 | | V | $I_C = 10$ mA (pulsed) $I_B = 0$ |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 4.0 | | 4.0 | | 4.0 | | V | $I_E = 10$ μA, $I_C = 0$ |
| $\tau_s$ | Charge Storage Time Constant (see test circuit no. 3162) | | 6.0 | | 6.0 | | 6.0 | ns | $I_C = 5.0$ mA, $I_{B1} = I_{B2} = 5.0$ mA |
| $t_{on}$ | Turn On Time (see test circuit no. 3161) | | 15 | | 12 | | 12 | ns | $I_C = 10$ mA, $I_{B1} = 2.0$ mA |
| $t_{off}$ | Turn Off Time (see test circuit no. 3161) | | 15 | | 12 | | 12 | ns | $I_C = 10$ mA, $I_{B1} = -I_{B2} = 1.0$ mA |
| $f_T$ | Current Gain Bandwidth | 600 | | | | | | MHz | $I_C = 5.0$ mA, $V_{CE} = 4.0$ V, f = 100 MHz |
| | | | | 600 | | 600 | | MHz | $I_C = 10$ mA, $V_{CE} = 4.0$ V, f = 100 MHz |
| $BV_{CES}$ | Collector to Emitter Breakdown | | | | | 11 | | V | $I_C = 10$ μA, $V_{EB} = 0$ |

4

# 2N718A • 2N/PN1613 • 2N956 • 2N/PN1711

## NPN SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C (PN1613, PN1711)**
- **$V_{CEO}$ . . . 32 V (MIN)**
- **$h_{FE}$ . . . 40-120 @ 150 mA, 20 (MIN) @ 500 mA (2N718A, 2N/PN1613)**
  **. . . 100-300 @ 150 mA, 40 (MIN) @ 500 mA (2N956, 2N/PN1711)**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

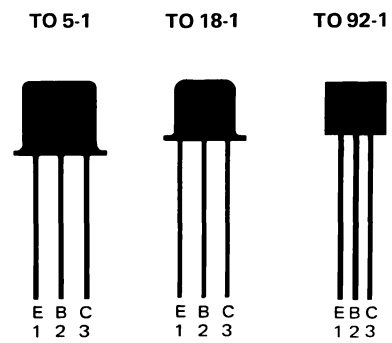
| **Maximum Temperatures** | **2N718A/2N1613 2N1711/2N956** | **PN1613/PN1711** |
|---|---|---|
| Storage Temperature | −65°C to +200°C | −55°C to +150°C |
| Operating Junction Temperature | 200°C | 150°C |

| **Maximum Power Dissipation** (Notes 2 & 3) | **2N718A 2N956** | **2N1711 2N1613** | **PN1711 PN1613** |
|---|---|---|---|
| Total Dissipation | | | |
| at 25°C Case Temperature | 1.8 W | 3.0 W | 1.0 W |
| at 100°C Case Temperature | 1.0 W | 1.7 W | |
| at 25°C Ambient Temperature | 0.5 W | 0.8 W | 0.625 W |

**Maximum Voltages**

| | | |
|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 75 V |
| $V_{CER}$ | Collector to Emitter Voltage ($R_{BE} \leq 10\,\Omega$) (Note 4) | 50 V |
| †$V_{CEO}$ | Collector to Emitter Voltage | 32 V |
| $V_{EBO}$ | Emitter to Base Voltage | 7.0 V |

**See Package Outlines**




| **2N1613 2N1711** | **2N718A 2N956** | **PN1613 PN1711** |
|---|---|---|

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N718A, 2N/PN1613 MIN. | 2N718A, 2N/PN1613 MAX. | 2N956, 2N/PN1711 MIN. | 2N956, 2N/PN1711 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 40 | 120 | 100 | 300 | | $I_C$ = 150 mA, $V_{CE}$ = 10 V |
| | | 35 | | 75 | | | $I_C$ = 10 mA, $V_{CE}$ = 10 V |
| | | 20 | | 40 | | | $I_C$ = 500 mA, $V_{CE}$ = 10 V |
| | | 20 | | 35 | | | $I_C$ = 10 mA, $V_{CE}$ = 10 V, $T_A$ = −55°C |
| $h_{FE}$ | DC Current Gain | 20 | | 35 | | | $I_C$ = 0.1 mA, $V_{CE}$ = 10 V |
| | | | | 20 | | | $I_C$ = 10 μA, $V_{CE}$ = 10 V |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 5) | | 1.3 | | 1.3 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | 1.5 | | 1.5 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| $h_{fe}$ | High Frequency Current Gain | 3.0 | | 3.5 | | | $I_C$ = 50 mA, $V_{CE}$ = 10 V, f = 20 MHz |
| $C_{ob}$ | Output Capacitance | | 25 | | 25 | pF | $I_E$ = 0, $V_{CB}$ = 10 V |
| $C_{TE}$ | Emitter Transition Capacitance | | 80 | | 80 | pF | $I_C$ = 0, $V_{EB}$ = 0.5 V |
| NF | Noise Figure | | 12 | | 8.0 | dB | $I_C$ = 0.3 mA, $V_{CE}$ = 10 V, f = 1.0 kHz, $R_S$ = 510 Ω; BW = 1.0 Hz |
| $I_{CBO}$ | Collector Cutoff Current | | 10 | | 10 | nA | $I_E$ = 0, $V_{CB}$ = 60 V |
| | | | 10 | | 10 | μA | $I_E$ = 0, $V_{CB}$ = 60 V, $T_A$ = 150°C |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 75 | | 75 | | V | $I_C$ = 0.1 mA, $I_E$ = 0 |
| $V_{CER(sus)}$ | Collector to Emitter Sustaining Voltage (Note 5) | 50 | | 50 | | V | $I_C$ = 100 mA, (pulsed), $R_{BE} \leq 10\,\Omega$ |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 7.0 | | 7.0 | | V | $I_C$ = 0, $I_E$ = 0.1 mA |
| $I_{EBO}$ | Emitter Current | | 10 | | 5.0 | nA | $I_C$ = 0, $V_{EB}$ = 5.0 V |

Additional Electrical Characteristics on following page.

NOTES:

*Planar is a patented Fairchild process.

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C; junction to case thermal resistance of 97.2°C/W (derating factor of 10.3 mW/°C), junction to ambient thermal resistance of 350°C/W (derating factor of 2.86 mW/°C) for 2N718A, 2N956; junction to case thermal resistance of 58.3°C/W (derating factor of 17.2 mW/°C) junction to ambient thermal resistance of 219°C (derating factor of 4.56 mW/°C) for 2N1513, 2N1711 . A maximum junction temperature of 150°C for PN1613, PN1711 junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle ≤ 2%.
6. For product family characteristic curves, refer to Section 5 — SS15.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N718A, 2N/PN1613 MIN. | 2N718A, 2N/PN1613 MAX. | 2N956, 2N/PN1711 MIN. | 2N956, 2N/PN1711 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{ib}$ | Input Resistance | 24 | 34 | 24 | 34 | Ω | $I_C$ = 1.0 mA, $V_{CB}$ = 5.0 V, f = 1.0 kHz |
| | | 4.0 | 8.0 | 4.0 | 8.0 | Ω | $I_C$ = 5.0 mA, $V_{CB}$ = 10 V, f = 1.0 kHz |
| $h_{rb}$ | Voltage Feedback Ratio | | 3.0 | | 5.0 | $X10^{-4}$ | $I_C$ = 1.0 mA, $V_{CB}$ = 5.0 V, f = 1.0 kHz |
| | | | 3.0 | | 5.0 | $X10^{-4}$ | $I_C$ = 5.0 mA, $V_{CB}$ = 10 V, f = 1.0 kHz |
| $h_{fe}$ | Small Signal Current Gain | 30 | 100 | 50 | 200 | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V, f = 1.0 kHz |
| | | 35 | 150 | 70 | 300 | | $I_C$ = 5.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $h_{ob}$ | Output Conductance | 0.05 | 0.5 | 0.05 | 0.5 | μmho | $I_C$ = 1.0 mA, $V_{CB}$ = 5.0 V, f = 1.0 kHz |
| | | 0.1 | 1.0 | 0.1 | 1.0 | μmho | $I_C$ = 5.0 mA, $V_{CB}$ = 10 V, f = 1.0 kHz |
| $t_d + t_r + t_f$ | (see test circuit no. 287) | | 30 | | | ns | $I_C$ = 50 mA, $V_{CC}$ = +20 V |

*Planar is a patented Fairchild process.
†Fairchild exceeds JEDEC registered value for this parameter.

# 2N834 • MPS834

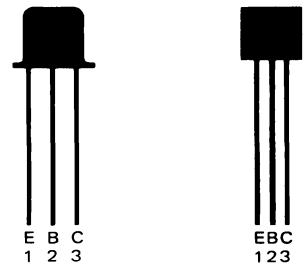
## NPN HIGH SPEED SATURATED LOGIC SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C (MPS834)**
- **$t_{on}$ . . . 16 ns (MAX) @ 10 mA (MPS834)**
- **$t_{off}$ . . . 30 ns (MAX) @ 10 mA (MPS834)**
- **$t_s$ . . . 25 ns (MAX) @ 10 mA**
- **COMPLEMENTS . . . 2N408 (TO18), MPSL08 (TO92)**

**See Package Outlines**

**TO18-1** **TO92-1**




**2N834** **MPS834**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | 2N834 | MPS834 |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | −65°C to 175°C | −55°C to 150°C |
| Operating Junction Temperature | | 175°C | 150°C |
| Lead Temperature (10 seconds) | | 240°C | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | **2N834** | **MPS834** |
| Total Dissipation at 25°C Ambient Temperature | | 0.300 W | 0.625 W |
| at 25°C Case Temperature | | 1.0 W | 1.0 W |
| **Maximum Voltages and Current** | | | |
| $V_{CBO}$ | Collector to Base Voltage | | 40 V |
| $V_{CES}$ | Collector to Emitter Voltage | | 30 V |
| $V_{EBO}$ | Emitter to Base Voltage | | 5.0 V |
| $I_C$ | Collector Current | | 200 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N834 MIN. | 2N834 MAX. | MPS834 MIN. | MPS834 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 40 | | | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| | | | | 40 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| | | | | 5.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $I_{CES}$ | Collector Cutoff Current | | 10 | | 10 | μA | $V_{CE}$ = 30 V, $V_{BE}$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 500 | | 500 | nA | $V_{CB}$ = 20 V, $I_E$ = 0 |
| | | | 30 | | | μA | $V_{CB}$ = 20 V, $I_E$ = 0, $T_A$ = 150°C |
| $h_{FE}$ | DC Current Gain (Note 4) | 25 | | 25 | | | $I_C$ = 10 mA, $V_{CE}$ = 1.0 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 4) | | 0.25 | | 0.25 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | 0.4 | | 0.4 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 4) | | 0.9 | | 0.9 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $f_T$ | Current Gain Bandwidth Product | 350 | | | | MHz | $I_C$ = 10 mA, $V_{CE}$ = 15 V, f = 100 MHz |
| | | | | 350 | | MHz | $I_C$ = 10 mA, $V_{CE}$ = 20 V, f = 100 MHz |
| $C_{ob}$ | Output Capacitance | | 4.0 | | 4.0 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 100 kHz |
| $t_{on}$ | Turn On Time (see test circuit no. 566) | | 35 | | 16 | ns | $I_C$ = 10 mA, $I_{B1}$ = 3.0 mA, $V_{CC}$ = 3.0 V |
| $t_{off}$ | Turn Off Time (see test circuit no. 566) | | 75 | | 30 | ns | $I_C$ = 10 mA, $I_{B1}$ = 3.0 mA, $I_{B2}$ = 1.0 mA, $V_{CC}$ = 3.0 V |
| $\tau_s$ | Storage Time (see test circuit no. 567) | | 25 | | 25 | ns | $I_C$ = 10 mA, $I_{B1}$ = $I_{B2}$ = 10 mA, $V_{CC}$ = 10 V |

*Planar is a patented Fairchild process.

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 175°C and junction to case thermal resistance of 150°C/W (derating factor of 6.67 mW/°C); junction to ambient thermal resistance of 500°C/W (derating factor of 2.0 mW/°C) for 2N834. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C) for MPS834.
4. Pulse conditions: length = 300 μs; duty cycle = ≤ 2%.
5. For product family characteristic curves, refer to Section 5 — SS28.

# 2N918 • MPS918 • 2N5770 • 2N3563 • MPS3563

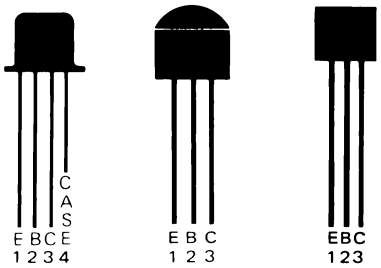
## NPN SMALL SIGNAL HIGH FREQUENCY AMPLIFIERS AND OSCILLATORS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $G_{pe}$ . . . 15 dB (MIN) @ 200 MHz (2N918)
- $P_D$ . . . 30 mW (MIN) @ 500 MHz (2N918, 2N5770)
- $C_{ob}$ . . . 1.7 pF (MAX) @ 10 V
- NF . . . 6.0 dB (MAX) @ 60 MHz
- $f_T$ . . . 900 MHz (MIN) (2N5770)

See Package Outlines

TO18-3 TO18-4 TO92-1




2N918 2N3563 2N5770 MPS3563 MPS918

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| Maximum Temperatures | 2N918 | 2N3563 | MPS918/2N5770 MPS3563 |
|---|---|---|---|
| Storage Temperature | −65°C to +300°C | −55°C to +125°C | −55°C to +150°C |
| Operating Junction Temperature | 200°C | 125°C | 150°C |
| Lead Temperature (10 seconds) | 260°C | 260°C | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | | |
| Total Dissipation | | | |
| at $T_A$ = 25°C | 0.2 W | 0.2 W | 0.625 W |
| at or below $T_A$ = 65°C | | | 0.300 W |
| at $T_C$ = 25°C | 0.3 W | 0.5 W | 1.0 W |

| Maximum Voltages and Current | | 2N/MPS3563 | 2N/MPS918 2N5770 |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 30 V | 30 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 12 V | 15 V |
| $V_{EBO}$ | Emitter to Base Voltage | 2.0 V | 3.0 V |
| $I_C$ | Collector Current | 50 mA | 50 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N3563 MPS3563 MIN. | 2N3563 MPS3563 MAX. | MPS918 MIN. | MPS918 MAX. | 2N5770 2N918 MIN. | 2N5770 2N918 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain (Note 5) | | | 20 | | 20 | | | $I_C$ = 3.0 mA, $V_{CE}$ = 1.0 V |
| | | 20 | 200 | | | | | | $I_C$ = 8.0 mA, $V_{CE}$ = 10 V |
| $V_{CE}$ (sat) | Collector to Emitter Saturation Voltage (Note 5) | | | | 0.4 | | 0.4 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $V_{BE}$ (sat) | Base to Emitter Saturation Voltage | | | | 1.0 | | 1.0 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $C_{ob}$ | Output Capacitance | | 1.7 | | 1.7 | | 1.7 | pF | $I_E$ = 0, $V_{CB}$ = 10 V, f = 1.0 MHz |
| | | | | | 3.0 | (2N918) | 3.0 | pF | $I_E$ = 0, $V_{CB}$ = 0, f = 1.0 MHz |
| $C_{ib}$ | Input Capacitance | | | | 2.0 | (2N5770) | 2.0 | pF | $I_C$ = 0, $V_{EB}$ = 0.5 V, f = 1.0 MHz |
| | | | | | | (2N918) | 1.6 | pF | $I_C$ = 0, $V_{EB}$ = 0.5 V, f = 1.0 MHz |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | | 10 | | 10 | nA | $I_E$ = 0, $V_{CB}$ = 15 V |
| | | | | | | | 1.0 | μA | $I_E$ = 0, $V_{CB}$ = 15 V, $T_A$ = 150°C |
| $h_{fe}$ | High Frequency Current Gain | | | 6.0 | | 6.0 (2N918) | | | $I_C$ = 4.0 mA, $V_{CE}$ = 10 V, f = 100 MHz |
| | | 6.0 | 15 | | | 9.0 (2N5770) | | | $I_C$ = 8.0 mA, $V_{CE}$ = 10 V, f = 100 MHz |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 584°C/W (derating factor of 1.71 mW/°C); junction to ambient thermal resistance of 875°C/W (derating factor of 1.14 mW/°C) for 2N918. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/W (derating factor of 2.0 mW/°C) for 2N3563. These ratings give a maximum junction temperature of 150°C and junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C) for 2N5770, MPS918 and MPS3563.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length ≤ 300 μs; duty cycle ≤ 1%.
6. For product family characteristic curves, refer to Section 5 — SS27.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N3563 MPS3563 MIN. | 2N3563 MPS3563 MAX. | MPS918 MIN. | MPS918 MAX. | 2N5770 2N918 MIN. | 2N5770 2N918 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $G_{pe}$ | Available Power Gain (neutralized) (see test circuit no. 254 for 2N918, MPS918, 2N/MPS3563) (see test circuit no. 255 for 2N5770) | 14 | 26 | 15 | | 15 | | dB<br>dB | $I_C$ = 6.0 mA, $V_{CB}$ = 12 V, f = 200 MHz<br>$I_C$ = 8.0 mA, $V_{CE}$ = 10 V, f = 200 MHz |
| $P_O$ | Power Output (see test circuit no. 264) | | | 30 | | 30 | | mW | $I_C$ = 8.0 mA, $V_{CB}$ = 15 V, f = 500 MHz |
| $\eta$ | Collector Efficiency | | | 25 | | 25 | | % | $I_C$ = 8.0 mA, $V_{CB}$ = 15 V, f = 500 MHz |
| NF | Noise Figure | | | | 6.0 | | 6.0 | dB | $I_C$ = 1.0 mA, $V_{CE}$ = 6.0 V, $R_G$ = 400Ω, f = 60 MHz |
| $V_{CEO\ (sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | 12 | | 15 | | 15 | | V | $I_C$ = 3.0 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 30 | | | | | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| | | | | 30 | | 30 | | V | $I_C$ = 1.0 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 2.0 | | 3.0 | | 3.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $r_b'C_c$ | Collector to Base Time Constant | 8.0 | 25 | | | | | pF | $I_C$ = 8.0 mA, $V_{CB}$ = 10 V, f = 79.8 MHz |
| $h_{fe}$ | Small Signal Current Gain | 20 | 250 | | | | | | $I_C$ = 8.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |

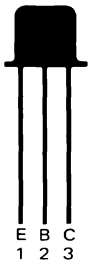
# 2N930

## NPN LOW LEVEL LOW NOISE AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- $V_{CEO}$ . . . 45 V (MIN)
- $h_{FE}$ . . . 100–300 @ 10 μA
- NF . . . 3.0 dB (MAX) @ 1.0 kHz

See TO18-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Junction Temperature | | 175°C |
| Lead Temperature (10 seconds) | | 300°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Case Temperature | | 0.6 W |
| at 25°C Ambient Temperature | | 0.3 W |
| **Maximum Voltages and Current** | | |
| $V_{CBO}$ | Collector to Base Voltage | 45 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 45 V |
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V |
| $I_C$ | Collector Current | 30 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | | 600 | | $I_C$ = 10 mA, $V_{CE}$ = 5.0 V |
| $h_{FE}$ | DC Current Gain | 150 | | | $I_C$ = 500 μA, $V_{CE}$ = 5.0 V |
| | | 100 | 300 | | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V |
| | | 20 | | | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V, $T_A$ = −55°C |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 5) | 0.6 | 1.0 | V | $I_C$ = 10 mA, $I_B$ = 0.5 mA |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | 1.0 | V | $I_C$ = 10 mA, $I_B$ = 0.5 mA |
| $h_{ib}$ | Input Resistance | 25 | 32 | Ω | $I_C$ = 1.0 mA, $V_{CB}$ = 5.0 V, f = 1.0 kHz |
| $h_{ob}$ | Output Conductance | | 1.0 | μmho | $I_C$ = 1.0 mA, $V_{CB}$ = 5.0 V, f = 1.0 kHz |
| $h_{rb}$ | Voltage Feedback Ratio | | 600 | $\times 10^{-6}$ | $I_C$ = 1.0 mA, $V_{CB}$ = 5.0 V, f = 1.0 kHz |
| $h_{fe}$ | Small Signal Current Gain | 150 | 600 | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V, f = 1.0 kHz |
| $h_{fe}$ | High Frequency Current Gain | 1.0 | | | $I_C$ = 500 μA, $V_{CE}$ = 5.0 V, f = 30 MHz |
| $I_{CBO}$ | Collector to Base Cutoff Current | | 10 | nA | $I_E$ = 0, $V_{CB}$ = 45 V |
| $I_{CES}$ | Collector to Emitter Cutoff Current | | 10 | nA | $V_{CE}$ = 45 V, $V_{EB}$ = 0 |
| | | | 10 | μA | $V_{CE}$ = 45 V, $V_{EB}$ = 0, $T_A$ = 170°C |
| $I_{EBO}$ | Emitter to Base Cutoff Current | | 10 | nA | $I_C$ = 0, $V_{EB}$ = 5.0 V |
| $I_{CEO}$ | Collector to Emitter Cutoff Current | | 2.0 | nA | $I_B$ = 0, $V_{CE}$ = 5.0 V |
| $C_{ob}$ | Output Capacitance | | 8.0 | pF | $I_E$ = 0, $V_{CB}$ = 5.0 V |
| NF | Noise Figure | | 3.0 | dB | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V, f = 1.0 kHz, $R_S$ = 10 kΩ, BW = 15.7 kHz |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | 45 | | V | $I_C$ = 10 mA, $I_B$ = 0 (pulsed) |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | V | $I_C$ = 0, $I_E$ = 10 nA |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 175°C and junction to case thermal resistance of 250°C/W (derating factor of 4.0 mW/°C); junction to ambient thermal resistance of 500°C/W (derating factor of 2.0 mW/°C).
4. This rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length ≤ 300 μs; duty cycle ≤ 2%.
6. For product family characteristic curves, refer to Section 5-SS8.

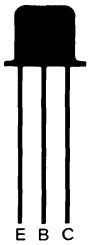
# 2N997

## NPN HIGH GAIN COMPOUND AMPLIFIER

DIFFUSED SILICON PLANAR* TRANSISTOR

- **$LV_{CEO}$ . . . 40 V (MIN)**
- **$h_{FE}$ . . . 7000 (MIN) @ 100 mA**

**See TO18-1 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +300°C |
| Operating Junction Temperature | | 175°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation @ 25°C Case Temperature | | 1.5 W |
| @ 25°C Ambient Temperature | | 0.5 W |
| **Maximum Voltages and Currents** | | |
| $V_{CBO}$ | Collector to Base Voltage | 75 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 40 V |
| $V_{EBO}$ | Emitter to Base Voltage | 7.0 V |
| $I_C$ | Collector Current | 300 mA |
| $I_B$ | Base Current | 50 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 1000 | | | $I_C$ = 100 μA, $V_{CE}$ = 10 V |
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 7000 | 70000 | | $I_C$ = 100 mA, $V_{CE}$ = 10 V |
| | | 4000 | | | $I_C$ = 10 mA, $V_{CE}$ = 10 V |
| | | 1000 | | | $I_C$ = 100 mA, $V_{CE}$ = 10 V, $T_A$ = −55°C |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | 1.6 | V | $I_C$ = 100 mA, $I_B$ = 1.0 mA |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 5) | 0.9 | 1.8 | V | $I_C$ = 100 mA, $V_{CE}$ = 10 V |
| $I_{CBO}$ | Collector Cutoff Current | | 10 | nA | $I_E$ = 0, $V_{CB}$ = 60 V |
| $I_{CBO}$ | Collector Cutoff Current | | 10 | μA | $I_E$ = 0, $V_{CB}$ = 60 V, $T_A$ = 150°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 10 | nA | $I_C$ = 0, $V_{EB}$ = 5.0 V |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 75 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 5) | 40 | | V | $I_C$ = 30 mA, $I_B$ = 0 (pulsed) |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 7.0 | | V | $I_C$ = 0, $I_E$ = 100 μA |

* Planar is a patented Fairchild process.

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 175°C and junction to case thermal resistance of 100°C/W (derating factor of 10 mW/°C); junction to ambient thermal resistance of 300°C/W (derating factor of 3.33 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle ≤2%.

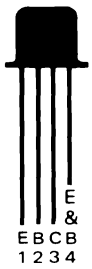
# 2N998

## NPN ULTRA HIGH GAIN COMPOUND AMPLIFIER

DIFFUSED SILICON PLANAR* TRANSISTOR

- **$h_{FE}$ . . . 2000 (MIN) @ 100 mA**
- **$LV_{CEO}$ . . . 60 V (MIN)**
- **$BV_{EBO}$ . . . 15 V (MIN)**
- **INTERNAL EMITTER-BASE JUNCTION IS ACCESSIBLE**

**See TO18-3 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| **Maximum Temperatures** | |
| Storage Temperature | −65°C to +300°C |
| Operating Junction Temperature | 200°C |
| Lead Temperature (no time limit) | 300°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | |
| Total Dissipation at 25°C Case Temperature | 1.8 W |
| at 100°C Case Temperature | 1.0 W |
| at 25°C Ambient Temperature | 0.5 W |
| **Maximum Voltages** | |
| $V_{CBO}$ Collector to Base Voltage | 100 V |
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | 60 V |
| $V_{EBO}$ Emitter to Base Voltage | 15 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 800 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V |
| $h_{FE}$ | DC Pulsed Current Gain (Note 5) | 1600 | 8000 | | $I_C$ = 10 mA, $V_{CE}$ = 5.0 V |
| | (Each transistor) | 2000 | | | $I_C$ = 100 mA, $V_{CE}$ = 5.0 V |
| | | 25 | | | $I_C$ = 10 mA, $V_{CE}$ = 5.0 V |
| $V_{BE(sat)}$ | Base Saturation Voltage | | 1.8 | V | $I_C$ = 50 mA, $I_B$ = 0.5 mA |
| $V_{CE(sat)}$ | Collector Saturation Voltage | | 1.2 | V | $I_C$ = 50 mA, $I_B$ = 0.5 mA |
| $C_{ob}$ | Output Capacitance | | 30 | pF | $I_E$ = 0, $V_{CB}$ = 10 V |
| $C_{TE}$ | Emitter Transition Capacitance | | 50 | pF | $I_C$ = 0, $V_{EB}$ = 0.5 V |
| $h_{fe}$ | Current Gain | 1000 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V, f = 1.0 kHz |
| $I_{CBO}$ | Collector Cutoff Current | | 10 | nA | $I_E$ = 0, $V_{CB}$ = 90 V |
| | | | 15 | μA | $I_E$ = 0, $V_{CB}$ = 90 V, $T_A$ = 150°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 10 | nA | $I_C$ = 0, $V_{EB}$ = 10 V |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 100 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $V_{CEO}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | 60 | | V | $I_C$ = 30 mA, $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 15 | | V | $I_C$ = 0, $I_E$ = 100 μA |
| NF | Noise Figure (Note 6) | | 6.0 | dB | $I_C$ = 0.1 mA, $V_{CE}$ = 10 V, BW = 200 Hz, f = 1.0 kHz, RG= 5.0 kΩ |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 97.2°C/W (derating factor of 10.3 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. Measured with a constant current supply of 20 μA connected to the emitter of the input transistor.

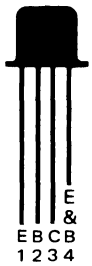
# 2N999

## NPN HIGH GAIN COMPOUND AMPLIFIER

DIFFUSED SILICON PLANAR* TRANSISTOR

- $h_{FE}$ . . . 7000 (MIN) @ 100 mA
- $LV_{CEO}$ . . . 60 V (MIN)
- TWO TRANSISTORS INTERNALLY CONNECTED IN DARLINGTON CONFIGURATION
- INTERNAL EMITTER-BASE JUNCTION IS ACCESSABLE

See TO18-3 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +300°C |
| Operating Junction Temperature | | 200°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Case Temperature | | 1.8 W |
| at 100°C Case Temperature | | 1.0 W |
| at 25°C Ambient Temperature | | 0.5 W |
| **Maximum Voltages and Current** | | |
| $V_{CBO}$ | Collector to Base Voltage | 60 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 60 V |
| $V_{EBO}$ | Emitter to Base Voltage | 15 V |
| $I_C$ | Collector Current | 500 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 1000 | | | $I_C$ = 100 μA, $V_{CE}$ = 10 V |
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 7000 | 70,000 | | $I_C$ = 100 mA, $V_{CE}$ = 10 V |
| | | 4000 | | | $I_C$ = 10 mA, $V_{CE}$ = 10 V |
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 1000 | | | $I_C$ = 100 mA, $V_{CE}$ = 10 V, $T_A$ = −55°C |
| $V_{CE(sat)}$ | Collector Saturation Voltage | | 1.6 | V | $I_C$ = 100 mA, $I_B$ = 1.0 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage | | 1.8 | V | $I_C$ = 100 mA, $I_B$ = 1.0 mA |
| $C_{TE}$ | Emitter Transition Capacitance | | 10 | pF | $I_C$ = 0, $V_{EB}$ = 0.5 V |
| $C_{ob}$ | Output Capacitance | | 20 | pF | $I_E$ = 0, $V_{CB}$ = 10 V |
| $I_{CBO}$ | Collector Cutoff Current | | 10 | nA | $I_E$ = 0, $V_{CB}$ = 60 V |
| $I_{CBO}$ | Collector Cutoff Current | | 10 | μA | $I_E$ = 0, $V_{CB}$ = 60 V, $T_A$ = 150°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 10 | nA | $I_C$ = 0, $V_{EB}$ = 10 V |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 60 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | 60 | | V | $I_C$ = 30 mA, $I_B$ = 0 (pulsed) |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 15 | | V | $I_C$ = 0, $I_E$ = 100 μA |

*Planar is a patented Fairchild process.

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 97.2°C/W (derating factor of 10.3 mW/°C); junction to ambient thermal resistance of 350°C/W (derating factor of 2.86 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.

# 2N1893 • PN1893

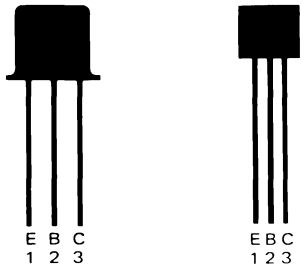
## NPN SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 800 mW (2N1893) 625 mW (PN1893) @ $T_A$ = 25°C**
- **$V_{CEO}$ . . . 80 V (MIN)**
- **$h_{FE}$ . . . 40-120 @ 150 mA**
- **COMPLEMENTS . . . 2N4013 (TO 5), MPSA56 (TO 92)**

See Package Outlines

TO5-1 TO92-1




2N1893 PN1893

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | 2N1893 | PN1893 |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | −65°C to +300°C | −55°C to +150°C |
| Operating Junction Temperature | 200°C | 150°C |
| Lead Temperature (10 seconds) | 300°C | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Case Temperature | 3.0 W | 1.0 W |
| at 100°C Case Temperature | 1.7 W | |
| at 25°C Ambient Temperature | 0.8 W | 0.625 W |
| **Maximum Voltages** | | |
| $V_{CBO}$ Collector to Base Voltage | | 120 V |
| $V_{CER}$ Collector to Emitter Voltage ($R_{BE} \leq 10\ \Omega$) (Note 4) | | 100 V |
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | | 80 V |
| $V_{EBO}$ Emitter to Base Voltage | | 7.0 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 40 | 120 | | $I_C$ = 150 mA, $V_{CE}$ = 10 V |
| | | 35 | | | $I_C$ = 10 mA, $V_{CE}$ = 10 V |
| | | 20 | | | $I_C$ = 10 mA, $V_{CE}$ = 10 V, $T_A$ = −55°C |
| $h_{FE}$ | DC Current Gain | 20 | | | $I_C$ = 0.1 mA, $V_{CE}$ = 10 V |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 5) | | 0.9 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| | | | 1.3 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | 1.2 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| | | | 5.0 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| $h_{fe}$ | High Frequency Current Gain | 2.5 | | | $I_C$ = 50 mA, $V_{CE}$ = 10 V, f = 20 MHz |
| $C_{ob}$ | Output Capacitance | | 15 | pF | $I_E$ = 0, $V_{CB}$ = 10 V |
| $C_{ib}$ | Input Capacitance | | 85 | pF | $I_C$ = 0, $V_{EB}$ = 0.5 V |
| $I_{CBO}$ | Collector Cutoff Current | | 10 | nA | $I_E$ = 0, $V_{CB}$ = 90 V |
| | | | 15 | μA | $I_E$ = 0, $V_{CB}$ = 90 V, $T_A$ = 150°C |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 120 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $V_{CER(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | 100 | | V | $I_C$ = 100 mA (pulsed), $R_{BE} \leq 10\ \Omega$ |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | 80 | | V | $I_C$ = 30 mA (pulsed), $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 7.0 | | V | $I_C$ = 0, $I_E$ = 100 μA |
| $I_{EBO}$ | Emitter Current | | 10 | nA | $I_C$ = 0, $V_{EB}$ = 5.0 V |
| $h_{ib}$ | Input Resistance | 20 | 30 | Ω | $I_C$ = 1.0 mA, $V_{CB}$ = 5.0 V, f = 1.0 kHz |
| | | 4.0 | 8.0 | Ω | $I_C$ = 5.0 mA, $V_{CB}$ = 10 V, f = 1.0 kHz |
| $h_{rb}$ | Voltage Feedback Ratio | | 1.25 | $X10^{-4}$ | $I_C$ = 1.0 mA, $V_{CB}$ = 5.0 V, f = 1.0 kHz |
| | | | 1.50 | $X10^{-4}$ | $I_C$ = 5.0 mA, $V_{CB}$ = 10 V, f = 1.0 kHz |
| $h_{fe}$ | Small Signal Current Gain | 30 | 100 | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V, f = 1.0 kHz |
| | | 45 | | | $I_C$ = 5.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $h_{ob}$ | Output Conductance | | 0.5 | μmho | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V, f = 1.0 kHz |
| | | | 0.5 | μmho | $I_C$ = 5.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |

*Planar is a patented Fairchild process.

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 58.3°C/W (derating factor of 17.2 mW/°C); junction to ambient thermal resistance of 219°C/W (derating factor of 4.56 mW/°C) for 2N1893. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C) for PN1893.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse Conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 - SS17.

# 2N/PN2218/19 • 2N/PN2221/22

## NPN SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS AND SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C (PN DEVICES)**
- **$V_{CEO}$ . . . 30 V (MIN)**
- **$h_{FE}$ . . . 100-300 @ 150 mA (2N/PN2219, 2N/PN2222)**
  **30 (MIN) @ 500 mA (2N/PN2219, 2N/PN2222)**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| **Maximum Temperatures** | **2N2218, 2N2219 2N2221, 2N2222** | **PN2218, PN2219 PN2221, PN2222** |
|---|---|---|
| Storage Temperature | −65°C to 200°C | −55°C to +150°C |
| Operating Junction Temperature | 175°C | 150°C |

**Maximum Power Dissipation** (Notes 2 & 3)

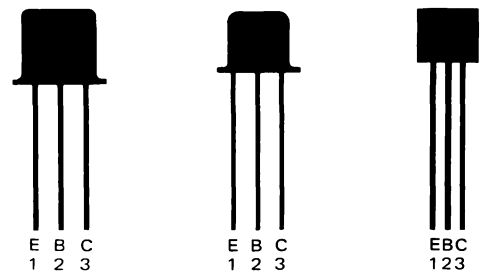
| | **2N2218/9** | **2N2221/2** | **PN2218/9** |
|---|---|---|---|
| Total Dissipation at 25°C Case Temperature | 3.0 W | 1.8 W | 1.0 W |
| at 25°C Ambient Temperature | 0.8 W | 0.5 W | 0.625 W |

**Maximum Voltages and Current**

| | | |
|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 60 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 30 V |
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V |
| $I_C$ | Collector Current | 800 mA |

**See Package Outlines**

**TO5-1** **TO18-1** **TO92-1**




**2N2218/9** **2N2221/2** **PN2218/9 PN2221/2**

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N/PN2218 2N/PN2221 MIN. | MAX. | 2N/PN2219 2N/PN2222 MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain (Note 5) | 40 | 120 | 100 | 300 | | $I_C$ = 150 mA, $V_{CE}$ = 10 V |
| | | 20 | | 50 | | | $I_C$ = 150 mA, $V_{CE}$ = 1.0 V |
| | | 35 | | 75 | | | $I_C$ = 10 mA, $V_{CE}$ = 10 V |
| | | 25 | | 50 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V |
| | | 20 | | 35 | | | $I_C$ = 0.1 mA, $V_{CE}$ = 10 V |
| | | 20 | | 30 | | | $I_C$ = 500 mA, $V_{CE}$ = 10 V |
| $V_{CE\ (sat)}$ | Collector to Emitter Saturation Voltage | | 0.4 | | 0.4 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | (Note 5) | | 1.6 | | 1.6 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| $V_{BE\ (sat)}$ | Base to Emitter Saturation Voltage | | 1.3 | | 1.3 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | (Note 5) | | 2.6 | | 2.6 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| $h_{fe}$ | High Frequency Current Gain | 2.5 | | 2.5 | | | $I_C$ = 20 mA, $V_{CE}$ = 20 V, f = 100 MHz |
| $I_{CBO}$ | Collector Cutoff Current | | 10 | | 10 | nA | $I_E$ = 0, $V_{CB}$ = 50 V |
| | | | 10 | | 10 | μA | $I_E$ = 0, $V_{CB}$ = 50 V, $T_A$ = 150°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 10 | | 10 | nA | $I_C$ = 0, $V_{EB}$ = 3.0 V |
| $C_{ob}$ | Output Capacitance | | 8.0 | | 8.0 | pF | $I_E$ = 0, $V_{CB}$ = 10 V |
| Re ($h_{ie}$) | Real Part of Common Emitter High Frequency Input Impedance | | 60 | | 60 | Ω | $I_C$ = 20 mA, $V_{CE}$ = 20 V, f = 300 MHz |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 60 | | 60 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $V_{CEO\ (sus)}$ | Collector to Emitter Sustaining Voltage (Note 5) | 30 | | 30 | | V | $I_C$ = 10 mA (pulsed), $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | 5.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |

*Planar is a patented Fairchild process

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 175°C, junction to case thermal resistance of 50°C/W (derating factor of 20 mW/°C), and junction to ambient thermal resistance of 188°C/W (derating factor of 5.33 mW/°C) for 2N2218, 2N2219; for 2N2221 and 2N2222, junction to case thermal resistance of 83.5°C/W (derating factor of 12 mW/°C); junction to ambient thermal resistance of 300°C/W (derating factor of 3.33 mW/°C). These ratings give a maximum junction temperature of 150°C, junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C) for PN2218, PN2219, PN2221, PN2222.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse Conditions: length = 300 μs; duty cycle ≤2%.
6. For product family characteristic curves, refer to Section 5-SS15.

# 2N/PN2218A/19A • 2N/PN2221A/22A

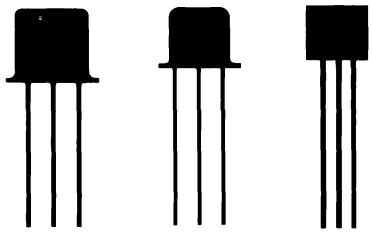
## NPN SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS AND SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C (PN DEVICES)**
- **$V_{CEO}$ . . . 40 V (MIN) @ 10 mA**
- **$h_{FE}$ . . . 40-120 (2N/PN2218A, 2N/PN2221A) @ 150 mA**
  **. . . 100-300 (2N/PN2219A, 2N/PN2222A) @ 150 mA**
- **$t_{on}$ . . . 35 ns (MAX) @ 150 mA, $t_{off}$ . . . 285 ns (MAX) @ 150 mA**
- **COMPLEMENTS . . . 2N/PN2904A SERIES**

See Package Outlines

TO5-1 TO18-1 TO92-1




| TO5-1 | TO18-1 | TO92-1 |
|---|---|---|
| 2N2218A<br>2N2219A | 2N2221A<br>2N2222A | PN2218A<br>PN2219A<br>PN2221A<br>PN2222A |

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | | |
|---|---|---|---|
| **Maximum Temperatures** | **2N2218A/19A**<br>**2N2221A/22A** | | **PN2218A/19A**<br>**PN2221A/22A** |
| Storage Temperature | −65°C to +200°C | | −55°C to +150°C |
| Operating Junction Temperature | 175°C | | 150°C |
| **Maximum Power Dissipation** | **2N2218A** | **2N2221A** | **PN2218A/19A** |
| (Notes 2 & 3) | **2N2219A** | **2N2222A** | **PN2221A/22A** |
| Total Dissipation | | | |
| at 25°C Case Temperature | 3.0 W | 1.8 W | 1.0 W |
| at 25°C Ambient Temperature | 0.8 W | 0.5 W | 0.625 W |
| **Maximum Voltages and Currents** | | | |
| $V_{CBO}$ Collector to Base Voltage | | | 75 V |
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | | | 40 V |
| $V_{EBO}$ Emitter to Base Voltage | | | 6.0 V |
| $I_C$ Collector Current | | | 800 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N/PN2218A 2N/PN2221A MIN. | MAX. | 2N/PN2219A 2N/PN2222A MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 20 | | 35 | | | $I_C$ = 100 μA, $V_{CE}$ = 10 V |
| | | 25 | | 50 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V |
| | (Note 5) | 35 | | 75 | | | $I_C$ = 10 mA, $V_{CE}$ = 10 V |
| | (Note 5) | 40 | 120 | 100 | 300 | | $I_C$ = 150 mA, $V_{CE}$ = 10 V |
| | (Note 5) | 25 | | 40 | | | $I_C$ = 500 mA, $V_{CE}$ = 10 V |
| | (Note 5) | 15 | | 35 | | | $I_C$ = 10 mA, $V_{CE}$ = 10 V, $T_A$ = −55°C |
| | (Note 5) | 20 | | 50 | | | $I_C$ = 150 mA, $V_{CE}$ = 1.0 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | 0.3 | | 0.3 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | | | 1.0 | | 1.0 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 5) | 0.6 | 1.2 | 0.6 | 1.2 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | | | 2.0 | | 2.0 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| $h_{fe}$ | High Frequency Current Gain | 2.5 | | 3.0 | | | $I_C$ = 20 mA, $V_{CE}$ = 20 V, f = 100 MHz |
| $I_{CEX}$ | Collector Reverse Current | | 10 | | 10 | nA | $V_{EB}$ = 3.0 V, $V_{CE}$ = 60 V |
| $I_{CBO}$ | Collector Reverse Current | | 10 | | 10 | nA | $I_E$ = 0, $V_{CB}$ = 60 V |
| | | | 10 | | 10 | μA | $I_E$ = 0, $V_{CB}$ = 60 V, $T_A$ = 150°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 10 | | 10 | nA | $I_C$ = 0, $V_{EB}$ = 3.0 V |
| $C_{ob}$ | Output Capacitance | | 8.0 | | 8.0 | pF | $I_E$ = 0, $V_{CB}$ = 10 V, f = 100 kHz |
| $C_{ib}$ | Input Capacitance | | 25 | | 25 | pF | $I_C$ = 0, $V_{EB}$ = 0.5 V, f = 100 kHz |
| $R_E$ ($h_{ie}$) | Real Part of Common Emitter High Frequency Input Impedance | | 60 | | 60 | Ω | $I_C$ = 20 mA, $V_{CE}$ = 20 V, f = 300 MHz |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 75 | | 75 | | V | $I_C$ = 10 μA, $I_C$ = 0 |

Additional Electrical Characteristics on following page.

NOTES:

*Planar is a patented Fairchild process.

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
3. These ratings give a maximum junction temperature of 175°C, junction to case thermal resistance of 50°C/W (derating factor of 20 mW/°C), and junction to ambient thermal resistance of 188 C/W (derating factor of 5.33 mW/°C) for 2N2218A, 2219A. For the 2N2221A and 2N2222A, junction to case thermal resistance of 83.5°C/W (derating factor of 12 mW/°C) junction to ambient thermal resistance of 300°C/W (derating factor of 3.33 mW/°C). These ratings give a maximum junction temperature of 150°C, junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C) for PN2218A, PN2219A, PN2221A, PN2222A.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 — SS15.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N/PN2218A 2N/PN2221A MIN. | MAX. | 2N/PN2219A 2N/PN2222A MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 5) | 40 | | 40 | | V | $I_C = 10$ mA, $I_B = 0$ |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 6.0 | | 6.0 | | V | $I_C = 0$, $I_E = 10\,\mu A$ |
| $I_{BL}$ | Base Current | | 20 | | 20 | nA | $V_{EB} = 3.0$ V, $V_{CE} = 60$ V |
| $t_d$ | Turn On Delay Time (see test circuit no. 231) | | 10 | | 10 | ns | $I_{CS} = 150$ mA, $V_{CC} = 30$ V, $I_{B1} = 15$ mA |
| $t_r$ | Rise Time (see test circuit no. 231) | | 25 | | 25 | ns | $I_{CS} = 150$ mA, $V_{CC} = 30$ V, $I_{B1} = 15$ mA |
| $t_s$ | Storage Time (see test circuit no. 232) | | 225 | | 225 | ns | $V_{CC} = 30$ V, $I_C = 150$ mA, $I_{B1} = I_{B2} = 15$ mA |
| $t_f$ | Fall Time (see test circuit no. 232) | | 60 | | 60 | ns | $V_{CC} = 30$ V, $I_{CS} = 150$ mA, $I_{B1} = I_{B2} = 15$ mA |
| $T_A$ | Active Region Time Constant | | 2.5 | | 2.5 | ns | $I_C = 150$ mA, $V_{CE} = 30$ V |
| $r_{b'}C_c$ | Collector to Base Time Constant | | 150 | | 150 | ps | $I_C = 20$ mA, $V_{CE} = 20$ V, f = 31.8 MHz |
| NF | Noise Figure | | | | 4.0 | dB | $I_C = 100\,\mu A$, $V_{CE} = 10$ V, $R_G = 1.0$ kΩ, BW = 1.0 Hz, f = 1.0 kHz |
| $h_{ie}$ | Input Resistance | 1.0 | 3.5 | 2.0 | 8.0 | kΩ | $I_C = 1.0$ mA, $V_{CB} = 10$ V, f = 1.0 kHz |
| | | 0.2 | 1.0 | 0.25 | 1.25 | kΩ | $I_C = 10$ mA, $V_{CB} = 10$ V, f = 1.0 kHz |
| $h_{oe}$ | Output Conductance | 3.0 | 15 | 5.0 | 35 | μmho | $I_C = 1.0$ mA, $V_{CE} = 10$ V, f = 1.0 kHz |
| | | 10 | 100 | 25 | 200 | μmho | $I_C = 10$ mA, $V_{VB} = 10$ V, f = 1.0 kHz |
| $h_{re}$ | Voltage Feedback Ratio | | 500 | | 800 | $X10^{-6}$ | $I_C = 1.0$ mA, $V_{CB} = 10$ V, f = 1.0 kHz |
| | | | 250 | | 400 | $X10^{-6}$ | $I_C = 10$ mA, $V_{CB} = 10$ V, f = 1.0 kHz |
| $h_{fe}$ | Small Signal Current Gain | 30 | 150 | 50 | 300 | | $I_C = 1.0$ mA, $V_{CB} = 10$ V, f = 1.0 kHz |
| | | 50 | 300 | 75 | 375 | | $I_C = 10$ mA, $V_{CB} = 10$ V, f = 1.0 kHz |

# 2N2369 • 2N2369A • 2N5769 • MPS2369

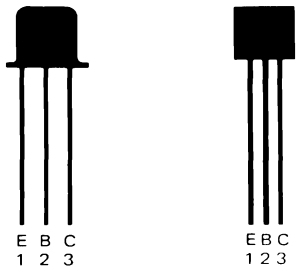
## NPN HIGH SPEED SATURATED SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C (2N5760, MPS2369)
- $V_{CEO}$ . . . 15 V (MIN)
- $t_s$ . . . 13 ns (MAX) @ 10 mA
- $t_{on}$ . . . 12 ns (MAX) @ 10 mA, $t_{off}$ . . . 18 ns (MAX) @ 10 mA
- COMPLEMENTS . . . 2N4209 (TO18), 2N5771 (TO92)

See Package Outlines

TO18-1 TO92-1




2N2369 2N2369A 2N5769 MPS2369

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | 2N2369, 2N2369A | 2N5769, MPS2369 |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | −65°C to +200°C | −55°C to +150°C |
| Operating Junction Temperature | | 200°C | 150°C |
| Lead Temperature (60 seconds) | | 300°C | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | | |
| Total Dissipation at 25°C Case Temperature | | 1.2 W | 1.0 W |
| at 100°C Case Temperature | | 0.68 W | 0.260 W |
| at 25°C Ambient Temperature | | 0.36 W | 0.625 W |
| **Maximum Voltages and Currents** | | | |
| $V_{CBO}$ | Collector to Base Voltage | | 40 V |
| $V_{CES}$ | Collector to Emitter Voltage | | 40 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | | 15 V |
| $V_{EBO}$ | Emitter to Base Voltage | | 4.5 V |
| $I_C$ | Collector Current (10 μs pulse) | | 500 mA |
| $I_C$ | DC Collector Current | | 200 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N2369 MIN. | 2N2369 MAX. | 2N2369A 2N5769 MIN. | 2N2369A 2N5769 MAX. | MPS2369 MIN. | MPS2369 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 40 | 120 | | | 40 | 120 | | $I_C$ = 10 mA, $V_{CE}$ = 1.0 V |
| | | 20 | | | | 20 | | | $I_C$ = 100 mA, $V_{CE}$ = 2.0 V |
| | | | | 40 | 120 | | | | $I_C$ = 10 mA, $V_{CE}$ = 0.35 V |
| | | | | 30 | | | | | $I_C$ = 30 mA, $V_{CE}$ = 0.4 V |
| | | | | 20 | | | | | $I_C$ = 100 mA, $V_{CE}$ = 1.0 V |
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 20 | | | | 20 | | | $I_C$ = 10 mA, $V_{CE}$ = 1.0 V, $T_A$ = −55°C |
| | | | | 20 | | | | | $I_C$ = 10 mA, $V_{CE}$ = 0.35 V, $T_A$ = −55°C |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | 40 | | 40 | | 40 | | V | $I_C$ = 10 μA, $V_{BE}$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 40 | | 40 | | 40 | | V | $I_C$ = 10 μA, $V_{BE}$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | 15 | | 15 | | 15 | | V | $I_C$ = 10 mA (pulsed), $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 4.5 | | 4.5 | | 4.5 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 400 | | 400 | | 400 | nA | $I_E$ = 0, $V_{CB}$ = 20 V |
| $I_{CES}$ | Collector Cutoff Current | | | | | | 30 | μA | $I_E$ = 0, $V_{CB}$ = 20 V, $T_A$ = 125°C |
| $I_{CBO}$ | Collector Cutoff Current | | 30 | | 30 | | | μA | $I_E$ = 0, $V_{CB}$ = 20 V, $T_A$ = 150°C |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | 0.25 | | | | 0.25 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | | | 0.2 | | | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | | | 0.25 | | | V | $I_C$ = 30 mA, $I_B$ = 3.0 mA |
| | | | | | 0.5 | | | V | $I_C$ = 100 mA, $I_B$ = 10 mA |

Additional Electrical Characteristics on following page.

NOTES:

*Planar is a patented Fairchild process.

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 146°C/W (derating factor of 6.85 mW/°C); junction to ambient thermal resistance of 486°C/W (derating factor of 2.06 mW/°C) for 2N2369 & 2N2369A. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C (derating factor of 5.0 mW/°C) for MPS2369 & 2N5769.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse Conditions: length = 300 μs; duty cycle ≤ 2%.
6. For product family characteristic curves, refer to Section 5 — SS28.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N2369 MIN. | 2N2369 MAX. | 2N2369A 2N5769 MIN. | 2N2369A 2N5769 MAX. | MPS2369 MIN. | MPS2369 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | | | 0.3 | | | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA, $T_A$ = 125°C |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 5) | 0.70 | 0.85 | 0.70 | 0.85 | 0.70 | 0.85 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | | | 1.15 | | | V | $I_C$ = 30 mA, $I_B$ = 3.0 mA |
| | | | | | 1.6 | | | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| | | | | 0.59 | 1.02 | | | | $I_C$ = 10 mA, $I_B$ = 1.0 mA $T_A$ = −55°C to +125°C |
| $C_{ob}$ | Output Capacitance | | 4.0 | | 4.0 | | 4.0 | pF | $V_{CB}$ = 5.0 V, $I_E$ = 0, f = 140 kHz |
| $h_{fe}$ | High Frequency Current Gain | 5.0 | | 5.0 | | 5.0 | | | $I_C$ = 10 mA, $V_{CE}$ = 10 V, f = 100 MHz |
| $\tau_s$ | Charge Storage Time Constant (see test circuit no. 3111) | | 13 | | 13 | | 13 | n | $I_C$ = 10 mA, $I_{B1}$ = $I_{B2}$ = 10 mA, $V_{CC}$ = 10 V |
| $t_{on}$ | Turn On Time (see test circuit no. 210) | | 12 | | 12 | | 12 | n | $I_C$ = 10 mA, $I_{B1}$ = 3.0 mA, $V_{CC}$ = 3.0 V |
| $t_{off}$ | Turn Off Time (see test circuit no. 210) | | 18 | | 18 | | 18 | n | $I_C$ = 10 mA, $I_{B1}$ = 3.0 mA, $I_{B2}$ = −1.5 mA, $V_{CC}$ = 3.0 V |

# 2N2484 • PN2484 • 2N3117

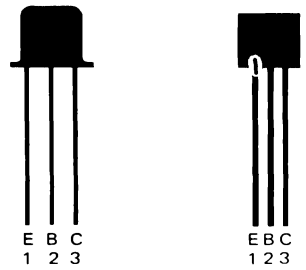
## NPN LOW LEVEL LOW NOISE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C (PN2484)
- $V_{CEO}$ . . . 60 V (MIN)
- $h_{FE}$ . . . 100-500 (2N/PN2484), 250-500 (2N3117) @ 10 μA
- NF . . . 3.0 dB (MAX) (2N/PN2484), 1.0 dB (MAX) (2N3117) @ 1.0 kHz
  . . . 2.0 dB (MAX) (2N/PN2484), 1.0 dB (MAX) (2N3117) @ 10 kHz

See Package Outlines

TO18-1 TO92-1




2N2484
2N3117

PN2484

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| **Maximum Temperatures** | **2N2484** | **PN2484** | **2N3117** |
|---|---|---|---|
| Storage Temperature | −65°C to +300°C | −55°C to +150°C | −65°C to +200°C |
| Operating Junction Temperature | 200°C | 150°C | 200°C |
| Lead Temperature (60 seconds) | 300°C | 260°C | 300°C |

| **Maximum Power Dissipation** (Notes 2 & 3) | **2N2484, 2N3117** | **PN2484** |
|---|---|---|
| Total Dissipation at 25°C Case Temperature | 1.2 W | 1.0 W |
| at 25°C Ambient Temperature | 0.36 W | 0.625 W |

| **Maximum Voltages and Current** | | | |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 60 V | 60 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 60 V | 60 V |
| $V_{EBO}$ | Emitter to Base Voltage | 6.0 V | 6.0 V |
| $I_C$ | Collector Current | 50 mA | 50 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N/PN2484 MIN. | 2N/PN2484 MAX. | 2N3117 MIN. | 2N3117 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain (Note 5) | | 800 | | | | $I_C$ = 10 mA, $V_{CE}$ = 5.0 V |
| | | 250 | | 400 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V |
| | | 200 | | | | | $I_C$ = 500 μA, $V_{CE}$ = 5.0 V |
| | | 175 | | 300 | | | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V |
| | | 100 | 500 | 250 | 500 | | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V |
| | | 30 | | 100 | | | $I_C$ = 1.0 μA, $V_{CE}$ = 5.0 V |
| | | 20 | | 50 | | | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V, $T_A$ = −55°C |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage | 0.5 | 0.7 | | 0.7 | V | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | 0.35 | | 0.35 | V | $I_C$ = 1.0 mA, $I_B$ = 0.1 mA |
| $h_{fe}$ | High Frequency Current Gain | 2.0 | | 2.0 | | | $I_C$ = 0.5 mA, $V_{CE}$ = 5.0 V, f = 30 MHz |
| | | 3.0 | | | | | $I_C$ = 50 μA, $V_{CE}$ = 5.0 V, f = 5.0 MHz |
| $I_{CBO}$ | Collector Cutoff Current | | 10 | | 10 | nA | $I_E$ = 0, $V_{CB}$ = 45 V |
| | | | 10 | | 10 | μA | $I_E$ = 0, $V_{CB}$ = 45 V, $T_A$ = 150°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 10 | | 10 | nA | $V_{EB}$ = 5.0 V, $I_C$ = 0 |
| $I_{CEO}$ | Collector to Emitter Cutoff Current | | 2.0 | | | nA | $I_B$ = 0, $V_{CE}$ = 5.0 V |
| $C_{ob}$ | Output Capacitance | | 6.0 | | 4.5 | pF | $I_E$ = 0, $V_{CB}$ = 5.0 V, f = 140 kHz |
| $C_{ib}$ | Input Capacitance | | 6.0 | | 6.0 | pF | $I_C$ = 0, $V_{EB}$ = 0.5 V, f = 140 kHz |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 60 | | 60 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | 60 | | 60 | | V | $I_C$ = 10 mA (pulsed), $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 6.0 | | 6.0 | | V | $I_C$ = 0, $I_E$ = 10 μA |
| $h_{fe}$ | High Frequency Current Gain | 150 | 900 | 400 | 900 | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V, f = 1.0 kHz |

Additional Electrical Characteristics on following page.

NOTES:

*Planar is a patented Fairchild process.

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 147°C/W (derating factor of 6.85 mW/°C); junction to ambient thermal resistance of 485°C/W (derating factor of 2.06 mW/°C) for 2N2484 and 2N3117. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C) for PN2484.
4. These ratings refer to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 - SS8.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N/PN2484 MIN. | 2N/PN2484 MAX. | 2N3117 MIN. | 2N3117 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{ie}$ | Input Resistance | 3.5 | 24 | 10 | 24 | kΩ | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V, f = 1.0 kHz |
| $h_{re}$ | Reverse Voltage Feedback Ratio | | 800 | | 800 | $\times 10^{-6}$ | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V, f = 1.0 kHz |
| $h_{oe}$ | Output Conductance | | 40 | | 40 | μmhos | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V, f = 1.0 kHz |
| NF | Wide Band Noise Figure | | 3.0 | | | dB | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V, $R_S$ = 10 kΩ, Power Bandwidth of 15.7 kHz with 3.0 dB pts at 10 Hz and 10 kHz |
| NF | Narrow Band Noise Figure | | 3.0 | | | dB | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V, f = 1.0 kHz, $R_S$ = 10 kΩ Power Bandwidth of 200 Hz |
| | | | 2.0 | | | dB | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V, f = 10 kHz, $R_S$ = 10 kΩ, Power Bandwidth of 2.0 kHz |
| | | | 10 | | | dB | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V, f = 100 Hz, $R_S$ = 10 kΩ, Power Bandwidth of 20 Hz |
| | | | | | 1.0 | dB | $I_C$ = 5.0 μA, $V_{CE}$ = 5.0 V, $R_S$ = 50 kΩ, f = 1.0 kHz, Power Bandwidth of 200 Hz |
| | | | | | 1.0 | dB | $I_C$ = 5.0 μA, $V_{CE}$ = 5.0 V, $R_S$ = 50 kΩ, f = 10 kHz, Power Bandwidth of 1.0 kHz |
| | | | | | 4.0 | dB | $I_C$ = 30 μA, $V_{CE}$ = 5.0 V, $R_S$ = 10 kΩ, f = 100 kHz, Power Bandwidth of 20 Hz |
| | | | | | 15 | dB | $I_C$ = 30 μA, $V_{CE}$ = 5.0 V, $R_S$ = 10 kΩ, f = 10 Hz, Power Bandwidth = 2.0 Hz |

# 2N2639 through 2N2644

## DUAL NPN LOW LEVEL LOW NOISE DIFFERENTIAL AMPLIFIERS

DIFFUSED SILICON PLANAR* TRANSISTORS

- **$V_{CEO}$ . . . 45 V (MIN)**
- **NF . . . 4.0 dB (MAX) WIDE BAND**
- **GUARANTEED BETA RATIO**
- **GUARANTEED $V_{BE}$ MATCHING AND TRACKING**

**See TO5-9 Package Outline**

CBEEBC
123456

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Lead Temperature (10 seconds) | | 300°C |
| **Maximum Power Dissipation** | **One Side** | **Both Sides** |
| Total Dissipation at or below 25°C Ambient Temperature | 0.3 W | 0.6 W |
| Linear Derating Factor | 2.0 mW/°C | 4.0 mW/°C |
| at or below 25°C Case Temperature | 0.6 W | 1.2 W |
| Linear Derating Factor | 4.0 mW/°C | 8.0 mW/°C |
| **Maximum Voltages and Current** | | |
| $V_{EBO}$ Emitter to Base Voltage | | 5.0 V |
| $V_{CBO}$ Collector to Base Voltage | | 45 V |
| $V_{CEO}$ Collector to Emitter Voltage | | 45 V |
| $I_C$ Collector Current | | 30 mA |

**MATCHING CHARACTERISTICS** (25 C Ambient Termperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N2639/42 MIN. | 2N2639/42 MAX. | 2N2640/43 MIN. | 2N2640/43 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $\frac{h_{FE1}}{h_{FE2}}$ | DC Current Gain Ratio (Note 3) | 0.9 | 1.0 | 0.8 | 1.0 | | $V_{CE}$ = 5.0 V, $I_C$ = 10 μA |
| $\lvert V_{BE1}-V_{BE2}\rvert$ | Base to Emitter Voltage Differential | | 5.0 | | 10 | mV | $V_{CE}$ = 5.0 V, $I_C$ = 10 μA |
| $\lvert\Delta(V_{BE1}-V_{BE2})\rvert$ | Base to Emitter Voltage Differential Temperature Coefficient | | 10 | | 20 | μV/°C | $V_{CE}$ = 5.0 V, $I_C$ = 10 μA @ $T_A$ = −55°C to +25°C and $T_A$ = +25°C to +125°C |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N2639/40/41 MIN. | 2N2639/40/41 MAX. | 2N2642/43/44 MIN. | 2N2642/43/44 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $I_{CBO}$ | Collector Cutoff Current | | 10 | | 10 | nA | $V_{CB}$ = 45 V, $I_E$ = 0 |
| | | | 10 | | 10 | μA | $V_{CB}$ = 45 V, $I_E$ = 0, $T_A$ = 150°C |
| $I_{CEO}$ | Collector Cutoff Current | | 10 | | 10 | nA | $V_{CE}$ = 5.0 V, $I_B$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 10 | | 10 | nA | $V_{EB}$ = 5.0 V, $I_C$ = 0 |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 2) | 45 | | 45 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $h_{FE}$ | DC Current Gain | 50 | 300 | 100 | 300 | | $V_{CE}$ = 5.0 V, $I_C$ = 10 μA |
| | | 55 | | 110 | | | $V_{CE}$ = 5.0 V, $I_C$ = 100 μA |
| | | 65 | | 130 | | | $V_{CE}$ = 5.0 V, $I_C$ = 1.0 mA |
| | | 10 | | 20 | | | $V_{CE}$ = 5.0 V, $I_C$ = 10 μA, $T_A$ = −55°C |
| $V_{BE}$ | Base to Emitter Voltage (Note 2) | 0.6 | 1.0 | 0.6 | 1.0 | V | $I_C$ = 10 mA, $I_B$ = 0.5 mA |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These parameters must be measured with a pulse duration = 300 μs; duty cycle ≤ 2%.
3. The lower of the two $h_{FE}$ readings is taken as $h_{FE1}$ for purposes of this ratio.
4. For product family characteristic curves, refer to Section 5 - SS8.

# 2N2639 through 2N2644

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N2639/40/41 MIN. | 2N2639/40/41 MAX. | 2N2642/43/44 MIN. | 2N2642/43/44 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 2) | | 1.0 | | 1.0 | V | $I_C$ = 10 mA, $I_B$ = 0.5 mA |
| $h_{ib}$ | Input Resistance | 25 | 32 | 25 | 32 | Ω | $V_{CB}$ = 5.0 V, $I_C$ = 1.0 mA, f = 1.0 kHz |
| $h_{rb}$ | Reverse Voltage Feedback Ratio | | 600 | | 600 | $\times 10^{-6}$ | $V_{CB}$ = 5.0 V, $I_C$ = 1.0 mA, f = 1.0 kHz |
| $h_{ob}$ | Output Capacitance | | 1.0 | | 1.0 | μmho | $V_{CB}$ = 5.0 V, $I_C$ = 1.0 mA, f = 1.0 kHz |
| $h_{fe}$ | Small Signal Current Gain | 65 | 600 | 130 | 600 | | $V_{CE}$ = 5.0 V, $I_C$ = 1.0 mA, f = 1.0 kHz |
| $\|h_{fe}\|$ | Magnitude of Small Signal Current Gain | 4.0 | | 4.0 | | | $V_{CE}$ = 5.0 V, $I_C$ = 1.0 mA, f = 20 MHz |
| $C_{ob}$ | Output Capacitance | | 8.0 | | 8.0 | pF | $I_E$ = 0, $V_{CB}$ = 5.0 V, f = 1.0 MHz |
| NF | Average Noise Figure | | 4.0 | | 4.0 | dB | $V_{CB}$ = 5.0 V, $I_E$ = 10 μA, $R_G$ = 10 kΩ, BW of 10 Hz to 15.7 kHz |

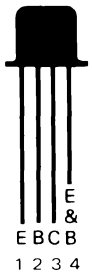
# 2N2723 • 2N2724 • 2N2725

## NPN LOW LEVEL AMPLIFIERS

DIFFUSED SILICON PLANAR* TRANSISTORS

- $h_{fe}$ . . . 1500 @ 10 mA (2N2723)
- . . . 5000 @ 10 mA (2N2724)
- $V_{CEO}$ . . . 45 V (MIN) (2N2725)
- NF . . . 6.0 dB (MAX) @ 1.0 kHz (2N2724)

See TO18-3 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Junction Temperature | 200°C |
| Lead Temperature (10 seconds) | 240°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 1.8 W |
| at 100°C Case Temperature | 1.0 W |
| at 25°C Ambient Temperature | 0.5 W |

**Maximum Voltages and Current**

| | | 2N2723, 2N2724 | 2N2725 |
|---|---|---|---|
| $V_{B1C0}$ | Collector to Base Voltage | 80 V | 45 V |
| $V_{CE20}$ | Collector to Emitter Voltage (Note 4) | 60 V | 45 V |
| $V_{E2B10}$ | Emitter to Base Voltage | 12 V | 10 V |
| $I_C$ | Collector Current | 40 mA | 30 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N2723 MIN. | 2N2723 MAX. | 2N2724 MIN. | 2N2724 MAX. | 2N2725 MIN. | 2N2725 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $I_{CB1O}$ | Collector Cutoff Current | | 10 | | 10 | | | nA | $V_{CB_1}$ = 60 V, $I_{E_1}$ = 0 |
| | | | | | | | 2.0 | nA | $V_{CB_1}$ = 30 V, $I_{E_1}$ = 0 |
| | | | 10 | | 10 | | | μA | $V_{CB_1}$ = 60 V, $I_{E_1}$ = 0, $T_A$ = 150°C |
| | | | | | | | 2.0 | μA | $V_{CB_1}$ = 30 V, $I_{E_1}$ = 0, $T_A$ = 150°C |
| $I_{E2B1O}$ | Emitter Cutoff Current | | 10 | | 10 | | | nA | $V_{E2B1}$ = 10 V, $I_C$ = 0 |
| | | | | | | | 1.0 | nA | $V_{E2B1}$ = 6.0 V, $I_C$ = 0 |
| $BV_{CB_1O}$ | Collector to Base Breakdown Voltage | 80 | | 80 | | 45 | | V | $I_C$ = 10 μA, $I_{E2}$ = 0 |
| $BV_{E_2B_1O}$ | Emitter to Base Breakdown Voltage | 12 | | 12 | | 10 | | V | $I_C$ = 0, $I_{E_2}$ = 10 μA |
| $BV_{CE_2O}$ | Collector to Emitter Breakdown Voltage (Note 5) | 60 | | 60 | | 45 | | V | $I_C$ = 10 mA (pulsed), $I_{B_1}$ = 0 |
| $V_{CE_2(sat)}$ | Collector to Emitter Saturation Voltage | | 1.0 | | 1.0 | | 1.0 | V | $I_C$ = 10 mA, $I_{B_1}$ = 1.0 mA |
| $V_{BE_2(sat)}$ | Base to Emitter Saturation Voltage | | 1.7 | | 1.7 | | 1.7 | V | $I_C$ = 10 mA, $I_{B_1}$ = 1.0 mA |
| $C_{ob_1}$ | Output Capacitance | | 10 | | 10 | | 10 | pF | $V_{CB_1}$ = 10 V, $I_{E_2}$ = 0, f = 140 kHz |
| $h_{fe_2}$ | Small Signal Current Gain | 1,500 | 15,000 | 5,000 | 60,000 | | | | $I_C$ = 10 mA, $V_{CE_2}$ = 5.0 V, f = 1.0 kHz |
| | | | | | | 1,500 | 15,000 | | $I_C$ = 10 μA, $V_{CE_2}$ = 5.0 V, f = 1.0 kHz |
| $h_{fe}$ | High Frequency Current Gain | 5.0 | | 5.0 | | 5.0 | | | $V_{CE}$ = 10 V, $I_C$ = 10 mA, f = 20 MHz |
| $h_{FE_2}$ | DC Current Gain | 2,000 | 10,000 | 7,000 | 50,000 | | | | $I_C$ = 10 mA, $V_{CE_2}$ = 5.0 V, $I_{B_2}$ = 0 |
| | | | | | | 2,000 | 10,000 | | $I_C$ = 100 μA, $V_{CE_2}$ = 5.0 V, $I_{B_2}$ = 0 |
| NF | Noise Figure | | 10 | | | | | dB | $I_C$ = 50 μA, $V_{CE}$ = 5.0 V, $R_G$ = 3.0 kΩ, Bandwidth = 100 Hz, f = 1.0 kHz |
| | | | | | 6.0 | | | dB | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V, $R_G$ = 10 kΩ, Bandwidth = 100 Hz, f = 1.0 kHz |
| | | | | | | | 6.0 | dB | $I_C$ = 3.0 μA, $V_{CE}$ = 5.0 V, $R_G$ = 30 kΩ, Bandwidth = 100 Hz, f = 1.0 kHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 95°C/W (derating factor of 10.5 mW/°C); junction to ambient thermal resistance of 345°C/W (derating factor of 2.9 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 12 ms; duty cycle = 2%.

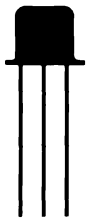
# 2N2894 • 2N2894A • 2N3012 • 2N3209

## PNP HIGH SPEED LOGIC SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$V_{CEO}$ . . . 12 V (MIN) (2N2894/A, 2N3012), 20 V (MIN) (2N3209)**
- **$t_{on}$ . . . 60 ns (MAX) @ 30 mA**
- **$t_{off}$ . . . 35 ns (MAX) @ 30 mA (2N2894A)**
- **$f_T$ . . . 400 MHz (MIN)**
  **. . . 800 MHz (MIN) 2N2894A**
- **COMPLEMENTS . . . 2N2396A, 2N4137**

**See TO18-1 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Junction Temperature | 200°C |
| Lead Temperature (60 seconds) | 300°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 1.2 W |
| at 25°C Ambient Temperature | 0.36 W |

| **Maximum Voltages and Current** | | **2N2894, 2N3012** | **2N2894A** | **2N3209** |
|---|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | −12 V | −12 V | −20 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | −12 V | −12 V | −20 V |
| $V_{EBO}$ | Emitter to Base Voltage | −4.0 V | −4.5 V | −4.0 V |
| $V_{CES}$ | Collector to Emitter Voltage | −12 V | −12 V | −20 V |
| $I_C$ | Collector Current | 200 mA | 200 mA | 200 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N2894 MIN. | 2N2894 MAX. | 2N2894A MIN. | 2N2894A MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Pulse Current Gain | 30 | | 30 | | | $I_C$ = 10 mA, $V_{CE}$ = −0.3 V |
| | (Note 5) | 40 | 150 | 40 | 120 | | $I_C$ = 30 mA, $V_{CE}$ = −0.5 V |
| | | 25 | | 30 | | | $I_C$ = 100 mA, $V_{CE}$ = −1.0 V |
| | | | | 20 | | | $I_C$ = 1.0 mA, $V_{CE}$ = −0.5 V |
| | | 17 | | 20 | | | $I_C$ = 30 mA, $V_{CE}$ = −0.5 V, $T_A$ = −55°C |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | −0.15 | | −0.13 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | −0.2 | | −0.19 | V | $I_C$ = 30 mA, $I_B$ = 3.0 mA |
| | | | −0.5 | | −0.45 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 5) | −0.78 | −0.98 | −0.78 | −0.92 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | −0.85 | −1.2 | −0.85 | −1.15 | V | $I_C$ = 30 mA, $I_B$ = 3.0 mA |
| | | | −1.7 | −1.0 | −1.5 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| $V_{CEO(sus)}$ | Collector Emitter Sustaining Voltage (Notes 4 & 5) | −12 | | −12 | | V | $I_C$ = 10 mA (pulsed), $I_B$ = 0 |
| $h_{fe}$ | High Frequency Current Gain | 4.0 | | 8.0 | | | $I_C$ = 30 mA, $V_{CE}$ = −10 V, f = 100 MHz |
| $I_{CES}$ | Collector Reverse Current | | 80 | | | nA | $V_{CE}$ = −6.0 V, $V_{EB}$ = 0 |
| | | | | | 50 | nA | $V_{CE}$ = −10 V, $V_{EB}$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 10 | | | μA | $V_{CB}$ = −6.0 V, $I_E$ = 0, $T_A$ = 125°C |
| | | | | | 10 | μA | $V_{CB}$ = −10 V, $I_E$ = 0, $T_A$ = 125°C |
| $C_{ob}$ | Output Capacitance | | 6.0 | | 4.5 | pF | $V_{CB}$ = −5.0 V, $I_E$ = 0, f = 140 kHz |
| $C_{ib}$ | Emitter Transition Capacitance | | 6.0 | | 6.0 | pF | $V_{EB}$ = −0.5 V, $I_C$ = 0, f = 140 kHz |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −12 | | −12 | | V | $I_C$ = 10 μA, $I_E$ = 0 |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 146°C/W (derating factor of 6.85 mW/°C); junction to ambient thermal resistance of 486°C/W (derating factor of 2.06 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5-SS30.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N2894 MIN. | 2N2894 MAX. | 2N2894A MIN. | 2N2894A MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | −12 | | −12 | | V | $I_C = 10\ \mu A$, $V_{EB} = 0$ |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −4.0 | | −4.5 | | V | $I_E = 100\ \mu A$, $I_C = 0$ |
| $t_{on}$ | Turn On Time (see test circuit no. 220) | | 60 | | 60 | ns | $I_C \approx 30$ mA, $I_B \approx 1.5$ mA, $V_{CC} = -3.0$ V |
| $t_{off}$ | Turn Off Time (see test circuit no. 220) | | 90 | | 35 | ns | $I_C \approx 30$ mA, $I_{B1} \approx I_{B2} = 1.5$ mA, $V_{CC} = -2.0$ V |
| $t_{on}$ | Turn On Time (see test circuit no. 378) | | | | 20 | ns | $I_C \approx 30$ mA, $I_{B1} \approx 3.0$ mA, $V_{CC} = -3.0$ V |
| $t_{off}$ | Turn Off Time (see test circuit no. 378) | | | | 25 | ns | $I_C \approx 30$ mA, $I_{B1} \approx I_{B2} \approx 3.0$ mA, $V_{CC} = -3.0$ V |
| $\tau_s$ | Storage Time (see test circuit no. 384) | | | | 20 | ns | $I_C \approx 10$ mA, $I_{B1} \approx I_{B2} \approx 10$ mA, $V_{CC} = -3.0$ V |

| SYMBOL | CHARACTERISTIC | 2N3012 MIN. | 2N3012 MAX. | 2N3209 MIN. | 2N3209 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Pulse Current Gain | 25 | | 25 | | | $I_C = 10$ mA, $V_{CE} = -0.3$ V |
| | (Note 5) | 30 | 120 | 30 | 120 | | $I_C = 30$ mA, $V_{CE} = -0.5$ V |
| | | 20 | | 15 | | | $I_C = 100$ mA, $V_{CE} = -1.0$ V |
| | | | | 12 | | | $I_C = 30$ mA, $V_{CE} = -0.5$ V, $T_A = -55°C$ |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | −0.15 | | −0.15 | V | $I_C = 10$ mA, $I_B = 1.0$ mA |
| | | | −0.2 | | −0.2 | V | $I_C = 30$ mA, $I_B = 3.0$ mA |
| | | | −0.5 | | −0.6 | V | $I_C = 100$ mA, $I_B = 10$ mA |
| | | | −0.4 | | | V | $I_C = 30$ mA, $I_B = 3.0$ mA, $T_A = 85°C$ |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 5) | −0.78 | −0.98 | −0.78 | −0.98 | V | $I_C = 10$ mA, $I_B = 1.0$ mA |
| | | −0.85 | −1.2 | −0.85 | −1.2 | V | $I_C = 30$ mA, $I_B = 3.0$ mA |
| | | | −1.7 | | −1.7 | V | $I_C = 100$ mA, $I_B = 10$ mA |
| $V_{CEO(sus)}$ | Collector Emitter Sustaining Voltage (Note 4 & 5) | −12 | | −20 | | V | $I_C = 10$ mA (pulsed), $I_B = 0$ |
| $h_{fe}$ | High Frequency Current Gain | 4.0 | | 4.0 | | | $I_C = 30$ mA, $V_{CE} = -10$ V, f = 100 MHz |
| $I_{CES}$ | Collector Reverse Current | | 80 | | | nA | $V_{CE} = -6.0$ V, $V_{EB} = 0$ |
| | | | | | 80 | nA | $V_{CE} = -10$ V, $V_{EB} = 0$ |
| | | | 5.0 | | | μA | $V_{CE} = -6.0$ V, $V_{EB} = 0$, $T_A = 85°C$ |
| | | | | | 10 | μA | $V_{CE} = -10$ V, $V_{EB} = 0$, $T_A = 125°C$ |
| $C_{ob}$ | Output Capacitance | | 6.0 | | 5.0 | pF | $V_{CB} = -5.0$ V, $I_E = 0$, f = 140 kHz |
| $C_{ib}$ | Emitter Transition Capacitance | | 6.0 | | 6.0 | pF | $V_{EB} = -0.5$ V, $I_C = 0$, f = 140 kHz |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −12 | | −20 | | V | $I_C = 10\ \mu A$, $I_E = 0$ |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | −12 | | −20 | | V | $I_C = 10\ \mu A$, $V_{EB} = 0$ |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −4.0 | | −4.0 | | V | $I_E = 100\ \mu A$, $I_C = 0$ |
| $t_{on}$ | Turn On Time (see test circuit no. 220) | | 60 | | 60 | ns | $I_C \approx 30$ mA, $I_B \approx 1.5$ mA |
| $t_{off}$ | Turn Off Time (see test circuit no. 220) | | 75 | | 90 | ns | $I_C \approx 30$ mA, $I_{B1} \approx I_{B2} \approx 1.5$ mA, $V_{CC} = -2.0$ V |

4

# 2N/PN2904/5/6/7 • 2N/PN2904A/5A/6A/7A

## PNP SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS AND SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C (PN Series)**
- **$V_{CEO}$ . . . 60 V (MIN) ("A" suffix devices), 40 V (MIN) (Non-suffix devices)**
- **$h_{FE}$ . . . 40-120 (2N/PN2904/6), 100-300 (2N/PN2905/7)**
- **$t_{on}$ . . . 45 ns (MAX) @ 150 mA, $t_{off}$ . . . 100 ns (MAX) @ 150 mA**
- **COMPLEMENTS . . . 2N/PN2218 Series, 2N/PN2218A Series**

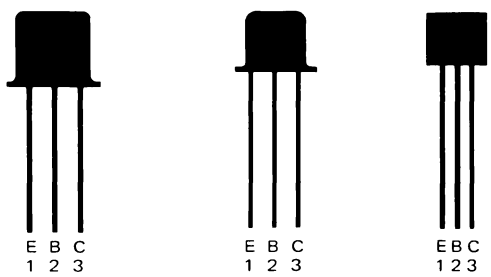
**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| **Maximum Temperatures** | **2N Series** | **PN Series** |
|---|---|---|
| Storage Temperature | −65°C to +200°C | −55°C to +150°C |
| Operating Junction Temperature | 200°C | 150°C |

| **Maximum Power Dissipation** (Notes 2 & 3) | | **2N2904/A** | **2N2906/A** |
|---|---|---|---|
| Total Dissipation | **PN Series** | **2N2905/A** | **2N2907/A** |
| at 25°C Case Temperature | 1.0 W | 3.0 W | 1.8 W |
| at 25°C Ambient Temperature | 0.625 W | 0.6 W | 0.4 W |

| **Maximum Voltages and Current** | | **2N/PN2904 Series** | **2N/PN2904A Series** |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | −60 V | −60 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | −40 V | −60 V |
| $V_{EBO}$ | Emitter to Base Voltage | −5.0 V | −5.0 V |
| $I_C$ | Collector Current | 600 mA | 600 mA |

**See Package Outline**




**2N2904/A 2N2905/A** | **2N2906/A 2N2907/A** | **PN Series**

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N/PN2904 2N/PN2906 MIN. | MAX. | 2N/PN2904A 2N/PN2906A MIN. | MAX. | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain (Note 5) | 40 | 120 | 40 | 120 | $I_C$ = 150 mA, $V_{CE}$ = −10 V |
| | | 20 | | 40 | | $I_C$ = 500 mA, $V_{CE}$ = −10 V |
| | | 35 | | 40 | | $I_C$ = 10 mA, $V_{CE}$ = −10 V |
| | | 25 | | 40 | | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V |
| | | 20 | | 40 | | $I_C$ = 0.1 mA, $V_{CE}$ = −10 V |

| SYMBOL | CHARACTERISTIC | 2N/PN2905 2N/PN2907 MIN. | MAX. | 2N/PN2905A 2N/PN2907A MIN. | MAX. | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain (Note 5) | 100 | 300 | 100 | 300 | $I_C$ = 150 mA, $V_{CE}$ = −10 V |
| | | 30 | | 50 | | $I_C$ = 500 mA, $V_{CE}$ = −10 V |
| | | 75 | | 100 | | $I_C$ = 10 mA, $V_{CE}$ = −10 V |
| | | 50 | | 100 | | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V |
| | | 35 | | 75 | | $I_C$ = 0.1 mA, $V_{CE}$ = −10 V |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 58.3°C/W (derating factor of 17.2 mW/°C); junction to ambient thermal resistance of 292°C/W (derating factor of 3.42 mW/°C) for 2N2904, 2N2904A, 2N2905 and 2N2905A; junction to case thermal resistance of 97.3°C/W (derating factor of 10.3 mW/°C); junction to ambient thermal resistance of 437°C/W (derating factor of 2.28 mW/°C) for the 2N2906, 2N2906A, 2N2907 and 2N2907A. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C) for PN2904/A, PN2905/A, PN2906/A, and PN2907/A.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse Conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5-SS22.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature for all "A" Suffix Devices unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N/PN2904/5 2N/PN2906/7 MIN. | MAX. | 2N/PN2904A 2N/PN2905A 2N/PN2906A 2N/PN2907A MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | −0.4 | | −0.4 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | | | −1.6 | | −1.6 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 5) | | −1.3 | | −1.3 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | | | −2.6 | | −2.6 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| $I_{CEX}$ | Collector Reverse Current | | 50 | | 50 | nA | $V_{CE}$ = −30 V, $V_{EB}$ = −0.5 V |
| $I_B$ | Base Current | | 50 | | 50 | nA | $V_{CE}$ = −30 V, $V_{EB}$ = −0.5 V |
| $C_{ob}$ | Output Capacitance | | 8.0 | | 8.0 | pF | $I_E$ = 0, $V_{CB}$ = −10 V, f = 100 kHz |
| $C_{ib}$ | Emitter Transition Capacitance | | 30 | | 30 | pF | $I_C$ = 0, $V_{EB}$ = −2.0 V, f = 100 kHz |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −60 | | −60 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | −60 | | −40 | | V | $I_C$ = 10 mA (pulsed), $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −5.0 | | −5.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $t_d$ | Turn On Delay Time (see test circuit no. 224) | | 10 | | 10 | ns | $I_C$ = 150 mA, $I_{B1}$ = 15 mA, $V_{CC}$ = 30 V |
| $t_r$ | Rise Time (see test circuit no. 224) | | 40 | | 40 | ns | $I_C$ = 150 mA, $I_{B1}$ = $I_{B2}$ = 15 mA, $V_{CC}$ = 30 V |
| $t_s$ | Storage Time (see test circuit no. 225) | | 80 | | 80 | ns | $I_C$ = 150 mA, $I_{B1}$ = 15 mA, $V_{CC}$ = 6.0 V |
| $t_f$ | Fall Time (see test circuit no. 225) | | 30 | | 30 | ns | $I_C$ = 150 mA, $I_{B1}$ = $I_{B2}$ = 15 mA $V_{CC}$ = 6.0 V |
| $t_{on}$ | Turn On Time (see test circuit no. 224) | | | | 45 | ns | $I_C$ = 150 mA, $I_{B1}$ = 15 mA, $V_{CC}$ = 3.0 V |
| $t_{off}$ | Turn Off Time (see test circuit no. 225) | | | | 100 | ns | $I_C$ = 150 mA, $I_{B1}$ = $I_{B2}$ = 15 mA, $V_{CC}$ = 6.0 V |
| $h_{fe}$ | High Frequency Current Gain | 2.0 | | 2.0 | | | $I_C$ = 50 mA, $V_{CE}$ = 20 V, f = 100 MHz |
| $I_{CBO}$ | Collector Cutoff Current | | 20 | | 10 | nA | $I_E$ = 0, $V_{CB}$ = −50 V |
| | | | 20 | | 10 | μA | $I_E$ = 0, $V_{CB}$ = −50 V, $T_A$ = 150°C |

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# 2N2913 • 2N2914 • 2N2972 • 2N2973

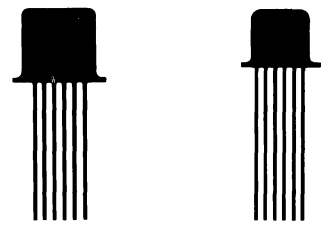
## DUAL NPN LOW LEVEL LOW NOISE DIFFERENTIAL AMPLIFIERS

DIFFUSED SILICON PLANAR* TRANSISTORS

- **NF . . . 4.0 dB (MAX) (2N2913/2N2972)**
- **$V_{CEO}$ . . . 45 V (MIN)**

See Package Outlines

TO5-9 TO18-5




2N2913 2N2914 2N2972 2N2973

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Junction Temperature | 200°C |
| Lead Temperature (60 seconds) | 300°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | 2N2913 2N2914 One Side | 2N2913 2N2914 Both Sides | 2N2972 2N2973 One Side | 2N2972 2N2973 Both Sides |
|---|---|---|---|---|
| Total Dissipation | | | | |
| at 25°C Case Temperature | 0.75 W | 1.5 W | 0.5 W | 0.75 W |
| at 100°C Case Temperature | 0.43 W | 0.86 W | 0.29 W | 0.43 W |
| at 25°C Ambient Temperature | 0.3 W | 0.5 W | 0.25 W | 0.30 W |

**Maximum Voltages and Current**

| | | |
|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 45 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 45 V |
| $V_{EBO}$ | Emitter to Base Voltage | 6.0 V |
| $I_C$ | Collector Current | 30 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N2913 2N2972 MIN. | 2N2913 2N2972 MAX. | 2N2914 2N2973 MIN. | 2N2914 2N2973 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_{CE(sat)}$ | Collector Saturation Voltage | | 0.35 | | 0.35 | V | $I_C$ = 1.0 mA, $I_B$ = 0.1 mA |
| $I_{CBO}$ | Collector Cutoff Current | | 10 | | 10 | nA | $I_E$ = 0, $V_{CB}$ = 45 V |
| | | | 10 | | 10 | μA | $I_E$ = 0, $V_{CB}$ = 45 V, $T_A$ = 150°C |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 5) | 45 | | 45 | | V | $I_C$ = 10 mA, $I_B$ = 0 (pulsed) |
| NF | Narrow Band Noise Figure | | 4.0 | | 3.0 | dB | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V, f = 1 kHz, $R_S$ = 10 kΩ, Bandwidth = 200 Hz |
| NF | Wide Band Noise Figure | | 4.0 | | 3.0 | dB | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V, $R_S$ = 10 kΩ, f = 10 Hz to 10 kHz, Bandwidth of 15.7 kHz |
| $h_{FE}$ | DC Current Gain | 60 | 240 | 150 | 600 | | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V |
| | | 150 | | 300 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V |
| | | 100 | | 225 | | | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V |
| | | 15 | | 30 | | | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V, $T_A$ = −55°C |
| $V_{BE(ON)}$ | Emitter to Base "On" Voltage | | 0.7 | | 0.7 | V | $I_C$ = 0.1 mA, $V_{CE}$ = 5.0 V |
| $I_{CEO}$ | Collector Cutoff Current | | 2.0 | | 2.0 | nA | $I_B$ = 0, $V_{CE}$ = 5.0 V |
| $I_{EBO}$ | Emitter Cutoff Current | | 2.0 | | 2.0 | nA | $I_C$ = 0, $V_{EB}$ = 5.0 V |
| $h_{fe}$ | High Frequency Current Gain | 3.0 | | 3.0 | | | $I_C$ = 0.5 mA, $V_{CE}$ = 5.0 V, f = 20 MHz |
| $C_{ob}$ | Output Capacitance | | 6.0 | | 6.0 | pF | $I_E$ = 0, $V_{CB}$ = 5.0 V, f = 140 kHz |
| $h_{ib}$ | Input Resistance | 25 | 32 | 25 | 32 | Ω | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V, f = 1.0 kHz |
| $h_{ob}$ | Output Conductance | | 1.0 | | 1.0 | μmhos | $I_C$ = 1.0 mA, $V_{CB}$ = 5.0 V, f = 1.0 kHz |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 45 | | 45 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 6.0 | | 6.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |

NOTES:

*Planar is a patented Fairchild process.

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to ambient thermal resistance of 584°C/W (derating factor of 1.71 mW/°C) for one side; 350°C/W (derating factor of 2.86 mW/°C) for both sides for the 2N2913 and 2N2914. For the 2N2972 and 2N2973, junction to ambient thermal resistance is 700°C/W (derating factor of 1.43 mW/°C) for one side; 584°C/W (derating factor of 1.71 mW/°C) for both sides.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 — SS8.

# 2N2915/A • 2N2919/A • 2N2974 • 2N2978

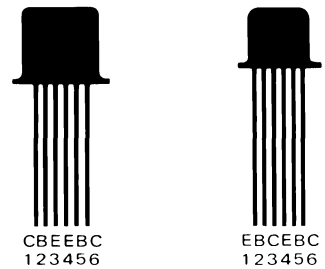
## DUAL NPN LOW LEVEL LOW NOISE DIFFERENTIAL AMPLIFIERS

DIFFUSED SILICON PLANAR* TRANSISTORS

- $LV_{CEO}$ . . . 60 V (MIN)
- $h_{FE}$ . . . 60 (MIN) @ $I_C$ = 10 μA
- $|V_{BE1} - V_{BE2}|$ . . . 1.5 mV (MAX) @ 100 μA
- $\Delta V_{BE}$ . . . 5.0 μV/°C (MAX) @ 100 μA, $T_A$ = −55°C to +125°C
- NF . . . 4.0 dB (MAX) @ f = 1.0 kHz

See Package Outlines

TO5-9 TO18-5




2N2915/A
2N2919/A

2N2974
2N2978

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Junction Temperature | 200°C |
| Lead Temperature (60 second) | 300°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | 2N2915/A, 2N2919/A | | 2N2974, 2N2978 | |
|---|---|---|---|---|
| | One Side | Both Sides | One Side | Both Sides |
| Total Dissipation at 25°C Case Temperature | 0.75 W | 1.5 W | 0.5 W | 0.75 W |
| at 100°C Case Temperature | 0.43 W | 0.86 W | 0.29 W | 0.43 W |
| at 25°C Ambient Temperature | 0.30 W | 0.50 W | 0.25 W | 0.30 W |

**Maximum Voltages and Current for each Transistor**

| | | 2N2915/A, 2N2974 | 2N2919/A, 2N2978 |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 45 V | 60 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 45 V | 60 V |
| $V_{EBO}$ | Emitter to Base Voltage | 6.0 V | 6.0 V |
| $I_C$ | Collector Current | 30 mA | 30 mA |

**MATCHING CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N2915A 2N2919A MIN. | 2N2915A 2N2919A MAX. | 2N2915, 2N2919 2N2974, 2N2978 MIN. | 2N2915, 2N2919 2N2974, 2N2978 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $\frac{h_{FE1}}{h_{FE2}}$ | DC Current Gain Ratio (Note 5) | 0.9 | 1.0 | 0.9 | 1.0 | | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V |
| $\frac{h_{FE1}}{h_{FE2}}$ | DC Current Gain Ratio (Note 5) ($T_A$ = −55°C to +125°C) | 0.85 | 1.0 | | | | $V_{CE}$ = 5.0 V, $I_C$ = 100 μA to 1.0 mA |
| $\lvert V_{BE1}-V_{BE2}\rvert$ | Base to Emitter Voltage Differential (Note 6) | | 2.0 | | 5.0 | mV | $I_C$ = 10 μA to 1.0 mA, $V_{CE}$ = 5.0 V |
| | | | 1.5 | | 3.0 | mV | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V |
| $\lvert\Delta(V_{BE1}-V_{BE2})\rvert$ | Base to Emitter Voltage Differential Change ($T_A$ = −55°C to +25°C) | | 0.4 (5 μV/°C) | | 0.8 (10 μV/°C) | mV | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V |
| $\lvert\Delta(V_{BE1}-V_{BE2})\rvert$ | Base to Emitter Voltage Differential Change ($T_A$ = +25°C to +125°C) | | 0.5 (5 μV/°C) | | 1.0 (10 μV/°C) | mV | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V |

Additional Electrical Characteristics on following page.

NOTES:

*Planar is a patented Fairchild process.

1. These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to ambient thermal resistance of 584°C/W (derating factor of 1.71 mW/°C) for one side; 350°C/W (derating factor of 2.86 mW/°C) for both sides for the 2N2915, 2N2915A, 2N2919 and 2N2919A. For the 2N2974, 2N2978, junction to ambient thermal resistance of 700°C/W (derating factor of 1.43 mW/°C) for one side; 584°C/W (derating factor of 1.71 mW/°C) for both sides.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Lowest of two $h_{FE}$ readings is taken as $h_{FE1}$ for purposes of this ratio.
6. Absolute values.
7. Pulse conditions: length = 300 μs; duty cycle = 1%.
8. For product family characteristic curves, refer to Section 5 - SS8.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N2915/A 2N2974 MIN. | 2N2915/A 2N2974 MAX. | 2N2919/A 2N2978 MIN. | 2N2919/A 2N2978 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 150 | | 150 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V |
| | | 100 | | 100 | | | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V |
| | | 60 | 240 | 60 | 240 | | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V |
| | | 15 | | 15 | | | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V, $T_A$ = −55°C |
| $V_{CE(sat)}$ | Collector Saturation Voltage | | 0.35 | | 0.35 | V | $I_C$ = 1.0 mA, $I_B$ = 0.1 mA |
| $V_{BE(ON)}$ | Emitter to Base "On" Voltage | | 0.7 | | 0.7 | V | $I_C$ = 0.1 mA, $V_{CE}$ = 5.0 V |
| $I_{CBO}$ | Collector Cutoff Current | | 10 | | 2.0 | nA | $I_E$ = 0, $V_{CB}$ = 45 V |
| | | | 10 | | 10 | μA | $I_E$ = 0, $V_{CB}$ = 45 V, $T_A$ = 150°C |
| $I_{CEO}$ | Collector Cutoff Current | | 2.0 | | 2.0 | nA | $I_B$ = 0, $V_{CE}$ = 5.0 V |
| $I_{EBO}$ | Emitter Cutoff Current | | 2.0 | | 2.0 | nA | $I_C$ = 0, $V_{EB}$ = 5.0 V |
| $C_{ob}$ | Output Capacitance | | 6.0 | | 6.0 | pF | $I_E$ = 0, $V_{CB}$ = 5.0 V, f = 140 kHz |
| $h_{ib}$ | Input Resistance | 25 | 32 | 25 | 32 | Ω | $I_C$ = 1.0 mA, $V_{CB}$ = 5.0 V, f = 1.0 kHz |
| $h_{ob}$ | Output Conductance | | 1.0 | | 1.0 | μmhos | $I_C$ = 1.0 mA, $V_{CB}$ = 5.0 V, f = 1.0 kHz |
| $h_{fe}$ | High Frequency Current Gain | 3.0 | 8.0 | 3.0 | | | $I_C$ = 0.5 mA, $V_{CE}$ = 5.0 V, f = 20 MHz |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 45 | | 60 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (pulsed) (Notes 4 & 7) | 45 | | 60 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 6.0 | | 6.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| NF | Narrow Band Noise Figure | | 4.0 | | 4.0 | dB | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V, f = 1.0 kHz, $R_S$ = 10 kΩ, PBW = 200 Hz |
| NF | Wide Band Noise Figure | | 4.0 | | 4.0 | dB | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V, f = 10 Hz to 10 kHz, $R_S$ = 10 kΩ, PBW = 15.7 kHz |
| $C_{ib}$ | Input Capacitance | | | | | | |
| | 2N2915A | | 10 | | | pF | $I_C$ = 0, $V_{EB}$ = 0.5 V, f = 1.0 MHz |
| | 2N2919A | | | | 10 | pF | |

# 2N2916/A • 2N2920/A • 2N2975 • 2N2979

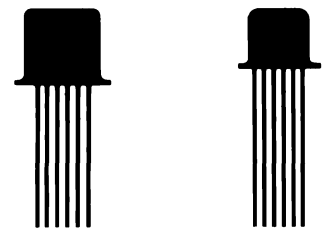
## DUAL NPN LOW LEVEL LOW NOISE DIFFERENTIAL AMPLIFIERS

DIFFUSED SILICON PLANAR* TRANSISTORS

- **$V_{CEO}$ . . . 60 V (MIN) (2N2920/20A/79)**
- **$h_{FE}$ . . . 150 (MIN) @ 10 μA**
- **TIGHT $V_{CE}$ MATCHING . . . 1.5 mV (MAX) @ 100 μA (2N2916A/20A)**
- **TIGHT $V_{BE}$ TRACKING . . . 5.0 μV/°C (MAX) @ 100 μA, −55°C TO +125°C**
- **BETA MATCH GUARANTEED OVER TEMPERATURE . . . 15% (MAX) FROM 100 μA TO 1.0 mA, −55°C TO +125°C**
- **NF . . . 3.0 dB (MAX) @ 1.0 kHz**

**See Package Outlines**

**TO5-9** **TO18-5**




**2N2916**
**2N2916A**
**2N2920**
**2N2920A**

**2N2975**
**2N2979**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Junction Temperature | 200°C |
| Lead Temperature (60 seconds) | 300°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | 2N2916/A, 2N2920/A | | 2N2975, 2N2979 | |
|---|---|---|---|---|
| | One Side | Both Sides | One Side | Both Sides |
| Total Dissipation at 25°C Case Temperature | 0.75 W | 1.5 W | 0.5 W | 0.75 W |
| at 100°C Case Temperature | 0.43 W | 0.86 W | 0.29 W | 0.43 W |
| at 25°C Ambient Temperature | 0.3 W | 0.5 W | 0.25 W | 0.3 W |

**Maximum Voltages and Current**

| | | 2N2916/16A/75 | 2N2920/20A/79 |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 45 V | 60 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 45 V | 60 V |
| $V_{EBO}$ | Emitter to Base Voltage | 6.0 V | 6.0 V |
| $I_C$ | Collector Current | 30 mA | 30 mA |

**MATCHING AND ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N2916A 2N2920A MIN. | 2N2916A 2N2920A MAX. | 2N2916, 2N2920 2N2975, 2N2979 MIN. | 2N2916, 2N2920 2N2975, 2N2979 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $\frac{h_{FE1}}{h_{FE2}}$ | DC Current Gain Ratio (Note 5) | 0.9 | 1.0 | 0.9 | 1.0 | | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V |
| | | 0.85 | 1.0 | | | | $I_C$ = 100 μA to 1.0 mA, $V_{CE}$ = 5.0 V, $T_A$ = 55°C to +125°C |
| $\lvert V_{BE1}-V_{BE2} \rvert$ | Base to Emitter Voltage Differential (Note 6) | | 2.0 | | 5.0 | mV | $I_C$ = 10 μA to 1.0 mA, $V_{CE}$ = 5.0 V |
| | | | 1.5 | | 3.0 | mV | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V |
| $\lvert \Delta(V_{BE1}-V_{BE2}) \rvert$ | Base to Emitter Voltage Differential Change | | 0.4 (5 μV/°C) | | 0.8 (10 μV/°C) | mV | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V, $T_A$ = −55°C to +25°C |
| | | | 0.5 (5 μV/°C) | | 1.0 (10 μV/°C) | mV | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V, $T_A$ = 25°C to +125°C |
| $h_{fe}$ | High Frequency Current Gain | 3.0 | 8.0 | 3.0 | | | $I_C$ = 0.5 mA, $V_{CE}$ = 5.0 V, f = 20 MHz |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to ambient thermal resistance of 584°C/W (derating factor of 1.71 mW/°C) for one side; 350°C/W (derating factor of 2.86 mW/°C) for both sides for the 2N2916, 2N2916A, 2N2920, and 2N2920A. For the 2N2975 and 2N2979, junction to ambient thermal resistance of 700°C/W (derating factor of 1.43 mW/°C) for one side; 584°C/W (derating factor of 1.71 mW/°C) for both sides.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Lowest of two $h_{FE}$ readings is taken as $h_{FE1}$ for purposes of this ratio.
6. Absolute values.
7. Pulse conditions: length = 300 μs; duty cycle = 1%.
8. For product family characteristic curves, refer to Section 5 - SS8.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N2916/16A/75 MIN. | 2N2916/16A/75 MAX. | 2N2920/20A/79 MIN. | 2N2920/20A/79 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 300 | | 300 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V |
| | | 225 | | 225 | | | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V |
| | | 150 | 600 | 150 | 600 | | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V |
| | 2N2916A, 2N2920A only | 40 | | 40 | | | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V, $T_A$ = −55°C |
| | | 30 | | | | | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V, $T_A$ = −55°C |
| $V_{CE(sat)}$ | Collector Saturation Voltage | | 0.35 | | 0.35 | V | $I_C$ = 1.0 mA, $I_B$ = 0.1 mA |
| $V_{BE(ON)}$ | Emitter to Base "On" Voltage | | 0.7 | | 0.7 | V | $I_C$ = 0.1 mA, $V_{CE}$ = 5.0 V |
| $I_{CBO}$ | Collector Cutoff Current | | 10 | | 2.0 | nA | $I_E$ = 0, $V_{CB}$ = 45 V |
| | | | 10 | | 10 | μA | $I_E$ = 0, $V_{CB}$ = 45 V, $T_A$ = 150°C |
| $I_{CEO}$ | Collector Cutoff Current | | 2.0 | | 2.0 | nA | $I_B$ = 0, $V_{CE}$ = 5.0 V |
| $I_{EBO}$ | Emitter Cutoff Current | | 2.0 | | 2.0 | nA | $I_C$ = 0, $V_{EB}$ = 5.0 V |
| $C_{ob}$ | Output Capacitance | | 6.0 | | 6.0 | pF | $I_E$ = 0, $V_{CB}$ = 5.0 V, f = 140 kHz |
| $h_{ib}$ | Input Resistance | 25 | 32 | 25 | 32 | Ω | $I_C$ = 1.0 mA, $V_{CB}$ = 5.0 V, f = 1.0 kHz |
| $h_{ob}$ | Output Conductance | | 1.0 | | 1.0 | μmhos | $I_C$ = 1.0 mA, $V_{CB}$ = 5.0 V, f = 1.0 kHz |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 45 | | 60 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Pulsed) (Notes 4 & 7) | 45 | | 60 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 6.0 | | 6.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| NF | Wide Band Noise Figure | | 3.0 | | 3.0 | dB | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V, f = 10 Hz to 10 kHz, PBW = 15.7 Hz, $R_S$ = 10 kΩ |
| NF | Narrow Band Noise Figure | | 3.0 | | 3.0 | dB | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V, f = 1.0 kHz, PBW = 200 Hz, $R_S$ = 10 kΩ |
| $C_{ib}$ | Input Capacitance | | | | | | |
| | 2N1916A, 2N2920A only | | 10 | | 10 | pF | $I_C$ = 0, $V_{EB}$ = 0.5 V, f = 1.0 MHz |

# 2N2917 • 2N2918 • 2N2976 • 2N2977

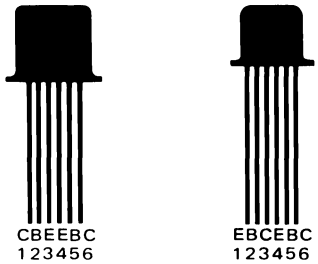
## NPN LOW LEVEL LOW NOISE DIFFERENTIAL AMPLIFIERS

DIFFUSED SILICON PLANAR* TRANSISTORS

- **$h_{FE1}/h_{FE2}$ . . . 25% (MAX) @ 100 μA**
- **$V_{BE1}$-$V_{BE2}$ . . . 5.0 mV (MAX) @ 100 μA, 10 mV (MAX) FROM 10 μA TO 1.0 mA**
- **$\Delta V_{BE}$ . . . 20 μV/°C (MAX) @ 100 μA**
- **$V_{CEO}$ . . . 45 V (MIN)**
- **NF . . . 3.0 dB (MAX) WIDE BAND AND AT 1.0 kHz (2N2977, 2N2918)**

**See Package Outlines**

**TO5-9** **TO18-5**




**2N2917** **2N2976**
**2N2918** **2N2977**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Junction Temperature | 200°C |
| Lead Temperature (60 seconds) | 300°C |

| **Maximum Power Dissipation** (Notes 2 & 3) | **2N2917/18 ONE SIDE** | **2N2917/18 BOTH SIDES** | **2N2976/77 ONE SIDE** | **2N2976/77 BOTH SIDES** |
|---|---|---|---|---|
| Total Dissipation | | | | |
| at 25°C Case Temperature | 0.75 W | 1.5 W | 0.5 W | 0.75 W |
| at 100°C Case Temperature | 0.43 W | 0.86 W | 0.29 W | 0.43 W |
| at 25°C Ambient Temperature | 0.3 W | 0.50 W | 0.25 W | 0.30 W |

**Maximum Voltages and Currents for Each Transistor**

| | | |
|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 45 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 45 V |
| $V_{EBO}$ | Emitter to Base Voltage | 6.0 V |
| $I_C$ | Collector Current | 30 mA |

**MATCHING AND ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N2917 2N2976 MIN. | 2N2917 2N2976 MAX. | 2N2918 2N2977 MIN. | 2N2918 2N2977 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $\frac{h_{FE1}}{h_{FE2}}$ | DC Current Gain Ratio (Note 5) | 0.8 | 1.0 | 0.8 | 1.0 | | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V |
| $\lvert V_{BE1}-V_{BE2}\rvert$ | Base to Emitter Voltage Differential (Note 6) | | 10 | | 10 | mV | $I_C$ = 10 μA to 1.0 mA, $V_{CE}$ = 5.0 V |
| | | | 5.0 | | 5.0 | mV | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V |
| $\lvert\Delta(V_{BE1}-V_{BE2})\rvert$ | Base to Emitter Voltage Differential Change | | 1.6 | | 1.6 | mV | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V $T_A$ = −55°C to +25°C (20 μV/°C) |
| | | | 2.0 | | 2.0 | mV | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V, $T_A$ = +25°C to +125°C (20 μV/°C) |
| NF | Narrow Band Noise Figure | | 4.0 | | 3.0 | dB | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V, BW = 200 Hz, $R_S$ = 10 kΩ, f = 1 kHz |
| NF | Wide Band Noise Figure | | 4.0 | | 3.0 | dB | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V, 3.0 dB pts. @ 25 Hz & 10 Hz $R_S$ = 10 kΩ, f = 15.7 kHz |

Additional Electrical Characteristics on following page.

NOTES:

*Planar is a patented Fairchild process.

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to ambient thermal resistance of 584°C/W (derating factor of 1.71 mW/°C) for one side; 292°C/W (derating factor of 2.86 mW/°C) for both sides for the 2N2917 and 2N2918. For the 2N2976 and 2N2977 junction to ambient thermal resistance of 700°C/W (derating factor of 1.43 mW/°C) for one side; 584°C/W (derating factor of 1.71 mW/°C) for both sides.
4. Ratings refers to a high current point where collector to emitter voltage is lowest.
5. Lowest of two $h_{FE}$ readings is taken as $h_{FE1}$ for purposes of this ratio.
6. Absolute values.
7. Pulse conditions: length = 300 μs; duty cycle = 1%.
8. For product family characteristic curves, refer to Section 5 — SS8.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N2917 2N2976 MIN. | 2N2917 2N2976 MAX. | 2N2918 2N2977 MIN. | 2N2918 2N2977 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 150 | | 300 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V |
| | | 100 | | 225 | | | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V |
| | | 60 | 240 | 150 | 600 | | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V |
| | | 15 | | 30 | | | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V, $T_A$ = −55°C |
| $V_{CE(sat)}$ | Collector Saturation Voltage | | 0.35 | | 0.35 | V | $I_C$ = 1.0 mA, $I_B$ = 0.1 mA |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage | | 0.7 | | 0.7 | V | $I_C$ = 0.1 mA, $V_{CE}$ = 5.0 V |
| $I_{CBO}$ | Collector Cutoff Current | | 10 | | 10 | nA | $I_E$ = 0, $V_{CB}$ = 45 V |
| | | | 10 | | 10 | μA | $I_E$ = 0, $V_{CB}$ = 45 V, $T_A$ = +150°C |
| $I_{CEO}$ | Collector Cutoff Current | | 2.0 | | 2.0 | nA | $I_B$ = 0, $V_{CE}$ = 5.0 V |
| $I_{EBO}$ | Emitter Cutoff Current | | 2.0 | | 2.0 | nA | $I_C$ = 0, $V_{EB}$ = 5.0 V |
| $C_{ob}$ | Output Capacitance | | 6.0 | | 6.0 | pF | $I_E$ = 0, $V_{CB}$ = 5.0 V, f = 140 kHz |
| $h_{fe}$ | High Frequency Current Gain | 3.0 | | 3.0 | | | $I_C$ = 0.5 mA, $V_{CE}$ = 5.0 V, f = 20 MHz |
| $h_{ib}$ | Input Resistance | 25 | 32 | 25 | 32 | Ω | $I_C$ = 1.0 mA, $V_{CB}$ = 5.0 V, f = 1 kHz |
| $h_{ob}$ | Output Conductance | | 1.0 | | 1.0 | μmho | $I_C$ = 1.0 mA, $V_{CB}$ = 5.0 V, f = 1 kHz |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 45 | | 45 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 7) | 45 | | 45 | | V | $I_C$ = 10 mA, (pulsed), $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 6.0 | | 6.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |

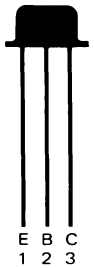
# 2N3009 • 2N3013 • 2N3014

## NPN HIGH SPEED SATURATED LOGIC SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$V_{CEO}$ . . . 20 V (MIN) (2N3014), 15 V (MIN) (2N3009, 2N3013)**
- **$\tau_s$ . . . 18 ns (MAX) @ 10 mA**
- **$t_{on}$ . . . 15 ns (MAX) @ 300 mA (2N3009, 2N3013), 16 ns (MAX) @ 30 mA (2N3014)**
- **$t_{off}$ . . . 25 ns (MAX) @ 300 mA (2N3009, 2N3013), @ 30 mA (2N3014)**
- **COMPLEMENTS . . . 2N5455, 2N5456**

**See TO18-2 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +200°C |
| Operating Junction Temperature | 200°C |
| Lead Temperature (60 seconds) | 300°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Ambient Temperature | 0.36 W |
| at 25°C Case Temperature | 1.2 W |

| **Maximum Voltages and Current** | | **2N3009** | **2N3013** | **2N3014** |
|---|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 40 V | 40 V | 40 V |
| $V_{CES}$ | Collector to Emitter Voltage | 40 V | 40 V | 40 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 15 V | 15 V | 20 V |
| $V_{EBO}$ | Emitter to Base Voltage | 4.0 V | 5.0 V | 5.0 V |
| $I_C$ | Collector Current | 200 mA | 200 mA | 200 mA |
| | Pulse = 10 μs | 500 mA | 500 mA | 500 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N3009 MIN. | 2N3009 MAX. | 2N3013 MIN. | 2N3013 MAX. | 2N3014 MIN. | 2N3014 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain (Note 5) | 30 | 120 | 30 | 120 | 30 | 120 | | $I_C$ = 30 mA, $V_{CE}$ = 0.4 V |
| | | | | | | 25 | | | $I_C$ = 10 mA, $V_{CE}$ = 0.4 V |
| | | 25 | | 25 | | | | | $I_C$ = 100 mA, $V_{CE}$ = 0.5 V |
| | | | | | | 25 | | | $I_C$ = 100 mA, $V_{CE}$ = 1.0 V |
| | | 15 | | 15 | | | | | $I_C$ = 300 mA, $V_{CE}$ = 1.0 V |
| | | | | 12 | | 12 | | | $I_C$ = 30 mA, $V_{CE}$ = 0.4 V, $T_A$ = −55°C |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | | | | | 0.18 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | 0.18 | | 0.18 | | 0.18 | V | $I_C$ = 30 mA, $I_B$ = 3.0 mA |
| | | | 0.28 | | 0.28 | | 0.35 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| | | | 0.5 | | 0.5 | | | V | $I_C$ = 300 mA, $I_B$ = 30 mA |
| | | | 0.3 | | | | | V | $I_C$ = 30 mA, $I_B$ = 3.0 mA, $T_A$ = 85°C |
| | | | | | 0.25 | | 0.25 | V | $I_C$ = 30 mA, $I_B$ = 3.0 mA, $T_A$ = 125°C |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 5) | 0.75 | 0.95 | 0.75 | 0.95 | 0.75 | 0.95 | V | $I_C$ = 30 mA, $I_B$ = 3.0 mA |
| | | | 1.2 | | 1.2 | | 1.2 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| | | | 1.7 | | 1.7 | | | V | $I_C$ = 300 mA, $I_B$ = 30 mA |
| | | | | | | 0.7 | 0.8 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $h_{fe}$ | High Frequency Current Gain | 3.5 | | 3.5 | | 3.5 | | | $I_C$ = 30 mA, $V_{CE}$ = 10 V, f = 100 MHz |
| $C_{ob}$ | Output Capacitance | | 5.0 | | 5.0 | | 5.0 | pF | $I_E$ = 0, $V_{CB}$ = 5.0 V |
| $C_{ib}$ | Input Capacitance | | 8.0 | | 8.0 | | 8.0 | pF | $I_C$ = 0, $V_{BE}$ = 0.5 V |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 146°C/W (derating factor of 6.85 mW/°C); junction to ambient thermal resistance of 486°C/W (derating factor of 2.06 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 - SS5.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N3009 MIN. | 2N3009 MAX. | 2N3013 MIN. | 2N3013 MAX. | 2N3014 MIN. | 2N3014 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $I_{CES}$ | Collector Reverse Current | | 0.5 | | 0.3 | | 0.3 | μA | $V_{CE}$ = 20 V, $V_{BE}$ = 0 |
| | | | 15 | | | | | μA | $V_{CE}$ = 20 V, $V_{BE}$ = 0, $T_A$ = 85°C |
| | | | | | 40 | | 40 | μA | $V_{CE}$ = 20 V, $V_{BE}$ = 0, $T_A$ = 125°C |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 40 | | 40 | | 40 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | 40 | | 40 | | 40 | | V | $I_C$ = 100 μA, $V_{BE}$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | 15 | | 15 | | 20 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 4.0 | | 5.0 | | 5.0 | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $\tau_s$ | Charge Storage Time Constant (see test circuit no. 3111) | | 18 | | 18 | | 18 | ns | $I_C \approx I_{B1} \approx = I_{B2} \approx$ 10 mA |
| $t_{on}$ | Turn On Time | | | | | | | | |
| | (see test circuit no. 233) | | 15 | | 15 | | | ns | $I_C \approx$ 300 mA, $I_{B1} \approx$ 30 mA |
| | (see test circuit no. 268) | | | | | | 16 | ns | $I_C \approx$ 30 mA, $I_{B1} \approx$ 3.0 mA |
| $t_{off}$ | Turn Off Time | | | | | | | | |
| | (see test circuit no. 233) | | 25 | | 25 | | | ns | $I_C \approx$ 300 mA, $I_{B1} \approx -I_{B2} \approx$ 3.0 mA |
| | (see test circuit no. 286) | | | | | | 25 | ns | $I_C \approx$ 30 mA, $I_{B1} \approx -I_{B2} \approx$ 3.0 mA |

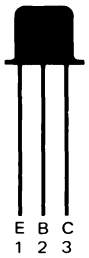
# 2N3011

## NPN HIGH SPEED SATURATED LOGIC SWITCH

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- $V_{CEO}$ . . . . 12 V (MIN)
- $\tau_s$ . . . 13 ns (MAX) @ 10 mA
- $t_{on}$ . . . 15 ns (MAX) @ 30 mA
- $t_{off}$ . . . 20 ns (MAX) @ 30 mA
- COMPLEMENTS . . . 2N4208

See TO18-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Junction Temperature | | 200°C |
| Lead Temperature (60 seconds) | | 300°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Case Temperature | | 1.2 W |
| at 100°C Case Temperature | | 0.68 W |
| at 25°C Ambient Temperature | | 0.36 W |
| **Maximum Voltages and Currents** | | |
| $V_{CBO}$ | Collector to Base Voltage | 30 V |
| $V_{CES}$ | Collector to Emitter Voltage | 30 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 12 V |
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V |
| $I_C$ | Collector Current (Pulse Width = 10 μs) | 500 mA |
| $I_C$ | DC Collector Current | 200 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 30 | 120 | | $I_C$ = 10 mA, $V_{CE}$ = 0.35 V |
| | | 25 | | | $I_C$ = 30 mA, $V_{CE}$ = 0.4 V |
| | | 12 | | | $I_C$ = 100 mA, $V_{CE}$ = 1.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | 0.2 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | 0.25 | V | $I_C$ = 30 mA, $I_B$ = 3.0 mA |
| | | | 0.5 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| | | | 0.3 | | $I_C$ = 10 mA, $I_B$ = 1.0 mA, $T_A$ = 85°C |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 5) | 0.72 | 0.87 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | 1.15 | V | $I_C$ = 30 mA, $I_B$ = 3.0 mA |
| | | | 1.6 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| $h_{fe}$ | High Frequency Current Gain | 4.0 | | | $I_C$ = 20 mA, $V_{CE}$ = 10 V, f = 100 MHz |
| $C_{ob}$ | Output Capacitance | | 4.0 | pF | $I_E$ = 0, $V_{CB}$ = 5.0 V, f = 140 kHz |
| $I_{CES}$ | Collector Reverse Current | | 400 | nA | $V_{CE}$ = 20 V, $V_{BE}$ = 0 |
| | | | 10 | μA | $V_{CE}$ = 20 V, $V_{BE}$ = 0, $T_A$ = 85°C |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 30 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | 30 | | V | $I_C$ = 10 μA, $V_{EB}$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 5) | 12 | | V | $I_C$ = 10 mA, (pulsed) $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector to Base Cutoff Current | | 4.0 | μA | $V_{CB}$ = 20 V |
| $\tau_s$ | Charge Storage Time Constant (see test circuit no. 3111) | | 13 | ns | $I_C \cong I_{B1} \cong I_{B2} \cong$ 10 mA |
| $t_{on}$ | Turn On Time (see test circuit no. 286) | | 15 | ns | $I_C \approx$ 30 mA, $I_{B1} \approx$ 3.0 mA, $V_{CC}$ = 2.0 V |
| $t_{off}$ | Turn Off Time (see test circuit no. 286) | | 20 | ns | $I_C \approx$ 30 mA, $I_{B1} \approx$ 3.0 mA, $V_{CC}$ = 2.0 V, $I_{B2} \approx$ 3.0 mA |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 146°C/W (derating factor of 6.85 mW/°C); junction to ambient thermal resistance of 486°C/W (derating factor of 2.06 mW/°C) for 2N3011.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 2%.
6. For product family characteristic curves, refer to Section 5-SS28.

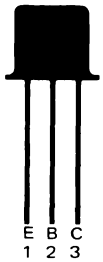
# 2N3019 • 2N3020

## NPN SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $V_{CEO}$ . . . 80 V (MIN)
- $h_{FE}$ . . . 100-300 @ 150 mA (2N3019)
- . . . 50 (MIN) @ 100 μA & 500 mA (2N3019)
- $V_{CE(sat)}$ . . . 0.5 V (MAX) @ 500 mA
- COMPLEMENTS . . . 2N4031, 2N4033

See TO5-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Junction Temperature | | 200°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Ambient Temperature | | 0.8 W |
| at 25°C Case Temperature | | 5.0 W |
| **Maximum Voltages and Current** | | |
| $V_{CEO}$ | Collector to Emitter Voltage | 80 V |
| $V_{CB}$ | Collector to Base Voltage | 140 V |
| $V_{EB}$ | Emitter to Base Voltage | 7.0 V |
| $I_C$ | Collector Current | 1.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N3019 MIN. | 2N3019 MAX. | 2N3020 MIN. | 2N3020 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 4) | 80 | | 80 | | V | $I_C$ = 30 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 140 | | 140 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 7.0 | | 7.0 | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 10 | | 10 | nA | $V_{CB}$ = 90 V, $I_E$ = 0 |
| | | | 10 | | 10 | μA | $V_{CB}$ = 90 V, $I_E$ = 0, $T_A$ = 150°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 10 | | 10 | nA | $V_{EB}$ = 5.0 V, $I_C$ = 0 |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 4) | | 0.2 | | 0.2 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | | | 0.5 | | 0.5 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 4) | | 1.1 | | 1.1 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| $h_{FE}$ | DC Current Gain (Note 4) | 50 | | 30 | 100 | | $I_C$ = 0.1 mA, $V_{CE}$ = 10 V |
| | | 90 | | 40 | 120 | | $I_C$ = 10 mA, $V_{CE}$ = 10 V |
| | | 100 | 300 | 40 | 120 | | $I_C$ = 150 mA, $V_{CE}$ = 10 V |
| | | 40 | | | | | $I_C$ = 150 mA, $V_{CE}$ = 10 V, $T_A$ = −55°C |
| | | 50 | | 30 | 100 | | $I_C$ = 500 mA, $V_{CE}$ = 10 V, |
| | | 15 | | 15 | | | $I_C$ = 1.0 A, $V_{CE}$ = 10 V |
| $h_{fe}$ | Current Gain Bandwidth Product | 5.0 | | 5.0 | | | $I_C$ = 50 mA, $V_{CE}$ = 10 V, f = 20 MHz |
| $C_{ob}$ | Output Capacitance | | 12 | | 12 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 1.0 MHz |
| $C_{ib}$ | Input Capacitance | | 60 | | 60 | pF | $V_{EB}$ = 0.5 V, $I_C$ = 0, f = 1.0 MHz |
| $h_{fe}$ | Small Signal Current Gain | 80 | 400 | 30 | 200 | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V, f = 1.0 kHz |
| $r_b'C_c$ | Collector Base Time Constant | | 400 | | 400 | ps | $I_C$ = 10 mA, $V_{CE}$ = 10 V, f = 4.0 MHz |
| NF | Noise Figure | | 4.0 | | | dB | $I_C$ = 100 μA, $V_{CE}$ = 10 V, f = 1.0 kHz, $R_S$ = 1.0 kΩ |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 35°C/W (derating factor of 28.6 mW/°C); junction to ambient thermal resistance of 217°C/W (derating factor of 4.6 mW/°C).
4. Pulse conditions: length ≤300 μs; duty cycle ≤1%.
5. For product family characteristic curves, refer to Section 5 — SS17.

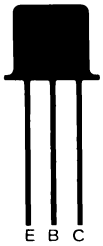
# 2N3053

## NPN SMALL SIGNAL GENERAL PURPOSE AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- **$V_{CEO}$ . . . 40 V (MIN)**
- **$h_{FE}$ . . . 50-250 @ 150 mA**
- **$f_T$ . . . 100 MHz (MIN) @ 50 mA**

**See TO5-1 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Junction Temperature | | 200°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Case Temperature | | 5.0 W |
| Linear Derating Factor | | 28.6 mW/°C |
| **Maximum Voltages and Current** | | |
| $V_{CEO}$ | Collector to Emitter Voltage | 40 V |
| $V_{CBO}$ | Collector to Base Voltage | 60 V |
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V |
| $I_C$ | Collector Current (Continuous) | 700 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | 40 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{CER}$ | Collector to Emitter Breakdown Voltage | 50 | | V | $I_C$ = 100 μA, $R_{BE}$ = 10 Ω |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 60 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $I_{CEX}$ | Collector Cutoff Current | | 0.25 | μA | $V_{CE}$ = 30 V, $V_{EB(OFF)}$ = 1.5 V |
| $I_{EBO}$ | Base Cutoff Current | | 0.25 | μA | $I_C$ = 0, $V_{EB}$ = 4.0 V |
| $h_{FE}$ | DC Current Gain (Note 4) | 25 | | | $I_C$ = 150 mA, $V_{CE}$ = 2.5 V |
| | | 50 | 250 | | $I_C$ = 150 mA, $V_{CE}$ = 10 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 4) | | 1.4 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 4) | | 1.7 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage | | 1.7 | V | $I_C$ = 150 mA, $V_{CE}$ = 2.5 V |
| $h_{fe}$ | Current Gain Bandwidth Product | 5.0 | | | $I_C$ = 50 mA, $V_{CE}$ = 10 V, f = 20 MHz |
| $C_{ob}$ | Output Capacitance | | 15 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 140 kHz |
| $C_{ib}$ | Input Capacitance | | 80 | pF | $V_{EB}$ = 0.5 V, $I_C$ = 0, f = 140 kHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 35°C/W (derating factor of 28.6 mW/°C).
4. Pulse conditions: length = 300 μs; duty cycle = 2%.

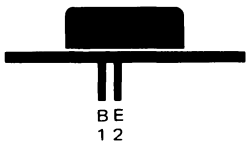
# 2N3054

## 25 WATT NPN POWER TRANSISTOR

DIFFUSED SILICON BI-MESAR™ TRANSISTOR

- **$LV_{CEO}$ . . . 55 V (MIN)**
- **$h_{FE}$ . . . 25-100 @ $I_C$ = 500 mA, $V_{CE}$ = 4.0 V**

**See TO66-1 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Junction Temperature | | 200°C |
| **Maximum Power Dissipation** | | |
| Total Dissipation at 25°C Case Temperature | | 25 W |
| Linear Derating Factor | | 0.142 W/°C |
| **Maximum Voltages and Currents** | | |
| $V_{CBO}$ | Collector to Base Voltage | 90 V |
| $V_{CEO}$ | Collector to Emitter Voltage | 55 V |
| $V_{EBO}$ | Emitter to Base Voltage | 7.0 V |
| $I_C$ | Collector Current | 4.0 A |
| $I_B$ | Base Current | 2.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $I_{CEX}$ | Collector Cutoff Current | | 1.0 | mA | $V_{CE}$ = 90 V, $V_{EB}$ = 1.5 V |
| | | | 6.0 | mA | $V_{CE}$ = 90 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 1.0 | mA | $V_{EB}$ = 7.0 V, $I_C$ = 0 |
| $I_{CEO}$ | Collector Cutoff Current | | 0.5 | mA | $V_{CE}$ = 30 V, $I_B$ = 0 |
| $V_{CEO(sus)}$ | Collector Sustaining Voltage (Note 2) | 55 | | V | $I_C$ = 100 mA, $I_B$ = 0 |
| $V_{CER(sus)}$ | Collector Sustaining Voltage (Note 2) | 60 | | V | $I_C$ = 100 mA, $R_{BE}$ = 100 Ω |
| $h_{FE}$ | DC Current Gain (Note 2) | 5.0 | | | $I_C$ = 3.0 A, $V_{CE}$ = 4.0 V |
| | | 25 | 100 | | $I_C$ = 500 mA, $V_{CE}$ = 4.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 2) | | 1.0 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| | | | 6.0 | V | $I_C$ = 3.0 A, $I_B$ = 1.0 A |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 2) | | 1.7 | V | $I_C$ = 500 mA, $V_{CE}$ = 4.0 V |
| $f_{hfe}$ | Small Signal Cutoff Frequency | 30 | | kHz | $V_{CE}$ = 4.0 V, $I_C$ = 100 mA |
| $h_{fe}$ | Small Signal Current Gain | 25 | 180 | | $V_{CE}$ = 4.0 V, $I_C$ = 100 mA, f = 1.0 kHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. Pulse conditions: length = 300 μs; duty cycle = 2%.
3. For product family characteristic curves, refer to Section 5-PWR5.

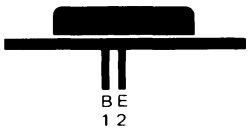
# 2N3055

## 115 WATT NPN POWER

DIFFUSED SILICON BI-MESAR™ TRANSISTOR

- $V_{CEO}$ . . . 60 V (MIN)
- $h_{FE}$ . . . 20-70 @ $I_C$ = 4.0 A, $V_{CE}$ = 4.0 V
- $V_{CE(sat)}$ . . . 1.0 V (MAX) @ $I_C$ = 4.0 A

See TO3-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| **Maximum Temperatures** | |
| Storage Temperature | −65°C to +200°C |
| Operating Junction Temperature | −65°C to +200°C |
| Lead Temperature (10 seconds) | 235°C |
| **Maximum Power Dissipation** | |
| Total Dissipation at 25°C Case Temperature | 115 W |
| Linear Derating Factor | 0.66 W/°C |
| **Maximum Voltages and Currents** | |
| $V_{CBO}$ Collector to Base Voltage | 100 V |
| $V_{CEO}$ Collector to Emitter Voltage | 60 V |
| $V_{EBO}$ Emitter to Base Voltage | 7.0 V |
| $I_C$ Collector Current | 15 A |
| $I_B$ Base Current | 7.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $I_{CEX}$ | Collector Cutoff Current | | 5.0 | mA | $V_{CE}$ = 100 V, $V_{EB}$ = 1.5 V |
| $I_{CEX}$ | Collector Cutoff Current | | 30 | mA | $V_{CE}$ = 100 V, $V_{EB}$ = 1.5 V, $T_A$ = 150°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 5.0 | mA | $V_{EB}$ = 7.0 V, $I_C$ = 0 |
| $I_{CEO}$ | Collector Cutoff Current | | 700 | μA | $V_{CE}$ = 30 V, $I_B$ = 0 |
| $V_{CEO(sus)}$ | Collector Sustaining Voltage (Note 2) | 60 | | V | $I_C$ = 200 mA, $I_B$ = 0 |
| $V_{CER(sus)}$ | Collector Sustaining Voltage (Note 2) | 70 | | V | $I_C$ = 200 mA, $R_{BE}$ = 100 Ω |
| $h_{FE}$ | DC Current Gain (Note 2) | 5.0 | | | $I_C$ = 10 A, $V_{CE}$ = 4.0 V |
| $h_{FE}$ | DC Current Gain (Note 2) | 20 | 70 | | $I_C$ = 4.0 A, $V_{CE}$ = 4.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 2) | | 1.1 | V | $I_C$ = 4.0 A, $I_B$ = 400 mA |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 2) | | 8.0 | V | $I_C$ = 10 A, $I_B$ = 3.3 A |
| $V_{BE(ON)}$ | Base "On" Voltage (Note 2) | | 1.8 | V | $I_C$ = 4.0 A, $V_{CE}$ = 4.0 V |
| $fh_{fe}$ | Small Signal Current Gain Frequency | 10 | | kHz | $I_C$ = 1.0 A, $V_{CE}$ = 4.0 V |
| $h_{fe}$ | Small Signal Current Gain | 15 | 120 | | $I_C$ = 1.0 A, $V_{CE}$ = 4.0 V, f = 1.0 kHz |

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. Pulse conditions: length = 300 μs; duty cycle = 1%.
3. For product family characteristic curves, refer to Section 5 — PWR 6.

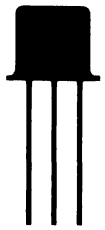
# 2N3107 • 2N3108 • 2N3109 • 2N3110

## NPN SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS AND SATURATED SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $V_{CEO}$ . . . 40 V (MIN) (2N3109/10)
  . . . 60 V (MIN) (2N3107/8)
- $V_{CE(sat)}$ . . . 1.0 V (MAX) @ 1.0 A
- NF . . . 7.0 dB (MAX) @ 1.0 kHz
- $t_{on}$ . . . 200 ns (MAX) @ 150 mA
- $t_{off}$ . . . 600 ns (MAX) (2N3108/10), 1.0 μs (MAX) (2N3107/9) @ 150 mA
- $h_{FE}$ . . . 100-300 @ 150 mA (2N3107/9)
  . . . 40 (MIN) @ 500 mA (2N3107/9)

See TO5-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to 200°C |
| Operating Junction Temperature | 200°C |
| Lead Temperature (60 seconds) | 300°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 5.0 W |
| at 25°C Ambient Temperature | 0.8 W |

**Maximum Voltages**

| | | 2N3107 2N3108 | 2N3109 2N3110 |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 100 V | 80 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 60 V | 40 V |
| $V_{EBO}$ | Emitter to Base Voltage | 7.0 V | 7.0 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N3107 2N3109 MIN. | 2N3107 2N3109 MAX. | 2N3108 2N3110 MIN. | 2N3108 2N3110 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 100 | 300 | 40 | 120 | | $I_C$ = 150 mA, $V_{CE}$ = 1.0 V |
| | | 40 | | 25 | | | $I_C$ = 500 mA, $V_{CE}$ = 10 V |
| | | 35 | | 20 | | | $I_C$ = 0.1 mA, $V_{CE}$ = 10 V |
| | | 30 | | 15 | | | $I_C$ = 150 mA, $V_{CE}$ = 10 V, $T_A$ = −55°C |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 5) | | 1.1 | | 1.1 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | (Notes 5 & 6) | | 2.0 | | 2.0 | V | $I_C$ = 1.0 A, $I_B$ = 100 mA |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | 0.25 | | 0.25 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | (Notes 5 & 6) | | 1.0 | | 1.0 | V | $I_C$ = 1.0 A, $I_B$ = 100 mA |
| $h_{fe}$ | High Frequency Current Gain | 3.5 | | 3.0 | | | $I_C$ = 50 mA, $V_{CE}$ = 10 V, f = 20 MHz |
| $C_{ob}$ | Open Circuit Output Capacitance | | | | | | |
| | (2N3107 only) | | 20 | | | pF | $I_E$ = 0, $V_{CB}$ = 10 V, f = 140 kHz |
| | (2N3108 only) | | | | 20 | pF | $I_E$ = 0, $V_{CB}$ = 10 V, f = 140 kHz |
| | (2N3109 only) | | 25 | | | pF | $I_E$ = 0, $V_{CB}$ = 10 V, f = 140 kHz |
| | (2N3110 only) | | | | 25 | pF | $I_E$ = 0, $V_{CB}$ = 10 V, f = 140 kHz |
| $C_{ib}$ | Open Circuit Input Capacitance | | 80 | | 80 | pF | $I_E$ = 0, $V_{EB}$ = 0.5 V, f = 140 kHz |
| $I_{CES}$ | Collector Reverse Current | | 10 | | 10 | nA | $V_{CE}$ = 60 V, $V_{EB}$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 10 | | 10 | μA | $V_{CB}$ = 60 V, $I_E$ = 0, $T_A$ = 150°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 10 | | 10 | nA | $I_C$ = 0, $V_{EB}$ = 5.0 V |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 35°C/W (derating factor of 28.6 mW/°C); junction to ambient thermal resistance of 218°C/W (derating factor of 4.5 mW/°C).
4. The rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. Saturation voltage measured with 1/4" lead length.
7. For product family characteristic curves, refer to Section 5 - SS17.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N3107 2N3109 MIN. | 2N3107 2N3109 MAX. | 2N3108 2N3110 MIN. | 2N3108 2N3110 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | | | | | | |
| | (2N3107 only) | 100 | | | | V | $I_E = 0, I_C = 100\ \mu A$ |
| | (2N3108 only) | | | 100 | | V | $I_E = 0, I_C = 100\ \mu A$ |
| | (2N3109 only) | 80 | | | | V | $I_E = 0, I_C = 100\ \mu A$ |
| | (2N3110 only) | | | 80 | | V | $I_E = 0, I_C = 100\ \mu A$ |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | | | | | | |
| | (2N3107 only) | 60 | | | | V | $I_B = 0, I_C = 30$ mA |
| | (2N3108 only) | | | 60 | | V | $I_B = 0, I_C = 30$ mA |
| | (2N3109 only) | 40 | | | | V | $I_B = 0, I_C = 30$ mA |
| | (2N3110 only) | | | 40 | | V | $I_B = 0, I_C = 30$ mA |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 7.0 | | 7.0 | | V | $I_C = 0, I_E = 100\ \mu A$ |
| NF | Noise Figure | | 7.0 | | 7.0 | dB | $I_C = 30\ \mu A$, $V_{CE} = 10$ V, f = 1.0 kHz, BW = 200 Hz, $R_S = 1.0\ k\Omega$ |
| $t_{on}$ | Turn On Time (see test circuit no. 288) | | 200 | | 200 | ns | $I_C \approx 150$ mA, $I_{B1} \approx 7.5$ mA, $I_{B2} \approx 7.5$ mA |
| $t_{off}$ | Turn Off Time (see test circuit no. 288) | | 1000 | | 600 | ns | $I_C \approx 150$ mA, $I_{B1} \approx 7.5$ mA, $I_{B2} \approx 7.5$ mA |

4

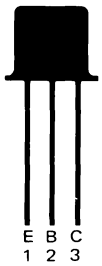
# 2N3137

## NPN CLASS C RF AMPLIFIER

DIFFUSED NPN SILICON PLANAR* EPITAXIAL TRANSISTOR

- **$G_{PE}$ . . . 6.0 dB (MIN) @ 250 MHz**
- **$\eta$ . . . 40% (MIN) @ 250 MHz**
- **$V_{CEO}$ . . . 20 V (MIN)**

**See TO5-1 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Junction Temperature | | 200°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Case Temperature | | 1.0 W |
| at 25°C Ambient Temperature | | 0.6 W |
| **Maximum Voltages and Current** | | |
| $V_{CBO}$ | Collector to Base Voltage | 40 V |
| $V_{CEO}$ | Collector to Emitter Voltage | 20 V |
| $V_{EBO}$ | Emitter to Base Voltage | 4.0 V |
| $I_C$ | Collector Current (Continuous) | 150 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $V_{CBO}$ | Collector to Base Breakdown Voltage | 40 | | V | $I_C$ = 0.1 mA, $I_E$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage | 20 | | V | $I_C$ = 15 mA, $I_B$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 0.05 | μA | $V_{CB}$ = 20 V, $I_E$ = 0 |
| | | | 50 | μA | $V_{CB}$ = 20 V, $I_E$ = 0, $T_A$ = 150°C |
| $V_{EBO}$ | Emitter to Base Breakdown Voltage | 4.0 | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 4) | 20 | 120 | | $V_{CE}$ = 5.0 V, $I_C$ = 50 mA |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | | 0.3 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $\|h_{fe}\|$ | High Frequency Current Gain | 5.0 | | | $V_{CE}$ = 10 V, $I_C$ = 50 mA, f = 100 MHz |
| $C_{ob}$ | Common Base Output Capacitance | | 3.5 | pF | $V_{CB}$ = 10 V, $I_C$ = 0, f = 100 kHz |
| $G_{PE}$ | Power Gain (see test circuit no. 230) | 6.0 | | dB | Pin = 100 mW, $V_{CE}$ = 20 V, $f_o$ = 250 MHz |
| $\eta$ | Collector Efficiency (see test circuit no. 230) | 40 | | % | $V_{CE}$ = 20 V, $f_o$ = 250 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 175°C/W (derating factor of 5.71 mW/°C); junction to ambient thermal resistance of 292°C/W (derating factor of 3.42 mW/°C).
4. Pulse conditions: length = 300 μs; duty cycle = 1%.
5. For product family characteristic curves, refer to Section 5 — SS2.

# 2N/PN3250 • 2N/PN3250A • 2N/PN3251 • 2N/PN3251A

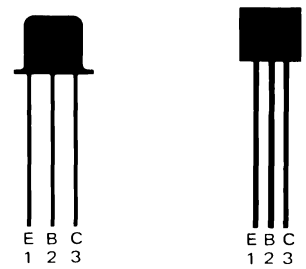
## PNP SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS AND SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C (PN SERIES)**
- **$V_{CEO}$ . . . 40 V (MIN) (2N/PN3250/1), 60 V (MIN) ("A" SUFFIX DEVICES)**
- **NF . . . 6.0 dB @ $I_C$ = 100 μA, $V_{CE}$ = 5.0 V**
- **$h_{FE}$ . . . 100-300 @ 10 mA (2N/PN3251/A)**
- **$f_T$ . . . 250 MHz (MIN) @ 10 mA (2N/PN3250/A)**
- **COMPLEMENTS . . . 2N3946, 2N3947 (40 V); 2N870, 2N871 (60 V) – (TO18)**
  **2N3903, 2N3904 (40 V); PN1893, PE6022 (60 V) – (TO92)**

See Package Outlines

TO18-1 TO92-1




| TO18-1 | TO92-1 |
|---|---|
| 2N3250 | PN3250 |
| 2N3251 | PN3251 |
| 2N3250A | PN3250A |
| 2N3251A | PN3251A |

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| **Maximum Temperatures** | **PN3250/51/50A/51A** | **2N/PN3250/51/50A/51A** |
|---|---|---|
| Storage Temperature | −55°C to +150°C | −65°C to +200°C |
| Operating Junction Temperature | 150°C | 200°C |
| Lead Temperature (60 seconds) | 260°C | 300°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Case Temperature | 1.0 W | 1.2 W |
| at 25°C Ambient Temperature | 0.625 W | 0.36 W |
| **Maximum Voltage and Current** | **2N/PN3250/51** | **2N/PN3250A/51A** |
| $V_{CBO}$ Collector Base Voltage | −50 V | −60 V |
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | −40 V | −60 V |
| $V_{EBO}$ Emitter to Base Voltage | −5.0 V | −5.0 V |
| $I_C$ Collector Current | 200 mA | 200 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N3250/A PN3250/A MIN. | 2N3250/A PN3250/A MAX. | 2N3251/A PN3251/A MIN. | 2N3251/A PN3251/A MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 40 | | 80 | | | $I_C$ = 100 μA, $V_{CE}$ = −1.0 V |
| | | 45 | | 90 | | | $I_C$ = 1.0 mA, $V_{CE}$ = −1.0 V |
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 50 | 150 | 100 | 300 | | $I_C$ = 10 mA, $V_{CE}$ = −1.0 V |
| | | 15 | | 30 | | | $I_C$ = 50 mA, $V_{CE}$ = −1.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | −0.25 | | −0.25 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | −0.50 | | −0.50 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 5) | −0.6 | −0.9 | −0.6 | −0.9 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | −1.2 | | −1.2 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $h_{fe}$ | High Frequency Current Gain | 2.5 | | 3.0 | | | $I_C$ = 10 mA, $V_{CE}$ = −20 V, f = 100 MHz |
| $r_b'C_c$ | Collector Base Time Constant | | 250 | | 250 | ps | $I_C$ = 10 mA, $V_{CE}$ = −20 V, f = 31.8 MHz |
| NF | Noise Figure | | 6.0 | | 6.0 | dB | $I_C$ = 100 μA, $V_{CE}$ = −5.0 V, f = 100 Hz, RG = 1 kΩ |
| $t_d$ | Delay Time (see test circuit no. 333) | | 35 | | 35 | ns | $I_C$ = 10 mA, $I_{B1}$ = 1.0 mA, $V_{CC}$ = 3.0 V |
| $t_r$ | Rise Time (see test circuit no. 333) | | 35 | | 35 | ns | $I_C$ = 10 mA, $I_{B1}$ = 1.0 mA, $V_{CC}$ = 3.0 V |
| $t_s$ | Storage Time (see test circuit no. 239) | | 175 | | 200 | ns | $I_C$ = 10 mA, $I_{B1}$ = $I_{B2}$ = 1.0 mA $V_{CC}$ = 3.0 V |
| $t_f$ | Fall Time (see test circuit no. 239) | | 50 | | 50 | ns | $I_C$ = 10 mA, $I_{B1}$ = $I_{B2}$ = 1.0 mA $V_{CC}$ = 3.0 V |
| $I_{CEX}$ | Collector Reverse Current (Note 5) | | 20 | | 20 | nA | $V_{CE}$ = −40 V, $V_{EB}$ = −3.0 V |

Additional Electrical Characteristics on following page.

NOTES:

*Planar is a patented Fairchild process.

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 145°C/W (derating factor of 6.9 mW/°C); junction to ambient thermal resistance of 486°C/W (derating factor of 2.1 mW/°C) for 2N series. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C) for P/N series.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves refer to Section 5 – SS23.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N3250/A PN3250/A MIN. | MAX. | 2N3251/A PN3251/A MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $I_{BL}$ | Base Current | | 50 | | 50 | nA | $V_{CE}$ = –40 V, $V_{EB}$ = –3.0 V |
| $C_{ob}$ | Output Capacitance | | 6.0 | | 6.0 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 100 kHz |
| $C_{ib}$ | Input Capacitance | | 8.0 | | 8.0 | pF | $V_{EB}$ = 1.0 V, $I_C$ = 0, f = 100 kHz |
| $h_{fe}$ | Small Signal Current Gain | 50 | 200 | 100 | 400 | | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $h_{re}$ | Voltage Feedback Ratio | | 10 | | 20 | $X10^{-4}$ | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $h_{ie}$ | Input Impedance | 1.0 | 6.0 | 2.0 | 12 | kΩ | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $h_{oe}$ | Output Admittance | 4.0 | 40 | 10 | 60 | μmhos | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |

| SYMBOL | CHARACTERISTIC | 2N3250 PN3250 2N3251 PN3251 MIN. | MAX. | 2N3250A PN3250A 2N3251A PN3251A MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | –50 | | –60 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | –5.0 | | –5.0 | | V | $I_C$ = 0, $I_E$ = 10 μA |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Notes 4 & 5) | –40 | | –60 | | V | $I_C$ = 10 mA, $I_B$ = 0 |

# 2N3409 • 2N3410 • 2N3411

## DUAL NPN LOW LEVEL LOW NOISE DIFFERENTIAL AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $V_{BE}$ . . . 10 mV (2N3409/10), 5.0 mV (2N3411) @ 100 μA
- $\frac{h_{FE1}}{h_{FE2}}$ . . . 0.8-1.0 (2N3409), 0.9-1.0 (2N3410/11) @ 100 μA

See TO5-9 Package Outline


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | One Side | Both Sides |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | | −65°C to +200°C |
| Lead Temperature (10 seconds) | | | 230°C |
| **Maximum Power Dissipation** | | | |
| Total Dissipation at 25°C Case Temperature | | 500 mW | 600 mW |
| Linear Derating Factor | | 2.9 mW/°C | 3.4 mW/°C |
| **Maximum Voltages and Current** | | | |
| $V_{EBO}$ | Emitter to Base Voltage | | 5.0 V |
| $V_{CBO}$ | Collector to Base Voltage | | 60 V |
| $V_{CEO}$ | Collector to Emitter Voltage | | 30 V |
| $V_{C1C2}$ | $Collector_1$ to $Collector_2$ | | ±100 V |
| | Voltage Rating any Lead to Case | | ±100 V |
| $I_C$ | Collector Current | | 500 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Note 2)

| SYMBOL | CHARACTERISTIC | 2N3409 MIN. | 2N3409 MAX. | 2N3410 MIN. | 2N3410 MAX. | 2N3411 MIN. | 2N3411 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $I_{CBO}$ | Collector Cutoff Current | | 10 | | 10 | | 10 | nA | $V_{CB}$ = 50 V |
| | | | 10 | | 10 | | 10 | μA | $V_{CB}$ = 50 V, $T_A$ = 150°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 10 | | 10 | | 10 | nA | $V_{EB}$ = 3.0 V |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | 5.0 | | 5.0 | | V | $I_C$ = 0, $I_E$ = 10 μA |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 60 | | 60 | | 60 | | V | $I_E$ = 0, $I_C$ = 10 μA |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 3) | 30 | | 30 | | 30 | | V | $I_C$ = 10 mA |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | | 0.15 | | 0.15 | | 0.15 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage | | 0.85 | | 0.85 | | 0.85 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $h_{fe}$ | Static Forward Current Transfer Ratio | 30 | 120 | 30 | 120 | 30 | 120 | | $I_C$ = 100 μA, $V_{CE}$ = 10 V |
| | | 40 | 160 | 40 | 160 | 40 | 160 | | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V |
| | | 50 | 200 | 50 | 200 | 50 | 200 | | $I_C$ = 10 mA, $V_{CE}$ = 10 V |
| | | | | 20 | 100 | 20 | 100 | | $I_C$ = 10 μA, $V_{CE}$ = 10 V |
| $\frac{h_{FE1}}{h_{FE2}}$ | Static Forward Current Transfer Ratio | 0.8 | 1.0 | 0.9 | 1.0 | 0.9 | 1.0 | | $I_C$ = 100 μA, $V_{CE}$ = 10 V |
| | | | | | | 0.9 | 1.0 | | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V |
| $\lvert\Delta(V_{BE1}-V_{BE2})\rvert$ | Base to Emitter Voltage Differential | | 10 | | 10 | | 5.0 | mV | $I_C$ = 100 μA, $V_{CE}$ = 10 V |
| | | | | | | | 5.0 | mV | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.
2. Unit not under test open circuit unless otherwise specified.
3. Pulse conditions: width ≤ 300 μs; duty cycle ≤ 2%.
4. For product family characteristic curves, refer to Section 5-SS15.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) Note 2. (Cont'd.)

| SYMBOL | CHARACTERISTIC | 2N3409 MIN. | 2N3409 MAX. | 2N3410 MIN. | 2N3410 MAX. | 2N3411 MIN. | 2N3411 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $\lvert\Delta(V_{BE1}-V_{BE2})\rvert$ | Base to Emitter Voltage Differential Gradient | | 2.0 | | 1.0 | | 1.0 | mV | $V_{CE}$ = 10 V, $I_C$ = 100 μA, $T_A$ = +25°C to +125°C |
| | | | 1.6 | | 0.8 | | 0.8 | mV | $V_{CE}$ = 10 V, $I_C$ = 100 μA, $T_A$ = −55°C to +25°C |
| $C_{ob}$ | Output Capacitance | | 8.0 | | 8.0 | | 8.0 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 100 kHz |
| $C_{ib}$ | Input Capacitance | | 20 | | 20 | | 20 | pF | $V_{EB}$ = 0.5 V, $I_C$ = 0, f = 100 kHz |
| $h_{fe}$ | Magnitude of Small Signal, Short Circuit Forward Current Transfer Ratio | 2.5 | 8.0 | 2.5 | 8.0 | 2.5 | 8.0 | | $V_{CE}$ = 20 V, $I_C$ = 20 mA, f = 100 MHz |
| NF | Noise Figure | | 4.0 | | 4.0 | | 4.0 | dB | $V_{CE}$ = 5.0 V, $I_C$ = 100 μA f = 1.0 kHz, $R_G$ = 1.0 kΩ, BW = 1.0 Hz |

# 2N3423 • 2N3424

## DUAL NPN LOW NOISE SENSE AND HIGH FREQUENCY DIFFERENTIAL AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $\frac{h_{FE1}}{h_{FE2}}$ . . . 10% @ 3.0 mA
- $|V_{BE1}-V_{BE2}|$ . . . 5.0 mV (MAX) @ 3.0 mA
- $|\Delta(V_{BE1}-V_{BE2})|$ . . . 20 μV/°C (MAX) @ 3.0 mA, −55°C to +125°C
- $f_T$ . . . 600 MHz (MIN) @ 4.0 mA
- NF . . . 3.5 dB (TPY) @ 60 Hz

See TO5-9 Package Outline


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | One Side | Both Sides |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | | −65°C to +200°C |
| Operating Junction Temperature | | | 200°C |
| Lead Temperature (60 seconds) | | | 300°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | | |
| Total Dissipation at 25°C Case Temperature | | 0.6 W | 1.2 W |
| at 100°C Case Temperature | | 0.25 W | 0.5 W |
| at 25°C Ambient Temperature | | 0.3 W | 0.45 W |
| **Maximum Voltages and Current** | | | |
| $V_{CBO}$ | Collector to Base Voltage | | 30 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | | 15 V |
| $V_{EBO}$ | Emitter to Base Voltage | | 3.0 V |
| $I_C$ | Collector Current | | 50 mA |
| $V_{C1C2}$ | Collector$_1$ to Collector$_2$ Voltage | | ±200 V |
| | Voltage Rating Any Lead to Case | | ±200 V |

**MATCHING CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N3423 MIN. | 2N3423 MAX. | 2N3424 MIN. | 2N3424 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $\frac{h_{FE1}}{h_{FE2}}$ | DC Current Gain Ratio (Note 5) | 0.8 | 1.0 | 0.9 | 1.0 | | $I_C$ = 3.0 mA, $V_{CE}$ = 3.0 V |
| $\|V_{BE1}-V_{BE2}\|$ | Base to Emitter Voltage Differential | | 10 | | 5.0 | mV | $I_C$ = 3.0 mA, $V_{CE}$ = 3.0 V |
| $\|\Delta(V_{BE1}-V_{BE2})\|$ | Base to Emitter Voltage Differential Change | | 3.2 (40 μV/°C) | | 1.6 (20 μV/°C) | mV | $I_C$ = 3.0 mA, $V_{CE}$ = 3.0 V, $T_A$ = −55°C to +25°C |
| $\|\Delta(V_{BE1}-V_{BE2})\|$ | Base to Emitter Voltage Differential Change | | 4.0 (40 μV/°C) | | 2.0 (20 μV/°C) | mV | $I_C$ = 3.0 mA, $V_{CE}$ = 3.0 V, $T_A$ = +25°C to +125°C |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 20 | | | $I_C$ = 3.0 mA, $V_{CE}$ = 1.0 V |
| | | 20 | 200 | | $I_C$ = 3.0 mA, $V_{CE}$ = 3.0 V |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 30 | | V | $I_C$ = 1.0 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 3.0 | | V | $I_C$ = 0, $I_E$ = 10 μA |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 6) | 15 | | V | $I_C$ = 3.0 mA, $I_B$ = 0 |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to ambient thermal resistance of 584°C/W (derating factor of 1.72 mW/°C) for one side; 389°C/W (derating factor of 2.57 mW/°C) for both sides; junction to case thermal resistance 290°C/W (derating factor of 3.44 mW/°C) for one side; 145°C/W (derating factor of 6.85 mW/°C) for both sides.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Lowest of two $h_{FE}$ readings is taken as $h_{FE1}$ for purpose of this ratio.
6. Pulse conditions: length = 300 μs; duty cycle = 1%.
7. For product family characteristic curves, refer to Section 5 - SS27.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $V_{CE(sat)}$ | Collector Saturation Voltage | | 0.4 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage | | 1.0 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $I_{CBO}$ | Collector Cutoff Current | | 10 | nA | $I_E$ = 0, $V_{CB}$ = 15 V |
| | | | 1.0 | μA | $I_E$ = 0, $V_{CB}$ = 15 V, $T_A$ = 150°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 10 | μA | $I_C$ = 0, $V_{EB}$ = 3.0 V |
| $h_{fe}$ | High Frequency Current Gain | 6.0 | 12 | | $I_C$ = 4.0 mA, $V_{CE}$ = 10 V, f = 100 MHz |
| $C_{ob}$ | Common to Base Output Capacitance | | 1.7 | pF | $I_E$ = 0, $V_{CB}$ = 10 V, f = 140 kHz |
| | | | 3.0 | pF | $I_E$ = 0, $V_{CB}$ = 0, f = 140 kHz |
| $C_{ib}$ | Common to Base Input Capacitance | | 2.0 | pF | $I_C$ = 0, $V_{EB}$ = 0.5 V, f = 140 kHz |
| $RE_{(hie)}$ | Real Part of Common Emitter Input Impedance | | 45 | Ω | $I_C$ = 3.0 mA, $V_{CE}$ = 3.0 V, f = 350 MHz |
| NF | Noise Figure (see test circuit no. 568) | 3.5 (TYP) | | dB | $I_C$ = 1.0 mA, $V_{CE}$ = 6.0 V, f = 60 MHz, $R_G$ = 400 Ω |

# 2N3439 • 2N3440

## NPN POWER

DIFFUSED SILICON PLANAR* TRANSISTORS

- $P_D$ . . . 10 W @ $T_C$ = 25°C
- $V_{CEO}$ . . . 250-350 V (MIN)

See TO5-2 Package Outline


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | | |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | −65°C to +200°C | |
| Operating Junction Temperature | | −65°C to +200°C | |
| **Maximum Power Dissipation** | | | |
| Total Dissipation at 25°C Case Temperature | | 10 W | |
| at 25°C Ambient Temperature | | 1.0 W | |
| **Maximum Voltages and Currents** | | **2N3439** | **2N3440** |
| $V_{CBO}$ | Collector to Base Voltage | 450 V | 300 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Applicable from 0 to 50 mA) | 350 V | 250 V |
| $V_{EBO}$ | Emitter to Base Voltage | 7.0 V | 7.0 V |
| $I_C$ | Collector Current (Continuous) | 1.0 A | 1.0 A |
| $I_B$ | Base Current (Continuous) | 0.5 A | 0.5 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| $I_{CBO}$ | Collector Cutoff Current | 2N3439 | | 20 | μA | $I_E = 0, V_{CB} = 360$ V |
| | | 2N3440 | | 20 | μA | $I_E = 0, V_{CB} = 250$ V |
| $I_{EBO}$ | Emitter Cutoff Current | | | 20 | μA | $I_C = 0, V_{EB} = 6.0$ V |
| $h_{FE}$ | DC Pulse Current Gain (Note 2) | | 40 | 160 | | $I_C = 20$ mA, $V_{CE} = 10$ V |
| $\|h_{fe}\|$ | Magnitude of Common Emitter Small Signal Current Gain | | 3.0 | | | $I_C = 10$ mA, $V_{CE} = 10$ V, f = 5.0 MHz |
| $h_{fe}$ | Low Frequency Current Gain | | 25 | | | $I_C = 5.0$ mA, $V_{CE} = 10$ V, f = 1.0 kHz |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 2) | | | 0.5 | V | $I_C = 50$ mA, $I_B = 4.0$ mA |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 2) | | | 1.3 | V | $I_C = 50$ mA, $I_B = 4.0$ mA |
| $C_{ob}$ | Common Base Open Circuit Output Capacitance | | | 10 | pF | $I_E = 0, V_{CB} = 10$ V, f = 1.0 MHz |
| $C_{ib}$ | Common Base Short Circuit Input Capacitance | | | 75 | pF | $I_C = 0, V_{EB} = 5.0$ V, f = 1.0 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. Pulse conditions: length = 300 μs; duty cycle = 1%.
3. For product family characteristic curves, refer to Section 5 — PWR8.

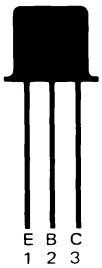
# 2N3467 • 2N3468

## PNP SMALL SIGNAL HIGH VOLTAGE HIGH CURRENT SATURATED SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $t_{on}$ . . . 40 ns (MAX) @ 500 mA
- $t_{off}$ . . . 90 ns (MAX) @ 500 mA
- $V_{CE(sat)}$ . . . 0.5 V (MAX) (2N3467), 0.6 V (MAX) (2N3468) @ 500 mA
- $h_{FE}$ . . . 40-120 (2N3467), 25-75 (2N3468) @ 500 mA
- $V_{CEO}$ . . . 40 V (MIN) (2N3467), 50 V (MIN) (2N3468)
- COMPLEMENTS . . . 2N3724, 2N3725

See TO5-2 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Junction Temperature | 200°C |
| Lead Temperature (60 seconds) | 300°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Ambient Temperature | 1.0 W |
| at 25°C Case Temperature | 5.0 W |

**Maximum Voltage and Current**

| | | 2N3467 | 2N3468 |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | −40 V | −50 V |
| $V_{EBO}$ | Emitter to Base Voltage | −5.0 V | −5.0 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | −40 V | −50 V |
| $I_C$ | Collector Current | 1.0 A | 1.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N3467 MIN. | 2N3467 MAX. | 2N3468 MIN. | 2N3468 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $t_d$ | Delay Time (see test circuit no. 386) | | 10 | | 10 | ns | $I_C$ = 500 mA, $I_{B1}$ = 50 mA, $V_{CC}$ = 30 V |
| $t_r$ | Rise Time (see test circuit no. 386) | | 30 | | 30 | ns | $I_C$ = 500 mA, $I_{B1}$ = 50 mA, $V_{CC}$ = 30 V |
| $t_s$ | Storage Time (see test circuit no. 387) | | 60 | | 60 | ns | $I_C$ = 500 mA, $I_{B1}$ = $I_{B2}$ = 50 mA, $V_{CC}$ = −30 V |
| $t_f$ | Fall Time (see test circuit no. 387) | | 30 | | 30 | ns | $I_C$ = 500 mA, $I_{B1}$ = $I_{B2}$ = 50 mA, $V_{CC}$ = −30 V |
| $Q_T$ | Total Control Charge (see test circuit no. 388) | | 6.0 | | 6.0 | nC | $I_C$ = 500 mA, $I_B$ = 50 mA, $V_{CC}$ = −30 V |
| $h_{FE}$ | DC Pulsed Current Gain (Note 5) | 40 | | 25 | | | $I_C$ = 150 mA, $V_{CE}$ = −1.0 V |
| | | 40 | 120 | 25 | 75 | | $I_C$ = 500 mA, $V_{CE}$ = −1.0 V |
| | | 40 | | 25 | | | $I_C$ = 1.0 A, $V_{CE}$ = −5.0 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | −0.3 | | −0.35 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | | | −0.5 | | −0.6 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| | | | −1.0 | | −1.2 | V | $I_C$ = 1.0 A, $I_B$ = 100 mA |
| $C_{ob}$ | Output Capacitance | | 25 | | 25 | pF | $V_{CB}$ = −10 V, $I_E$ = 0, f = 100 kHz |
| $C_{ib}$ | Input Capacitance | | 100 | | 100 | pF | $V_{EB}$ = −0.5 V, $I_C$ = 0, f = 100 kHz |
| $f_T$ | Current Gain Bandwidth Product | 175 | | 150 | | MHz | $I_C$ = 50 mA, $V_{CE}$ = −10 V, f = 100 MHz |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −40 | | −50 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −5.0 | | −5.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 5) | | −1.0 | | −1.0 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | | −0.8 | −1.2 | −0.8 | −1.2 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| | | | −1.6 | | −1.6 | V | $I_C$ = 1.0 A, $I_B$ = 100 mA |
| $I_{CBO}$ | Collector Cutoff Current | | 100 | | 100 | nA | $V_{CB}$ = −30 V, $I_E$ = 0 |
| | | | 15 | | 15 | μA | $V_{CB}$ = −30 V, $I_E$ = 0, $T_A$ = 100°C |
| $I_{CEX}$ | Collector Cutoff Current | | 100 | | 100 | nA | $V_{CE}$ = −30 V, $V_{EB}$ = −30 V |
| $I_{BL}$ | Base Cutoff Current | | 120 | | 120 | nA | $V_{CE}$ = −30 V, $V_{EB}$ = −3.0 V |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
3. These ratings give a maximum junction temperature of 200°C, junction to case thermal resistance of 35°C/W, (derating factor of 28.6 mW/°C); junction to ambient thermal resistance of 175°C/W, (derating factor of 5.71 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5-SS7.

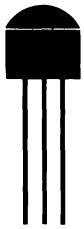
# 2N3564 • 2N5127

## NPN SMALL SIGNAL GENERAL PURPOSE RF AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$V_{CEO}$ . . . 12 V (MIN) (2N5127, 15 V (MIN) (2N3564)**
- **$C_{ob}$ . . . 3.5 pF @ $V_{CB}$ = 10 V**
- **$f_T$ . . . 750 MHz (TYP) @ 15 mA**

**See TO18-4 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +125°C |
| Operating Junction Temperature | 125°C |
| Lead Temperature (10 seconds) | 260°C |

**Maximum Power Dissipation** (Note 2)

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 0.5 W |
| at 25°C Ambient Temperature | 0.2 W |

| **Maximum Voltages and Current** | | **2N3564** | **2N5127** |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 30 V | 20 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 3) | 15 V | 12 V |
| $V_{EBO}$ | Emitter to Base Voltage | 4.0 V | 3.0 V |
| $I_C$ | Collector Current | 100 mA | 100 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N3564 MIN. | 2N3564 MAX. | 2N5127 MIN. | 2N5127 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 30 | | 20 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 4.0 | | 3.0 | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Noes 3 & 4) | 15 | | 12 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 4) | | 0.3 | | | V | $I_C$ = 20 mA, $I_B$ = 2.0 mA |
| | | | | | 0.3 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 4) | | 0.97 | | | V | $I_C$ = 20 mA, $I_B$ = 2.0 mA |
| | | | | | 1.0 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | | | nA | $V_{CB}$ = 15 V, $I_E$ = 0 |
| | | | | | 50 | nA | $V_{CB}$ = 10 V, $I_E$ = 0 |
| | | | | | 5.0 | μA | $V_{CB}$ = 10 V, $I_E$ = 0, $T_A$ = 65°C |
| $h_{FE}$ | DC Pulse Current Gain (Note 4) | 20 | 200 | | | | $I_C$ = 15 mA, $V_{CE}$ = 10 V |
| | | | | 15 | 300 | | $I_C$ = 2.0 mA, $V_{CE}$ = 10 V |
| $h_{fe}$ | Low Frequency Current Gain | 20 | 500 | | | | $I_C$ = 15 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| | | | | 12 | 400 | | $I_C$ = 2.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $h_{fe}$ | High Frequency Current Gain | 4.0 | 12 | | | | $I_C$ = 15 mA, $V_{CE}$ = 10 V, f = 100 MHz |
| | | | | 1.5 | | | $I_C$ = 2.0 mA, $V_{CE}$ = 10 V, f = 100 MHz |
| $C_{cb}$ | Collector to Base Capacitance | | 3.5 | | 3.5 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 1.0 MHz |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 4) | | | | 1.0 | V | $I_C$ = 10 mA, $V_{CE}$ = 10 V |
| $RE_{(hie)}$ | Small Signal Input Impedance | 20 | 100 | | | Ω | $I_C$ = 15 mA, $V_{CE}$ = 10 V, f = 350 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/W (derating factor of 2.0 mW/°C).
3. Rating refers to a high current point where collector to emitter voltage is lowest.
4. Pulse conditions: length = 300 μs; duty cycle ≤ 1%.
5. For product family characteristic curves, refer to Section 5-SS2.

4

# 2N3565 • PN3565

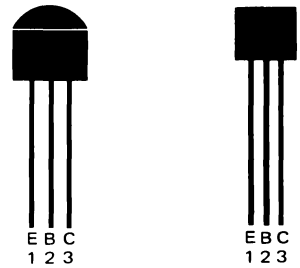
## NPN LOW LEVEL HIGH GAIN AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- $h_{FE}$ . . . 150 - 600 @ 1.0 mA
- $V_{CEO}$ . . . 25 V (MIN)

See Package Outlines

TO18-4 TO92-1




2N3565 PN3565

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | 2N3565 | PN3565 |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | −55°C to +125°C | −55°C to +150°C |
| Operating Junction Temperature | | 125°C | 150°C |
| Lead Temperature | | 260°C | 260°C |
| **Maximum Power Dissipation** (Note 2) | | | |
| Total Dissipation at 25°C Case Temperature | | 0.5 W | 1.0 W |
| at 65°C Case Temperature | | 0.3 W | |
| at 25°C Ambient Temperature | | 0.2 W | 0.625 W |
| **Maximum Voltages and Current** | | | |
| $V_{CBO}$ | Collector to Base Voltage | 30 V | 30 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 3) | 25 V | 25 V |
| $V_{EBO}$ | Emitter to Base Voltage | 6.0 V | 6.0 V |
| $I_C$ | Collector Current | 50 mA | 50 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 150 | 600 | | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V |
| †$h_{FE}$ | DC Current Gain | 70 | | | $I_C$ = 100 μA, $V_{CE}$ = 10 V |
| $h_{fe}$ | High Frequency Current Gain | 2.0 | 12 | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V, f = 20 MHz |
| †$V_{CE(sat)}$ | Collector Saturation Voltage | | 0.35 | V | $I_C$ = 1.0 mA, $I_B$ = 0.1 mA |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | nA | $I_E$ = 0, $V_{CB}$ = 25 V |
| †$I_{CBO}$ | Collector Cutoff Current | | 3.0 | μA | $I_E$ = 0, $V_{CB}$ = 25 V, $T_A$ = 65°C |
| $C_{ob}$ | Open Circuit Output Capacitance | | 4.0 | pF | $I_E$ = 0, $V_{CB}$ = 5.0 V, f = 140 kHz |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 30 | | V | $I_E$ = 0, $I_C$ = 100 μA |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage | 25 | | V | $I_B$ = 0, $I_C$ = 2.0 mA |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 6.0 | | V | $I_C$ = 0, $I_E$ = 10 μA |
| $h_{ie}$ | Input Resistance | 2.0 | 20 | kΩ | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V f = 1.0 kHz |
| $h_{oe}$ | Output Conductance | 0.5 | 100 | μmhos | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V, f = 1.0 kHz |
| $h_{fe}$ | Small Signal Current Gain | 120 | 750 | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V, f = 1.0 kHz |

*Planar is a patented Fairchild process.

†Fairchild exceeds JEDEC registered value.

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/W (derating factor of 2.0 mW/°C) for 2N3565. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C) for PN3565.
3. Rating refers to a high current point where collector to emitter voltage is lowest.
4. For product family characteristic curves, refer to Section 5 - SS8.

# 2N3566 • PN3566

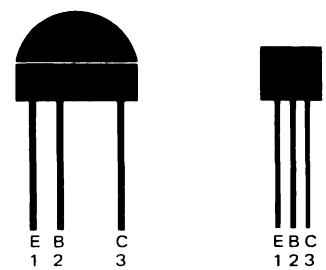
## NPN SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C (PN3566)**
- **$h_{FE}$ . . . 150 - 600 @ 10 mA**
- **$V_{CEO}$ . . . 30 V (MIN)**
- **Complements . . . 2N3638A (TO5), MPS3638A (TO92)**

**See Package Outlines**

**TO5-4** **TO92-1**




**2N3566** **PN3566**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | 2N3566 | PN3566 |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | −55°C to +125°C | −55°C to +150°C |
| Operating Junction Temperature | 125°C | 150°C |
| Lead Temperature (10 seconds) | 260°C | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Case Temperature | 0.8 W | 1.0 W |
| at 75°C Case Temperature | 0.4 W | |
| at 25°C Ambient Temperature | 0.3 W | 0.625 W |
| **Maximum Voltages and Current** | | |
| $V_{CBO}$ Collector to Base Voltage | 40 V | 40 V |
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | 30 V | 30 V |
| $V_{EBO}$ Emitter to Base Voltage | 5.0 V | 5.0 V |
| $I_C$ Collector Current | 200 mA | 200 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 150 | 600 | | $I_C$ = 10 mA, $V_{CE}$ = 10 V |
| | | 80 | | | $I_C$ = 2.0 mA, $V_{CE}$ = 10 V |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (pulsed) (Note 5) | | 0.9 | V | $I_C$ = 100 mA, $V_{CE}$ = 1.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (pulsed) (Note 5) | | 1.0 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| $h_{fe}$ | High Frequency Current Gain | 2.0 | 35 | | $I_C$ = 30 mA, $V_{CE}$ = 10 V, f = 20 MHz |
| $C_{ob}$ | Open Circuit Output Capacitance | | 25 | pF | $I_E$ = 0, $V_{CB}$ = 10 V, f = 140 kHz |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | nA | $I_E$ = 0, $V_{CB}$ = 20 V |
| †$I_{CBO}$ | Collector Cutoff Current | | 5.0 | μA | $I_E$ = 0, $V_{CB}$ = 20 V, $T_A$ = 75°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 10 | μA | $I_C$ = 0, $V_{EB}$ = 5.0 V |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 40 | | V | $I_E$ = 0, $I_C$ = 100 μA |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | 30 | | V | $I_C$ = 30 mA, $I_B$ = 0, (pulsed) |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | V | $I_C$ = 0, $I_E$ = 10 μA |

*Planar is a patented Fairchild process.
†Fairchild exceeds JEDEC registered Value.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 333°C/W (derating factor of 3.0 mW/°C) for 2N3566. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C) for PN3566.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse Conditions: length = 300 μs; duty cycle ≤ 1%.
6. For product family characteristic curves, refer to Section 5 - SS15.

# 2N/PN3567 • 2N/PN3568 • 2N/PN3569

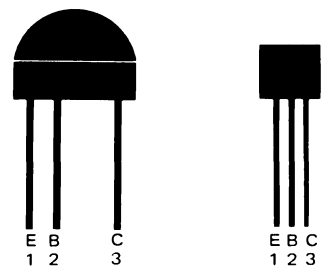
## NPN SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C (PN Series)**
- **$V_{CEO}$ . . . 40 V (MIN) (2N/PN3567, 2N/PN3569); 60 V (MIN) (2N/PN3568)**
- **$h_{FE}$ . . . 100-300 @ 150 mA (2N/PN3569); 40-120 @ 150 mA (2N/PN3567, 2N/PN3568)**
- **COMPLEMENTS . . . 2N4354, 2N4355 (TO5)**
  **. . . MPS4354, MPS4355 (TO92)**

**See Package Outlines**

**TO5-4** **TO92-1**




**2N3567 2N3568 2N3569** | **PN3567 PN3568 PN3569**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | 2N3567/8/9 | PN3567/8/9 |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | −55°C to +125°C | −55°C to +150°C |
| Operating Junction Temperature | | 125°C | 150°C |
| Lead Temperature (10 seconds) | | 260°C | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | | |
| Total Dissipation at 25°C Case Temperature | | 0.8 W | 1.0 W |
| at 25°C Ambient Temperature | | 0.3 W | 0.625 W |
| **Maximum Voltages and Currents** | | **2N/PN3568** | **2N/PN3567/9** |
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V | 5.0 V |
| $V_{CBO}$ | Collector to Base Voltage | 80 V | 80 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Notes 4 & 6) | 60 V | 40 V |
| $I_C$ | Collector Current | 500 mA | 500 mA |
| $I_B$ | Base Current | 100 mA | 100 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N/PN3567 MIN. | 2N/PN3567 MAX. | 2N/PN3568 MIN. | 2N/PN3568 MAX. | 2N/PN3569 MIN. | 2N/PN3569 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $I_{CBO}$ | Collector Cutoff Current | | 50 | | 50 | | 50 | nA | $V_{CB}$ = 40 V, $I_E$ = 0 |
| | | | 5.0 | | 5.0 | | 5.0 | μA | $V_{CB}$ = 40 V, $I_E$ = 0, $T_A$ = 75°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 25 | | 25 | | 25 | nA | $V_{EB}$ = 4.0 V, $I_C$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 80 | | 80 | | 80 | | V | $I_E$ = 0, $I_C$ = 100 μA |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | 5.0 | | 5.0 | | V | $I_C$ = 0, $I_E$ = 10 μA |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 5) | 40 | | 60 | | 40 | | V | $I_B$ = 0, $I_C$ = 30 mA |
| $h_{FE}$ | DC Current Gain (Note 5) | 40 | 120 | 40 | 120 | 100 | 300 | | $V_{CE}$ = 1.0 V, $I_C$ = 150 mA |
| | | 40 | | 40 | | 100 | | | $V_{CE}$ = 1.0 V, $I_C$ = 30 mA |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 5) | | 1.1 | | 1.1 | | 1.1 | V | $V_{CE}$ = 1.0 V, $I_C$ = 150 mA |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | 0.25 | | 0.25 | | 0.25 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| $C_{cb}$ | Collector to Base Capacitance | | 20 | | 20 | | 20 | pF | $I_E$ = 0, $V_{CB}$ = 10 V, f = 140 kHz |
| $C_{eb}$ | Emitter to Base Capacitance | | 80 | | 80 | | 80 | pF | $I_C$ = 0, $V_{EB}$ = 0.5 V, f = 140 kHz |
| $\|h_{fe}\|$ | Magnitude of Common Emitter Small Signal Current Gain | 3.0 | 30 | 3.0 | 30 | 3.0 | 30 | | $V_{CE}$ = 10 V, $I_C$ = 50 mA f = 20 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 333°C/W (derating factor of 3.0 mW/°C) for 2N3567, 2N3568, and 2N3569. These ratings give a maximum junction temperature of 150°C/W and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C) for PN3567, PN3568, and PN3569.
4. This rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse Conditions: length = 300 μs; duty cycle = 1%.
6. Applicable 0 to 30 mA.

# 2N3638 • 2N3638A • MPS3638 • MPS3638A

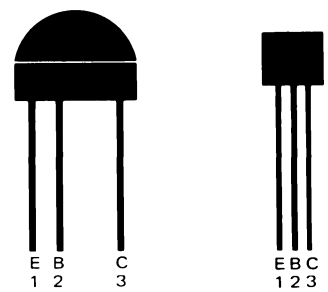
## PNP SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS AND SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C (MPS3638, MPS3638A)**
- **$V_{CEO}$ . . . −25 V (MIN)**
- **$h_{FE}$ . . . 30 (MIN) (2N/MPS3638), 100 (MIN) (2N/MPS3638A) @ 50 mA**
- **$t_{on}$ . . . 75 ns (MAX) @ 300 mA**
- **$t_{off}$ . . . 170 ns (MAX) @ 300 mA**
- **COMPLEMENTS . . . 2N/PN3641, 2N/PN3643**

See Package Outlines

TO 5-4 TO 92-1




2N3638 2N3638A MPS3638 MPS3638A

| ABSOLUTE MAXIMUM TEMPERATURES (Note 1) | 2N3638 2N3638A | MPS3638 MPS3638A |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | −55°C to +125°C | −55°C to +150°C |
| Operating Junction Temperature | 125°C | 150°C |
| Lead Temperature (10 seconds) | 260°C | 260°C |
| **Maximum Power Dissipation (Notes 2 & 3)** | | |
| Total Dissipation at 25°C Ambient Temperature | 0.3 W | 0.625 W |
| at 25°C Case Temperature | 0.7 W | 1.0 W |
| **Maximum Voltages and Current** | | |
| $V_{CBO}$ Collector to Base Voltage | −25 V | −25 V |
| $V_{CES}$ Collector to Emitter Voltage | −25 V | −25 V |
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | −25 V | −25 V |
| $V_{EBO}$ Emitter to Base Voltage | −4.0 V | −4.0 V |
| $I_C$ Collector Current (Note 2) | 500 mA | 500 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N3638 MPS3638 MIN. | 2N3638 MPS3638 MAX. | 2N3638A MPS3638A MIN. | 2N3638A MPS3638A MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Pulse Current Gain (Note 5) (MPS3638) | 20 | | | | | $I_C$ = 10 mA, $V_{CE}$ = −10 V |
| | | | | 100 | | | $I_C$ = 10 mA, $V_{CE}$ = −10 V |
| | | | | 80 | | | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V |
| | | 30 | | 100 | | | $I_C$ = 50 mA, $V_{CE}$ = −1.0 V |
| | | 20 | | 20 | | | $I_C$ = 300 mA, $V_{CE}$ = −2.0 V |
| $V_{CE(sat)}$ | Pulsed Collector Saturation Voltage (Note 5) | | −0.25 | | −0.25 | V | $I_C$ = 50 mA, $I_B$ = 2.5 mA |
| | | | −1.0 | | −1.0 | V | $I_C$ = 300 mA, $I_B$ = 30 mA |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | −25 | | −25 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −25 | | −25 | | V | $I_C$ = 100 μA, $V_{BE}$ = 0 |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | −25 | | −25 | | V | $I_C$ = 100 μA, $V_{BE}$ = 0 |
| $t_{on}$ | Turn On Time (see test circuit no. 536) | | 75 | | 75 | ns | $I_C \approx$ 300 mA, $I_{B1} \approx$ 30 mA, $V_{CC}$ = 10 V |
| $t_{off}$ | Turn Off Time (see test circuit no. 536) | | 170 | | 170 | ns | $I_C \approx$ 300 mA, $I_{B1} \approx I_{B2} \approx$ 30 mA, $V_{CC}$ = 10 V |
| $h_{fe}$ | Magnitude of small signal Current Gain | 1.0 | | 1.5 | | | $I_C$ = 50 mA, $V_{CE}$ = −3.0 V, f = 100 MHz |
| $C_{ob}$ | Common Base Open Circuit, Output Capacitance | | 20 | | 10 | pF | $V_{CB}$ = −10 V, $I_E$ = 0, f = 140 kHz |
| $C_{ib}$ | Common Base Open Circuit, Input Capacitance | | | (2N3638A) | 35 | pF | $I_C$ = 0, $V_{EB}$ = −0.5 V, f = 140 kHz |
| | | | 65 | (MPS3638A) | 25 | pF | $I_C$ = 0, $V_{EB}$ = −0.5 V, f = 140 kHz |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 5) | | −1.1 | | −1.1 | V | $I_C$ = 50 mA, $I_B$ = 2.5 mA, |
| | | −0.8 | −2.0 | −0.8 | −2.0 | V | $I_C$ = 300 mA, $I_B$ = 30 mA |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −4.0 | | −4.0 | | V | $I_E$ = 100 μA, $I_C$ = 0 |

Additional Electrical Characteristics on following page.

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 143°C/W (derating factor of 7.0 mW/°C); junction to ambient thermal resistance of 333°C/W (derating factor of 3.0 mW/°C) for 2N3638 & 2N3638A. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C) for MPS3638 & MPS3638A.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse Conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5-SS22.

*Planar is a patented Fairchild process.

4

**ELECTRIC CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N3638 MPS3638 MIN. | 2N3638 MPS3638 MAX. | 2N3638A MPS3638A MIN. | 2N3638A MPS3638A MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $I_{CES}$ | Collector Reverse Current | | 35 | | 35 | nA | $V_{CE} = -15$ V, $V_{BE} = 0$ |
| | | | 2.0 | | 2.0 | μA | $V_{CE} = -15$ V, $V_{BE} = 0$, $T_A = 65°C$ |
| $h_{fe}$ | Small Signal Current Gain | | | | | | |
| | 2N3638 | 25 | | | | | $I_C = 10$ mA, $V_{CE} = -10$ V, f = 1.0 kHz |
| | MPS3638 | 25 | 180 | | | | $I_C = 10$ mA, $V_{CE} = -10$ V, f = 1.0 kHz |
| | | | | 100 | | | $I_C = 10$ mA, $V_{CE} = -10$ V, f = 1.0 kHz |
| $h_{ie}$ | Input Resistance | | 2000 | | 2000 | Ω | $I_C = 10$ mA, $V_{CE} = 10$ V, f = 1.0 kHz |
| | MPS3638 | | 1500 | | | Ω | |
| $h_{oe}$ | Output Conductance | | 1200 | | 1200 | μmhos | $I_C = 10$ mA, $V_{CE} = -10$ V, f = 1.0 kHz |
| $h_{re}$ | Voltage Feedback Ratio | | 2600 | | 1500 | $X10^{-6}$ | $I_C = 10$ mA, $V_{CE} = -10$ V, f = 1.0 kHz |

# 2N3639 • 2N3640 • MPS3639 • MPS3640

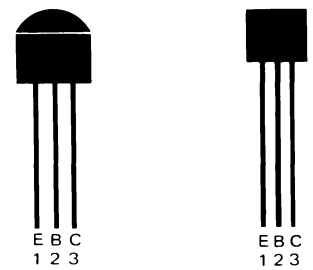
## PNP HIGH SPEED SATURATED LOGIC SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C (MPS3639/40)**
- **$V_{CEO}$ . . . 12 V (MIN) (2N/MPS3640)**
- **$t_{on}$ . . . 25 ns (MAX) @ 50 mA, 60 ns (MAX) @ 10 mA**
- **$t_{off}$ . . . 35 ns (MAX) @ 50 mA, 75 ns (MAX) @ 10 mA**
- **COMPLEMENTS . . . 2N4274 (TO18), 2N5769 (TO92)**

**See Package Outlines**

**TO18-4** **TO92-1**




**2N3639 2N3640** **MPS3639 MPS3640**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | 2N3639/40 | MPS3639/40 |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | −55°C to +125°C | −55°C to +150°C |
| Operating Junction Temperature | | 125°C | 150°C |
| Lead Temperature (10 seconds) | | 260°C | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | | |
| Total Dissipation at 25°C Case Temperature | | 0.5 W | 1.0 W |
| at 25°C Ambient Temperature | | 0.2 W | 0.625 W |
| **Maximum Voltages and Current** | | **2N/MPS3639** | **2N/MPS3640** |
| $V_{CBO}$ | Collector to Base Voltage | −6.0 V | −12 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | −6.0 V | −12 V |
| $V_{EBO}$ | Emitter to Base Voltage | −4.0 V | −4.0 V |
| $I_C$ | Collector Current | 80 mA | 80 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N3639 MIN. | 2N3639 MAX. | 2N3640 MIN. | 2N3640 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $\tau_s$ | Storage Time | | | | | | $I_C \simeq 10$ mA, $I_{B1} \simeq I_{B2} \simeq 10$ mA, |
| | (see test circuit no. 234) | | 30 | | 50 | ns | $V_{CC} = 3.0$ V |
| $t_{on}$ | Turn On Time | | | | | | $I_C \simeq 50$ mA, $I_{B1} \simeq 5.0$ mA, |
| | (see test circuit no. 235 | | 25 | | 25 | ns | $V_{CC} = 6.0$ V |
| | (see test circuit no. 219) | | 60 | | 60 | ns | $I_C \simeq 10$ mA, $I_{B1} \simeq 0.5$ mA, |
| | | | | | | | $V_{CC} = -1.5$ V |
| $t_{off}$ | Turn Off Time | | | | | | $I_C \simeq 50$ mA, $I_{B1} \simeq I_{B2} \simeq 5.0$ mA, |
| | (see test circuit no. 235) | | 25 | | 35 | ns | $V_{CC} = 6.0$ V |
| | (see test circuit no. 219) | | 60 | | 75 | ns | $I_C \simeq 10$ mA, $I_{B1} \simeq I_{B2} \simeq 0.5$ mA, |
| | | | | | | | $V_{CC} = 1.5$ V |
| $h_{fe}$ | High Frequency Current Gain | 3.0 | | 3.0 | | | $I_C = 10$ mA, $V_{CB} = 0$, f = 100 MHz |
| | | 5.0 | | 5.0 | | | $I_C = 10$ mA, $V_{CE} = -5.0$ V, |
| | | | | | | | f = 100 MHz |
| $h_{FE}$ | DC Pulse Current Gain (Note 4) | 30 | 120 | 30 | 120 | | $I_C = 10$ mA, $V_{CE} = -0.3$ V |
| | | 20 | | 20 | | | $I_C = 50$ mA, $V_{CE} = -1.0$ V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation | | −0.16 | | −0.2 | V | $I_C = 10$ mA, $I_B = 1.0$ mA |
| | Voltage (Note 4) | | −0.5 | | −0.6 | V | $I_C = 50$ mA, $I_B = 5.0$ mA |
| | | | −0.25 | | −0.3 | V | $I_C = 10$ mA, $I_B = 0.5$ mA |
| | | | −0.23 | | −0.25 | V | $I_C = 10$ mA, $I_B = 1.0$ mA, |
| | | | | | | | $T_A = 65°C$ |
| $V_{BE(sat)}$ | Base Saturation Voltage | −0.75 | −0.95 | −0.75 | −0.95 | V | $I_C = 10$ mA, $I_B = 0.5$ mA |
| | (Note 4) | −0.8 | −1.0 | −0.8 | −1.0 | V | $I_C = 10$ mA, $I_B = 1.0$ mA |
| | | | 1.5 | | 1.5 | V | $I_C = 50$ mA, $I_B = 5.0$ mA |
| $I_{CES}$ | Collector Reverse Current | | 50 | | | nA | $V_{CE} = -3.0$ V, $V_{BE} = 0$ |
| | | | | | 50 | nA | $V_{CE} = -6.0$ V, $V_{BE} = 0$ |
| | | | 1.0 | | | μA | $V_{CE} = -3.0$ V, $V_{BE} = 0$, |
| | | | | | | | $T_A = 65°C$ |
| | | | | | 1.0 | μA | $V_{CE} = -6.0$ V, $V_{BE} = 0$, |
| | | | | | | | $T_A = 65°C$ |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/W (derating factor of 2.0 mW/°C) for 2N3639, 2N3640. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C) for MPS3639, MPS3640.
4. Pulse conditions: length = 300 μs; duty cycle = 1%.
5. For product family characteristic curves, refer to Section 5 — SS31.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N3639 MIN. | 2N3639 MAX. | 2N3640 MIN. | 2N3640 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $C_{ob}$ | Output Capacitance | | 3.5 | | 3.5 | pF | $I_E = 0, V_{CB} = -5.0$ V, f = 140 kHz |
| | | | 5.5 | | 5.5 | pF | $I_E = 0, V_{CB} = 0$, f = 140 kHz |
| $C_{ib}$ | Input Capacitance | | 3.5 | | 3.5 | pF | $I_C = 0, V_{EB} = -0.5$ V, f = 140 kHz |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −6.0 | | −12 | | V | $I_C = 100\ \mu A, I_E = 0$ |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | −6.0 | | −12 | | V | $I_C = 100\ \mu A, V_{BE} = 0$ |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 4) | −6.0 | | −12 | | V | $I_C = 10$ mA, $I_B = 0$ |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −4.0 | | −4.0 | | V | $I_E = 100\ \mu A, I_C = 0$ |

| SYMBOL | CHARACTERISTIC | MPS3639 MIN. | MPS3639 MAX. | MPS3640 MIN. | MPS3640 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $t_{on}$ | Turn on Time | | | | | | $I_C \simeq 50$ mA, $I_{B1} \simeq 5.0$ mA, |
| | (see test circuit no. 235) | | 25 | | 25 | ns | $V_{CC} = 6.0$ V |
| | (see test circuit no. 219) | | 60 | | 60 | ns | $I_C \simeq 10$ mA, $I_{B1} \simeq 0.5$ mA, $V_{CC} = -1.5$ V |
| $t_{off}$ | Turn Off Time | | | | | | $I_C \simeq 50$ mA, $I_{B1} \simeq I_{B2} \simeq 5.0$ mA, |
| | (see test circuit no. 235) | | 25 | | 35 | ns | $V_{CC} = -6.0$ V |
| | (see test circuit no. 219) | | 60 | | 75 | ns | $I_C \simeq 10$ mA, $I_{B1} \simeq I_{B2} \simeq 0.5$ mA, $V_{CC} = 1.5$ V |
| $h_{fe}$ | High Frequency Current Gain | 3.0 | | | | | $I_C = 10$ mA, $V_{CB} = 0$, f = 100 MHz |
| | | 5.0 | | 5.0 | | | $I_C = 10$ mA, $V_{CE} = -5.0$ V, f = 100 MHz |
| $h_{FE}$ | DC Pulse Current Gain (Note 4) | 30 | 120 | 30 | 120 | | $I_C = 10$ mA, $V_{CE} = -0.3$ V |
| | | 20 | | 20 | | | $I_C = 50$ mA, $V_{CE} = -1.0$ V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 4) | | −0.16 | | −0.2 | V | $I_C = 10$ mA, $I_B = 1.0$ mA |
| | | | −0.5 | | −0.6 | V | $I_C = 50$ mA, $I_B = 5.0$ mA |
| | | | −0.23 | | −0.25 | V | $I_C = 10$ mA, $I_B = 1.0$ mA, $T_A = 65°C$ |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 4) | −0.75 | −0.95 | −0.75 | −0.95 | V | $I_C = 10$ mA, $I_B = 0.5$ mA |
| | | −0.8 | −1.0 | −0.8 | −1.0 | V | $I_C = 10$ mA, $I_B = 1.0$ mA |
| | | | 1.5 | | 1.5 | V | $I_C = 50$ mA, $I_B = 5.0$ mA |
| $I_{CES}$ | Collector Reverse Current | | 10 | | | nA | $V_{CE} = -3.0$ V, $V_{BE} = 0$ |
| | | | | | 10 | nA | $V_{CE} = -6.0$ V, $V_{BE} = 0$ |
| | | | 1.0 | | | μA | $V_{CE} = -3.0$ V, $V_{BE} = 0$, $T_A = 65°C$ |
| | | | | | 1.0 | μA | $V_{CE} = -6.0$ V, $V_{BE} = 0$, $T_A = 65°C$ |
| $C_{ob}$ | Output Capacitance | | 3.5 | | 3.5 | pF | $I_E = 0, V_{CB} = -5.0$ V, f = 140 kHz |
| $C_{ib}$ | Input Capacitance | | 3.5 | | 3.5 | pF | $I_C = 0, V_{EB} = -0.5$ V, f = 140 kHz |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −6.0 | | −12 | | V | $I_C = 100\ \mu A, I_E = 0$ |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | −6.0 | | −12 | | V | $I_C = 100\ \mu A, V_{BE} = 0$ |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 4) | −6.0 | | −12 | | V | $I_C = 10$ mA, $I_B = 0$ |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −4.0 | | −4.0 | | V | $I_E = 100\ \mu A, I_C = 0$ |

# 2N/PN3641 • 2N/PN3642 • 2N/PN3643

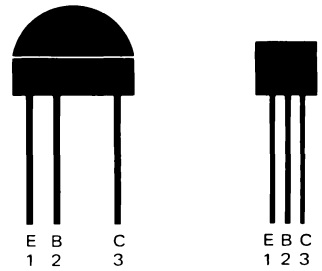
## NPN GENERAL PURPOSE SMALL SIGNAL AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C (PN SERIES)
- $P_G$ . . . 400 mW RF POWER OUT AT 30 MHz
- $V_{CEO}$ . . . 30 V (MIN) (2N/PN3641 • 2N/PN3643), 45 V (MIN) (2N/PN3642)
- $h_{FE}$ . . . 100 (MIN) @ 150 mA, 25 (MIN) @ 500 mA (2N/PN3643)
- $f_T$ . . . 250 MHz (MIN) (2N/PN3643)
- $t_{on}$ . . . = 60 ns (MAX) @ 300 mA, $t_{off}$ . . . = 150 ns (MAX) @ 300 mA
- COMPLEMENTS . . . 2N3638/A • 2N3644 (TO5), MPS3638/A • PN3644 (TO92)

See Package Outlines

TO5-4 TO92-1




2N3641 PN3641
2N3642 PN3642
2N3643 PN3643

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | PN Series | 2N Series |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | −55°C to +150°C | −55°C to +125°C |
| Operating Junction Temperature | 150°C | 125°C |
| Lead Temperature (10 seconds) | 260°C | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Case Temperature | 1.0 W | 0.7 W |
| at 25°C Ambient Temperature | 0.625 W | 0.35 W |
| **Maximum Voltages and Current** | **2N/PN3641/43** | **2N/PN3642** |
| $V_{EBO}$ Emitter to Base Voltage | 5.0 V | 5.0 V |
| $V_{CBO}$ Collector to Base Voltage | 60 V | 60 V |
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | 30 V | 45 V |
| $I_C$ Collector Current | 500 mA | 500 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N3641 PN3641 MIN. | 2N3641 PN3641 MAX. | 2N3642 PN3642 MIN. | 2N3642 PN3642 MAX. | 2N3643 PN3643 MIN. | 2N3643 PN3643 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $I_{CES}$ | Collector Cutoff Current | | 50 | | 50 | | 50 | nA | $V_{CE}$ = 50 V, $V_{BE}$ = 0 |
| | | | 1.0 | | 1.0 | | 1.0 | μA | $V_{CE}$ = 50 V, $V_{BE}$ = 0, $T_A$ = 65°C |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | 60 | | 60 | | 60 | | V | $I_C$ = 10 μA, $V_{BE}$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 60 | | 60 | | 60 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | 5.0 | | 5.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $BV_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | 30 | | 45 | | 30 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 5) | 40 | 120 | 40 | 120 | 100 | 300 | | $V_{CE}$ = 10 V, $I_C$ = 150 mA |
| | | 15 | | 15 | | 25 | | | $V_{CE}$ = 10 V, $I_C$ = 500 mA |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | 0.22 | | 0.22 | | 0.22 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| $h_{fe}$ | Magnitude of Common Emitter, Short Circuit Small Signal Current Gain | 1.5 | | 1.5 | | 2.5 | | | $V_{CE}$ = 5.0 V, $I_C$ = 50 mA, f = 100 MHz |
| $C_{ob}$ | Output Capacitance | | 8.0 | | 8.0 | | 8.0 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 140 kHz |
| $G_{PE}$ | Amplifier Power Gain (see test circuit no. 238) | 10 | | 10 | | 10 | | dB | (Zero Signal) $V_{CE}$ = 15 V, $I_C$ = 0, $R_G$ = 140 Ω, $R_L$ = 260 Ω, f = 30 MHz, $P_{IN}$ = 40 mW |
| $\eta$ | Collector Efficiency (see test circuit no. 238) | 60 | | 60 | | 60 | | % | (Zero Signal) $V_{CE}$ = 15 V, $I_C$ = 0, $R_G$ = 140 Ω, $R_L$ = 260 Ω, f = 30 MHz, $P_{IN}$ = 40 mW |
| † $t_{on}$ | Turn On Time (see test circuit no. 241) | | 60 | | 60 | | 60 | ns | $I_C$ ≈ 300 mA, $I_{B1}$ ≈ 30 mA |
| † $t_{off}$ | Turn Off Time (see test circuit no. 242) | | 150 | | 150 | | 150 | ns | $I_C$ ≈ 300 mA, $I_{B1}$ ≈ $I_{B2}$ ≈ 30 mA |

†Fairchild exceeds JEDEC registered Values.

NOTES:

*Planar is a patented Fairchild process.

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 143°C/W (derating factor of 7.0 mW/°C); junction to ambient thermal resistance of 28.6°C/W (derating factor of 3.5 mW/°C) for 2N3641, 2N3642, 2N3643. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C. Junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C) for PN3641, PN3642, PN3643.
4. This rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5-SS15.

4

# 2N3644 • 2N3645 • PN3644 • PN3645

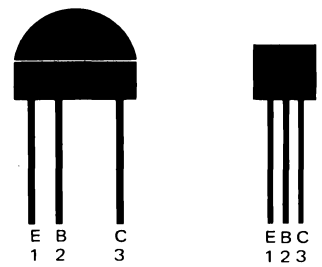
## PNP SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS AND SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C (PN3644, PN3645)**
- **$V_{CEO}$ . . . −45 V (MIN) (2N/PN3644), 60 V (MIN) (2N/PN3645)**
- **$h_{FE}$ . . . 80-240 @ 50 mA**
- **$t_{on}$ . . . 40 ns (MAX) @ 300 mA**
- **$t_{off}$ . . . 100 ns (MAX) @ 300 mA**
- **COMPLEMENTS . . . 2N/PN3569, PE/SE6020**

**See Package Outlines**

**TO5-4** **TO92-1**




**2N3644** **PN3644**
**2N3645** **PN3645**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | 2N3644/45 | PN3644/45 |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | −55°C to +125°C | −55°C to +150°C |
| Operating Junction Temperature | | 125°C | 150°C |
| Lead Temperature (10 seconds) | | 260°C | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | | |
| Total Dissipation at 25°C Case Temperature | | 0.07 W | 1.0 W |
| at 25°C Ambient Temperature | | 0.3 W | 0.625 W |
| **Maximum Voltages and Current** | | **2N/PN3645** | **2N/PN3644** |
| $V_{CBO}$ | Collector to Base Voltage | −60 V | −45 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | −60 V | −45 V |
| $V_{EBO}$ | Emitter to Base Voltage | −5.0 V | −5.0 V |
| $I_C$ | Collector Current | 500 mA | 500 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N3644 PN3644 MIN. | 2N3644 PN3644 MAX. | 2N3645 PN3645 MIN. | 2N3645 PN3645 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 40 | | 40 | | | $I_C$ = 100 μA, $V_{CE}$ = −10 V |
| | | 80 | | 80 | | | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V |
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 100 | | 100 | | | $I_C$ = 10 mA, $V_{CE}$ = −10 V |
| | | 80 | 240 | 80 | 240 | | $I_C$ = 50 mA, $V_{CE}$ = 1.0 V |
| | | 100 | 300 | 100 | 300 | | $I_C$ = 150 mA, $V_{CE}$ = −10 V |
| | | 20 | | 20 | | | $I_C$ = 300 mA, $V_{CE}$ = −2.0 V |
| $h_{fe}$ | High Frequency Current Gain | 2.0 | | 2.0 | | | $I_C$ = 20 mA, $V_{CE}$ = −20 V, f = 100 MHz |
| $C_{ob}$ | Output Capacitance | | 8.0 | | 8.0 | pF | $I_E$ = 0, $V_{CB}$ = −10 V, f = 140 kHz |
| $C_{ib}$ | Input Capacitance | | 35 | | 35 | pF | $I_C$ = 0, $V_{EB}$ = −0.5 V, f = 140 kHz |
| $V_{CE(sat)}$ | Pulsed Collector Saturation Voltage (Note 5) | | −0.25 | | −0.25 | V | $I_C$ = 50 mA, $I_B$ = 2.5 mA |
| | | | −0.4 | | −0.4 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | | | −1.0 | | −1.0 | V | $I_C$ = 300 mA, $I_B$ = 30 mA |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | −45 | | −60 | | V | $I_C$ = 10 mA (pulsed), $I_B$ = 0 |
| $V_{BE(sat)}$ | Pulsed Base | | −1.0 | | −1.0 | V | $I_C$ = 50 mA, $I_B$ = 2.5 mA |
| | | | −1.3 | | −1.3 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | | −0.8 | −2.0 | −0.8 | −2.0 | V | $I_C$ = 300 mA, $I_B$ = 30 mA |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −5.0 | | | −5.0 | V | $I_C$ = 0, $I_E$ = 10 μA |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −45 | | −60 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $t_{on}$ | Turn On Time (see test circuit no. 246) | | 40 | | 40 | ns | $I_C \approx$ 300 mA, $I_{B1} \approx$ 30 mA, $V_{CC}$ = −30 V |
| $t_{off}$ | Turn Off Time (see test circuit no. 246) | | 100 | | 100 | ns | $I_C \approx$ 300 mA, $I_{B1} \approx I_{B2} \approx$ 30 mA, $V_{CE}$ = −30 V |
| $I_{CES}$ | Collector Reverse Current | | 35 | | | nA | $V_{CE}$ = −30 V, $V_{BE}$ = 0 |
| | | | | | 35 | nA | $V_{CE}$ = −50 V, $V_{BE}$ = 0 |
| | | | 2.0 | | | μA | $V_{CE}$ = −30 V, $V_{BE}$ = 0, $T_A$ = 65°C |
| | | | | | 2.0 | μA | $V_{CE}$ = −50 V, $V_{BE}$ = 0, $T_A$ = 65°C |

NOTES:

*Planar is a patented Fairchild process.

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 143°C/W (derating factor of 7.0 mW/°C); junction to ambient thermal resistance of 333°C/W (derating factor of 3.0 mW/°C) for 2N3644 & 2N3645. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C) for PN3644 & PN3645.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 — SS22.

# 2N3646 • MPS3646 • 2N5772

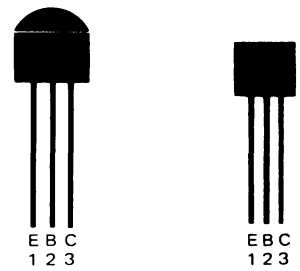
## NPN HIGH SPEED SATURATED LOGIC SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C (MPS3646, 2N5772)**
- **$V_{CEO}$ . . . 15 V (MIN)**
- **$\tau_s$ . . . 18 ns (MAX) @ 10 mA**
- **$t_{on}$ . . . 18 ns (MAX) @ 300 mA**
- **$t_{off}$ . . . 28 ns (MAX) @ 300 mA**

**See Package Outlines**

**TO18-4** **TO92-1**




**2N3646** **MPS3646 2N5772**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | 2N3646 | 2N5772 MPS3646 |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | −55°C to +125°C | −55°C to +150°C |
| Operating Junction Temperature | | 125°C | 150°C |
| Lead Temperature (10 seconds) | | 260°C | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | | |
| Total Dissipation at 25°C Ambient Temperature | | 0.2 W | 0.625 W |
| at 25°C Case Temperature | | 0.5 W | 1.0 W |
| **Maximum Voltages and Current** | | | |
| $V_{CBO}$ | Collector to Base Voltage | 40 V | 40 V |
| $V_{CES}$ | Collector to Emitter Voltage | 40 V | 40 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 15 V | 15 V |
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V | 5.0 V |
| $I_C$ | Collector Current | 200 mA | 200 mA |
| | Pulse = 10 μs | 500 mA | 500 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain (Note 5) | 30 | 120 | | $I_C$ = 30 mA, $V_{CE}$ = 0.4 V |
| | | 25 | | | $I_C$ = 100 mA, $V_{CE}$ = 0.5 V |
| | | 15 | | | $I_C$ = 300 mA, $V_{CE}$ = 1.0 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | 0.20 | V | $I_C$ = 30 mA, $I_B$ = 3.0 mA |
| | | | 0.28 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| | | | 0.5 | V | $I_C$ = 300 mA, $I_B$ = 30 mA |
| | | | 0.3 | V | $I_C$ = 30 mA, $I_B$ = 3.0 mA, $T_A$ = 65°C |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 5) | 0.75 | 0.95 | V | $I_C$ = 30 mA, $I_B$ = 3.0 mA |
| | | | 1.2 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| | | | 1.7 | V | $I_C$ = 300 mA, $I_B$ = 30 mA |
| $h_{fe}$ | High Frequency Current Gain | 3.5 | | | $I_C$ = 30 mA, $V_{CE}$ = 10 V, f = 100 MHz |
| $C_{ob}$ | Output Capacitance | | 5.0 | pF | $I_E$ = 0, $V_{CB}$ = 5.0 V, f = 140 kHz |
| $C_{TE}$ | Emitter Transition Capacitance | | 8.0 | pF | $I_C$ = 0, $V_{BE}$ = 0.5 V, f = 140 kHz |
| $I_{CES}$ | Collector Reverse Current | | 0.5 | μA | $V_{CE}$ = 20 V, $V_{BE}$ = 0 |
| | | | 3.0 | μA | $V_{CE}$ = 20 V, $V_{BE}$ = 0, $T_A$ = 65°C |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 40 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | 40 | | V | $I_C$ = 10 μA, $V_{BE}$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | 15 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $\tau_s$ | Charge Storage Time Constant (see test circuit no. 3111) | | 18 | ns | $I_C \approx I_{B1} \approx -I_{B2} \approx$ 10 mA, $V_{CC}$ = 10 V |
| $t_{on}$ | Turn On Time (see test circuit no. 233) | | 18 | ns | $I_C \approx$ 300 mA, $I_{B1} \approx$ 30 mA, $V_{CC}$ = 10 V |
| $t_{off}$ | Turn Off Time (see test circuit no. 233) | | 28 | ns | $I_C \approx$ 300 mA, $I_{B1} \approx -I_{B2}$ = 30 mA, $V_{CC}$ = 10 V |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/W (derating factor of 2.0 mW/°C) for 2N3646. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C) for 2N5772 and MPS3646.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 - SS5.

# 2N/PN3688 • 2N/PN3689 • 2N/PN3690 • SE5006

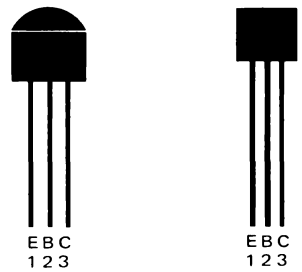
## NPN RF AGC AMPLIFIERS

DIFFUSED SILICON PLANAR* TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C (PN Series)
- FORWARD AGC CAPABILITY
- CHARACTERIZED FOR FREQUENCIES FROM 455 kHz TO 200 MHz

See Package Outlines

TO18-4 TO92-1




2N3688/89/90
SE5006

PN3688/89/90

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | 2N3688/89/90 | PN3688/89/90 |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | −55°C to +125°C | −55°C to +150°C |
| Operating Junction Temperature | 125°C | 150°C |
| Soldering Temperature | 260°C | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Case Temperature | 0.5 W | 1.0 W |
| at 65°C Case Temperature | 0.3 W | |
| at 25°C Ambient Temperature | 0.2 W | 0.625 W |
| **Maximum Voltages** | | |
| $V_{CBO}$ Collector to Base Voltage | 40 V | 40 V |
| $V_{CEO}$ Collector to Emitter Voltage (Note 3) | 40 V | 40 V |
| $V_{EBO}$ Emitter to Base Voltage | 4.0 V | 4.0 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N3688/89/90 PN3688/89/90 MIN. | MAX. | SE5006 MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $C_{ob}$ | Output Capacitance | 0.5 | 1.6 | | 1.6 | pF | $I_E$ = 0, $V_{CB}$ = 10 V |
| NF | Noise Figure 2N/PN3690 (see test circuit no. 226A) | | 5.5 | | | dB | $I_C$ = 4.0 mA, $V_{CC}$ = 10 V, f = 200 MHz, $R_S$ = 100 Ω |
| $h_{fe}$ | High Frequency Current Gain | 4.0 | 9.0 | 4.0 | | | $I_C$ = 4.0 mA, $V_{CE}$ = 10 V, f = 100 MHz |
| PG | Power Gain 2N/PN3688/89 (see test circuit no. 228A) | 29 | | | | dB | $I_C$ = 4.0 mA, $V_{CE}$ = 10 V, f = 45 MHz |
| | 2N/PN3690 (see test circuit no. 226A) | 15 | | | | dB | $I_C$ = 4.0 mA, $V_{CE}$ = 10 V, f = 200 MHz |
| | (see test circuit no. 354) | | | 35 | | dB | $I_C$ = 4.0 mA, $V_{CC}$ = 12 V, f = 455 kHz |
| | (see test circuit no. 352) | | | 28 | | dB | $I_C$ = 4.0 mA, $V_{CC}$ = 12 V, f = 10.7 MHz |
| | (see test circuit no. 353) | | | 20 | | dB | $I_C$ = 4.0 mA, $V_{CC}$ = 15 V, f = 100 MHz |
| AGC | Automatic Gain Control (see test circuit no. 228A) | | | | | | |
| | 2N/PN3688 | 8.0 | 10.5 | | | mA | f = 45 MHz, $I_C$ for which $P_G = P_{G1}$ −30 dB in 45 MHz test circuit |
| | 2N/PN3689 | 9.5 | 12 | | | mA | f = 45 MHz, $I_C$ for which $P_G = P_{G1}$ −30 dB in 45 MHz test circuit |
| | (see test circuit no. 226A) 2N/PN3690 | 9.0 | 14 | | | mA | f = 200 MHz, $I_C$ for which $P_G = P_{G1}$ −30 dB in 200 MHz test circuit |
| | (see test circuit no. 353) | | | 6.0 | 10.5 | mA | f = 100 MHz, $I_C$ for which $PG_{AGC}$ = PG −30 dB |

Additional Electrical Characteristics on following page.

NOTES:

*Planar is a patented Fairchild process.

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/W (derating factor of 2.0 mW/°C) for 2N3688, 2N3689, 2N3690 and SE5006. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C) for PN3688, PN3689, and PN3690.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 - SS1.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N3688/89/90 PN3688/89/90 MIN. | MAX. | SE5006 MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $r_b'C_c$ | Collector to Base Time Constant | | 15 | | | ps | $I_C$ = 4.0 mA, $V_{CE}$ = 10 V, f = 80 MHz |
| $h_{FE}$ | DC Current Gain (Note 5) | 30 | | 30 | | | $I_C$ = 4.0 mA, $V_{CE}$ = 10 V |
| $I_{EBO}$ | Emitter Cutoff Current | | 100 | | | | $I_C$ = 0, $V_{EB}$ = 4.0 V |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | | 50 | nA | $I_E$ = 0, $V_{CB}$ = 20 V |
| | | | 5.0 | | 5.0 | μA | $I_E$ = 0, $V_{CB}$ = 20 V, $T_A$ = 65°C |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 40 | | 40 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | 40 | | 40 | | V | $I_C$ = 3.0 mA (pulsed), $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 4.0 | | 4.0 | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $V_{CE(sat)}$ | Collector Saturation Voltage | | | | 2.0 | V | $I_C$ = 10 mA, $I_B$ = 5.0 mA |
| $V_{BE(sat)}$ | Pulsed Base Saturation Voltage (Note 5) | | | | 0.98 | V | $I_C$ = 10 mA, $I_B$ = 5.0 mA |

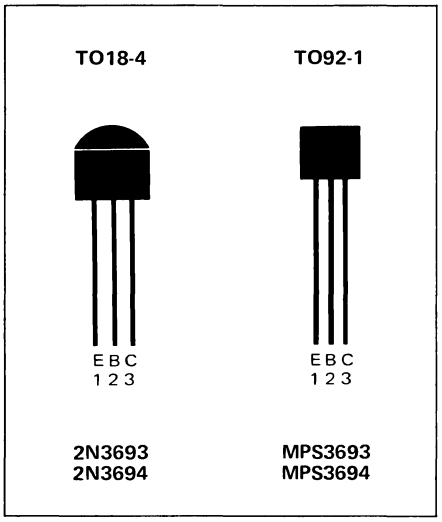
4

# 2N3693 • 2N3694 • MPS3693 • MPS3694

## NPN SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C (MPS3693/4)
- $V_{CEO}$ . . . 45 V (MIN)
- $h_{FE}$ . . . 100-400 (2N/MPS3694)
- NF . . . 4.0 dB (TYP) @ 1.0 MHz
- $A_{PG}$ . . . 55 dB (TYP) @ 455 kHz
- $G_C$ . . . 20 dB (TYP) FROM 108 MHz TO 10.7 MHz
- COMPLEMENTS . . . 2N4121, 2N4122 (TO18); 2N3905, 2N3906 (TO92)




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | 2N3693/4 | MPS3693/4 |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | −55°C to +125°C | −55°C to +150°C |
| Operating Junction Temperature | 125°C | 150°C |
| Soldering Temperature (10 seconds) | 260°C | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Case Temperature | 0.5 W | 1.0 W |
| at 65°C Case Temperature | 0.3 W | – |
| at 25°C Ambient Temperature | 0.2 W | 0.625 W |
| **Maximum Voltages and Current** | | |
| $V_{CBO}$ Collector to Base Voltage | | 45 V |
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | | 45 V |
| $V_{EBO}$ Emitter to Base Voltage | | 4.0 V |
| $I_C$ Collector Current | | 30 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N3693 MIN. | 2N3693 MAX. | 2N3694 MIN. | 2N3694 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 40 | 160 | 100 | 400 | | $I_C$ = 10 mA, $V_{CE}$ = 10 V |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | | 50 | nA | $I_E$ = 0, $V_{CB}$ = 30 V |
| | | | 5.0 | | 5.0 | μA | $I_E$ = 0, $V_{CB}$ = 30 V, $T_A$ = 65°C |
| $C_{ob}$ | Output Capacitance | 0.5 | 6.0 | 0.5 | 6.0 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 1.0 MHz |
| $r_b'C_c$ | Collector Base Time Constant | | 55 | | 55 | ps | $I_C$ = 10 mA, $V_{CE}$ = 15 V, f = 80 MHz |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 45 | | 45 | | V | $I_C$ = 0.1 mA, $I_E$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 5) | 45 | | 45 | | V | $I_B$ = 0, $I_C$ = 10 mA (pulsed) |
| $I_{EBO}$ | Emitter Cutoff Current | | 100 | | 100 | μA | $V_{EB}$ = 4.0 V, $I_C$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 4.0 | | 4.0 | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $h_{fe}$ | High Frequency Current Gain | 2.0 | 5.0 | 2.0 | 5.0 | | $I_C$ = 10 mA, $V_{CE}$ = 15 V, f = 100 MHz |

| SYMBOL | CHARACTERISTIC | MPS3693 MIN. | MPS3693 MAX. | MPS3694 MIN. | MPS3694 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 40 | 160 | 100 | 400 | | $I_C$ = 10 mA, $V_{CE}$ = 10 V |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | | 50 | nA | $I_E$ = 0, $V_{CB}$ = 35 V |
| | | | 5.0 | | 5.0 | μA | $I_E$ = 0, $V_{CB}$ = 35 V, $T_A$ = 65°C |
| $C_{ob}$ | Output Capacitance | | 3.5 | | 3.5 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 1.0 MHz |
| $r_b'C_c$ | Collector Base Time Constant | | 55 | | 55 | ps | $I_C$ = 10 mA, $V_{CE}$ = 15 V, f = 31.8 MHz |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 45 | | 45 | | V | $I_C$ = 0.1 mA, $I_E$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 5) | 45 | | 45 | | V | $I_B$ = 0, $I_C$ = 10 mA (pulsed) |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 4.0 | | 4.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $h_{fe}$ | High Frequency Current Gain | 2.0 | | 2.0 | | | $I_C$ = 10 mA, $V_{CE}$ = 15 V, f = 100 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/W (derating factor of 2.0 mW/°C) for 2N2693, 2N3694. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C) for MPS3693, MPS3694.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.

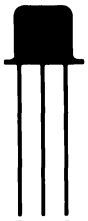
# 2N3700 • 2N3701

## NPN SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $V_{CEO}$ . . . 80 V (MIN) @ 30 mA
- $V_{CE(sat)}$ . . . 0.5 V (MAX)@ 500 mA

See TO18-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| **Maximum Temperatures** | |
| Storage Temperature | −65°C to +200°C |
| Operating Junction Temperature | 200°C |
| Lead Temperature (60 seconds) | 300°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | |
| Total Dissipation at 25°C Case Temperature | 1.8 W |
| at 100°C Case Temperature | 1.0 W |
| at 25°C Ambient Temperature | 0.5 W |
| **Maximum Voltages and Current** | |
| $V_{CBO}$ Collector to Base Voltage | 140 V |
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | 80 V |
| $V_{EBO}$ Emitter to Base Voltage | 7.0 V |
| $I_C$ Collector Current | 1.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N3700 MIN. | 2N3700 MAX. | 2N3701 MIN. | 2N3701 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 100 | 300 | 40 | 120 | | $I_C$ = 150 mA, $V_{CE}$ = 10 V |
| | | 90 | | 40 | 120 | | $I_C$ = 10 mA, $V_{CE}$ = 10 V |
| | | 50 | | 30 | 100 | | $I_C$ = 0.1 mA, $V_{CE}$ = 10 V |
| | | 50 | | 30 | 100 | | $I_C$ = 500 mA, $V_{CE}$ = 10 V |
| | | 15 | | 15 | | | $I_C$ = 1.0 A, $V_{CE}$ = 10 V |
| | | 40 | | | | | $I_C$ = 150 mA, $V_{CE}$ = 10 V, $T_A$ = −55°C |
| $V_{BE(sat)}$ | Pulsed Base Saturation Voltage | | 1.1 | | 1.1 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| $V_{CE(sat)}$ | Pulsed Collector Saturation | | 0.2 | | 0.2 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | Voltage (Note 5) | | 0.5 | | 0.5 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| $h_{fe}$ | High Frequency Current Gain | 5.0 | 10 | 4.0 | 10 | | $I_C$ = 50 mA, $V_{CE}$ = 10 V, f = 20 MHz |
| $h_{fe}$ | Small Signal Current Gain | 80 | 400 | 30 | 200 | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V, f = 1.0 kHz |
| $C_{ob}$ | Output Capacitance | | 12 | | 12 | pF | $I_E$ = 0, $V_{CB}$ = 10 V, f = 1.0 MHz |
| $C_{ib}$ | Input Capacitance | | 60 | | 60 | pF | $I_C$ = 0, $V_{EB}$ = 0.5 V, f = 1.0 MHz |
| $r_b'C_c$ | Collector to Base Time Constant | 25 | 400 | 25 | 400 | ps | $I_C$ = 10 mA, $V_{CB}$ = 10 V, f = 4.0 MHz |
| $I_{CBO}$ | Collector Cutoff Current | | 10 | | 10 | nA | $I_E$ = 0, $V_{CB}$ = 90 V |
| | | | 10 | | 10 | μA | $I_E$ = 0, $V_{CB}$ = 90 V, $T_A$ = 150°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 10 | | 10 | nA | $I_C$ = 0, $V_{EB}$ = 5.0 V |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 140 | | 140 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | 80 | | 80 | | V | $I_C$ = 30 mA, $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 7.0 | | 7.0 | | V | $I_C$ = 0, $I_E$ = 100 μA |
| NF | Noise Figure | | 4.0 | | | dB | $I_C$ = 100 μA, $V_{CE}$ = 10 V, f = 1.0 kHz, $R_G$ = 1.0 kΩ |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 97°C/W (derating factor of 10.3 mW/°C); junction to ambient thermal resistance of 350°C/W (derating factor of 2.85 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle ≤1%.
6. For product family characteristic curves, refer to Section 5 — SS17.

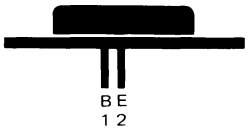
# 2N3713 • 2N3714 • 2N3715 • 2N3716

## 150 WATT NPN POWER

DIFFUSED SILICON BI-MESAR™ TRANSISTORS

- $T_C$ . . . 150 W @ 25°C
- $I_C$ . . . 10 A
- COMPLEMENTS . . . 2N3789 THROUGH 2N3792

See TO3-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | | |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | −65°C to +200°C | |
| Operating Junction Temperature | | −65°C to +200°C | |
| **Maximum Power Dissipation** | | | |
| Total Dissipation at 25°C Case Temperature | | 150 W | |
| Linear Derating Factor | | 0.855 W/°C | |
| **Maximum Voltages and Currents** | | **2N3713 2N3715** | **2N3714 2N3716** |
| $V_{CBO}$ | Collector to Base Voltage | 80 V | 100 V |
| $V_{CEO}$ | Collector to Emitter Voltage | 60 V | 80 V |
| $V_{EBO}$ | Emitter to Base Voltage | 7.0 V | 7.0 V |
| $I_C$ | Collector Current | 10 A | 10 A |
| $I_B$ | Base Current | 4.0 A | 4.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N3713 2N3715 MIN. | 2N3713 2N3715 MAX. | 2N3714 2N3716 MIN. | 2N3714 2N3716 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $I_{CEX}$ | Collector Cutoff Current | | 10 | | | mA | $V_{CE}$ = 60 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| $I_{CEX}$ | Collector Cutoff Current | | | | 10 | mA | $V_{CE}$ = 80 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| $I_{CEX}$ | Collector Cutoff Current | | 1.0 | | | mA | $V_{CE}$ = 80 V, $V_{EB}$ = 1.5 V |
| $I_{CEX}$ | Collector Cutoff Current | | | | 1.0 | mA | $V_{CE}$ = 100 V, $V_{EB}$ = 1.5 V |
| $I_{EBO}$ | Emitter Cutoff Current | | 1.0 | | 1.0 | mA | $V_{EB}$ = 7.0 V, $I_C$ = 0 |
| $V_{CEO}$ | Collector to Emitter Sustaining Voltage (Note 2) | 60 | | 80 | | V | $I_C$ = 200 mA, $I_B$ = 0 |
| $I_{CEO}$ | Collector Cutoff Current | | 0.7 | | | mA | $V_{CE}$ = 30 V, $I_B$ = 0 |
| $I_{CEO}$ | Collector Cutoff Current | | | | 0.7 | mA | $V_{CE}$ = 40 V, $I_B$ = 0 |

| SYMBOL | CHARACTERISTIC | 2N3713 2N3714 MIN. | 2N3713 2N3714 MAX. | 2N3715 2N3716 MIN. | 2N3715 2N3716 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain (Note 2) | 5.0 | | 5.0 | | | $I_C$ = 10 A, $V_{CE}$ = 4.0 V |
| $h_{FE}$ | DC Current Gain (Note 2) | 25 | 75 | 50 | 150 | | $I_C$ = 1.0 A, $V_{CE}$ = 2.0 V |
| $h_{FE}$ | DC Current Gain (Note 2) | 15 | | 30 | | | $I_C$ = 3.0 A, $V_{CE}$ = 2.0 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 2) | | 1.0 | | 0.8 | V | $I_C$ = 5.0 A, $I_B$ = 500 mA |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 2) | | 4.0 | | 4.0 | V | $I_C$ = 10 A, $I_B$ = 2.0 A |
| $V_{BE}$ | Base to Emitter Voltage (Note 2) | | 2.0 | | 1.8 | V | $I_C$ = 5.0 A, $V_{CE}$ = 2.0 V |
| $V_{BE}$ | Base to Emitter Voltage (Note 2) | | 4.0 | | 4.0 | V | $I_C$ = 10 A, $V_{CE}$ = 4.0 V |
| $f_{hfe}$ | Small Signal Cutoff Frequency | 30 | | 30 | | kHz | $I_C$ = 500 mA, $V_{CE}$ = 10 V |
| $h_{fe}$ | Small Signal Current Gain | 25 | 250 | 25 | 250 | | $I_C$ = 500 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $\|h_{fe}\|$ | Magnitude of Common Emitter Small Signal Current Gain | 4.0 | | 4.0 | | | $I_C$ = 500 mA, $V_{CE}$ = 10 V, f = 1.0 MHz |
| $C_{ob}$ | Output Capacitance | | 250 | | 250 | pF | $V_{CB}$ = 10 V, $I_C$ = 0, f = 0.1 MHz |

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. Pulse conditions: length = 300 μs; duty cycle = 2%.
3. For family characteristic curves, refer to Section 5 — PWR 6.

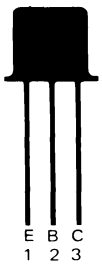
# 2N3722 • FT3723

## NPN SMALL SIGNAL HIGH VOLTAGE HIGH CURRENT SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$V_{CEO}$ . . . 60 V (MIN) (2N3722) 70 V (MIN) (FT3723)**
- **$h_{FE}$ . . . 40 – 150 @ 100 mA**
  **. . . 12 (MIN) @ 800 mA**
- **$t_{on}$ . . . 50 ns (MAX) @ 500 mA (2N3722)**
- **$t_{off}$ . . . 100 ns (MAX) @ 500 mA (2N3722)**

**See TO5-1 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | –65°C to +200°C |
| Operating Junction Temperature | 200°C |
| Lead Temperature (60 seconds) | 300°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 4.0 W |
| at 25°C Ambient Temperature | 0.8 W |

**Maximum Voltages and Current**

| | | 2N3722 | FT3723 |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 80 V | 100 V |
| $V_{CES}$ | Collector to Emitter Voltage | 80 V | 100 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 60 V | 70 V |
| $V_{EBO}$ | Emitter to Base Voltage | 6.0 V | 6.0 V |
| $I_C$ | Collector Current (Note 5) | 1.0 A | 1.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N3722 MIN. | 2N3722 MAX. | FT3723 MIN. | FT3723 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | 60 | | 70 | | V | $I_C$ = 10 mA (pulsed), $I_B$ = 0 |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | 0.25 | | 0.25 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | 0.22 | | 0.28 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| | | | 0.37 | | 0.44 | V | $I_C$ = 300 mA, $I_B$ = 30 mA |
| | | | 0.50 | | 0.75 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| | | | 2.0 | | | V | $I_C$ = 800 mA, $I_B$ = 80 mA |
| $t_{on}$ | Turn On Time (see test circuit no. 265) | | 50 | | 70 | ns | $I_C \approx$ 500 mA, $I_{B1} \approx$ 50 mA |
| $t_{off}$ | Turn Off Time (see test circuit no. 265) | | 100 | | 130 | ns | $I_C \approx$ 500 mA, $I_{B1} \approx I_{B2} \approx$ 50 mA |
| $C_{ob}$ | Output Capacitance | | 10 | | 9.0 | pF | $I_E$ = 0, $V_{CB}$ = 10 V |
| $C_{ib}$ | Input Capacitance | | 65 | | 65 | pF | $V_{EB}$ = 0.5 V, $I_C$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 5) | 25 | | 25 | | | $I_C$ = 10 mA, $V_{CE}$ = 1.0 V |
| | | 40 | 150 | 40 | 150 | | $I_C$ = 100 mA, $V_{CE}$ = 1.0 V |
| | | 20 | | 15 | | | $I_C$ = 300 mA, $V_{CE}$ = 2.0 V |
| | | 15 | | | | | $I_C$ = 500 mA, $V_{CE}$ = 2.0 V |
| | | | | 15 | | | $I_C$ = 500 mA, $V_{CE}$ = 3.0 V |
| | | 12 | | 12 | | | $I_C$ = 800 mA, $V_{CE}$ = 5.0 V |
| | | 15 | | 15 | | | $I_C$ = 100 mA, $V_{CE}$ = 1.0 V, $T_A$ = –55°C |
| | | 20 | | 20 | | | $I_C$ = 200 mA, $V_{CE}$ = 2.0 V, $T_A$ = –55°C |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 5) | | 0.75 | | 0.75 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | 0.85 | | 0.85 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| | | | 1.1 | | 1.1 | V | $I_C$ = 300 mA, $I_B$ = 30 mA |
| | | 0.86 | 1.2 | 0.86 | 1.2 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| | | | 1.5 | | | V | $I_C$ = 800 mA, $I_B$ = 80 mA |
| $h_{fe}$ | High Frequency Current Gain | 3.0 | | 3.0 | | | $I_C$ = 50 mA, $V_{CE}$ = 10 V, f = 100 MHz |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 43.8°C/W (derating factor of 22.8 mW/°C); junction to ambient thermal resistance of 219°C/W (derating factor of 4.56 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5-SS9.

4

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N3722 MIN. | 2N3722 MAX. | FT3723 MIN. | FT3723 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $I_{CES}$ | Collector Reverse Current | | 500 | | | nA | $V_{CE}$ = 40 V, $V_{EB}$ = 0 |
| | | | | | 500 | nA | $V_{CE}$ = 50 V, $V_{EB}$ = 0 |
| | | | 70 | | | μA | $V_{CE}$ = 40 V, $V_{EB}$ = 0, $T_A$ = 125°C |
| | | | | | 70 | μA | $V_{CE}$ = 50 V, $V_{EB}$ = 0, $T_A$ = 125°C |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 80 | | 100 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | 80 | | 100 | | V | $I_C$ = 100 μA, $V_{EB}$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 6.0 | | 6.0 | | V | $I_E$ = 100 μA, $I_C$ = 0 |

# 2N3724/3725 • 2N4013/4014 • 2N4046/4047

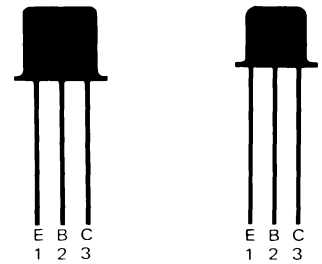
## NPN SMALL SIGNAL HIGH CURRENT HIGH SPEED SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $t_{on}$ . . . 35 ns (MAX), $t_{off}$ . . . 60 ns (MAX) @ 500 mA
- $V_{CEO}$ . . . 30 V (MIN) (2N3724, 2N4013, 2N4046), 50 V (MIN) (2N3725, 2N4014, 2N4047)
- $V_{CE(sat)}$ . . . 0.65 V (MAX) @ 800 mA, 0.75 V (MAX) @ 1.0 A (2N3724, 2N4013, 2N4046)
- $h_{FE}$ . . . 40-150 @ 100 mA (2N4046/7), 60-150 @ 100 mA (2N3724/5, 2N4013/4)

See Package Outlines

TO5-1 TO18-1




2N3724/5 2N4046/7 2N4013 2N4014

**ABSOLUTE MAXIMUM TEMPERATURES** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Junction Temperature | 200°C |
| Lead Temperature (60 seconds) | 300°C |

| **Maximum Power Dissipation** (Notes 2 & 3) | **2N4013/4** | **2N3724/5, 2N4046/7** |
|---|---|---|
| Total Dissipation at 25°C Case Temperature | 1.2 W | 3.5 W |
| at 25°C Ambient Temperature | 0.36 W | 0.8 W |

| **Maximum Voltages and Currents** | | **2N3724, 2N4013 2N4046** | **2N3725, 2N4014 2N4047** |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 50 V | 80 V |
| $V_{CES}$ | Collector to Emitter Voltage | 50 V | 80 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 30 V | 50 V |
| $V_{EBO}$ | Emitter to Base Voltage | 6.0 V | 6.0 V |
| $I_C$ | Collector Current (Note 5) | 1.0 A | 1.0 A |
| $I_C$ | DC Collector Current | 500 mA | 500 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N3724 2N4013 2N4046 MIN. | MAX. | 2N3725 2N4014 2N4047 MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | 30 | | 50 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $t_{on}$ | Turn On Time (see test circuit no. 265) | | 35 | | 35 | ns | $I_C$ = 500 mA, $I_{B1}$ = 50 mA |
| $t_{off}$ | Turn Off time (see test circuit no. 265) | | 60 | | 60 | ns | $I_C$ = 500 mA, $I_{B1}$ = 50 mA, $I_{B2}$ = −50 mA |
| $C_{ob}$ | Output Capacitance | | 12 | | 10 | pF | $I_E$ = 0, $V_{CB}$ = 10 V |
| $C_{ib}$ | Input Capacitance | | 55 | | 55 | pF | $I_C$ = 0, $V_{BE}$ = 0.5 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | 0.25 | | 0.25 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | 0.2 | | 0.26 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| | | | 0.32 | | 0.4 | V | $I_C$ = 300 mA, $I_B$ = 30 mA |
| | | | 0.42 | | 0.52 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| | | | 0.65 | | 0.8 | V | $I_C$ = 800 mA, $I_B$ = 80 mA |
| | | | 0.75 | | 0.95 | V | $I_C$ = 1.0 A, $I_B$ = 100 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 5) | | 0.76 | | 0.76 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | 0.86 | | 0.86 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| | | | 1.1 | | 1.1 | V | $I_C$ = 300 mA, $I_B$ = 30 mA |
| | | | 1.5 | | 1.5 | V | $I_C$ = 800 mA, $I_B$ = 80 mA |
| | | | 1.7 | | 1.7 | V | $I_C$ = 1.0 A, $I_B$ = 100 mA |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 50 | | 80 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | 50 | | 80 | | V | $I_C$ = 10 μA, $V_{BE}$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 6.0 | | 6.0 | | V | $I_C$ = 0, $I_E$ = 10 μA |

Additional Electrical Characteristics on following page.

NOTES:

*Planar is a patented Fairchild process.

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 50°C/W (derating factor of 20 mW/°C) for 2N3724, 2N3725, 2N4046 and 2N4047; and 146°C/W (derating factor of 6.85 mW/°C) for the 2N4013 and 2N4014; junction to ambient thermal resistance of 219°C/W (derating factor of 4.56 mW/°C) for the 2N3724, 2N3725, 2N4046, and 2N4047, and 485°C/W (derating factor of 2.06 mW/°C) for the 2N4013, and 2N4014.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 - SS13.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N3724, 2N4013 MIN. | 2N3724, 2N4013 MAX. | 2N3725, 2N4014 MIN. | 2N3725, 2N4014 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $I_{CBO}$ | Collector Cutoff Current | | 1.7 | | | μA | $I_E = 0, V_{CB} = 40$ V |
| | | | | | 1.7 | μA | $I_E = 0, V_{CB} = 60$ V |
| | | | 120 | | | μA | $I_E = 0, V_{CB} = 40$ V, $T_A = 100°C$ |
| | | | | | 120 | μA | $I_E = 0, V_{CB} = 60$ V, $T_A = 100°C$ |
| $I_{CES}$ | Collector Reverse Current | | 10 | | | μA | $I_E = 0, V_{CE} = 50$ V |
| | | | | | 10 | μA | $I_E = 0, V_{CE} = 80$ V |
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 60 | 150 | 60 | 150 | | $I_C = 100$ mA, $V_{CE} = 1.0$ V |
| | | 35 | | 35 | | | $I_C = 500$ mA, $V_{CE} = 1.0$ V |
| | | 40 | | 40 | | | $I_C = 300$ mA, $V_{CE} = 1.0$ V |
| | | 30 | | 25 | | | $I_C = 1.0$ A, $V_{CE} = 5.0$ V |
| | | 30 | | 30 | | | $I_C = 10$ mA, $V_{CE} = 1.0$ V |
| | | 25 | | 20 | | | $I_C = 800$ mA, $V_{CE} = 2.0$ V |
| | | 30 | | 30 | | | $I_C = 100$ mA, $V_{CE} = 1.0$ V, $T_A = -55°C$ |
| | | 20 | | 20 | | | $I_C = 500$ mA, $V_{CE} = 1.0$ V, $T_A = -55°C$ |
| $V_{BE(sat)}$ | Base Saturation Voltage | 0.8 | 1.1 | 0.8 | 1.1 | V | $I_C = 500$ mA, $I_B = 50$ mA |
| $h_{fe}$ | High Frequency Current Gain | 3.0 | | 3.0 | | | $I_C = 50$ mA, $V_{CE} = 10$ V, f = 100 MHz |

| SYMBOL | CHARACTERISTIC | 2N4046 MIN. | 2N4046 MAX. | 2N4047 MIN. | 2N4047 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $I_{CBO}$ | Collector Cutoff Current | | 1.7 | | | μA | $I_E = 0, V_{CB} = 40$ V |
| | | | | | 1.7 | μA | $I_E = 0, V_{CB} = 60$ V |
| | | | 120 | | | μA | $I_E = 0, V_{CB} = 40$ V, $T_A = 85°C$ |
| | | | | | 120 | μA | $I_E = 0, V_{CB} = 60$ V, $T_A = 85°C$ |
| $I_{CES}$ | Collector Reverse Current | | 10 | | | μA | $I_E = 0, V_{CE} = 50$ V |
| | | | | | 10 | μA | $I_E = 0, V_{CE} = 80$ V |
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 40 | 150 | 40 | 150 | | $I_C = 100$ mA, $V_{CE} = 1.0$ V |
| | | 30 | | 20 | | | $I_C = 500$ mA, $V_{CE} = 1.0$ V |
| | | 30 | | 30 | | | $I_C = 300$ mA, $V_{CE} = 1.0$ V |
| | | 25 | | 15 | | | $I_C = 1.0$ A, $V_{CE} = 5.0$ V |
| | | 20 | | 20 | | | $I_C = 10$ mA, $V_{CE} = 1.0$ V |
| | | 20 | | 15 | | | $I_C = 800$ mA, $V_{CE} = 2.0$ V |
| $V_{BE(sat)}$ | Base Saturation Voltage | 0.9 | 1.2 | 0.9 | 1.2 | V | $I_C = 500$ mA, $I_B = 50$ mA |
| $h_{fe}$ | High Frequency Current Gain | 2.5 | | 2.5 | | | $I_C = 50$ mA, $V_{CE} = 10$ V, f = 100 MHz |

# 2N3726 • 2N3727 • 2N4015 • 2N4016

## PNP LOW LEVEL LOW NOISE DIFFERENTIAL AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $\frac{h_{FE1}}{h_{FE2}}$ . . . 0.9-1.0 @ $I_C$ = 100 μA TO 1.0 mA
- $h_{FE}$ . . . 135-350 @ $I_C$ = 1.0 mA
- NF . . . 4.0 dB (MAX) @ $I_C$ = 30 μA, f = 1.0 kHz

See TO5-9 Package Outline

CBEEBC
123456

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Junction Temperature | | 200°C |
| Lead Temperature (60 seconds) | | 300°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | **One Side** | **Both Sides** |
| Total Dissipation at 25°C Case Temperature | 0.85 W | 1.4 W |
| at 100°C Case Temperature | 0.48 W | 0.80 W |
| at 25°C Ambient Temperature | 0.40 W | 0.50 W |
| **Maximum Voltages and Current** | **2N4015, 2N4016** | **2N3726, 2N3727** |
| $V_{CBO}$ Collector to Base Voltage | −60 V | −45 V |
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | −60 V | −45 V |
| $V_{EBO}$ Emitter to Base Voltage | −5.0 V | −5.0 V |
| $I_C$ Collector Current | 300 mA | 300 mA |

**MATCHING CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N3726/4015 MIN. | 2N3726/4015 MAX. | 2N3727/4016 MIN. | 2N3727/4016 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $\frac{h_{FE1}}{h_{FE2}}$ | DC Current Gain Ratio (Note 5) | 0.9 | 1.0 | 0.9 | 1.0 | | $I_C$ = 100 μA to 1.0 mA, $V_{CE}$ = −5.0 V |
| $\lvert V_{BE1}-V_{BE2}\rvert$ | Base to Emitter Voltage Differential | | 5.0 | | 2.5 | mV | $I_C$ = 100 μA to 1.0 mA, $V_{CE}$ = −5.0 V |
| $\lvert\Delta(V_{BE1}-V_{BE2})\rvert$ | Base to Emitter Voltage Differential Change | | 1.6 | | 0.8 | mV | $I_C$ = 100 μA to 1.0 mA, $V_{CE}$ = −5.0 V, $T_A$ = −55°C to +125°C |
| | | | 2.0 | | 1.0 | mV | $I_C$ = 100 μA to 1.0 mA, $V_{CE}$ = −5.0 V, $T_A$ = +25°C to +125°C |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N3726/27 MIN. | 2N3726/27 MAX. | 2N4015/16 MIN. | 2N4015/16 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 80 | | 80 | | | $I_C$ = 10 μA, $V_{CE}$ = −5.0 V |
| | | 120 | | 120 | | | $I_C$ = 100 μA, $V_{CE}$ = −5.0 V |
| | | 135 | 350 | 135 | 350 | | $I_C$ = 1.0 mA, $V_{CE}$ = −5.0 V |
| $h_{FE}$ | DC Current Gain (Note 6) | 115 | | 115 | | | $I_C$ = 50 mA, $V_{CE}$ = −5.0 V |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 45 | | 60 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | 5.0 | | V | $I_E$ = −10 μA, $I_C$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 6) | 45 | | 60 | | V | $I_C$ = 10 mA, $I_B$ = 0 |

Additional Electrical Characteristics are on following page.

NOTES:

*Planar is a patented Fairchild process.

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on application involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to ambient thermal resistance of 431°C/W (derating factor of 2.29 mW/°C) for one side; 350°C/W (derating factor of 2.86 mW/°C) for both sides; junction to case thermal resistance of 206°C/W (derating factor of 4.85 mW/°C) for one side; 125°C/W (derating factor of 8.0 mW/°C) for both sides.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Lowest of two $h_{FE}$ reading is taken as $h_{FE1}$ for purposes of this ratio.
6. Pulse conditions: 300 μs; duty cycle = 1%.
7. For product family characteristic curves, refer to Section 5 - SS22.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N3726/27 MIN. | 2N3726/27 MAX. | 2N4015/16 MIN. | 2N4015/16 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 6) | | 0.25 | | 0.25 | V | $I_C$ = 50 mA, $I_B$ = 2.5 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 6) | | 1.0 | | 1.0 | V | $I_C$ = 50 mA, $I_B$ = 2.5 mA |
| $I_{CBO}$ | Collector Cutoff Current | | 10 | | | nA | $I_E$ = 0, $V_{CB}$ = −30 V |
| | | | | | 10 | nA | $I_E$ = 0, $V_{CB}$ = −50 V |
| | | | 10 | | | μA | $I_E$ = 0, $V_{CB}$ = −30 V, $T_A$ = 150°C |
| | | | | | 10 | μA | $I_E$ = 0, $V_{CB}$ = −50 V, $T_A$ = 150°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 100 | | 100 | nA | $I_C$ = 0, $V_{EB}$ = −3.0 V |
| $\|h_{fe}\|$ | Magnitude of Small Signal | 3.0 | | 3.0 | | | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V, f = 20 MHz |
| | Current Gain | 2.0 | 6.0 | 2.0 | 6.0 | | $I_C$ = 50 mA, $V_{CE}$ = −20 V, f = 100 MHz |
| $C_{ob}$ | Output Capacitance | | 8.0 | | 8.0 | pF | $I_E$ = 0, $V_{CB}$ = −10 V, f = 1.0 MHz |
| $C_{ib}$ | Input Capacitance | | 30 | | 25 | pF | $I_E$ = 0, $V_{EB}$ = −0.5 V, f = 1.0 MHz |
| NF | Noise Figure | | 4.0 | | 4.0 | dB | $I_C$ = 30 μA, $V_{CE}$ = −5.0 V, f = 1.0 kHz, $R_S$ = 10 kΩ, BW = 200 Hz |
| $h_{ie}$ | Input Impedance | | 11.5 | | 11.5 | kΩ | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V, f = 1.0 kHz |
| $h_{re}$ | Reverse Voltage Feedback Ratio | | 1.5 | | 1.5 | $\times 10^{-3}$ | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V, f = 1.0 kHz |
| $h_{oe}$ | Output Conductance | | 80 | | 80 | μmho | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V, f = 1.0 kHz |
| $h_{fe}$ | Small Signal Current Gain | 135 | 420 | 135 | 420 | | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V, f = 1.0 kHz |

# 2N3728 • 2N3729

## NPN HIGH PERFORMANCE DIFFERENTIAL AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $\frac{h_{FE1}}{h_{FE2}}$ . . . 0.9-1.0 FROM 100 μA to 1.0 mA @ 25°C, 0.8-1.0 FROM 100 μA to 1.0 mA, −55°C to +125°C
- $|V_{BE1}-V_{BE2}|$ . . . 3.0 mV (MAX) FROM 100 μA to 1.0 mA
- $|\Delta V_{BE}|$ . . . 10 μV/°C (MAX) FROM 100 μA to 1.0 mA, −55°C to +125°C

See TO5-9 Package Outline

CBEEBC
123456

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Junction Temperature | 200°C |
| Lead Temperature (60 seconds) | 300°C |

| **Maximum Power Dissipation** (Notes 2 & 3) | **One Side** | **Both Sides** |
|---|---|---|
| Total Dissipation at 25°C Case Temperature | 1.0 W | 1.6 W |
| at 100°C Case Temperature | 0.57 W | 0.91 W |
| at 25°C Ambient Temperature | 0.45 W | 0.55 W |

**Maximum Voltages and Current**

| | | |
|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 60 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 30 V |
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V |
| $I_C$ | Collector Current | 500 mA |
| $V_{C1C2}$ | Collector$_1$ to Collector$_2$ Voltage | ±200 V |
| | Voltage Rating any Lead to Case | ±200 V |

**MATCHING CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| $\frac{h_{FE1}}{h_{FE2}}$ | DC Current Gain Ratio (Note 5) | 2N3728 | 0.8 | 1.0 | | $I_C$ = 100 μA to 1.0 mA, $V_{CE}$ = 5.0 V |
| | | 2N3729 | 0.9 | 1.0 | | |
| $\frac{h_{FE1}}{h_{FE2}}$ | DC Current Gain Ratio (Note 5) | 2N3729 | 0.8 | 1.0 | | $I_C$ = 100 μA to 1.0 mA, $V_{CE}$ = 5.0 V<br>$T_A$ = −55°C to +125°C |
| $\|V_{BE1}-V_{BE2}\|$ | Base to Emitter Voltage Differential | 2N3728 | | 5.0 | mV | $I_C$ = 100 μA to 1.0 mA, $V_{CE}$ = 5.0 V |
| | | 2N3729 | | 3.0 | mV | |
| $\|\Delta(V_{BE1}-V_{BE2})\|$ | Base to Emitter Voltage Differential | 2N3728 | | 1.6<br>(20 μV/°C) | mV | $I_C$ = 100 μA to 1.0 mA, $V_{CE}$ = 5.0 V<br>$T_A$ = −55°C to +25°C |
| | | 2N3729 | | 0.8<br>(10 μV/°C) | mV | $I_C$ = 100 μA to 1.0 mA, $V_{CE}$ = 5.0 V<br>$T_A$ = −55°C to +25°C |
| $\|\Delta(V_{BE1}-V_{BE2})\|$ | Base to Emitter Voltage Differential | 2N3728 | | 2.0<br>(20 μV/°C) | mV | $I_C$ = 100 μA to 1.0 mA, $V_{CE}$ = 5.0 V<br>$T_A$ = +25°C to +125°C |
| | | 2N3729 | | 1.0<br>(10 μV/°C) | mV | $I_C$ = 100 μA to 1.0 mA, $V_{CE}$ = 5.0 V<br>$T_A$ = +25°C to +125°C |

Additional Electrical Characteristics on following page.

NOTES:

*Planar is a patented Fairchild process.

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to ambient thermal resistance of 384°C/W (derating factor of 2.57 mW/°C) for one side; 318°C/W (derating factor of 3.14 mW/°C) for both sides; junction to case thermal resistance of 175°C/W (derating factor of 5.71 mW/°C) for one side; 109°C/W (derating factor of 9.15 mW/°C) for both sides.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Lowest of two $h_{FE}$ readings is taken as $h_{FE1}$ for purposes of this ratio.
6. Pulse conditions: length = 300 μs; duty cycle = 1%.
7. For product family characteristic curves, refer to Section 5-SS15.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd.)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 30 | | | $I_C$ = 0.1 mA, $V_{CE}$ = 5.0 V |
| | | 45 | 180 | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V |
| | | 80 | 280 | | $I_C$ = 150 mA, $V_{CE}$ = 5.0 V (Note 6) |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 60 | | | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | | $I_C$ = 0, $I_E$ = 10 μA |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 6) | 30 | | | $I_C$ = 10 mA, $I_B$ = 0 |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 6) | | 0.22 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 6) | | 1.1 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| $I_{CBO}$ | Collector Cutoff Current | | 10 | nA | $I_E$ = 0, $V_{CB}$ = 50 V |
| | | | 10 | μA | $I_E$ = 0, $V_{CB}$ = 50 V, $T_A$ = 150°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 10 | nA | $I_C$ = 0, $V_{EB}$ = 3.0 V |
| $h_{fe}$ | High Frequency Current Gain | 4.0 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 20 MHz |
| | | 2.5 | 6.0 | | $I_C$ = 50 mA, $V_{CE}$ = 10 V, f = 100 MHz |
| $C_{ob}$ | Common Base, Open Circuit, Output Capacitance | | 8.0 | pF | $I_E$ = 0, $V_{CB}$ = 10 V, f = 140 kHz |
| $C_{ib}$ | Common Base, Open Circuit, Input Capacitance | | 20 | pF | $I_C$ = 0, $V_{EB}$ = 2.0 V, f = 140 kHz |
| $h_{ie}$ | Input Impedance | 1.2 | 6.0 | kΩ | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $h_{re}$ | Reverse Voltage Feedback Ratio | | 300 | $x10^{-6}$ | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $h_{oe}$ | Output Conductance | | 20 | | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $h_{fe}$ | Forward Current Transfer Ratio | 50 | 200 | | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| NF | Wide Band Noise Figure | | 7.0 | dB | $I_C$ = 0.1 mA, $V_{CE}$ = 5.0 V, f = 15.7 kHz, 3.0 dB pts. @ 25 Hz and 10 kHz, $R_S$ = 1.0 kΩ |

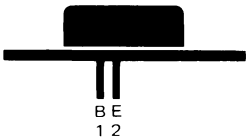
# 2N3740 • 2N3741 • 2N4898 • 2N4899 • 2N4900

## 25 WATT PNP POWER

DIFFUSED SILICON BI-MESAR™ TRANSISTORS

- $V_{CE(sat)}$ . . . −0.6 V @ 1.0 A
- $f_T$ . . . 3.0 MHz @ $V_{CE}$ = 10 V, $I_C$ = 250 mA (2N4898, 2N4899, 2N4900)
- COMPLEMENTS . . . 2N3766 (2N3740); 2N3767 (2N3741); 2N4190 (2N4898); 2N4911 (2N4899); 2N4912 (2N4900)

See TO66-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Junction Temperature | 200°C |
| Lead Temperature (10 seconds) | 235°C |

**Maximum Power Dissipation**

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 25 W |
| Linear Derating Factor | 0.143 W/°C |

**Maximum Voltages and Currents**

| | | 2N4898 | 2N4899 | 2N4900 | 2N3740 | 2N3741 |
|---|---|---|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | −40 V | −60 V | −80 V | −60 V | −80 V |
| $V_{CEO}$ | Collector to Emitter Voltage | −40 V | −60 V | −80 V | −60 V | −80 V |
| $V_{EBO}$ | Emitter to Base Voltage | −5.0 V | −5.0 V | −5.0 V | −7.0 V | −7.0 V |
| $I_C$ | Collector Current | 1.0 A | 1.0 A | 1.0 A | 1.0 A | 1.0 A |
| $I_B$ | Base Current | 1.0 A | 1.0 A | 1.0 A | 2.0 A | 2.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N4898 MIN. | 2N4898 MAX. | 2N4899 MIN. | 2N4899 MAX. | 2N4900 MIN. | 2N4900 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $I_{CEX}$ | Collector Cutoff Current | | 1.0 | | | | | mA | $V_{CE}$ = −40 V, $V_{EB}$ = −1.5 V, $T_C$ = 150°C |
| | | | | | 1.0 | | | mA | $V_{CE}$ = −60 V, $V_{EB}$ = −1.5 V, $T_C$ = 150°C |
| | | | | | | | 1.0 | mA | $V_{CE}$ = −80 V, $V_{EB}$ = −1.5 V, $T_C$ = 150°C |
| | | | 0.1 | | | | | mA | $V_{CE}$ = −40 V, $V_{EB}$ = −1.5 V |
| | | | | | 0.1 | | | mA | $V_{CE}$ = −60 V, $V_{EB}$ = −1.5 V |
| | | | | | | | 0.1 | mA | $V_{CE}$ = −80 V, $V_{EB}$ = −1.5 V |
| $I_{CBO}$ | Collector Cutoff Current | | 0.1 | | | | | mA | $V_{CB}$ = −40 V, $I_E$ = 0 |
| | | | | | 0.1 | | | mA | $V_{CB}$ = −60 V, $I_E$ = 0 |
| | | | | | | | 0.1 | mA | $V_{CB}$ = −80 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 1.0 | | 1.0 | | 1.0 | mA | $V_{EB}$ = −5.0 V |
| $I_{CEO}$ | Collector Cutoff Current | | 0.5 | | | | | mA | $V_{CE}$ = −20 V, $I_B$ = 0 |
| | | | | | 0.5 | | | mA | $V_{CE}$ = −30 V, $I_B$ = 0 |
| | | | | | | | 0.5 | mA | $V_{CE}$ = −40 V, $I_B$ = 0 |
| $V_{CEO(sus)}$ | Collector Sustaining Voltage (Note 2) | −40 | | −60 | | −80 | | V | $I_C$ = 100 mA, $I_B$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 2) | 10 | | 10 | | 10 | | | $I_C$ = 1.0 A, $V_{CE}$ = −1.0 V |
| | | 20 | 100 | 20 | 100 | 20 | 100 | | $I_C$ = 500 mA, $V_{CE}$ = −1.0 V |
| | | 40 | | 40 | | 40 | | | $I_C$ = 50 mA, $V_{CE}$ = −1.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 2) | | −0.6 | | −0.6 | | −0.6 | V | $I_C$ = 1.0 A, $I_B$ = 100 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 2) | | −1.3 | | −1.3 | | −1.3 | V | $I_C$ = 1.0 A, $I_B$ = 100 mA |
| $V_{BE}$ | Base to Emitter Voltage (Note 2) | | −1.3 | | −1.3 | | −1.3 | V | $I_C$ = 1.0 A, $V_{CE}$ = 1.0 V |
| $h_{fe}$ | Small Signal Current Gain | 25 | | 25 | | 25 | | | $V_{CE}$ = −10 V, $I_C$ = 250 mA, f = 1.0 kHz |
| $fh_{fe}$ | Small Signal Current Gain Frequency | 3.0 | | 3.0 | | 3.0 | | MHz | $V_{CE}$ = −10 V, $I_C$ = 250 mA |
| $C_{ob}$ | Output Capacitance | | 100 | | 100 | | 100 | pF | $V_{CB}$ = −10 V, $I_E$ = 0, f = 100 kHz |

Additional Electrical Characteristics are on the following page.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. Pulse conditions: length = 300 μs; duty cycle = 2%.
3. For product family characteristic curves, refer to Section 5 — PWR 14.

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N3740 MIN. | 2N3740 MAX. | 2N3741 MIN. | 2N3741 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $I_{CEX}$ | Collector Cutoff Current | | 1.0 | | | mA | $V_{CE}$ = −40 V, $V_{EB}$ = −1.5 V, $T_C$ = 150°C |
| | | | | | 1.0 | mA | $V_{CE}$ = −60 V, $V_{EB}$ = −1.5 V, $T_C$ = 150°C |
| | | | 0.1 | | | mA | $V_{CE}$ = −60 V, $V_{EB}$ = −1.5 V |
| | | | | | 0.1 | mA | $V_{CE}$ = −80 V, $V_{EB}$ = −1.5 V |
| $I_{CBO}$ | Collector Cutoff Current | | 0.1 | | | mA | $V_{CB}$ = −60 V, $I_E$ = 0 |
| | | | | | 0.1 | mA | $V_{CB}$ = −80 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter to Cutoff Current | | 0.5 | | 0.5 | mA | $V_{EB}$ = −7.0 V |
| $I_{CEO}$ | Collector Cutoff Current | | 1.0 | | | mA | $V_{CE}$ = −40 V, $I_B$ = 0 |
| | | | | | 1.0 | mA | $V_{CE}$ = −60 V, $I_B$ = 0 |
| $V_{CEO(sus)}$ | Collector Sustaining Voltage (Note 2) | −60 | | −80 | | | $I_C$ = 100 mA, $I_B$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 2) | 10 | | 10 | | | $I_C$ = 1.0 A, $V_{CE}$ = −1.0 V |
| | | 20 | | 20 | | | $V_{CE}$ = −1.0 V, $I_C$ = 500 mA |
| | | 30 | 100 | 30 | 100 | | $V_{CE}$ = −1.0 V, $I_C$ = 250 mA |
| | | 40 | | 40 | | | $V_{CE}$ = −1.0 V, $I_C$ = 100 mA |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 2) | | −0.6 | | −0.6 | V | $I_C$ = 1.0 A, $I_B$ = 125 mA |
| $V_{BE}$ | Base to Emitter Voltage (Note 2) | | −1.0 | | −1.0 | V | $I_C$ = 250 mA, $V_{CE}$ = 1.0 V |
| $h_{fe}$ | Small Signal Current Gain | 25 | | 25 | | | $V_{CE}$ = −10 V, $I_C$ = 50 mA, f = 1.0 kHz |
| $h_{fe}$ | High Frequency Small Signal Current Gain | 4.0 | | 4.0 | | | $V_{CE}$ = −10 V, $I_C$ = 0.1 A, f = 1.0 MHz |
| $C_{ob}$ | Output Capacitance | | 100 | | 100 | pF | $V_{CB}$ = −10 V, $I_C$ = 0, f = 1.0 MHz |

# 2N3766 • 2N3767

## 20 WATT NPN POWER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $V_{CE(sat)}$ . . . 1.0 V @ $I_C$ = 0.5 A
- $h_{FE}$ . . . 40-160 @ $I_C$ = 500 mA, $V_{CE}$ = 10 V
- COMPLEMENTS . . . 2N3740 (2N3766); 2N3741 (2N3767)

See TO66-1 Package Outline


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | −65°C to +175°C | |
| Operating Junction Temperature | −65°C to +175°C | |
| Lead Temperature (10 seconds) | 240°C | |
| **Maximum Power Dissipation** | | |
| Continuous Power Dissipation at 25°C Case Temperature | 20 W | |
| Linear Derating Factor | 0.133 W/°C | |
| **Maximum Voltages and Currents** | **2N3766** | **2N3767** |
| $V_{CBO}$ Collector to Base Voltage | 80 V | 100 V |
| $V_{EBO}$ Emitter to Base Voltage | 6.0 V | 6.0 V |
| $V_{CEO}$ Collector to Emitter Voltage | 60 V | 80 V |
| $I_C$ Operating Collector Current (Continuous) | 4.0 A | 4.0 A |
| $I_B$ Base Current (Continuous) | 2.5 A | 2.5 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| $I_{CEX}$ | Collector Cutoff Current | 2N3766 | | 1.0 | mA | $V_{CE}$ = 50 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| | | 2N3767 | | 1.0 | mA | $V_{CE}$ = 70 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| $I_{CEX}$ | Collector Cutoff Current | 2N3766 | | 0.1 | mA | $V_{CE}$ = 80 V, $V_{EB}$ = 1.5 V |
| | | 2N3767 | | 0.1 | mA | $V_{CE}$ = 100 V, $V_{EB}$ = 1.5 V |
| $I_{CBO}$ | Collector Cutoff Current | 2N3766 | | 0.1 | mA | $V_{CB}$ = 80 V, $I_E$ = 0 |
| | | 2N3767 | | 0.1 | mA | $V_{CB}$ = 100 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | | 0.75 | mA | $V_{EB}$ = 6.0 V, $I_C$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 2) | 2N3766 | 60 | | V | $I_B$ = 0, $I_C$ = 100 mA |
| | | 2N3767 | 80 | | V | $I_B$ = 0, $I_C$ = 100 mA |
| $I_{CEO}$ | Collector Cutoff Current | 2N3766 | | 0.7 | mA | $I_B$ = 0, $V_{CE}$ = 40 V |
| | | 2N3767 | | 0.7 | mA | $I_B$ = 0, $V_{CE}$ = 60 V |
| $h_{FE}$ | DC Forward Current Gain (Note 2) | | 30 | | | $I_C$ = 50 mA, $V_{CE}$ = 10 V |
| | | | 40 | 160 | | $I_C$ = 500 mA, $V_{CE}$ = 10 V |
| | | | 20 | | | $I_C$ = 1.0 A, $V_{CE}$ = 10 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | 2N3766 | | 2.5 | V | $I_C$ = 1.0 A, $I_B$ = 0.1 A |
| | | 2N3767 | | 1.0 | V | $I_C$ = 0.5 A, $I_B$ = 0.05 A |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage | | | 1.5 | V | $I_C$ = 1.0 A, $V_{CE}$ = 10 V |
| $h_{fe}$ | Small Signal Current Gain | | 40 | | | $V_{CE}$ = 10 V, $I_C$ = 0.1 A, f = 1.0 kHz |
| $\|h_{fe}\|$ | Magnitude of Common Emitter Small Signal Current Gain | | 1.0 | | | $V_{CE}$ = 10 V, $I_C$ = 0.5 A, f = 10 MHz |
| $C_{ob}$ | Common Base Output Capacitance | | | 30 | pF | $V_{CB}$ = 10 V, $I_C$ = 0 |

*Planar is a Fairchild patented process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. Pulse conditions: length = 300 μs; duty cycle = 2%.
3. For product family characteristic curves, refer to Section 5-PWR 18.

# 2N3789 • 2N3790 • 2N3791 • 2N3792

## 150 WATT PNP POWER

DIFFUSED SILICON BI-MESAR™ TRANSISTORS

- $T_C$ . . . 150 W @ 25°C
- $I_C$ . . . 10 A
- COMPLEMENTS . . . 2N3713 THROUGH 2N3716

See TO3-1 Package Outline


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | | |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | −65°C to +200°C | |
| Operating Junction Temperature | | −65°C to +200°C | |
| **Maximum Power Dissipation** | | | |
| Total Dissipation at 25°C Case Temperature | | 150 W | |
| Linear Derating Factor | | 0.855 W/°C | |
| **Maximum Voltages and Currents** | | **2N3789 2N3791** | **2N3790 2N3792** |
| $V_{CBO}$ | Collector to Base Voltage | −60 V | −80 V |
| $V_{CEO}$ | Collector to Emitter Voltage | −60 V | −80 V |
| $V_{EBO}$ | Emitter to Base Voltage | −7.0 V | −7.0 V |
| $I_C$ | Collector Current (Continuous) | 10 A | 10 A |
| $I_B$ | Base Current (Continuous) | 4.0 A | 4.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N3789 2N3791 MIN. | 2N3789 2N3791 MAX. | 2N3790 2N3792 MIN. | 2N3790 2N3792 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 2) | −60 | | −80 | | V | $I_C$ = 200 mA, $I_B$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 5.0 | | 5.0 | mA | $V_{EB}$ = −7.0 V, $I_C$ = 0 |
| $fh_{fe}$ | Small Signal Cutoff Frequency | 30 | | 30 | | kHz | $V_{CE}$ = −10 V, $I_C$ = 0.5 A |
| $\|h_{fe}\|$ | Magnitude of Common Emitter Small Signal Current Gain | 4.0 | | 4.0 | | | $V_{CE}$ = −10 V, $I_C$ = 0.5 A, f = 1.0 MHz |
| $h_{fe}$ | Small Signal Current Gain | 25 | 250 | 25 | 250 | | $V_{CE}$ = −10 V, $I_C$ = 0.5 A, f = 1.0 kHz |
| $C_{ob}$ | Common Base Output Capacitance | | 500 | | 500 | pF | $V_{CB}$ = −10 V, $I_C$ = 0, f = 100 kHz |
| $I_{CEX}$ | Collector Cutoff Current | | 1.0 | | | mA | $V_{CE}$ = −60 V, $V_{EB}$ = −1.5 V |
| $I_{CEX}$ | Collector Cutoff Current | | | | 1.0 | mA | $V_{CE}$ = −80 V, $V_{EB}$ = −1.5 V |
| $I_{CEX}$ | Collector Cutoff Current | | 5.0 | | | mA | $V_{CE}$ = −60 V, $V_{EB}$ = −1.5 V, $T_C$ = 150°C |
| $I_{CEX}$ | Collector Cutoff Current | | | | 5.0 | mA | $V_{CE}$ = −80 V, $V_{EB}$ = −1.5 V, $T_C$ = 150°C |
| $I_{CEO}$ | Collector Cutoff Current | | 10 | | | mA | $V_{CE}$ = −30 V, $I_B$ = 0 |
| $I_{CEO}$ | Collector Cutoff Current | | | | 10 | mA | $V_{CE}$ = −40 V, $I_B$ = 0 |

| SYMBOL | CHARACTERISTIC | 2N3789 2N3790 MIN. | 2N3789 2N3790 MAX. | 2N3791 2N3792 MIN. | 2N3791 2N3792 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Pulse Current Gain (Note 2) | 25 | 90 | 50 | 180 | | $V_{CE}$ = −2.0 V, $I_C$ = 1.0 A |
| $h_{FE}$ | | 15 | | 30 | | | $V_{CE}$ = −2.0 V, $I_C$ = 3.0 A |
| $h_{FE}$ | | 4.0 | | 4.0 | | | $V_{CE}$ = −4.0 V, $I_C$ = 10 A |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 2) | | −1.0 | | −1.0 | V | $I_C$ = 5.0 A, $I_B$ = 0.5 A |
| $V_{CE(sat)}$ | | | −4.0 | | −4.0 | V | $I_C$ = 10 A, $I_B$ = 2.0 A |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 2) | | −2.0 | | −1.8 | V | $I_C$ = 5.0 A, $V_{CE}$ = −2.0 V |
| $V_{BE(ON)}$ | | | −4.0 | | −4.0 | V | $I_C$ = 10 A, $V_{CE}$ = −4.0 V |

NOTES:

*Planar is a Fairchild patented process.

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. Pulse conditions: length = 300 μs; duty cycle = 2%.
3. For product family characteristic curves, refer to Section 5 — PWR 15.

# 2N3800 through 2N3803 • 2N3806 through 2N3809

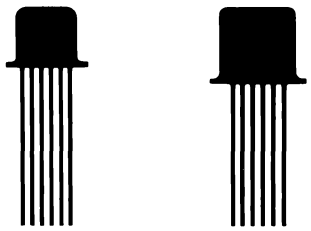
## DUAL PNP LOW LEVEL LOW NOISE DIFFERENTIAL AMPLIFIERS

DIFFUSED SILICON PLANAR* TRANSISTORS

- $V_{CEO}$ . . . 60 V
- NF . . . . . 1.5 dB (MAX) @ 1.0 kHz AND 10 kHz

See Package Outlines

TO18-5 TO5-9




2N3800/1 2N3802/3 | 2N3806/7 2N3808/9

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature (Note 2) | −65°C to +200°C |
| Operating Junction Temperature | 200°C |
| Lead Temperature (10 seconds) | 230°C |

**Maximum Power Dissipation**

| | 2N3800/2N3801 2N3802/2N3803 | | 2N3806/2N3807 2N3808/2N3809 | |
|---|---|---|---|---|
| | One Side | Both Sides | One Side | Both Sides |
| Total Dissipation at 25°C Ambient Temperature | 250 mW | 360 mW | 500 mW | 600 mW |
| Linear Derating Factor | 1.43 mW/°C | 2.06 mW/°C | 2.9 mW/°C | 3.4 mW/°C |

**Maximum Voltage and Current** (One side)

| | | |
|---|---|---|
| $V_{EBO}$ | Emitter to Base Voltage | −5.0 V |
| $V_{CBO}$ | Collector to Base Voltage | −60 V |
| $V_{CEO}$ | Collector to Emitter Voltage | −60 V |
| $I_C$ | DC Collector Current | 50 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N3800 2N3806 MIN. | 2N3800 2N3806 MAX. | 2N3801 2N3807 MIN. | 2N3801 2N3807 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $I_{CBO}$ | Collector Cutoff Current | | 10 | | 10 | nA | $V_{CB}$ = −50 V, $I_E$ = 0 |
| | | | 10 | | 10 | μA | $V_{CB}$ = −50 V, $I_E$ = 0, $T_A$ = 150°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 20 | | 20 | nA | $V_{EB}$ = −4.0 V |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −5.0 | | −5.0 | | V | $I_C$ = 0, $I_E$ = 10 μA |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −60 | | −60 | | V | $I_E$ = 0, $I_C$ = 10 μA |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 3) | −60 | | −60 | | V | $I_C$ = 10 mA |
| $h_{FE}$ | DC Current Gain | 100 | | 225 | | | $I_C$ = 10 μA, $V_{CE}$ = −5.0 V |
| | | 150 | 450 | 300 | 900 | | $I_C$ = 100 μA, $V_{CE}$ = −5.0 V |
| | | 150 | 450 | 300 | 900 | | $I_C$ = 500 μA, $V_{CE}$ = −5.0 V |
| | | 150 | 450 | 300 | 900 | | $I_C$ = 1.0 mA, $V_{CE}$ = −5.0 V |
| | | 125 | | 250 | | | $I_C$ = 10 mA, $V_{CE}$ = −5.0 V |
| | | 75 | | 150 | | | $I_C$ = 100 μA, $V_{CE}$ = −5.0 V, $T_A$ = −55°C |
| $V_{BE(On)}$ | Base to Emitter "On" Voltage | | −0.7 | | −0.7 | V | $I_C$ = 100 μA, $V_{CE}$ = −5.0 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | | −0.2 | | −0.2 | V | $I_C$ = 100 μA, $I_B$ = 10 μA |
| | | | −0.25 | | −0.25 | V | $I_C$ = 1.0 mA, $I_B$ = 100 μA |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage | | −0.7 | | −0.7 | V | $I_C$ = 100 μA, $I_B$ = 10 μA |
| | | | −0.8 | | −0.8 | V | $I_C$ = 1.0 mA, $I_B$ = 100 μA |
| $C_{ob}$ | Output Capacitance | | 4.0 | | 4.0 | pF | $V_{CB}$ = −5.0 V, $I_E$ = 0, f = 100 kHz |
| $C_{ib}$ | Input Capacitance | | 8.0 | | 8.0 | pF | $V_{EB}$ = −0.5 V, $I_C$ = 0, f = 100 kHz |
| $\|h_{fe}\|$ | Magnitude of High Frequency Current Gain | 1.0 | | 1.0 | | | $I_C$ = 500 μA, $V_{CE}$ = −5.0 V, f = 30 MHz |
| | | 1.0 | 5.0 | 1.0 | 5.0 | | $I_C$ = 1.0 mA, $V_{CE}$ = −5.0 V, f = 100 MHz |
| $h_{ie}$ | Input Impedance | 3.0 | 30 | 10 | 40 | kΩ | $V_{CE}$ = −10 V, $I_C$ = 1.0 mA, f = 1.0 kHz |
| $h_{re}$ | Reverse Voltage Feedback Ratio | | 25 | | 25 | x $10^{-4}$ | $V_{CE}$ = −10 V, $I_C$ = 1.0 mA, f = 1.0 kHz |
| $h_{oe}$ | Output Conductance | 5.0 | 60 | 5.0 | 60 | μmho | $V_{CE}$ = −10 V, $I_C$ = 1.0 mA, f = 1.0 kHz |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. Emitter Base Termination open.
4. For product family characteristic curves, refer to Section 5-SS33.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N3800 2N3806 MIN. | MAX. | 2N3801 2N3807 MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{fe}$ | Small Signal Current Gain | 150 | 600 | 300 | 900 | | $V_{CE}$ = −10 V, $I_C$ = 1.0 mA, f = 1.0 kHz |
| $RE(h_{ie})$ | Real Part of Common Emitter Small Signal Input Impedance | 3.0 | 30 | 10 | 40 | kΩ | $V_{CE}$ = −10 V, $I_C$ = 1.0 mA, f = 1.0 kHz |
| NF | Noise Figure | | 3.0 | | 1.5 | dB | $I_C$ = 100 μA, $V_{CE}$ = −10 V, f = 1.0 kHz PBW = 200 Hz, $R_G$ = 3.0 kΩ |
| | | | 2.5 | | 1.5 | dB | $I_C$ = 100 μA, $V_{CE}$ = −10 V, f = 10 kHz, PBW = 2.0 kHz, $R_G$ = 3.0 kΩ |
| | | | 3.5 | | 2.5 | dB | $I_C$ = 100 μA, $V_{CE}$ = 10 V, $R_G$ = 3.0 kΩ, 3.0 dB down at 10 Hz and 10 kHz PBW = 15.7 kHz |
| | | | 7.0 | | 4.0 | dB | $I_C$ = 100 μA, $V_{CE}$ = 10 V, $R_G$ = 3.0 kΩ, f = 100 Hz, PBW = 20 Hz |

| SYMBOL | CHARACTERISTIC | 2N3802 2N3808 MIN. | MAX. | 2N3803 2N3809 MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $I_{CBO}$ | Collector Cutoff Current | | 10 | | 10 | nA | $V_{CB}$ = −50 V, $I_E$ = 0 |
| | | | 10 | | 10 | μA | $V_{CB}$ = −50 V, $I_E$ = 0, $T_A$ = 150°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 20 | | 20 | nA | $V_{EB}$ = −4.0 V |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −5.0 | | −5.0 | | V | $I_C$ = 0, $I_E$ = 10 μA |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −60 | | −60 | | V | $I_E$ = 0, $I_C$ = 10 μA |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 3) | −60 | | −60 | | V | $I_C$ = 10 mA |
| $h_{FE}$ | DC Current Gain | 100 | | 225 | | | $I_C$ = 10 μA, $V_{CE}$ = −5.0 V |
| | | 150 | 450 | 300 | 900 | | $I_C$ = 100 μA, $V_{CE}$ = −5.0 V |
| | | 150 | 450 | 300 | 900 | | $I_C$ = 500 μA, $V_{CE}$ = −5.0 V |
| | | 150 | 450 | 300 | 900 | | $I_C$ = 1.0 mA, $V_{CE}$ = −5.0 V |
| | | 125 | | 250 | | | $I_C$ = 10 mA, $V_{CE}$ = −5.0 V |
| | | 75 | | 150 | | | $I_C$ = 100 μA, $V_{CE}$ = −5.0 V, $T_A$ = −55°C |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage | | −0.7 | | −0.7 | V | $I_C$ = 100 μA, $V_{CE}$ = −5.0 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | | −0.2 | | −0.2 | V | $I_C$ = 100 μA, $I_B$ = 10 μA |
| | | | −0.25 | | −0.25 | V | $I_C$ = 1.0 mA, $I_B$ = 100 μA |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage | | −0.7 | | −0.7 | V | $I_C$ = 100 μA, $I_B$ = 10 μA |
| | | | −0.8 | | −0.8 | V | $I_C$ = 1.0 mA, $I_B$ = 100 μA |
| $\frac{h_{FE1}}{h_{FE2}}$ | Static Forward Current Transfer Ratio | 0.8 | 1.0 | 0.8 | 1.0 | | $V_{CE}$ = −5.0 V, $I_C$ = 0.1 mA |
| $\lvert V_{BE1}-V_{BE2}\rvert$ | Base to Emitter Voltage Differential | | −8.0 | | −8.0 | mV | $V_{CE}$ = −5.0 V, $I_C$ = 10 μA to 10 mA |
| | | | −5.0 | | −5.0 | mV | $V_{CE}$ = −5.0 V, $I_C$ = 100 μA |
| $\lvert\Delta(V_{BE1}-V_{BE2})\rvert$ | Base to Emitter Voltage Differential Gradient | | −2.0 | | −2.0 | mV | $V_{CE}$ = −5.0 V, $I_C$ = 0.1 mA, $T_A$ = +25°C to +125°C |
| | | | −1.6 | | −1.6 | mV | $V_{CE}$ = −5.0 V, $I_C$ = 0.1 mA, $T_A$ = −55°C to +25°C |
| $C_{ob}$ | Output Capacitance | | 4.0 | | 4.0 | pF | $V_{CB}$ = −5.0 V, $I_E$ = 0, f = 100 kHz |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N3802 2N3808 MIN. | MAX. | 2N3803 2N3809 MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $C_{ib}$ | Input Capacitance | | 8.0 | | 8.0 | pF | $V_{EB}$ = −0.5 V, $I_C$ = 0, f = 100 kHz |
| $h_{fe}$ | Magnitude of High Frequency | 1.0 | | 1.0 | | | $I_C$ = 500 μA, $V_{CE}$ = −5.0 V, f = 30 MHz |
| | Current Gain | 1.0 | 5.0 | 1.0 | 5.0 | | $I_C$ = 1.0 mA, $V_{CE}$ = −5.0 V, f = 100 MHz |
| $h_{ie}$ | Input Impedance | 3.0 | 30 | 10 | 40 | kΩ | $V_{CE}$ = −10 V, $I_C$ = 1.0 mA, f = 1.0 kHz |
| $h_{re}$ | Reverse Voltage Feedback Ratio | | 25 | | 25 | $\times 10^{-4}$ | $V_{CE}$ = −10 V, $I_C$ = 1.0 mA, f = 1.0 kHz |
| $h_{oe}$ | Output Conductance | 5.0 | 60 | 5.0 | 60 | μmho | $V_{CE}$ = −10 V, $I_C$ = 1.0 mA, f = 1.0 kHz |
| $h_{fe}$ | Small Signal Current Gain | 150 | 600 | 300 | 900 | | $V_{CE}$ = −10 V, $I_C$ = 1.0 mA, f = 1.0 kHz |
| $RE(h_{ie})$ | Real Part of Common Emitter Small Signal Input Impedance | 3.0 | 30 | 10 | 40 | kΩ | $V_{CE}$ = −10 V, $I_C$ = 1.0 mA, f = 1.0 kHz |
| NF | Noise Figure | | 3.0 | | 1.5 | dB | $I_C$ = 100 μA, $V_{CE}$ = −10 V, f = 1.0 kHz PBW = 200 Hz, $R_G$ = 3.0 kΩ |
| | | | 2.5 | | 1.5 | dB | $I_C$ = 100 μA, $V_{CE}$ = −10 V, f = 10 kHz, PBW = 2.0 kHz, $R_G$ = 3.0 kΩ |
| | | | 7.0 | | 4.0 | dB | $I_C$ = 100 μA, $V_{CE}$ = 10 V, f = 100 Hz, PBW = 20 Hz, $R_G$ = 3.0 kΩ |
| | | | 3.5 | | 2.5 | dB | $I_C$ = 100 μA, $V_{CE}$ = 10 V, $R_G$ = 3.0 kΩ, 3.0 dB down at 10 Hz and 10 kHz PBW = 15.7 kHz |

4

# 2N3804/A • 2N3805/A • 2N3810/A • 2N3811/A

## DUAL PNP LOW LEVEL LOW NOISE DIFFERENTIAL AMPLIFIERS

DIFFUSED SILICON PLANAR* TRANSISTORS

- **$V_{CEO}$ . . . 60 V (MIN)**
- **NF . . . 1.5 dB (MAX) @ 1.0 kHz AND 10 kHz (2N3805/A, 2N3811/A)**

**See Package Outlines**

**TO18-5** **TO5-9**

EBCEBC
123456

CBEEBC
123456

**2N3804/A**
**2N3805/A**

**2N3810/A**
**2N3811/A**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature (Note 2) | −65°C to +200°C |
| Operating Junction Temperature | 200°C |
| Lead Temperature (10 seconds) | 230°C |

**Maximum Power Dissipation**

| | 2N3804/A 2N3805/A | | 2N3810/A 2N3811/A | |
|---|---|---|---|---|
| | **One Side** | **Both Sides** | **One Side** | **Both Sides** |
| Total Dissipation at 25°C Ambient Temperature | 250 mW | 360 mW | 500 mW | 600 mW |
| Linear Derating Factor | 1.43 mW/°C | 2.06 mW/°C | 2.9 mW/°C | 3.4 mW/°C |

**Maximum Voltage and Current** (One side)

| | | |
|---|---|---|
| $V_{EBO}$ | Emitter to Base Voltage | −5.0 V |
| $V_{CBO}$ | Collector to Base Voltage | −60 V |
| $V_{CEO}$ | Collector to Emitter Voltage | −60 V |
| $I_C$ | DC Collector Current | 50 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N3804 2N3810 MIN. | MAX. | 2N3805 2N3811 MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $I_{CBO}$ | Collector Cutoff Current | | 10 | | 10 | nA | $V_{CB}$ = −50 V, $I_C$ = 0 |
| | | | 10 | | 10 | μA | $V_{CB}$ = −50 V, $I_E$ = 0, $T_A$ = 150°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 20 | | 20 | nA | $V_{EB}$ = −4.0 V |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −5.0 | | −5.0 | | V | $I_C$ = 0, $I_E$ = 10 μA |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −60 | | −60 | | V | $I_E$ = 0, $I_C$ = 10 μA |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 3) | −60 | | −60 | | V | $I_C$ = 10 mA |
| $h_{FE}$ | DC Current Gain | 100 | | 225 | | | $I_C$ = 10 μA, $V_{CE}$ = −5.0 V |
| | | 150 | 450 | 300 | 900 | | $I_C$ = 100 μA, $V_{CE}$ = −5.0 V |
| | | 150 | 450 | 300 | 900 | | $I_C$ = 500 μA, $V_{CE}$ = −5.0 V |
| | | 150 | 450 | 300 | 900 | | $I_C$ = 1.0 mA, $V_{CE}$ = −5.0 V |
| | | 125 | | 250 | | | $I_C$ = 10 mA, $V_{CE}$ = −5.0 V |
| | | 75 | | 150 | | | $I_C$ = 100 μA, $V_{CE}$ = −5.0 V, $T_A$ = −55°C |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage | | −0.7 | | −0.7 | V | $I_C$ = 100 μA, $V_{CE}$ = −5.0 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | | −0.2 | | −0.2 | V | $I_C$ = 100 μA, $I_B$ = 10 μA |
| | | | −0.25 | | −0.25 | V | $I_C$ = 1.0 mA, $I_B$ = 100 μA |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage | | −0.7 | | −0.7 | V | $I_C$ = 100 μA, $I_B$ = 10 μA |
| | | | −0.8 | | −0.8 | V | $I_C$ = 1.0 mA, $I_B$ = 100 μA |
| $\frac{h_{FE1}}{h_{FE2}}$ | DC Current Gain Ratio | 0.9 | 1.0 | 0.9 | 1.0 | | $V_{CE}$ = −5.0 V, $I_C$ = 0.1 mA |
| $\lvert V_{BE1}-V_{BE2}\rvert$ | Base to Emitter Voltage Differential | | −5.0 | | −5.0 | mV | $V_{CE}$ = −5.0 V, $I_C$ = 10 μA to 10 mA |
| | | | −3.0 | | −3.0 | mV | $V_{CE}$ = −5.0 V, $I_C$ = 100 μA |
| $\lvert\Delta(V_{BE1}-V_{BE2})\rvert$ | Base to Emitter Voltage Differential Gradient | | −1.0 | | −1.0 | mV | $V_{CE}$ = −5.0 V, $I_C$ = 0.1 mA, $T_A$ = 25°C to 125°C |
| | | | −0.8 | | −0.8 | mV | $V_{CE}$ = −5.0 V, $I_C$ = 0.1 mA, $T_A$ = −55°C to +25°C |

Additional Electrical Characteristics on following pages.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. Emitter Base Termination open.
4. For product family characteristic curves, refer to Section 5-SS33.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N3804 2N3810 MIN. | MAX. | 2N3805 2N3811 MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $C_{ob}$ | Output Capacitance | | 4.0 | | 4.0 | pF | $V_{CB} = -5.0$ V, $I_E = 0$, f = 100 kHz |
| $C_{ib}$ | Input Capacitance | | 8.0 | | 8.0 | pF | $V_{EB} = 0.5$ V, $I_C = 0$, f = 100 kHz |
| $\|h_{fe}\|$ | Magnitude of Common Emitter | 1.0 | | 1.0 | | | $I_C = 500\ \mu A$, $V_{CE} = -5.0$ V, f = 30 MHz |
| | Small Signal Current Gain | 1.0 | 5.0 | 1.0 | 5.0 | | $I_C = 1.0$ mA, $V_{CE} = -5.0$ V, f = 100 MHz |
| $h_{ie}$ | Input Impedance | 3.0 | 30 | 10 | 40 | kΩ | $V_{CE} = -10$ V, $I_C = 1.0$ mA, f = 1.0 kHz |
| $h_{re}$ | Reverse Voltage Feedback Ratio | | 25 | | 25 | $\times 10^{-4}$ | $V_{CE} = -10$ V, $I_C = 1.0$ mA, f = 1.0 kHz |
| $h_{oe}$ | Output Conductance | 5.0 | 60 | 5.0 | 60 | μmho | $V_{CE} = -10$ V, $I_C = 1.0$ mA, f = 1.0 kHz |
| $h_{fe}$ | Small Signal Current Gain | 150 | 600 | 300 | 900 | | $V_{CE} = -10$ V, $I_C = 1.0$ mA, f = 1.0 kHz |
| $RE(h_{ie})$ | Real Part of Common Emitter Small Signal Input Impedance | 3.0 | 30 | 10 | 40 | kΩ | $V_{CE} = -10$ V, $I_C = 1.0$ mA, f = 1.0 kHz |
| NF | Noise Figure | | 3.0 | | 1.5 | dB | $I_C = 100\ \mu A$, $V_{CE} = -10$ V, f = 1.0 kHz, PBW = 200 Hz, $R_G = 3.0$ kΩ |
| | | | 2.5 | | 1.5 | dB | $I_C = 100\ \mu A$, $V_{CE} = -10$ V, f = 10 kHz, PBW = 2.0 kHz, $R_G = 3.0$ kΩ |
| | | | 7.0 | | 4.0 | dB | $I_C = 100\ \mu A$, $V_{CE} = -10$ V, f = 100 Hz, PBW = 20 Hz, $R_G = 3.0$ kΩ |
| | | | 3.5 | | 2.5 | dB | $I_C = 100\ \mu A$, $V_{CE} = -10$ V, $R_G = 3.0$ kΩ 3.0 dB down at 10 Hz and 10 kHz PBW = 15.7 kHz |

| SYMBOL | CHARACTERISTIC | 2N3804A 2N3810A MIN. | MAX. | 2N3805A 2N3811A MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $I_{CBO}$ | Collector Cutoff Current | | 10 | | 10 | nA | $V_{CB} = -50$ V, $I_C = 0$ |
| | | | 10 | | 10 | μA | $V_{CB} = -50$ V, $I_E = 0$, $T_A = 150°C$ |
| $I_{EBO}$ | Emitter Cutoff Current | | 20 | | 20 | nA | $V_{EB} = -4.0$ V |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −5.0 | | −5.0 | | V | $I_C = 0$, $I_E = 10\ \mu A$ |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −60 | | −60 | | V | $I_E = 0$, $I_C = 10\ \mu A$ |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 3) | −60 | | −60 | | V | $I_C = 10$ mA |
| $h_{FE}$ | DC Current Gain | 100 | | 225 | | | $I_C = 10\ \mu A$, $V_{CE} = -5.0$ V |
| | | 150 | 450 | 300 | 900 | | $I_C = 100\ \mu A$, $V_{CE} = -5.0$ V |
| | | 150 | 450 | 300 | 900 | | $I_C = 500\ \mu A$, $V_{CE} = -5.0$ V |
| | | 150 | 450 | 300 | 900 | | $I_C = 1.0$ mA, $V_{CE} = -5.0$ V |
| | | 125 | | 250 | | | $I_C = 10$ mA, $V_{CE} = -5.0$ V |
| | | 75 | | 150 | | | $I_C = 100\ \mu A$, $V_{CE} = -5.0$ V, $T_A = -55°C$ |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage | | −0.7 | | −0.7 | V | $I_C = 100\ \mu A$, $V_{CE} = -5.0$ V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | | −0.2 | | −0.2 | V | $I_C = 100\ \mu A$, $I_B = 10\ \mu A$ |
| | | | −0.25 | | −0.25 | V | $I_C = 1.0$ mA, $I_B = 100\ \mu A$ |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage | | −0.7 | | −0.7 | V | $I_C = 100\ \mu A$, $I_B = 10\ \mu A$ |
| | | | −0.8 | | −0.8 | V | $I_C = 1.0$ mA, $I_B = 100\ \mu A$ |
| $\frac{h_{FE1}}{h_{FE2}}$ | DC Current Gain Ratio | 0.95 | 1.0 | 0.95 | 1.0 | | $V_{CE} = -5.0$ V, $I_C = 0.1$ mA |
| | | 0.85 | 1.0 | 0.85 | 1.0 | | $V_{CE} = -5.0$ V, $I_C = 0.1$ mA, $T_A = -55°C$ to $+125°C$ |

4

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N3804A 2N3810A MIN. | MAX. | 2N3805A 2N3811A MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $\lvert V_{BE1}-V_{BE2}\rvert$ | Base to Emitter Voltage Differential | | −5.0 | | −5.0 | mV | $V_{CE}$ = −5.0 V, $I_C$ = 10 μA to 10 mA |
| | | | −1.5 | | −1.5 | mV | $V_{CE}$ = −5.0 V, $I_C$ = 100 μA |
| $\lvert\Delta(V_{BE1}-V_{BE2})\rvert$ | Base to Emitter Voltage Differential Gradient | | −0.5 | | −0.5 | mV | $V_{CE}$ = −5.0 V, $I_C$ = 0.1 mA $T_A$ = 25°C to 125°C |
| | | | −0.4 | | −0.4 | mV | $V_{CE}$ = −5.0 V, $I_C$ = 0.1 mA $T_A$ = −55°C to +25°C |
| $C_{ob}$ | Output Capacitance | | 4.0 | | 4.0 | pF | $V_{CB}$ = −5.0 V, $I_E$ = 0, f = 100 kHz |
| $C_{ib}$ | Input Capacitance | | 8.0 | | 8.0 | pF | $V_{EB}$ = 0.5 V, $I_C$ = 0, f = 100 kHz |
| $\lvert h_{fe}\rvert$ | Magnitude of Common Emitter Small Signal Current Gain | 1.0 | | 1.0 | | | $I_C$ = 500 μA, $V_{CE}$ = −5.0 V, f = 30 mHz |
| | | 1.0 | 5.0 | 1.0 | 5.0 | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V, f = 100 MHz |
| $h_{ie}$ | Input Impedance | 3.0 | 30 | 10 | 40 | kΩ | $V_{CE}$ = −10 V, $I_C$ = 1.0 mA, f = 1.0 kHz |
| $h_{re}$ | Reverse Voltage Feedback Ratio | | 25 | | 25 | x $10^{-4}$ | $V_{CE}$ = −10 V, $I_C$ = 1.0 mA, f = 1.0 kHz |
| $h_{oe}$ | Output Conductance | 5.0 | 60 | 5.0 | 60 | μmho | $V_{CE}$ = −10 V, $I_C$ = 1.0 mA, f = 1.0 kHz |
| $h_{fe}$ | Small Signal Current Gain | 150 | 600 | 300 | 900 | | $V_{CE}$ = −10 V, $I_C$ = 1.0 mA, f = 1.0 kHz |
| RE($h_{ie}$) | Real Part of Common Emitter Small Signal Input Impedance | 3.0 | 30 | 10 | 40 | kΩ | $V_{CE}$ = −10 V, $I_C$ = 1.0 mA, f = 1.0 kHz |
| NF | Noise Figure | | 3.0 | | 1.5 | dB | $I_C$ = 100 μA, $V_{CE}$ = −10 V, f = 1.0 kHz, PBW = 200 Hz, $R_G$ = 3.0 kΩ |
| | | | 2.5 | | 1.5 | dB | $I_C$ = 100 μA, $V_{CE}$ = −10 V, f = 10 kHz, PBW = 2.0 kHz, $R_G$ = 3.0 kΩ |
| | | | 7.0 | | 4.0 | dB | $I_C$ = 100 μA, $V_{CE}$ = −10 V, f = 100 Hz, PBW = 20 Hz, $R_G$ = 3.0 kΩ |
| | | | 3.5 | | 2.5 | dB | $I_C$ = 100 μA, $V_{CE}$ = −10 V, $R_G$ = 3.0 kΩ, 3 dB down at 10 Hz and 10 kHz PBW = 15.7 kHz |

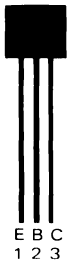
# 2N3903 • 2N3904

## NPN GENERAL PURPOSE SMALL SIGNAL AMPLIFIERS AND SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- $V_{CEO}$ . . . 40 V (MIN)
- $h_{FE}$ . . . 100-300 @ 10 mA (2N3904)
- NF . . . 5.0 dB (MAX) WIDE BAND (2N3904)
- COMPLEMENTS . . . 2N3905, 2N3906

See TO92-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| **†Maximum Temperatures** | |
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |
| **†Maximum Power Dissipation** (Notes 2 & 3) | |
| Total Dissipation at 25°C Ambient Temperature | 0.625 W |
| at 70°C Ambient Temperature | 0.400 W |
| at 25°C Case Temperature | 1.0 W |
| **Maximum Voltages and Current** | |
| $V_{CEO}$ Collector to Emitter Voltage | 40 V |
| $V_{CBO}$ Collector to Base Voltage | 60 V |
| $V_{EBO}$ Emitter to Base Voltage | 6.0 V |
| $I_C$ Collector Current | 200 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N3903 MIN. | 2N3903 MAX. | 2N3904 MIN. | 2N3904 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 60 | | 60 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 4) | 40 | | 40 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 6.0 | | 6.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $I_{CEX}$ | Collector Cutoff Current | | 50 | | 50 | nA | $V_{CE}$ = 30 V, $V_{EB}$ = 3.0 V |
| $I_{BL}$ | Base Cutoff Current | | 50 | | 50 | nA | $V_{CE}$ = 30 V, $V_{EB}$ = 3.0 V |
| $h_{FE}$ | DC Current Gain (Note 4) | 20 | | 40 | | | $I_C$ = 0.1 mA, $V_{CE}$ = 1.0 V |
| | | 35 | | 70 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 1.0 V |
| | | 50 | 150 | 100 | 300 | | $I_C$ = 10 mA, $V_{CE}$ = 1.0 V |
| | | 30 | | 60 | | | $I_C$ = 50 mA, $V_{CE}$ = 1.0 V |
| | | 15 | | 30 | | | $I_C$ = 100 mA, $V_{CE}$ = 1.0 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 4) | | 0.2 | | 0.2 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | 0.3 | | 0.3 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 4) | 0.65 | 0.85 | 0.65 | 0.85 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | 0.95 | | 0.95 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $f_T$ | Current Gain Bandwidth Product | 250 | | 300 | | MHz | $I_C$ = 10 mA, $V_{CE}$ = 20 V, f = 100 MHz |
| $C_{ob}$ | Output Capacitance | | 4.0 | | 4.0 | pF | $I_E$ = 0, $V_{CB}$ = 5.0 V, f = 100 kHz |
| $C_{ib}$ | Input Capacitance | | 8.0 | | 8.0 | pF | $V_{BE}$ = 0.5 V, $I_C$ = 0, f = 100 kHz |
| $h_{ie}$ | Input Impedance | 1.0 | 8.0 | 1.0 | 10 | kΩ | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $h_{re}$ | Voltage Feedback Ratio | 0.1 | 5.0 | 0.5 | 8.0 | $\times 10^{-4}$ | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $h_{fe}$ | Small Signal Current Gain | 50 | 200 | 100 | 400 | | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $h_{oe}$ | Output Admittance | 1.0 | 40 | 1.0 | 40 | μmho | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| NF | Noise Figure | | 6.0 | | 5.0 | dB | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V, $R_G$ = 1.0 kΩ, f = 10 Hz to 15.7 kHz |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

†Fairchild exceeds JEDEC registered value for this parameter.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Pulse conditions: length = 300 μs; duty cycle = 2%.
5. For product family characteristic curves, refer to Section 5-SS14.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N3903 MIN. | 2N3903 MAX. | 2N3904 MIN. | 2N3904 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $t_d$ | Delay Time (see test circuit no. 526) | | 35 | | 35 | ns | $V_{CC}$ = 3.0 V, $V_{BE(OFF)}$ = 0.5 V, $I_C$ = 10 mA, $I_{B1}$ = 1.0 mA |
| $t_r$ | Rise Time (see test circuit no. 526) | | 35 | | 35 | ns | $V_{CC}$ = 3.0 V, $V_{BE(OFF)}$ = 0.5 V, $I_C$ = 10 mA, $I_{B1}$ = 1.0 mA |
| $t_s$ | Storage Time (see test circuit no. 527) | | 175 | | 200 | ns | $V_{CC}$ = 3.0 V, $I_C$ = 10 mA, $I_{B1}$ = $I_{B2}$ = 1.0 mA |
| $t_f$ | Fall Time (see test circuit no. 527) | | 50 | | 50 | ns | $V_{CC}$ = 3.0 V, $I_C$ = 10 mA, $I_{B1}$ = $I_{B2}$ = 1.0 mA |

# 2N3905 • 2N3906

## PNP SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS AND SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- $V_{CEO}$ . . . −40 V (MIN)
- $h_{FE}$ . . . 100-300 @ 10 mA (2N3906)
- NF . . . 4.0 dB (MAX) WIDEBAND (2N3906)
- COMPLEMENTS . . . 2N3903, 2N3904

See TO92-1 Package Outline


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**†Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |
| Lead Temperature (60 seconds) | 260°C |

**†Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Ambient Temperature | 0.625 W |
| at 70°C Ambient Temperature | 0.400 W |
| at 25°C Case Temperature | 1.0 W |

**Maximum Voltages and Current**

| | | |
|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | −40 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | −40 V |
| $V_{EBO}$ | Emitter to Base Voltage | −5.0 V |
| $I_C$ | Collector Current | 200 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N3905 MIN. | 2N3905 MAX. | 2N3906 MIN. | 2N3906 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 30 | | 60 | | | $I_C$ = 0.1 mA, $V_{CE}$ = −1.0 V |
| | | 40 | | 80 | | | $I_C$ = 1.0 mA, $V_{CE}$ = −1.0 V |
| | | 50 | 150 | 100 | 300 | | $I_C$ = 10 mA, $V_{CE}$ = −1.0 V |
| | | 30 | | 60 | | | $I_C$ = 50 mA, $V_{CE}$ = −1.0 V |
| | | 15 | | 30 | | | $I_C$ = 100 mA, $V_{CE}$ = −1.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage | | −0.25 | | −0.25 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | (Note 5) | | −0.4 | | −0.4 | | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage | −0.65 | −0.85 | −0.65 | −0.85 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | (Note 5) | | −0.95 | | −0.95 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $I_{CEX}$ | Collector Cutoff Current | | 50 | | 50 | nA | $V_{CE}$ = −30 V, $V_{EB}$ = −3.0 V |
| $I_{BL}$ | Base Cutoff Current | | 50 | | 50 | nA | $V_{CE}$ = −30 V, $V_{EB}$ = −3.0 V |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −40 | | −40 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 5) | −40 | | −40 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $BV_{EBO}$ | Base to Emitter Breakdown Voltage | −5.0 | | −5.0 | | V | $I_C$ = 0, $I_E$ = 10 μA |
| $C_{ob}$ | Output Capacitance | | 4.5 | | 4.5 | pF | $I_E$ = 0, $V_{CB}$ = −5.0 V, f = 100 kHz |
| $C_{ib}$ | Input Capacitance | | 10 | | 10 | pF | $I_C$ = 0, $V_{EB}$ = −0.5 V, f = 100 kHz |
| $f_T$ | Current Gain Bandwidth Product | 200 | | 250 | | MHz | $I_C$ = 10 mA, $V_{CE}$ = −20 V, f = 100 MHz |
| $t_d$ | Delay Time (see test circuit no. 333) | | 35 | | 35 | ns | $I_C \cong$ 10 mA, $I_{B1} \cong$ 1.0 mA, $V_{CC}$ = −3.0 V |
| $t_r$ | Rise Time (see test circuit no. 333) | | 35 | | 35 | ns | $I_C \cong$ 10 mA, $I_{B1} \cong$ 1.0 mA, $V_{CC}$ = −3.0 V |
| $t_s$ | Storage Time (see test circuit no. 239) | | 200 | | 225 | ns | $I_C \cong$ 10 mA, $I_{B1} \cong$ 1.0 mA, $I_{B2} \cong$ −1.0 mA, $V_{CC}$ = −3.0 V |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.
†Fairchild exceeds JEDEC registered value for this parameter.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 2%.
6. For product family characteristic curves, refer to Section 5 — SS23.

**ELECTRICAL CHARACTERISTICS** (25° C Ambient Temperature unless otherwise noted) **(Cont'd)**

| SYMBOL | CHARACTERISTIC | 2N3905 MIN. | 2N3905 MAX. | 2N3906 MIN. | 2N3906 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $t_f$ | Fall Time (see test circuit no. 239) | | 60 | | 75 | ns | $I_C \cong 10$ mA, $I_{B1} \cong 1.0$ mA, $I_{B2} \cong -1.0$ mA, $V_{CC} = -3.0$ V |
| $h_{ie}$ | Input Impedance | 0.5 | 8.0 | 2.0 | 12 | kΩ | $I_C = 1.0$ mA, $V_{CE} = -10$ V, f = 1.0 kHz |
| $h_{re}$ | Voltage Feedback Ratio | 0.1 | 5.0 | 0.1 | 10 | $\times 10^{-4}$ | $I_C = 1.0$ mA, $V_{CE} = -10$ V, f = 1.0 kHz |
| $h_{fe}$ | Small Signal Current Gain | 50 | 200 | 100 | 400 | | $I_C = 1.0$ mA, $V_{CE} = -10$ V, f = 1.0 kHz |
| $h_{oe}$ | Output Admittance | 1.0 | 40 | 3.0 | 60 | μmho | $I_C = 1.0$ mA, $V_{CE} = -10$ V, f = 1.0 kHz |
| NF | Noise Figure (Wide Band) | | 5.0 | | 4.0 | dB | $I_C = 100$ μA, $V_{CE} = -5.0$ V, $R_S = 1.0$ kΩ, f = 10 Hz to 15.7 kHz |

# 2N3923

## NPN SMALL SIGNAL HIGH VOLTAGE GENERAL PURPOSE AMPLIFIER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- $V_{CEO}$ . . . 150V (MIN)
- $h_{FE}$ . . . 30-120 @ 25 mA
- $f_T$ . . . 40 MHz (MIN)
- $C_{ob}$ . . . 3.5 pF (MAX)

See TO5-1 Package Outline


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | -65°C to +200°C |
| Operating Junction Temperature | | 200°C |
| Lead Temperature (60 seconds) | | 300°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Case Temperature | | 3.0 W |
| at 25°C Ambient Temperature | | 0.8 W |
| **Maximum Voltages and Current** | | |
| $V_{CES}$ | Collector to Emitter Voltage | 150 V |
| $V_{CBO}$ | Collector to Base Voltage | 150 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 150 V |
| $V_{EBO}$ | Emitter to Base Voltage | 6.0 V |
| $I_C$ | Collector Current | 100 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN | MAX | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 30 | 120 | | $I_C$ = 25 mA, $V_{CE}$ = 10 V |
| | | 15 | | | $I_C$ = 25 mA, $V_{CE}$ = 10 V, $T_A$ = -55°C |
| $h_{FE}$ | DC Current Gain | 15 | | | $I_C$ = 100 μA, $V_{CE}$ = 10 V |
| $V_{CEO\ (sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | 150 | | V | $I_C$ = 10 mA (pulsed), $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 150 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | 150 | | V | $I_C$ = 100 μA, $V_{EB}$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 6.0 | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $V_{BE\ (sat)}$ | Base Saturation Voltage (Note 5) | | 0.9 | V | $I_C$ = 25 mA, $I_B$ = 2.5 mA |
| $V_{CE\ (sat)}$ | Collector Saturation Voltage (Note 5) | | 1.0 | V | $I_C$ = 25 mA, $I_B$ = 2.5 mA |
| $I_{CBO}$ | Collector Cutoff Current | | 10 | nA | $I_E$ = 0, $V_{CB}$ = 100 V |
| | | | 10 | μA | $I_E$ = 0, $V_{CB}$ = 100 V, $T_A$ = 150°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 50 | nA | $I_C$ = 0, $V_{EB}$ = 4.0 V |
| $h_{fe}$ | High Frequency Current Gain | 2.0 | | | $I_C$ = 10 mA, $V_{CE}$ = 10 V, f = 20 MHz |
| $h_{fe}$ | Small Signal Current Gain | 20 | | | $I_C$ = 25 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $C_{ob}$ | Output Capacitance | | 3.5 | pF | $I_E$ = 0, $V_{CB}$ = 20 V, f = 1.0 MHz |
| $C_{ib}$ | Input Capacitance | | 25 | pF | $I_C$ = 0, $V_{EB}$ = 0.5 V, f = 1.0 MHz |
| RE ($h_{ie}$) | Real Part of Input Impedance | | 50 | Ω | $I_C$ = 10 mA, $V_{CE}$ = 10 V, f = 300 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 58°C/W (derating factor of 17.2 mW/°C); junction to ambient thermal resistance of 219°C/W (derating factor of 4.56 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5-SS16.

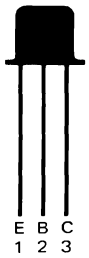
# 2N3946 • 2N3947

## NPN SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS AND SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $V_{CEO}$ . . . 40 V (MIN)
- $h_{FE}$ . . . 100-300 @ 10 mA (2N3947)
- NF . . . 5.0 dB (MAX) WIDE BAND (2N3947)
- COMPLEMENTS . . . 2N3250, 2N3251

See TO18-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65° C to +200° C |
| Operating Junction Temperature | | 200° C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25° C Ambient Temperature | | 0.36 mW |
| at 25° C Case Temperature | | 1.2 W |
| **Maximum Voltages and Current** | | |
| $V_{CEO}$ | Collector to Emitter Voltage | 40 V |
| $V_{CBO}$ | Collector to Base Voltage | 60 V |
| $V_{EBO}$ | Emitter to Base Voltage | 6.0 V |
| $I_C$ | Collector Current | 200 mA |

**ELECTRICAL CHARACTERISTICS** (25° C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N3946 MIN. | 2N3946 MAX. | 2N3947 MIN. | 2N3947 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 60 | | 60 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 4) | 40 | | 40 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 6.0 | | 6.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $I_{CEX}$ | Collector Cutoff Current | | 10 | | 10 | nA | $V_{CE}$ = 40 V, $V_{EB}$ = 3.0 V |
| | | | 15 | | 15 | μA | $V_{CE}$ = 40 V, $V_{EB}$ = 3.0 V, $T_A$ = 150° C |
| $I_{BL}$ | Base Cutoff Current | | 25 | | 25 | nA | $V_{CE}$ = 40 V, $V_{EB}$ = 3.0 V |
| $h_{FE}$ | DC Current Gain (Note 4) | 30 | | 60 | | | $I_C$ = 0.1 mA, $V_{CE}$ = 1.0 V |
| | | 45 | | 90 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 1.0 V |
| | | 50 | 150 | 100 | 300 | | $I_C$ = 10 mA, $V_{CE}$ = 1.0 V |
| | | 20 | | 40 | | | $I_C$ = 50 mA, $V_{CE}$ = 1.0 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 4) | | 0.2 | | 0.2 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | 0.3 | | 0.3 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 4) | 0.6 | 0.9 | 0.6 | 0.9 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | 1.0 | | 1.0 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $h_{fe}$ | Current Gain Bandwidth Product | 2.5 | | 3.0 | | | $I_C$ = 10 mA, $V_{CE}$ = 20 V, f = 100 MHz |
| $C_{ob}$ | Output Capacitance | | 4.0 | | 4.0 | pF | $I_E$ = 0, $V_{CB}$ = 10 V, f = 100 kHz |
| $C_{ib}$ | Input Capacitance | | 8.0 | | 8.0 | pF | $V_{EB}$ = 1.0 V, $I_C$ = 0, f = 100 kHz |
| $h_{ie}$ | Input Impedance | 0.5 | 6.0 | 2.0 | 12 | kΩ | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $h_{re}$ | Voltage Feedback Ratio | | 10 | | 20 | $x10^{-4}$ | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $h_{fe}$ | Small Signal Current Gain | 50 | 250 | 100 | 700 | | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $h_{oe}$ | Output Admittance | 1.0 | 30 | 5.0 | 50 | μmhos | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| NF | Noise Figure | | 5.0 | | 5.0 | dB | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V, $R_G$ = 1.0 kΩ f = 10 Hz to 15.7 kHz |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on application involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200° C and junction to ambient thermal resistance of 486° C/W (derating factor of 2.06 mW/° C); junction to case thermal resistance of 146° C/W (derating factor of 6.9 mW/° C).
4. Pulse conditions: length = 300 μs; duty cycle = 2%.
5. For product family characteristic curves, refer to Section 5 — SS14.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N3946 MIN. | 2N3946 MAX. | 2N3947 MIN. | 2N3947 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $t_d$ | Delay Time (see test circuit no. 526) | | 35 | | 35 | ns | $V_{CC}$ = 3.0 V, $V_{BE(OFF)}$ = 0.5 V, $I_C$ = 10 mA, $I_{B1}$ = 1.0 mA |
| $t_r$ | Rise Time (see test circuit no. 526) | | 300 | | 300 | ns | $V_{CC}$ = 3.0 V, $V_{BE(OFF)}$ = 0.5 V, $I_C$ = 10 mA, $I_{B1}$ = 1.0 mA |
| $t_s$ | Storage Time (see test circuit no. 527) | | 300 | | 375 | ns | $V_{CC}$ = 3.0 V, $I_C$ = 10 mA, $I_{B1}$ = $I_{B2}$ = 1.0 mA |
| $t_f$ | Fall Time (see test circuit no. 527) | | 75 | | 75 | ns | $V_{CC}$ = 3.0 V, $I_C$ = 10 mA, $I_{B1}$ = $I_{B2}$ = 1.0 mA |
| $r_b'C_c$ | Collector to Base Time Constant | | 200 | | 200 | ps | $I_C$ = 10 mA, $V_{CE}$ = 20 V, f = 31.8 MHz |

4

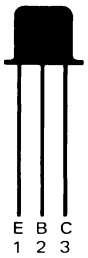
# 2N3962 • 2N3964 • 2N3965

## PNP LOW LEVEL LOW NOISE AMPLIFIERS

SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$V_{CEO}$ . . . −60 V (MIN) (2N3962, 2N3965), 45 V (MIN) (2N3964)**
- **NF . . . 2.0 dB (MAX) @ 1.0 kHz (2N3964, 2N3965)**
  **. . . 4.0 dB (MAX) @ 100 Hz (2N3964, 2N3965)**
- **$h_{FE}$ . . . 180 (MIN) @ 1.0 μA (2N3964, 2N3965)**
  **. . . 250 – 500 @ 10 μA (2N3964, 2N3965)**
  **. . . 250 – 600 @ 1.0 mA (2N3964, 2N3965)**
- **EXCELLENT BETA LINEARITY FROM 1.0 μA TO 50 mA**

**See TO18-1 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Junction Temperature | | 200°C |
| Lead Temperature (60 seconds) | | 300°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Case Temperature | | 1.2 W |
| at 25°C Ambient Temperature | | 0.36 W |
| **Maximum Voltages and Current** | **2N3962, 2N3965** | **2N3964** |
| $V_{CBO}$ Collector to Base Voltage | −60 V | −45 V |
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | −60 V | −45 V |
| $V_{EBO}$ Emitter to Base Voltage | −6.0 V | −6.0 V |
| $I_C$ Collector Current | 200 mA | 200 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N3962 MIN. | 2N3962 MAX. | 2N3964 MIN. | 2N3964 MAX. | 2N3965 MIN. | 2N3965 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 60 | | 180 | | 180 | | | $I_C$ = 1.0 μA, $V_{CE}$ = −5.0 V |
| | | 100 | 300 | 250 | 500 | 250 | 500 | | $I_C$ = 10 μA, $V_{CE}$ = −5.0 V |
| | | 100 | | 250 | | 250 | | | $I_C$ = 100 μA, $V_{CE}$ = −5.0 V |
| | | 100 | 450 | 250 | 600 | 250 | 600 | | $I_C$ = 1.0 mA, $V_{CE}$ = −5.0 V |
| | | 40 | | 100 | | 100 | | | $I_C$ = 10 μA, $V_{CE}$ = −5.0 V, $T_A$ = −55°C |
| | | | 600 | | 800 | | 800 | | $I_C$ = 1.0 mA, $V_{CE}$ = −5.0 V, $T_A$ = 100°C |
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 100 | | 200 | | 200 | | | $I_C$ = 10 mA, $V_{CE}$ = −5.0 V |
| | | 90 | | 180 | | 180 | | | $I_C$ = 50 mA, $V_{CE}$ = −5.0 V |
| | | 45 | | 90 | | 90 | | | $I_C$ = 50 mA, $V_{CE}$ = −5.0 V, $T_A$ = −55°C |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −6.0 | | −6.0 | | −6.0 | | V | $I_C$ = 0, $I_E$ = 10 μA |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −60 | | −45 | | −60 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | −60 | | −45 | | −60 | | V | $I_C$ = 10 μA, $I_B$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | −60 | | −45 | | −60 | | V | $I_C$ = 5.0 mA, $I_B$ = 0 |
| NF | Wide Band Noise Figure | | 3.0 | | 2.0 | | 2.0 | dB | $I_C$ = 20 μA, $V_{CE}$ = −5.0 V, $R_S$ = 10 kΩ, BW = 15.7 kHz, f = 10 Hz to 10 kHz |
| NF | Narrow Band Noise Figure | | 3.0 | | 2.0 | | 2.0 | dB | $I_C$ = 20 μA, $V_{CE}$ = −5.0 V, $R_S$ = 10 kΩ, BW = 1.5 kHz, f = 10 kHz |
| | | | 3.0 | | 2.0 | | 2.0 | dB | $I_C$ = 20 μA, $V_{CE}$ = −5.0 V, $R_S$ = 10 kΩ, BW = 150 Hz, f = 1.0 kHz |
| | | | 10 | | 4.0 | | 4.0 | dB | $I_C$ = 20 μA, $V_{CE}$ = −5.0 V, $R_S$ = 10 kΩ, BW = 15 Hz, f = 100 Hz |
| | | | | | 8.0 | | 8.0 | dB | $I_C$ = 20 μA, $V_{CE}$ = −5.0 V, $R_S$ = 10 kΩ, BW = 2.0 Hz, f = 10 Hz |
| $I_{CES}$ | Collector Reverse Current | | 10 | | | | 10 | nA | $V_{CE}$ = −50 V, $V_{EB}$ = 0 |
| | | | | | 10 | | | nA | $V_{CE}$ = −40 V, $V_{EB}$ = 0 |
| | | | 10 | | | | 10 | μA | $V_{CE}$ = −50 V, $V_{EB}$ = 0 $T_A$ = 150°C |
| | | | | | 10 | | | μA | $V_{CE}$ = −40 V, $V_{EB}$ = 0, $T_A$ = 150°C |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 146°C/W (derating factor of 6.85 mW/°C); junction to ambient thermal resistance of 486°C/W (derating factor of 2.06 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves refer to Section 5-SS33.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont.)

| SYMBOL | CHARACTERISTIC | 2N3962 | | 2N3964 | | 2N3965 | | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| | | MIN. | MAX. | MIN. | MAX. | MIN. | MAX. | | |
| $I_{EBO}$ | Emitter Cutoff Current | | 10 | | 10 | | 10 | nA | $I_C = 0$, $V_{EB} = -4.0$ V |
| $V_{CE(sat)}$ | Collector Saturation Voltage | | −0.25 | | −0.25 | | −0.25 | V | $I_C = 10$ mA, $I_B = 0.5$ mA |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | −0.4 | | −0.4 | | −0.4 | V | $I_C = 50$ mA, $I_B = 5.0$ mA |
| $V_{BE(sat)}$ | Base Saturation Voltage | | −0.9 | | −0.9 | | −0.9 | V | $I_C = 10$ mA, $I_B = 0.5$ mA |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 5) | | −0.95 | | −0.95 | | −0.95 | V | $I_C = 50$ mA, $I_B = 5.0$ mA |
| $h_{ie}$ | Input Resistance | 2.5 | 17 | 6.0 | 20 | 6.0 | 20 | kΩ | $I_C = 1.0$ mA, $V_{CE} = -5.0$ V, f = 1.0 kHz |
| $h_{oe}$ | Output Conductance | 5.0 | 40 | 5.0 | 50 | 5.0 | 50 | μmho | $I_C = 1.0$ mA, $V_{CE} = -5.0$ V, f = 1.0 kHz |
| $h_{re}$ | Voltage Feedback Ratio | | 10 | | 10 | | 10 | $\times 10^{-4}$ | $I_C = 1.0$ mA, $V_{CE} = -5.0$ V, f = 1.0 kHz |
| $h_{fe}$ | Small Signal Current Gain | 100 | 550 | 250 | 700 | 250 | 700 | | $I_C = 1.0$ mA, $V_{CE} = -5.0$ V, f = 1.0 kHz |
| $h_{fe}$ | High Frequency Current Gain | 2.0 | 8.0 | 2.5 | 8.0 | 2.5 | 8.0 | | $I_C = 0.5$ mA, $V_{CE} = -5.0$ V, f = 20 MHz |
| $C_{ob}$ | Open Circuit Output Capacitance | | 6.0 | | 6.0 | | 6.0 | pF | $I_E = 0$, $V_{CB} = -5.0$ V, f = 1.0 MHz |
| $C_{ib}$ | Open Circuit Input Capacitance | | 15 | | 15 | | 15 | pF | $I_C = 0$, $V_{EB} = -0.5$ V, f = 1.0 MHz |

4

# 2N4017 • 2N4018 • 2N4019

## DUAL PNP HIGH GAIN LOW NOISE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$LV_{CEO}$ . . . 80 V (MIN), 2N4017**
- **$h_{FE}$ . . . 250 (MIN) @ 10 μA, 2N4019**
- **NF . . . 4.0 dB (MAX) @ 100 Hz; 8.0 dB (MAX) @ 10 Hz, 2N4019**

**See TO5-9 Package Outline**

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123456

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Junction Temperature | 200°C |
| Lead Temperature (60 seconds) | 300°C |

| **Maximum Power Dissipation** (Notes 2 & 3) | **One Side** | **Both Sides** |
|---|---|---|
| Total Dissipation at 25°C Case Temperature | 0.80 W | 1.3 W |
| at 25°C Ambient Temperature | 0.40 W | 0.60 W |

| **Maximum Voltages and Current for each Transistor** | | **2N4017** | **2N4018** | **2N4019** |
|---|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | −80 V | −60 V | −45 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | −80 V | −60 V | −45 V |
| $V_{EBO}$ | Emitter to Base Voltage | −6.0 V | −6.0 V | −6.0 V |
| $I_C$ | Collector Current | 200 mA | 200 mA | 200 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N4017 MIN. | 2N4017 MAX. | 2N4018 MIN. | 2N4018 MAX. | 2N4019 MIN. | 2N4019 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 60 | | 60 | | 180 | | | $I_C$ = 1.0 μA, $V_{CE}$ = −5.0 V |
| | | 100 | 350 | 100 | 500 | 250 | 500 | | $I_C$ = 10 μA, $V_{CE}$ = −5.0 V |
| | | 100 | | 100 | | 250 | | | $I_C$ = 100 μA, $V_{CE}$ = −5.0 V |
| | | 100 | 500 | 100 | 600 | 250 | 600 | | $I_C$ = 1.0 mA, $V_{CE}$ = −5.0 V |
| | | | 600 | | 800 | | 800 | | $I_C$ = 1.0 mA, $V_{CE}$ = −5.0 V, $T_A$ = 100°C |
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 100 | | 100 | | 200 | | | $I_C$ = 10 mA, $V_{CE}$ = −5.0 V |
| | | 90 | | 90 | | 180 | | | $I_C$ = 50 mA, $V_{CE}$ = −5.0 V |
| | | 40 | | 40 | | 80 | | | $I_C$ = 50 mA, $V_{CE}$ = −5.0 V, $T_A$ = −55°C |
| | | 40 | | 40 | | 100 | | | $I_C$ = 10 μA, $V_{CE}$ = −5.0 V, $T_A$ = −55°C |
| NF | Noise Figure | | | | | | 8.0 | dB | $I_C$ = 20 μA, $V_{CE}$ = −5.0 V, f = 10 Hz, BW = 2.0 Hz, $R_S$ = 10 kΩ |
| | | | 3.0 | | 3.0 | | 2.0 | dB | $I_C$ = 20 μA, $V_{CE}$ = −5.0 V, f = 1.0 kHz, BW = 150 Hz, $R_S$ = 10 kΩ |
| | | | 10 | | 10 | | 4.0 | dB | $I_C$ = 20 μA, $V_{CE}$ = −5.0 V, f = 100 Hz, BW = 15 Hz, $R_S$ = 10 kΩ |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −80 | | −60 | | −45 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | −80 | | −60 | | −45 | | V | $I_C$ = 5.0 mA (pulsed), $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −6.0 | | −6.0 | | −6.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $V_{CE(sat)}$ | Collector Saturation Breakdown Voltage (pulsed) (Note 5) | | −0.25 | | −0.25 | | −0.25 | V | $I_C$ = 10 mA, $I_B$ = 0.5 mA |
| | | | −0.4 | | −0.4 | | −0.4 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to ambient thermal resistance of 437°C/W (derating factor of 2.3 mW/°C) for one side; 292°C/W (derating factor of 3.4 mW/°C) for both sides; junction to case thermal resistance of 219°C/W (derating factor of 4.57 mW/°C) for one side; 135 C/W (derating factor of 7.4 mW/°C) for both sides.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 - SS33.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N4017 MIN. | 2N4017 MAX. | 2N4018 MIN. | 2N4018 MAX. | 2N4019 MIN. | 2N4019 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $V_{BE(sat)}$ | Base Saturation Voltage | | –0.9 | | –0.9 | | –0.9 | V | $I_C$ = 10 mA, $I_B$ = 0.5 mA |
| | (pulsed) (Note 5) | | –0.95 | | –0.95 | | –0.95 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $I_{CBO}$ | Collector Cutoff Current | | 10 | | | | | nA | $I_E$ = 0, $V_{CB}$ = –70 V |
| | | | | | 10 | | | nA | $I_E$ = 0, $V_{CB}$ = –50 V |
| | | | | | | | 10 | nA | $I_E$ = 0, $V_{CB}$ = –30 V |
| | | | 10 | | | | | μA | $I_E$ = 0, $V_{CB}$ = –70 V, $T_A$ = 125°C |
| | | | | | 10 | | | μA | $I_E$ = 0, $V_{CB}$ = –50 V, $T_A$ = 125°C |
| | | | | | | | 10 | μA | $I_E$ = 0, $V_{CB}$ = –30 V, $T_A$ = 125°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 10 | | 10 | | 10 | nA | $I_C$ = 0, $V_{EB}$ = –4.0 V |
| $h_{fe}$ | High Frequency Current Gain | 2.0 | 8.0 | 2.0 | 8.0 | 2.5 | 8.0 | | $I_C$ = 0.5 mA, $V_{CE}$ = –5.0 V f = 20 MHz |
| $C_{ob}$ | Output Capacitance | | 6.0 | | 6.0 | | 6.0 | pF | $I_E$ = 0, $V_{CB}$ = –5.0 V, f = 1.0 MHz |
| $h_{fe}$ | Small Signal Current Gain | 100 | 550 | 100 | 700 | 250 | 700 | | $I_C$ = 1.0 mA, $V_{CE}$ = –5.0 V, f = 1.0 kHz |
| $h_{ie}$ | Input Resistance | 2.5 | 17 | 2.5 | 20 | 6.0 | 20 | kΩ | $I_C$ = 1.0 mA, $V_{CE}$ = –5.0 V, f = 1.0 kHz |
| $h_{oe}$ | Output Conductance | 5.0 | 40 | 5.0 | 50 | 5.0 | 50 | μmhos | $I_C$ = 1.0 mA, $V_{CE}$ = –5.0 V, f = 1.0 kHz |
| $h_{re}$ | Voltage Feedback Ratio | | 10 | | 10 | | 10 | $\times 10^{-4}$ | $I_C$ = 1.0 mA, $V_{CE}$ = –5.0 V, f = 1.0 kHz |

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# 2N4020 through 2N4025

## DUAL PNP HIGH GAIN LOW NOISE DIFFERENTIAL AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $V_{CEO}$ . . . 45 V AND 60 V (MIN)
- NF . . . 4.0 dB (MAX) @ 100 Hz

See TO5-9 Package Outline

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**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Junction Temperature | | 200°C |
| Lead Temperature (60 seconds) | | 300°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | **One Side** | **Both Sides** |
| Total Dissipation at 25°C Case Temperature | 0.80 W | 1.3 W |
| at 25°C Ambient Temperature | 0.40 W | 0.60 W |
| **Maximum Voltages and Current** | **2N4021, 2N4022 2N4024, 2N4025** | **2N4020 2N4023** |
| $V_{CBO}$ Collector to Base Voltage | −60 V | −45 V |
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | −60 V | −45 V |
| $V_{EBO}$ Emitter to Base Voltage | −6.0 V | −6.0 V |
| $I_C$ Collector Current | 200 mA | 200 mA |

**MATCHING CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N4020/1/2 MIN. | 2N4020/1/2 MAX. | 2N4023/4/5 MIN. | 2N4023/4/5 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $\frac{h_{FE1}}{h_{FE2}}$ | DC Current Gain Ratio (Note 5) | 0.8 | 1.0 | 0.9 | 1.0 | | $I_C$ = 100 μA to 1.0 mA, $V_{CE}$ = −5.0 V |
| $\lvert V_{BE1}-V_{BE2}\rvert$ | Base to Emitter Voltage Differential | | 5.0 | | 3.0 | mV | $I_C$ = 100 μA, $V_{CE}$ = −5.0 V |
| | | | 10 | | 5.0 | mV | $I_C$ = 100 μA to 1.0 mA, $V_{CE}$ = −5.0 V |
| $\lvert\Delta(V_{BE1}-V_{BE2})\rvert$ | Base to Emitter Voltage Differential Change | | 1.6 | | 0.8 | mV | $I_C$ = 100 μA, $V_{CE}$ = −5.0 V, $T_A$ = −55°C to +25°C |
| | | | 2.0 | | 1.0 | mV | $I_C$ = 100 μA, $V_{CE}$ = −5.0 V, $T_A$ = +25°C to +125°C |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N4021 2N4024 MIN. | 2N4021 2N4024 MAX. | 2N4020/2 2N4023/5 MIN. | 2N4020/2 2N4023/5 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 60 | | 180 | | | $I_C$ = 1.0 μA, $V_{CE}$ = −5.0 V |
| | | 100 | 350 | 250 | 500 | | $I_C$ = 10 μA, $V_{CE}$ −5.0 V |
| | | 40 | | 100 | | | $I_C$ = 10 μA, $V_{CE}$ = −5.0 V, $T_A$ = −55°C |
| | | 100 | 400 | 250 | 550 | | $I_C$ = 100 μA, $V_{CE}$ = −5.0 V |
| | | 100 | 500 | 250 | 600 | | $I_C$ = 1.0 mA, $V_{CE}$ = −5.0 V, |
| | | | 600 | | 800 | | $I_C$ = 1.0 mA, $V_{CE}$ = −5.0 V, $T_A$ = 100°C |
| $h_{FE}$ | DC Pulse Current Gain (Note 6) | 100 | | 200 | | | $I_C$ = 10 mA, $V_{CE}$ = −5.0 V |
| | | 90 | | 180 | | | $I_C$ = 50 mA, $V_{CE}$ = −5.0 V |
| | | 40 | | 80 | | | $I_C$ = 50 mA, $V_{CE}$ = 5.0 V, $T_A$ = −55°C |

Additional Electrical Characteristics on following page.

NOTES:

*Planar is a patented Fairchild process.

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to ambient thermal resistance of 437°C/W (derating factor of 2.3 mW/°C) for one side; 292°C/W (derating factor of 3.4 mW/°C) for both sides; junction to case thermal resistance of 2.9°C/W (derating factor of 4.56 mW/°C) for one side; 135°C/W (derating factor of 7.4 mW/°C) for both sides.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Lowest of two $h_{FE}$ ratings is taken as $h_{FE1}$ for purpose of this ratio.
6. Pulse conditions: length = 300 μs; duty cycle = 1%.
7. For product family characteristic curves, refer to Section 5 - SS33.

# 2N4020 through 2N4025

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N4021 2N4024 MIN. | 2N4021 2N4024 MAX. | 2N4020/2 2N4023/5 MIN. | 2N4020/2 2N4023/5 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| NF | Noise Figure | | 3.0 | | 2.0 | dB | $I_C$ = 20 μA, $V_{CE}$ = 5.0 V, f = 1.0 kHz $R_S$ = 10 kΩ, BW = 150 Hz |
| | | | | | 8.0 | dB | $I_C$ = 20 μA, $V_{CE}$ = −5.0 V, f = 10 Hz, $R_S$ = 10 kΩ, BW = 2.0 Hz |
| | | | 10 | | 4.0 | dB | $I_C$ = 20 μA, $V_{CE}$ = −5.0 V, f = 100 Hz, $R_S$ = 10 kΩ, BW = 15 Hz |
| $V_{CE(sat)}$ | Collector Saturation Voltage | | −0.25 | | −0.25 | V | $I_C$ = 10 mA, $I_B$ = 0.5 mA |
| | (Note 6) | | −0.4 | | −0.4 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $V_{BE}$ | Base Saturation Voltage | | −0.9 | | −0.9 | V | $I_C$ = 10 mA, $I_B$ = 0.5 mA |
| | (Note 6) | | −0.95 | | −0.95 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $C_{ob}$ | Common Base, Open Circuit Output Capacitance | | 6.0 | | 6.0 | pF | $I_E$ = 0, $V_{CB}$ = −5.0 V, f = 1.0 MHz |
| $C_{ib}$ | Common Base, Open Circuit Input Capacitance | | 15 | | 15 | pF | $I_C$ = 0, $V_{EB}$ = −0.5 V, f = 1.0 MHz |
| $h_{fe}$ | High Frequency Current Gain | 2.0 | 8.0 | 2.5 | 8.0 | | $I_C$ = 0.5 mA, $V_{CE}$ = −5.0 V, f = 20 MHz |
| $h_{ie}$ | Input Resistance | 2.5 | 17 | 6.0 | 20 | kΩ | $I_C$ = 1.0 mA, $V_{CE}$ = −5.0 V, f = 1.0 kHz |
| $h_{oe}$ | Output Conductance | 5.0 | 40 | 5.0 | 50 | μmho | $I_C$ = 1.0 mA, $V_{CE}$ = −5.0 V, f = 1.0 kHz |
| $h_{re}$ | Reverse Voltage Feedback Ratio | | 10 | | 10 | $\times 10^{-4}$ | $I_C$ = 1.0 mA, $V_{CE}$ = −5.0 V, f = 1.0 kHz |
| $h_{fe}$ | Small Signal Current Gain | 100 | 550 | 250 | 700 | | $I_C$ = 1.0 mA, $V_{CE}$ = −5.0 V, f = 1.0 kHz |

| SYMBOL | CHARACTERISTIC | 2N4020 2N4023 MIN. | 2N4020 2N4023 MAX. | 2N4021/2 2N4024/5 MIN. | 2N4021/2 2N4024/5 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $I_{CBO}$ | Collector Cutoff Current | | 10 | | | nA | $I_E$ = 0, $V_{CB}$ = −30 V |
| | | | | | 10 | nA | $I_E$ = 0, $V_{CB}$ = −50 V |
| | | | 10 | | | μA | $I_E$ = 0, $V_{CB}$ = −30 V, $T_A$ = 125°C |
| | | | | | 10 | μA | $I_E$ = 0, $V_{CB}$ = −50 V, $T_A$ = 125°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 10 | | 10 | nA | $I_C$ = 0, $V_{CB}$ = −40 V |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −45 | | −60 | | V | $I_E$ = 0, $I_C$ = 10 μA |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 6) | −45 | | −60 | | V | $I_C$ = 5.0 mA, $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −6.0 | | −6.0 | | V | $I_C$ = 0, $I_E$ = 10 μA |

4

# 2N4030 • 2N4031 • 2N4032 • 2N4033

## PNP SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$V_{CEO}$ . . . 60 V (MIN) (2N4030, 2N4032), 80 V (MIN) (2N4031, 2N4033)**
- **$h_{FE}$ . . . 100-300 @ 100 mA, (2N4032, 2N4033), 40 (MIN) (2N4032) 25 (MIN) (2N4033) @ 1.0 A**
- **COMPLEMENTS . . . 2N3107, 2N3108, 2N3109, 2N3020**

**See TO5-1 Package Outline**


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Junction Temperature | 200°C |
| Lead Temperature (60 seconds) | 300°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 4.0 W |
| at 25°C Ambient Temperature | 0.8 W |

**Maximum Voltages and Current**

| | | **2N4030 2N4032** | **2N4031 2N4033** |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | −60 V | −80 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | −60 V | −80 V |
| $V_{EBO}$ | Emitter to Base Voltage | −5.0 V | −5.0 V |
| $I_C$ | Collector Current | 1.0 | 1.0 |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N4030 MIN. | 2N4030 MAX. | 2N4031 MIN. | 2N4031 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 30 | | 30 | | | $I_C$ = 100 μA, $V_{CE}$ = −5.0 V |
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 40 | 120 | 40 | 120 | | $I_C$ = 100 mA, $V_{CE}$ = −5.0 V |
| | | 25 | | 25 | | | $I_C$ = 500 mA, $V_{CE}$ = −5.0 V |
| | | 15 | | 10 | | | $I_C$ = 1.0 A, $V_{CE}$ = −5.0 V |
| | | 15 | | 15 | | | $I_C$ = 100 mA, $V_{CE}$ = −5.0 V, $T_A$ = −55°C |
| $\|h_{fe}\|$ | Magnitude of Common Emitter Small Signal Current Gain | 1.0 | 4.0 | 1.0 | 4.0 | | $I_C$ = 50 mA, $V_{CE}$ = −10 V, f = 100 MHz |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −5.0 | | −5.0 | | V | $I_C$ = 0, $I_E$ = 10 μA |
| $C_{cb}$ | Collector to Base Capacitance | | 20 | | 20 | pF | $I_E$ = 0, $V_{CB}$ = −10 V, f = 1.0 MHz |
| $C_{ib}$ | Input Capacitance | | 110 | | 110 | pF | $I_C$ = 0, $V_{EB}$ = −0.5 V, f = 1.0 MHz |
| $t_{on}$ | Turn On Time (see test circuit no. 341) | | 100 | | 100 | ns | $I_C \approx$ 500 mA, $I_{B1} \approx$ 50 mA |
| $t_s$ | Storage Time (see test circuit no. 341) | | 350 | | 350 | ns | $I_C \approx$ 500 mA, $I_{B1} \approx -I_{B2} \approx$ 50 mA |
| $t_f$ | Fall Time (see test circuit no. 341) | | 50 | | 50 | ns | $I_C \approx$ 500 mA, $I_{B1} \approx -I_{B2} \approx$ 50 mA |
| $V_{CE\ (sat)}$ | Collector Saturation Voltage (Note 5) | | −0.15 | | −0.15 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | | | −0.5 | | −0.5 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| | | | −1.0 | | | V | $I_C$ = 1.0 A, $I_B$ = 100 mA |
| $V_{BE\ (sat)}$ | Base Saturation Voltage (Note 5) | | −0.9 | | −0.9 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| $V_{BE\ (ON)}$ | Base to Emitter Voltage (Note 5) | | −1.1 | | −1.1 | V | $I_C$ = 500 mA, $V_{CE}$ = −0.5 V |
| | | | −1.2 | | | V | $I_C$ = 1.0 A, $V_{CE}$ = −1.0 V |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −60 | | −80 | | V | $I_E$ = 0, $I_C$ = 10 μA |
| $V_{CEO}$ | Collector to Emitter Sustaining Voltage (Note 5) | −60 | | −80 | | V | $I_C$ = 10 mA (pulsed), $I_B$ = 0 |
| $I_{EBO}$ | Emitter Current | | 10 | | 10 | μA | $I_C$ = 0, $V_{EB}$ = −5.0 V |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | | | nA | $I_E$ = 0, $V_{CB}$ = −50 V |
| | | | | | 50 | nA | $I_E$ = 0, $V_{CB}$ = −60 V |
| | | | 50 | | | μA | $I_E$ = 0, $V_{CB}$ = −50 V, $T_A$ = 150°C |
| | | | | | 50 | μA | $I_E$ = 0, $V_{CB}$ = −60 V, $T_A$ = 150°C |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 43.7°C/W (derating factor of 22.8 mW/°C); junction to ambient thermal resistance of 219°C/W (derating factor of 4.56 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic vurves, refer to Section 5-SS24.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N4032 MIN. | 2N4032 MAX. | 2N4033 MIN. | 2N4033 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 75 | | 75 | | | $I_C$ = 100 μA, $V_{CE}$ = −5.0 V |
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 100 | 300 | 100 | 300 | | $I_C$ = 100 mA, $V_{CE}$ = −5.0 V |
| | | 70 | | 70 | | | $I_C$ = 500 mA, $V_{CE}$ = −5.0 V |
| | | 40 | | 25 | | | $I_C$ = 1.0 A, $V_{CE}$ = −5.0 V |
| | | 40 | | 40 | | | $I_C$ = 100 mA, $V_{CE}$ = −5.0 V, $T_A$ = −55°C |
| $\|h_{fe}\|$ | Magnitude of Common Emitter Small Signal Current Gain | 1.5 | 5.0 | 1.5 | 5.0 | | $I_C$ = 50 mA, $V_{CE}$ = −10 V, f = 100 MHz |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −5.0 | | −5.0 | | V | $I_C$ = 0, $I_E$ = 10 μA |
| $C_{cb}$ | Collector to Base Capacitance | | 20 | | 20 | pF | $I_E$ = 0, $V_{CB}$ = −10 V, f = 1.0 MHz |
| $C_{ib}$ | Input Capacitance | | 110 | | 110 | pF | $I_C$ = 0, $V_{EB}$ = −0.5 V, f = 1.0 MHz |
| $t_{on}$ | Turn On Time (see test circuit no. 341) | | 100 | | 100 | ns | $I_C \approx$ 500 mA, $I_{B1} \approx$ 50 mA |
| $t_s$ | Storage Time (see test circuit no. 341) | | 350 | | 350 | ns | $I_C \approx$ 500 mA, $I_{B1} \approx I_{B2} \approx$ 50 mA |
| $t_f$ | Fall Time (see test circuit no. 341) | | 50 | | 50 | ns | $I_C \approx$ 500 mA, $I_{B1} \approx I_{B2} \approx$ 50 mA |
| $V_{CE\ (sat)}$ | Collector Saturation Voltage (Note 5) | | −0.15 | | −0.15 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | | | −0.5 | | −0.5 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| | | | | | −1.0 | V | $I_C$ = 1.0 A, $I_B$ = 100 mA |
| $V_{BE\ (sat)}$ | Base Saturation Voltage (Note 5) | | −0.9 | | −0.9 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| $V_{BE\ (ON)}$ | Base to Emitter Voltage (Note 5) | | −1.1 | | −1.1 | V | $I_C$ = 500 mA, $V_{CE}$ = −0.5 V |
| | | | −1.2 | | | V | $I_C$ = 1.0 A, $V_{CE}$ = −1.0 V |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −60 | | −80 | | V | $I_E$ = 0, $I_C$ = 10 μA |
| $V_{CEO}$ | Collector to Emitter Sustraining Voltage (Note 5) | −60 | | −80 | | V | $I_C$ = 10 mA (pulsed), $I_B$ = 0 |
| $I_{EBO}$ | Emitter Current | | 10 | | 10 | μA | $I_C$ = 0, $V_{EB}$ = −5.0 V |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | | | nA | $I_E$ = 0, $V_{CB}$ = −50 V |
| | | | | | 50 | nA | $I_E$ = 0, $V_{CB}$ = −60 V |
| | | | 50 | | | μA | $I_E$ = 0, $V_{CB}$ = −50 V, $T_A$ = 150°C |
| | | | | | 50 | μA | $I_E$ = 0, $V_{CB}$ = −60 V, $T_A$ = 150°C |

4

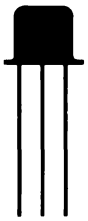
# 2N4034 • 2N4035

## PNP SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS AND SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$V_{CEO}$ . . . –40 V (MIN)**
- **$h_{FE}$ . . . 150-300 @ 10 mA (2N4035)**
- **NF . . . 6.0 dB (MAX) @ 15 MHz**
- **$f_T$ . . . 400 MHz (MIN) (2N4034) 450 MHz (MIN) (2N4035)**
- **COMPLEMENTS . . . 2N3946 AND 2N3947**

**See TO18-1 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | –65°C to 200°C |
| Operating Junction Temperature | 200°C |
| Lead Temperature (60 seconds) | 300°C |

**Maximum Power Disispation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 1.0 W |
| at 25°C Ambient Temperature | 0.36 W |

**Maximum Voltages and Current**

| | | |
|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | –40 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | –40 V |
| $V_{EBO}$ | Emitter to Base Voltage | –5.0 V |
| $I_C$ | Collector Current | 100 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N4034 MIN. | 2N4034 MAX. | 2N4035 MIN. | 2N4035 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 20 | | 70 | | | $I_C$ = 10 μA, $V_{CE}$ = –1.0 V |
| | | 50 | | 140 | | | $I_C$ = 100 μA, $V_{CE}$ = –1.0 V |
| $h_{FE}$ | DC Pulse Current Gain | 70 | 200 | 150 | 300 | | $I_C$ = 10 mA, $V_{CE}$ = –1.0 V |
| | (Note 5) | 15 | | 30 | | | $I_C$ = 50 mA, $V_{CE}$ = –1.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage | | –0.3 | | –0.3 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| | (Pulsed, Note 5) | | –0.14 | | –0.14 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage | –0.7 | –0.9 | –0.7 | –0.9 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | –40 | | –40 | | V | $I_C$ = 10 mA, $I_B$ = 0 (Pulsed) |
| $h_{fe}$ | High Frequency Current Gain | 4.0 | | 4.5 | | | $I_C$ = 10 mA, $V_{CE}$ = –20 V, f = 100 MHz |
| $C_{cb}$ | Collector to Base Output Capacitance | | 3.5 | | 3.5 | pF | $I_E$ = 0, $V_{CB}$ = –10 V |
| $C_{ib}$ | Input Capacitance | | 5.5 | | 5.5 | pF | $I_C$ = 0, $V_{EB}$ = –0.5 V |
| NF | Noise Figure | | 6.0 | | 6.0 | dB | $I_C$ = 1.0 mA, $V_{CE}$ = –5.0 V, $R_S$ = 100 Ω, BW = 15 MHz, f = 100 MHz |
| $r_b'C_c$ | Collector Base Time Constant | | 40 | | 40 | ps | $I_C$ = 10 mA, $V_{CE}$ = –20 V, f = 80 MHz |
| $t_{on}$ | Turn On Time (see test circuit no. 342) | | 40 | | 40 | ns | $I_C$ = 50 mA, $I_{B1}$ = 5.0 mA |
| $t_{off}$ | Turn Off Time (see test circuit no. 342) | | 150 | | 150 | ns | $I_C$ = 50 mA, $I_{B1}$ = $I_{B2}$ = 5.0 mA |
| $h_{FE}$ | DC Current Gain | 60 | | 150 | | | $I_C$ = 1.0 mA, $V_{CE}$ = –1.0 V |
| $h_{FE}$ | Pulse Current Gain (Note 5) | 30 | | 70 | | | $I_C$ = 10 mA, $V_{CE}$ = –1.0 V, $T_A$ = –55°C |
| $V_{CE(sat)}$ | Collector Saturation Voltage | | –0.13 | | –0.13 | V | $I_C$ = 1.0 mA, $I_B$ = 0.1 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage (Pulsed, Note 5) | | –1.1 | | –1.1 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage | | –0.75 | | –0.75 | V | $I_C$ = 1.0 mA, $I_B$ = 0.1 mA |
| $I_{CES}$ | Collector Reverse Current | | 15 | | 15 | nA | $V_{CE}$ = –30 V, $V_{BE}$ = 0 |
| | | | 15 | | 15 | μA | $V_{CE}$ = –30 V, $V_{BE}$ = 0, $T_A$ = 125°C |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 175°C/W (derating factor of 5.71 mW/°C); junction to ambient thermal resistance of 500°C/W (derating factor of 2.06 mW/°C).
4. This rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N4034 MIN. | 2N4034 MAX. | 2N4035 MIN. | 2N4035 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −40 | | −40 | | V | $I_C = 10\ \mu A$, $I_E = 0$ |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | −40 | | −40 | | V | $I_C = 10\ \mu A$, $V_{BE} = 0$ |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −5.0 | | −5.0 | | V | $I_C = 0$, $I_E = 10\ \mu A$ |
| $h_{ie}$ | Input Resistance | 1.0 | 8.0 | 4.0 | 12 | kΩ | $I_C = 1.0$ mA, $V_{CE} = -10$ V, f = 1.0 kHz |
| $h_{oe}$ | Output Conductance | 2.0 | 24 | 8.0 | 40 | μmho | $I_C = 1.0$ mA, $V_{CE} = -10$ V, f = 1.0 kHz |
| $h_{re}$ | Voltage Feedback Ratio | | 3.0 | | 4.0 | | $I_C = 1.0$ mA, $V_{CE} = -10$ V, f = 1.0 kHz |
| $h_{fe}$ | Forward Current Transfer Ratio | 50 | 300 | 150 | 450 | | $I_C = 1.0$ mA, $V_{CE} = -10$ V, f = 1.0 kHz |

4

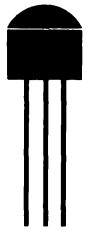
# 2N4121 • 2N4122

## PNP SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS AND SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$h_{FE}$ . . . 150-300 @ 10 mA (2N4122)**
- **$f_T$ . . . 450 MHz (MIN) @ 10 mA (2N4122)**
- **$r_b'C_c$ . . . 50 ps (MAX)**
- **$C_{cb}$ . . . 4.5 pF (MAX)**
- **NF . . . 6.0 dB (MAX) @ 100 MHz**
- **$V_{CEO}$ . . . 40 V (MIN)**

**See TO18-4 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −55°C to +125°C |
| Operating Junction Temperature | | 125°C |
| Lead Temperature (10 seconds) | | 260°C |
| **Maximum Power Dissipation** | | |
| Total Dissipation at 25°C Case Temperature (Notes 2 & 3) | | 0.5 W |
| at 25°C Ambient Temperature (Notes 2 & 3) | | 0.2 W |
| **Maximum Voltages and Current** | | |
| $V_{CBO}$ | Collector to Base Voltage | −40 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | −40 V |
| $V_{EBO}$ | Emitter to Base Voltage | −5.0 V |
| $I_C$ | Collector Current | 100 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N4121 MIN. | 2N4121 MAX. | 2N4122 MIN. | 2N4122 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 40 | | 100 | | | $I_C$ = 100 μA, $V_{CE}$ −1.0 V |
| | | 60 | | 150 | | | $I_C$ = 1.0 mA, $V_{CE}$ = −1.0 V |
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 70 | 200 | 150 | 300 | | $I_C$ = 10 mA, $V_{CE}$ = −1.0 V |
| | | 15 | | 30 | | | $I_C$ = 50 mA, $V_{CE}$ = −1.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage | | −0.13 | | −0.13 | V | $I_C$ = 1.0 mA, $I_B$ = 0.1 mA |
| $V_{CE(sat)}$ | Collector Saturation | | −0.14 | | −0.14 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | Voltage (Note 5) | | −0.3 | | −0.3 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage | | −0.75 | | −0.75 | V | $I_C$ = 1.0 mA, $I_B$ = 0.1 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage | −0.7 | −0.9 | −0.7 | −0.9 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | (Note 5) | | −1.1 | | −1.1 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $t_{on}$ | Turn On Time | | 40 | | 40 | ns | $I_C$ = 50 mA, $I_{B1}$ = 5.0 mA |
| | (see test circuit no. 342) | | | | | | |
| $t_{off}$ | Turn Off Time | | 150 | | 150 | ns | $I_C$ = 50 mA, $I_{B1}$ = 5.0 mA |
| | (see test circuit no. 342) | | | | | | $I_{B2}$ = 5.0 mA |
| $\|h_{fe}\|$ | Magnitude of Small Signal | 4.0 | | 4.5 | | | $I_C$ = 10 mA, $V_{CE}$ = −20 V, f = 100 MHz |
| | Current Gain | | | | | | |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining | −40 | | −40 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| | Voltage (Note 5) | | | | | | (Pulsed) |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −40 | | −40 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{CES}$ | Collector to Emitter Breakdown | −40 | | −40 | | V | $I_C$ = 10 μA, $V_{BE}$ = 0 |
| | Voltage | | | | | | |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −5.0 | | −5.0 | | V | $I_C$ = 0, $I_E$ = 10 μA |
| $I_{CES}$ | Collector Reverse Current | | 25 | | 25 | nA | $V_{CE}$ = −30 V, $V_{BE}$ = 0 |
| $I_{CES}$ | Collector Reverse Current | | 25 | | 25 | μA | $V_{CE}$ = −30 V, $V_{BE}$ = 0, $T_A$ = 65°C |
| $C_{cb}$ | Collector to Base Capacitance | | 4.5 | | 4.5 | pF | $I_E$ = 0, $V_{CB}$ = −10 V |
| $C_{ib}$ | Open Circuit Input Capacitance | | 8.0 | | 8.0 | pF | $I_C$ = 0, $V_{EB}$ = −0.5 V |
| $r_b'C_c$ | Collector to Base Time Constant | | 50 | | 50 | ps | $I_C$ = 10 mA, $V_{CE}$ = −20 V, f = 80 MHz |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/W (derating factor of 2.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 — SS23.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N4121 MIN. | 2N4121 MAX. | 2N4122 MIN. | 2N4122 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| NF | Noise Figure | | 6.0 | | 6.0 | dB | $I_C$ = 1.0 mA, $V_{CE}$ = −5.0 V, $R_S$ = 100 Ω, BW = 15 MHz, f = 100 MHz |
| | | | 4.0 | | 4.0 | dB | $I_C$ = 100 μA, $V_{CE}$ = −5.0 V, $R_S$ = 1.0 kΩ, f = 10 Hz to 10 kHz, BW = 15.7 kHz |
| $h_{ie}$ | Input Resistance | 1.0 | 8.0 | 4.0 | 12 | kΩ | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V, f = 1.0 kHz |
| $h_{oe}$ | Output Conductance | 2.0 | 24 | 8.0 | 40 | μmho | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V, f = 1.0 kHz |
| $h_{re}$ | Voltage Feedback Ratio | | 3.0 | | 4.0 | $x10^{-4}$ | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V, f = 1.0 kHz |
| $h_{fe}$ | Forward Current Transfer Ratio | 50 | 300 | 150 | 450 | | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V, f = 1.0 kHz |

4

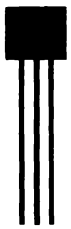
# 2N4123 • 2N4124

## NPN SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS AND SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- $V_{CEO}$ . . . 25 V (MIN) (2N4124)
- $h_{FE}$ . . . 120-360 @ 2.0 mA (2N4124)
- NF . . . 5.0 dB (MAX) WIDE BAND (2N4124)
- COMPLEMENTS . . . 2N4125, 2N4126

See TO92-1 Package Outline



EBC
123

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**†Maximum Temperature**

| | |
|---|---|
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |
| Lead Temperature (60 seconds) | 260°C |

**†Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 1.0 W |
| at 25°C Ambient Temperature | 0.625 W |
| at 70°C Ambient Temperature | 0.400 W |

| **Maximum Voltages and Current** | | **2N4123** | **2N4124** |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 40 V | 30 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 30 V | 25 V |
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V | 5.0 V |
| $I_C$ | Collector Current | 200 mA | 200 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N4123 MIN. | 2N4123 MAX. | 2N4124 MIN. | 2N4124 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Pulse Current Gain | 50 | 150 | 120 | 360 | | $I_C$ = 2.0 mA, $V_{CE}$ = 1.0 V |
| | (Note 5) | 25 | | 60 | | | $I_C$ = 50 mA, $V_{CE}$ = 1.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | 0.3 | | 0.3 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 5) | | 0.95 | | 0.95 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | | 50 | nA | $V_{CB}$ = 20 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 50 | | 50 | nA | $V_{EB}$ = 3.0 V, $I_C$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 40 | | 30 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 5) | 30 | | 25 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $BV_{EBO}$ | Base to Emitter Breakdown Voltage | 5.0 | | 5.0 | | V | $I_C$ = 0, $I_E$ = 10 μA |
| $C_{cb}$ | Collector to Base Capacitance | | 4.0 | | 4.0 | pF | $I_E$ = 0, $V_{CB}$ = 5.0 V, f = 100 kHz |
| $C_{ib}$ | Input Capacitance | | 8.0 | | 8.0 | pF | $I_C$ = 0, $V_{EB}$ = 0.5 V, f = 100 kHz |
| $\|h_{fe}\|$ | Magnitude of Small Signal Current Gain | 2.5 | | 3.0 | | | $I_C$ = 10 mA, $V_{CE}$ = 20 V, f = 100 MHz |
| $h_{fe}$ | Small Signal Current Gain | 50 | 200 | 120 | 480 | | $I_C$ = 2.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| NF | Noise Figure | | 6.0 | | 5.0 | dB | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V, $R_S$ = 1.0 kΩ, f = 10 Hz to 15.7 kHz |

†Fairchild exceeds JEDEC registered values.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 2%.
6. For product family characteristic curves, refer to Section 5 — SS14.

# 2N4125 • 2N4126

## PNP SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS AND SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- $V_{CEO}$ . . . −25 V (MIN) (2N4126)
- $h_{FE}$ . . . 120-360 @ 2.0 mA (2N4126)
- NF . . . 4.0 dB (MAX) WIDEBAND (2N4126)
- COMPLEMENTS . . . 2N4123, 2N4124

See TO92-1 Package Outline


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **†Maximum Temperatures** | | |
| Storage Temperature | | −55°C to +150°C |
| Operating Junction Temperature | | 150°C |
| Lead Temperature (60 seconds) | | 230°C |
| **†Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Case Temperature | | 1.0 W |
| at 25°C Ambient Temperature | | 0.625 W |
| at 70°C Ambient Temperature | | 0.400 W |
| **Maximum Voltages and Current** | **2N4125** | **2N4126** |
| $V_{CBO}$ Collector to Base Voltage | −30 V | −25 V |
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | −30 V | −25 V |
| $V_{EBO}$ Emitter to Base Voltage | −4.0 V | −4.0 V |
| $I_C$ Collector Current | 200 mA | 200 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N4125 MIN. | 2N4125 MAX. | 2N4126 MIN. | 2N4126 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 50 | 150 | 120 | 360 | | $I_C$ = 2.0 mA, $V_{CE}$ = −1.0 V |
| | | 25 | | 60 | | | $I_C$ = 50 mA, $V_{CE}$ = −1.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | −0.4 | | −0.4 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 5) | | −0.95 | | −0.95 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | | 50 | nA | $V_{CB}$ = −20 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 50 | | 50 | nA | $V_{EB}$ = −3.0 V, $I_C$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −30 | | −25 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 5) | −30 | | −25 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −4.0 | | −4.0 | | V | $I_C$ = 0, $I_E$ = 10 μA |
| $C_{cb}$ | Collector to Base Capacitance | | 4.5 | | 4.5 | pF | $I_E$ = 0, $V_{CB}$ = −5.0 V, f = 100 kHz |
| $C_{ib}$ | Input Capacitance | | 10 | | 10 | pF | $I_C$ = 0, $V_{EB}$ = −0.5 V, f = 100 kHz |
| $\|h_{fe}\|$ | Magnitude of Small Signal Current Gain | 2.0 | | 2.0 | | | $I_C$ = 10 mA, $V_{CE}$ = −20 V, f = 100 MHz |
| $h_{fe}$ | Small Signal Current Gain | 50 | 200 | 120 | 480 | | $I_C$ = 2.0 mA, $V_{CE}$ = −1.0 V, f = 1.0 kHz |
| NF | Noise Figure | | 5.0 | | 4.0 | dB | $I_C$ = 100 μA, $V_{CE}$ = −5.0 V, $R_S$ = 1.0 kΩ, f = 10 Hz to 15.7 kHz |

*Planar is a patented Fairchild process.

†Fairchild exceeds JEDEC registered value for this parameter.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 2%.
6. For product family characteristic curves, refer to Section 5 — SS23.

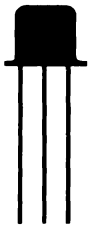
# 2N4208 • 2N4209

## PNP SMALL SIGNAL ULTRA HIGH SPEED SATURATED SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $\tau_s$ . . . 20 ns (MAX)
- $t_{on}$ . . . 15 ns (MAX), $t_{off}$ . . . 20 ns (MAX)
- $C_{ob}$ . . . 3.0 pF (MAX)
- $C_{ib}$ . . . 3.5 pF (MAX)
- $f_T$ . . . 850 MHz (MIN) (2N4209)
- $V_{CE}$ . . . 0.18 V (MAX) @ $I_C$ = 10 mA (2N4209)
- $V_{CEO}$ . . . 15 V (MIN) 2N4209
- COMPLEMENTS . . . 2N2369A

See TO18-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | 2N4208 | 2N4209 |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | −65°C to +200°C | |
| Operating Temperature | | 200°C | |
| Lead Temperature (60 seconds) | | 300°C | |
| **Maximum Power Dissipation** (Notes 2 & 3) | | | |
| Total Dissipation at 25°C Case Temperature | | 0.7 W | |
| at 25°C Ambient Temperature | | 0.3 W | |
| **Maximum Voltages and Current** | | | |
| $V_{CBO}$ | Collector to Base Voltage | −12 V | −15 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | −12 V | −15 V |
| $V_{EBO}$ | Emitter to Base Voltage | −4.5 V | −4.5 V |
| $I_C$ | Collector Current | 50 mA | 50 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N4208 MIN. | 2N4208 MAX. | 2N4209 MIN. | 2N4209 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $\tau_s$ | Charge Storage Time (see test circuit no. 234) | | 20 | | 20 | ns | $I_C$ = 10 mA, $I_{B1}$ = $I_{B2}$ ≈ 10 mA, $V_{CC}$ = −3.0 V |
| $t_{on}$ | Turn On Time (see test circuit no. 348) | | 15 | | 15 | ns | $I_C$ = 10 mA, $I_{B1}$ ≈ 1.0 mA, $V_{CC}$ = −1.5 V |
| $t_{off}$ | Turn Off Time (see test circuit no. 348) | | 20 | | 20 | ns | $I_C$ = 10 mA, $I_{B1}$ = $I_{B2}$ ≈ 1.0 mA, $V_{CC}$ = −1.5 V |
| $C_{ob}$ | Output Capacitance | | 3.0 | | 3.0 | pF | $I_E$ = 0, $V_{CB}$ = −5.0 V |
| $C_{ib}$ | Input Capacitance | | 3.5 | | 3.5 | pF | $I_C$ = 0, $V_{EB}$ = −0.5 V |
| $h_{fe}$ | High Frequency Current Gain | 7.0 | | 8.5 | | | $I_C$ = 10 mA, f = 100 MHz, $V_{CE}$ = −10 V |
| $h_{FE}$ | DC Current Gain | 15 | | 35 | | | $I_C$ = 1.0 mA, $V_{CE}$ = −0.5 V |
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 30 | 120 | 50 | 120 | | $I_C$ = 10 mA, $V_{CE}$ = −0.3 V |
| | | 30 | | 40 | | | $I_C$ = 50 mA, $V_{CE}$ = −1.0 V |
| | | 12 | | 20 | | | $I_C$ = 10 mA, $V_{CE}$ = −0.3 V, $T_A$ = −55°C |
| $V_{CE(sat)}$ | Collector Saturation Voltage | | −0.13 | | −0.15 | V | $I_C$ = 1.0 mA, $I_B$ = 0.1 mA |
| $V_{CE(sat)}$ | Pulsed Collector Saturation Voltage (Note 5) | | −0.15 | | −0.18 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | −0.5 | | −0.6 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage | | −0.8 | | −0.8 | V | $I_C$ = 1.0 mA, $I_B$ = 0.1 mA |
| $V_{BE(sat)}$ | Pulsed Base Saturation Voltage (Note 5) | −0.8 | −0.95 | −0.8 | −0.95 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | −1.5 | | −1.5 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 250°C/W (derating factor of 4.0 mW/°C); junction to ambient thermal resistance of 583°C/W (derating factor of 1.72 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 — SS31.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N4208 MIN. | 2N4208 MAX. | 2N4209 MIN. | 2N4209 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $I_{CES}$ | Collector Reverse Current | | 10 | | | nA | $V_{CE} = -6.0$ V, $V_{BE} = 0$ |
| | | | | | 10 | nA | $V_{CE} = -8.0$ V, $V_{BE} = 0$ |
| | | | 5.0 | | | μA | $V_{CE} = -6.0$ V, $V_{BE} = 0$, $T_A = 125°C$ |
| | | | | | 5.0 | μA | $V_{CE} = -8.0$ V, $V_{BE} = 0$, $T_A = 125°C$ |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −4.5 | | −4.5 | | V | $I_C = 0$, $I_E = 100$ μA |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 5) | −12 | | −15 | | V | $I_C = 3.0$ mA, $I_B = 0$ |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | −12 | | −15 | | V | $I_C = 100$ μA, $V_{BE} = 0$ |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −12 | | −15 | | V | $I_C = 100$ μA, $I_E = 0$ |

4

# 2N4234 • 2N4235 • 2N4236

## 6 WATT PNP POWER

DIFFUSED SILICON BI-MESAR ™ TRANSISTORS

- $V_{CE(sat)}$ . . . 0.6 V @ $I_C$ = 1.0 A
- COMPLEMENTS . . . 2N4237 THROUGH 2N4239

See TO5-1 Package Outline


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Junction Temperature | −65°C to +200°C |

**Maximum Power Dissipation**

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 6.0 W |
| Linear Derating Factor | 34 mW/°C |

| **Maximum Voltages and Currents** | | **2N4234** | **2N4235** | **2N4236** |
|---|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | −40 V | −60 V | −80 V |
| $V_{CEO}$ | Collector to Emitter Voltage | −40 V | −60 V | −80 V |
| $V_{EBO}$ | Emitter to Base Voltage | −7.0 V | −7.0 V | −7.0 V |
| $I_C$ | Collector Current (Continuous) | 1.0 A | 1.0 A | 1.0 A |
| $I_B$ | Base Current (Continuous) | 0.2 A | 0.2 A | 0.2 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 2) | 2N4234 | −40 | | V | $I_C$ = 100 mA, $I_B$ = 0 |
| | | 2N4235 | −60 | | V | $I_C$ = 100 mA, $I_B$ = 0 |
| | | 2N4236 | −80 | | V | $I_C$ = 100 mA, $I_B$ = 0 |
| $I_{CEX}$ | Collector Cutoff Current | 2N4234 | | 100 | μA | $V_{CE}$ = −40 V, $V_{EB}$ = −1.5 V |
| | | 2N4235 | | 100 | μA | $V_{CE}$ = −60 V, $V_{EB}$ = −1.5 V |
| | | 2N4236 | | 100 | μA | $V_{CE}$ = −80 V, $V_{EB}$ = −1.5 V |
| $I_{CEX}$ | Collector Cutoff Current | 2N4234 | | 1.0 | mA | $V_{CE}$ = −30 V, $V_{EB}$ = −1.5 V, $T_C$ = 150°C |
| | | 2N4235 | | 1.0 | mA | $V_{CE}$ = −40 V, $V_{EB}$ = −1.5 V, $T_C$ = 150°C |
| | | 2N4236 | | 1.0 | mA | $V_{CE}$ = −60 V, $V_{EB}$ = −1.5 V, $T_C$ = 150°C |
| $I_{CBO}$ | Collector Cutoff Current | 2N4234 | | 100 | μA | $V_{CB}$ = −40 V, $I_E$ = 0 |
| | | 2N4235 | | 100 | μA | $V_{CB}$ = −60 V, $I_E$ = 0 |
| | | 2N4236 | | 100 | μA | $V_{CB}$ = −80 V, $I_E$ = 0 |
| $I_{CEO}$ | Collector Cutoff Current | 2N4234 | | 1.0 | mA | $V_{CE}$ = −30 V, $I_B$ = 0 |
| | | 2N4235 | | 1.0 | mA | $V_{CE}$ = −40 V, $I_B$ = 0 |
| | | 2N4236 | | 1.0 | mA | $V_{CE}$ = −60 V, $I_B$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | | 500 | μA | $V_{EB}$ = −7.0 V, $I_C$ = 0 |
| $h_{FE}$ | DC Pulsed Current Gain (Note 2) | | 40 | | | $I_C$ = 100 mA, $V_{CE}$ = −1.0 V |
| | | | 30 | 150 | | $I_C$ = 250 mA, $V_{CE}$ = −1.0 V |
| | | | 20 | | | $I_C$ = 500 mA, $V_{CE}$ = −1.0 V |
| | | | 10 | | | $I_C$ = 1.0 A, $V_{CE}$ = −1.0 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 2) | | | −0.6 | V | $I_C$ = 1.0 A, $I_B$ = 125 mA |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 2) | | | −1.5 | V | $I_C$ = 1.0 A, $I_B$ = 100 mA |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage | | | −1.0 | V | $V_{CE}$ = −1.0 V, $I_C$ = 250 mA |
| $\|h_{fe}\|$ | Magnitude of Common Emitter Small Signal Current Gain | | 3.0 | | | $V_{CE}$ = −10 V, $I_C$ = 100 mA, f = 1.0 MHz |
| $h_{fe}$ | Small Signal Current Gain | | 25 | | | $V_{CE}$ = −10 V, $I_C$ = 50 mA, f = 1.0 kHz |
| $C_{ob}$ | Common Base Output Capacitance | | | 100 | pF | $V_{CB}$ = −10 V, $I_E$ = 0, f = 100 kHz |

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. Pulse conditions: length = 300 μs; duty cycle = 2%.
3. For product family characteristic curves, refer to Section 5 - PWR 14.

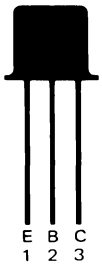
# 2N4237 • 2N4238 • 2N4239

## 5 WATT NPN POWER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $V_{CE(sat)}$ . . . 0.6 V @ $I_C$ = 1.0 A
- COMPLEMENTS . . . 2N4234 THROUGH 2N4236

See TO5-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +200°C |
| Operating Junction Temperature | −55°C to +200°C |
| Lead Temperature (2 seconds) | 230°C |

**Maximum Power Dissipation**

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature (Note 3) | 5.0 W |
| at 25°C Ambient Temperature (Note 3) | 0.8 W |

| **Maximum Voltages and Current** | | **2N4237** | **2N4238** | **2N4239** |
|---|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 50 V | 80 V | 100 V |
| $V_{EBO}$ | Emitter to Base Voltage | 6.0 V | 6.0 V | 6.0 V |
| $V_{CEO}$ | Collector to Emitter Voltage | 40 V | 60 V | 80 V |
| $I_C$ | Collector Current (Note 2) | 1.0 A | 1.0 A | 1.0 A |
| $I_B$ | Base Current (Note 2) | 0.5 A | 0.5 A | 0.5 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| $I_{CEX}$ | Collector Cutoff Current | 2N4237 | | 0.1 | mA | $V_{CE}$ = 50 V, $V_{EB}$ = 1.5 V |
| | | 2N4238 | | 0.1 | mA | $V_{CE}$ = 80 V, $V_{EB}$ = 1.5 V |
| | | 2N4239 | | 0.1 | mA | $V_{CE}$ = 100 V, $V_{EB}$ = 1.5 V |
| $I_{CEX}$ | Collector Cutoff Current | 2N4237 | | 1.0 | mA | $V_{CE}$ = 30 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| | | 2N4238 | | 1.0 | mA | $V_{CE}$ = 50 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| | | 2N4239 | | 1.0 | mA | $V_{CE}$ = 70 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| $I_{CBO}$ | Collector Cutoff Current | 2N4237 | | 0.1 | mA | $V_{CB}$ = 50 V, $I_E$ = 0 |
| | | 2N4238 | | 0.1 | mA | $V_{CB}$ = 80 V, $I_E$ = 0 |
| | | 2N4239 | | 0.1 | mA | $V_{CB}$ = 100 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | | 0.5 | mA | $V_{EB}$ = 6.0 V, $I_C$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 4) | 2N4237 | 40 | | V | $I_C$ = 100 mA, $I_B$ = 0 |
| | | 2N4238 | 60 | | V | $I_C$ = 100 mA, $I_B$ = 0 |
| | | 2N4239 | 80 | | V | $I_C$ = 100 mA, $I_B$ = 0 |
| $I_{CEO}$ | Collector Cutoff Current | 2N4237 | | 1.0 | mA | $V_{CE}$ = 30 V, $I_B$ = 0 |
| | | 2N4238 | | 1.0 | mA | $V_{CE}$ = 40 V, $I_B$ = 0 |
| | | 2N4239 | | 1.0 | mA | $V_{CE}$ = 60 V, $I_B$ = 0 |
| $h_{FE}$ | DC Pulse Current Gain (Note 4) | 2N4237 | 30 | 150 | | $I_C$ = 250 mA, $V_{CE}$ = 1.0 V |
| | | 2N4238 | 30 | | | $I_C$ = 500 mA, $V_{CE}$ = 4.0 V |
| | | 2N4239 | 15 | | | $I_C$ = 1.0 A, $V_{CE}$ = 1.0 V |
| $V_{CE(sat)}$ | Pulsed Collector Saturation Voltage (Note 4) | | | 0.6 | V | $I_C$ = 1.0 A, $I_B$ = 100 mA |
| | | | | 0.3 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| $V_{BE(sat)}$ | Pulsed Base Saturation Voltage (Note 4) | | | 1.5 | V | $I_C$ = 1.0 A, $I_B$ = 100 mA |
| $V_{BE(ON)}$ | Pulsed Base to Emitter "On" Voltage (Note 4) | | | 1.0 | V | $I_C$ = 250 mA, $V_{CE}$ = 1.0 V |
| $\|h_{fe}\|$ | Magnitude of Common Emitter Small Signal Current Gain | | 1.0 | | | $I_C$ = 100 mA, $V_{CE}$ = 10 V, f = 1.0 MHz |
| $h_{fe}$ | Small Signal Current Gain | | 30 | | | $I_C$ = 100 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $C_{ob}$ | Common Base Output Capacitance | | | 100 | pF | $I_C$ = 0, $V_{CB}$ = 10 V, f = 0.1 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 35°C/W (derating factor of 28.5 mW/°C); junction to ambient thermal resistance of 218.8°C/W (derating factor of 4.5 mW/°C).
4. Pulse conditions: length = 300 μs; duty cycle = 2%.
5. For product family characteristic curves, refer to Section 5 - PWR 5.

# 2N4248/9/50 • 2N4250A • PN4248/9/50 • PN4250A

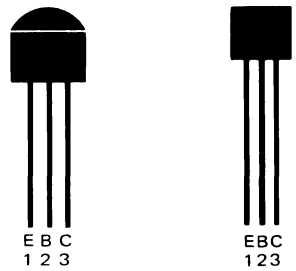
## PNP LOW LEVEL LOW NOISE AMPLIFIERS

DIFFUSED SILICON PLANAR* TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C (PN SERIES)
- NF . . . 2.0 dB (MAX) @ 1.0 kHz (2N/PN4250/A)
- $h_{FE}$ . . . 250-700 @ 100 μA (2N/PN4250/A)
- $V_{CEO}$ . . . 40 V (MIN) 2N4248, 2N4250; 60 V (MIN) 2N4249, 2N4250A
- EXCELLENT BETA LINEARITY FROM 1.0 μA to 50 mA

See Package Outlines

TO18-4 TO92-1




2N4248/9 2N4250/A PN4248/9 PN4250/A

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| **Maximum Temperatures** | **2N4248/9 2N4250/A** | **PN4248/9 PN4250/A** |
|---|---|---|
| Storage Temperature | −55°C to +125°C | −55°C to +150°C |
| Operating Junction Temperature | 125°C | 150°C |
| Lead Temperature (10 seconds) | 260°C | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Case Temperature | 0.5 W | 1.0 W |
| at 25°C Ambient Temperature | 0.2 W | 0.625 W |
| **Maximum Voltages** | **2N/PN4248 2N/PN4250** | **2N/PN4249 2N/PN4250A** |
| $V_{CBO}$ Collector to Base Voltage | −40 V | −60 V |
| $V_{CEO}$ Collector to Emitter Voltage | −40 V | −60 V |
| $V_{CES}$ Collector to Emitter Voltage | −40 V | −60 V |
| $V_{EBO}$ Emitter to Base Voltage | −5.0 V | −5.0 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N4248 PN4248 MIN. | MAX. | 2N4249 PN4249 MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $I_{CBO}$ | Collector Cutoff Current | | 10 | | 10 | nA | $V_{CB}$ = −40 V, $I_E$ = 0 |
| †$I_{CBO}$ | Collector Cutoff Current | | 3.0 | | 3.0 | μA | $V_{CB}$ = −40 V, $I_E$ = 0, $T_A$ = 65°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 20 | | 20 | nA | $V_{EB}$ = −3.0 V, $I_C$ = 0 |
| $h_{FE}$ | DC Current Gain | 50 | | 100 | 300 | | $I_C$ = 100 μA, $V_{CE}$ = −5.0 V |
| †$h_{FE}$ | DC Current Gain | 50 | | 100 | | | $I_C$ = 1.0 mA, $V_{CE}$ = −5.0 V |
| †$h_{FE}$ | DC Pulse Current Gain (Note 5) | 50 | | 100 | | | $I_C$ = 10 mA, $V_{CE}$ = −5.0 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | −0.25 | | −0.25 | V | $I_C$ = 10 mA, $I_B$ = 0.5 mA |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −40 | | −60 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −5.0 | | −5.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | −40 | | −60 | | V | $I_C$ = 10 μA |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 5) | −40 | | −60 | | V | $I_C$ = 5.0 mA (pulsed), $I_B$ = 0 |
| $h_{fe}$ | Small Signal Current Gain | 50 | 1000 | 100 | 550 | | $I_C$ = 1.0 mA, $V_{CE}$ = −5.0 V, f = 1.0 kHz |
| $C_{ob}$ | Output Capacitance | | 6.0 | | 6.0 | pF | $I_E$ = 0, $V_{CB}$ = −5.0 V, f = 1.0 MHz |
| NF | Wide Band Noise Figure | | | | 3.0 | dB | $V_{CE}$ = −5.0 V, $I_C$ = 20 μA, $R_S$ = 10 kΩ, PBW = 15.7 kHz, f = 10Hz to 10 kHz |
| NF | Narrow Band Noise Figure | | | | 3.0 | dB | $V_{CE}$ = −5.0 V, $I_C$ = 20 μA, $R_S$ = 10 kΩ, f = 1.0 kHz, PBW = 150 Hz |
| | | | | | 3.0 | dB | $V_{CE}$ = −5.0 V, $I_C$ = 250 μA, $R_S$ = 1.0 kΩ, f = 1.0 kHz, PBW = 150 Hz |
| $h_{ie}$ | Input Resistance | | | 2.5 | 17 | kΩ | $V_{CE}$ = −5.0 V, $I_C$ = 1.0 mA, f = 1.0 kHz |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

†Fairchild exceeds JEDEC registered values.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/W (derating factor of 2.0 mW/°C) for 2N4848 thru 4850A. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C) for PN4848 thru PN4850A.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5-SS33.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N4248 PN4248 MIN. | MAX. | 2N4249 PN4249 MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{oe}$ | Output Conductance | | | 5.0 | 40 | μmhos | $V_{CE} = -5.0$ V, $I_C = 1.0$ mA, f = 1.0 kHz |
| $h_{re}$ | Voltage Feedback Ratio | | | | 10 | $\times 10^{-4}$ | $V_{CE} = -5.0$ V, $I_C = 1.0$ mA, f = 1.0 kHz |
| $th_{fe}$ | High Frequency Current Gain | 2.0 | | 2.0 | | | $I_C = 0.5$ mA, $V_{CE} = -5.0$ V, f = 20 MHz |
| $tV_{BE(sat)}$ | Base to Emitter Saturation Voltage | | −0.9 | | −0.9 | V | $I_C = 10$ mA, $I_B = 0.5$ mA |
| $tC_{ib}$ | Input Capacitance | | 16 | | 16 | pF | $I_C = 0$, $V_{EB} = -0.5$ V, f = 1.0 MHz |

| SYMBOL | CHARACTERISTIC | 2N4250 PN4250 MIN. | MAX. | 2N4250A PN4250A MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $I_{CBO}$ | Collector Cutoff Current | | 10 | | | nA | $V_{CB} = -40$ V, $I_E = 0$ |
| | | | | | 10 | nA | $V_{CB} = -50$ V, $I_E = 0$ |
| $tI_{CBO}$ | Collector Cutoff Current | | 3.0 | | | μA | $V_{CB} = -40$ V, $I_E = 0$, $T_A = 65°C$ |
| $I_{EBO}$ | Emitter Cutoff Current | | 20 | | 20 | nA | $V_{EB} = -3.0$ V, $I_C = 0$ |
| $h_{FE}$ | DC Current Gain | 250 | 700 | 250 | 700 | | $I_C = 100$ μA, $V_{CE} = -5.0$ V |
| $thFE$ | DC Pulse Current | 250 | | | | | $I_C = 1.0$ mA, $V_{CE} = -5.0$ V |
| $thFE$ | DC Pulse Current Gain (Note 5) | 250 | | | | | $I_C = 10$ mA, $V_{CE} = -5.0$ V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | −0.25 | | −0.25 | V | $I_C = 10$ mA, $I_B = 0.5$ mA |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −40 | | −60 | | V | $I_C = 10$ μA, $I_E = 0$ |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −5.0 | | −5.0 | | V | $I_E = 10$ μA, $I_C = 0$ |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | −40 | | −60 | | V | $I_C = 10$ μA |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 5) | −40 | | −60 | | V | $I_C = 5.0$ mA (pulsed), $I_B = 0$ |
| $h_{fe}$ | Small Signal Current Gain | 250 | 800 | 250 | 800 | | $I_C = 1.0$ mA, $V_{CE} = -5.0$ V, f = 1.0 kHz |
| $C_{ob}$ | Output Capacitance | | 6.0 | | 6.0 | pF | $I_E = 0$, $V_{CB} = -5.0$ V, f = 1.0 MHz |
| NF | Wide Band Noise Figure | | 2.0 | | 2.0 | dB | $V_{CE} = -5.0$ V, $I_C = 20$ μA, $R_S = 10$ kΩ PBW = 15.7 kHz, f = 10 Hz to 10 kHz |
| NF | Narrow Band Noise Figure | | 2.0 | | 2.0 | dB | $V_{CE} = -5.0$ V, $I_C = 20$ μA, $R_S = 10$ kΩ f = 1.0 kHz, PBW = 150 Hz |
| | | | 2.0 | | 2.0 | dB | $V_{CE} = -5.0$ V, $I_C = 250$ μA, $R_S = 1.0$ kΩ f = 1.0 kHz, PBW = 150 Hz |
| $h_{ie}$ | Input Resistance | 6.0 | 20 | 6.0 | 20 | kΩ | $V_{CE} = -5.0$ V, $I_C = 1.0$ mA, f = 1.0 kHz |
| $h_{oe}$ | Output Conductance | 5.0 | 50 | 5.0 | 50 | μmhos | $V_{CE} = -5.0$ V, $I_C = 1.0$ mA, f = 1.0 kHz |
| $h_{re}$ | Voltage Feedback Ratio | | 10 | | 10 | $\times 10^{-4}$ | $V_{CE} = -5.0$ V, $I_C = 1.0$ mA, f = 1.0 kHz |
| $th_{fe}$ | High Frequency Current Gain | 2.5 | | | | | $I_C = 0.5$ mA, $V_{CE} = -5.0$ V, f = 20 MHz |
| $tV_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 5) | | −0.9 | | | V | $I_C = 10$ mA, $I_B = 0.5$ mA |
| $tC_{ib}$ | Input Capacitance | | 16 | | | pF | $I_C = 0$, $V_{EB} = -0.5$ V, f = 1.0 MHz |

4

# 2N4258 • 2N4258A • PN4258 • PN4258A

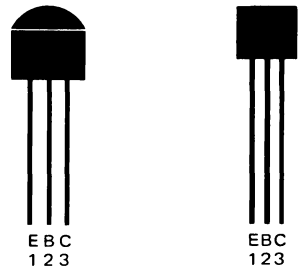
## PNP SMALL SIGNAL ULTRA HIGH SPEED LOGIC SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C (PN4258/A)
- $V_{CEO}$ . . . 12 V (MIN)
- $h_{FE}$ . . . 30-120 @ 10 mA
- $t_{on}$ . . . 15 ns (MAX) @ 10 mA
- $t_{off}$ . . . 18 ns (MAX) @ 10 mA (2N/PN4258A)
- COMPLEMENTS . . . 2N4274, (TO18), 2N5769 (TO92)

See Package Outlines

TO18-4 TO92-1




2N4258 2N4258A PN4258 PN4258A

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | 2N4258/A | PN4258/A |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | −55°C to +125°C | −55°C to +150°C |
| Operating Junction Temperature | | 125°C | 150°C |
| Lead Temperature (10 seconds) | | 260°C | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | | |
| Total Dissipation at 25°C Case Temperature | | 0.5 W | 1.0 W |
| at 25°C Ambient Temperature | | 0.2 W | 0.625 W |
| **Maximum Voltages and Current** | | **2N/PN4258** | **2N/PN4258A** |
| $V_{CBO}$ | Collector to Base Voltage | −12 V | −12 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | −12 V | −12 V |
| $V_{EBO}$ | Emitter to Base Voltage | −4.5 V | −4.5 V |
| $I_C$ | Collector Current | 50 mA | 50 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N/PN4258 MIN. | 2N/PN4258 MAX. | 2N/PN4258A MIN. | 2N/PN4258A MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $I_{CES}$ | Collector Reverse Current | | 10 | | 10 | nA | $V_{CE}$ = −6.0 V, $V_{BE}$ = 0 |
| | | | 5.0 | | 5.0 | μA | $V_{CE}$ = −6.0 V, $V_{BE}$ = 0, $T_A$ = 65°C |
| $I_B$ | Base Current | | | | 1.0 | nA | $V_{CE}$ = −6.0 V, $V_{BE}$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −12 | | −12 | | V | $I_E$ = 0, $I_C$ = 100 μA |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −4.5 | | −4.5 | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | −12 | | −12 | | V | $I_C$ = 100 μA, $V_{CE}$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | −12 | | −12 | | V | $I_C$ = 3.0 mA, $I_B$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 5) | 30 | 120 | 30 | 120 | | $I_C$ = 10 mA, $V_{CE}$ = −3.0 V |
| | | 15 | | 15 | | | $I_C$ = 1.0 mA, $V_{CE}$ = −0.5 V |
| | | 30 | | 30 | | | $I_C$ = 50 mA, $V_{CE}$ = −1.0 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | −0.15 | | −0.15 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | −0.5 | | −0.5 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 5) | −0.75 | −0.95 | −0.75 | −0.95 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | −1.5 | | −1.5 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $\tau_s$ | Charge Storage Time (see test circuit no. 234) | | 20 | | 15 | ns | $I_C \approx$ 10 mA, $I_{B1} \approx -I_{B2} \approx$ 10 mA |
| $t_{on}$ | Turn On Time (see test circuit no. 348) | | 15 | | 15 | ns | $I_C \approx$ 10 mA, $I_{B1} \approx$ 1.0 mA |
| $t_{off}$ | Turn Off Time (see test circuit no. 348) | | 20 | | 18 | ns | $I_C \approx$ 10 mA, $I_{B1} \approx -I_{B2} \approx$ 1.0 mA |
| $C_{cb}$ | Collector to Base Capacitance | | 3.0 | | 3.0 | pF | $I_E$ = 0, $V_{CB}$ = −5.0 V |
| $C_{ib}$ | Input Capacitance | | 3.5 | | 3.5 | pF | $I_C$ = 0, $V_{EB}$ = −0.5 V |
| $\lvert h_{fe} \rvert$ | Magnitude of Small Signal Current Gain | 7.0 | | 7.0 | | | $I_C$ = 10 mA, $V_{CE}$ = −10 V, f = 100 MHz |
| | | 5.0 | | 5.0 | | | $I_C$ = 10 mA, $V_{CE}$ = −5.0 V, f = 100 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/W (derating factor of 2.0 mW/°C) for 2N4258, 2N4258A. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C) for PN4258, PN4258A.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 - SS31.

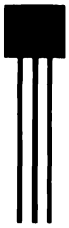
# 2N4264 • 2N4265

## NPN SMALL SIGNAL HIGH SPEED SATURATED SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C**
- **$f_T$ . . . 300 MHz (MIN) @ 10 mA**
- **$C_{cb}$ . . . 4.0 pF (MAX)**
- **$\tau_s$ . . . 20 ns (MAX) @ 10 mA**
- **$V_{CE\ (sat)}$ . . . 0.22 V (MAX) @ 10 mA**
- **COMPLEMENTS . . . MPS3640, 2N5771**

**See TO92-1 Package Outline**



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**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**†Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |
| Lead Temperature (60 seconds) | 260°C |

**†Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Ambient Temperature | 0.625 W |
| at 70°C Ambient Temperature | 0.400 W |
| at 25°C Case Temperature | 1.00 W |

**Maximum Voltages and Current**

| | | **2N4264** | **2N4265** |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 30 V | 30 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 15 V | 12 V |
| $V_{EBO}$ | Emitter to Base Voltage | 6.0 V | 6.0 V |
| $I_C$ | Collector Current | 200 mA | 200 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N4264 MIN. | 2N4264 MAX. | 2N4265 MIN. | 2N4265 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 25 | | 50 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 1.0 V |
| | | 40 | 160 | 100 | 400 | | $I_C$ = 10 mA, $V_{CE}$ = 1.0 V |
| | | 20 | | 45 | | | $I_C$ = 10 mA, $V_{CE}$ = 1.0 V, $T_A$ = 55°C |
| | | 40 | | 90 | | | $I_C$ = 30 mA, $V_{CE}$ = 1.0 V |
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 30 | | 55 | | | $I_C$ = 100 mA, $V_{CE}$ = 1.0 V |
| | | 20 | | 35 | | | $I_C$ = 200 mA, $V_{CE}$ = 1.0 V |
| $V_{CE\ (sat)}$ | Collector Saturation Voltage (Note 5) | | 0.22 | | 0.22 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | 0.35 | | 0.35 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| $V_{BE\ (sat)}$ | Base Saturation Voltage (Note 5) | 0.65 | 0.80 | 0.65 | 0.80 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | 0.75 | 0.95 | 0.75 | 0.95 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| $\|h_{fe}\|$ | Magnitude of Common Emitter Small Signal Current Gain | 3.0 | | 3.0 | | | $V_{CE}$ = 10 V, $I_C$ = 10 mA, f = 100 MHz |
| $C_{cb}$ | Collector Base Capacitance | | 4.0 | | 4.0 | pF | $I_E$ = 0, $V_{CB}$ = 5.0 V, f = 100 kHz |
| $C_{ib}$ | Input Capacitance | | 8.0 | | 8.0 | pF | $V_{BE}$ = 0.5 V, $I_C$ = 0, f = 100 kHz |
| $I_{CEX}$ | Collector Cutoff Current | | 100 | | 100 | nA | $V_{CE}$ = 12 V, $V_{EB}$ = 0.25 V |
| $I_{BL}$ | Base Cutoff Current | | 100 | | 100 | nA | $V_{CE}$ = 12 V, $V_{EB}$ = 0.25 V |
| | | | 10 | | 10 | μA | $V_{CE}$ = 12 V, $V_{EB}$ = 0.25 V, $T_A$ = 100°C |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 30 | | 30 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | 15 | | 12 | | V | $I_C$ = 1.0 mA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 6.0 | | 6.0 | | V | $I_C$ = 0, $I_E$ = 10 μA |
| $\tau_s$ | Storage Time (see test circuit no. 561) | | 20 | | 20 | ns | $I_C \cong I_{B1} \cong I_{B2}$ = 10 mA |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.
†Fairchild exceeds JEDEC registered values.

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C, and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C) and junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 2%.
6. For product family characteristic curves, refer to Section 5-SS5.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N4264 MIN. | 2N4264 MAX. | 2N4265 MIN. | 2N4265 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $t_{on}$ | Turn On Time (see test circuit no. 531) | | 25 | | 25 | ns | $I_C \cong 10$ mA, $I_B = 3.0$ mA, $V_{CC} = 3.0$ V |
| $t_{off}$ | Turn Off Time (see test circuit no. 531) | | 35 | | 35 | ns | $I_C \cong 10$ mA, $I_{B1} \cong 3.0$ mA, $I_{B2} \cong 1.5$ mA, $V_{CC} = 3.0$ V |
| $t_d$ | Delay Time (see test circuit no. 562) | | 8.0 | | 8.0 | ns | $I_C = 100$ mA, $I_{B1} = 10$ mA, $V_{CC} = 10$ V |
| $t_r$ | Rise Time (see test circuit no. 562) | | 15 | | 15 | ns | $I_C = 100$ mA, $I_{B1} = 10$ mA, $V_{CC} = 10$ V |
| $t_s$ | Storage Time (see test circuit no. 562) | | 20 | | 20 | ns | $I_C = 100$ mA, $I_{B1} = I_{B2} = 10$ mA, $V_{CC} = 10$ V |
| $t_f$ | Fall Time (see test circuit no. 562) | | 15 | | 15 | ns | $I_C = 100$ mA, $I_{B1} = I_{B2} = 10$ mA, $V_{CC} = 10$ V |
| $Q_T$ | Total Charge Control (see test circuit no. 563) | | 80 | | 80 | pC | $I_C = 10$ mA, $I_B = 1.0$ mA, $V_{CC} = 3.0$ V |

# 2N4274 • 2N4275

## NPN SMALL SIGNAL HIGH SPEED SATURATED SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$V_{CEO}$ . . . 12 V (MIN) (2N4274), 15 V (MIN) (2N4275)**
- **$f_T$ . . . 400 MHz (MIN)**
- **$C_{cb}$ . . . 4.0 pF (MAX) @ 5.0 V**
- **$\tau_s$ . . . 13 ns (MAX) @ 10 mA**
- **$V_{CE(sat)}$ . . . 0.2 V (MAX) @ 10 mA**
- **$t_{on}$ and $t_{off}$ . . . 12 ns (MAX) @ 10 mA**
- **COMPLEMENTS . . . 2N3640, 2N5910**

**See TO18-4 Package Outline**


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +125°C |
| Operating Junction Temperature | 125°C |
| Lead Temperature (10 seconds) | 260°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 0.5 W |
| at 25°C Ambient Temperature | 0.2 W |

**Maximum Voltages and Currents**

| | | 2N4274 | 2N4275 |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 30 V | 40 V |
| $V_{CES}$ | Collector to Emitter Voltage | 30 V | 40 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 12 V | 15 V |
| $V_{EBO}$ | Emitter to Base Voltage | 4.5 V | 4.5 V |
| $I_C$ | Collector Current (10 μs pulse) | 500 mA | 500 mA |
| $I_C$ | Collector Current | 100 mA | 100 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N4274 MIN. | 2N4274 MAX. | 2N4275 MIN. | 2N4275 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Pulse Current Gain | 35 | 120 | 35 | 120 | | $I_C$ = 10 mA, $V_{CE}$ = 1.0 V |
| | | 30 | | 30 | | | $I_C$ = 30 mA, $V_{CE}$ = 0.4 V |
| | | 18 | | 18 | | | $I_C$ = 100 mA, $V_{CE}$ = 1.0 V |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 5) | 0.72 | 0.85 | 0.72 | 0.85 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | 0.74 | 1.00 | 0.74 | 1.00 | V | $I_C$ = 10 mA, $I_B$ = 3.3 mA |
| | | | 1.15 | | 1.15 | V | $I_C$ = 30 mA, $I_B$ = 3.0 mA |
| | | | 1.60 | | 1.60 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | 0.20 | | 0.20 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | 0.18 | | 0.18 | V | $I_C$ = 10 mA, $I_B$ = 3.3 mA |
| | | | 0.25 | | 0.25 | V | $I_C$ = 30 mA, $I_B$ = 3.0 mA |
| | | | 0.50 | | 0.50 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| | | | 0.30 | | 0.30 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA, $T_A$ = 65°C |
| $h_{fe}$ | High Frequency Current Gain | 4.0 | | 4.0 | | | $I_C$ = 10 mA, $V_{CE}$ = 10 V, f = 100 MHz |
| $C_{cb}$ | Collector to Base Capacitance | | 4.0 | | 4.0 | pF | $I_E$ = 0, $V_{CB}$ = 5.0 V |
| $I_{CES}$ | Collector Reverse Current | | 400 | | 400 | nA | $V_{CE}$ = 20 V, $V_{BE}$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 10 | | 10 | μA | $I_E$ = 0, $V_{CB}$ = 20 V, $T_A$ = 65°C |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | 30 | | 40 | | V | $I_C$ = 10 μA, $V_{BE}$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 30 | | 40 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 5) | 12 | | 15 | | V | $I_C$ = 10 mA (pulsed) $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 4.5 | | 4.5 | | V | $I_C$ = 0, $I_E$ = 10 μA |
| $\tau_s$ | Charge Storage Time Constant (see test circuit no. 3111) | | 13 | | 13 | ns | $I_C = I_{B1} = -I_{B2}$ = 10 mA |
| $t_{on}$ | Turn On Time (see test circuit no. 381) | | 12 | | 12 | ns | $I_C$ = 10 mA, $I_{B1}$ = 3.3 mA |
| $t_{off}$ | Turn Off Time (see test circuit no. 381) | | 12 | | 12 | ns | $I_C$ = 10 mA, $I_{B1} = I_{B2}$ = 3.3 mA |

*Planar is a patented Fairchild process.

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/W (derating factor of 5.0 mW/°C). Junction to ambient thermal resistance of 500°C/W (derating factor of 2.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5-SS28.

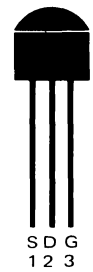
# 2N4342 • 2N4343 • 2N4360

## P-CHANNEL FIELD EFFECT

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **NOISE VOLTAGE . . . 0.08 $\mu V/\sqrt{Hz}$ (MAX) @ 100 Hz (2N4342/3)**
- **$y_{fs}$ . . . 4000 $\mu$mhos (MIN) (2N4343)**
- **$r_{DS\ (on)}$ . . . 350Ω (MAX) (2N4343)**

**See TO18-4 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +125°C |
| Operating Junction Temperature | 125°C |
| Soldering Temperature (10 seconds) | 260°C |

**Maximum Power Dissipation** (Note 2)

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 0.5 W |
| at 65°C Case Temperature | 0.3 W |
| at 25°C Ambient Temperature | 0.2 W |

**Maximum Voltages**

| | | 2N4360 | 2N4342<br>2N4343 |
|---|---|---|---|
| $BV_{SGO}$ | Source to Gate Breakdown Voltage | 20 V | 25 V |
| $BV_{DSO}$ | Drain to Source Breakdown Voltage | −20 V | −25 V |
| $BV_{DGO}$ | Drain to Gate Breakdown Voltage | −20 V | −25 V |

**ELECTRICAL CHARACTERISTICS:** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N4360 MIN. | 2N4360 MAX. | 2N4342 MIN. | 2N4342 MAX. | 2N4343 MIN. | 2N4343 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $e_n$ | Equivalent Input Noise Voltage | | 0.19 | | | | | $\mu V/\sqrt{Hz}$ | $V_{DS}$ = −10 V, $I_D$ = 1.0 mA, f = 100 Hz, BW = 15 Hz |
| | | | | 0.08 | | | | $\mu V/\sqrt{Hz}$ | $V_{DS}$ = −10 V, $V_{GS}$ = 0, f = 100 Hz, BW = 15 Hz |
| | | | | | | | 0.08 | $\mu V/\sqrt{Hz}$ | $V_{DS}$ = −10 V, $V_{GS}$ = 2.0 V, f = 100 Hz, BW = 15 Hz |
| NF | Noise Figure Common Source Configuration | | 5.0 | | | | | dB | $V_{DS}$ = −10 V, $I_D$ = 1.0 mA, f = 100 Hz, $R_G$ = 1 MΩ, BW = 15 Hz |
| | | | | | 1.5 | | | dB | $V_{DS}$ = −10 V, $V_{GS}$ = 0, f = 100 Hz, $R_G$ = 1.0 MΩ, BW = 15 Hz |
| | | | | | | | 1.5 | dB | $V_{DS}$ = −10 V, $V_{GS}$ = 2.0 V, f = 100 Hz, $R_G$ = 1.0 MΩ, BW = 15 Hz |
| $\lvert y_{fs}\rvert$ | Forward Transadmittance | 2,000 | 8,000 | 2,000 | 6,000 | 4,000 | 8,000 | $\mu$mhos | $V_{DS}$ = −10 V, $V_{GS}$ = 0, f = 1.0 kHz |
| $\lvert y_{os}\rvert$ | Output Admittance | | 100 | | 75 | | 100 | $\mu$mhos | $V_{DS}$ = −10 V, $V_{GS}$ = 0, f = 1.0 kHz |
| $BV_{GSS}$ | Gate to Source Breakdown Voltage | 20 | | 25 | | 25 | | V | $I_G$ = 10 $\mu$A, $V_{DS}$ = 0 |
| $I_{DSS}$ | Drain Current | 3.0 | 30 | 4.0 | 12 | 10 | 30 | mA | $V_{DS}$ = −10 V, $V_{GS}$ = 0 |
| $V_{GS}$ | Gate to Source Voltage | 0.4 | 9.0 | | | | | V | $V_{DS}$ = −10 V, $I_D$ = 0.3 mA |
| | | | | 0.7 | 5.0 | | | V | $V_{DS}$ = −10 V, $I_D$ = 0.4 mA |
| | | | | | | 1.8 | 9.0 | V | $V_{DS}$ = −10 V, $I_D$ = 1.0 mA |
| $V_{GS(OFF)}$ | Gate to Source Cutoff Voltage | 0.7 | 10 | 1.0 | 5.5 | 2.0 | 10 | V | $V_{DS}$ = −10 V, $I_D$ = 1.0 $\mu$A |
| $I_{GSS}$ | Gate Reverse Current | | 10 | | 10 | | 10 | nA | $V_{GS}$ = 15 V, $V_{DS}$ = 0 |
| | | | 0.5 | | 0.5 | | 0.5 | $\mu$A | $V_{GS}$ = 15 V, $V_{DS}$ = 0, $T_A$ = 65°C |
| $C_{iss}$ | Input Capacitance | | 20 | | 20 | | 20 | pF | $V_{DS}$ = −10 V, $V_{GS}$ = 0, f = 1.0 MHz |
| $C_{rss}$ | Reverse Transfer Capacitance | | 5.0 | | 5.0 | | 5.0 | pF | $V_{DS}$ = −10 V, $V_{GS}$ = 0, f = 1.0 MHz |
| $r_{DS(ON)}$ | Drain "On" Resistance | | 700 | | 700 | | 350 | Ω | $I_D$ = 0, $V_{GS}$ = 0, f = 1.0 kHz |
| $Re(y_{fs})$ | Forward Transconductance | 1,500 | | 1,500 | | 3,000 | | $\mu$mhos | $V_{DS}$ = −10 V, $V_{GS}$ = 0, f = 1.0 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/W (derating factor of 2.0 mW/°C).
3. For product family characteristic curves, refer to Section 5-SS34.

# 2N/MPS4354 • 2N/MPS4355 • 2N/MPS4356

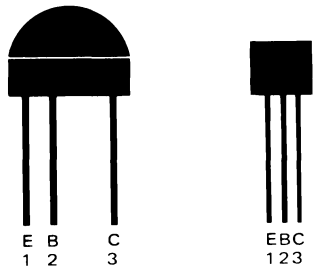
## PNP GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C (MPS SERIES)
- $V_{CEO}$ . . . –60 V (MIN) (2N/MPS4354 , 2N/MPS4355)
  . . . –80 V (MIN) (2N/MPS4356)
- NF . . . 3.0 dB (MAX) AT 1.0 kHz
- $V_{CE(sat)}$ . . . –1.0 V (MAX) AT $I_C$ = 1.0 A (2N/MPS4355)
- COMPLEMENTS . . . 2N3567, 2N3568, 2N3569 (TO5)
  PN3567, PN3568, PN3569 (TO92)

See Package Outlines

TO 5-4 TO 92-1




| TO 5-4 | TO 92-1 |
|---|---|
| 2N4354 | MPS4354 |
| 2N4355 | MPS4355 |
| 2N4356 | MPS4356 |

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | MPS4354/55/56 | 2N4354/55/56 |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | –55°C to +150°C | –55°C to +125°C |
| Operating Junction Temperature | | 150°C | 125°C |
| Lead Temperature (10 seconds) | | 260°C | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | | |
| Total Dissipation at 25°C Case Temperature | | 1.0 W | 0.8 W |
| at 25°C Ambient Temperature | | 0.625 W | 0.35 W |
| **Maximum Voltages and Current** | | **2N/MPS4354/55** | **2N/MPS4356** |
| $V_{CBO}$ | Collector to Base Voltage | –60 V | –80 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | –60 V | –80 V |
| $V_{EBO}$ | Emitter to Base Voltage | –5.0 V | –5.0 V |
| $I_C$ | Collector Current | 500 mA | 500 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N4354 MPS4354 MIN. | 2N4354 MPS4354 MAX. | 2N4355 MPS4355 MIN. | 2N4355 MPS4355 MAX. | 2N4356 MPS4356 MIN. | 2N4356 MPS4356 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 25 | | 60 | | 25 | | | $I_C$ = 100 μA, $V_{CE}$ = –10 V |
| | | 40 | | 75 | | 40 | | | $I_C$ = 1.0 mA, $V_{CE}$ = –10 V |
| | | 50 | 500 | 100 | 400 | 50 | 250 | | $I_C$ = 10 mA, $V_{CE}$ = –10 V |
| | | 40 | | 75 | | 40 | | | $I_C$ = 100 mA, $V_{CE}$ = –10 V |
| | | 30 | | 75 | | 30 | | | $I_C$ = 500 mA, $V_{CE}$ = –10 V |
| $\|h_{fe}\|$ | Magnitude of Common Emitter Small Signal Current Gain | 1.0 | 5.0 | 1.0 | 5.0 | 1.0 | 5.0 | | $I_C$ = 50 mA, $V_{CE}$ = –10 V, f = 100 MHz |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | –60 | | –60 | | –80 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | –5.0 | | –5.0 | | –5.0 | | V | $I_C$ = 0, $I_E$ = 10 μA |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 5) | –60 | | –60 | | –80 | | V | $I_C$ = 10 mA (pulsed), $I_B$ = 0 |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | –0.15 | | –0.15 | | –0.15 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | | | –0.5 | | –0.5 | | –0.5 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| | | | | | –1.0 | | | V | $I_C$ = 1.0 A, $I_B$ = 100 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 5) | | –0.9 | | –0.9 | | –0.9 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | | | –1.1 | | –1.1 | | –1.1 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| | | | | | –1.2 | | | V | $I_C$ = 1.0 A, $I_B$ = 100 mA |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 5) | | –1.1 | | –1.1 | | –1.1 | V | $I_C$ = 500 mA, $V_{CE}$ = –0.5 V |
| | | | | | –1.2 | | | V | $I_C$ = 1.0 A, $V_{CE}$ = –1.0 V |

Additional Electrical Characteristics on following page.

NOTES;

*Planar is a patented Fairchild process.

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 286°C/W (derating factor of 3.5 mW/°C) for 2N4354, 2N4355, 2N4356. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C) for MPS4354, MPS4355, MPS4356.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 — SS24.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N4354 MPS4354 MIN. | 2N4354 MPS4354 MAX. | 2N4355 MPS4355 MIN. | 2N4355 MPS4355 MAX. | 2N4356 MPS4356 MIN. | 2N4356 MPS4356 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $I_{CBO}$ | Collector Cutoff Current | | 50 | | 50 | | 50 | nA | $I_E = 0$, $V_{CB} = -50$ V |
| | | | 5.0 | | 5.0 | | 5.0 | μA | $I_E = 0$, $V_{CB} = -50$ V, $T_A = 75°C$ |
| $I_{EBO}$ | Emitter to Base Current | | 100 | | 100 | | 100 | nA | $I_C = 0$, $V_{EB} = -4.0$ V |
| $C_{cb}$ | Collector to Base Capacitance | | 30 | | 30 | | 30 | pF | $I_E = 0$, $V_{CB} = -10$ V, f = 1.0 MHz |
| $C_{eb}$ | Emitter to Base Capacitance | | 110 | | 110 | | 110 | pF | $I_C = 0$, $V_{EB} = -0.5$ V, f = 1.0 MHz |
| $t_{on}$ | Turn On Time (see test circuit no. 341) | | 100 | | 100 | | 100 | ns | $I_C \approx 500$ mA, $I_{B1} \approx 50$ mA, $V_{CC} = -30$ V |
| $t_{off}$ | Turn Off Time (see test circuit no. 341) | | 400 | | 400 | | 400 | ns | $I_C \approx 500$ mA, $I_{B1} \approx I_{B2} \approx 50$ mA, $V_{CC} = -30$ V |
| NF | Noise Figure | | 3.0 | | 3.0 | | 3.0 | dB | $I_C = 100$ μA, $V_{CE} = -10$ V, $R_S = 1.0$ kΩ, f = 1.0 kHz, BW = 1.0 Hz |

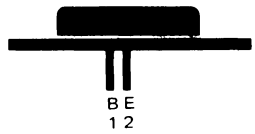
# 2N4398 • 2N4399

## 200 WATT PNP POWER

DIFFUSED SILICON BI-MESAR ™ TRANSISTORS

- $P_D$ . . . 200 W
- $I_C$ . . . 30 A (MAX)

See TO3-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +200°C |
| Operating Junction Temperature | | −65°C to +200°C |
| **Maximum Power Dissipation** | | |
| Total Dissipation at 25°C Case Temperature | | 200 W |
| Linear Derating Factor | | 1.15 W/°C |
| **Maximum Voltage and Currents** | **2N4398** | **2N4399** |
| $V_{CBO}$ Collector to Base Voltage | −40 V | −60 V |
| $V_{CEO}$ Collector to Emitter Voltage | −40 V | −60 V |
| $V_{EBO}$ Emitter to Base Voltage | −5.0 V | −5.0 V |
| $I_C$ Collector Current (Continuous) | 30 A | 30 A |
| $I_B$ Base Current (Continuous) | 7.5 A | 7.5 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining | 2N4398 | −40 | | V | $I_C$ = 200 mA, $I_B$ = 0 |
| | Voltage (Note 2) | 2N4399 | −60 | | V | $I_C$ = 200 mA, $I_B$ = 0 |
| $I_{CEX}$ | Collector Cutoff Current | 2N4398 | | 5.0 | mA | $V_{CE}$ = −40 V, $V_{EB}$ = −1.5 V |
| | | 2N4399 | | 5.0 | mA | $V_{CE}$ = −60 V, $V_{EB}$ = −1.5 V |
| $I_{CEX}$ | Collector Cutoff Current | 2N4398 | | 10 | mA | $V_{CE}$ = −30 V, $V_{EB}$ = −1.5 V, $T_C$ = 150°C |
| $I_{CBO}$ | Collector Cutoff Current | 2N4398 | | 1.0 | mA | $V_{CB}$ = −40 V, $I_E$ = 0 |
| | | 2N4399 | | 1.0 | mA | $V_{CB}$ = −60 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | | 5.0 | mA | $V_{EB}$ = −5.0 V, $I_C$ = 0 |
| $I_{CEO}$ | Collector Cutoff Current | 2N4398 | | 5.0 | mA | $V_{CE}$ = −40 V, $I_B$ = 0 |
| | | 2N4399 | | 5.0 | mA | $V_{CE}$ = −60 V, $I_B$ = 0 |
| $h_{FE}$ | DC Pulse Current Gain (Note 2) | | 5.0 | | | $V_{CE}$ = −4.0 V, $I_C$ = 30 A |
| | | | 15 | 60 | | $V_{CE}$ = −4.0 V, $I_C$ = 15 A |
| | | | 40 | | | $V_{CE}$ = −2.0 V, $I_C$ = 1.0 A |
| $V_{CE(sat)}$ | Collector to Emitter Saturation | | | −4.0 | V | $I_C$ = 30 A, $I_B$ = 6.0 A |
| | Voltage (Note 2) | | | −1.0 | V | $I_C$ = 15 A, $I_B$ = 1.5 A |
| | | | | −0.75 | V | $I_C$ = 10 A, $I_B$ = 1.0 A |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage | | | −3.0 | V | $I_C$ = 30 A, $V_{CE}$ = −4.0 V |
| | (Note 2) | | | −1.8 | V | $I_C$ = 15 A, $V_{CE}$ = −2.0 V |
| $V_{BE(sat)}$ | Base to Emitter Saturation | | | −1.85 | V | $I_C$ = 15 A, $I_B$ = 1.5 A |
| | Voltage (Note 2) | | | | | |
| $\|h_{fe}\|$ | Magnitude of Common Emitter Small Signal Current Gain | | 4.0 | | | $V_{CE}$ = −10 V, $I_C$ = 1.0 A, f = 1.0 MHz |
| $h_{fe}$ | Small Signal Current Gain | | 40 | | | $V_{CE}$ = −10 V, $I_C$ = 1.0 A, f = 1.0 kHz |
| $t_r$ | Rise Time | | | 0.4 | μs | $V_{CC}$ = −30 V, $I_C$ = 10 A, $I_{B1}$ = $I_{B2}$ = 1.0 A |
| $t_s$ | Storage Time | | | 1.5 | μs | |
| $t_f$ | Fall Time | | | 0.6 | μs | |

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. Pulse conditions: length = 300 μs; duty cycle = 2%.
3. For product family characteristic curves, refer to Section 5 - PWR 16.

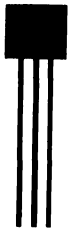
# 2N4400 • 2N4401

## SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS AND SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_C$ = 25°C
- $V_{CEO}$ . . . 40 V (MIN)
- $h_{FE}$ . . . 100-300 @ 150 mA (2N4401)
- . . . 40 (MIN) @ 500 mA (2N4401)
- $t_{on}$ . . . 35 ns (MAX) @ 150 mA
- $t_{off}$ . . . 255 ns (MAX) @ 150 mA
- COMPLEMENTS . . . 2N4402, 2N4403

See TO92-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| **†Maximum Temperatures** | |
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |
| Lead Temperature (10 seconds) | 260°C |
| **†Maximum Power Dissipation** (Notes 2 & 3) | |
| Total Dissipation at 25°C Case Temperature | 1.0 W |
| at 25°C Ambient Temperature | 0.625 W |
| **Maximum Voltages and Current** | |
| $V_{CBO}$ Collector to Base Voltage | 60 V |
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | 40 V |
| $V_{EBO}$ Emitter to Base Voltage | 6.0 V |
| $I_C$ Collector Current | 600 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N4400 MIN. | 2N4400 MAX. | 2N4401 MIN. | 2N4401 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 5) | 40 | | 40 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 60 | | 60 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 6.0 | | 6.0 | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $I_{CEX}$ | Collector Cutoff Current | | 100 | | 100 | nA | $V_{CE}$ = 35 V, $V_{EB}$ = 0.4 V |
| $I_{BL}$ | Base Reverse Current | | 100 | | 100 | nA | $V_{CE}$ = 35 V, $V_{EB}$ = 0.4 V |
| $h_{FE}$ | DC Current Gain | | | 20 | | | $I_C$ = 100 μA, $V_{CE}$ = 1.0 V |
| | | 20 | | 40 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 1.0 V |
| | | 40 | | 80 | | | $I_C$ = 10 mA, $V_{CE}$ = 1.0 V |
| $h_{FE}$ | DC Pulse Current Gain | 50 | 150 | 100 | 300 | | $I_C$ = 150 mA, $V_{CE}$ = 1.0 V |
| | (Note 5) | 20 | | 40 | | | $I_C$ = 500 mA, $V_{CE}$ = 2.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage | | 0.4 | | 0.4 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | (Note 5) | | 0.75 | | 0.75 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage | 0.75 | 0.95 | 0.75 | 0.95 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | (Note 5) | | 1.2 | | 1.2 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| $f_T$ | Current Gain Bandwidth Product | 200 | | 250 | | MHz | $I_C$ = 20 mA, $V_{CE}$ = 10 V, f = 100 MHz |
| $C_{cb}$ | Collector to Base Capacitance | | 6.5 | | 6.5 | pF | $V_{CB}$ = 5.0 V, $I_E$ = 0, f = 100 kHz |
| $C_{eb}$ | Emitter to Base Capacitance | | 30 | | 30 | pF | $V_{EB}$ = 0.5 V, $I_C$ = 0, f = 100 kHz |
| $h_{ie}$ | Input Impedance | 0.5 | 7.5 | 1.0 | 15 | kΩ | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $h_{re}$ | Voltage Feedback Ratio | 0.1 | 8.0 | 0.1 | 8.0 | $\times 10^{-4}$ | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $h_{fe}$ | Small Signal Current Gain | 20 | 250 | 40 | 500 | | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $h_{oe}$ | Output Admittance | 1.0 | 30 | 1.0 | 30 | μmhos | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

†Fairchild exceeds JEDEC registered value for this parameter.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = ≤2%.
6. For product family characteristic curves, refer to Section 5 — SS15.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N4400 MIN. | 2N4400 MAX. | 2N4401 MIN. | 2N4401 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $t_d$ | Delay Time (see test circuit no. 559) | | 15 | | 15 | ns | $I_C$ = 150 mA, $I_{B1}$ = 15 mA, $V_{CC}$ = 30 V |
| $t_r$ | Rise Time (see test circuit no. 559) | | 20 | | 20 | ns | $I_C$ = 150 mA, $I_{B1}$ = 15 mA $V_{CC}$ = 30 V |
| $t_s$ | Storage Time (see test circuit no. 560) | | 225 | | 225 | ns | $I_C$ = 150 mA, $I_{B1}$ = $I_{B2}$ = 15 mA, $V_{CC}$ = 30 V |
| $t_f$ | Fall Time (see test circuit no. 560) | | 30 | | 30 | ns | $I_C$ = 150 mA, $I_{B1}$ = $I_{B2}$ = 15 mA, $V_{CC}$ = 30 V |

4

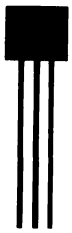
# 2N4402 • 2N4403

## PNP SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS AND SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- $V_{CEO}$ . . . –40 V (MIN)
- $h_{FE}$ . . . 100-300 @ 150 mA (2N4403)
- . . . 20 (MIN) @ 500 mA (2N4403)
- $t_{on}$ . . . 35 ns (MAX) @ 150 mA
- $t_{off}$ . . . 255 ns (MAX) @ 150 mA
- COMPLEMENTS . . . 2N4400, 2N4401

See TO92-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **†Maximum Temperatures** | | |
| Storage Temperature | | –55°C to +150°C |
| Operating Junction Temperature | | 150°C |
| Lead Temperature (10 seconds) | | 260°C |
| **†Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Case Temperature | | 1.0 W |
| at 25°C Ambient Temperature | | 0.625 W |
| **Maximum Voltages and Current** | | |
| $V_{CBO}$ | Collector to Base Voltage | –40 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | –40 V |
| $V_{EBO}$ | Emitter to Base Voltage | –5.0 V |
| $I_C$ | Collector Current | 600 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N4402 MIN. | 2N4402 MAX. | 2N4403 MIN. | 2N4403 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 5) | –40 | | –40 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | –40 | | –40 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | –5.0 | | –5.0 | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $I_{CEX}$ | Collector Reverse Current | | 100 | | 100 | nA | $V_{CE}$ = –35 V, $V_{EB}$ = –0.4 V |
| $I_{BL}$ | Base Reverse Current | | 100 | | 100 | nA | $V_{CE}$ = –35 V, $V_{EB}$ = –0.4 V |
| $h_{FE}$ | DC Current Gain | | | 30 | | | $I_C$ = 100 μA, $V_{CE}$ = 1.0 V |
| | | 30 | | 60 | | | $I_C$ = 1.0 mA, $V_{CE}$ = –1.0 V |
| | | 50 | | 100 | | | $I_C$ = 10 mA, $V_{CE}$ = –1.0 V |
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 50 | 150 | 100 | 300 | | $I_C$ = 150 mA, $V_{CE}$ = –2.0 V |
| | | 20 | | 20 | | | $I_C$ = 500 mA, $V_{CE}$ = –2.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage | | –0.4 | | –0.4 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | (Note 5) | | –0.75 | | –0.75 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage | –0.75 | –0.95 | –0.75 | –0.95 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | (Note 5) | | –1.3 | | –1.3 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| $f_T$ | Current Gain Bandwidth Product | 150 | | 200 | | MHz | $I_C$ = 20 mA, $V_{CE}$ = –10 V, f = 100 MHz |
| $C_{cb}$ | Collector to Base Capacitance | | 8.5 | | 8.5 | pF | $V_{CB}$ = –10 V, $I_E$ = 0, f = 140 kHz |
| $C_{eb}$ | Emitter to Base Capacitance | | 30 | | 30 | pF | $V_{EB}$ = –0.5 V, $I_C$ = 0, f = 140 kHz |
| $h_{ie}$ | Input Impedance | 0.75 | 7.5 | 1.5 | 15 | kΩ | $I_C$ = 1.0 mA, $V_{CE}$ = –10 V, f = 1.0 kHz |
| $h_{re}$ | Voltage Feedback Ratio | 0.1 | 8.0 | 0.1 | 8.0 | $\times 10^{-4}$ | $I_C$ = 1.0 mA, $V_{CE}$ = –10 V, f = 1.0 kHz |
| $h_{fe}$ | Small Signal Current Gain | 30 | 250 | 60 | 500 | | $I_C$ = 1.0 mA, $V_{CE}$ = –10 V, f = 1.0 kHz |
| $h_{oe}$ | Output Admittance | 1.0 | 100 | 1.0 | 100 | μmhos | $I_C$ = 1.0 mA, $V_{CE}$ = –10 V, f = 1.0 kHz |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

†Fairchild exceeds JEDEC registered value for this parameter.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle <2%.
6. For product family characteristic curves, refer to Section 5 — SS22.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N4402 MIN. | 2N4402 MAX. | 2N4403 MIN. | 2N4403 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $t_d$ | Delay Time (see test circuit no. 557) | | 15 | | 15 | ns | $I_C$ = 150 mA, $I_{B1}$ = 15 mA, $V_{CC}$ = −30 V |
| $t_r$ | Rise Time (see test circuit no. 557) | | 20 | | 20 | ns | $I_C$ = 150 mA, $I_{B1}$ = 15 mA, $V_{CC}$ = −30 V |
| $t_s$ | Storage Time (see test circuit no. 558) | | 225 | | 225 | ns | $I_C$ = 150 mA, $I_{B1}$ = $I_{B2}$ = 15 mA $V_{CC}$ = −30 V |
| $t_f$ | Fall Time (see test circuit no. 558) | | 30 | | 30 | ns | $I_C$ = 150 mA, $I_{B1}$ = $I_{B2}$ = 15 mA, $V_{CC}$ = −30 V |

4

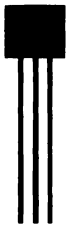
# 2N4409 • 2N4410

## NPN NEON DISPLAY TUBE DRIVERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- $V_{CEO}$ . . . 80 V (MIN) (2N4410)
- $h_{FE}$ . . . 60 V (MIN) @ 1.0 AND 10 mA
- COMPLEMENTS . . . MPSA55, MPSA56

See TO92-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**†Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |

**†Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Ambient Temperature | 0.625 W |
| at 25°C Case Temperature | 1.0 W |

| **Maximum Voltages and Current** | | **2N4409** | **2N4410** |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 80 V | 120 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 50 V | 80 V |
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V | 5.0 V |
| $I_C$ | Collector Current | 250 mA | 250 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N4409 MIN. | 2N4409 MAX. | 2N4410 MIN. | 2N4410 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | 50 | | 80 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $BV_{CEX}$ | Collector to Emitter Breakdown Voltage | 80 | | 120 | | V | $I_C$ = 500 μA, $V_{BB}$ = −5.0 V, $R_{BE}$ = 8.2 kΩ |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 80 | | 120 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | 5.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 10 | | | nA | $V_{CB}$ = 60 V, $I_E$ = 0 |
| | | | | | 10 | nA | $V_{CB}$ = 100 V, $I_E$ = 0 |
| | | | 1.0 | | | μA | $V_{CB}$ = 60 V, $I_E$ = 0, $T_A$ = 100°C |
| | | | | | 1.0 | μA | $V_{CB}$ = 100 V, $I_E$ = 0, $T_A$ = 100°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 100 | | 100 | nA | $V_{EB}$ = 4.0 V, $I_C$ = 0 |
| $h_{FE}$ | DC Current Gain | 60 | | 60 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 1.0 V |
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 60 | 400 | 60 | 400 | | $I_C$ = 10 mA, $V_{CE}$ = 1.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage | | 0.2 | | 0.2 | V | $I_C$ = 1.0 mA, $I_B$ = 0.1 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage | | 0.8 | | 0.8 | V | $I_C$ = 1.0 mA, $I_B$ = 0.1 mA |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage | | 0.8 | | 0.8 | V | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V |
| $\|h_{fe}\|$ | Magnitude of Common Emitter Small Signal Current Gain | 2.0 | 10 | 2.0 | 10 | | $I_C$ = 10 mA, $V_{CE}$ = 10 V, f = 30 MHz |
| $C_{cb}$ | Collector to Base Capacitance | | 12 | | 12 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 140 kHz |
| †$C_{eb}$ | Emitter to Base Capacitance | | 50 | | 50 | pF | $V_{EB}$ = 0.5 V, $I_C$ = 0, f = 100 kHz |

*Planar is a patented Fairchild process.

†Fairchild exceeds JEDEC registered values.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 — SS16.

# 2N4888 • 2N4889 • PN4888 • PN4889

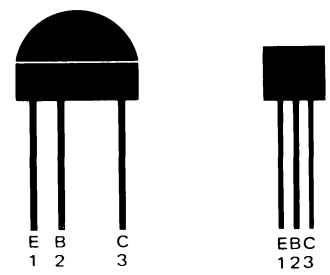
## PNP LOW NOISE HIGH VOLTAGE AMPLIFIERS

DIFFUSED SILICON PLANAR* TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C (PN4888/9)
- $V_{CEO}$ . . . 150 V (MIN)
- NF . . . 3.0 dB (MAX) @ 1.0 kHz (2N/PN4889)
- $C_{ob}$ . . . 4.0 pF (MAX)
- $h_{FE}$ . . . 80-300 @ 10 mA (2N/PN4889)
- EXCELLENT BETA LINEARITY FROM 10 μA to 50 mA

See Package Outlines

TO5-4 TO92-1




2N4888/9 PN488/9

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | PN4888/9 | 2N4888/9 |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | −55°C to +150°C | −55°C to +125°C |
| Operating Junction Temperature | | 150°C | 125°C |
| Lead Temperature (10 seconds) | | 260°C | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | | |
| Total Dissipation at 25°C Case Temperature | | 1.0 W | 0.8 W |
| at 25°C Ambient Temperature | | 0.625 W | 0.3 W |
| **Maximum Voltages and Current** | | | |
| $V_{CBO}$ | Collector to Base Voltage | −150 V | −150 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | −150 V | −150 V |
| $V_{EBO}$ | Emitter to Base Voltage | −6.0 V | −6.0 V |
| $I_C$ | Collector Current | 100 mA | 100 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N/PN4888 MIN. | 2N/PN4888 MAX. | 2N/PN4889 MIN. | 2N/PN4889 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage | −150 | | −150 | | V | $I_C$ = 2.0 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −150 | | −150 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | −150 | | −150 | | V | $I_C$ = 100 μA, $I_B$ = 0 |
| NF | Narrow Band Noise Figure | | | | 10 | dB | $I_C$ = 250 μA, $V_{CE}$ = −5.0 V, $R_S$ = 1.0 kΩ, BW = 15 Hz, f = 100 Hz |
| | | | | | 3.0 | dB | $I_C$ = 30 μA, $V_{CE}$ = −5.0 V, $R_S$ = 10 kΩ, BW = 150 Hz, f = 1.0 kHz |
| | | | | | 3.0 | dB | $I_C$ = 250 μA, $V_{CE}$ = −5.0 V, $R_S$ = 1.0 kΩ, BW = 1.5 kHz, f = 10 kHz |
| | | | | | 4.0 | dB | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V, $R_S$ = 1.0 kΩ, BW = 2.0 kHz, f = 1.0 MHz |
| NF | Wide Band Noise Figure | | | | 4.0 | dB | $I_C$ = 250 μA, $V_{CE}$ = −5.0 V, $R_S$ = 1.0 kΩ, BW = 15.7 kHz, f = 10 Hz to 10 kHz |
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | | | 60 | | | $I_C$ = 100 μA, $V_{CE}$ = −10 V |
| | | 30 | | 70 | | | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V |
| | | 40 | 400 | 80 | 300 | | $I_C$ = 10 mA, $V_{CE}$ = −10 V |
| $C_{ob}$ | Output Capacitance | | 4.0 | | 4.0 | pF | $V_{CB}$ = −20 V, $I_E$ = 0, f = 1.0 MHz |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | | 10 | nA | $V_{CB}$ = −100 V, $I_E$ = 0 |
| | | | 2.5 | | 0.5 | μA | $V_{CB}$ = −100 V, $I_E$ = 0, $T_A$ = 65°C |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 333°C/W (derating factor of 3.0 mW/°C) for 2N4888 and 2N4889. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C) for PN4888 and PN4889.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N/PN4888 MIN. | 2N/PN4888 MAX. | 2N/PN4889 MIN. | 2N/PN4889 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_{CE(sat)}$ | Pulsed Collector Saturation Voltage (Note 5) | | −0.5 | | −0.5 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −6.0 | | −6.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 50 | | 10 | nA | $V_{EB}$ = −4.0 V, $I_C$ = 0 |
| $V_{BE(ON)}$ | Pulsed Base to Emitter "On" Voltage (Note 5) | | −0.8 | | −0.7 | V | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V |
| $V_{BE(sat)}$ | Pulsed Base Saturation Voltage (Note 5) | | −0.9 | | −0.9 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $C_{ib}$ | Input Capacitance | | 30 | | 25 | pF | $V_{EB}$ = −0.5 V, $I_C$ = 0, f = 1.0 MHz |
| $h_{fe}$ | High Frequency Current Gain | 1.5 | 8.0 | 2.0 | 8.0 | | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V, f = 20 MHz |
| $h_{ie}$ | Small Signal Short Circuit, Input Resistance | 0.75 | 20 | 1.7 | 12 | kΩ | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V, f = 1.0 kHz |
| $h_{oe}$ | Small Signal Open Circuit Output Conductance | 1.4 | 40 | 3.0 | 25 | μmhos | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V, f = 1.0 kHz |
| $h_{re}$ | Small Signal Open Circuit Reverse Voltage Feedback Ratio | | | | 5 | $x10^{-4}$ | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V, f = 1.0 kHz |
| $h_{fe}$ | Common Emitter Small Signal Short Circuit Forward Current Transfer Ratio | 30 | 500 | 65 | 400 | | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V, f = 1.0 kHz |

# 2N4895 • 2N4896 • 2N4897 • 2N5334 • 2N5335

## NPN POWER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $V_{CE(sat)}$ . . . 0.7 V @ $I_C$ = 2.0 A
- LOW LEAKAGE . . . $I_{CES}$ (MAX) = 100 μA @ $T_C$ = 150°C

See TO5-1 Package Outline


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Junction Temperature | 200°C |
| Lead Temperature (60 seconds) | 300°C |

| **Maximum Power Dissipation** | **2N5334/5** | **2N4895/6/7** |
|---|---|---|
| Total Dissipation at 25°C Case Temperature | 6.0 W | |
| at 100°C Case Temperature | | 4.0 W |
| Linear Derating Factor | 34 mW/°C | 40 mW/°C |
| Total Dissipation at 25°C Ambient Temperature | 1.0 W | 0.8 W |
| Linear Derating Factor | 5.71 mW/°C | 4.57 mW/°C |

| **Maximum Voltage and Current** | | **2N4895/6** | **2N4897** | **2N5334** | **2N5335** |
|---|---|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 120 V | 150 V | 60 V | 80 V |
| $V_{EBO}$ | Emitter to Base Voltage | 6.0 V | 6.0 V | 8.0 V | 8.0 V |
| $V_{CEO}$ | Collector to Emitter Voltage | 60 V | 80 V | 60 V | 80 V |
| $I_C$ | Collector Current | 5.0 A | 5.0 A | 3.0 A | 3.0 A |
| $I_B$ | Base Current | 1.0 A | 1.0 A | 0.5 A | 0.5 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N4895 MIN. | 2N4895 MAX. | 2N4896 MIN. | 2N4896 MAX. | 2N4897 MIN. | 2N4897 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $I_{CES}$ | Collector Cutoff Current | | 0.1 | | 0.1 | | | mA | $V_{CE}$ = 60 V, $V_{BE}$ = 0, $T_A$ = 150°C |
| | | | | | | | 0.1 | mA | $V_{CE}$ = 100 V, $V_{BE}$ = 0, $T_A$ = 150°C |
| | | | 1.0 | | 1.0 | | | mA | $V_{CE}$ = 120 V, $V_{BE}$ = 0 |
| | | | | | | | 1.0 | mA | $V_{CE}$ = 150 V, $V_{BE}$ = 0 |
| | | | 1.0 | | 1.0 | | | μA | $V_{CE}$ = 60 V, $V_{BE}$ = 0 |
| | | | | | | | 1.0 | μA | $V_{CE}$ = 100 V, $V_{BE}$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 1.0 | | 1.0 | | 1.0 | μA | $V_{EB}$ = 4.0 V, $I_E$ = 0 |
| | | | 1.0 | | 1.0 | | 1.0 | mA | $V_{EB}$ = 6.0 V, $I_E$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | 60 | | 60 | | 80 | | V | $I_C$ = 50 mA, $I_B$ = 0 |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Notes 5 & 6) | | 1.0 | | 1.0 | | 1.0 | V | $I_C$ = 5.0 A, $I_B$ = 0.5 A |
| $V_{BE(sat)}$ | Base to Emitter Voltage (Notes 5 & 6) | | 1.6 | | 1.6 | | 1.6 | V | $I_C$ = 5.0 A, $I_B$ = 0.5 A |
| $h_{FE}$ | DC Current Gain (Note 5) | 40 | 120 | 100 | 300 | 40 | 120 | | $I_C$ = 2.0 A, $V_{CE}$ = 2.0 V |
| | | 15 | | 35 | | 15 | | | $I_C$ = 2.0 A, $V_{CE}$ = 2.0 V, $T_A$ = −55°C |
| $t_r$ | Rise Time | | 300 | | 300 | | 300 | ns | $I_C$ = 5.0 A, $I_{B1}$ = 0.5 A |
| $t_d$ | Delay Time | | 50 | | 50 | | 50 | ns | $I_C$ = 5.0 A, $I_{B1}$ = 0.5 A |
| $t_s$ | Storage Time | | 350 | | 350 | | 350 | ns | $I_C$ = 5.0 A, $I_{B1}$ = $I_{B2}$ = 0.5 A |
| $t_f$ | Fall Time | | 300 | | 300 | | 300 | ns | $I_C$ = 5.0 A, $I_{B1}$ = $I_{B2}$ = 0.5 A |
| $C_{ob}$ | Output Capacitance | | 80 | | 80 | | 80 | pF | $I_E$ = 0, $V_{CB}$ = 10 V, f = 0.14 MHz |
| $C_{ib}$ | Input Capacitance | | 500 | | 500 | | 500 | pF | $V_{EB}$ = 0.5 V, $I_C$ = 0, f = 0.14 MHz |
| $\|h_{fe}\|$ | Magnitude of Common Emitter Small Signal Current Gain | 2.5 | | 4.0 | | 2.5 | | | $V_{CE}$ = 5.0 V, $I_C$ = 0.5 A, f = 20 MHz |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 25°C/W (derating factor of 40 mW/°C); junction to ambient thermal resistance of 219°C/W (derating factor of 4.57 mW/°C) for 2N4895/6/7.
4. This rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
6. Point of measurement: 1/4" from header.
7. For product family characteristic curves, refer to Section 5 - PWR 1.

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N5334 MIN. | 2N5334 MAX. | 2N5335 MIN. | 2N5335 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $I_{CEX}$ | Collector Cutoff Current | | 0.5 | | | mA | $V_{CE}$ = 55 V, $V_{EB}$ = 1.5 V, $T_A$ = 150°C |
| | | | | | 0.5 | mA | $V_{CE}$ = 75 V, $V_{EB}$ = 1.5 V, $T_A$ = 150°C |
| | | | 5.0 | | | μA | $V_{CE}$ = 55 V, $V_{EB}$ = 1.5 V |
| | | | | | 5.0 | μA | $V_{CE}$ = 75 V, $V_{EB}$ = 1.5 V |
| $I_{CBO}$ | Collector Cutoff Current | | 5.0 | | | μA | $V_{CB}$ = 60 V, $I_E$ = 0 |
| | | | | | 5.0 | μA | $V_{CB}$ = 80 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 0.1 | | 0.1 | mA | $V_{EB}$ = 8.0 V, $I_E$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | 60 | | 80 | | V | $I_C$ = 50 mA, $I_B$ = 0 |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Notes 5 & 6) | | 0.7 | | 0.7 | V | $I_C$ = 2.0 A, $I_B$ = 200 mA |
| $V_{BE(sat)}$ | Base to Emitter Voltage (Notes 5 & 6) | | 1.5 | | 1.5 | V | $I_C$ = 2.0 A, $I_B$ = 200 mA |
| $h_{FE}$ | DC Current Gain (Note 5) | 30 | 150 | 30 | 150 | | $V_{CE}$ = 2.0 V, $I_C$ = 1.0 A |
| | | 15 | | 15 | | | $V_{CE}$ = 2.0 V, $I_C$ = 2.0 A |
| $t_r$ | Rise Time | | 50 | | 50 | ns | $I_C$ = 1.0 A, $I_{B1}$ = 100 mA |
| $t_s$ | Storage Time | | 950 | | 950 | ns | $I_C$ = 1.0 A, $I_{B1}$ = $I_{B2}$ = 100 mA |
| $t_f$ | Fall Time | | 100 | | 100 | ns | $I_C$ = 1.0 A, $I_{B1}$ = $I_{B2}$ = 100 mA |
| $C_{ob}$ | Output Capacitance | | 75 | | 75 | pF | $I_E$ = 0, $V_{CB}$ = 10 V, f = 100 kHz |
| $C_{ib}$ | Input Capacitance | | 250 | | 250 | pF | $V_{EB}$ = 2.0 V, $I_C$ = 0, f = 100 kHz |
| $\|h_{fe}\|$ | Magnitude of Common Emitter Small Signal Current Gain | 4.0 | | 4.0 | | | $V_{CE}$ = 10 V, $I_C$ = 100 mA, f = 10 MHz |

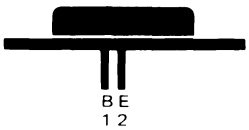
# 2N4901/2/3 • 2N4904/5/6

## 87.5 WATT PNP POWER

DIFFUSED SILICON BI-MESAR™ TRANSISTORS

- $h_{FE}$ . . . 25-100 @ $V_{CE} = -2.0$ V, $I_C = 2.5$ A (2N4904/5/6)
  20-80 @ $V_{CE} = -2.0$ V, $I_C = 1.0$ A (2N4901/2/3)

See TO3-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | | |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | | −65°C to +200°C |
| Operating Junction Temperature | | | +200°C |
| **Maximum Power Dissipation** | | | |
| Total Dissipation at 25°C Case Temperature | | | 87.5 W |
| Linear Derating Factor | | | 0.5 W/°C |
| **Maximum Voltages and Currents** | **2N4901/4** | **2N4902/5** | **2N4903/6** |
| $V_{CBO}$ Collector to Base Voltage | −40 V | −60 V | −80 V |
| $V_{EBO}$ Emitter to Base Voltage | −5.0 V | −5.0 V | −5.0 V |
| $V_{CEO}$ Collector to Emitter Voltage | −40 V | −60 V | −80 V |
| $I_C$ Collector Current | 5.0 A | 5.0 A | 5.0 A |
| $I_B$ Base Current | 1.0 A | 1.0 A | 1.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N4901/4 MIN. | 2N4901/4 MAX. | 2N4902/5 MIN. | 2N4902/5 MAX. | 2N4903/6 MIN. | 2N4903/6 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $I_{CEX}$ | Collector Cutoff Current | | 2.0 | | | | | | $V_{CE} = -40$ V, $V_{EB} = -1.5$ V, $T_A = 150°C$ |
| | | | | | 2.0 | | | | $V_{CE} = -60$ V, $V_{EB} = -1.5$ V, $T_A = 150°C$ |
| | | | | | | | 2.0 | mA | $V_{CE} = -80$ V, $V_{EB} = -1.5$ V, $T_A = 150°C$ |
| | | | 0.1 | | | | | mA | $V_{CE} = -40$ V, $V_{EB} = -1.5$ V |
| | | | | | 0.1 | | | mA | $V_{CE} = -60$ V, $V_{EB} = -1.5$ V |
| | | | | | | | 0.1 | mA | $V_{CE} = -80$ V, $V_{EB} = -1.5$ V |
| $I_{EBO}$ | Emitter Cutoff Current | | 1.0 | | 1.0 | | 1.0 | mA | $V_{EB} = -5.0$ V |
| $I_{CEO}$ | Collector Cutoff Current | | 1.0 | | | | | mA | $V_{CE} = -40$ V, $I_B = 0$ |
| | | | | | 1.0 | | | mA | $V_{CE} = -60$ V, $I_B = 0$ |
| | | | | | | | 1.0 | mA | $V_{CE} = -80$ V, $I_B = 0$ |
| $V_{CEO(sus)}$ | Collector Sustaining Voltage (Note 2) | −40 | | −60 | | −80 | | V | $I_C = 200$ mA, $I_B = 0$ |

| SYMBOL | CHARACTERISTIC | 2N4901/2/3 MIN. | 2N4901/2/3 MAX. | 2N4904/5/6 MIN. | 2N4904/5/6 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain (Note 2) | 7.0 | | 7.0 | | | $I_C = 5.0$ A, $V_{CE} = -2.0$ V |
| | | 20 | 80 | | | | $I_C = 1.0$ A, $V_{CE} = -2.0$ V |
| | | | | 25 | 100 | | $I_C = 2.5$ A, $V_{CE} = -2.0$ V |
| $V_{CE(sat)}$ | Collector Saturation Voltage | | −1.5 | | −1.5 | V | $I_C = 5.0$ A, $I_B = 1.0$ A |
| | (Note 2) | | −0.4 | | | V | $I_C = 1.0$ A, $I_B = 0.1$ A |
| | | | | | −1.0 | V | $I_C = 2.5$ A, $I_B = 0.25$ A |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage | | −1.2 | | | V | $I_C = 1.0$ A, $V_{CE} = -2.0$ V |
| | (Note 2) | | | | −1.4 | V | $I_C = 2.5$ A, $V_{CE} = -2.0$ V |
| $h_{fe}$ | Small Signal Current Gain | 4.0 | | | | | $V_{CE} = -10$ V, $I_C = 1.0$ A, f = 1.0 MHz |
| | | | | 4.0 | | | $V_{CE} = -10$ V, $I_C = 0.5$ A, f = 1.0 MHz |
| | | 20 | | 40 | | | $V_{CE} = -10$ V, $I_C = 0.5$ A, f = 1.0 kHz |

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. Pulse conditions: length = 300 μs; duty cycle ≤ 2%.
3. For product family characteristic curves, refer to Section 5-PWR15.

4

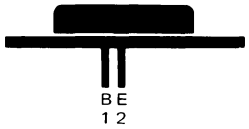
# 2N4907 • 2N4908 • 2N4909

## 150 WATT PNP POWER

DIFFUSED SILICON BI-MESAR™ TRANSISTORS

- $h_{FE}$ . . . 20-80 @ $V_{CE} = -4.0$ V, $I_C = 4.0$ A

See TO3-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | | |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | | −65°C to +200°C |
| Operating Junction Temperature | | | +200°C |
| **Maximum Power Dissipation** | | | |
| Total Dissipation at 25°C Case Temperature | | | 150 W |
| Linear Derating Factor | | | 0.86 W/°C |
| **Maximum Voltages and Currents** | **2N4907** | **2N4908** | **2N4909** |
| $V_{CBO}$ Collector to Base Voltage | −40 V | −60 V | −80 V |
| $V_{EBO}$ Emitter to Base Voltage | −5.0 V | −5.0 V | −5.0 V |
| $V_{CEO}$ Collector to Emitter Voltage | −40 V | −60 V | −80 V |
| $I_C$ Collector Current | 10 A | 10 A | 10 A |
| $I_B$ Base Current | 7.0 A | 7.0 A | 7.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N4907 MIN. | 2N4907 MAX. | 2N4908 MIN. | 2N4908 MAX. | 2N4909 MIN. | 2N4909 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $I_{CEX}$ | Collector Cutoff Current | | 30 | | | | | mA | $V_{CE} = -40$ V, $V_{EB} = -1.5$ V, $T_A = 150°C$ |
| | | | | | 30 | | | mA | $V_{CE} = -60$ V, $V_{EB} = -1.5$ V, $T_A = 150°C$ |
| | | | | | | | 30 | mA | $V_{CE} = -80$ V, $V_{EB} = -1.5$ V, $T_A = 150°C$ |
| | | | 2.0 | | | | | mA | $V_{CE} = -40$ V, $V_{EB} = -1.5$ V |
| | | | | | 2.0 | | | mA | $V_{CE} = -60$ V, $V_{EB} = -1.5$ V |
| | | | | | | | 2.0 | mA | $V_{CE} = -80$ V, $V_{EB} = -1.5$ V |
| $I_{EBO}$ | Emitter Cutoff Current | | 5.0 | | 5.0 | | 5.0 | mA | $V_{EB} = -5.0$ V |
| $I_{CEO}$ | Collector Cutoff Current | | 0.7 | | | | | mA | $V_{CE} = -20$ V, $I_B = 0$ |
| | | | | | 0.7 | | | mA | $V_{CE} = -30$ V, $I_B = 0$ |
| | | | | | | | 0.7 | mA | $V_{CE} = -40$ V, $I_B = 0$ |
| $V_{CEO(sus)}$ | Collector Sustaining Voltage (Note 2) | −40 | | −60 | | −80 | | V | $I_C = 200$ mA, $I_B = 0$ |
| $h_{FE}$ | DC Current Gain (Note 2) | 5.0 | | 5.0 | | 5.0 | | | $I_C = 10$ A, $V_{CE} = -4.0$ V |
| | | 20 | 80 | 20 | 80 | 20 | 80 | | $I_C = 4.0$ A, $V_{CE} = -4.0$ V |
| $V_{CE(sat)}$ | Collector Saturation Voltage | | −2.0 | | −2.0 | | −2.0 | V | $I_C = 10$ A, $I_B = 2.0$ A |
| | (Note 2) | | −0.75 | | −0.75 | | −0.75 | V | $I_C = 4.0$ A, $I_B = 400$ mA |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 2) | | −1.5 | | −1.5 | | −1.5 | V | $I_C = 4.0$ A, $V_{CE} = -4.0$ V |
| $h_{fe}$ | Small Signal Current Gain | 4.0 | | 4.0 | | 4.0 | | | $V_{CE} = -10$ V, $I_C = 1.0$ A, f = 1.0 MHz |
| | | 15 | | 15 | | 15 | | | $V_{CE} = -4.0$ V, $I_C = 1.0$ A, f = 1.0 kHz |
| $C_{ob}$ | Output Capacitance | | 600 | | 600 | | 600 | pF | $V_{CB} = 10$ V, $I_E = 0$, f = 100 kHz |

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. Pulse conditions: length = 300 μs; duty cycle ≤ 2%.
3. For product family characteristic curves, refer to Section 5-PWR15.

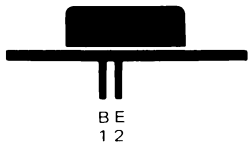
# 2N4910 • 2N4911 • 2N4912 • 2N4231 • 2N4232 • 2N4233

## NPN POWER

DIFFUSED SILICON BI-MESAR™ TRANSISTORS

- **$V_{CE(sat)}$ . . . 0.7 V @ $I_C$ = 1.5 A (2N4231/2/3)**
- **$h_{FE}$ . . . 25-100 @ $I_C$ = 1.5 A, $V_{CE}$ = 2.0 V (2N4231/2/3)**
- **COMPLEMENTS . . . 2N4898 SERIES (2N4910 SERIES)**

**See TO66-1 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | -65°C to +200°C |
| Operating Junction Temperature | 200°C |

| **Maximum Power Dissipation** | **2N4910/1/2** | **2N4231/2/3** |
|---|---|---|
| Total Dissipation at 25°C Case Temperature | 25 W | 35 W |
| Linear Derating Factor | 0.143 W/°C | 0.2 W/°C |

| **Maximum Voltages and Currents** | | **2N4910, 2N4231** | **2N4911, 2N4232** | **2N4912, 2N4233** |
|---|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 40 V | 60 V | 80 V |
| $V_{CEO}$ | Collector to Emitter Voltage | 40 V | 60 V | 80 V |
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V | 5.0 V | 5.0 V |

| | | **2N4910/1/2** | **2N4231/2/3** |
|---|---|---|---|
| $I_C$ | Collector Current | 1.0 A | 3.0 A |
| $I_B$ | Base Current | 1.0 A | 1.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N4910 2N4231 MIN. | 2N4910 2N4231 MAX. | 2N4911 2N4232 MIN. | 2N4911 2N4232 MAX. | 2N4912 2N4233 MIN. | 2N4912 2N4233 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $I_{CEX}$ | Collector Cutoff Current | | 1.0 | | | | | mA | $V_{CE}$ = 40 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| | | | | | 1.0 | | | mA | $V_{CE}$ = 60 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| | | | | | | | 1.0 | mA | $V_{CE}$ = 80 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| | | | 0.1 | | | | | mA | $V_{CE}$ = 40 V, $V_{EB}$ = 1.5 V |
| | | | | | 0.1 | | | mA | $V_{CE}$ = 60 V, $V_{EB}$ = 1.5 V |
| | | | | | | | 0.1 | mA | $V_{CE}$ = 80 V, $V_{EB}$ = 1.5 V |
| $V_{CEO(sus)}$ | Collector Sustaining Voltage (Note 2) | 40 | | | | | | V | $I_B$ = 0, $I_C$ = 100 mA |
| | | | | 60 | | | | V | $I_B$ = 0, $I_C$ = 100 mA |
| | | | | | | 80 | | V | $I_B$ = 0, $I_C$ = 100 mA |

| SYMBOL | CHARACTERISTIC | | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| $I_{CBO}$ | Collector Cutoff Current | 2N4910 | | 100 | μA | $V_{CB}$ = 40 V, $I_E$ = 0 |
| | | 2N4231 | | 50 | μA | $V_{CB}$ = 40 V, $I_E$ = 0 |
| | | 2N4911 | | 100 | μA | $V_{CB}$ = 60 V, $I_E$ = 0 |
| | | 2N4232 | | 50 | μA | $V_{CB}$ = 60 V, $I_E$ = 0 |
| | | 2N4912 | | 100 | μA | $V_{CB}$ = 80 V, $I_E$ = 0 |
| | | 2N4233 | | 50 | μA | $V_{CB}$ = 80 V, $I_E$ = 0 |
| $I_{CEO}$ | Collector Cutoff Current | 2N4910 | | 0.5 | mA | $V_{CE}$ = 20 V, $I_B$ = 0 |
| | | 2N4911 | | 0.5 | mA | $V_{CE}$ = 30 V, $I_B$ = 0 |
| | | 2N4912 | | 0.5 | mA | $V_{CE}$ = 40 V, $I_B$ = 0 |
| | | 2N4231 | | 1.0 | mA | $V_{CE}$ = 30 V, $I_B$ = 0 |
| | | 2N4232 | | 1.0 | mA | $V_{CE}$ = 50 V, $I_B$ = 0 |
| | | 2N4233 | | 1.0 | mA | $V_{CE}$ = 70 V, $I_B$ = 0 |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. Pulse conditions: length = 300 μs; duty cycle = 2%.
3. For product family characteristic curves, refer to Section 5-PWR 5.

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N4910/1/2 MIN. | 2N4910/1/2 MAX. | 2N4231/2/3 MIN. | 2N4231/2/3 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $I_{EBO}$ | Emitter Cutoff Current | | | | 500 | μA | $V_{EB}$ = 5.0 V, $I_C$ = 0 |
| | | | 1.0 | | | mA | $V_{EB}$ = 5.0 V, $I_C$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 2) | 10 | | | | | $I_C$ = 1.0 A, $V_{CE}$ = 1.0 V |
| | | 20 | 100 | | | | $I_C$ = 500 mA, $V_{CE}$ = 1.0 V |
| | | 40 | | | | | $I_C$ = 50 mA, $V_{CE}$ = 1.0 V |
| | | | | 10 | | | $I_C$ = 3.0 A, $V_{CE}$ = 2.0 V |
| | | | | 25 | 100 | | $I_C$ = 1.5 A, $V_{CE}$ = 2.0 V |
| | | | | 40 | | | $I_C$ = 0.5 A, $V_{CE}$ = 2.0 V |
| $C_{ob}$ | Output Capacitance | | 100 | | 200 | pF | $V_{CB}$ = 10 V, $I_C$ = 0, f = 100 kHz |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 2) | | 0.6 | | | V | $I_C$ = 1.0 A, $I_B$ = 0.1 A |
| | | | | | 2.0 | V | $I_C$ = 3.0 A, $I_B$ = 0.3 A |
| | | | | | 0.7 | V | $I_C$ = 1.5 A, $I_B$ = 0.15 A |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 2) | | 1.3 | | | V | $I_C$ = 1.0 A, $I_B$ = 0.1 A |
| $V_{BE}$ | Base to Emitter Voltage (Note 2) | | 1.3 | | | V | $I_C$ = 1.0 A, $V_{CE}$ = 1.0 V |
| | | | | | 1.4 | V | $I_C$ = 1.5 A, $V_{CE}$ = 2.0 V |
| $\|h_{fe}\|$ | Magnitude of Common Emitter Small Signal Current Gain | 3.0 | | | | | $V_{CE}$ = 10 V, $I_C$ = 250 mA, f = 1.0 MHz |
| | | | | 4.0 | | | $V_{CE}$ = 10 V, $I_C$ = 0.5 A, f = 1.0 MHz |
| $h_{fe}$ | Small Signal Current Gain | 25 | | | | | $V_{CE}$ = 10 V, $I_C$ = 250 mA, f = 1.0 kHz |
| | | | | 20 | | | $V_{CE}$ = 10 V, $I_C$ = 0.5 A, f = 1.0 kHz |

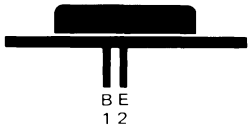
# 2N4913 • 2N4914 • 2N4915

## 87.5 WATT NPN POWER

DIFFUSED SILICON BI-MESAR™ TRANSISTORS

- $V_{CE(sat)}$ . . . 0.75 @ $I_C$ = 2.5 A
- $h_{fe}$ . . . 25-100 @ $I_C$ = 2.5 A, $V_{CE}$ = 2.0 V
- COMPLEMENTS . . . 2N4904 THROUGH 2N4906

See TO3-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Junction Temperature | −65°C to +200°C |

**Maximum Power Dissipation**

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 87.5 W |
| Linear Derating Factor | 0.5 W/°C |

| **Maximum Voltages and Currents** | | **2N4913** | **2N4914** | **2N4915** |
|---|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 40 V | 60 V | 80 V |
| $V_{CEO}$ | Collector to Emitter Voltage | 40 V | 60 V | 80 V |
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V | 5.0 V | 5.0 V |
| $I_C$ | Collector Current | 5.0 A | 5.0 A | 5.0 A |
| $I_B$ | Base Current | 1.0 A | 1.0 A | 1.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| $I_{CEX}$ | Collector Cutoff Current | 2N4913 | | 0.1 | mA | $V_{CE}$ = 40 V, $V_{EB}$ = 1.5 V |
| | | 2N4914 | | 0.1 | mA | $V_{CE}$ = 60 V, $V_{EB}$ = 1.5 V |
| | | 2N4915 | | 0.1 | mA | $V_{CE}$ = 80 V, $V_{EB}$ = 1.5 V |
| $I_{CEX}$ | Collector Cutoff Current | 2N4913 | | 2.0 | mA | $V_{CE}$ = 40 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| | | 2N4914 | | 2.0 | mA | $V_{CE}$ = 60 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| | | 2N4915 | | 2.0 | mA | $V_{CE}$ = 80 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| $I_{EBO}$ | Emitter Cutoff Current | | | 1.0 | mA | $V_{EB}$ = 5.0 V, $I_C$ = 0 |
| $V_{CEO(sus)}$ | Collector Sustaining Voltage | 2N4913 | 40 | | V | $I_C$ = 200 mA, $I_B$ = 0 |
| | (Note 2) | 2N4914 | 60 | | V | $I_C$ = 200 mA, $I_B$ = 0 |
| | | 2N4915 | 80 | | V | $I_C$ = 200 mA, $I_B$ = 0 |
| $I_{CEO}$ | Collector Cutoff Current | 2N4913 | | 1.0 | mA | $V_{CE}$ = 40 V, $I_B$ = 0 |
| | | 2N4914 | | 1.0 | mA | $V_{CE}$ = 60 V, $I_B$ = 0 |
| | | 2N4915 | | 1.0 | mA | $V_{CE}$ = 80 V, $I_B$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 2) | | 7.0 | | | $I_C$ = 5.0 A, $V_{CE}$ = 2.0 V |
| | | | 25 | 100 | | $I_C$ = 2.5 A, $V_{CE}$ = 2.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage | | | 1.5 | V | $I_C$ = 5.0 A, $I_B$ = 1.0 A |
| | (Note 2) | | | 0.75 | V | $I_C$ = 2.5 A, $I_B$ = 0.25 A |
| $V_{BE}$ | Base to Emitter "On" Voltage (Note 2) | | | 1.4 | V | $I_C$ = 2.5 A, $V_{CE}$ = 2.0 V |
| $\|h_{fe}\|$ | Magnitude of Common Emitter Small Signal Current Gain | | 4.0 | | | $V_{CE}$ = 10 V, $I_C$ = 1.0 A, f = 1.0 MHz |
| $h_{fe}$ | Small Signal Current Gain | | 20 | | | $V_{CE}$ = 10 V, $I_C$ = 0.5 A, f = 1.0 kHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. Pulse conditions: length = 300 μs; duty cycle = 2%.
3. For product family characteristic curves, refer to Section 5 - PWR 6.

# 2N4916 • 2N4917 • PN4916 • PN4917

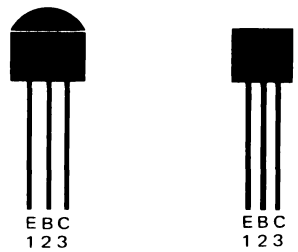
## PNP SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS AND SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C (PN4916/7)
- $V_{CEO}$ . . . 30 V (MIN)
- $h_{FE}$ . . . 150 to 300 @ 10 mA
- $f_T$ . . . 450 MHz (MIN) @ 10 mA
- $r_b'C_c$ . . . 50 ps (MAX)
- $C_{cb}$ . . . 4.5 pF (MAX)
- COMPLEMENTS . . . 2N3693, 2N3694 (TO18), 2N3903, 2N3904 (TO92)

See Package Outlines

TO18-4 TO92-1




2N4916 2N4917 PN4916 PN4917

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | 2N4916/7 | PN4916/7 |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | −55°C to +125°C | −55°C to +150°C |
| Operating Junction Temperature | | 125°C | 150°C |
| Lead Temperature (10 seconds) | | 260°C | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | | |
| Total Dissipation at 25°C Case Temperature | | 0.5 W | 1.0 W |
| at 25°C Ambient Temperature | | 0.2 W | 0.625 W |
| **Maximum Voltages and Current** | | | |
| $V_{CBO}$ | Collector to Base Voltage | −30 V | −30 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | −30 V | −30 V |
| $V_{EBO}$ | Emitter to Base Voltage | −5.0 V | −5.0 V |
| $I_C$ | Collector Current | 100 mA | 100 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N4916, PN4916 MIN. | 2N4916, PN4916 MAX. | 2N4917, PN4917 MIN. | 2N4917, PN4917 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 40 | | 100 | | | $I_C$ = 100 μA, $V_{CE}$ = −1.0 V |
| | | 60 | | 150 | | | $I_C$ = 1.0 mA, $V_{CE}$ = −1.0 V |
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 70 | 200 | 150 | 300 | | $I_C$ = 10 mA, $V_{CE}$ = −1.0 V |
| | | 15 | | 30 | | | $I_C$ = 50 mA, $V_{CE}$ = −1.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage | | −0.13 | | −0.13 | V | $I_C$ = 1.0 mA, $I_B$ = 0.1 mA |
| $V_{CE(sat)}$ | Pulsed Collector Saturation Voltage (Note 5) | | −0.14 | | −0.14 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | −0.3 | | −0.3 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage | | −0.75 | | −0.75 | V | $I_C$ = 1.0 mA, $I_B$ = 0.1 mA |
| $V_{BE(sat)}$ | Pulsed Base Saturation Voltage (Note 5) | −0.7 | −0.9 | −0.7 | −0.9 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | −0.75 | −1.1 | −0.75 | −1.1 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $t_{on}$ | Turn On Time (see test circuit no. 407) | | 40 | | 40 | ns | $I_C$ = 50 mA, $I_{B1}$ = 5.0 mA |
| $t_{off}$ | Turn Off Time (see test circuit no. 407) | | 150 | | 150 | ns | $I_C$ = 50 mA, $I_{B1}$ = 5.0 mA, $I_{B2}$ = 5.0 mA |
| $\|h_{fe}\|$ | Magnitude of Small Signal Current Gain | 4.0 | | 4.5 | | | $I_C$ = 10 mA, $V_{CE}$ = −20 V, f = 100 MHz |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | −30 | | −30 | | V | $I_C$ = 10 mA, $I_B$ = 0 (pulsed) |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −30 | | −30 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | −30 | | −30 | | V | $I_C$ = 10 μA, $V_{BE}$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −5.0 | | −5.0 | | V | $I_C$ = 0, $I_E$ = 10 μA |
| $I_{CES}$ | Collector Reverse Current | | 25 | | 25 | nA | $V_{CE}$ = −15 V, $V_{EB}$ = 0 |
| | | | 25 | | 25 | μA | $V_{CE}$ = −15 V, $V_{EB}$ = 0, $T_A$ = 65°C |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/W (derating factor of 2.0 mW/°C) for 2N4916 and 2N4917. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C) for PN4916 and PN4917.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N4916, PN4916 MIN. | 2N4916, PN4916 MAX. | 2N4917, PN4917 MIN. | 2N4917, PN4917 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $C_{cb}$ | Collector to Base Capacitance | | 4.5 | | 4.5 | pF | $I_E = 0$, $V_{CE} = -10$ V |
| $C_{eb}$ | Emitter to Base Capacitance | | 8.0 | | 8.0 | pF | $I_C = 0$, $V_{EB} = -0.5$ V |
| $r_b'C_c$ | Collector to Base Time Constant | | 50 | | 50 | ps | $I_C = 10$ mA, $V_{CE} = -20$ V, f = 80 MHz |
| NF | Noise Figure | | 6.0 | | 6.0 | dB | $I_C = 1.0$ mA, $V_{CE} = -5.0$ V, $R_S = 100\ \Omega$, BW = 15 MHz, f = 100 MHz |
| | | | 4.0 | | 4.0 | dB | $I_C = 100\ \mu A$, $V_{CE} = -5.0$ V, $R_S = 1.0\ k\Omega$, BW = 15.7 kHz, 3.0 dB Points @ 10 Hz & 10 kHz |

4

# 2N4960 • 2N4961 • 2N4962 • 2N4963

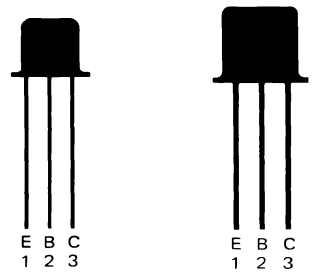
## NPN SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS AND SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $V_{CEO}$ . . . 80 V (MIN) 2N4916/63
- $h_{FE}$ . . . 12 SPECIFICATIONS FROM 100 μA TO 500 mA, −55°C to +125°C
- $V_{CE(sat)}$ . . . 0.5 V (MAX) @ 500 mA; 0.18 V (MAX) @ 150 mA
- $f_T$ . . . 250 MHz (MIN) @ 50 mA

See Package Outlines

TO18-1 TO5-1




2N4962 2N4963 2N4960 2N4961

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | | |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | | −65°C to +200°C |
| Operating Junction Temperature | | | 200°C |
| Lead Temperature (60 seconds) | | | 300°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | **2N4960/2** | **2N4961/3** |
| Total Dissipation at 25°C Case Temperature | | 3.5 W | 1.5 W |
| at 25°C Ambient Temperature | | 0.8 W | 0.5 W |
| **Maximum Voltages and Current** | | | |
| $V_{CBO}$ | Collector to Base Voltage | 60 V | 80 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 60 V | 80 V |
| $V_{EBO}$ | Emitter to Base Voltage | 6.5 V | 6.5 V |
| $I_C$ | Collector Current | 1.0 A | 1.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N4960, 2N4962 MIN. | 2N4960, 2N4962 MAX. | 2N4960, 2N4962 MIN. | 2N4960, 2N4962 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 30 | | 30 | | | $I_C$ = 100 μA, $V_{CE}$ = 10 V |
| | | 60 | | 60 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V |
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 90 | | 90 | | | $I_C$ = 10 mA, $V_{CE}$ = 10 V |
| | | 100 | | 100 | | | $I_C$ = 50 mA, $V_{CE}$ = 10 V |
| | | 10 | | 10 | | | $I_C$ = 150 mA, $V_{CE}$ = 1.0 V, $T_A$ = −55°C |
| | | 40 | | 40 | | | $I_C$ = 150 mA, $V_{CE}$ = 1.0 V |
| | | | 500 | | 500 | | $I_C$ = 150 mA, $V_{CE}$ = 1.0 V, $T_A$ = 125°C |
| | | 25 | | 25 | | | $I_C$ = 150 mA, $V_{CE}$ = 10 V, $T_A$ = −55°C |
| | | 100 | 300 | 100 | 300 | | $I_C$ = 150 mA, $V_{CE}$ = 10 V |
| | | | 650 | | 650 | | $I_C$ = 150 mA, $V_{CE}$ = 10 V, $T_A$ = 125°C |
| | | 70 | | 70 | | | $I_C$ = 300 mA, $V_{CE}$ = 10 V |
| | | 45 | | 45 | | | $I_C$ = 500 mA, $V_{CE}$ = 10 V |
| $\|h_{fe}\|$ | Magnitude of Common Emitter, Small Signal, Current Gain | 2.5 | 6.0 | 2.5 | 6.0 | | $I_C$ = 50 mA, $V_{CE}$ = 10 V, f = 100 MHz |
| $V_{CE(sat)}$ | Pulsed Collector Saturation Voltage (Note 5) | | 0.07 | | 0.07 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | 0.18 | | 0.18 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | | | 0.36 | | 0.36 | V | $I_C$ = 150 mA, $I_B$ = 15 mA, $T_A$ = 125°C |
| | | | 0.31 | | 0.31 | V | $I_C$ = 300 mA, $I_B$ = 30 mA |
| | | | 0.50 | | 0.50 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.
†Fairchild exceeds JEDEC registered value.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 50°C/W (derating factor of 20 mW/°C) for the 2N4960 and 2N4961; 117°C/W (derating factor of 8.6 mW/°C) for 2N4962 and 2N4963. Junction to ambient thermal resistance of 219°C/W (derating factor of 4.6 mW/°C) for the 2N4960 and 2N4961; 350° C/W (derating factor of 2.9 mW/°C for the 2N4962 and 2N4963.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 - SS17.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N4961, 2N4963 MIN. | 2N4961, 2N4963 MAX. | 2N4961, 2N4963 MIN. | 2N4961, 2N4963 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_{BE(sat)}$ | Pulsed Base Saturation Voltage (Note 5) | | 0.72 | | 0.72 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | 1.10 | | 1.10 | V | $I_C$ = 150 mA, $I_B$ = 15 mA, $T_A$ = −55°C |
| | | 0.78 | 0.90 | 0.78 | 0.90 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| | | 0.63 | | 0.63 | | V | $I_C$ = 150 mA, $I_B$ = 15 mA, $T_A$ = 125°C |
| | | | 1.05 | | 1.05 | V | $I_C$ = 300 mA, $I_B$ = 30 mA |
| | | | 1.30 | | 1.30 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| $V_{BE(ON)}$ | Pulsed Base Emitter "On" Voltage (Note 5) | | 0.88 | | 0.88 | V | $I_C$ = 150 mA, $V_{CE}$ = 10 V |
| †$V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | 60 | | 80 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | 60 | | 80 | | V | $I_C$ = 10 μA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 60 | | 80 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 6.5 | | 6.5 | | V | $I_C$ = 0, $I_E$ = 10 μA |
| $I_{CBO}$ | Collector Cutoff Current | | 10 | | 10 | nA | $I_E$ = 0, $V_{CB}$ = 50 V |
| | | | 10 | | 10 | μA | $I_E$ = 0, $V_{CB}$ = 50 V, $T_A$ = 125 C |
| $I_{EBO}$ | Emitter Cutoff Current | | 10 | | 10 | nA | $I_C$ = 0, $V_{EB}$ = 4.0 V |
| $C_{cb}$ | Collector to Base Capacitance | | 15 | | 15 | pF | $I_E$ = 0, $V_{CB}$ = 10 V, f = 1.0 MHz |
| $C_{eb}$ | Emitter to Base Capacitance | | 75 | | 75 | pF | $I_C$ = 0, $V_{EB}$ = 0.5 V, f = 1.0 MHz |
| $t_{on}$ | Turn On Time (see test circuit no. 417) | | 150 | | 150 | ns | $I_C \approx$ 150 mA, $I_{B1} \approx$ 15 mA, $V_{CC}$ = 50 V |
| $t_{off}$ | Turn Off Time (see test circuit no. 417) | | 1.0 | | 1.0 | μs | $I_C \approx$ 150 mA, $I_{B1} \approx$ 15 mA, $I_{B2} \approx$ 15 mA, $V_{CE}$ = 50 V |

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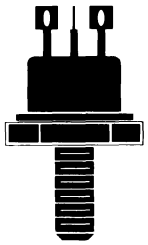
# 2N5002 • 2N5003 • 2N5004 • 2N5005

## 50 WATT NPN-PNP POWER

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 50 W @ $T_C$ = 50°C, $V_{CE}$ = 40 V**
- **$LV_{CEO}$ . . . 80 V (MIN)**
- **$f_T$ . . . 60 AND 70 MHz (MIN)**
- **COMPLEMENTS . . . 2N5002, 2N5004 (NPN) 2N5003, 2N5005 (PNP)**

**See TO59-1 Package Outline**



**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Junction Temperature | 200°C |
| Lead Temperature (60 seconds) | 300°C |

**Maximum Power Dissipation**

| | |
|---|---|
| Total Dissipation at 50°C Case Temperature, $V_{CE}$ = 40 V (Note 4) | 50 W |

**Maximum Voltages and Current**

| | | 2N5003 2N5005 | 2N5002 2N5004 |
|---|---|---|---|
| $V_{CES}$ | Collector to Emitter Voltage | −100 V | 100 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 2) | −80 V | 80 V |
| $V_{EBO}$ | Emitter to Base Voltage | −5.5 V | 6.0 V |
| $I_C$ | Collector Current | 5.0 A | 5.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N5002 2N5004 MIN. | 2N5002 2N5004 MAX. | 2N5003 2N5005 MIN. | 2N5003 2N5005 MAX. | UNITS | TEST CONDITIONS Reverse Voltage Polarity for PNP |
|---|---|---|---|---|---|---|---|
| $V_{CEO(sus)}$ | Collector Sustaining Voltage (Note 3) | 80 | | −80 | | V | $I_C$ = 100 mA, $I_B$ = 0 |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 3) | | 0.75 | | −0.75 | V | $I_C$ = 2.5 A, $I_B$ = 0.25 A |
| | | | 1.5 | | −1.5 | V | $I_C$ = 5.0 A, $I_B$ = 0.5 A |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 3) | | 1.45 | | −1.45 | V | $I_C$ = 2.5 A, $I_B$ = 0.25 A |
| | | | 2.2 | | −2.2 | V | $I_C$ = 5.0 A, $I_B$ = 0.5 A |
| $I_{CEO}$ | Collector Cutoff Current Base Open | | 50 | | 50 | μA | $I_B$ = 0, $V_{CE}$ = 40 V |
| $I_{CES}$ | Collector Cutoff Current | | 1.0 | | 1.0 | μA | $V_{CE}$ = 60 V, $V_{BE}$ = 0 |
| $I_{CES}$ | Collector Cutoff Current | | 1.0 | | 1.0 | mA | $V_{CE}$ = 100 V, $V_{BE}$ = 0 |
| $I_{CEX}$ | Collector Reverse Current | | 500 | | 500 | μA | $V_{CE}$ = 60 V, $V_{EB}$ = 2.0 V, $T_C$ = 150°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 1.0 | | | mA | $V_{EB}$ = 6.0 V, $I_C$ = 0 |
| | | | | | 1.0 | mA | $V_{EB}$ = 5.5 V, $I_C$ = 0 |
| | | | 1.0 | | | μA | $V_{EB}$ = 5.0 V, $I_C$ = 0 |
| | | | | | 1.0 | μA | $V_{EB}$ = 4.0 V, $I_C$ = 0 |
| $C_{cb}$ | Collector to Base Capacitance | | 250 | | 250 | pF | $I_E$ = 0, $V_{CB}$ = 10 V, f = 1.0 MHz |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 3) | | 1.45 | | −1.45 | V | $I_C$ = 2.5 A, $V_{CE}$ = 5.0 V |

| SYMBOL | CHARACTERISTIC | 2N5002 2N5003 MIN. | 2N5002 2N5003 MAX. | 2N5004 2N5005 MIN. | 2N5004 2N5005 MAX. | TEST CONDITIONS Reverse Voltage Polarity for PNP |
|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Pulse Current Gain (Note 3) | 20 | | 50 | | $I_C$ = 50 mA, $V_{CE}$ = 5.0 V |
| | | 30 | 90 | 70 | 200 | $I_C$ = 2.5 A, $V_{CE}$ = 5.0 V |
| | | 20 | | 40 | | $I_C$ = 5.0 A, $V_{CE}$ = 5.0 V |
| $h_{FE}$ | DC Pulse Current Gain (Note 3) | 15 | | 35 | | $I_C$ = 2.5 A, $V_{CE}$ = 5.0 V, $T_A$ = −55°C |
| $h_{fe}$ | High Frequency Current Gain | 3.0 | | 3.5 | | $I_C$ = 0.5 A, $V_{CE}$ = 5.0 V, f = 20 MHz |
| $h_{fe}$ | High Frequency Current Gain | 20 | | 50 | | $I_C$ = 100 mA, $V_{CE}$ = 5.0 V, f = 1.0 kHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. This rating refers to a high current point where collector to emitter voltage is lowest.
3. Pulse conditions: length = 300 μs; duty cycle = 1%.
4. Contact factory for maximum permissible power under pulsed or reverse biased operating conditions.
5. For additional product family characteristics, refer to P19 for 2N5002, 2N5004, P11 for 2N5003, 2N5005.

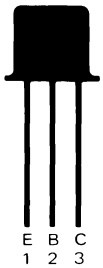
# 2N5022 • 2N5023

## PNP SMALL SIGNAL HIGH VOLTAGE HIGH CURRENT SATURATED SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $t_{on}$ . . . 25 ns (TYP), 40 ns (MAX) @ 500 mA , $t_{off}$ . . . 65 ns (TYP), 90 ns (MAX) @ 500 mA
- $V_{CE(sat)}$ . . . 0.7 V (MAX) (2N5023) @ 1.0 A , 0.8 V (MAX) (2N5022) @ 1.0 A
- $h_{FE}$ . . . 25-100 (2N5022), 40-100 (2N5023) @ 500 mA , 25 (MIN) (2N5022), 40 (MIN) (2N5023) @ 1.0 A
- $V_{CEO}$ . . . 50 V (MIN) (2N5022), 30 V (MIN) (2N5023)
- COMPLEMENTS . . . 2N3724, 2N3725

See TO5-2 Package outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Junction Temperature | 200°C |
| Lead Temperature (60 seconds) | 300°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Ambient Temperature | 1.0 W |
| at 25°C Case Temperature | 4.0 W |

| **Maximum Voltages and Current** | | **2N5022** | **2N5023** |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | −50 V | −30 V |
| $V_{EBO}$ | Emitter to Base Voltage | −5.0 V | −5.0 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | −50 V | −30 V |
| $V_{CES}$ | Collector to Emitter Voltage | −50 V | −30 V |
| $I_C$ | Collector Current (Note 5) | 1.0 A | 1.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N5022 MIN. | 2N5022 MAX. | 2N5023 MIN. | 2N5023 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $t_{on}$ | Turn On Time (see test circuit no. 386) | | 40 | | 40 | ns | $I_C \approx 500$ mA, $I_{B1} \approx 50$ mA |
| $t_{off}$ | Turn Off Time (see test circuit no. 387) | | 90 | | 90 | ns | $I_C \approx 500$ mA, $I_{B1} \approx 50$ mA, $I_{B2} \approx -50$ mA |
| $h_{FE}$ | DC Current Gain (Note 5) | 15 | | 30 | | | $I_C = 100$ mA, $V_{CE} = -1.0$ V |
| | | 25 | 100 | 40 | 100 | | $I_C = 500$ mA, $V_{CE} = -1.0$ V |
| | | 25 | | 40 | | | $I_C = 1.0$ A, $V_{CE} = -5.0$ V |
| | | 10 | | 20 | | | $I_C = 500$ mA, $V_{CE} = -1.0$ V, $T_A = -55°C$ |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | −0.2 | | −0.17 | V | $I_C = 100$ mA, $I_B = 10$ mA |
| | | | −0.4 | | −0.35 | V | $I_C = 500$ mA, $I_B = 50$ mA |
| | | | −0.8 | | −0.70 | V | $I_C = 1.0$ A, $I_B = 100$ mA |
| $\|h_{fe}\|$ | Magnitude of Common Emitter Small Signal Current Gain | 1.7 | | 2.0 | | | $I_C = 50$ mA, $V_{CE} = -10$ V, f = 100 MHz |
| $C_{cb}$ | Collector to Base Capacitance | | 25 | | 25 | pF | $V_{CB} = -10$ V, $I_E = 0$, f = 100 kHz |
| $C_{eb}$ | Emitter to Base Capacitance | | 100 | | 100 | pF | $V_{EB} = -0.5$ V, $I_C = 0$, f = 100 kHz |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 5) | −50 | | −30 | | V | $I_C = 10$ mA, $I_B = 0$ |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −50 | | −30 | | V | $I_C = 100\ \mu A$, $I_E = 0$ |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | −50 | | −30 | | V | $I_C = 100\ \mu A$, $V_{BE} = 0$ |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −5.0 | | −5.0 | | V | $I_E = 100\ \mu A$, $I_C = 0$ |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 5) | | −1.0 | | −1.0 | V | $I_C = 100$ mA, $I_B = 10$ mA |
| | | −0.8 | −1.4 | −0.8 | −1.4 | V | $I_C = 500$ mA, $I_B = 50$ mA |
| | | | −1.75 | | −1.75 | V | $I_C = 1.0$ A, $I_B = 100$ mA |
| $I_{CES}$ | Collector Reverse Current | | 100 | | | nA | $V_{CE} = -30$ V, $V_{BE} = 0$ |
| | | | | | 100 | nA | $V_{CE} = -20$ V, $V_{BE} = 0$ |
| | | | 15 | | | μA | $V_{CE} = -30$ V, $V_{BE} = 0$, $T_A = 100°C$ |
| | | | | | 15 | μA | $V_{CE} = -20$ V, $V_{BE} = 0$, $T_A = 100°C$ |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to case thermal resistance of 43.8°C/W (derating factor of 22.8 mW/°C); junction to ambient thermal resistance of 175°C/W (derating factor of 5.72 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 — SS7.

4

# 2N5058 • 2N5059

## NPN SMALL SIGNAL HIGH VOLTAGE GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$V_{CEO}$ . . . 250 V (MIN) (2N5059), 300 V (MIN) (2N5058)**
- **$C_{cb}$ . . . 10 pF (MAX)**
- **$h_{FE}$ . . . 30-150 @ 30 mA (2N5059)**

**See TO5-2 Package Outline**


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperature**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Junction Temperature | 175°C |
| Lead Temperature (10 seconds) | 300°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 5.0 W |
| at 25°C Ambient Temperature | 1.0 W |

| **Maximum Voltages and Current** | | **2N5058** | **2N5059** |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 300 V | 250 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 3) (Applicable from 0 to 30 mA) | 300 V | 250 V |
| $V_{EBO}$ | Emitter to Base Voltage | 7.0 V | 6.0 V |
| $I_C$ | Collector Current (Continuous) | 150 mA | 150 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N5058 MIN. | 2N5058 MAX. | 2N5059 MIN. | 2N5059 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $I_{CBO}$ | Collector Cutoff Current | | 50 | | 50 | nA | $I_E = 0$, $V_{CB} = 100$ V |
| | | | 20 | | 20 | μA | $I_E = 0$, $V_{CB} = 100$ V, $T_A = 125°C$ |
| $I_{EBO}$ | Emitter Cutoff Current | | 10 | | 10 | nA | $I_C = 0$, $V_{EB} = 5.0$ V |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 300 | | 250 | | V | $I_C = 100$ μA, $I_E = 0$ |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 4) | 300 | | 250 | | V | $I_C = 30$ mA, $I_B = 0$ |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 7.0 | | 6.0 | | V | $I_E = 100$ μA, $I_C = 0$ |
| $h_{FE}$ | DC Current Gain | 10 | | 10 | | | $I_C = 5.0$ mA, $V_{CE} = 25$ V |
| $h_{FE}$ | DC Pulse Current Gain (Note 4) | 35 | 150 | 30 | 150 | | $I_C = 30$ mA, $V_{CE} = 25$ V |
| | | 10 | | | | | $I_C = 30$ mA, $V_{CE} = 25$ V, $T_A = -55°C$ |
| | | 35 | | 30 | | | $I_C = 100$ mA, $V_{CE} = 25$ V |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 4) | | 0.82 | | 0.82 | V | $I_C = 30$ mA, $V_{CE} = 25$ V |
| $V_{BE(sat)}$ | Base Saturation Voltage Voltage (Note 4) | | 0.85 | | 0.85 | V | $I_C = 30$ mA, $I_B = 3.0$ mA |
| $V_{CE(sat)}$ | Collector Saturation Voltage Voltage (Note 4) | | 1.0 | | 1.0 | V | $I_C = 30$ mA, $I_B = 3.0$ mA |
| $C_{cb}$ | Collector to Base Capacitance | | 10 | | 10 | pF | $I_E = 0$, $V_{CB} = 10$ V, f = 1.0 MHz |
| $C_{eb}$ | Emitter to Base Capacitance | | 75 | | 75 | pF | $I_C = 0$, $V_{EB} = 0.5$ V, f = 1.0 MHz |
| $\|h_{fe}\|$ | Magnitude of Common Emitter Small Signal Current Gain | 1.5 | 8.0 | 1.5 | 8.0 | | $I_C = 10$ mA, $V_{CE} = 25$ V, f = 20 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These ratings based on maximum junction temperature of 175°C and junction to case thermal resistance of 30°C/W (derating factor of 33.3 mW/°C); junction to ambient thermal resistance of 150°C/W (derating factor of 6.67 mW/°C).
3. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
4. Pulse conditions: length = 300 μs; duty cycle = 1%.
5. For product family characteristic curves, refer to Section 5 — SS11.

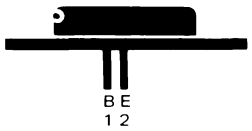
# 2N5067 • 2N5068 • 2N5069

## 87.5 WATT NPN POWER

DIFFUSED SILICON BI-MESAR ™ TRANSISTORS

- $V_{CE(sat)}$ . . . 0.4 V @ $I_C$ = 1.0 A
- $h_{fe}$ . . . 20-80 @ $I_C$ = 1.0 A, $V_{CE}$ = 2.0 V
- COMPLEMENTS . . . 2N4901 THROUGH 2N4903

See TO3-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Junction Temperature | −65°C to +200°C |

**Maximum Power Dissipation**

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 87.5 W |
| Linear Derating Factor | 0.5 W/°C |

| **Maximum Voltages and Currents** | | **2N5067** | **2N5068** | **2N5069** |
|---|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 40 V | 60 V | 80 V |
| $V_{CEO}$ | Collector to Emitter Voltage | 40 V | 60 V | 80 V |
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V | 5.0 V | 5.0 V |
| $I_C$ | Collector Current | 5.0 A | 5.0 A | 5.0 A |
| $I_B$ | Base Current | 1.0 A | 1.0 A | 1.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| $I_{CEX}$ | Collector Cutoff Current | 2N5067 | | 1.0 | mA | $V_{CE}$ = 40 V, $V_{EB}$ = 1.5 V |
| | | 2N5068 | | 1.0 | mA | $V_{CE}$ = 60 V, $V_{EB}$ = 1.5 V |
| | | 2N5069 | | 1.0 | mA | $V_{CE}$ = 80 V, $V_{EB}$ = 1.5 V |
| $I_{CEX}$ | Collector Cutoff Current | 2N5067 | | 2.0 | mA | $V_{CE}$ = 40 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| | | 2N5068 | | 2.0 | mA | $V_{CE}$ = 60 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| | | 2N5069 | | 2.0 | mA | $V_{CE}$ = 80 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| $I_{EBO}$ | Emitter Cutoff Current | | | 1.0 | mA | $V_{EB}$ = 5.0 V, $I_C$ = 0 |
| $I_{CEO}$ | Collector Cutoff Current | 2N5067 | | 1.0 | mA | $V_{CE}$ = 40 V, $I_B$ = 0 |
| | | 2N5068 | | 1.0 | mA | $V_{CE}$ = 60 V, $I_B$ = 0 |
| | | 2N5069 | | 1.0 | mA | $V_{CE}$ = 80 V, $I_B$ = 0 |
| $V_{CEO(sus)}$ | Collector Sustaining Voltage | 2N5067 | 40 | | V | $I_C$ = 200 mA, $I_B$ = 0 |
| | | 2N5068 | 60 | | V | $I_C$ = 200 mA, $I_B$ = 0 |
| | | 2N5069 | 80 | | V | $I_C$ = 200 mA, $I_B$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 2) | | 7.0 | | | $I_C$ = 5.0 A, $V_{CE}$ = 2.0 V |
| | | | 20 | 80 | | $I_C$ = 1.0 A, $V_{CE}$ = 2.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage | | | 0.4 | V | $I_C$ = 1.0 A, $I_B$ = 0.1 A |
| | (Note 2) | | | 1.5 | V | $I_C$ = 5.0 A, $I_B$ = 1.0 A |
| $V_{BE}$ | Base Emitter Voltage | | | 1.2 | V | $I_C$ = 1.0 A, $V_{CE}$ = 2.0 V |
| $\|h_{fe}\|$ | Magnitude of Common Emitter Small Signal Current Gain | | 4.0 | | | $V_{CE}$ = 10 V, $I_C$ = 1.0 A, f = 1.0 MHz |
| $h_{fe}$ | Small Signal Current Gain | | 20 | | | $V_{CE}$ = 10 V, $I_C$ = 0.5 A, f = 1.0 kHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. Pulse conditions: length = 300 μs; duty cycle = 2%.
3. For product family characteristic curves, refer to Section 5 - PWR 6.

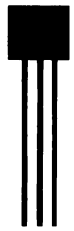
# 2N5086 • 2N5087

## PNP LOW LEVEL LOW NOISE HIGH GAIN AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C**
- **$V_{CEO}$ . . . −50 V (MIN)**
- **$h_{FE}$ . . . 250 (MIN) FROM 100 μA to 10 mA (2N5087)**
- **NF . . . 2.0 dB (MAX) WIDE BAND and 1.0 kHz (2N5087)**
- **COMPLEMENTS . . . 2N5209, 2N5210**

**See TO92-1 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| **†Maximum Temperatures** | |
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |
| Lead Temperature (10 seconds) | 260°C |
| **†Maximum Power Dissipation** (Notes 2 & 3) | |
| Total Dissipation at 25°C Case Temperature | 0.625 W |
| at 25°C Ambient Temperature | 1.0 W |
| at 70°C Ambient Temperature | 0.400 W |
| **Maximum Voltages and Currents** | |
| $V_{CBO}$ Collector to Base Voltage | −50 V |
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | −50 V |
| $V_{EBO}$ Emitter to Base Voltage | −3.0 V |
| $I_C$ Collector Current (Peak) | 100 mA |
| $I_C$ Collector Current (Continuous) | 50 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N5086 MIN. | 2N5086 MAX. | 2N5087 MIN. | 2N5087 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CEO(sat)}$ | Collector to Emitter Sustaining Voltage | −50 | | −50 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −50 | | −50 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| †$I_{CBO}$ | Collector Cutoff Current | | 10 | | 10 | nA | $V_{CB}$ = −10 V, $I_E$ = 0 |
| | | | 50 | | 50 | nA | $V_{CB}$ = −35 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 50 | | 50 | nA | $V_{EB}$ = −3.0 V, $I_C$ = 0 |
| $h_{FE}$ | DC Current Gain | 150 | 500 | 250 | 800 | | $I_C$ = 100 μA, $V_{CE}$ = −5.0 V |
| | | 150 | | 250 | | | $I_C$ = 1.0 mA, $V_{CE}$ = −5.0 V |
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 150 | | 250 | | | $I_C$ = 10 mA, $V_{CE}$ = −5.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | −0.3 | | −0.3 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $V_{BE(ON)}$ | Emitter to Base "On" Voltage (Note 5) | | −0.85 | | −0.85 | V | $I_C$ = 1.0 mA, $V_{CE}$ = −5.0 V |
| $f_T$ | Current Gain Bandwidth Product | 40 | | 40 | | MHz | $I_C$ = 500 μA, $V_{CE}$ = −5.0 V, f = 20 MHz |
| $C_{cb}$ | Output Capacitance | | 4.0 | | 4.0 | pF | $V_{CB}$ = −5.0 V, $I_E$ = 0, f = 100 kHz |
| $h_{fe}$ | Small Signal Current Gain | 150 | 600 | 250 | 900 | | $I_C$ = 1.0 mA, $V_{CE}$ = −5.0 V, f = 1.0 kHz |
| NF | Noise Figure | | 3.0 | | 2.0 | dB | $I_C$ = 20 μA, $V_{CE}$ = −5.0 V, $R_S$ = 10 kΩ, f = 10 Hz to 15.7 kHz |
| | | | 3.0 | | 2.0 | dB | $I_C$ = 100 μA, $V_{CE}$ = −5.0 V, $R_S$ = 3.0 kΩ f = 1.0 kHz |

†Fairchild exceeds JEDEC registered value for this parameter.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The facotry should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 — SS33.

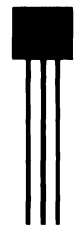
# 2N5088 • 2N5089

## NPN LOW LEVEL LOW NOISE HIGH GAIN AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C**
- **$V_{CEO}$ . . . 25 V (MIN) (2N5089)**
- **$h_{FE}$ . . . 400 (MIN) FROM 100 μA to 10 mA (2N5089)**
- **NF . . . 2.0 dB (MAX) WIDE BAND**
- **COMPLEMENTS . . . 2N5086, 2N5087**

See TO92-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **†Maximum Temperature** | | |
| Storage Temperature | | −55°C to +150°C |
| Operating Junction Temperature | | 150°C |
| Lead Temperature (10 seconds) | | 260°C |
| **†Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Ambient Temperature | | 0.625 W |
| at 25°C Case Temperature | | 1.0 W |
| **Maximum Voltages and Current** | **2N5088** | **2N5089** |
| $V_{CBO}$ Collector to Base Voltage | 35 V | 30 V |
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | 30 V | 25 V |
| †$V_{EBO}$ Emitter to Base Voltage | 4.5 V | 4.5 V |
| $I_C$ Collector Current | 50 mA | 50 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N5088 MIN. | 2N5088 MAX. | 2N5089 MIN. | 2N5089 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage | 30 | | 25 | | V | $I_C$ = 1.0 mA, $I_E$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 35 | | 30 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | | | nA | $V_{CB}$ = 20 V, $I_E$ = 0 |
| | | | | | 50 | nA | $V_{CB}$ = 15 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 50 | | 50 | nA | $V_{EB}$ = 3.0 V, $I_C$ = 0 |
| | | | 100 | | 100 | nA | $V_{EB}$ = 4.5 V, $I_C$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 5) | 300 | 900 | 400 | 1200 | | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V |
| | | 350 | | 450 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V |
| | | 300 | | 400 | | | $I_C$ = 10 mA, $V_{CE}$ = 5.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | 0.5 | | 0.5 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 5) | | 0.8 | | 0.8 | V | $I_C$ = 10 mA, $V_{CE}$ = 5.0 V |
| †$f_T$ | Current Gain Bandwidth Product | 50 | | 50 | | MHz | $I_C$ = 500 μA, $V_{CE}$ = 5.0 V, f = 20 MHz |
| $C_{cb}$ | Collector to Base Capacitance | | 4.0 | | 4.0 | pF | $V_{CB}$ = 5.0 V, $I_E$ = 0, f = 100 kHz |
| †$C_{eb}$ | Emitter to Base Capacitance | | 10 | | 10 | pF | $V_{BE}$ = 0.5 V, $I_C$ = 0, f = 100 kHz |
| $h_{fe}$ | Small Signal Current Gain | 350 | 1400 | 450 | 1800 | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V, f = 1.0 kHz |
| NF | Noise Figure | | 3.0 | | 2.0 | dB | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V, $R_S$ = 10 kΩ, f = 10 Hz to 15.7 kHz |

†Fairchild exceeds JEDEC registered values.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions' length = 300 μs; duty cycle = 1%.

4

# 2N5126 • PN5126

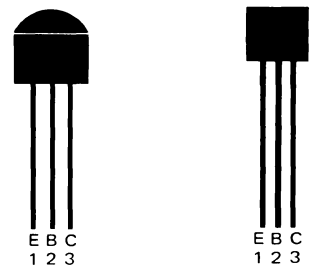
## NPN RF AMPLIFIERS

DIFFUSED SILICON PLANAR* TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C (PN5126)
- $C_{cb}$ . . . 1.6 pF (MAX)
- PG . . . 26 dB (TYP) @ 100 MHz
- $LV_{CEO}$ . . . 20 V (MIN)
- NF . . . 5.5 dB (TYP) @ 100 MHz
- FORWARD AGC CHARACTERISTIC

See Package Outlines

TO18-4 TO92-1




2N5126 PN5126

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | 2N5126 | PN5126 |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | −55°C to +125°C | −55°C to +150°C |
| Operating Junction Temperature | 125°C | 150°C |
| Lead Temperature (10 seconds) | 260°C | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Case Temperature | 0.5 W | 1.0 W |
| at 25°C Ambient Temperature | 0.2 W | 0.625 W |
| **Maximum Voltages and Current** | | |
| $V_{CBO}$ Collector to Base Voltage | 20 V | 20 V |
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | 20 V | 20 V |
| $V_{EBO}$ Emitter to Base Voltage | 3.0 V | 3.0 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | TYP. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| $C_{cb}$ | Collector to Base Capacitance | | 1.1 | 1.6 | pF | $I_E$ = 0, $V_{CB}$ = 10 V, f = 1.0 MHz |
| NF | Noise Figure | | 5.5 | | dB | $I_C$ = 4.0 mA, $V_{CC}$ = 15 V, f = 100 MHz, $R_S$ = 100 Ω |
| $h_{fe}$ | High Frequency Current Gain | 3.0 | 6.0 | | | $I_C$ = 4.0 mA, $V_{CE}$ = 10 V, f = 100 MHz |
| $A_V$ | Voltage Gain (see test circuit no. 354) | | 37 | | dB | f = 455 kHz, $I_C$ = 4.0 mA, $V_{CC}$ = 12 V |
| PG | Power Gain (see test circuit no. 352) | | 30 | | dB | $I_C$ = 4.0 mA, $V_{CC}$ = 12 V, f = 10.7 MHz |
| | | | 26 | | dB | $I_C$ = 4.0 mA, $V_{CC}$ = 15 V, f = 100 MHz |
| AGC | Automatic Gain Control (see test circuit no. 353) | | 9.0 | | mA | $I_C$ for which $PG_{AGC}$ = PG−30 dB, f = 100 MHz |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | | 2.0 | V | $I_C$ = 10 mA, $I_B$ = 5.0 mA |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 5) | | | 0.98 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $h_{FE}$ | DC Current Gain (Note 5) | 20 | 70 | 350 | | $I_C$ = 4.0 mA, $V_{CE}$ = 10 V |
| $I_{CBO}$ | Collector Cutoff Current | | 1.0 | 50 | nA | $I_E$ = 0, $V_{CB}$ = 10 V |
| | | | | 5.0 | μA | $I_E$ = 0, $V_{CB}$ = 10 V, $T_A$ = 65°C |
| $I_{EBO}$ | Emitter Cutoff Current | | | 100 | μA | $I_C$ = 0, $V_{EB}$ = 3.0 V |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 5) | 20 | | | V | $I_C$ = 3.0 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 20 | | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 3.0 | | | V | $I_C$ = 0, $I_E$ = 0.1 mA |
| $h_{fe}$ | Small Signal Current Gain | 15 | | 400 | | $I_C$ = 4.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 5) | | | 0.98 | V | $I_C$ = 10 mA, $V_{CE}$ = 10 V |

NOTES:

*Planar is a patented Fairchild process.

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/W (derating factor of 2.0 mW/°C) for 2N5126. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C) for PN5126.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 - SS1.

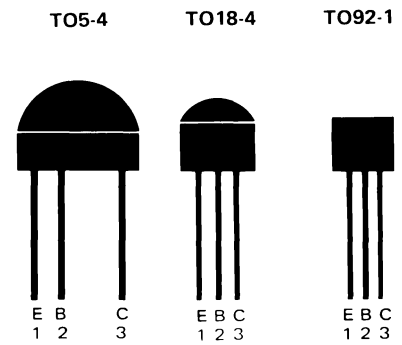
# 2N5128 • 2N5129 • PN5128 • PN5129

## NPN SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS AND SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C (PN5128/9)
- $h_{FE}$ . . . 35 (MIN) @ 50 mA, 20 (MIN) @ 10 mA
- $f_T$ . . . 150 MHz (MIN) @ 50 mA
- $t_{on}$ . . . 14 ns (TYP) @ 300 mA, $t_{off}$ . . . 80 ns (TYP) @ 300 mA
- $V_{CE\ (sat)}$ . . . −0.25 V (MAX) @ 150 mA, −0.35 V (TYP) @ 500 mA

See Package Outlines




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| **Maximum Temperature** | **PN5128/9** | **2N5128/9** |
|---|---|---|
| Storage Temperature | −55°C to +150°C | −55°C to +125°C |
| Operating Junction Temperature | 150°C | 125°C |
| Lead Temperature (10 seconds) | 260°C | 260°C |

| **Maximum Power Dissipation** (Notes 2 & 3) | **PN5128/9** | **2N5128** | **2N5129** |
|---|---|---|---|
| Total Dissipation at 25°C Case Temperature | 1.0 W | 0.5 W | 0.7 W |
| at 25°C Ambient Temperature | 0.625 W | 0.2 W | 0.3 W |

**Maximum Voltages**

| | | |
|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 15 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 12 V |
| $V_{EBO}$ | Emitter to Base Voltage | 3.0 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $h_{fe}$ | High Frequency Current Gain | 1.5 | 8.0 | | $I_C$ = 50 mA, $V_{CE}$ = 5.0 V, f = 100 MHz |
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 20 | | | $I_C$ = 10 mA, $V_{CE}$ = 10 V |
| | | 35 | 350 | | $I_C$ = 50 mA, $V_{CE}$ = 10 V |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | 15 | | V | $I_C$ = 10 μA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 15 | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $V_{CEO\ (sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | 12 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 3.0 | | V | $I_C$ = 0, $I_E$ = 10 μA |
| $C_{cb}$ | Collector to Base Capacitance | | 10 | pF | $I_E$ = 0, $V_{CB}$ = 10 V, f = 1.0 MHz |
| $V_{CE\ (sat)}$ | Pulsed Collector Saturation Voltage (Note 5) | | 0.25 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| $V_{BE\ (sat)}$ | Pulsed Emitter Saturation Voltage (Note 5) | | 1.10 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | nA | $V_{CE}$ = 10 V, $I_E$ = 0 |
| | | | 1.0 | μA | $V_{CE}$ = 10 V, $I_E$ = 0, $T_A$ = 65°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 10 | μA | $V_{EB}$ = 3.0 V, $I_C$ = 0 |
| $V_{BE\ (ON)}$ | Base to Emitter "On" Voltage (Note 5) | | 1.1 | V | $I_C$ = 150 mA, $V_{CE}$ = 5.0 V |

*Planar is a patented Fairchild process.

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/W (derating factor of 2.0 mW/°C) for 2N5128; to junction a case thermal resistance of 143°C/W (derating factor of 7.0 mW/°C) and a junction to ambient thermal resistance of 333°C/W (derating factor of 3.0 mW/°C) for 2N5129. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/° C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C) for PN5128 and PN5129.
4. This rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5-SS15.

# 2N5130 • PN5130

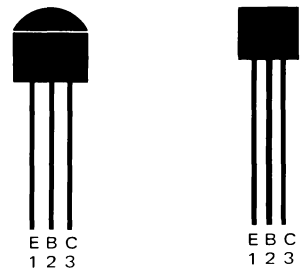
## NPN SMALL SIGNAL RF AMPLIFIERS AND OSCILLATORS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$G_{pe}$ . . . 15 dB (TYP) @ 200 MHz**
- **$P_O$ . . . 7.0 mW (TYP) @ 930 MHz**
- **NF . . . 4.0 dB (TYP) @ 60 MHz**

**See Package Outlines**

**TO18-4** **TO92-1**




**2N5130** **PN5130**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | 2N5130 | PN5130 |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | −55°C to +125°C | −55°C to +150°C |
| Operating Junction Temperature | | 125°C | 150°C |
| Lead Temperature (10 seconds) | | 260°C | 260°C |
| **Maximum Power Dissipation** (Note 2) | | | |
| Total Dissipation at 25°C Case Temperature | | 0.5 W | |
| at 25°C Ambient Temperature | | 0.2 W | |
| at or below 65°C Ambient Temperature | | | 0.300 W |
| **Maximum Voltages and Current** | | | |
| $V_{EBO}$ | Emitter to Base Voltage | 1.0 V | 1.0 V |
| $V_{CBO}$ | Collector to Base Voltage | 30 V | 30 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 12 V | 12 V |
| $I_C$ | Collector Current | 50 mA | 50 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $I_{CBO}$ | Collector Cutoff Current | | 50 | nA | $V_{CB}$ = 10 V, $I_C$ = 0 |
| | | | 5.0 | μA | $V_{CB}$ = 10 V, $I_E$ = 0, $T_A$ = 65°C |
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 15 | 250 | | $I_C$ = 8.0 mA, $V_{CE}$ = 10 V |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 30 | | V | $I_E$ = 0, $I_C$ = 100 μA |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 1.0 | | V | $I_C$ = 0, $I_E$ = 10 μA |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | 12 | | V | $I_C$ = 3.0 mA, $I_B$ = 0 |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) | | 0.6 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 5) | | 1.0 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 5) | | 1.0 | V | $I_C$ = 10 mA, $V_{CE}$ = 10 V |
| $h_{fe}$ | Forward Current Transfer Ratio | 12 | 300 | V | $I_C$ = 8.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $C_{cb}$ | Collector to Base Capacitance | | 1.7 | pF | $I_E$ = 0, $V_{EB}$ = 10 V, f = 1.0 MHz |
| $\|h_{fe}\|$ | Magnitude of Small Signal Current Gain | 4.5 | | | $I_C$ = 8.0 mA, $V_{CE}$ = 10 V, f = 100 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/W (derating factor of 2.0 mW/°C) for 2N5130. These ratings give a maximum junction temperature of 150°C and junction to ambient thermal resistance of 283°C/W (derating factor of 3.53 mW/°C) for PN5130.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 - SS27.

# 2N5131 • PN5131 • 2N5132 • PN5132

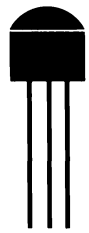
## NPN SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS

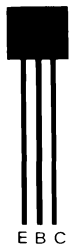
DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C (PN Devices)**
- **$V_{CEO}$ . . . 15 V (MIN) (2N/PN5131), 20 V (MIN) (2N/PN5132)**
- **$h_{FE}$ . . . 30 - 500 (2N/PN5131), 30 - 400 (2N/PN5132) @ 10 mA**
- **$P_G$ . . . 55 dB (TYP) @ 455 kHz, 32 dB (TYP) @ 10.7 MHz (2N/PN5132)**
- **COMPLEMENTS . . . 2N4121, 2N4916 (TO18)**
  **. . . 2N4125, PN4916 (TO92)**

**See Package Outlines**

**TO18-4** **TO92-1**




**2N5131** **PN5131**
**2N5132** **PN5132**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | 2N5131/2 | PN5131/2 |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | −55°C to +125°C | −55°C to +150°C |
| Operating Junction Temperature | 125°C | 150°C |
| Lead Temperature (10 seconds) | 260°C | 260°C |
| **Maximum Power Dissipation** | | |
| Total Dissipation at 25°C Case Temperature | 0.5 W | 1.0 W |
| at 25°C Ambient Temperature | 0.2 W | 0.625 W |

**Maximum Voltages**

| | | | |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | | 20 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 2N/PN5131 | 15 V |
| | | 2N/PN5132 | 20 V |
| $V_{EBO}$ | Emitter to Base Voltage | | 3.0 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N/PN5131 MIN. | 2N/PN5131 TYP. | 2N/PN5131 MAX. | 2N/PN5132 MIN. | 2N/PN5132 TYP. | 2N/PN5132 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 30 | | 500 | | | | | $I_C$ = 10 mA, $V_{CE}$ = 1.0 V |
| | | | | | 30 | | 400 | | $I_C$ = 10 mA, $V_{CE}$ = 10 V |
| $h_{fe}$ | High Frequency Current Gain | | | | 2.0 | | | | $I_C$ = 10 mA, $V_{CE}$ = 15 V, f = 100 MHz |
| | | 1.0 | | | | | | | $I_C$ = 10 mA, $V_{CE}$ = 10 V, f = 100 MHz |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | | 1.0 | | | 2.0 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $V_{BE(ON)}$ | Base to Emitter Voltage (Note 5) | | | 1.0 | | | | V | $I_C$ = 10 mA, $V_{CE}$ = 5.0 V |
| | | | | | | | 0.9 | V | $I_C$ = 10 mA, $V_{CE}$ = 10 V |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 5) | | | | | | 0.90 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $I_{CBO}$ | Collector Cutoff Current | | | 50 | | | 50 | nA | $I_E$ = 0, $V_{CB}$ = 10 V |
| | | | | 5.0 | | | 5.0 | μA | $I_E$ = 0, $V_{CB}$ = 10 V, $T_A$ = 65°C |
| $I_{EBO}$ | Emitter Cutoff Current | | | 10 | | | 10 | μA | $I_C$ = 0, $V_{EB}$ = 3.0 V |
| $C_{cb}$ | Collector to Base Capacitance | | | 6.0 | | | 3.5 | pF | $I_E$ = 0, $V_{CB}$ = 10 V, f = 1.0 MHz |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | 15 | | | | | | V | $I_C$ = 3.0 mA, $I_B$ = 0 |
| | | | | | 20 | | | V | $I_C$ = 10 mA (pulsed), $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 20 | | | | | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| | | | | | 20 | | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 3.0 | | | 3.0 | | | V | $I_C$ = 0, $I_E$ = 10 μA |
| $h_{fe}$ | Small Signal Current Gain | | | | 20 | | 650 | | $I_C$ = 10 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| | | 25 | | 600 | | | | | $I_C$ = 10 mA, $V_{CE}$ = 1.0 V, f = 1.0 kHz |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/W (derating factor of 2.0 mW/°C) for 2N5131 and 2N5132. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C) for PN5131 and PN5132.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N/PN5131 MIN. | 2N/PN5131 TYP. | 2N/PN5131 MAX. | 2N/PN5132 MIN. | 2N/PN5132 TYP. | 2N/PN5132 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| NF | Noise Figure | | | | | 4.0 | | dB | $I_C$ = 3.0 mA, $V_{CE}$ = 10 V, f = 1.0 MHz, $R_S$ = 300 Ω |
| $A_{pg}$ | Available Power Gain (neutralized) (see test circuit no. 2012) | | | | | 32 | | dB | $I_C$ = 7.0 mA, $V_{CE}$ = 10 V, f = 10.7 MHz |
| | (see test circuit no. 2013) | | | | | 55 | | dB | $I_C$ = 3.0 mA, $V_{CE}$ = 10 V, f = 455 kHz |
| $G_C$ | Conversion Gain (see test circuit no. 2014) | | | | | 20 | | dB | $I_C$ = 7.0 mA, $V_{CE}$ = 10 V, f = 108 MHz to 10.7 MHz |
| $r_b'C_c$ | Collector-Base Time Constant | | | | | 30 | | ps | $I_C$ = 10 mA, $V_{CE}$ = 15 V, f = 80 MHz |

# 2N5133 • PN5133

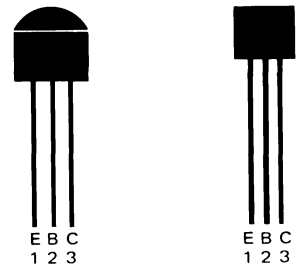
## NPN LOW LEVEL AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C (PN5133)
- $h_{FE}$ . . . 60 (MIN), 220 (TYP) @ 1.0 mA
- $BV_{CEO}$ . . . 18 V (MIN) @ 3.0 mA

See Package Outlines

TO18-4 TO92-1




2N5133 PN5133

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | 2N5133 | PN5133 |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | −55°C to +125°C | −55°C to +150°C |
| Operating Junction Temperature | 125°C | 150°C |
| Lead Temperature (10 seconds) | 260°C | 260°C |
| **Maximum Power Dissipation** (Note 2) | | |
| Total Dissipation at 25°C Case Temperature | 0.5 W | 1.0 W |
| at 25°C Ambient Temperature | 0.2 W | 0.625 W |
| **Maximum Voltages** | | |
| $V_{CBO}$ Collector to Base Voltage | 20 V | 20 V |
| $V_{CEO}$ Collector to Emitter Voltage (Note 3) | 18 V | 18 V |
| $V_{EBO}$ Emitter to Base Voltage | 3.0 V | 3.0 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 60 | 1000 | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V |
| $h_{fe}$ | High Frequency Current Gain | 2.0 | 20 | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V, f = 20 MHz |
| $V_{CE(sat)}$ | Collector Saturation Voltage | | 0.4 | V | $I_C$ = 1.0 mA, $I_B$ = 0.1 mA |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | nA | $I_E$ = 0, $V_{CB}$ = 15 V |
| | | | 5.0 | μA | $I_E$ = 0, $V_{CB}$ = 15 V, $T_A$ = 65°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 50 | nA | $I_C$ = 0, $V_{EB}$ = 2.0 V |
| $C_{cb}$ | Collector to Base Capacitance | | 5.0 | pF | $I_E$ = 0, $V_{CB}$ = 5.0 V |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 20 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 3 & 4) | 18 | | V | $I_C$ = 3.0 mA, $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 3.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage | | 0.75 | V | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V |
| $h_{fe}$ | Small Signal Current Gain | 50 | 1100 | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V, f = 1.0 kHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/W (derating factor of 2.0 mW/°C) for 2N5133. These ratings give a maximum junction temperature of 150°C, junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C). Junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C) for PN5133.
3. Rating refers to a high current point where collector to emitter voltage is lowest.
4. Pulse conditions: length = 300 μs; duty cycle = 1%.
5. For product family characteristic curves, refer to Section 5 - SS8.

# 2N5134 • PN5134

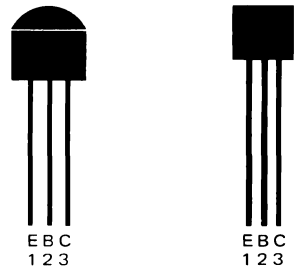
## NPN SMALL SIGNAL HIGH SPEED SATURATED SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C (PN5134)
- $f_T$ . . . 250 MHz (MIN)
- $C_{cb}$ . . . 4.0 pF (MAX) @ 5.0 V
- $\tau_s$ . . . 18 ns (MAX) @ 10 mA
- $t_{on}$ . . . 18 ns (MAX) @ 10 mA, $t_{off}$ . . . 18 ns (MAX) @ 10 mA
- COMPLEMENTS . . . 2N3639, MPS3639

See Package Outlines

TO18-4 TO92-1




2N5134 PN5134

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | 2N5134 | PN5134 |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | −55°C to +125°C | −55°C to +150°C |
| Operating Junction Temperature | | 125°C | 150°C |
| Lead Temperature (10 seconds) | | 260°C | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | | |
| Total Dissipation at 25°C Case Temperature | | 0.5 W | 1.0 W |
| at 25°C Ambient Temperature | | 0.2 W | 0.625 W |
| **Maximum Voltages and Currents** | | | |
| $V_{CBO}$ | Collector to Base Voltage | 20 V | 20 V |
| $V_{CES}$ | Collector to Emitter Voltage | 20 V | 20 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 10 V | 10 V |
| $V_{EBO}$ | Emitter to Base Voltage | 3.5 V | 3.5 V |
| $I_C$ | Collector Current (10 μs pulse) | 500 mA | 500 mA |
| $I_C$ | Collector Current | 100 mA | 100 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | TYP. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 20 | 66 | 150 | | $I_C$ = 10 mA, $V_{CE}$ = 1.0 V |
| | | 15 | 71 | | | $I_C$ = 30 mA, $V_{CE}$ = 0.4 V |
| | | | 40 | | | $I_C$ = 100 mA, $V_{CE}$ = 1.0 V |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 5) | 0.70 | 0.80 | 0.90 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | 0.72 | 0.85 | 1.10 | V | $I_C$ = 10 mA, $I_B$ = 3.3 mA |
| | | | 0.90 | | V | $I_C$ = 30 mA, $I_B$ = 3.0 mA |
| | | | 1.10 | | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | 0.14 | 0.25 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | 0.12 | 0.20 | V | $I_C$ = 10 mA, $I_B$ = 3.3 mA |
| | | | 0.17 | | V | $I_C$ = 30 mA, $I_B$ = 3.0 mA |
| | | | 0.28 | | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| | | | 0.19 | | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA, $T_A$ = 65°C |
| $h_{fe}$ | High Frequency Current Gain | 2.5 | 5.75 | | | $I_C$ = 10 mA, $V_{CE}$ = 10 V, f = 100 MHz |
| $C_{cb}$ | Collector to Base Capacitance | | 2.3 | 4.0 | pF | $I_E$ = 0, $V_{CB}$ = 5.0 V |
| $I_{CES}$ | Collector Reverse Current | | 0.05 | 0.40 | μA | $V_{CE}$ = 15 V, $V_{EB}$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 1.0 | 10 | μA | $I_E$ = 0, $V_{CB}$ = 15 V, $T_A$ = 65°C |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | 20 | | | V | $I_C$ = 10 μA, $V_{EB}$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 20 | | | V | $I_C$ = 10 μA, $I_E$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | 10 | | | V | $I_C$ = 10 mA (pulsed), $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 3.5 | | | V | $I_C$ = 0, $I_E$ = 10 μA |
| $\tau_s$ | Charge Storage Time Constant (see test circuit no. 3111) | | 7.0 | 18 | ns | $I_C$ = 10 mA, $I_{B1} \approx -I_{B2} \approx$ 10 mA, $V_{CC}$ = 10 V |
| $t_{on}$ | Turn On Time (see test circuit no. 381) | | 8.0 | 18 | ns | $I_C \approx$ 10 mA, $I_{B1} \approx$ 3.3 mA, $V_{CC}$ = 3.0 V |
| $t_{off}$ | Turn Off Time (see test circuit no. 381) | | 7.0 | 18 | ns | $I_C \approx$ 10 mA, $I_{B1} \approx$ 3.3 mA, $I_{B2} \approx$ −3.3 mA, $V_{CC}$ = 3.0 V |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/W (derating factor of 2.0 mW/°C) for 2N5134. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C) for PN5134.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 - SS28.

# 2N/PN5135 • 2N/PN5136 • 2N/PN5137

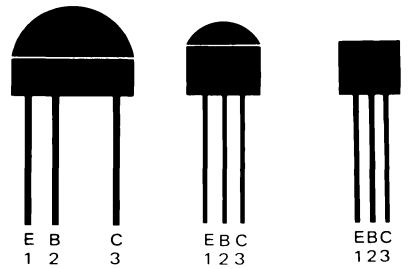
## NPN SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C (PN SERIES)**
- **$V_{CEO}$ . . . 25 V (MIN) (2N/PN5135)**
- **$f_T$. . . 40 MHz (MIN)**
- **$h_{FE}$ . . . 50-600 @ 10 mA (2N/PN5135), 20-400 @ 150 mA (2N/PN5136/7)**
- **COMPLEMENTS . . . 2N/PN5142, 2N/PN5143**

See Package Outlines

TO 5-4 TO 18-4 TO 92-1




2N5135
2N5136

2N5137

PN5135
PN5136
PN5137

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | **PN5135/36/37** | **2N5135/36/37** |
| Storage Temperature Range | −55°C to +150°C | −55°C to +125°C |
| Operating Junction Temperature | 150°C | 125°C |
| Lead Temperature (10 seconds) | 260°C | 260°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| Total Dissipation | **PN5135/36/37** | **2N5135/36** | **2N5137** |
|---|---|---|---|
| at 25°C Case Temperature | 1.0 W | 0.8 W | 0.6 W |
| at 25°C Ambient Temperature | 0.625 W | 0.3 W | 0.22 W |

| **Maximum Voltages and Current** | | **2N/PN5135** | **2N/PN5136/37** |
|---|---|---|---|
| $V_{CES}$ | Collector to Emitter Voltage | 30 V | 30 V |
| $V_{CBO}$ | Collector to Base Voltage | 30 V | 30 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 25 V | 20 V |
| $V_{EBO}$ | Emitter to Base Voltage | 4.0 V | 3.0 V |
| $I_C$ | Collector Current | 200 mA | 500 mA |

**ELECTRICAL CHARACTERISTIC** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N5135 PN5135 MIN. | 2N5135 PN5135 MAX. | 2N5136 PN5136 MIN. | 2N5136 PN5136 MAX. | 2N5137 PN5137 MIN. | 2N5137 PN5137 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 50 | 600 | | | | | | $I_C$ = 10 mA, $V_{CE}$ = 10 V |
| | | 15 | | | | | | | $I_C$ = 2.0 mA, $V_{CE}$ = 1.0 V |
| | | | | 20 | 400 | 20 | 400 | | $I_C$ = 150 mA, $V_{CE}$ = 1.0 V |
| | | | | 20 | | 20 | | | $I_C$ = 30 mA, $V_{CE}$ = 1.0 V |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 5) | | 1.0 | | | | | V | $I_C$ = 100 mA, $V_{CE}$ = 10 V |
| | | | | | 1.1 | | 1.1 | V | $I_C$ = 150 mA, $V_{CE}$ = 1.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | 1.0 | | | | | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| | | | | | 0.25 | | 0.25 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 5) | | 1.0 | | | | | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| | | | | | 1.1 | | 1.1 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| $\|h_{fe}\|$ | Magnitude of Common Emitter Small Signal Current Gain | 2.0 | 15 | | | | | | $I_C$ = 30 mA, $V_{CE}$ = 10 V, f = 20 MHz |
| | | | | 2.0 | 20 | 2.0 | 20 | | $I_C$ = 50 mA, $V_{CE}$ = 5.0 V, f = 20 MHz |
| $C_{cb}$ | Collector to Base Capacitance | | 25 | | 35 | | 35 | pF | $I_E$ = 0, $V_{CB}$ = 10 V, f = 1.0 MHz |
| $C_{eb}$ | Emitter to Base Capacitance | | | | 85 | | 85 | pF | $I_C$ = 0, $V_{EB}$ = 0.5 V, f = 1.0 MHz |
| $I_{CBO}$ | Collector Cutoff Current | | 300 | | | | | nA | $I_E$ = 0, $V_{CB}$ = 15 V |
| | | | | | 100 | | 100 | nA | $I_E$ = 0, $V_{CB}$ = 20 V |
| | | | 10 | | | | | μA | $I_E$ = 0, $V_{CB}$ = 15 V, $T_A$ = 65°C |
| | | | | | 10 | | 10 | μA | $I_E$ = 0, $V_{CB}$ = 20 V, $T_A$ = 65°C |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature 125°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C) for 2N5135/2N5136 and 167°C/W (derating factor of 6.0 mW/°C) for 2N5137. Junction to ambient thermal resistance is 333°C/W (derating factor of 3.0 mW/°C) for 2N5135 and 2N5136, and 455°C/W (derating factor of 2.2 mW/°C) for 2N5137. Maximum junction temperature is 150°C, and junction to case thermal resistance is 125°C/W (derating factor of 8.0 mW/°C) for PN5135, PN5136, and PN5137. Junction to ambient thermal resistance is 200°C/W (derating factor of 5.0 mW/°C) for PN5135, PN5136, and PN5137.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 - SS15.

**ELECTRICAL CHARACTERISTIC** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N5135 PN5135 MIN. | 2N5135 PN5135 MAX. | 2N5136 PN5136 MIN. | 2N5136 PN5136 MAX. | 2N5137 PN5137 MIN. | 2N5137 PN5137 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $I_{EBO}$ | Emitter Cutoff Current | | | | 100 | | 100 | nA | $I_C = 0$, $V_{EB} = 2.0$ V |
| | | | 10 | | | | | μA | $I_C = 0$, $V_{EB} = 4.0$ V |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | 30 | | 30 | | 30 | | V | $I_C = 100$ μA, $V_{BE} = 0$ |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 30 | | 30 | | 30 | | V | $I_E = 0$, $I_C = 100$ μA |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | 25 | | 20 | | 20 | | V | $I_C = 10$ mA (pulsed), $I_B = 0$ |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 4.0 | | 3.0 | | 3.0 | | V | $I_C = 0$, $I_E = 10$ μA |

# 2N5138 • PN5138

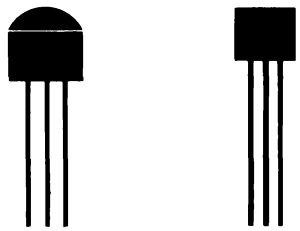
## PNP LOW LEVEL AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C (PN5138)
- $h_{FE}$ . . . 50 (MIN) @ 100 μA & 10 mA
- $V_{CEO}$ . . . 30 V (MIN)

See Package Outlines

TO18-4 TO92-1




2N5138 PN5138

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | 2N5138 | PN5138 |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | −55°C to +125°C | −55°C to +150°C |
| Operating Junction Temperature | 125°C | 150°C |
| Lead Temperature (10 seconds) | 260°C | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Case Temperature | 0.5 W | 1.0 W |
| at 25°C Ambient Temperature | 0.2 W | 0.625 W |
| **Maximum Voltages** | | |
| $V_{CBO}$ Collector to Base Voltage | −30 V | −30 V |
| $V_{CEO}$ Collector to Emitter Voltage | −30 V | −30 V |
| $V_{EBO}$ Emitter to Base Voltage | −5.0 V | −5.0 V |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 50 | 800 | | $I_C$ = 100 μA, $V_{CE}$ = −10 V |
| | | 50 | | | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V |
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 50 | | | $I_C$ = 10 mA, $V_{CE}$ = −10 V |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −30 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | −30 | | V | $I_C$ = 10 mA (pulsed), $I_B$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −5.0 | | V | $I_C$ = 0, $I_E$ = 100 μA |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | nA | $I_E$ = 0, $V_{CB}$ = −20 V |
| | | | 3.0 | μA | $I_E$ = 0, $V_{CB}$ = −20 V, $T_A$ = 65°C |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | −0.3 | V | $I_C$ = 10 mA, $I_B$ = 0.5 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 5) | | −1.0 | V | $I_C$ = 10 mA, $I_B$ = 0.5 mA |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 5) | | −1.0 | V | $I_C$ = 10 mA, $V_{CE}$ = −10 V |
| $h_{fe}$ | Small Signal Current Gain | 40 | 1000 | | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V, f = 1.0 kHz |
| $h_{fe}$ | High Frequency Current Gain | 1.5 | | | $I_C$ = 0.5 mA, $V_{CE}$ = −5.0 V, f = 20 MHz |
| $C_{cb}$ | Collector to Base Capacitance | | 7.0 | pF | $I_E$ = 0, $V_{CB}$ = −5.0 V, f = 1.0 MHz |
| $C_{eb}$ | Emitter to Base Capacitance | | 30 | pF | $I_C$ = 0, $V_{EB}$ = −0.5 V, f = 1.0 MHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/W (derating factor of 2.0 mW/°C); for 2N5138. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C) for PN5138.
4. This rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 - SS33.

# 2N5139 • PN5139

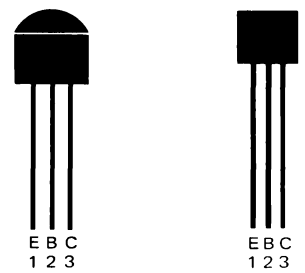
## PNP SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS AND SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C (PN5139)
- $V_{CEO}$ . . . –20 V (MIN)
- $h_{FE}$ . . . 40 (MIN) @ 10 mA
- $f_T$ . . . 300 MHz (MIN)
- $C_{cb}$ . . . 5.0 pF (MAX) @ –10 V

See Package Outlines

TO18-4 TO92-1




2N5139 PN5139

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | 2N5139 | PN5139 |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | –55°C to +125°C | –55°C to +150°C |
| Operating Junction Temperature | | 125°C | 150°C |
| Lead Temperature (10 seconds) | | 260°C | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | | |
| Total Dissipation at 25°C Case Temperature | | 0.5 W | 1.0 W |
| at 25°C Ambient Temperature | | 0.2 W | 0.625 W |
| **Maximum Voltages and Current** | | | |
| $V_{CBO}$ | Collector to Base Voltage | | –20 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | | –20 V |
| $V_{EBO}$ | Emitter to Base Voltage | | –5.0 V |
| $I_C$ | Collector Current | | 100 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | TYP. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 30 | 70 | | | $I_C$ = 100 μA, $V_{CE}$ = –10 V |
| | | 40 | 100 | | | $I_C$ = 1.0 mA, $V_{CE}$ = –10 V |
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 40 | 150 | | | $I_C$ = 10 mA, $V_{CE}$ = –1.0 V |
| | | 15 | 30 | | | $I_C$ = 50 mA, $V_{CE}$ = –10 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage | | | –0.15 | V | $I_C$ = 1.0 mA, $I_B$ = 0.1 mA |
| $V_{CE(sat)}$ | Pulsed Collector Saturation Voltage (Note 5) | | | –0.20 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | –0.2 | –0.5 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $V_{BE(sat)}$ | Pulsed Base Saturation Voltage (Note 5) | –0.7 | –0.77 | –1.0 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | –0.75 | | –1.25 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $t_{on}$ | Turn On Time (see test circuit no. 407) | | | 50 | ns | $I_C \approx$ 50 mA, $I_{B1} \approx$ 5.0 mA |
| $t_{off}$ | Turn Off Time (see test circuit no. 407) | | | 200 | ns | $I_C \approx$ 50 mA, $I_{B1} \approx$ 5.0 mA, $I_{B2} \approx$ –5.0 mA |
| $\|h_{fe}\|$ | Magnitude of Small Signal Current Gain | 3.0 | 5.0 | | | $I_C$ = 10 mA, $V_{CE}$ = –20 V, f = 100 MHz |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 5) | –20 | | | V | $I_C$ = 10 mA (pulsed), $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | –20 | | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | –20 | | | V | $I_C$ = 100 μA, $V_{BE}$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | –5.0 | | | V | $I_C$ = 0, $I_E$ = 100 μA |
| $I_{CES}$ | Collector Reverse Current | | | 50 | nA | $V_{CE}$ = –15 V, $V_{EB}$ = 0 |
| | | | | 25 | μA | $V_{CE}$ = –15 V, $V_{EB}$ = 0, $T_A$ = 65°C |
| $C_{cb}$ | Collector to Base Capacitance | | | 5.0 | pF | $I_E$ = 0, $V_{CB}$ = –10 V, f = 1.0 MHz |
| $C_{eb}$ | Emitter to Base Capacitance | | | 8.0 | pF | $I_C$ = 0, $V_{EB}$ = –0.5 V, f = 1.0 MHz |

*Planar is a patented Fairchild process.

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/W (derating factor of 2.0 mW/°C) for 2N5139. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C) for PN5139.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.

# 2N5142 • 2N5143 • PN5142 • PN5143

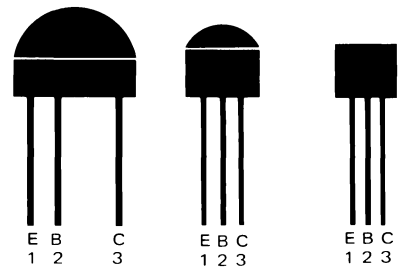
## PNP SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS AND SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C (PN5142/3)
- $h_{FE}$ . . . 30 (MIN) @ 50 mA
  . . . 15 (MIN) @ 300 mA
- $t_{on}$ . . . 100 ns (MAX) @ 300 mA
- $t_{off}$ . . . 200 ns (MAX) @ 300 mA
- $V_{CEO}$ . . . 20 V (MIN) @ 10 mA

See Package Outlines

TO5-4 TO18-4 TO92-1




2N5142 2N5143 PN5142 PN5143

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| **Maximum Temperatures** | **2N5142, 2N5143** | **PN5142, PN5143** |
|---|---|---|
| Storage Temperature | −55°C to +125°C | −55°C to +150°C |
| Operating Junction Temperature | 125°C | 150°C |
| Lead Temperature, (10 seconds) | 260°C | 260°C |

| **Maximum Power Dissipation** (Notes 2 & 3) | **2N5142** | **2N5143** | **PN5142/3** |
|---|---|---|---|
| Total Dissipation at 25°C Case Temperature | 0.7 W | 0.5 W | 1.0 W |
| at 25°C Ambient Temperature | 0.3 W | 0.2 W | 0.625 W |

| **Maximum Voltages and Current** | | | | |
|---|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | −20 V | −20 V | −20 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | −20 V | −20 V | −20 V |
| $V_{EBO}$ | Emitter to Base Voltage | −4.0 V | −4.0 V | −4.0 V |
| $I_C$ | Collector Current | 500 mA | 500 mA | 500 mA |

**ELECTRICAL CHARACTERISTICS:** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS. | TEST CONDITIONS |
|---|---|---|---|---|---|
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 30 | | | $I_C$ = 50 mA, $V_{CE}$ = 1.0 V |
| | | 15 | | | $I_C$ = 300 mA, $V_{CE}$ = −10 V |
| $h_{fe}$ | High Frequency Current Gain | 1.0 | | | $I_C$ = 50 mA, $V_{CE}$ = −3.0 V, f = 100 MHz |
| $C_{cb}$ | Collector to Base Capacitance | | 10 | pF | $I_E$ = 0, $V_{CB}$ = −10 V, f = 1.0 MHz |
| $C_{eb}$ | Emitter to Base Capacitance | | 30 | pF | $I_C$ = 0, $V_{EB}$ = −0.5 V, f = 1.0 MHz |
| $V_{CE\ (sat)}$ | Collector Saturation Voltage (pulsed, | | −0.5 | V | $I_C$ = 50 mA, $I_B$ = 2.5 mA |
| | Note 5) | | −2.0 | V | $I_C$ = 300 mA, $I_B$ = 30 mA |
| $V_{CEO\ (sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 5) | −20 | | V | $I_C$ = 10 mA (pulsed), $I_B$ = 0 |
| $V_{BE\ (sat)}$ | Base Saturation Voltage (pulsed, Note 5) | | −1.5 | V | $I_C$ = 50 mA, $I_B$ = 2.5 mA |
| | | −0.8 | −2.5 | V | $I_C$ = 300 mA, $I_B$ = 30 mA |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −4.0 | | V | $I_C$ = 0, $I_E$ = 100 μA |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −20 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $t_{on}$ | Turn On Time (see test circuit no. 245) | | 100 | ns | $I_C \approx$ 300 mA, $I_{B1} \approx$ 30 mA |
| $t_{off}$ | Turn Off Time (see test circuit no. 245) | | 200 | ns | $I_C \approx$ 300 mA, $I_{B1} \approx$ 30 mA, $I_{B2} \approx$ −30 mA |
| $I_{CES}$ | Collector Reverse Current | | 50 | nA | $V_{CE}$ = −12V, $V_{BE}$ = 0 |
| | | | 2.0 | μA | $V_{CE}$ = −12 V, $V_{BE}$ = 0, $T_A$ = 65°C |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 143°C/W (derating factor of 7.0 mW/°C) for 2N5142, and 200°C/W (derating factor of 5.0 mW/°C) for 2N5143; junction to ambient thermal resistance of 333°C/W (derating factor of 3.0 mW/°C) for 2N5142, and 500°C/W (derating factor of 2.0 mW/°C) for 2N5143. Maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C) and junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C) for PN5142, PN5143.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse Conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5-SS22.

# 2N5209 • 2N5210

## NPN LOW LEVEL LOW NOISE HIGH GAIN AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C**
- **$V_{CEO}$ . . . 50 V (MIN)**
- **$h_{FE}$ . . . 200 (MIN) @ 100 μA (2N5210)**
  **. . . 250 (MIN) @ 1.0 mA AND 10 mA (2N5210)**
- **NF . . . 2.0 dB (MAX) WIDE BAND (2N5210)**
- **COMPLEMENTS . . . 2N5086, 2N5087**

**See TO92-1 Package Outline**


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| **† Maximum Temperatures** | |
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |
| Lead Temperature (10 seconds) | 260°C |
| **† Maximum Power Dissipation** (Notes 2 & 3) | |
| Total Dissipation at 25°C Case Temperature | 1.0 W |
| at 25°C Ambient Temperature | 0.625 W |
| at 70°C Ambient Temperature | 0.400 W |
| **Maximum Voltages and Current** | |
| $V_{CBO}$ Collector to Base Voltage | 50 V |
| $V_{CEO}$ Collector to Emitter Voltage | 50 V |
| $V_{EBO}$ Emitter to Base Voltage | 4.5 V |
| $I_C$ Collector Current | 50 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N5209 MIN. | 2N5209 MAX. | 2N5210 MIN. | 2N5210 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | 50 | | 50 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 50 | | 50 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| †$I_{CBO}$ | Collector Cutoff Current | | 10 | | 10 | nA | $V_{CB}$ = 10 V, $I_E$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 50 | | 50 | nA | $V_{CB}$ = 35 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 50 | | 50 | nA | $V_{EB}$ = 3.0 V, $I_C$ = 0 |
| †$I_{EBO}$ | Emitter Cutoff Current | | 100 | | 100 | nA | $V_{EB}$ = 4.5 V, $I_C$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 4) | 100 | 300 | 200 | 600 | | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V |
| | | 150 | | 250 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V |
| | | 150 | | 250 | | | $I_C$ = 10 mA, $V_{CE}$ = 5.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 4) | | 0.7 | | 0.7 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage | | 0.85 | | 0.85 | V | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V |
| $f_T$ | Current Gain Bandwidth Product | 30 | | 30 | | MHz | $I_C$ = 500 μA, $V_{CE}$ = 5.0 V, f = 20 MHz |
| $C_{cb}$ | Collector to Base Capacitance | | 4.0 | | 4.0 | pF | $V_{CB}$ = 5.0 V, $I_E$ = 0, f = 100 kHz |
| $h_{fe}$ | Small Signal Current Gain | 150 | 600 | 250 | 900 | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V, f = 1.0 kHz |
| NF | Noise Figure | | 3.0 | | 2.0 | dB | $I_C$ = 20 μA, $V_{CE}$ = 5.0 V, $R_S$ = 22 kΩ, f = 10 Hz to 15.7 kHz |
| | | | 4.0 | | 3.0 | dB | $I_C$ = 20 μA, $V_{CE}$ = 5.0 V, $R_S$ = 10 kΩ, f = 1.0 kHz |

*Planar is a patented Fairchild process.
†Fairchild exceeds JEDEC registered values.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C).
4. Pulse conditions: length = 300 μs; duty cycle < 2%.
5. Rating refers to a high current point where collector to emitter voltage is lowest.

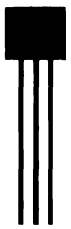
# 2N5219 • 2N5223

## NPN SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS AND OSCILLATORS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- $V_{CEO}$ . . . 15 V (MIN) (2N5219), 20 V (MIN) (2N5223)
- $h_{FE}$ . . . 35-500 (2N5219), 50-800 (2N5223) @ 2.0 mA
- $f_T$ . . . 150 MHz (MIN) @ 10 mA
- $C_{cb}$ . . . 4.0 pF (MAX)
- COMPLEMENTS . . . 2N5221, 2N5227

See TO92-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**†Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |
| Lead Temperature (60 seconds) | 260°C |

**†Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Ambient Temperature | 0.625 W |
| at 25°C Case Temperature | 1.0 W |

| **Maximum Voltages and Current** | | **2N5219** | **2N5223** |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 20 V | 25 V |
| $V_{CEO}$ | Collector to Emitter Voltage | 15 V | 20 V |
| $V_{EBO}$ | Emitter to Base Voltage | 3.0 V | 3.0 V |
| $I_C$ | Collector Current | 100 mA | 100 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N5219 MIN. | 2N5219 MAX. | 2N5223 MIN. | 2N5223 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | 15 | | 20 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 20 | | 25 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 3.0 | | 3.0 | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 100 | | 100 | nA | $V_{CB}$ = 10 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 500 | | | nA | $V_{EB}$ = 2.0 V, $I_C$ = 0 |
| | | | | | 500 | nA | $V_{EB}$ = 3.0 V, $I_C$ = 0 |
| $h_{FE}$ | DC Current Gain | 35 | 500 | 50 | 800 | | $I_C$ = 2.0 mA, $V_{CE}$ = 10 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 4) | | 0.4 | | 0.7 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 4) | | 1.0 | | 1.2 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $f_T$ | Current Gain Bandwidth Product | 150 | | 150 | | MHz | $I_C$ = 10 mA, $V_{CE}$ = 10 V, f = 100 MHz |
| $C_{cb}$ | Collector to Base Capacitance | | 4.0 | | 4.0 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 1.0 MHz |
| $h_{fe}$ | Small Signal Current Gain | 35 | 1500 | 50 | 1600 | | $I_C$ = 2.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |

*Planar is a patented Fairchild process.
†Fairchild exceeds JEDEC registered values.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C).
4. Pulse conditions: length = 300 μs; duty cycle < 2%.

# 2N5220 • 2N5221

## NPN-PNP SMALL SIGNAL GENERAL PURPOSE COMPLEMENTARY AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- $V_{CEO}$ . . . 15 V (MIN)
- $h_{FE}$ . . . 30–600 @ 50 mA
- $V_{CE\,(sat)}$ . . . 0.5 V (MAX) @ 150 mA
- COMPLEMENTS 2N5220 (NPN), 2N5221 (PNP)

See TO92-1 Package Outline


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**†Maximum Temperature**

| | |
|---|---|
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |
| Lead Temperature (60 seconds) | 260°C |

**†Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Ambient Temperature | 0.625 mW |
| at 25°C Case Temperature | 1.0 W |

**Maximum Voltages and Current**

| | | 2N5220 | 2N5221 |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 15 V | −15 V |
| $V_{CEO}$ | Collector to Emitter Voltage | 15 V | −15 V |
| $V_{EBO}$ | Emitter to Base Voltage | 3.0 V | −3.0 V |
| $I_C$ | DC Collector Current | 500 mA | 500 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N5220 MIN. | 2N5220 MAX. | 2N5221 MIN. | 2N5221 MAX. | UNITS | TEST CONDITIONS (Reverse Voltage Polarity for PNP) |
|---|---|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 4) | 15 | | −15 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 15 | | −15 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 3.0 | | −3.0 | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 100 | | 100 | nA | $V_{CB}$ = 10 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 100 | | 100 | nA | $V_{EB}$ = 3.0 V, $I_C$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 4) | 25 | | 25 | | | $I_C$ = 10 mA, $V_{CE}$ = 10 V |
| $h_{FE}$ | DC Current Gain (Note 4) | 30 | 600 | 30 | 600 | | $I_C$ = 50 mA, $V_{CE}$ = 10 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 4) | | 0.5 | | −0.5 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 4) | | 1.1 | | −1.1 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| $f_T$ | Current Gain Bandwidth Product | 100 | | 100 | | MHz | $I_C$ = 20 mA, $V_{CE}$ = 10 V |
| $C_{cb}$ | Collector to Base Capacitance | | 10 | | 15 | pF | $V_{CB}$ = 5.0 V, $I_E$ = 0, f = 1.0 MHz |
| $h_{fe}$ | Small Signal Current Gain | 30 | 1800 | 30 | 1800 | | $I_C$ = 50 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |

*Planar is a patented Fairchild process.
†Fairchild exceeds JEDEC registered values.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Pulse conditions: length = 300 μs; duty cycle < 2%.
5. For product family characteristic curves refer to Section 5-SS15 for 2N5220 and SS22 for 2N5221.

# 2N5224

## NPN LOW LEVEL SWITCH

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- $V_{CEO}$ . . . 12 V (MIN)
- $t_{on}$ . . . 45 ns (MAX) @ 10 mA
- $t_{off}$ . . . 60 ns (MAX) @ 10 mA
- $f_T$ . . . 250 MHz (MIN) @ 10 mA
- $C_{cb}$ . . . 4.0 pF (MAX)
- COMPLEMENTS . . . MPSL08

See TO92-1 Package Outline


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| **†Maximum Temperatures** | |
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |
| Lead Temperature (60 seconds) | 260°C |
| **†Maximum Power Dissipation** (Notes 2 & 3) | |
| Total Dissipation at 25°C Ambient Temperature | 0.625 W |
| at 25°C Case Temperature | 1.0 W |
| **Maximum Voltages and Current** | |
| $V_{CBO}$ Collector to Base Voltage | 25 V |
| $V_{CEO}$ Collector to Emitter Voltage | 12 V |
| $V_{EBO}$ Emitter to Base Voltage | 5.0 V |
| $I_C$ DC Collector Current | 100 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 4) | 12 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 25 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 500 | nA | $V_{CB}$ = 15 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 100 | μA | $V_{EB}$ = 4.0 V, $I_C$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 4) | 40 | 400 | | $I_C$ = 10 mA, $V_{CE}$ = 1.0 V |
| | | 15 | | | $I_C$ = 100 mA, $V_{CE}$ = 1.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 4) | | 0.35 | V | $I_C$ = 10 mA, $I_B$ = 3.0 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 4) | | 0.9 | V | $I_C$ = 10 mA, $I_B$ = 3.0 mA |
| $f_T$ | Current Gain Bandwidth Product | 250 | | MHz | $I_C$ = 10 mA, $V_{CE}$ = 10 V, f = 100 MHz |
| $C_{cb}$ | Collector to Base Capacitance | | 4.0 | pF | $V_{CB}$ = 5.0 V, $I_E$ = 0, f = 1.0 MHz |
| $t_d$ | Delay Time (see test circuit test no. 531) | | 25 | ns | $I_C$ = 10 mA, $I_{B1}$ = 3.0 mA, $V_{CC}$ = 3.0 V |
| $t_r$ | Rise Time (see test circuit test no. 531) | | 20 | ns | $I_C$ = 10 mA, $I_{B1}$ = 3.0 mA, $V_{CC}$ = 3.0 V |
| $t_s$ | Storage Time (see test circuit test no. 531) | | 35 | ns | $I_C$ = 10 mA, $I_{B1}$ = $I_{B2}$ = 3.0 mA $V_{CC}$ = 3.0 V |
| $t_f$ | Fall Time (see test circuit no. 531) | | 25 | ns | $I_C$ = 10 mA, $I_{B1}$ = $I_{B2}$ = 3.0 mA, $V_{CC}$ = 3.0 V |

*Planar is a patented Fairchild process.

†Fairchild exceeds JEDEC registered values.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Pulse conditions: length = 300 μs; duty cycle < 2%.
5. For product family characteristic curves, refer to Section 5-SS5.

4

# 2N5225 • 2N5226

## NPN-PNP SMALL SIGNAL GENERAL PURPOSE COMPLEMENTARY AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- $V_{CEO}$ . . . 25 V (MIN)
- $h_{FE}$ . . . 30–600 @ 50 mA
- $V_{CE(sat)}$ . . . 0.8 V (MAX) @ 100 mA
- COMPLEMENTS . . . 2N5225 (NPN), 2N5226 (PNP)

See TO92-1 Package Outline


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**† Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |
| Lead Temperature (60 seconds) | 260°C |

**† Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Ambient Temperature | 0.625 W |
| at 25°C Case Temperature | 1.0 W |

| **Maximum Voltages and Current** | | **2N5225** | **2N5226** |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 25 V | −25 V |
| $V_{CEO}$ | Collector to Emitter Voltage | 25 V | −25 V |
| $V_{EBO}$ | Emitter to Base Voltage | 4.0 V | −4.0 V |
| $I_C$ | Collector Current | 500 mA | 500 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N5225 MIN. | 2N5225 MAX. | 2N5226 MIN. | 2N5226 MAX. | UNITS | TEST CONDITIONS (Reverse Voltage Polarity for PNP) |
|---|---|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 4) | 25 | | −25 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 25 | | −25 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 4.0 | | −4.0 | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 300 | | 300 | nA | $V_{CB}$ = 15 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 500 | | 500 | | $V_{EB}$ = 4.0 V, $I_C$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 4) | 25 | | 25 | | | $I_C$ = 10 mA, $V_{CE}$ = 10 V |
| | | 30 | 600 | 30 | 600 | | $I_C$ = 50 mA, $V_{CE}$ = 10 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 4) | | 0.8 | | −0.8 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 4) | | 1.0 | | −1.0 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| $f_T$ | Current Gain Bandwidth Product | 50 | | 50 | | MHz | $I_C$ = 20 mA, $V_{CE}$ = 10 V, f = 20 MHz |
| $C_{cb}$ | Collector to Base Capacitance | | 20 | | 20 | pF | $V_{CB}$ = 5.0 V, $I_E$ = 0, f = 1.0 MHz |
| $h_{fe}$ | Small Signal Current | 30 | 1,800 | 30 | 1,800 | | $I_C$ = 50 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |

*Planar is a patented Fairchild process.
†Fairchild exceeds JEDEC registered value for this parameter.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Pulse conditions: length = 300 μs, duty cycle < 2%.
5. For product family characteristic curves, refer to Section 5-SS15 for 2N5225, SS22 for 2N5226.

# 2N5227

## PNP SMALL SIGNAL GENERAL PURPOSE AMPLIFIER AND OSCILLATOR

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- $V_{CEO}$ . . . 30 V (MIN)
- $h_{FE}$ . . . 50-700 @ 2.0 mA
- $f_T$ . . . 100 MHz (MIN) @ 10 mA
- $C_{cb}$ . . . 5.0 pF (MAX)
- COMPLEMENT . . . 2N5223

See TO92-1 Package Outline


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**†Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |
| Lead Temperature (60 seconds) | 260°C |

**†Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Ambient Temperature | 0.625 W |
| at 25°C Case Temperature | 1.0 W |

**Maximum Voltages and Current**

| | | |
|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | −30 V |
| $V_{CEO}$ | Collector to Emitter Voltage | −30 V |
| $V_{EBO}$ | Emitter to Base Voltage | −3.0 V |
| $I_C$ | DC Collector Current | 50 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | −30 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −30 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −3.0 | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 100 | nA | $V_{CB}$ = −10 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 500 | nA | $V_{EB}$ = −2.0 V |
| $h_{FE}$ | DC Current Gain | 30 | | | $I_C$ = 100 μA, $V_{CE}$ = −10 V |
| | | 50 | 700 | | $I_C$ = 2.0 mA, $V_{CE}$ = −10 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage | | −0.4 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage | | −1.0 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| $f_T$ | Current Gain Bandwidth Product | 100 | | V | $I_C$ = 10 mA, $V_{CE}$ = −10 V, f = 100 MHz |
| $h_{FE}$ | Small Signal Current Gain | 50 | 1500 | | $I_C$ = 2.0 mA, $V_{CE}$ = −10 V, f = 1.0 kHz |
| $C_{cb}$ | Collector to Base Capacitance | | 5.0 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 1.0 MHz |

†Fairchild exceeds JEDEC registered values.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).

# 2N5228

## PNP LOW LEVEL LOGIC SWITCH

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- $V_{CEO}$ . . . −5.0 V (MIN)
- $t_{on}$ . . . 75 ns (MAX) @ 10 mA
- $t_{off}$ . . . 140 ns (MAX) @ 10 mA
- $f_T$ . . . 300 MHz (MIN) @ 10 mA
- $C_{cb}$ . . . 5.0 pF (MAX)
- COMPLEMENTS . . . 2N5224

See TO92-1 Package Outline


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| **† Maximum Temperatures** | |
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |
| Lead Temperature (60 seconds) | 260°C |
| **† Maximum Power Dissipation** (Notes 2 & 3) | |
| Total Dissipation at 25°C Ambient Temperature | 0.625 W |
| at 25°C Case Temperature | 1.0 W |
| **Maximum Voltages and Current** | |
| $V_{CES}$ Collector to Emitter Voltage | −6.0 V |
| $V_{CBO}$ Collector to Base Voltage | −5.0 V |
| $V_{CEO}$ Collector to Emitter Voltage | −5.0 V |
| $V_{EBO}$ Emitter to Base Voltage | −3.0 V |
| $I_C$ DC Collector Current | 50 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | −5.0 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| | (Note 4) | −6.0 | | | |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | −5.0 | | V | $I_C$ = 100 μA, $V_{BE}$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −3.0 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $I_{CES}$ | Collector Cutoff Current | | 100 | nA | $V_{CE}$ = −4.0 V, $V_{BE}$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | 30 | 100 | μA | $V_{EB}$ = −2.5 V, $I_C$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 4) | 15 | | | $I_C$ = 10 mA, $V_{CE}$ = −0.3 V |
| | | | | | $I_C$ = 50 mA, $V_{CE}$ = −1.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 4) | −0.65 | −0.4 | V | $I_C$ = 10 mA, $I_B$ = 3.0 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 4) | 300 | −1.25 | V | $I_C$ = 10 mA, $I_B$ = 3.0 mA |
| $f_T$ | Current Gain Bandwidth Product | | | MHz | $I_C$ = 10 mA, $V_{CE}$ = −5.0 V, f = 100 MHz |
| $C_{cb}$ | Collector to Base Capacitance | | 5.0 | pF | $V_{CB}$ = −5.0 V, $I_E$ = 0, f = 1.0 MHz |
| $t_d$ | Delay Time (see test circuit no. 532) | | 25 | ns | $I_C \approx$ 10 mA, $I_{B1} \approx$ 3.0 mA, $V_{CC}$ = −3.0 V |
| $t_r$ | Rise Time (see test circuit no. 532) | | 50 | ns | $I_C \approx$ 10 mA, $I_{B1} \approx$ 3.0 mA, $V_{CC}$ = −3.0 V |
| $t_s$ | Storage Time (see test circuit no. 532) | | 90 | ns | $I_C \approx$ 10 mA, $I_{B1} \approx -I_{B2} \approx$ 3.0 mA, $V_{CC}$ = −3.0 V |
| $t_f$ | Fall Time (see test circuit no. 532) | | 50 | ns | $I_C \approx$ 10 mA, $I_{B1} \approx -I_{B2} \approx$ 3.0 mA, $V_{CC}$ = −3.0 V |

*Planar is a patented Fairchild process.
†Fairchild exceeds JEDEC registered values.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Pulse conditions: length = 300 μs; duty cycle < 2%.
5. For product family characteristic curves, refer to Section 5-SS31.

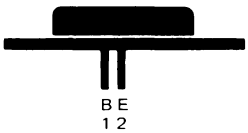
# 2N5301 • 2N5302 • 2N5303

## 200 WATT NPN POWER

DIFFUSED SILICON BI-MESAR™ TRANSISTORS

- $h_{FE}$ . . . 15–60 @ 10A (2N5303), @ 15A (2N5301, 2N5302)
- $V_{CE(sat)}$ . . . 2.0 V (MAX) @ 20 A
- COMPLEMENTS . . . 2N4398, 2N4399, 2N5745

See TO3-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | –65°C to +200°C |
| Operating Junction Temperature | 200°C |

**Maximum Power Dissipation**

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 200 W |
| Linear Derating Factor | 1.14 W/°C |

| **Maximum Voltages and Current** | | **2N5301** | **2N5302** | **2N5303** |
|---|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 40 V | 60 V | 80 V |
| $V_{CEO}$ | Collector to Emitter Voltage | 40 V | 60 V | 80 V |
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V | 5.0 V | 5.0 V |
| $I_C$ | Collector Current (Continuous) | 30 A | 30 A | 20 A |
| $I_B$ | Base Current (Continuous) | 7.5 A | 7.5 A | 7.5 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N5301 MIN. | 2N5301 MAX. | 2N5302 MAX. | 2N5302 MAX. | 2N5303 MIN. | 2N5303 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $I_{CEX}$ | Collector Cutoff Current | | 1.0 | | | | | mA | $V_{CE}$ = 40 V, $V_{EB}$ = 1.5 V |
| | | | | | 1.0 | | | mA | $V_{CE}$ = 60 V, $V_{EB}$ = 1.5 V |
| | | | | | | | 1.0 | mA | $V_{CE}$ = 80 V, $V_{EB}$ = 1.5 V |
| | | | 10 | | | | | mA | $V_{CE}$ = 40 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| | | | | | 10 | | | mA | $V_{CE}$ = 60 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| | | | | | | | 10 | mA | $V_{CE}$ = 80 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| $I_{CBO}$ | Collector Cutoff Current | | 1.0 | | | | | mA | $V_{CB}$ = 40 V, $I_E$ = 0 |
| | | | | | 1.0 | | | mA | $V_{CB}$ = 60 V, $I_E$ = 0 |
| | | | | | | | 1.0 | mA | $V_{CB}$ = 80 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 5.0 | | 5.0 | | 5.0 | mA | $V_{EB}$ = 5.0 V, $I_C$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 2) | 40 | | 60 | | 80 | | V | $I_C$ = 200 mA, $I_B$ = 0 |
| $I_{CEO}$ | Collector Cutoff Current | | 5.0 | | | | | mA | $V_{CE}$ = 40 V, $I_B$ = 0 |
| | | | | | 5.0 | | | mA | $V_{CE}$ = 60 V, $I_B$ = 0 |
| | | | | | | | 5.0 | mA | $V_{CE}$ = 80 V, $I_B$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 2) | 5.0 | | 5.0 | | | | | $V_{CE}$ = 2.0 V, $I_C$ = 30 A |
| | | | | | | 5.0 | | | $V_{CE}$ = 2.0 V, $I_C$ = 20 A |
| | | 15 | 60 | 15 | 60 | | | | $V_{CE}$ = 2.0 V, $I_C$ = 15 A |
| | | | | | | 15 | 60 | | $V_{CE}$ = 2.0 V, $I_C$ = 10 A |
| | | 40 | | 40 | | 40 | | | $V_{CE}$ = 2.0 V, $I_C$ = 1.0 A |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 2) | | 0.75 | | 0.75 | | 1.0 | V | $I_C$ = 10 A, $I_B$ = 1.0 A |
| | | | | | | | 1.5 | V | $I_C$ = 15 A, $I_B$ = 1.5 A |
| | | | 2.0 | | 2.0 | | | V | $I_C$ = 20 A, $I_B$ = 2.0 A |
| | | | | | | | 2.0 | V | $I_C$ = 20 A, $I_B$ = 4.0 A |
| | | | 3.0 | | 3.0 | | | V | $I_C$ = 30 A, $I_B$ = 6.0 A |

Additional Electrical Characteristics on following page.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. Pulse conditions: length = 300 μs; duty cycle = 2%.
3. For product family characteristic curves, refer to Section 5-PWR7.

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N5301 MIN. | 2N5301 MAX. | 2N5302 MIN. | 2N5302 MAX. | 2N5303 MIN. | 2N5303 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 2) | | 1.7 | | 1.7 | | 1.7 | V | $I_C$ = 10 A, $I_B$ = 1.0 A |
| | | | 1.8 | | 1.8 | | 2.0 | V | $I_C$ = 15 A, $I_B$ = 1.5 A |
| | | | 2.5 | | 2.5 | | | V | $I_C$ = 20 A, $I_B$ = 2.0 A |
| | | | | | | | 2.5 | V | $I_C$ = 20 A, $I_B$ = 4.0 A |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 2) | | 1.8 | | 1.8 | | | V | $V_{CE}$ = 2.0 V, $I_C$ = 15 A |
| | | | | | | | 1.5 | V | $V_{CE}$ = 2.0 V, $I_C$ = 10 A |
| | | | 3.0 | | 3.0 | | | V | $V_{CE}$ = 4.0 V, $I_C$ = 30 A |
| | | | | | | | 2.5 | V | $V_{CE}$ = 4.0 V, $I_C$ = 20 A |
| $f_T$ | Current Gain Bandwidth Product | 2.0 | | 2.0 | | 2.0 | | MHz | $V_{CE}$ = 10 V, $I_C$ = 1.0 A, f = 1.0 MHz |
| $h_{fe}$ | Small Signal Current Gain | 40 | | 40 | | 40 | | | $V_{CE}$ = 10 V, $I_C$ = 1.0 A, f = 1.0 kHz |
| $t_r$ | Rise Time | | 1.0 | | 1.0 | | 1.0 | μs | $V_{CC}$ = 30 V, $I_C$ = 10 A, $I_{B1}$ = $I_{B2}$ = $I_{B1}$ = 1.0 A |
| $t_s$ | Storage Time | | 2.0 | | 2.0 | | 2.0 | μs | $V_{CC}$ = 30 V, $I_C$ = 10 A, $I_{B1}$ = $I_{B2}$ = 1.0 A |
| $t_f$ | Fall Time | | 1.0 | | 1.0 | | 1.0 | μs | $V_{CC}$ = 30 V, $I_C$ = 10 A, $I_{B1}$ = $I_{B2}$ = 1.0 A |

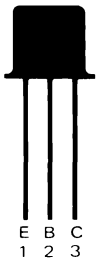
# 2N5320 • 2N5321 • 2N5322 • 2N5323

## 10 WATT NPN-PNP SILICON POWER

DIFFUSED SILICON PLANAR* TRANSISTORS

- $V_{CE(sat)}$ . . . −0.7 V
- $h_{FE}$ . . . 40-250 @ $V_{CE}$ = 4.0 V, $I_C$ = 0.5 A
- **COMPLEMENTS . . . 2N5320, NPN (2N5322, PNP); 2N5321, NPN (2N5323, PNP)**

See TO5-2 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Junction Temperature | 200°C |
| Lead Temperature (10 seconds) | 230°C |

**Maximum Power Dissipation**

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 10 W |
| Linear Derating Factor | 0.057 W/°C |

| **Maximum Voltages and Currents** | | **2N5320** | **2N5321** | **2N5322** | **2N5323** |
|---|---|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 100 V | 75 V | −100 V | −75 V |
| $V_{EBO}$ | Emitter to Base Voltage | 7.0 V | 5.0 V | −7.0 V | −5.0 V |
| $V_{CEO}$ | Collector to Emitter Voltage | 75 V | 50 V | −75 V | −50 V |
| $I_C$ | Collector Current | 2.0 A | 2.0 A | 2.0 A | 2.0 A |
| $I_B$ | Base Current | 1.0 A | 1.0 A | 1.0 A | 1.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N5320 MIN. | 2N5320 MAX. | 2N5321 MIN. | 2N5321 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $I_{CEX}$ | Collector Cutoff Current (Note 3) | | 5.0 | | | mA | $V_{CE}$ = 70 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| | | | | | 5.0 | mA | $V_{CE}$ = 45 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| | | | 0.1 | | | mA | $V_{CE}$ = 100 V, $V_{EB}$ = 1.5 V |
| | | | | | 0.1 | mA | $V_{CE}$ = 75 V, $V_{EB}$ = 1.5 V |
| $I_{EBO}$ | Emitter Cutoff Current | | 0.1 | | | mA | $V_{EB}$ = 7.0 V |
| | | | | | 0.1 | mA | $V_{EB}$ = 5.0 V |
| $V_{CEO(sus)}$ | Collector Sustaining Voltage (Note 2) | 75 | | 50 | | V | $I_B$ = 0, $I_C$ = 100 mA |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 2) | | 0.5 | | 0.8 | V | $I_B$ = 50 mA, $I_C$ = 500 mA |
| $h_{FE}$ | DC Current Gain (Note 2) | 10 | | | | | $V_{CE}$ = 2.0 V, $I_C$ = 1.0 A |
| | | 30 | 130 | 40 | 250 | | $V_{CE}$ = 4.0 V, $I_C$ = 0.5 A |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 2) | | 1.1 | | 1.4 | V | $I_C$ = 500 mA, $V_{CE}$ = 4.0 V |
| $t_{on}$ | Turn On Time (Note 3) | | 80 | | 80 | ns | $I_C$ = 500 mA, $I_{B1}$ = 50 mA |
| $t_{off}$ | Turn Off Time (Note 3) | | 800 | | 800 | ns | $I_C$ = 500 mA, $I_{B1}$ = 50 mA, $I_{B2}$ = −50 mA |
| $h_{fe}$ | Small Signal Current Gain | 5.0 | | 5.0 | | | $V_{CE}$ = 4.0 V, $i_C$ = 50 mA, f = 10 MHz |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values which the serviceability of any individual semiconductor device may be impaired.
2. Pulse conditions: length = 300 μs; duty cycle ≤ 10%.
3. Pulse Rep. Frequency = 1 kHz; pulse width = 20 μs.
4. Emitter diode is reversed biased.
5. For product family characteristic curves refer to Section 5 — PWR 2 for 2N5320 and 2N5321, PWR 12 for 2N5322 and 2N5323.

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N5322 MIN. | 2N5322 MAX. | 2N5323 MIN. | 2N5323 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $I_{CEX}$ | Collector Cutoff Current | | 5.0 | | | mA | $V_{CE} = -70$ V, $V_{EB} = -1.5$ V, $T_C = 150°C$ |
| | | | | | 5.0 | mA | $V_{CE} = -45$ V, $V_{EB} = -1.5$ V, $T_C = 150°C$ |
| | | | 0.1 | | | mA | $V_{CE} = -100$ V, $V_{EB} = -1.5$ V |
| | | | | | 0.1 | mA | $V_{CE} = -75$ V, $V_{EB} = -1.5$ V |
| $I_{EBO}$ | Emitter Cutoff Current | | 0.1 | | | mA | $V_{EB} = -7.0$ V |
| | | | | | 0.1 | mA | $V_{EB} = -5.0$ V |
| $V_{CEO(sus)}$ | Collector Sustaining Voltage (Note 2) | −75 | | −50 | | V | $I_B = 0$, $I_C = -100$ mA |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 2) | | −0.7 | | −1.2 | V | $I_B = 50$ mA, $I_C = 500$ mA |
| $V_{BE(ON)}$ | Base to Emitter "ON" Voltage (Note 2) | | −1.1 | | −1.4 | V | $I_C = 500$ mA, $V_{CE} = -4.0$ V |
| $h_{FE}$ | DC Current Gain (Note 2) | 10 | | | | | $V_{CE} = -2.0$ V, $I_C = 1.0$ A |
| | | 30 | 130 | 40 | 250 | | $V_{CE} = -4.0$ V, $I_C = 500$ mA |
| $t_{on}$ | Turn On Time (Note 3) | | 100 | | 100 | ns | $I_C = 500$ mA, $I_{B1} = -50$ mA |
| $t_{off}$ | Turn Off Time (Note 3) | | 1000 | | 1000 | ns | $I_C = 500$ mA, $I_{B1} = -50$ mA, $I_{B2} = 50$ mA |
| $h_{fe}$ | Small Signal Current Gain | 5.0 | | 5.0 | | | $V_{CE} = 4.0$ V, $I_C = 50$ mA, f = 10 MHz |

# 2N5336 • 2N5337 • 2N5338 • 2N5339

## 6 WATT NPN POWER

DIFFUSED SILICON PLANAR* TRANSISTORS

- **$LV_{CEO}$ . . . 80 V AND 100 V (MIN)**
- **$V_{CE(sat)}$ . . . 1.2 V (MAX) @ 5.0 A**
- **$P_D$ . . . 6.0 W @ $T_C$ = 25°C**

**See TO5-3 Package Outline**


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Junction Temperature | 200°C |

**Maximum Power Dissipation**

| | |
|---|---|
| Total Dissipation at ≤ 25°C Case Temperature (Note 3) | 6.0 W |

**Maximum Voltages and Currents**

| | | 2N5336 2N5337 | 2N5338 2N5339 |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 80 V | 100 V |
| $V_{CEO}$ | Collector to Emitter Voltage | 80 V | 100 V |
| $V_{EBO}$ | Emitter to Base Voltage | 6.0 V | 6.0 V |
| $I_C$ | Collector Current | 5.0 A | 5.0 A |
| $I_B$ | Base Current | 1.0 A | 1.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N5336 2N5337 MIN. | 2N5336 2N5337 MAX. | 2N5338 2N5339 MIN. | 2N5338 2N5339 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $I_{CEX}$ | Collector Cutoff Current | | 10 | | | μA | $V_{CE}$ = 75 V, $V_{EB}$ = 1.5 V |
| | | | 1.0 | | | mA | $V_{CE}$ = 75 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| | | | | | 10 | μA | $V_{CE}$ = 90 V, $V_{EB}$ = 1.5 V |
| | | | | | 1.0 | mA | $V_{CE}$ = 90 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| $I_{CBO}$ | | | 10 | | | μA | $V_{CB}$ = 80 V, $I_E$ = 0 |
| | | | | | 10 | μA | $V_{CB}$ = 100 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 100 | | 100 | μA | $V_{EB}$ = 6.0 V, $I_C$ = 0 |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 2) | 80 | | 100 | | V | $I_C$ = 50 mA, $I_B$ = 0 |
| $V_{CE(sat)}$ | Pulsed Collector Saturation Voltage (Note 2) | | 0.7 | | 0.7 | V | $I_C$ = 2.0 A, $I_B$ = 200 mA |
| | | | 1.2 | | 1.2 | V | $I_C$ = 5.0 A, $I_B$ = 500 mA |
| $V_{BE(sat)}$ | Pulsed Base Saturation Voltage (Note 2) | | 1.2 | | 1.2 | V | $I_C$ = 2.0 A, $I_B$ = 200 mA |
| | | | 1.8 | | 1.8 | V | $I_C$ = 5.0 A, $I_B$ = 500 mA |
| $t_d$ | Turn On Delay Time | | 100 | | 100 | ns | $V_{CC}$ = 4.0 V, $I_C$ = 2.0 A, $I_{B1}$ = 200 mA |
| $t_r$ | Turn On Rise Time | | 100 | | 100 | ns | $V_{CC}$ = 40 V, $I_C$ = 2.0 A, $I_{B1}$ = 200 mA |
| $t_s$ | Turn Off Storage Time | | 2.0 | | 2.0 | μs | $V_{CC}$ = 40 V, $I_C$ = 2.0 A, $I_{B1}$ = $I_{B2}$ = 200 mA |
| $t_f$ | Turn Off Fall Time | | 200 | | 200 | ns | $V_{CC}$ = 40 V, $I_C$ = 2.0 A, $I_{B1}$ = $I_{B2}$ = 200 mA |

| SYMBOL | CHARACTERISTIC | 2N5336 2N5338 MIN. | 2N5336 2N5338 MAX. | 2N5337 2N5339 MIN. | 2N5337 2N5339 MAX. | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Pulse Current Gain (Note 2) | 30 | | 60 | | $I_C$ = 500 mA, $V_{CE}$ = 2.0 V |
| | | 30 | 120 | 60 | 240 | $I_C$ = 2.0 A, $V_{CE}$ = 2.0 V |
| | | 20 | | 40 | | $I_C$ = 5.0 A, $V_{CE}$ = 2.0 V |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. Pulse conditions: length = 300 μs; duty cycle = 2%.
3. For product family characteristic curves, refer to Section 5-PWR4.

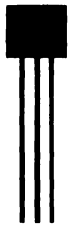
# 2N5400 • 2N5401

## PNP HIGH VOLTAGE SMALL SIGNAL GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C**
- **$V_{CEO}$ . . . −120 V (MIN) (2N5400), −150 V (MIN) (2N5401)**
- **$h_{FE}$ . . . 60-240 @ 10 mA (2N5401)**
- **$V_{CE(sat)}$ . . . −0.5 V (MAX) @ 50 mA**
- **COMPLEMENTS . . . 2N5550, MPS5551M**

**See TO92-1 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**†Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |

**†Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Ambient Temperature | 0.625 W |
| at 25°C Case Temperature | 1.0 W |

| **Maximum Voltages and Current** | | **2N5400** | **2N5401** |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | −130 V | −160 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | −120 V | −150 V |
| $V_{EBO}$ | Emitter to Base Voltage | −5.0 V | −5.0 V |
| $I_C$ | Collector Current | 600 mA | 600 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N5400 MIN. | 2N5400 MAX. | 2N5401 MIN. | 2N5401 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 5) | −120 | | −150 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −130 | | −160 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −5.0 | | −5.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 100 | | | nA | $V_{CB}$ = −100 V, $I_E$ = 0 |
| | | | | | 50 | nA | $V_{CB}$ = −120 V, $I_E$ = 0 |
| | | | 100 | | | μA | $V_{CB}$ = −100 V, $I_E$ = 0, $T_A$ = 100°C |
| | | | | | 50 | μA | $V_{CB}$ = −120 V, $I_E$ = 0, $T_A$ = 100°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 50 | | 50 | nA | $V_{EB}$ = −3.0 V, $I_C$ = 0 |
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 30 | | 50 | | | $I_C$ = 1.0 mA, $V_{CE}$ = −5.0 V |
| | | 40 | 180 | 60 | 240 | | $I_C$ = 10 mA, $V_{CE}$ = −5.0 V |
| | | 40 | | 50 | | | $I_C$ = 50 mA, $V_{CE}$ = −5.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | −0.20 | | −0.20 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | −0.5 | | −0.5 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 5) | | −1.0 | | −1.0 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | −1.0 | | −1.0 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $f_T$ | Current Gain Bandwidth Product | 100 | 400 | 100 | 300 | MHz | $I_C$ = 10 mA, $V_{CE}$ = −10 V, f = 100 MHz |
| $C_{ob}$ | Output Capacitance | | 6.0 | | 6.0 | pF | $V_{CB}$ = −10 V, $I_E$ = 0, f = 1.0 MHz |
| $h_{fe}$ | Small Signal Current Gain | 30 | 200 | 40 | 200 | | $I_C$ = 1.0 mA, $V_{CE}$ = −10 V, f = 1.0 kHz |
| NF | Noise Figure | | 8.0 | | 8.0 | dB | $I_C$ = 250 μA, $V_{CE}$ = −5.0 V, $R_S$ = 1.0 kΩ, f = 10 Hz to 15.7 kHz |

†Fairchild exceeds JEDEC registered value for this parameter.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 2%.
6. For product family characteristic curves, refer to Section 5 — SS25.

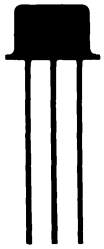
# 2N5455 • 2N5456

## PNP HIGH SPEED SATURATED LOGIC SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $t_{on}$ . . . 20 ns (MAX) @ 300 mA
- $t_{off}$ . . . 30 ns (MAX) @ 300 mA
- $\tau_s$ . . . 35 ns (MAX) @ 10 mA
- $V_{CEO}$ . . . 15 V (MIN) (2N5455), 25 V (MIN) (2N5456)
- COMPLEMENTS . . . 2N3013, 2N3014

See TO18-2 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +200°C |
| Operating Junction Temperature | 200°C |
| Lead Temperature (60 seconds) | 300°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 1.0 W |
| at 25°C Ambient Temperature | 0.34 W |

**Maximum Voltages and Current**

| | | 2N5456 | 2N5455 |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | −25 V | −15 V |
| $V_{CES}$ | Collector to Emitter Voltage | −25 V | −15 V |
| $V_{EBO}$ | Emitter to Base Voltage | −4.5 V | −4.5 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Notes 4 & 7) | −25 V | −15 V |
| $I_C$ | DC Collector Current | 300 mA | 300 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N5455 MIN. | 2N5455 MAX. | 2N5456 MIN. | 2N5456 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $I_{CES}$ | Collector Cutoff Current | | 50 | | | nA | $V_{CE}$ = −10 V, $V_{BE}$ = 0 |
| | | | | | 50 | nA | $V_{CE}$ = −15 V, $V_{BE}$ = 0 |
| | | | 50 | | | μA | $V_{CE}$ = −10 V, $V_{BE}$ = 0, $T_A$ = 125°C |
| | | | | | 50 | μA | $V_{CE}$ = −15 V, $V_{BE}$ = 0, $T_A$ = 125°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 100 | | 100 | μA | $V_{EB}$ = −4.5 V, $I_C$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −15 | | −25 | | V | $I_E$ = 0, $I_C$ = 100 μA |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | −15 | | −25 | | V | $I_C$ = 100 μA, $V_{BE}$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −4.5 | | −4.5 | | V | $I_C$ = 0, $I_E$ = 100 μA |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 6) | −15 | | −25 | | V | $I_C$ = 10 mA |
| $h_{FE}$ | DC Current Gain | 20 | | 20 | | | $V_{CE}$ = −0.4 V, $I_C$ = 10 mA |
| | (Note 6) | 30 | 120 | 30 | 120 | | $V_{CE}$ = −0.4 V, $I_C$ = 30 mA |
| | | 30 | | 30 | | | $V_{CE}$ = −1.0 V, $I_C$ = 100 mA |
| | | 25 | | 25 | | | $V_{CE}$ = −1.0 V, $I_C$ = 300 mA |
| | | 15 | | 15 | | | $V_{CE}$ = −1.0 V, $I_C$ = 100 mA, $T_A$ = −55°C |
| $V_{CE(sat)}$ | Collector to Emitter Saturation | | −0.15 | | −0.15 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | Voltage (Note 6) | | −0.15 | | −0.15 | V | $I_C$ = 30 mA, $I_B$ = 3.0 mA |
| | | | −0.23 | | −0.23 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| | | | −0.50 | | −0.55 | V | $I_C$ = 300 mA, $I_B$ = 30 mA |
| $V_{BE}$ | Base to Emitter Voltage | | −0.85 | | −0.85 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | (Note 6) | -0.70 | −0.96 | −0.70 | −0.96 | V | $I_C$ = 30 mA, $I_B$ = 3.0 mA |
| | | | −1.20 | | −1.20 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| | | | −1.60 | | −1.60 | V | $I_C$ = 300 mA, $I_B$ = 30 mA |
| $C_{eb}$ | Emitter to Base Capacitance (Note 5) | | 25 | | 25 | pF | $I_C$ = 0, $V_{EB}$ = −0.5 V, f = 1.0 MHz |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C, and junction to ambient thermal resistance of 515°C/W (derating factor of 1.94 mW/°C; junction to case thermal resistance of 175°C/W (derating factor of 5.7 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. $C_{eb}$ and $C_{cb}$ measurements employ a three terminal capacitance bridge incorporating a guard circuit. The terminal, for which the dc bias current is specified as zero, shall be connected to the guard terminal of the bridge. The case also shall be guarded.
6. Pulse Conditions: length = 300 μs; duty cycle = 1.0%.
7. Applicable 10 μA to 300 mA; pulse width ≤ 10 μs, duty cycle = 2.0%.
8. For product family characteristic curves, refer to Section 5-SS21.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N5455 MIN. | 2N5455 MAX. | 2N5456 MIN. | 2N5456 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $C_{cb}$ | Collector to Base Capacitance (Note 5) | | 6.0 | | 6.0 | pF | $I_E = 0$, $V_{CB} = -10$ V, f = 1.0 MHz |
| $\|h_{fe}\|$ | Magnitude of Small Signal Current Gain | 4.5 | | 4.5 | | | $V_{CE} = -10$ V, $I_C = 30$ mA, f = 100 MHz |
| $\tau_s$ | Charge Storage Time Constant (see test circuit no. 384.) | | 35 | | 35 | ns | $I_C = 10$ mA, $I_{B1} = I_{B2} = 10$ mA |
| $t_{on}$ | Turn On Time (see test circuit no. 470) | | 20 | | 20 | ns | $I_C = 300$ mA, $I_{B1} = 30$ mA |
| $t_{off}$ | Turn Off Time (see test circuit no. 470) | | 30 | | 30 | ns | $I_C = 300$ mA, $I_{B1} = I_{B2} = 30$ mA |

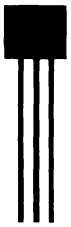
# 2N5457 • 2N5458 • 2N5459

## N-CHANNEL DEPLETION MODE JUNCTION FIELD EFFECT

DIFFUSED SILICON PLANAR* TRANSISTORS

- $y_{fs}$ . . . **1000 to 6000 μmhos**
- $I_{DSS}$ . . . **1.0 mA to 16 mA**

**See TO92-1 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +150°C |
| Operating Junction Temperature | | 150°C |
| † **Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Ambient Temperature | | 0.625 W |
| at 25°C Case Temperature | | 1.0 W |
| **Maximum Voltages and Current** | | |
| $V_{DS}$ | Drain to Source Voltage | 25 V |
| $V_{DG}$ | Drain to Gate Voltage | 25 V |
| $V_{GS(r)}$ | Reverse Gate to Source Voltage | 25 V |
| $I_G$ | Gate Current | 10 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N5457 MIN. | 2N5457 MAX. | 2N5458 MIN. | 2N5458 MAX. | 2N5459 MIN. | 2N5459 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $BV_{GSS}$ | Gate to Source Breakdown Voltage | 25 | | 25 | | 25 | | V | $I_G = -10\ \mu A$, $V_{DS} = 0$ |
| $I_{GSS}$ | Gate Reverse Current | | 1.0 | | 1.0 | | 1.0 | nA | $V_{GS} = -15$ V, $V_{DS} = 0$ |
| | | | 200 | | 200 | | 200 | nA | $V_{GS} = -15$ V, $V_{DS} = 0$, $T_A = 100°C$ |
| $V_{GS(OFF)}$ | Gate to Source Cutoff Voltage | 0.5 | 6.0 | 1.0 | 7.0 | 2.0 | 8.0 | V | $V_{DS} = 15$ V, $I_C = 10$ nA |
| $I_{DSS}$ | Zero Gate Voltage Drain Current (Note 4) | 1.0 | 5.0 | 2.0 | 9.0 | 4.0 | 16 | mA | $V_{DS} = 15$ V, $V_{GS} = 0$ |
| $\|y_{fs}\|$ | Forward Transfer Admittance (Note 4) | 1000 | 5000 | 1500 | 5500 | 2000 | 6000 | μmhos | $V_{DS} = 15$ V, $V_{GS} = 0$, f = 1.0 kHz |
| $\|y_{os}\|$ | Output Admittance (Note 4) | | 50 | | 50 | | 50 | μmhos | $V_{DS} = 15$ V, $V_{GS} = 0$, f = 1.0 kHz |
| $C_{iss}$ | Input Capacitance | | 7.0 | | 7.0 | | 7.0 | pF | $V_{DS} = 15$ V, $V_{GS} = 0$, f = 1.0 MHz |
| $C_{rss}$ | Reverse Transfer Capacitance | | 3.0 | | 3.0 | | 3.0 | pF | $V_{DS} = 15$ V, $V_{GS} = 0$, f = 1.0 MHz |
| NF | Common Source Spot Noise Figure | | 3.0 | | 3.0 | | 3.0 | dB | $V_{DS} = 15$ V, $V_{GS} = 0$, f = 1.0 kHz, $y_G = 1.0\ \mu$mho, $R_G = 1.0$ mΩ, BW = 1.0 Hz |

*Planar is a patented Fairchild process.
†Fairchild exceeds JEDEC registered value for this parameter.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Pulse conditions: pulse width ≤ 630 ms; duty cycle ≤ 10%.

# 2N5484 • 2N5485 • 2N5486

## N-CHANNEL DEPLETION MODE JUNCTION FIELD EFFECT

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C**
- **$G_{PS}$ . . . 18–30 dB @ 100 MHz, 10–20 dB @ 400 MHz (2N5485, 2N5486)**
- **NF . . . 2.0 dB (MAX) @ 100 MHz, 4.0 dB (MAX) @ 400 MHz, 2.5 dB (MAX) @ 1.0 kHz (2N5485, 2N5486)**

**See TO92-1 Package Outline**


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **† Maximum Temperatures** | | |
| Storage Temperature | | −65°C to +150°C |
| Operating Junction Temperature | | 150°C |
| **† Maximum Power Dissipation** (Notes 2 & 3) | | |
| Total Dissipation at 25°C Case Temperature | | 1.0 W |
| at 25°C Ambient Temperature | | 0.625 W |
| **Maximum Voltages and Currents** | | |
| $V_{DS}$ | Drain Gate Voltage | 25 V |
| $V_{GS}$ | Reverse Gate to Source Voltage | 25 V |
| $I_D$ | Drain Current | 30 mA |
| $I_{G(f)}$ | Forward Gate Current | 10 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N5484 MIN. | 2N5484 MAX. | 2N5485 MIN. | 2N5485 MAX. | 2N5486 MIN. | 2N5486 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $V_{(BR)GSS}$ | Gate to Source Breakdown Voltage | 25 | | 25 | | 25 | | V | $I_G$ = 1.0 μA, $V_{DS}$ = 0 |
| $V_{GS(OFF)}$ | Gate to Source Cutoff Voltage | 0.3 | 3.0 | 0.5 | 4.0 | 3.0 | 7.5 | V | $V_{DS}$ = 15 V, $I_D$ = 10 nA |
| $I_{GSS}$ | Gate Reverse Current | | 1.0 | | 1.0 | | 1.0 | nA | $V_{GS}$ = 20 V, $V_{DS}$ = 0 |
| | | | 0.2 | | 0.2 | | 0.2 | μA | $V_{GS}$ = 20 V, $V_{DS}$ = 0, $T_A$ = 100°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | 1.0 | 5.0 | 4.0 | 10 | 8.0 | 20 | mA | $V_{DS}$ = 15 V, $V_{GS}$ = 0 |
| $\|y_{fs}\|$ | Forward Transmittance | 3,000 | 6,000 | 3,500 | 7,000 | 4,000 | 8,000 | μmhos | $V_{DS}$ = 15 V, $V_{GS}$ = 0, f = 1.0 kHz |
| Re ($y_{fs}$) | Forward Transconductance | 2,500 | | | | | | μmhos | $V_{DS}$ = 15 V, $V_{GS}$ = 0, f = 100 MHz |
| | | | | 3,000 | | 3,500 | | μmhos | $V_{DS}$ = 15 V, $V_{GS}$ = 0, f = 400 MHz |
| $\|y_{os}\|$ | Output Admittance | | 50 | | 60 | | 75 | μmhos | $V_{DS}$ = 15 V, $V_{GS}$ = 0, f = 1.0 kHz |
| Re ($y_{os}$) | Output Conductance | | 75 | | | | | μmhos | $V_{DS}$ = 15 V, $V_{GS}$ = 0, f = 100 MHz |
| | | | | | 100 | | 100 | μmhos | $V_{DS}$ = 15 V, $V_{GS}$ = 0, f = 400 MHz |
| Re ($y_{is}$) | Input Conductance | | 100 | | | | | μmhos | $V_{DS}$ = 15 V, $V_{GS}$ = 0, f = 100 MHz |
| | | | | | 1.0 | | 1.0 | mmhos | $V_{DS}$ = 15 V, $V_{GS}$ = 0, f = 400 MHz |
| $C_{iss}$ | Input Capacitance | | 5.0 | | 5.0 | | 5.0 | pF | $V_{DS}$ = 15 V, $V_{GS}$ = 0, f = 1.0 MHz |
| $C_{rss}$ | Reverse Transfer Capacitance | | 1.0 | | 1.0 | | 1.0 | pF | $V_{DS}$ = 15 V, $V_{GS}$ = 0, f = 1.0 MHz |
| $C_{oss}$ | Output Capacitance | | 2.0 | | 2.0 | | 2.0 | pF | $V_{DS}$ = 15 V, $V_{GS}$ = 0, f = 1.0 MHz |
| NF | Noise Figure | | 2.5 | | 2.5 | | 2.5 | dB | $V_{DS}$ = 15 V, $V_{GS}$ = 0 $R_G$ = 1.0 MΩ, f = 1.0 kHz |
| | | | 3.0 | | | | | dB | $V_{DS}$ = 15 V, $I_D$ = 1.0 mA, $R_G$ = 1.0 kΩ, f = 100 MHz |
| | | | | | 2.0 | | 2.0 | dB | $V_{DS}$ = 15 V, $I_D$ = 4.0 mA, $R_G$ = 1.0 kΩ, f = 100 MHz |
| | | | | | 4.0 | | 4.0 | dB | $V_{DS}$ = 15 V, $I_D$ = 4.0 mA, $R_G$ = 1.0 kΩ, f = 400 MHz |
| | | 4.0 (TYP) | | | | | | dB | $V_{DS}$ = 15 V, $I_D$ = 1.0 mA, $R_G$ = 1.0 kΩ, f = 200 MHz |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.
†Fairchild exceeds JEDEC registered value.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N5484 | | 2N5485 | | 2N5486 | | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| | | MIN. | MAX. | MIN. | MAX. | MIN. | MAX. | | |
| $G_{PS}$ | Insertion Power Gain | 16 | 25 | | | | | dB | $V_{DS}$ = 15 V, $I_D$ = 1.0 mA, f = 100 MHz |
| | | | | 18 | 30 | 18 | 30 | dB | $V_{DS}$ = 15 V, $I_D$ = 4.0 mA, f = 100 MHz |
| | | | | 10 | 20 | 10 | 20 | dB | $V_{DS}$ = 15 V, $I_D$ = 4.0 mA, f = 400 MHz |

4

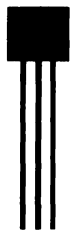
# 2N5550 • MPS5551M

## NPN SMALL SIGNAL HIGH VOLTAGE GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C**
- **$V_{CEO}$ . . . 160 V (MIN) (MPS5551M)**
- **$h_{FE}$ . . . 80–250 @ 10 mA (MPS5551M)**
- **$V_{CE(sat)}$ . . . 0.2 V (MAX) @ 50 mA (MPS5551M)**
- **COMPLEMENTS . . . 2N5400, 2N5401**

**See TO92-1 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**† Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |
| Lead Temperature (10 seconds) | 260°C |

**† Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Ambient Temperature | 0.625 W |
| at 25°C Case Temperature | 1.0 W |

| **Maximum Voltages and Current** | | **2N5550** | **MPS5551M** |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 160 V | 180 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 140 V | 160 V |
| $V_{EBO}$ | Emitter to Base Voltage | 6.0 V | 6.0 V |
| $I_C$ | Collector Current | 600 mA | 600 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N5550 MIN. | 2N5550 MAX. | MPS5551M MIN. | MPS5551M MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | 140 | | 160 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 160 | | 180 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 6.0 | | 6.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 100 | | | nA | $V_{CB}$ = 100 V, $I_E$ = 0 |
| | | | | | 50 | nA | $V_{CB}$ = 120 V, $I_E$ = 0 |
| | | | 100 | | | μA | $V_{CB}$ = 100 V, $I_E$ = 0, $T_A$ = 100°C |
| | | | | | 50 | μA | $V_{CB}$ = 120 V, $I_E$ = 0, $T_A$ = 100°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 50 | | 50 | nA | $V_{EB}$ = 4.0 V, $I_C$ = 0 |
| $h_{FE}$ | DC Pulse Current Gain (Note 5) | 60 | | 80 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V |
| | | 60 | 250 | 80 | 250 | | $I_C$ = 10 mA, $V_{CE}$ = 5.0 V |
| | | 20 | | 30 | | | $I_C$ = 50 mA, $V_{CE}$ = 5.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | 0.15 | | 0.15 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | 0.25 | | 0.20 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 5) | | 1.0 | | 1.0 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | 1.2 | | 1.0 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $C_{ob}$ | Output Capacitance | | 6.0 | | 6.0 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 1.0 MHz |
| $C_{ib}$ | Input Capacitance | | 30 | | 30 | pF | $V_{EB}$ = 0.5 V, $I_C$ = 0, f = 1.0 MHz |
| $f_T$ | Current Gain Bandwidth Product | 100 | 300 | 100 | 300 | MHz | $I_C$ = 10 mA, $V_{CE}$ = 10 V, f = 100 MHz |
| $h_{fe}$ | Small Signal Current Gain | 50 | 200 | 50 | 200 | | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| NF | Noise Figure | | 10 | | 8.0 | dB | $I_C$ = 250 μA, $V_{CE}$ = 5.0 V, $R_S$ = 1.0 kΩ, f = 10 Hz to 15.7 kHz |

*Planar is a patented Fairchild process.
†Fairchild exceeds JEDEC registered values.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5-SS16.

# 2N5668 • 2N5669 • 2N5670

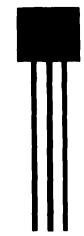
## N-CHANNEL JUNCTION FIELD EFFECT

DIFFUSED SILICON PLANAR* TRANSISTORS

**VHF AMPLIFIER AND MIXER**

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C**
- **NF . . . 2.5 dB (MAX)**
- **$C_{rss}$ . . . 1.0 pF (TYP)**
- **$C_{iss}$ . . . 4.7 pF (TYP)**

**See TO92-1 Package Outline**




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +150°C |
| Operating Junction Temperature | 150°C |

**† Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Case Temperature | 1.0 W |
| at 25°C Ambient Temperature | 0.625 W |

**Maximum Voltages and Currents**

| | | |
|---|---|---|
| $V_{DS}$ | Drain to Source Voltage | 25 V |
| $V_{DG}$ | Drain Gate Voltage | 25 V |
| $V_{GSR}$ | Reverse Gate to Source Voltage | 25 V |
| $I_{GF}$ | Forward Gate Current | 10 mA |
| $I_D$ | Drain Current | 20 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N5668 | | 2N5669 | | 2N5670 | | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| | | MIN. | MAX. | MIN. | MAX. | MIN. | MAX. | | |
| $V_{(BR)GSS}$ | Gate Source Breakdown Voltage | 25 | | 25 | | 25 | | V | $I_G$ = 10 μA, $V_{DS}$ = 0 |
| $V_{GS(Off)}$ | Gate Source Cutoff Voltage | 0.2 | 4.0 | 1.0 | 6.0 | 2.0 | 8.0 | V | $I_{DS}$ = 15 V, $I_D$ = 10 nA |
| $I_{GSS}$ | Gate Reverse Current | | 2.0 | | 2.0 | | 2.0 | nA | $V_{GS}$ = −15 V, $V_{DS}$ = 0 |
| | | | 2.0 | | 2.0 | | 2.0 | μA | $V_{GS}$ = −15 V, $V_{DS}$ = 0, $T_A$ = 100°C |
| $I_{DSS}$ | Zero Gate Voltage Drain | 1.0 | 5.0 | 4.0 | 10 | 8.0 | 20 | nA | $V_{DS}$ = 15 V, $V_{GS}$ = 0 |
| $\|y_{fs}\|$ | Forward Transadmittance | 1,500 | 6,500 | 2,000 | 6,500 | 3,000 | 7,500 | μmhos | $V_{DS}$ = 15 V, $V_{GS}$ = 0, f = 1.0 kHz |
| $R_e(y_{fs})$ | Forward Transconductance | 1,000 | | 1,600 | | 2,500 | | μmhos | $V_{DS}$ = 15 V, $V_{GS}$ = 0, f = 100 MHz |
| $\|y_{os}\|$ | Output Admittance | | 20 | | 50 | | 75 | μmhos | $V_{DS}$ = 15 V, $V_{GS}$ = 0, f = 1.0 kHz |
| $R_e(y_{os})$ | Output Conductance | | 50 | | 100 | | 150 | μmhos | $V_{DS}$ = 15 V, $V_{GS}$ = 0, f = 100 MHz |
| $R_e(y_{is})$ | Input Conductance | | 800 | | 800 | | 800 | μmhos | $V_{DS}$ = 15 V, $V_{GS}$ = 0, f = 100 MHz |
| $C_{iss}$ | Input Capacitance | | 7.0 | | 7.0 | | 7.0 | pF | $V_{DS}$ = 15 V, $V_{GS}$ = 0, f = 1.0 MHz |
| $C_{rss}$ | Reverse Transfer Capacitance | | 3.0 | | 3.0 | | 3.0 | pF | $V_{DS}$ = 15 V, $V_{GS}$ = 0, f = 1.0 MHz |
| $C_{oss}$ | Output Capacitance | | 4.0 | | 4.0 | | 4.0 | pF | $V_{DS}$ = 15 V, $V_{GS}$ = 0, f = 1.0 MHz |
| NF | Common Source Noise (see test circuit no. 2010) | | 2.5 | | 2.5 | | 2.5 | dB | $V_{DS}$ = 15 V, $V_{GS}$ = 0, f = 100 MHz, $R_G$ = 1.0 kΩ |
| $G_{ps}$ | Power Gain (see test circuit no. 2010) | 16 | | 16 | | 16 | | dB | $V_{DS}$ = 15 V, $V_{GS}$ = 0, f = 100 MHz |

*Planar is a patented Fairchild process.
†Fairchild exceeds JEDEC registered values.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 100 ms; duty cycle ≤ 10%.

4

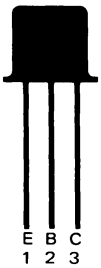
# 2N5679 • 2N5680 • 2N5681 • 2N5682

## 1.0 AMP 10 WATT NPN-PNP COMPLEMENTARY POWER

DIFFUSED SILICON PLANAR* TRANSISTORS

- $f_T$ . . . 30 MHz @ $I_C$ = 100 mA
- $V_{CE(sat)}$ . . . 0.6 V @ $I_C$ = 0.25 A
- COMPLEMENTS . . . 2N5679, PNP (2N5681, NPN); 2N5680, PNP (2N5682, NPN)

See TO5-2 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | | | | |
|---|---|---|---|---|---|
| **Maximum Temperatures** | | | | | |
| Storage Temperature | | | | | −65°C to +200°C |
| Operating Junction Temperature | | | | | 200°C |
| Lead Temperature (60 seconds) | | | | | 230°C |
| **Maximum Power Dissipation** | | | | | |
| Continuous Dissipation at 25°C Case Temperature | | | | | 10 W |
| Linear Derating Factor | | | | | 0.057 W/°C |
| Continuous Dissipation at 25°C Ambient Temperature | | | | | 1.0 W |
| Linear Derating Factor | | | | | 0.0057 W/°C |
| **Maximum Voltages and Currents** | | **2N5679** | **2N5680** | **2N5681** | **2N5682** |
| $V_{CBO}$ | Collector to Base Voltage | −100 V | −120 V | 100 V | 120 V |
| $V_{EBO}$ | Emitter to Base Voltage | −4.0 V | −4.0 V | 4.0 V | 4.0 V |
| $V_{CEO}$ | Collector to Emitter Voltage | −100 V | −120 V | 100 V | 120 V |
| $I_C$ | Collector Current | 1.0 A | 1.0 A | 1.0 A | 1.0 A |
| $I_B$ | Base Current | 0.5 A | 0.5 A | 0.5 A | 0.5 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N5679 MIN. | 2N5679 MAX. | 2N5680 MIN. | 2N5680 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_{CEO(sus)}$ | Collector Sustaining Voltage (Note 2) | −100 | | −120 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 2) | 5.0 | | 5.0 | | | $I_C$ = 1.0 A, $V_{CE}$ = −2.0 V |
| | | 40 | 150 | 40 | 150 | | $I_C$ = 250 mA, $V_{CE}$ = −2.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 2) | | −2.0 | | −2.0 | V | $I_C$ = 1.0 A, $I_B$ = 200 mA |
| | | | −1.0 | | −1.0 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| | | | −0.6 | | −0.6 | V | $I_C$ = 250 mA, $I_B$ = 25 mA |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 2) | | −1.0 | | −1.0 | V | $I_C$ = 250 mA, $V_{CE}$ = −2.0 V |
| $h_{fe}$ | High Frequency Current Gain | 3.0 | | 3.0 | | | $I_C$ = 100 mA, $V_{CE}$ = −10 V, f = 10 MHz |
| $C_{ob}$ | Common Base Output Capacitance | | 50 | | 50 | pF | $V_{CB}$ = −20 V, $I_E$ = 0, f = 1.0 MHz |
| $h_{fe}$ | Small Signal Current Gain | 40 | | 40 | | | $V_{CE}$ = −1.5 V, $I_C$ = 200 mA, f = 1.0 kHz |
| $I_{CEX}$ | Collector Cutoff Current (Note 3) | | 1.0 | | | mA | $V_{CE}$ = −100 V, $V_{EB}$ = −1.5 V, $T_C$ = 150°C |
| | | | | | 1.0 | mA | $V_{CE}$ = −120 V, $V_{EB}$ = −1.5 V, $T_C$ = 150°C |
| | | | 1.0 | | | μA | $V_{CE}$ = −100 V, $V_{EB}$ = −1.5 V |
| | | | | | 1.0 | μA | $V_{CE}$ = −120 V, $V_{EB}$ = −1.5 V |
| $I_{CBO}$ | Collector Cutoff Current | | 1.0 | | | μA | $V_{CB}$ = −100 V, $I_E$ = 0 |
| | | | | | 1.0 | μA | $V_{CB}$ = −120 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 1.0 | | 1.0 | μA | $V_{EB}$ = −4.0 V, $I_C$ = 0 |
| $I_{CEO}$ | Collector Cutoff Current | | 10 | | | μA | $V_{CE}$ = −70 V, $I_B$ = 0 |
| | | | | | 10 | μA | $V_{CE}$ = −80 V, $I_B$ = 0 |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. Pulse conditions: length = 300 μs; duty cycle = 2%.
3. Emitter diode is reversed biased.
4. For product family characteristic curves, refer to Section 5 — PWR 13 for 2N5679 and 2N5680, PWR 3 for 2N5681 and 2N5682.

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N5681 MIN. | 2N5681 MAX. | 2N5682 MIN. | 2N5682 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $I_{CEX}$ | Collector Cutoff Current | | 1.0 | | | mA | $V_{CE}$ = 100 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| | | | | | 1.0 | mA | $V_{CE}$ = 120 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| | | | 1.0 | | | μA | $V_{CE}$ = 100 V, $V_{EB}$ = 1.5 V |
| | | | | | 1.0 | μA | $V_{CE}$ = 120 V, $V_{EB}$ = 1.5 V |
| $I_{CBO}$ | Collector Cutoff Current | | 1.0 | | | μA | $V_{CB}$ = 100 V, $I_E$ = 0 |
| | | | | | 1.0 | μA | $V_{CB}$ = 120 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 1.0 | | 1.0 | μA | $V_{EB}$ = 4.0 V, $I_C$ = 0 |
| $I_{CEO}$ | Collector Cutoff Current | | 10 | | | μA | $V_{CE}$ = 70 V, $I_B$ = 0 |
| | | | | | 10 | μA | $V_{CE}$ = 80 V, $I_B$ = 0 |
| $V_{CEO(sus)}$ | Collector Sustaining Voltage (Note 2) | 100 | | 120 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 2) | 5.0 | | 5.0 | | | $I_C$ = 1.0 A, $V_{CE}$ = 2.0 V |
| | | 40 | 150 | 40 | 150 | | $I_C$ = 250 mA, $V_{CE}$ = 2.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 2) | | 2.0 | | 2.0 | V | $I_C$ = 1.0 A, $I_B$ = 200 mA |
| | | | 1.0 | | 1.0 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| | | | 0.6 | | 0.6 | V | $I_C$ = 250 mA, $I_B$ = 25 mA |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 2) | | 1.0 | | 1.0 | V | $I_C$ = 250 mA, $V_{CE}$ = 2.0 V |
| $h_{fe}$ | High Frequency Current Gain | 3.0 | | 3.0 | | | $I_C$ = 100 mA, $V_{CE}$ = 10 V, f = 10 MHz |
| $C_{ob}$ | Common Base Output Capacitance | | 50 | | 50 | pF | $V_{CB}$ = 20 V, $I_E$ = 0, f = 1.0 MHz |
| $h_{fe}$ | Small Signal Current Gain | 40 | | 40 | | | $V_{CE}$ = 1.5 V, $I_C$ = 200 mA, f = 1.0 kHz |

4

# 2N5771 • 2N5910 • PN5910

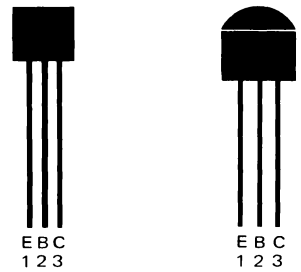
## PNP ULTRA HIGH SPEED SATURATED LOGIC SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C (2N5771, PN5910)**
- **$t_{on}$ . . . 15 ns (MAX) @ 10 mA, $t_{off}$ . . . 20 ns (MAX) @ 10 mA**
- **$\tau_s$ . . . 20 ns (MAX) @ 10 mA**
- **$V_{CEO}$ . . . 15 V (MIN) (2N5771), 20 V (MIN) (2N/PN5910)**
- **COMPLEMENTS . . . 2N5769, 2N5772, (TO92); 2N3646, 2N4275 (TO18)**

See Package Outlines

TO92-1 TO18-4




2N5771
PN5910

2N5910

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | 2N5910 | 2N5771, PN5910 |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | −55°C to +135°C | −55°C to +150°C |
| Operating Junction Temperature | | 135°C | 150°C |
| Lead Temperature (10 seconds) | | 260°C | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | | |
| Total Dissipation at 25°C Ambient Temperature | | 0.310 W | 0.625 W |
| at 25°C Case Temperature | | | 1.0 W |
| **Maximum Voltages and Current** | | **2N/PN5910** | **2N5771** |
| $V_{CBO}$ | Collector to Base Voltage | | −15 V |
| $V_{CEO}$ | Collector to Emitter Voltage | −20 V | −15 V |
| $V_{EBO}$ | Emitter to Base Voltage | −4.5 V | −4.5 V |
| $V_{CES}$ | Collector to Emitter Voltage | −20 V | |
| $I_C$ | Collector Current | 50 mA | 50 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N/PN5910 MIN. | 2N/PN5910 MAX. | 2N5771 MIN. | 2N5771 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $I_{CES}$ | Collector Reverse Current | | 10 | | | nA | $V_{CE}$ = −10 V, $V_{BE}$ = 0 |
| | | | | | 10 | nA | $V_{CE}$ = −8.0 V, $V_{BE}$ = 0 |
| | | | 5.0 | | | μA | $V_{CE}$ = −10 V, $V_{BE}$ = 0, $T_A$ = 65°C |
| | | | | | 5.0 | μA | $V_{CE}$ = −8.0 V, $V_{BE}$ = 0, $T_A$ = 125°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 100 | | | μA | $V_{EB}$ = −4.0 V, $I_C$ = 0 |
| | | | | | 1.0 | μA | $V_{EB}$ = −4.5 V, $I_C$ = 0 |
| $I_B$ | Base Current | | 10 | | | nA | $V_{CE}$ = −6.0 V, $V_{EB}$ = 0 |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | −20 | | −15 | | V | $I_C$ = 100 μA, $V_{BE}$ = 0 |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 5) | −20 | | −15 | | V | $I_C$ = 3.0 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | −20 | | −15 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | −4.5 | | −4.5 | | V | $I_E$ = 100 μA, $I_C$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 5) | 15 | | 35 | | | $V_{CE}$ = −0.5 V, $I_C$ = 1.0 mA |
| | | 30 | 120 | 50 | 120 | | $V_{CE}$ = −0.3 V, $I_C$ = 10 mA |
| | | 30 | | 40 | | | $V_{CE}$ = −1.0 V, $I_C$ = 50 mA |
| | | | | 20 | | | $I_C$ = 10 mA, $V_{CE}$ = −0.3 V, $T_A$ = −55°C |
| $V_{CE(sat)}$ | Collector Emitter Saturation Voltage (Note 5) | | −0.15 | | −0.18 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | | | −0.15 | V | $I_C$ = 1.0 mA, $I_B$ = 0.1 mA |
| | | | −0.5 | | −0.6 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 5) | | | | −0.8 | V | $I_C$ = 1.0 mA, $I_B$ = 0.1 mA |
| | | −0.75 | −0.95 | −0.8 | −0.95 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | −1.5 | | −1.5 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C) for 2N5771 and PN5910. These ratings give a maximum junction temperature of 135°C and junction to ambient thermal resistance of 355°C/W (derating factor of 2.82 MW/°C), for 2N5910.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5 - SS31.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N/PN5910 MIN. | 2N/PN5910 MAX. | 2N5771 MIN. | 2N5771 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $C_{eb}$ | Emitter to Base Capacitance | | 3.5 | | 3.5 | pF | $I_C = 0$, $V_{EB} = 0.5$ V, f = 140 kHz |
| $C_{cb}$ | Collector to Base Capacitance | | 3.0 | | 3.0 | pF | $I_E = 0$, $V_{CB} = -5.0$ V, f = 140 kHz |
| $h_{fe}$ | High Frequency Current Gain | 7.0 | | 8.5 | | | $I_C = 10$ mA, $V_{CE} = -10$ V, f = 100 MHz |
| $t_{on}$ | Turn On Time (see test circuit no. 348) | | 15 | | 15 | ns | $I_C = 10$ mA, $I_{B1} = 1.0$ mA |
| $t_{off}$ | Turn Off Time (see test circuit no. 348) | | 20 | | 20 | ns | $I_C = 10$ mA, $I_{B1} = I_{B2} = 1.0$ mA |
| $\tau_s$ | Charge Storage Time (see test circuit no. 234) | | 20 | | 20 | ns | $I_C = 10$ mA, $I_{B1} \simeq I_{B2} \simeq 10$ mA |
| $I_{CBO}$ | Collector to Base Cutoff Current | | | | 10 | ns | $V_{CB} = -8.0$ V, $I_C = 0$ |

4

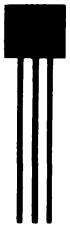
# 2N5830 • 2N5831 • 2N5832 • 2N5833

## NPN SMALL SIGNAL HIGH VOLTAGE GENERAL PURPOSE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- $V_{CEO}$ . . . 100 V (MIN) (2N5830), 140 V (MIN) (2N5831/2), 180 V (MIN) (2N5833)
- $h_{FE}$ . . . 80 (MIN) (2N5830/1), 175 (MIN) (2N5832), 50 (MIN) (2N5833)
- $C_{cb}$ . . . 4.0 pF (MAX)

See TO92-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −55°C to +150°C |
| Operating Junction Temperature | 150°C |
| Lead Temperature (10 seconds) | 260°C |

**Maximum Power Dissipation** (Notes 2 & 3)

| | |
|---|---|
| Total Dissipation at 25°C Ambient Temperature | 0.625 W |
| at 25°C Case Temperature | 1.0 W |

| **Maximum Voltages and Current** | | **2N5830** | **2N5831, 2N5832** | **2N5833** |
|---|---|---|---|---|
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V | 5.0 V | 6.0 V |
| $V_{CBO}$ | Collector to Base Voltage | 120 V | 160 V | 200 V |
| $V_{CEO}$ | Collector to Emitter Voltage | 100 V | 140 V | 180 V |
| $I_C$ | Collector Current | 600 mA | 600 mA | 600 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N5830 MIN. | 2N5830 MAX. | 2N5831 MIN. | 2N5831 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $I_{CBO}$ | Collector Cutoff Current | | 50 | | | nA | $V_{CB}$ = 100 V, $I_E$ = 0 |
| | | | | | 50 | nA | $V_{CB}$ = 120 V; $I_E$ = 0 |
| | | | 25 | | | μA | $V_{CB}$ = 100 V, $I_E$ = 0, $T_A$ = 100°C |
| | | | | | 25 | μA | $V_{CB}$ = 120 V, $I_E$ = 0, $T_A$ = 100°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 50 | | 50 | nA | $V_{EB}$ = 4.0 V, $I_C$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 120 | | 160 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | 5.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | 100 | | 140 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $h_{FE}$ | DC Current Gain | 60 | | 60 | | | $V_{CE}$ = 5.0 V, $I_C$ = 1.0 mA |
| | (Note 4) | 80 | 500 | 80 | 250 | | $V_{CE}$ = 5.0 V, $I_C$ = 10 mA |
| | | 80 | | 80 | | | $V_{CE}$ = 5.0 V, $I_C$ = 50 mA |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage | | 0.8 | | 0.8 | V | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V |
| $V_{BE(sat)}$ | Base to Emitter Saturation | | 0.8 | | 0.8 | V | $I_C$ = 1.0 mA, $I_B$ = 0.1 mA |
| | Voltage (Note 4) | | 1.0 | | 1.0 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | 1.0 | | 1.0 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $V_{CE(sat)}$ | Collector to Emitter | | 0.15 | | 0.15 | V | $I_C$ = 1.0 mA, $I_B$ = 0.1 mA |
| | Saturation Voltage (Note 4) | | 0.20 | | 0.20 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | 0.25 | | 0.25 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $h_{ie}$ | Input Resistance | | 6.0 | | 6.0 | kΩ | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $h_{oe}$ | Output Conductance | | 40 | | 40 | μmho | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $h_{fe}$ | Small Signal Current Gain | 60 | | 60 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $C_{cb}$ | Collector to Base Capacitance | | 4.0 | | 4.0 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 1.0 MHz |
| $\|h_{fe}\|$ | Magnitude of Common Emitter High Frequency Current Gain | 1.0 | 5.0 | 1.0 | 5.0 | | $I_C$ = 10 mA, $V_{CE}$ = 10 V, f = 100 MHz |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temeperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Pulse conditions: length ≤ 300 μs; duty cycle ≤ 1%.
5. For additional product family characteristic curves, refer to Section 5-SS16.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N5832 MIN. | 2N5832 MAX. | 2N5833 MIN. | 2N5833 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $I_{CBO}$ | Collector Cutoff Current | | 50 | | | nA | $V_{CB}$ = 120 V, $I_E$ = 0 |
| | | | | | 10 | nA | $V_{CB}$ = 160 V, $I_E$ = 0 |
| | | | 25 | | | μA | $V_{CB}$ = 120 V, $I_E$ = 0, $T_A$ = 100°C |
| | | | | | 25 | μA | $V_{CB}$ = 160 V, $I_E$ = 0, $T_A$ = 100°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 50 | | | nA | $V_{EB}$ = 4.0 V, $I_C$ = 0 |
| | | | | | 50 | nA | $V_{EB}$ = 5.0 V, $I_C$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 160 | | 200 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | 6.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | 140 | | 180 | | V | $I_C$ = 1.0 mA, $I_B$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 4) | 125 | | 50 | | | $V_{CE}$ = 5.0 V, $I_C$ = 1.0 mA |
| | | 175 | 500 | 50 | 250 | | $V_{CE}$ = 5.0 V, $I_C$ = 10 mA |
| | | 150 | | 50 | | | $V_{CE}$ = 5.0 V, $I_C$ = 50 mA |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage | | 0.8 | | 0.8 | V | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 4) | | 0.8 | | 0.8 | V | $I_C$ = 1.0 mA, $I_B$ = 0.1 mA |
| | | | 1.0 | | 1.0 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | 1.0 | | 1.0 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 4) | | 0.15 | | 0.15 | V | $I_C$ = 1.0 mA, $I_B$ = 0.1 mA |
| | | | 0.20 | | 0.20 | V | $I_C$ = 10 mA, $I_B$ = 1.0 mA |
| | | | 0.25 | | 0.25 | V | $I_C$ = 50 mA, $I_B$ = 5.0 mA |
| $h_{ie}$ | Input Resistance | | 6.0 | | 6.0 | kΩ | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $h_{oe}$ | Output Conductance | | 40 | | 40 | μmho | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $h_{fe}$ | Small Signal Current Gain | 125 | | 50 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $C_{cb}$ | Collector to Base Capacitance | | 4.0 | | 4.0 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 1.0 MHz |
| $\|h_{fe}\|$ | Magnitude of Common Emitter High Frequency Current Gain | 1.0 | 5.0 | 1.0 | 5.0 | | $I_C$ = 10 mA, $V_{CE}$ = 10 V, f = 100 MHz |

4

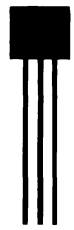
# 2N5845 • 2N5845A

## NPN SMALL SIGNAL HIGH SPEED HIGH CURRENT SATURATED SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- $P_D$ . . . 625 mW @ $T_A$ = 25°C
- $t_{on}$ . . . 30 ns (MAX) @ 500 mA (2N5845A)
- $t_{off}$ . . . 50 ns (MAX) @ 500 mA (2N5845A)
- $V_{CEO}$ . . . 40 V (MIN)
- $h_{FE}$ . . . 35 – 150 @ 500 mA, 1.0 V (2N5845A)
  . . . 50 – 200 @ 100 mA, 1.0 V (2N5845A)
- $V_{CE(sat)}$ . . . 0.5 V (MAX) @ 500 mA (2N5845A)

See TO92-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | |
|---|---|---|
| **† Maximum Temperatures** | | |
| | Storage Temperature | −55°C to +150°C |
| | Operating Junction Temperature | 150°C |
| | Lead Temperature (10 seconds) | 260°C |
| **† Maximum Power Dissipation** | | |
| | Total Dissipation at 25°C Case Temperature | 1.5 W |
| | at 25°C Ambient Temperature | 0.625 W |
| **Maximum Voltages and Current** | | |
| $V_{CBO}$ | Collector to Base Voltage | 50 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 40 V |
| $V_{EBO}$ | Emitter to Base Voltage | 6.0 V |
| $I_C$ | Collector Current | 600 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N5845 MIN. | 2N5845 MAX. | 2N5845A MIN. | 2N5845A MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 5) | 40 | | 40 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 50 | | 50 | | V | $I_C$ = 100 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 6.0 | | 6.0 | | V | $I_E$ = 10 μA, $I_C$ = 0 |
| $I_{CBO}$ | Collector Cutoff Current | | 500 | | 500 | nA | $V_{CB}$ = 40 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 50 | | 50 | nA | $V_{EB}$ = 4.0 V, $I_C$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 5) | 50 | | 50 | | | $I_C$ = 10 mA, $V_{CE}$ = 1.0 V |
| | | 50 | 200 | 50 | 200 | | $I_C$ = 100 mA, $V_{CE}$ = 1.0 V |
| | | 25 | 150 | 35 | 150 | | $I_C$ = 500 mA, $V_{CE}$ = 1.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | 0.25 | | 0.25 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| | | | 0.6 | | 0.5 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 5) | | 0.85 | | 0.85 | V | $I_C$ = 100 mA, $I_B$ = 10 mA |
| | | 0.8 | 1.1 | 0.8 | 1.1 | V | $I_C$ = 500 mA, $I_B$ = 50 mA |
| $\|h_{fe}\|$ | Magnitude of Small Signal Current Gain | 2.0 | | 2.5 | | | $I_C$ = 50 mA, $V_{CE}$ = 10 V, f = 100 MHz |
| $C_{cb}$ | Collector to Base Capacitance | | 9.0 | | 9.0 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 100 kHz |
| $C_{eb}$ | Emitter to Base Capacitance | | 70 | | 70 | pF | $V_{EB}$ = 0.5 V, $I_C$ = 0, f = 100 kHz |
| $t_{on}$ | Turn On Time (see test circuit no. 579) | | 40 | | 30 | ns | $I_C$ = 500 mA, $I_{B1}$ ≈ 50 mA, $V_{CC}$ = 40 V |
| $t_d$ | Delay Time (see test circuit no. 579) | | 17 | | 15 | ns | $I_C$ = 500 mA, $I_{B1}$ ≈ 50 mA |
| $t_r$ | Rise Time (see test circuit no. 579) | | 28 | | 25 | ns | $I_C$ = 500 mA, $I_{B1}$ ≈ 50 mA |
| $t_{off}$ | Turn Off Time (see test circuit no. 579) | | 60 | | 50 | ns | $I_C$ = 500 mA, $I_{B1}$ = $I_{B2}$ ≈ 50 mA, $V_{CC}$ = 40 V |
| $t_s$ | Storage Time (see test circuit no. 579) | | 40 | | 38 | ns | $I_C$ = 500 mA, $I_{B1}$ ≈ $I_{B2}$ ≈ 50 mA |
| $t_f$ | Fall Time (see test circuit no. 579) | | 30 | | 27 | ns | $I_C$ = 500 mA, $I_{B1}$ ≈ $I_{B2}$ ≈ 50 mA |

*Planar is a patented Fairchild process.
†Fairchild exceeds the JEDEC registered values.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 83°C/W (derating factor of 12 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 2%.
6. For product family characteristic curves, refer to Section 5-SS13.

# 2N/PN5855 • 2N/PN5856 • 2N/PN5857 • 2N/PN5858

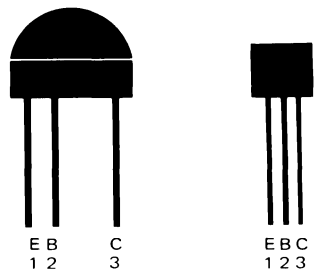
## PNP-NPN SMALL SIGNAL COMPLEMENTARY GENERAL PURPOSE

DIFFUSED SILICON PLANAR*EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C (FOR PN SERIES)**
- **$V_{CEO}$ . . . 60 V AND 80 V (MIN)**
- **$h_{FE}$ . . . 50 (MIN) FROM 10 mA TO 500 mA**
- **2N/PN5855, 2N/PN5857 (PNP); 2N/PN5856, 2N/PN5858 (NPN)**
- **COMPLEMENTS . . . SE6020, SE6021 (TO5), PE6020, PE6021 (TO92)**

**See Package Outlines**

**TO5-4** **TO92-1**




**2N5855/6 2N5857/8** **PN5856/6 PN5857/8**

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | 2N5855/6/7/8 | PN5855/6/7/8 |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | −55°C to +135°C | −55°C to +150°C |
| Operating Junction Temperature | | 135°C | 150°C |
| Lead Temperature (10 seconds) | | 260°C | 260°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | | |
| Total Dissipation at 25°C Ambient Temperature | | 0.750 W | 0.625 W |
| **Maximum Voltages and Current** (Reverse Voltage Polarity for PNP) | | **2N/PN5855 2N/PN5856** | **2N/PN5857 2N/PN5858** |
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V | 5.0 V |
| $V_{CBO}$ | Collector to Base Voltage | 60 V | 80 V |
| $V_{CEO}$ | Collector to Emitter Voltage | 60 V | 80 V |
| $I_C$ | Collector Current | 1.0 A | 1.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N/PN5855 2N/PN5856 MIN. | 2N/PN5855 2N/PN5856 MAX. | 2N/PN5857 2N/PN5858 MIN. | 2N/PN5857 2N/PN5858 MAX. | UNITS | TEST CONDITIONS (Reverse Voltage Polarity for PNP) |
|---|---|---|---|---|---|---|---|
| $I_{CBO}$ | Collector Cutoff Current | | 100 | | | nA | $V_{CB}$ = 40 V, $I_E$ = 0 |
| | | | | | 100 | nA | $V_{CB}$ = 60 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 100 | | 100 | nA | $V_{EB}$ = 4.0 V, $I_C$ = 0 |
| $h_{FE}$ | DC Current Gain (Note 4) | 50 | | 50 | | | $V_{CE}$ = 10 V, $I_C$ = 10 mA |
| | | 50 | 300 | 50 | 300 | | $V_{CE}$ = 10 V, $I_C$ = 150 mA |
| | | 50 | | 50 | | | $V_{CE}$ = 10 V, $I_C$ = 500 mA |
| | | 15 | | 15 | | | $V_{CE}$ = 10 V, $I_C$ = 1.0 A |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 4) | | 1.3 | | 1.3 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 4) | | 0.4 | | 0.4 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 60 | | 80 | | V | $I_E$ = 0, $I_C$ = 100 μA |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | 5.0 | | V | $I_C$ = 0, $I_E$ = 10 μA |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 4) | 60 | | 80 | | V | $I_C$ = 10 mA, $I_B$ = 0 |
| $h_{fe}$ | High Frequency Current Gain | 1.0 | | 1.0 | | | $I_C$ = 50 mA, $V_{CE}$ = 10 V, f = 100 MHz |
| $C_{ob}$ | Output Capacitance | | 15 | | 15 | pF | $I_E$ = 0, $V_{CB}$ = 10 V, f = 100 kHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C) for PN5855, PN5856, PN5857 and PN5858. These ratings give a maximum junction temperature of 135°C and junction to ambient thermal resistance of 150°C/W (derating factor of 6.8 mW/°C) for 2N5855, 2N5856, 2N5857 and 2N5858.
4. Pulse conditions: length = 300 μs; duty cycle = 1%.
5. For product family characteristic curves, refer to Section 5-SS24 for 2N/PN5855/57 and SS17 for 2N/PN5856/58.

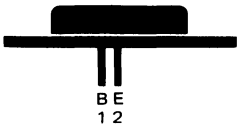
# 2N5871 • 2N5872

## 100 WATT PNP SILICON POWER

DIFFUSED SILICON BI-MESAR™ TRANSISTORS

- $V_{CE(sat)}$ . . . 1.0V @ $I_C$ = 4.0 A
- $I_{CEX}$ . . . 0.25 mA (MAX)
- $h_{FE}$ . . . 20-100 @ $I_C$ = 2.5 A

See TO3-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | 2N5871 | 2N5872 |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | | −65°C to + 200°C |
| Operating Junction Temperature | | | 200°C |
| Lead Temperature (10 seconds) | | | 250°C |
| **Maximum Power Dissipation** (Note 2) | | | |
| Total Dissipation at 25°C Case Temperature | | | 115 W |
| Linear Derating Factor | | | 0.658 W/°C |
| **Maximum Voltages and Currents** | | **2N5871** | **2N5872** |
| $V_{CBO}$ | Collector to Base Voltage | −60 V | −80 V |
| $V_{CEO}$ | Collector to Emitter Voltage | −60 V | −80 V |
| $V_{EBO}$ | Emitter to Base Voltage | −5.0 V | −5.0 V |
| $I_C$ | Collector Current (Continuous) | 7.0 A | 7.0 A |
| $I_C$ | Collector Current (Peak) | 15 A | 15 A |
| $I_B$ | Base Current (Continuous) | 2.0 A | 2.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N5871 MIN. | 2N5871 MAX. | 2N5872 MIN. | 2N5872 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 4) | −60 | | −80 | | V | $I_B$ = 0, $I_C$ = 100 mA |
| $h_{FE}$ | DC Current Gain (Note 4) | 4.0 | | 4.0 | | | $I_C$ = 7.0 A, $V_{CE}$ = −4.0 V |
| | | 20 | 100 | 20 | 100 | | $I_C$ = 2.5 A, $V_{CE}$ = −4.0 V |
| | | 35 | | 35 | | | $I_C$ = 500 mA, $V_{CE}$ = −4.0 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 4) | | −1.0 | | −1.0 | V | $I_C$ = 4.0 A, $I_B$ = 0.4 A |
| | | | −2.0 | | −2.0 | V | $I_C$ = 7.0 A, $I_B$ = 1.75 A |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 4) | | −1.5 | | −1.5 | V | $I_C$ = 2.5 A, $V_{CE}$ = −4.0 V |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 4) | | −2.5 | | −2.5 | V | $I_C$ = 7.0 A, $I_B$ = 1.75 A |
| $I_{CEX}$ | Collector Cutoff Current (Note 3) | | 0.25 | | | mA | $V_{CE}$ = −60 V, $V_{EB}$ = −1.5 V |
| | | | | | 0.25 | mA | $V_{CE}$ = −80 V, $V_{EB}$ = −1.5 V |
| | | | 2.0 | | | mA | $V_{CE}$ = −60 V, $V_{EB}$ = −1.5 V, $T_C$ = 150°C |
| | | | | | 2.0 | mA | $V_{CE}$ = −80 V, $V_{EB}$ = −1.5 V, $T_C$ = 150°C |
| $I_{CBO}$ | Collector Cutoff Current | | 0.25 | | | mA | $V_{CB}$ = −60 V, $I_E$ = 0 |
| | | | | | 0.25 | mA | $V_{CB}$ = −80 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 1.0 | | 1.0 | mA | $V_{EB}$ = 5.0 V |
| $I_{CEO}$ | Collector Cutoff Current | | 0.5 | | | mA | $I_B$ = 0, $V_{CE}$ = −30 V |
| | | | | | 0.5 | mA | $I_B$ = 0, $V_{CE}$ = −40 V |
| $\|h_{fe}\|$ | Magnitude of Common Emitter Small Signal Current Gain | 4.0 | | 4.0 | | | $V_{CE}$ = −10 V, $I_C$ = 0.25 A, f = 1.0 MHz |
| $C_{ob}$ | Output Capacitance | | 300 | | 300 | pF | $V_{CB}$ = −10 V, $I_E$ = 0, f = 1.0 MHz |
| $h_{fe}$ | Small Signal Current Gain | 20 | | 20 | | | $V_{CE}$ = −4.0 V, $I_C$ = 500 mA, f = 1.0 kHz |
| $t_r$ | Rise Time | | 0.7 | | 0.7 | μs | $V_{CC}$ = −30 V, $I_C$ = 2.5 A, $I_{B1}$ = 0.25 A |
| $t_s$ | Storage Time | | 1.0 | | 1.0 | μs | $V_{CC}$ = −30 V, $I_C$ = 2.5 A, $I_{B1}$ = $I_{B2}$ = 0.25 A |
| $t_f$ | Fall Time | | 0.8 | | 0.8 | μs | $V_{CC}$ = −30 V, $I_C$ = 2.5 A, $I_{B1}$ = $I_{B2}$ = 0.25 A |

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
3. Emitter diode is reversed biased.
4. Pulse conditions: length = 300 μs; duty cycle ≤ 10%.
5. For product family characteristic curves, refer to Section 5 — PWR 15.

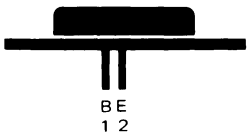
# 2N5873 • 2N5874

## 100 WATT NPN SILICON POWER

DIFFUSED SILICON BI-MESAR™ TRANSISTORS

- $V_{CE(sat)}$ . . . 1.0 V @ $I_C$ = 4.0 A
- $I_{CEX}$ . . . 0.25 mA
- $h_{FE}$ . . . 20-100 @ $I_C$ = 2.5 A

See TO3-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | 2N5873 | 2N5874 |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | | −65°C to +200°C |
| Operating Junction Temperature | | | 200°C |
| Lead Temperature (10 seconds) | | | 250°C |
| **Maximum Power Dissipation** | | | |
| Total Dissipation at 25°C Case Temperature | | | 115 W |
| Linear Derating Factor | | | 0.658 W/°C |
| **Maximum Voltages and Currents** | | **2N5873** | **2N5874** |
| $V_{CBO}$ | Collector to Base Voltage | 60 V | 80 V |
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V | 5.0 V |
| $V_{CEO}$ | Collector to Emitter Voltage | 60 V | 80 V |
| $I_C$ | Collector Current (Continuous) | 7.0 A | 7.0 A |
| $I_C$ | Collector Current (Peak) | 15 A | 15 A |
| $I_B$ | Base Current | 2.0 A | 2.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N5873 MIN. | 2N5873 MAX. | 2N5874 MIN. | 2N5874 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_{CEO(sus)}$ | Collector Sustaining Voltage (Note 2) | 60 | | 80 | | V | $I_B$ = 0, $I_C$ = 100 mA |
| $h_{FE}$ | DC Current Gain (Note 2) | 4.0 | | 4.0 | | | $I_C$ = 7.0 A, $V_{CE}$ = 4.0 V |
| | | 20 | 100 | 20 | 100 | | $I_C$ = 2.5 A, $V_{CE}$ = 4.0 V |
| | | 35 | | 35 | | | $I_C$ = 500 mA, $V_{CE}$ = 4.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 2) | | 1.0 | | 1.0 | V | $I_C$ = 4.0 A, $I_B$ = 0.4 A |
| | | | 2.0 | | 2.0 | V | $I_C$ = 7.0 A, $I_B$ = 1.75 A |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 2) | | 2.5 | | 2.5 | V | $I_C$ = 7.0 A, $I_B$ = 1.75 A |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 2) | | 1.5 | | 1.5 | V | $I_C$ = 2.5 A, $V_{CE}$ = 4.0 V |
| $\|h_{fe}\|$ | Magnitude of Common Emitter Small Signal Current Gain | 4.0 | | 4.0 | | | $V_{CE}$ = 10 V, $I_C$ = 0.25 A, f = 1.0 MHz |
| $h_{fe}$ | Small Signal Current Gain | 20 | | 20 | | | $V_{CE}$ = 4.0 V, $I_C$ = 500 mA, f = 1.0 kHz |
| $I_{CEX}$ | Collector Cutoff Current (Note 3) | | 2.0 | | | mA | $V_{CE}$ = 60 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| | | | | | 2.0 | mA | $V_{CE}$ = 80 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| | | | 0.25 | | | mA | $V_{CE}$ = 60 V, $V_{EB}$ = 1.5 V |
| | | | | | 0.25 | mA | $V_{CE}$ = 80 V, $V_{EB}$ = 1.5 V |
| $I_{CBO}$ | Collector Cutoff Current | | 0.25 | | | mA | $V_{CB}$ = 60 V, $I_E$ = 0 |
| | | | | | 0.25 | mA | $V_{CB}$ = 80 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 1.0 | | 1.0 | mA | $V_{EB}$ = 5.0 V |
| $I_{CEO}$ | Collector Cutoff Current | | 0.5 | | | mA | $I_B$ = 0, $V_{CE}$ = 30 V |
| | | | | | 0.5 | mA | $I_B$ = 0, $V_{CE}$ = 40 V |
| $C_{ob}$ | Output Capacitance | | 250 | | 250 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 1.0 MHz |
| $t_r$ | Rise Time | | 0.7 | | 0.7 | μs | $V_{CC}$ = 30 V, $I_C$ = 2.5 A, $I_{B1}$ = 0.25 A |
| $t_s$ | Storage Time | | 1.0 | | 1.0 | μs | $V_{CC}$ = 30 V, $I_C$ = 2.5 A, $I_{B1}$ = $I_{B2}$ = 0.25 A |
| $t_f$ | Fall Time | | 0.8 | | 0.8 | μs | $V_{CC}$ = 30 V, $I_C$ = 2.5 A, $I_{B1}$ = $I_{B2}$ = 0.25 A |

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. Pulse conditions: length = 300 μs; duty cycle ≤ 10%.
3. Emitter diode is reverse biased.
4. For product family characteristic curves, refer to Section 5 — PWR 6.

# 2N5875 • 2N5876

## 150 WATT PNP POWER

DIFFUSED SILICON BI-MESAR™ TRANSISTORS

- $V_{CE(sat)}$ . . . −1.0V (MAX) @ $I_C$ = 5.0 A
- $I_{CEX}$ . . . 0.5 mA (MAX)
- $h_{FE}$ . . . 20-100 @ $I_C$ = 4.0 A

See TO3-1 Package Outline

B E
1 2

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | 2N5875 | 2N5876 |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperatures | | −65°C to +200°C | |
| Operating Junction Temperature | | 200°C | |
| Lead Temperature (10 seconds) | | 250°C | |
| **Maximum Power Dissipation** (Note 2) | | | |
| Total Dissipation at 25°C Case Temperature | | 150 W | |
| Linear Derating Factor | | 0.857 W/°C | |
| **Maximum Voltages and Currents** | | | |
| $V_{CBO}$ | Collector to Base Voltage | −60 V | −80 V |
| $V_{CEO}$ | Collector to Emitter Voltage | −60 V | −80 V |
| $V_{EBO}$ | Emitter to Base Voltage | −5.0 V | −5.0 V |
| $I_C$ | Collector Current (Continuous) | 10 A | 10 A |
| $I_C$ | Collector Current (Peak) | 20 A | 20 A |
| $I_B$ | Base Current (Continuous) | 4.0 A | 4.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted.)

| SYMBOL | CHARACTERISTIC | 2N5875 MIN. | 2N5875 MAX. | 2N5876 MIN. | 2N5876 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $I_{CEX}$ | Collector Cutoff Current (Note 3) | | 0.5 | | | mA | $V_{CE}$ = −60 V, $V_{EB}$ = −1.5 V |
| | | | | | 0.5 | mA | $V_{CE}$ = −80 V, $V_{EB}$ = −1.5 V |
| | | | 5.0 | | | mA | $V_{CE}$ = −60 V, $V_{EB}$ = −1.5 V, $T_C$ = 150°C |
| | | | | | 5.0 | mA | $V_{CE}$ = −80 V, $V_{EB}$ = −1.5 V, $T_C$ = 150°C |
| $I_{CBO}$ | Collector Cutoff Current | | 0.5 | | | mA | $V_{CB}$ = −60 V, $I_E$ = 0 |
| | | | | | 0.5 | mA | $V_{CB}$ = −80 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 1.0 | | 1.0 | mA | $V_{EB}$ = −5.0 V |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 4) | −60 | | −80 | | V | $I_B$ = 0, $I_C$ = 200 mA |
| $I_{CEO}$ | Collector Cutoff Current | | 1.0 | | | mA | $I_B$ = 0, $V_{CE}$ = −30 V |
| | | | | | 1.0 | mA | $I_B$ = 0, $V_{CE}$ = −40 V |
| $h_{FE}$ | DC Current Gain (Note 4) | 4.0 | | 4.0 | | | $I_C$ = 10 A, $V_{CE}$ = −4.0 V |
| | | 20 | 100 | 20 | 100 | | $I_C$ = 4.0 A, $V_{CE}$ = −4.0 V |
| | | 35 | | 35 | | | $I_C$ = 1.0 A, $V_{CE}$ = −4.0 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 4) | | −1.0 | | −1.0 | V | $I_C$ = 5.0 A, $I_B$ = 0.5 A |
| | | | −3.0 | | −3.0 | V | $I_C$ = 10 A, $I_B$ = 2.5 A |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 4) | | −1.5 | | −1.5 | V | $I_C$ = 4.0 A, $V_{CE}$ = −4.0 V |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 4) | | −2.5 | | −2.5 | V | $I_C$ = 10 A, $I_B$ = 2.5 A |
| $\|h_{fe}\|$ | Magnitude of Common Emitter Small Signal Current Gain | 4.0 | | 4.0 | | | $V_{CE}$ = −10 V, $I_C$ = 0.5 A, f = 1.0 MHz |
| $C_{ob}$ | Output Capacitance | | 500 | | 500 | μF | $V_{CB}$ = −10 V, f = 1.0 MHz, $I_E$ = 0 |
| $h_{fe}$ | Small Signal Current Gain | 20 | | 20 | | | $V_{CE}$ = −4.0 V, $I_C$ = 1.0 A, f = 1.0 kHz |
| $t_r$ | Rise Time | | 0.7 | | 0.7 | μs | $V_{CC}$ = −30 V, $I_C$ = 4.0 A, $I_{B1}$ = 0.4 A |
| $t_s$ | Storage Time | | 1.0 | | 1.0 | μs | $V_{CC}$ = −30 V, $I_C$ = 4.0 A, $I_{B1}$ = $I_{B2}$ = 0.4 A |
| $t_f$ | Fall Time | | 0.8 | | 0.8 | μs | $V_{CC}$ = −30 V, $I_C$ = 4.0 A, $I_{B1}$ = $I_{B2}$ = 0.4 A |

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
3. Emitter diode is reverse biased.
4. Pulse conditions: length = 300 μs; duty cycle ≤ 10%.
5. For product family characteristic curves, refer to Section 5 — PWR 15.

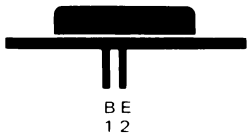
# 2N5877 • 2N5878

## 150 WATT NPN SILICON POWER

DIFFUSED SILICON BI-MESAR™ TRANSISTORS

- $V_{CE(sat)}$ . . . 1.0V (MAX) @ $I_C$ = 5.0 A
- $I_{CEX}$ . . . 0.5 mA (MAX)
- $h_{FE}$ . . . 20-100 @ $I_C$ = 4.0 A

See TO3-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | | |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | | −65°C to 200°C |
| Operating Junction Temperature | | | 200°C |
| Lead Temperature, (10 seconds) | | | 250°C |
| **Maximum Power Dissipation** | | | |
| Total Dissipation at 25°C Case Temperature | | | 150 W |
| Linear Derating Factor | | | 0.857 W/°C |
| **Maximum Voltage and Currents** | | **2N5877** | **2N5878** |
| $V_{CBO}$ | Collector to Base Voltage | 60 V | 80 V |
| $V_{CEO}$ | Collector to Emitter Voltage | 60 V | 80 V |
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V | 5.0 V |
| $I_C$ | Collector Current (Continuous) | 10 A | 10 A |
| $I_C$ | Collector Current (Peak) | 20 A | 20 A |
| $I_B$ | Base Current | 4.0 A | 4.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted.)

| SYMBOL | CHARACTERISTIC | 2N5877 MIN. | 2N5877 MAX. | 2N5878 MIN. | 2N5878 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 2) | | 1.0 | | 1.0 | V | $I_C$ = 5.0 A, $I_B$ = 0.5 A |
| | | | 3.0 | | 3.0 | V | $I_C$ = 10 A, $I_B$ = 2.5 A |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 2) | | 2.5 | | 2.5 | V | $I_C$ = 10 A, $I_B$ = 2.5 A |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 2) | | 1.5 | | 1.5 | V | $I_C$ = 4.0 A, $V_{CE}$ = 4.0 V |
| $\|h_{fe}\|$ | Magnitude of Common Emitter Small Signal Current Gain | 4.0 | | 4.0 | | | $V_{CE}$ = 10 V, $I_C$ = 0.5 A, f = 1.0 MHz |
| $h_{fe}$ | Small Signal Current Gain | 20 | | 20 | | | $V_{CE}$ = 4.0 V, $I_C$ = 1.0 A, f = 1.0 kHz |
| $C_{ob}$ | Output Capacitance | | 300 | | 300 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 1.0 MHz |
| $t_r$ | Rise Time | | 0.7 | | 0.7 | μs | $V_{CC}$ = 30 V, $I_C$ = 4.0 A, $I_{B1}$ = 0.4 A |
| $t_s$ | Storage Time | | 1.0 | | 1.0 | μs | $V_{CC}$ = 30 V, $I_C$ = 4.0 A, $I_{B1}$ = $I_{B2}$ = 0.4 A |
| $t_f$ | Fall Time | | 0.8 | | 0.8 | μs | $V_{CC}$ = 30 V, $I_C$ = 4.0 A, $I_{B1}$ = $I_{B2}$ = 0.4 A |
| $I_{CEX}$ | Collector Cutoff Current (Note 3) | | 5.0 | | | mA | $V_{CE}$ = 60 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| | | | | | 5.0 | mA | $V_{CE}$ = 80 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| | | | 0.5 | | | mA | $V_{CE}$ = 60 V, $V_{EB}$ = 1.5 V |
| | | | | | 0.5 | mA | $V_{CE}$ = 80 V, $V_{EB}$ = 1.5 V |
| $I_{EBO}$ | Emitter Cutoff Current | | 1.0 | | 1.0 | mA | $V_{EB}$ = 5.0 V |
| $I_{CBO}$ | Collector Cutoff Current | | 0.5 | | | mA | $V_{CB}$ = 60 V, $I_E$ = 0 |
| | | | | | 0.5 | mA | $V_{CB}$ = 80 V, $I_E$ = 0 |
| $V_{CEO(sus)}$ | Collector Sustaining Voltage (Note 2) | 60 | | 80 | | V | $I_B$ = 0, $I_C$ = 200 mA |
| $I_{CEO}$ | Collector Cutoff Current | | 1.0 | | | mA | $I_B$ = 0, $V_{CE}$ = 30 V |
| | | | | | 1.0 | mA | $I_B$ = 0, $V_{CE}$ = 40 V |
| $h_{FE}$ | DC Current Gain (Note 2) | 4.0 | | 4.0 | | | $I_C$ = 10 A, $V_{CE}$ = 4.0 V |
| | | 20 | 100 | 20 | 100 | | $I_C$ = 4.0 A, $V_{CE}$ = 4.0 V |
| | | 35 | | 35 | | | $I_C$ = 1.0 A, $V_{CE}$ = 4.0 V |

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. Pulse conditions: length = 300 μs; duty cycle ≤ 10%.
3. Emitter diode is reverse biased.
4. For product family characteristic curves, refer to Section 5 — PWR 6.

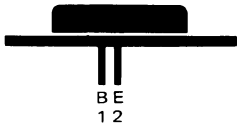
# 2N5879 • 2N5880

## 160 WATT PNP SILICON POWER

DIFFUSED SILICON BI-MESAR™ TRANSISTORS

- $V_{CE(sat)}$ . . . −1.0 V (MAX) @ $I_C$ = 7.0 A
- $I_{CEX}$ . . . 0.5 mA (MAX)
- $h_{FE}$ . . . 20-100 @ $I_C$ = 6.0 A

See TO3-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | | |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | | −65°C to +200°C |
| Operating Junction Temperature | | | 200°C |
| Lead Temperature (10 seconds) | | | 250°C |
| **Maximum Power Dissipation** (Note 2) | | | |
| Total Dissipation at 25°C Case Temperature | | | 160 W |
| Linear Derating Factor | | | 0.915 W/°C |
| **Maximum Voltages and Currents** | | **2N5879** | **2N5880** |
| $V_{CBO}$ | Collector to Base Voltage | −60 V | −80 V |
| $V_{CEO}$ | Collector to Emitter Voltage | −60 V | −80 V |
| $V_{EBO}$ | Emitter to Base Voltage | −5.0 V | −5.0 V |
| $I_C$ | Collector Current (Continuous) | 15 A | 15 A |
| $I_C$ | Collector Current (Peak) | 30 A | 30 A |
| $I_B$ | Base Current (Continuous) | 5.0 A | 5.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N5879 MIN. | 2N5879 MAX. | 2N5880 MIN. | 2N5880 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 4) | −60 | | −80 | | V | $I_B$ = 0, $I_C$ = 200 mA |
| $h_{FE}$ | DC Current Gain (Note 4) | 4.0 | | 4.0 | | | $I_C$ = 15 A, $V_{CE}$ = −4.0 V |
| | | 20 | 100 | 20 | 100 | | $I_C$ = 6.0 A, $V_{CE}$ = −4.0 V |
| | | 35 | | 35 | | | $I_C$ = 2.0 A, $V_{CE}$ = −4.0 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 4) | | −1.0 | | −1.0 | V | $I_C$ = 7.0 A, $I_B$ = 0.7 A |
| | | | −4.0 | | −4.0 | V | $I_C$ = 15 A, $I_B$ = 3.75 A |
| $V_{BE(ON)}$ | Base to Emitter Voltage (Note 4) | | −1.5 | | −1.5 | V | $I_C$ = 6.0 A, $V_{CE}$ = −4.0 V |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 4) | | −2.5 | | −2.5 | V | $I_C$ = 15 A, $I_B$ = 3.75 A |
| $h_{fe}$ | Small Signal Current Gain | 20 | | 20 | | | $V_{CE}$ = −4.0 V, $I_C$ = 2.0 A, f = 1.0 kHz |
| $I_{CEX}$ | Collector Cutoff Current (Note 3) | | 5.0 | | | mA | $V_{CE}$ = 60 V, $V_{EB}$ = −1.5 V, $T_C$ = 150°C |
| | | | | | 5.0 | mA | $V_{CE}$ = −80 V, $V_{EB}$ = −1.5 V, $T_C$ = 150°C |
| | | | 0.5 | | | mA | $V_{CE}$ = −60 V, $V_{EB}$ = −1.5 V |
| | | | | | 0.5 | mA | $V_{CE}$ = −80 V, $V_{EB}$ = −1.5 V |
| $I_{CBO}$ | Collector Cutoff Current | | 0.5 | | | mA | $V_{CB}$ = −60 V, $I_E$ = 0 |
| | | | | | 0.5 | mA | $V_{CB}$ = −80 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 1.0 | | 1.0 | mA | $V_{EB}$ = −5.0 V |
| $I_{CEO}$ | Collector Cutoff Current | | 1.0 | | | mA | $I_B$ = 0, $V_{CE}$ = −30 V |
| | | | | | 1.0 | mA | $I_B$ = 0, $V_{CE}$ = −40 V |
| $\|h_{fe}\|$ | Magnitude of Common Emitter Small Signal Current Gain | 4.0 | | 4.0 | | | $V_{CE}$ = −10 V, $I_C$ = 1.0 A, f = 1.0 MHz |
| $C_{ob}$ | Output Capacitance | | 600 | | 600 | pF | $V_{CB}$ = −10 V, $I_E$ = 0, f = 0.1 MHz |
| $t_r$ | Rise Time | | 0.7 | | 0.7 | μs | $V_{CC}$ = 30 V, $I_C$ = 6.0 A, $I_{B1}$ = 0.6 A |
| $t_s$ | Storage Time | | 1.0 | | 1.0 | μs | $V_{CC}$ = 30 V, $I_C$ = 6.0 A, $I_{B1}$ = $I_{B2}$ = 0.6 A |
| $t_f$ | Fall Time | | 0.8 | | 0.8 | μs | $V_{CC}$ = 30 V, $I_C$ = 6.0 A, $I_{B1}$ = $I_{B2}$ = 0.6 A |

NOTES:
1. These ratings are limiting values above which their serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on application involving pulsed or low duty cycle operation.
3. Emitter diode is reverse biased.
4. Pulse conditions: length = 300 μs; duty cycle ≤ 10%.
5. For product family characteristic curves, refer to Section 5 — PWR 16.

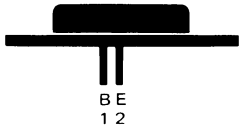
# 2N5881 • 2N5882

## 160 WATT NPN SILICON POWER

DIFFUSED SILICON BI-MESAR™ TRANSISTORS

- $V_{CE}$ . . . 1.0 V (MAX) @ $I_C$ = 7.0 A
- $I_{CEX}$ . . . 0.5 mA (MAX)
- $h_{FE}$ . . . 20-100 @ $I_C$ = 6.0 A

See TO3-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| **Maximum Temperatures** | |
| Storage Temperature | −65°C to +200°C |
| Operating Junction Temperature | 200°C |
| Lead Temperature (10 seconds) | 250°C |
| **Maximum Power Dissipation** | |
| Total Dissipation at 25°C Case Temperature | 160 W |
| Linear Derating Factor | 0.915 W/°C |

| **Maximum Voltages and Currents** | | **2N5881** | **2N5882** |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | 60 V | 80 V |
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V | 5.0 V |
| $V_{CEO}$ | Collector to Emitter Voltage | 60 V | 80 V |
| $I_C$ | Collector Current | 15 A | 15 A |
| $I_B$ | Base Current | 5.0 A | 5.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N5881 MIN. | 2N5881 MAX. | 2N5882 MIN. | 2N5882 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_{CEO(sus)}$ | Collector Sustaining Voltage (Note 2) | 60 | | 80 | | V | $I_B$ = 0, $I_C$ = 200 mA |
| $I_{CEO}$ | Collector Cutoff Current | | 1.0 | | | mA | $I_B$ = 0, $V_{CE}$ = 30 V |
| | | | | | 1.0 | mA | $I_B$ = 0, $V_{CE}$ = 40 V |
| $h_{FE}$ | DC Current Gain (Note 2) | 4.0 | | 4.0 | | | $I_C$ = 15 A, $V_{CE}$ = 4.0 V |
| | | 20 | 100 | 20 | 100 | | $I_C$ = 6.0 A, $V_{CE}$ = 4.0 V |
| | | 35 | | 35 | | | $I_C$ = 2.0 A, $V_{CE}$ = 4.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 2) | | 1.0 | | 1.0 | V | $I_C$ = 7.0 A, $I_B$ = 0.7 A |
| | | | 4.0 | | 4.0 | V | $I_C$ = 15 A, $I_B$ = 3.75 A |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 2) | | 2.5 | | 2.5 | V | $I_C$ = 15 A, $I_B$ = 3.75 A |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 2) | | 1.5 | | 1.5 | V | $I_C$ = 6.0 A, $V_{CE}$ = 4.0 V |
| $\lvert h_{fe} \rvert$ | Magnitude of Common Emitter Small Signal Current Gain | 4.0 | | 4.0 | | | $V_{CE}$ = 10 V, $I_C$ = 1.0 A, f = 1.0 MHz |
| $h_{fe}$ | Small Signal Current | 20 | | 20 | | | $V_{CE}$ = 4.0 V, $I_C$ = 2.0 A, f = 1.0 kHz |
| $I_{CEX}$ | Collector Cutoff Current (Note 3) | | 5.0 | | | mA | $V_{CE}$ = 60 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| | | | | | 5.0 | mA | $V_{CE}$ = 80 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| | | | 0.5 | | | mA | $V_{CE}$ = 60 V, $V_{EB}$ = 1.5 V |
| | | | | | 0.5 | mA | $V_{CE}$ = 80 V, $V_{EB}$ = 1.5 V |
| $I_{CBO}$ | Collector Cutoff Current | | 0.5 | | | mA | $V_{CB}$ = 60 V, $I_E$ = 0 |
| | | | | | 0.5 | mA | $V_{CB}$ = 80 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 1.0 | | 1.0 | mA | $V_{EB}$ = 5.0 V |
| $C_{ob}$ | Output Capacitance | | 400 | | 400 | pF | $V_{CB}$ = 10 V, $I_E$ = 0, f = 0.1 MHz |
| $t_r$ | Rise Time | | 0.7 | | 0.7 | μs | $V_{CC}$ = 30 V, $I_C$ = 6.0 A, $I_{B1}$ = 0.6 A |
| $t_s$ | Storage Time | | 1.0 | | 1.0 | μs | $V_{CC}$ = 30 V, $I_C$ = 6.0 A, $I_{B1}$ = $I_{B2}$ = 0.6 A |
| $t_f$ | Fall Time | | 0.8 | | 0.8 | μs | $V_{CC}$ = 30 V, $I_C$ = 6.0 A, $I_{B1}$ = $I_{B2}$ = 0.6 A |

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. Pulse conditions: length = 300 μs; duty cycle ≤ 100%.
3. Emitter diode is reversed biased.
4. For product family characteristic curves, refer to Section 5 — PWR7.

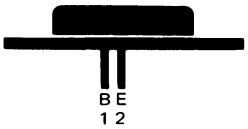
# 2N5883 • 2N5884

## 200 WATT PNP SILICON POWER

DIFFUSED SILICON BI-MESAR™ TRANSISTORS

- $V_{CE(sat)}$ . . . −1.0 V (MAX) @ $I_C$ = 15 A
- $I_{CEX}$ . . . 1.0 mA (MAX)
- $h_{FE}$ . . . 20-100 @ $I_C$ = 10 A

See TO3-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | 2N5883 | 2N5884 |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | −65°C to +200°C | |
| Operating Junction Temperature | | 200°C | |
| Lead Temperature (10 seconds) | | 250°C | |
| **Maximum Power Dissipation** (Note 2) | | | |
| Total Dissipation at 25°C Case Temperature | | 200 W | |
| Linear Derating Factor | | 1.15 mW/°C | |
| **Maximum Voltages and Currents** | | | |
| $V_{CBO}$ | Collector to Base Voltage | −60 V | −80 V |
| $V_{EBO}$ | Emitter to Base Voltage | −5.0 V | −5.0 V |
| $V_{CEO}$ | Collector to Emitter Voltage | −60 V | −80 V |
| $I_C$ | Collector Current (Continuous) | 25 A | 25 A |
| $I_C$ | Collector Current (Peak) | 50 A | 50 A |
| $I_B$ | Base Current (Continuous) | 7.5 A | 7.5 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N5883 MIN. | 2N5883 MAX. | 2N5884 MIN. | 2N5884 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 4) | −60 | | −80 | | V | $I_B$ = 0, $I_C$ = 200 mA |
| $h_{FE}$ | DC Current Gain (Note 4) | 4.0 | | 4.0 | | | $I_C$ = 25 A, $V_{CE}$ = −4.0 V |
| | | 20 | 100 | 20 | 100 | | $I_C$ = 10 A, $V_{CE}$ = −4.0 V |
| | | 35 | | 35 | | | $I_C$ = 3.0 A, $V_{CE}$ = −4.0 V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 4) | | −1.0 | | −1.0 | V | $I_C$ = 15 A, $I_B$ = 1.5 A |
| | | | −4.0 | | −4.0 | V | $I_C$ = 25 A, $I_B$ = 6.25 A |
| $V_{BE(ON)}$ | Base to Emitter Voltage (Note 4) | | −1.5 | | −1.5 | V | $I_C$ = 10 A, $V_{CE}$ = −4.0 V |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 4) | | −2.5 | | −2.5 | V | $I_C$ = 25 A, $I_B$ = 6.25 A |
| $h_{fe}$ | Small Signal Current Gain | 20 | | 20 | | | $V_{CE}$ = −4.0 V, $I_C$ = 3.0 A, f = 1.0 kHz |
| $I_{CEX}$ | Collector Cutoff Current (Note 3) | | 10 | | | mA | $V_{CE}$ = −60 V, $V_{EB}$ = −1.5 V, $T_C$ = 150°C |
| | | | | | 10 | mA | $V_{CE}$ = −80 V, $V_{EB}$ = −1.5 V, $T_C$ = 150°C |
| | | | 1.0 | | | mA | $V_{CE}$ = −60 V, $V_{EB}$ = −1.5 V |
| | | | | | 1.0 | mA | $V_{CE}$ = −80 V, $V_{EB}$ = −1.5 V |
| $I_{CBO}$ | Collector Cutoff Current | | 1.0 | | | mA | $V_{CB}$ = −60 V, $I_E$ = 0 |
| | | | | | 1.0 | mA | $V_{CB}$ = −80 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 1.0 | | 1.0 | mA | $V_{EB}$ = −5.0 V |
| $I_{CEO}$ | Collector Cutoff Current | | 2.0 | | | mA | $I_B$ = 0, $V_{CE}$ = −30 V |
| | | | | | 2.0 | mA | $I_B$ = 0, $V_{CE}$ = −40 V |
| $\|h_{fe}\|$ | Magnitude of Common Emitter Small Signal Current Gain | 4.0 | | 4.0 | | | $V_{CE}$ = −10 V, $I_C$ = 1.0 A, f = 1.0 MHz |
| $C_{ob}$ | Output Capacitance | | 1000 | | 1000 | pF | $V_{CB}$ = −10 V, $I_E$ = 0, f = 1.0 MHz |
| $t_r$ | Rise Time | | 0.7 | | 0.7 | μs | $V_{CC}$ = −30 V, $I_C$ = 10 A, $I_{B1}$ = 1.0 A |
| $t_s$ | Storage Time | | 1.0 | | 1.0 | μs | $V_{CC}$ = −30 V, $I_C$ = 10 A, $I_{B1}$ = $I_{B2}$ = 1.0 A |
| $t_f$ | Fall Time | | 0.8 | | 0.8 | μs | $V_{CC}$ = −30 V, $I_C$ = 10 A, $I_{B1}$ = $I_{B2}$ = 1.0 A |

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
3. Emitter diode is reverse biased.
4. Pulse conditions: length = 300 μs; duty cycle ≤ 10%.
5. For product family characteristic curves refer to Section 5 — PWR 16.

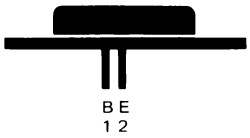
# 2N5885 • 2N5886

## 200 WATT NPN SILICON POWER

DIFFUSED SILICON BI-MESAR™ TRANSISTORS

- $V_{CE(sat)}$ . . . 1.0 V (MAX) @ $I_C$ = 15 A
- $I_{CEX}$ . . . 1.0 mA (MAX)
- $h_{FE}$ . . . 20-100 @ $I_C$ = 10 A

See TO3-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | | |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | | −65° C to 200° C |
| Operating Junction Temperature | | | 200° C |
| Lead Temperature (10 seconds) | | | 250° C |
| **Maximum Power Dissipation** | | | |
| Total Dissipation at 25° C Case Temperature | | | 200 W |
| Linear Derating Factor | | | 1.15 W/° C |
| **Maximum Voltages and Currents** | | **2N5885** | **2N5886** |
| $V_{CBO}$ | Collector to Base Voltage | 60 V | 80 V |
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V | 5.0 V |
| $V_{CEO}$ | Collector to Emitter Voltage | 60 V | 80 V |
| $I_C$ | Collector Current | 25 A | 25 A |
| $I_B$ | Base Current | 7.5 A | 7.5 A |

**ELECTRICAL CHARACTERISTICS** (25° C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N5885 MIN. | 2N5885 MAX. | 2N5886 MIN. | 2N5886 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $I_{CEX}$ | Collector Cutoff Current (Note 3) | | 10 | | | mA | $V_{CE}$ = 60 V, $V_{EB}$ = 1.5 V, $T_C$ = 150° C |
| | | | | | 10 | mA | $V_{CE}$ = 80 V, $V_{EB}$ = 1.5 V, $T_C$ = 150° C |
| | | | 1.0 | | | mA | $V_{CE}$ = 60 V, $V_{EB}$ = 1.5 V |
| | | | | | 1.0 | mA | $V_{CE}$ = 80 V, $V_{EB}$ = 1.5 V |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Note 2) | 60 | | 80 | | V | $I_B$ = 0, $I_C$ = 200 mA |
| $h_{FE}$ | DC Current Gain (Note 2) | 4.0 | | 4.0 | | | $I_C$ = 25 A, $V_{CE}$ = 4.0 V |
| | | 20 | 100 | 20 | 100 | | $I_C$ = 10 A, $V_{CE}$ = 4.0 V |
| | | 35 | | 35 | | | $I_C$ = 3.0 A, $V_{CE}$ = 4.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 2) | | 1.0 | | 1.0 | V | $I_C$ = 15 A, $I_B$ = 1.5 A |
| | | | 4.0 | | 4.0 | V | $I_C$ = 25 A, $I_B$ = 6.25 A |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 2) | | 2.5 | | 2.5 | V | $I_C$ = 25 A, $I_B$ = 6.25 A |
| $I_{CBO}$ | Collector Cutoff Current | | 1.0 | | | mA | $V_{CB}$ = 60 V, $I_E$ = 0 |
| | | | | | 1.0 | mA | $V_{CB}$ = 80 V, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 1.0 | | 1.0 | mA | $V_{EB}$ = 5.0 V |
| $I_{CEO}$ | Collector Cutoff Current | | 2.0 | | | mA | $I_B$ = 0, $V_{CE}$ = 30 V |
| | | | | | 2.0 | mA | $I_B$ = 0, $V_{CE}$ = 40 V |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 2) | | 1.5 | | 1.5 | V | $I_C$ = 10 A, $V_{CE}$ = 4.0 V |
| $\|h_{fe}\|$ | Magnitude of Common Emitter, Small Signal Short Circuit Forward Current Transfer Ratio | 4.0 | | 4.0 | | | $V_{CE}$ = 10 V, $I_C$ = 1.0 A, f = 1.0 MHz |
| $h_{fe}$ | Small Signal Current Gain | 20 | | 20 | | | $V_{CE}$ = 4.0 V, $I_C$ = 3.0 A, f = 1.0 kHz |
| $C_{ob}$ | Output Capacitance | | 500 | | 500 | pF | $V_{CB}$ = 10 V, $I_E$ = 0 A, f = 1.0 MHz |
| $t_r$ | Rise Time | | 0.7 | | 0.7 | μs | $V_{CC}$ = 30 V, $I_C$ = 10 A, $I_{B1}$ = 1.0 A |
| $t_f$ | Fall Time | | 0.8 | | 0.8 | μs | $V_{CC}$ = 30 V, $I_C$ = 10 A, $I_{B1}$ = $I_{B2}$ = 1.0 A |
| $t_s$ | Storage Time | | 1.0 | | 1.0 | μs | $V_{CC}$ = 30 V, $I_C$ = 10 A, $I_{B1}$ = $I_{B2}$ = 1.0 A |

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. Pulse conditions: length = 300 μs; duty cycle ≤ 10%.
3. Emitter diode is reversed biased.
4. For product family characteristic curves, refer to Section 5 — PWR 7.

# 2N5961 • 2N5962 • 2N5963

## NPN LOW LEVEL LOW NOISE AMPLIFIERS

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **$P_D$ . . . 625 mW @ $T_A$ = 25°C**
- **NF . . . 8.0 dB (MAX) @ 10 Hz, 1.0 kΩ (2N5963)**
- **$h_{FE}$ . . . 900 (MIN) @ 10 μA, 1200 (MIN) @ 10 mA (2N5963)**
- **$V_{CE(sat)}$ . . . 0.2 V (MAX) @ 10 mA/0.5 mA**
- **$I_{CBO}$ . . . 2.0 nA (MAX) @ $V_{CB}$ = 45 V, 50 nA (MAX) @ $V_{CB}$ = 45 V, $T_A$ = 65°C (2N5961)**

**See TO92-1 Package Outline**


**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | | | |
|---|---|---|---|---|
| **Maximum Temperatures** | | | | |
| Storage Temperature | | | | −55°C to 150°C |
| Operating Junction Temperature | | | | 150°C |
| Lead Temperature (10 seconds) | | | | 260°C |
| **†Maximum Power Dissipation** (Notes 2 & 3) | | | | |
| Total Dissipation at 25°C Case Temperature | | | | 1.0 W |
| at 25°C Ambient Temperature | | | | 0.625 W |
| at 70°C Ambient Temperature | | | | 0.400 W |
| **Maximum Voltages and Current** | | **2N5961** | **2N5962** | **2N5963** |
| $V_{CBO}$ | Collector to Base Voltage | 60 V | 45 V | 30 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | 60 V | 45 V | 30 V |
| $V_{EBO}$ | Emitter to Base Voltage | 8.0 V | 8.0 V | 8.0 V |
| $I_C$ | Collector Current (Continuous) | 50 mA | 50 mA | 50 mA |

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N5961 MIN. | 2N5961 MAX. | 2N5962 MIN. | 2N5962 MAX. | 2N5963 MIN. | 2N5963 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 100 | | 450 | | 900 | | | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V |
| | | 120 | | 500 | | 1000 | | | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V |
| | | 135 | | 550 | | 1200 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V |
| $h_{FE}$ | DC Pulse Current Gain Note 5) | 150 | 700 | 600 | 1400 | 1200 | 2200 | | $I_C$ = 10 mA, $V_{CE}$ = 5.0 V |
| NF | Narrow Band Noise Figure | | 6.0 | | 6.0 | | 6.0 | dB | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V, $R_S$ = 1.0 kΩ, BW = 400 Hz, f = 1.0 kHz |
| | | | | | 4.0 | | 3.0 | dB | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V, $R_S$ = 10 kΩ, BW = 400 Hz, f = 1.0 kHz |
| | | | | | 8.0 | | 6.0 | dB | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V, $R_S$ = 100 kΩ, BW = 400 Hz, f = 1.0 kHz |
| | | | 3.0 | | 3.0 | | 3.0 | dB | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V, $R_S$ = 10 kΩ, BW = 400 Hz, f = 1.0 kHz |
| | | | | | | | 8.0 | dB | $I_C$ = 100 μA, $V_{CE}$ = 5.0 V, $R_S$ = 1.0 kΩ, BW = 10 Hz, f = 10 Hz |
| NF | Wide Band Noise Figure | | 3.0 | | 3.0 | | 3.0 | dB | $I_C$ = 10 μA, $V_{CE}$ = 5.0 V, $R_S$ = 1.0 kΩ, BW = 15.7 kHz, f = 10 Hz to 10 kHz |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

†Fairchild exceeds JEDEC registered values.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Section 5-SS8.

**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd.)

| SYMBOL | CHARACTERISTIC | 2N5961 MIN. | 2N5961 MAX. | 2N5962 MIN. | 2N5962 MAX. | 2N5963 MIN. | 2N5963 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $I_{CBO}$ | Collector Cutoff Current | | 2.0 | | | | | nA | $I_E = 0, V_{CB} = 45$ V |
| | | | | | 2.0 | | | nA | $I_E = 0, V_{CB} = 30$ V |
| | | | | | | | 2.0 | nA | $I_E = 0, V_{CB} = 20$ V |
| | | | 50 | | | | | nA | $I_E = 0, V_{CB} = 45$ V, $T_A = 65°C$ |
| | | | | | 50 | | | nA | $I_E = 0, V_{CB} = 30$ V, $T_A = 65°C$ |
| | | | | | | | 50 | nA | $I_E = 0, V_{CB} = 20$ V, $T_A = 65°C$ |
| $I_{EBO}$ | Emitter Cutoff Current | | 1.0 | | 1.0 | | 1.0 | nA | $I_C = 0, V_{EB} = 5.0$ V |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | 60 | | 45 | | 30 | | V | $I_C = 5.0$ mA, $I_B = 0$ |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 60 | | 45 | | 30 | | V | $I_C = 10\ \mu A, I_E = 0$ |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 8.0 | | 8.0 | | 8.0 | | V | $I_E = 10\ \mu A, I_C = 0$ |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 5) | | 0.2 | | 0.2 | | 0.2 | V | $I_C = 10$ mA, $I_B = 0.5$ mA |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage | 0.5 | 0.7 | 0.5 | 0.7 | 0.5 | 0.7 | V | $I_C = 1.0$ mA, $V_{CE} = 5.0$ V |
| $\|h_{fe}\|$ | Magnitude of Common Emitter Small Signal Current Gain | 1.0 | | 1.0 | | 1.5 | | | $I_C = 10$ mA, $V_{CE} = 5.0$ V, f = 100 MHz |
| $C_{cb}$ | Collector to Base Capacitance | | 4.0 | | 4.0 | | 4.0 | pF | $V_{CB} = 5.0$ V, $I_E = 0$ |
| $C_{eb}$ | Emitter to Base Capacitance | | 6.0 | | 6.0 | | 6.0 | pF | $V_{EB} = 0.5$ V, $I_C = 0$ |
| $h_{fe}$ | Small Signal Current Gain | 150 | 1000 | 600 | 2000 | 1200 | 3000 | | $I_C = 10$ mA, $V_{CE} = 5.0$ V, f = 1.0 kHz |

4

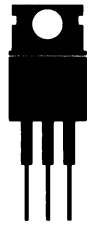
# 2N6121 • 2N6122 • 2N6123

## 40 WATT NPN SILICON POWER

MOLDED PLASTIC DIFFUSED SILICON BI-MESAR™ TRANSISTORS

- $P_D$ . . . 40 W
- $V_{CE(sat)}$ . . . 0.6 V (MAX) @ $I_C$ = 1.5 A
- $h_{FE}$ . . . 25-100 @ $I_C$ = 1.5 A (2N6121, 2N6122), 20-80 @ $I_C$ = 1.5 A (2N6123)
- PNP COMPLEMENTS . . . 2N6124, 2N6125, 2N6126

See TO220-00 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Maximum Temperatures**

| | |
|---|---|
| Storage Temperature | −65°C to +150°C |
| Operating Junction Temperature | 150°C |
| Lead Temperature (10 seconds) | 235°C |

**Maximum Power Dissipation**

| | |
|---|---|
| Total Power Dissipation at 25°C Case Temperature (Note 3) | 40 W |
| Linear Derating Factor | 320 mW/°C |

| **Maximum Voltages and Currents** | | **2N6121** | **2N6122** | **2N6123** |
|---|---|---|---|---|
| $V_{CEO}$ | Collector to Emitter Voltage | 45 V | 60 V | 80 V |
| $V_{CBO}$ | Collector to Base Voltage | 45 V | 60 V | 80 V |
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V | 5.0 V | 5.0 V |
| $I_C$ | Collector Current (Continuous) | 4.0 A | 4.0 A | 4.0 A |
| $I_B$ | Base Current | 1.0 A | 1.0 A | 1.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| $V_{CEO(sus)}$ | Collector Sustaining Voltage | 2N6121 | 45 | | V | $I_C$ = 100 mA, $I_B$ = 0 |
| | (Note 2) | 2N6122 | 60 | | V | $I_C$ = 100 mA, $I_B$ = 0 |
| | | 2N6123 | 80 | | V | $I_C$ = 100 mA, $I_B$ = 0 |
| $h_{FE}$ | DC Pulse Current Gain | 2N6121 | 25 | 100 | | $I_C$ = 1.5 A, $V_{CE}$ = 2.0 V |
| | | 2N6122 | 25 | 100 | | $I_C$ = 1.5 A, $V_{CE}$ = 2.0 V |
| | | 2N6123 | 20 | 80 | | $I_C$ = 1.5 A, $V_{CE}$ = 2.0 V |
| | | 2N6121 | 10 | | | $I_C$ = 4.0 A, $V_{CE}$ = 2.0 V |
| | | 2N6122 | 10 | | | $I_C$ = 4.0 A, $V_{CE}$ = 2.0 V |
| | | 2N6123 | 7.0 | | | $I_C$ = 4.0 A, $V_{CE}$ = 2.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage | | | 0.6 | V | $I_C$ = 1.5 A, $I_B$ = 0.15 A |
| | (Note 2) | | | 1.4 | V | $I_C$ = 4.0 A, $I_B$ = 1.0 A |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 2) | | | 1.2 | V | $I_C$ = 1.5 A, $V_{CE}$ = 2.0 V |
| $I_{CEO}$ | Collector Cutoff Current | | | 1.0 | mA | $V_{CE}$ = $V_{CEO}$, $I_B$ = 0 |
| $I_{CEX}$ | Collector Cutoff Current | | | 0.1 | mA | $V_{CE}$ = $V_{CEO}$, $V_{EB}$ = 1.5 V |
| $I_{CEX}$ | Collector Cutoff Current | | | 2.0 | mA | $V_{CE}$ = $V_{CEO}$, $V_{EB}$ = 1.5 V, $T_C$ = 125°C |
| $I_{CBO}$ | Collector Cutoff Current | | | 0.1 | mA | $V_{CB}$ = $V_{CEO}$, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | | 1.0 | mA | $V_{EB}$ = 5.0 V, $I_C$ = 0 |
| $\|h_{fe}\|$ | Magnitude of Common Emitter Small Signal Current Gain | | 2.5 | | | $I_C$ = 1.0 A, $V_{CE}$ = 4.0 V, f = 1.0 MHz |
| $h_{fe}$ | Small Signal Current Gain | | 25 | | | $I_C$ = 0.1 A, $V_{CE}$ = 2.0 V, f = 1.0 kHz |

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any individual device may be impaired.
2. Pulse conditions: length = 300 μs, duty cycle = 2%.
3. For product family characteristic curves, refer to Section 5-PWR5.

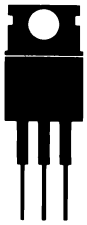
# 2N6124 • 2N6125 • 2N6126

## 40 WATT PNP POWER

MOLDED PLASTIC DIFFUSED SILICON BI-MESAR™ TRANSISTORS

- $P_D$ . . . 40 W
- $V_{CE(sat)}$ . . . −0.6 V (MAX) @ $I_C$ = 1.5 A
- $h_{FE}$ . . . 25-100 @ $I_C$ = 1.5 A (2N6124, 2N6125), 20-80 @ $I_C$ = 1.5 A (2N6126)
- NPN COMPLEMENTS . . . 2N6121, 2N6122, 2N6123

See TO220-00 Package Outline



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**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | |
|---|---|
| **Maximum Temperatures** | |
| Storage Temperature | −65°C to +150°C |
| Operating Junction Temperature | 150°C |
| Lead Temperature (10 seconds) | 235°C |
| **Maximum Power Dissipation** | |
| Total Dissipation at 25°C Case Temperature (Note 3) | 40 W |
| Linear Derating Factor | 320 mW/°C |

| **Maximum Voltages and Currents** | | **2N6124** | **2N6125** | **2N6126** |
|---|---|---|---|---|
| $V_{CEO}$ | Collector to Emitter Voltage | −45 V | −60 V | −80 V |
| $V_{CBO}$ | Collector to Base Voltage | −45 V | −60 V | −80 V |
| $V_{EBO}$ | Emitter to Base Voltage | −5.0 V | −5.0 V | −5.0 V |
| $I_C$ | Collector Current (Continuous) | 4.0 A | 4.0 A | 4.0 A |
| $I_B$ | Base Current | 1.0 A | 1.0 A | 1.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| $V_{CEO(sus)}$ | Collector Sustaining Voltage | 2N6124 | −45 | | V | $I_C$ = 100 mA, $I_B$ = 0 |
| | (Note 2) | 2N6125 | −60 | | V | $I_C$ = 100 mA, $I_B$ = 0 |
| | | 2N6126 | −80 | | V | $I_C$ = 100 mA, $I_B$ = 0 |
| $h_{FE}$ | DC Pulse Current Gain | 2N6124 | 25 | 100 | | $I_C$ = 1.5 A, $V_{CE}$ = −2.0 V |
| | (Note 2) | 2N6125 | 25 | 100 | | $I_C$ = 1.5 A, $V_{CE}$ = −2.0 V |
| | | 2N6126 | 20 | 80 | | $I_C$ = 1.5 A, $V_{CE}$ = −2.0 V |
| | | 2N6124 | 10 | | | $I_C$ = 4.0 A, $V_{CE}$ = −2.0 V |
| | | 2N6125 | 10 | | | $I_C$ = 4.0 A, $V_{CE}$ = −2.0 V |
| | | 2N6126 | 7.0 | | | $I_C$ = 4.0 A, $V_{CE}$ = −2.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage | | | −0.6 | V | $I_C$ = 1.5 A, $I_B$ = 0.15 A |
| | (Note 2) | | | −1.4 | V | $I_C$ = 4.0 A, $I_B$ = 1.0 A |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 2) | | | −1.2 | V | $I_C$ = 1.5 A, $V_{CE}$ = −2.0 V |
| $I_{CEO}$ | Collector Cutoff Current | | | 1.0 | mA | $V_{CE}$ = $V_{CEO}$, $I_B$ = 0 |
| $I_{CEX}$ | Collector Cutoff Current | | | 0.1 | mA | $V_{CE}$ = $V_{CEO}$, $V_{EB}$ = −1.5 V |
| $I_{CEX}$ | Collector Cutoff Current | | | 2.0 | mA | $V_{CE}$ = $V_{CEO}$, $V_{EB}$ = −1.5 V, $T_C$ = 125°C |
| $I_{CBO}$ | Collector Cutoff Current | | | 0.1 | mA | $V_{CB}$ = $V_{CEO}$, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | | 1.0 | mA | $V_{EB}$ = −5.0 V, $I_C$ = 0 |
| $\|h_{fe}\|$ | Magnitude of Common Emitter Small Signal Current Gain | | 2.5 | | | $I_C$ = 1.0 A, $V_{CE}$ = −4.0 V, f = 1.0 MHz |
| $h_{fe}$ | Small Signal Current Gain | | 25 | | | $I_C$ = 0.1 A, $V_{CE}$ = −2.0 V, f = 1.0 kHz |

NOTES:
1. These ratings are limiting values above which the serviceability of any individual device may be impaired.
2. Pulse conditions: length = 300 μs, duty cycle = 2%.
3. For product family characteristic curves, refer to Section 5-PWR14.

4

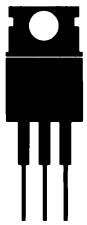
# 2N6129 • 2N6130 • 2N6131

## 50 WATT NPN SILICON POWER

DIFFUSED SILICON BI-MESAR™ TRANSISTORS

- $P_D$ . . . 50 W
- $h_{FE}$ . . . 20-100 @ $I_C$ = 2.5 A
- COMPLEMENTS . . . 2N6132 THROUGH 2N6134

See TO220-00 Package Outline



B C E
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**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | | | |
|---|---|---|---|---|
| **Maximum Temperatures** | | | | |
| Storage Temperature | | | | −65°C to 150°C |
| Operating Junction Temperature | | | | 150°C |
| Lead Temperature (10 seconds) | | | | 235°C |
| **Maximum Power Dissipation** (Note 2) | | | | |
| Total Power Dissipation at $T_C$ = 25°C | | | | 50 W |
| Linear Derating Factor | | | | 0.4 W/°C |
| **Maximum Voltages and Currents** | | **2N6129** | **2N6130** | **2N6131** |
| $V_{CEO}$ | Collector to Emitter Voltage | 40 V | 60 V | 80 V |
| $V_{CBO}$ | Collector to Base Voltage | 40 V | 60 V | 80 V |
| $V_{EBO}$ | Emitter to Base Voltage | 5.0 V | 5.0 V | 5.0 V |
| $I_C$ | Collector Current | 7.0 A | 7.0 A | 7.0 A |
| $I_B$ | Base Current | 3.0 A | 3.0 A | 3.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N6129 MIN. | 2N6129 MAX. | 2N6130 MIN. | 2N6130 MAX. | 2N6131 MIN. | 2N6131 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $V_{CEO(sus)}$ | Collector Sustaining Voltage (Note 3) | 40 | | 60 | | 80 | | V | $I_B$ = 0, $I_C$ = 100 mA |
| $h_{FE}$ | DC Current Gain (Note 3) | 7.0 | | 7.0 | | 5.0 | | | $V_{CE}$ = 4.0 V, $I_C$ = 7.0 A |
| | | 20 | 100 | 20 | 100 | 20 | 100 | | $V_{CE}$ = 4.0 V, $I_C$ = 2.5 A |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 3) | | 1.4 | | 1.4 | | 2.0 | V | $I_C$ = 7.0 A, $I_B$ = 3.0 A |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 3) | | 2.0 | | 2.0 | | 2.0 | V | $I_C$ = 2.5 A, $V_{CE}$ = 4.0 V |
| $\|h_{fe}\|$ | Magnitude of Common Emitter Small Signal Current Gain | 2.5 | | 2.5 | | 2.5 | | | $V_{CE}$ = 4.0 V, $I_C$ = 1.0 A, f = 1.0 MHz |
| $I_{CEX}$ | Collector Cutoff Current | | 2.0 | | 2.0 | | 2.0 | mA | $V_{CE}$ = Rated $LV_{CEO}$, $V_{EB}$ = 1.5 V, $T_C$ = 125°C |
| | | | 0.2 | | 0.2 | | 0.2 | mA | $V_{CE}$ = Rated $LV_{CEO}$, $V_{EB}$ = 1.5 V |
| $I_{CBO}$ | Collector Cutoff Current, Emitter Open | | 0.1 | | 0.1 | | 0.1 | mA | $V_{CB}$ = Rated $LV_{CEO}$, $I_E$ = 0 |
| $I_{EBO}$ | Emitter Cutoff Current | | 1.0 | | 1.0 | | 1.0 | mA | $V_{EB}$ = 5.0 V |
| $I_{CEO}$ | Collector Cutoff Current, Base Open | | 2.0 | | 2.0 | | 2.0 | mA | $V_{CE}$ = Rated $LV_{CEO}$, $I_B$ = 0 |
| $h_{fe}$ | Small Signal Current Gain | 25 | | 25 | | 25 | | | $I_C$ = 0.1 A, $V_{CE}$ = 4.0 V, f = 1.0 kHz |

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 2.5°C/W (derating factor of 400 mW/°C).
3. Pulse conditions: length = 300 μs; duty cycle = 1%.
4. For product family characteristic curves, refer to Section 5 — PWR10.

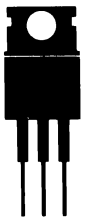
# 2N6132 • 2N6133 • 2N6134

## 50 WATT PNP SILICON POWER

DIFFUSED BI-MESAR™ TRANSISTORS

- $P_D$ . . . 50 W
- $h_{FE}$ . . . 20-100 @ $I_C$ = 2.5 A
- COMPLEMENTS 2N6129 THROUGH 2N6131

See TO220-00 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | 2N6132 | 2N6133 | 2N6134 |
|---|---|---|---|---|
| **Maximum Temperatures** | | | | |
| Storage Temperature | | | | −65°C to +150°C |
| Operating Junction Temperature | | | | 150°C |
| Lead Temperature, (10 seconds) | | | | 235°C |
| **Maximum Power Dissipation** (Note 2) | | | | |
| Total Power Dissipation at $T_C$ = 25°C | | | | 50 W |
| Linear Derating Factor | | | | 0.4 W/°C |
| **Maximum Voltage and Currents** | | **2N6132** | **2N6133** | **2N6134** |
| $V_{CEO}$ | Collector to Emitter Voltage | −40 V | −60 V | −80 V |
| $V_{CBO}$ | Collector to Base Voltage | −40 V | −60 V | −80 V |
| $V_{EBO}$ | Emitter to Base Voltage | −5.0 V | −5.0 V | −5.0 V |
| $I_C$ | Collector Current | 7.0 A | 7.0 A | 7.0 A |
| $I_B$ | Base Current | 3.0 A | 3.0 A | 3.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N6132 MIN. | 2N6132 MAX. | 2N6133 MIN. | 2N6133 MAX. | 2N6134 MIN. | 2N6134 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $V_{CEO(sus)}$ | Collector Sustaining Voltage (Note 3) | −40 | | −60 | | −80 | | V | $I_B$ = 0, $I_C$ = 100 mA |
| $h_{FE}$ | DC Current Gain (Note 3) | 7.0 | | 7.0 | | 5.0 | | | $V_{CE}$ = −4.0 V, $I_C$ = 7.0 A |
| | | 20 | 100 | 20 | 100 | 20 | 100 | | $V_{CE}$ = −4.0V, $I_C$ = 2.5 A |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 3) | | −1.4 | | −1.4 | | −1.8 | V | $I_C$ = 7.0 A, $I_B$ = 3.0 A |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 3) | | −2.0 | | −2.0 | | −2.0 | V | $I_C$ = 2.5 A, $V_{CE}$ = −4.0 V |
| $\|h_{fe}\|$ | Magnitude of Common Emitter Small Signal Current Gain | 2.5 | | 2.5 | | 2.5 | | | $V_{CE}$ = −4.0 V, $I_C$ = 1.0 A, f = 1.0 MHz |
| $I_{CEX}$ | Collector Cutoff Current | | 2.0 | | 2.0 | | 2.0 | mA | $V_{CE}$ = Rated $LV_{CFO}$, $V_{EB}$ = −1.5V, $T_C$ = 125°C |
| | | | 0.2 | | 0.2 | | 0.2 | mA | $V_{CE}$ = Rated $LV_{CEO}$, $V_{EB}$ = −1.5V, |
| $I_{EBO}$ | Emitter Cutoff Current | | 1.0 | | 1.0 | | 1.0 | mA | $V_{EB}$ = −5.0 V |
| $I_{CBO}$ | Collector Cutoff Current, Emitter Open | | 0.5 | | 0.5 | | 0.5 | mA | $V_{CB}$ = Rated $LV_{CEO}$, $I_E$ = 0 |
| $I_{CEO}$ | Collector Cutoff Current, Base Open | | 2.0 | | 2.0 | | 2.0 | mA | $V_{CE}$ = Rated $LV_{CEO}$, $I_B$ = 0 |
| $h_{fe}$ | Small Signal Current Gain | 25 | | 25 | | 25 | | | $V_{CE}$ = −4.0 V, $I_C$ = 0.1 A, f = 1.0 kHz |

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 2.5°C/W. (Derating factor of 400 mW/°C).
3. Pulse conditions: length = 300 μs; duty cycle = 1%.
4. For product family characteristic curves, refer to Section 5 — PWR 17.

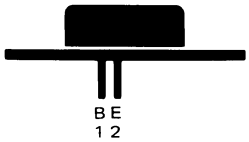
# 2N6233 • 2N6234 • 2N6235 • SE9051 • SE9052

## NPN SILICON POWER

DIFFUSED SILICON PLANAR* TRANSISTORS

- $f_T$ . . . 20 MHz (MIN)
- $P_D$ . . . 50 W
- $h_{FE}$ . . . 25-125 @ $I_C$ = 1.0 A

See TO66-1 Package Outline




**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | | | | | |
|---|---|---|---|---|---|---|
| **Maximum Temperatures** | | | | | | |
| Storage Temperature | | | | | | −65°C to 200°C |
| Operating Junction Temperature | | | | | | 200°C |
| Lead Temperature (Soldering 10 seconds) | | | | | | 260°C |
| **Maximum Power Dissipation** | | | | | | |
| Total Dissipation at 25°C Case Temperature | | | | | | 50 W |
| Linear Derating Factor | | | | | | 0.286 W/°C |
| **Maximum Voltages and Currents** | | **2N6233** | **2N6234** | **2N6235** | **SE9051** | **SE9052** |
| $V_{CBO}$ | Collector to Base Voltage | 250 V | 300 V | 350 V | 300 V | 325 V |
| $V_{CEO}$ | Collector to Emitter Voltage | 225 V | 275 V | 325 V | 275 V | 325 V |
| $V_{EBO}$ | Emitter to Base Voltage | 6.0 V | 6.0 V | 6.0 V | 4.0 V | 4.0 V |
| $I_C$ | Collector Current (Peak) | 10 A | 10 A | 10 A | 10 A | 10 A |
| $I_B$ | Base Current | 2.0 A | 2.0 A | 2.0 A | 2.0 A | 2.0 A |

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted)

| SYMBOL | CHARACTERISTIC | 2N6233 MIN. | 2N6233 MAX. | 2N6234 MIN. | 2N6234 MAX. | 2N6235 MIN. | 2N6235 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $V_{CEO}$ | Collector Sustaining Voltage (Note 2) | 225 | | 275 | | 325 | | V | $I_B$ = 0, $I_C$ = 20 mA |
| $h_{FE}$ | DC Current Gain (Note 2) | 25 | | 25 | | 25 | | | $V_{CE}$ = 5.0 V, $I_C$ = 0.1 A |
| | | 15 | 125 | 25 | 125 | 25 | 125 | | $V_{CE}$ = 5.0 V, $I_C$ = 1.0 A |
| | | 10 | | 10 | | 10 | | | $V_{CE}$ = 5.0 V, $I_C$ = 3.0 A |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 2) | | 2.5 | | 2.5 | | 2.5 | V | $I_C$ = 5.0 A, $I_B$ = 1.0 A |
| | | | 0.5 | | 0.5 | | 0.5 | V | $I_C$ = 1.0 A, $I_B$ = 0.1 A |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 2) | | 2.0 | | 2.0 | | 2.0 | V | $I_C$ = 5.0 A, $I_B$ = 1.0 A |
| | | | 1.0 | | 1.0 | | 1.0 | V | $I_C$ = 1.0 A, $I_B$ = 0.1 A |
| $V_{BE(ON)}$ | Base to Emitter "On" Voltage (Note 2) | | 1.0 | | 1.0 | | 1.0 | V | $I_C$ = 1.0 A, $V_{CE}$ = 5.0 V |
| $\|h_{fe}\|$ | Magnitude of Common Emitter Short Circuit Small Signal Current Gain | 2.0 | | 2.0 | | 2.0 | | | $V_{CE}$ = 10 V, $I_C$ = 0.25 A, f = 10 MHz |
| $I_{CEX}$ | Collector Cutoff Current (Note 3) | | 1.0 | | | | | mA | $V_{CE}$ = 250 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| | | | | | 1.0 | | | mA | $V_{CE}$ = 300 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |
| | | | | | | | 1.0 | mA | $V_{CE}$ = 350 V, $V_{EB}$ = 1.5 V, $T_C$ = 150°C |

Additional Electrical Characteristics on following page.

*Planar is a patented Fairchild process.

NOTES:
1. These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.
2. Pulse conditions: length = 300 μs; duty cycle ≤ 10%.
3. Emitter diode is reversed biased.
4. For product family characteristic curves refer to Section 5—PWR 9.

**ELECTRICAL CHARACTERISTICS** (25°C Case Temperature unless otherwise noted) (Cont'd)

| SYMBOL | CHARACTERISTIC | 2N6233 MIN. | 2N6233 MAX. | 2N6234 MIN. | 2N6234 MAX. | 2N6235 MIN. | 2N6235 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|---|---|
| $I_{EBO}$ | Emitter Cutoff Current | | 0.1 | | 0.1 | | 0.1 | mA | $V_{EB}$ = 6.0 V |
| $I_{CBO}$ | Collector Cutoff Current, Emitter Open | | 0.1 | | | | | mA | $V_{CB}$ = 250 V, $I_E$ = 0 |
| | | | | | 0.1 | | | mA | $V_{CB}$ = 300 V, $I_E$ = 0 |
| | | | | | | | 0.1 | mA | $V_{CB}$ = 350 V, $I_E$ = 0 |
| $I_{CEO}$ | Collector Cutoff Current, Base Open | | 1.0 | | | | | mA | $V_{CE}$ = 225 V, $I_B$ = 0 |
| | | | | | 1.0 | | | mA | $V_{CE}$ = 275 V, $I_B$ = 0 |
| | | | | | | | 1.0 | mA | $V_{CE}$ = 325 V, $I_B$ = 0 |
| $t_r$ | Rise Time | | 500 | | 500 | | 500 | ns | $V_{CC}$ = 200 V, $I_C$ = 1.0 A, $I_{B1}$ = 0.1 A |
| $t_f$ | Fall Time | | 500 | | 500 | | 500 | ns | $V_{CC}$ = 200 V, $I_C$ = 1.0 A $I_{B1}$ = $I_{B2}$ = 0.1 A |
| $t_s$ | Storage Time | | 3.5 | | 3.5 | | 3.5 | μs | $V_{CC}$ = 200 V, $I_C$ = 1.0 A $I_{B1}$ = $I_{B2}$ = 0.1 A |
| $C_{ob}$ | Output Capacitance | | 250 | | 250 | | 250 | pF | $V_{CB}$ = 10 V, f = 0.1 MHz |

| SYMBOL | CHARACTERISTIC | SE9051 MIN. | SE9051 MAX. | SE9052 MIN. | SE9052 MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|---|
| $I_{CEX}$ | Collector Cutoff Current (Note 3) | | 500 | | 500 | μA | $V_{CE}$ = 250 V, $V_{EB}$ = 0.5 V, $T_C$ = 150°C |
| | | | 15 | | 15 | μA | $V_{CE}$ = 250 V, $V_{EB}$ = 0.5 V |
| $I_{EBO}$ | Emitter Cutoff Current | | 10 | | 10 | μA | $V_{EB}$ = 4.0 V |
| $I_{CBO}$ | Collector Cutoff Current | | 100 | | | μA | $V_{CB}$ = 300 V, $I_B$ = 0 |
| | | | | | 100 | μA | $V_{CB}$ = 325 V, $I_B$ = 0 |
| $V_{CEO(sus)}$ | Collector Sustaining Voltage (Note 2) | 275 | | 325 | | V | $I_B$ = 0, $I_C$ = 100 mA |
| $h_{FE}$ | DC Current Gain (Note 2) | 20 | 100 | 20 | 100 | | $I_C$ = 1.0 A, $V_{CE}$ = 4.0 V |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 2) | | 0.4 | | 0.4 | V | $I_C$ = 1.2 A, $I_B$ = 200 mA |
| | | | 1.0 | | 1.0 | V | $I_C$ = 5.0 A, $I_B$ = 1.0 A |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 2) | | 1.6 | | 1.6 | V | $I_C$ = 5.0 A, $I_B$ = 1.0 A |
| $t_{on}$ | Turn On Time | | 300 | | 300 | ns | $V_{CC}$ = 250 V, $I_C$ = 1.2 A, $I_{B1}$ = 0.2 A |
| $t_f$ | Fall Time | | 500 | | 500 | ns | $V_{CC}$ = 250 V, $I_C$ = 1.2 A, $I_{B1}$ = $I_{B2}$ = 0.2 A |
| $t_s$ | Storage Time | | 5.0 | | 5.0 | μs | $V_{CC}$ = 250 V, $I_C$ = 1.2 A, $I_{B1}$ = $I_{B2}$ = 0.2 A |
| $f_T$ | Current Gain Bandwidth Product | 20 | | 20 | | MHz | $V_{CE}$ = 10 V, $I_C$ = 500 mA, f = 5.0 MHz |
| $C_{ob}$ | Output Capacitance | | 250 | | 250 | pF | $V_{CB}$ = 10 V, f = 0.1 MHz |

# DISCRETE PRODUCTS

## CONTENTS AND SECTION SELECTOR

# INTRODUCTION

## CURVES

The family characterization data in this section is divided into three major categories: Diodes, Power Transistors and Small Signal Transistors. Family curves within each division were arbitrarily assigned set numbers. These are not intended to correlate to the device type numbers.

The table below indicates the device or device series which is most representative of the characterization data.

I. DIODES

| CURVE SET NUMBER | FLATPAK | DIP | DO7 | DO34 | DO35 | DO41 | TO5-18 | ASSEM. |
|---|---|---|---|---|---|---|---|---|
| D1 | | | | | RF400 | | | |
| D2 | | | FJT1100 | | | | FJT2000 | |
| D3 | | | | | | | FCT1021 | |
| D4 | | | 1N3070 | | FDH400 | | | FA2321 |
| D5 | | | 1N485B | | FDH500 | | | FA2330 |
| D6 | | | FD600 | FDN600 | 1N4148 | | | FA2310 |
| D7 | | | 1N4376 | FDN700 | | | | |
| D8 | | | 1N746 | | | | | |
| D10 | | | | | | 1N4001 | | |
| D11 | FSA2500M | FSA2501M | | | | | FSA2502M | |

II. POWER TRANSISTORS

| CURVE SET NUMBER | TO3 | TO5 | TO59 | TO66 | TO220 |
|---|---|---|---|---|---|
| PWR1 | | 2N4895 | | | |
| PWR2 | | 2N5320 | | | |
| PWR3 | | 2N5681 | | | |
| PWR4 | | 2N5336 | | | |
| PWR5 | | 2N4237 | | 2N4231 | 2N6121 |
| PWR6 | 2N3715 | | | | |
| PWR7 | 2N5301 | | | | |
| PWR8 | | 2N3440 | | SE9331 | |
| PWR9 | | | | SE9051 | |
| PWR10 | | | | | 2N6129 |
| PWR11 | | | 2N5003 | | |
| PWR12 | | 2N5322 | | | |
| PWR13 | | 2N5679 | | | |
| PWR14 | | 2N4234 | | 2N4898 | 2N6124 |
| PWR15 | 2N3789 | | | | |
| PWR16 | 2N4398 | | | | |
| PWR17 | | | | | 2N6132 |
| PWR18 | | | | 2N3766 | |
| PWR19 | | | 2N5002 | | |

III. SMALL SIGNAL TRANSISTORS

| CURVE SET NUMBER | TO5 | | | TO18 | | | TO92 | DIP |
|---|---|---|---|---|---|---|---|---|
| | METAL | PLASTIC | DUAL | METAL | PLASTIC | DUAL | | |
| SS1 | | | | | 2N3688 | | PN3688 | |
| SS2 | 2N3137 | | | | 2N3564 | | | |
| SS3 | | | | SE5020 | | | | |
| SS4 | | | | | | | MPSA92 | |
| SS5 | | | | 2N3013 | 2N3646 | | 2N5772 | |
| SS6 | | | | | | | PE5025 | |
| SS7 | 2N5022 | | | | | | | FPQ3467 |
| SS8 | | | 2N2920 | 2N2484 | 2N3565 | 2N2979 | 2N5961 | |
| SS9 | 2N3722 | | | | | | | |
| SS10 | | | | SE5055 | | | | |
| SS11 | SE7055 | | | | | | | |
| SS12 | | | | SE5035 | | | PE5030B | |
| SS13 | 2N3724 | | | 2N4013 | | | 2N5845 | FPQ3724 |
| SS14 | | | | 2N3946 | | | 2N3903 | |
| SS15 | 2N2218 | 2N3643 | 2N3728 | 2N2221 | | | 2N4400 | |
| SS16 | 2N3923 | | | | | | 2N5830 | |
| SS17 | 2N4960 | 2N5856 | | 2N4962 | | | MPSA05 | |
| SS18 | | | | | | | BC317 | |
| SS19 | | | | | | | PE5010 | |
| SS20 | | | | | | | MPSA12 | |
| SS21 | | | | 2N5455 | | | | |
| SS22 | 2N2905 | 2N3644 | 2N4015 | 2N2907 | | | 2N4402 | |
| SS23 | | | | 2N3250A | | | 2N3905 | |
| SS24 | 2N4030 | 2N4354 | | | | | MPSA55 | |
| SS25 | | | | | | | 2N5400 | |
| SS26 | | | | FT0601 | | | | |
| SS27 | | | | 2N918 | 2N3563 | 2N3423 | 2N5770 | |
| SS28 | | | | 2N2369A | 2N4274 | MD2369A | 2N5769 | |
| SS29 | | | | 2N709 | | | | |
| SS30 | | | | 2N2894 | | | | |
| SS31 | | | | 2N4208 | 2N4258 | | 2N5771 | |
| SS32 | | | | 2N2894A | | | | |
| SS33 | | | 2N4020 | 2N3962 | 2N4248 | | 2N5086 | |
| SS34 | | | | | 2N4342 | | | |

# CURVE SET NUMBER D1

## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

### RF400

**FIGURE OF MERIT VERSUS FREQUENCY**

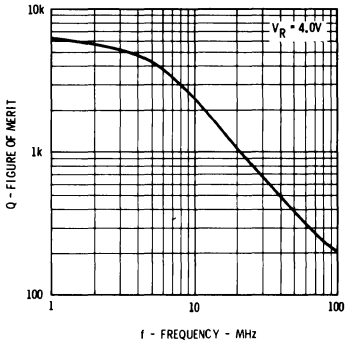
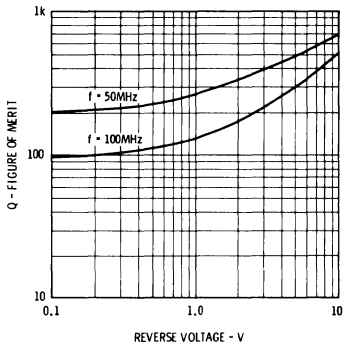
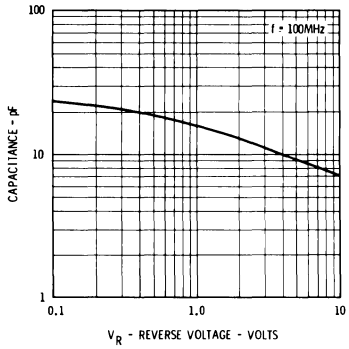



**FIGURE OF MERIT VERSUS REVERSE VOLTAGE**




**CAPACITANCE VERSUS REVERSE VOLTAGE**




### RF401

**FIGURE OF MERIT VERSUS FREQUENCY**

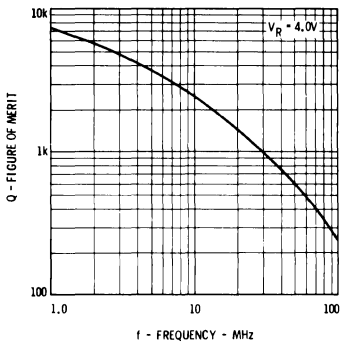
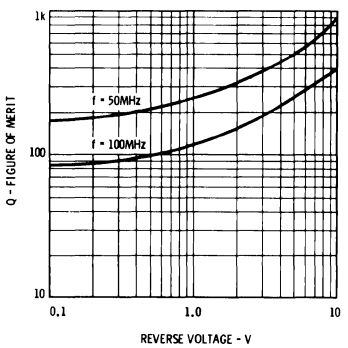
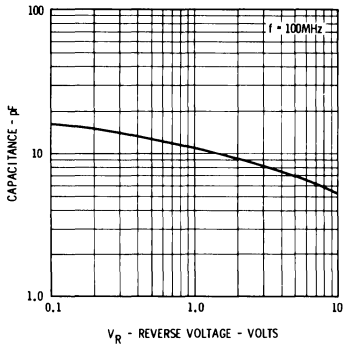


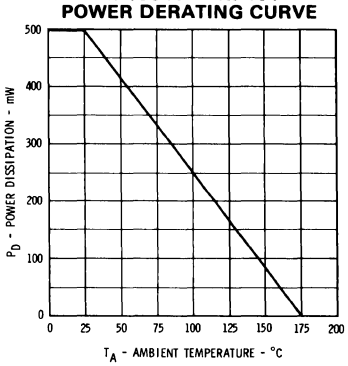

**FIGURE OF MERIT VERSUS REVERSE VOLTAGE**




**CAPACITANCE VERSUS REVERSE VOLTAGE**




**RF400 AND RF401 POWER DERATING CURVE**

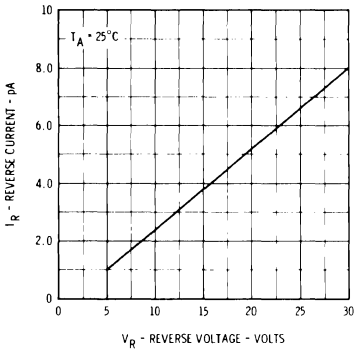


# CURVE SET NUMBER D2

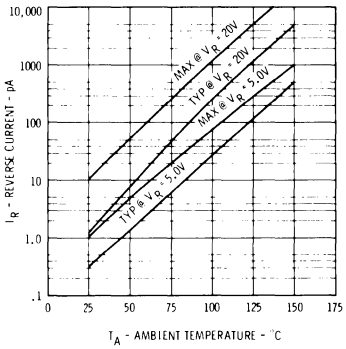
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

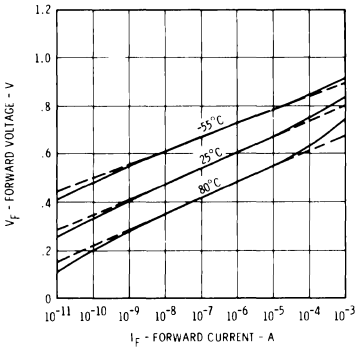
### REVERSE CURRENT VERSUS REVERSE VOLTAGE



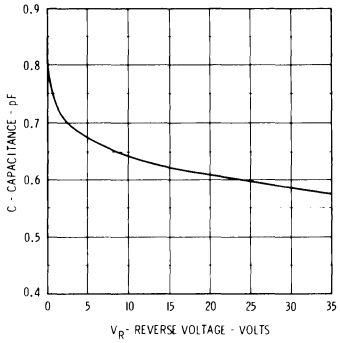

### REVERSE CURRENT VERSUS TEMPERATURE



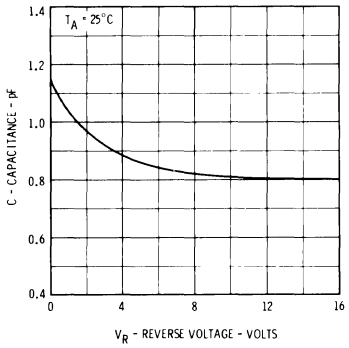

### FORWARD VOLTAGE VERSUS FORWARD CURRENT




### TO72 CAPACITANCE VERSUS REVERSE VOLTAGE



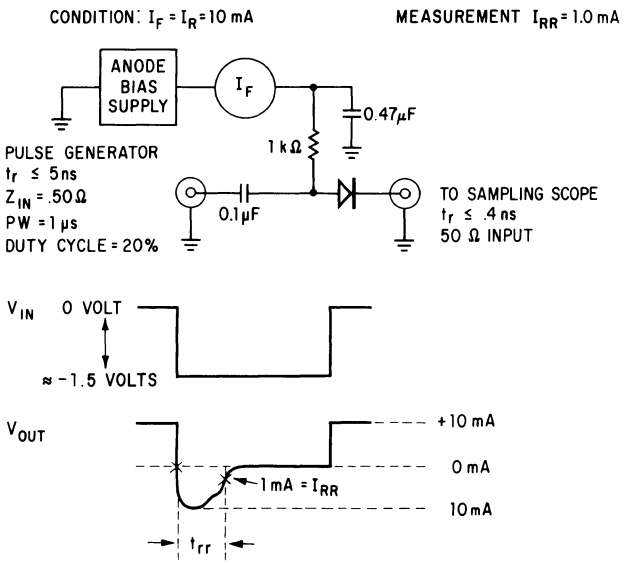

### DO7 CAPACITANCE VERSUS REVERSE VOLTAGE



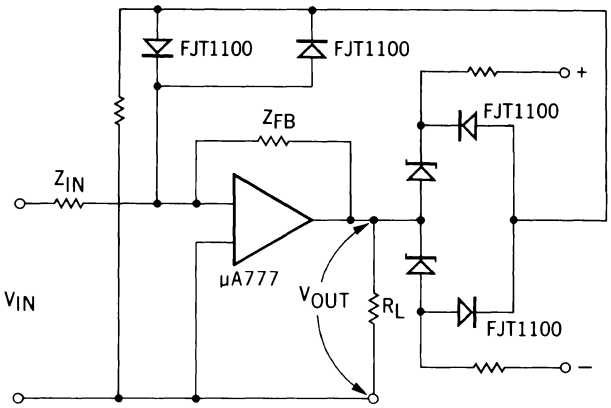

5

# CURVE SET NUMBER D2

### REVERSE RECOVERY TIME ($t_{rr}$) TEST CIRCUIT

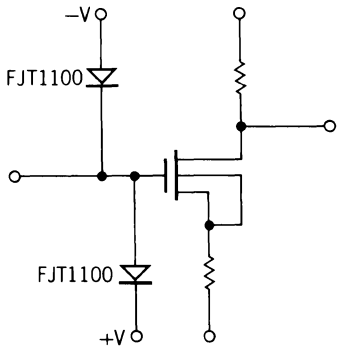



### A BOUND CIRCUIT FOR OPERATIONAL AMPLIFIERS



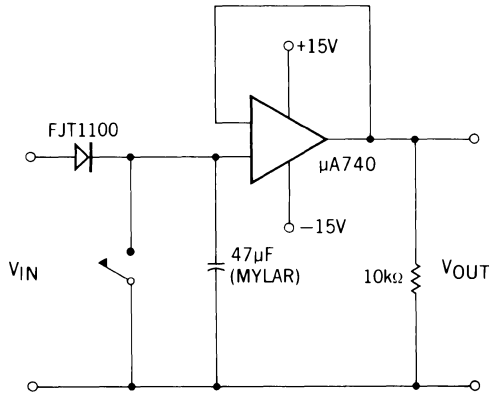

The bound circuit prevents overloading and saturation of operational amplifiers. The circuit has negligible effect on the operational amplifier until overload conditions occur. The use of the low leakage picoampere diode permits realization of extremely high input impedance for normal input voltages.

### MOS FET PROTECTION CIRCUIT

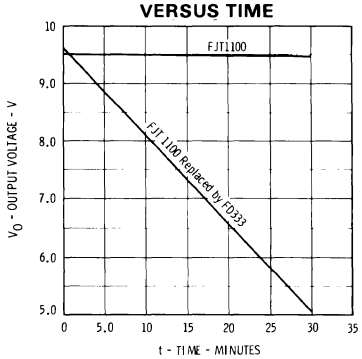



The picoampere diode affords excellent gate voltage protection while maintaining the DC input impedance at about one million megohms. In addition the very low capacity of the FJT1100 will have a relatively small effect on the circuit input capacity.

### PEAK FOLLOWER CIRCUIT




### OUTPUT VOLTAGE OF THE PEAK FOLLOWER CIRCUIT VERSUS TIME



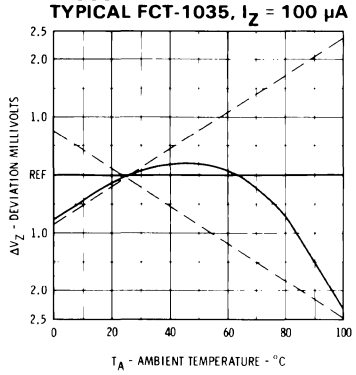

A nearly constant voltage peak follower circuit is available by using a picoampere diode. A comparison between the use of the FJT1100 and a "low leakage" FD333 diode in the circuit is shown in the curves of $V_{OUT}$ vs Time.

# CURVE SET NUMBER D3

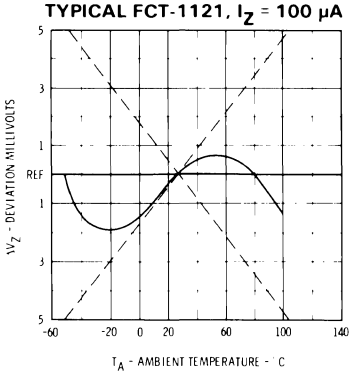
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

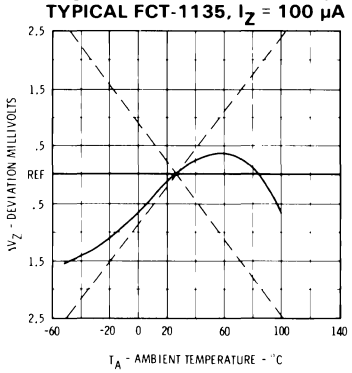
**REFERENCE VOLTAGE DEVIATION VERSUS AMBIENT TEMPERATURE TYPICAL FCT-1035, $I_Z$ = 100 μA**



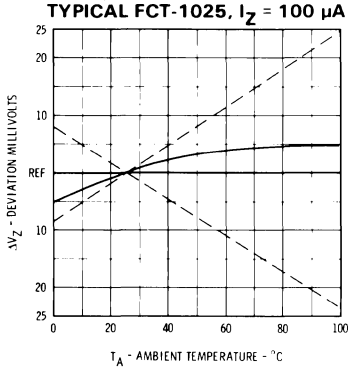

**REFERENCE VOLTAGE DEVIATION VERSUS AMBIENT TEMPERATURE TYPICAL FCT-1121, $I_Z$ = 100 μA**



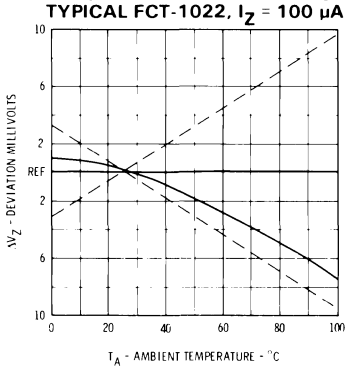

**REFERENCE VOLTAGE DEVIATION VERSUS AMBIENT TEMPERATURE TYPICAL FCT-1135, $I_Z$ = 100 μA**



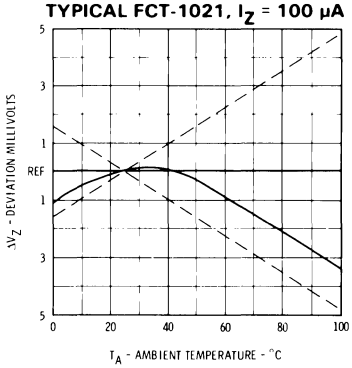

**REFERENCE VOLTAGE DEVIATION VERSUS AMBIENT TEMPERATURE TYPICAL FCT-1025, $I_Z$ = 100 μA**



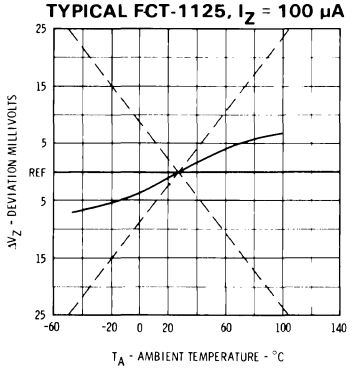

**REFERENCE VOLTAGE DEVIATION VERSUS AMBIENT TEMPERATURE TYPICAL FCT-1022, $I_Z$ = 100 μA**



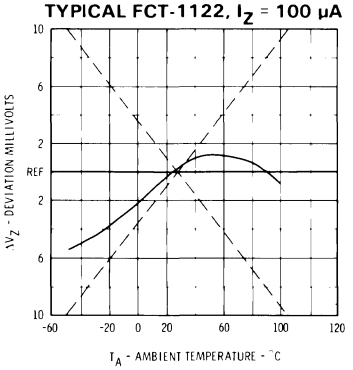

**REFERENCE VOLTAGE DEVIATION VERSUS AMBIENT TEMPERATURE TYPICAL FCT-1021, $I_Z$ = 100 μA**



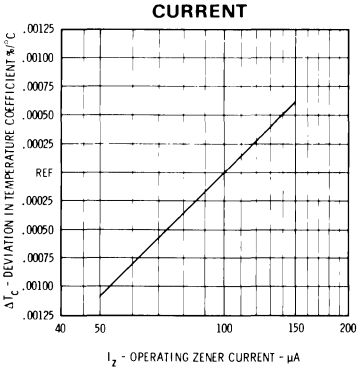

**REFERENCE VOLTAGE DEVIATION VERSUS AMBIENT TEMPERATURE TYPICAL FCT-1125, $I_Z$ = 100 μA**



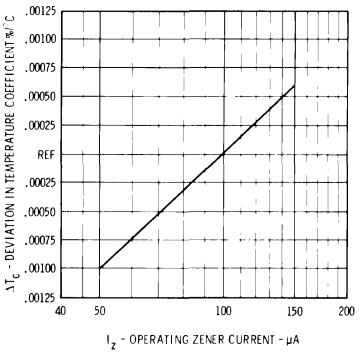

**REFERENCE VOLTAGE DEVIATION VERSUS AMBIENT TEMPERATURE TYPICAL FCT-1122, $I_Z$ = 100 μA**




**TEMPERATURE COEFFICIENT DEVIATION VERSUS OPERATING CURRENT**




**TEMPERATURE COEFFICIENT DEVIATION VERSUS OPERATING CURRENT**



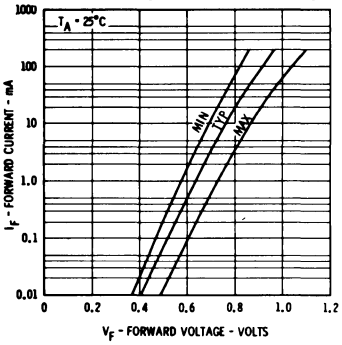

5

# CURVE SET NUMBER D4

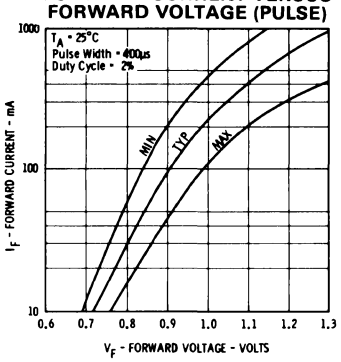
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

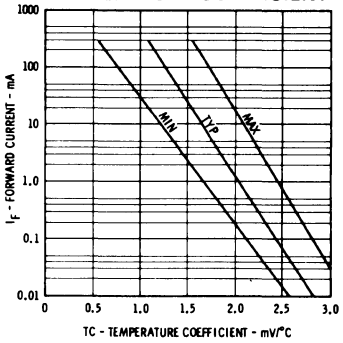
### DC FORWARD CURRENT VERSUS FORWARD VOLTAGE



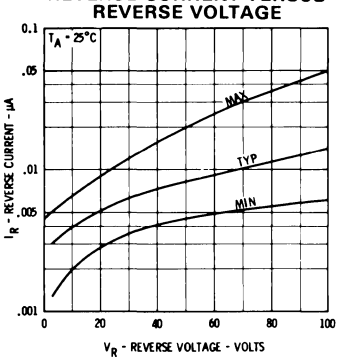

### FORWARD CURRENT VERSUS FORWARD VOLTAGE (PULSE)



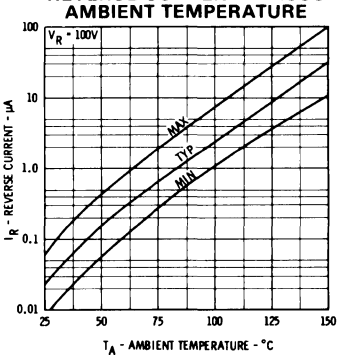

### DC FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



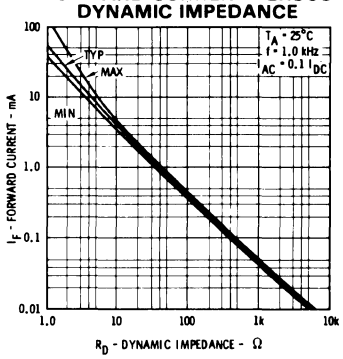

### REVERSE CURRENT VERSUS REVERSE VOLTAGE



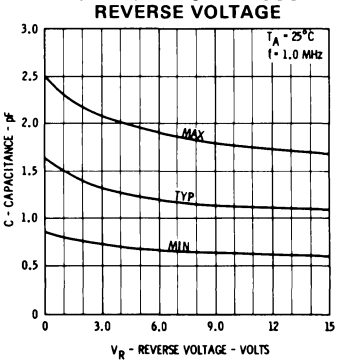

### REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



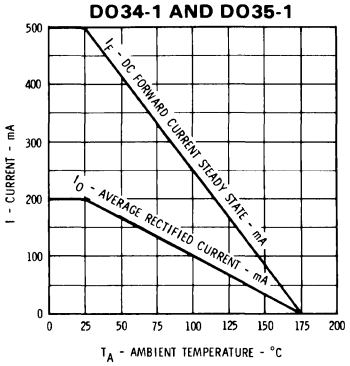

### FORWARD CURRENT VERSUS DYNAMIC IMPEDANCE



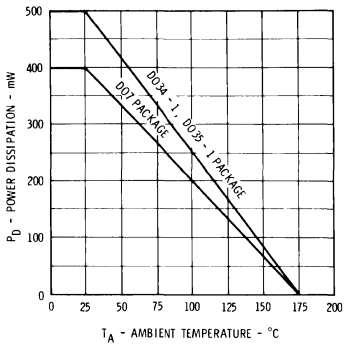

### CAPACITANCE VERSUS REVERSE VOLTAGE



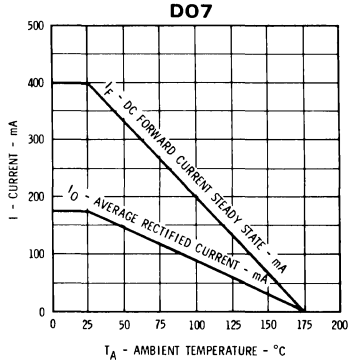

### AVERAGE RECTIFIED CURRENT AND FORWARD CURRENT VERSUS AMBIENT TEMPERATURE DO34-1 AND DO35-1




### POWER DERATING CURVE




### AVERAGE RECTIFIED CURRENT AND FORWARD CURRENT VERSUS AMBIENT TEMPERATURE DO7

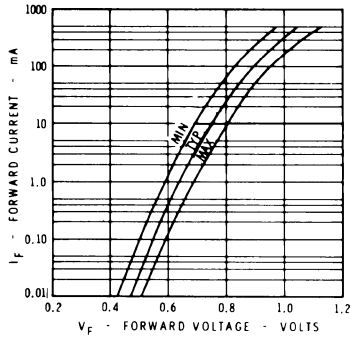


# CURVE SET NUMBER D5

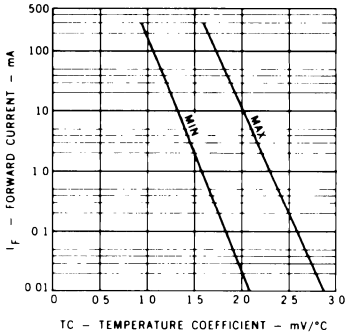
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

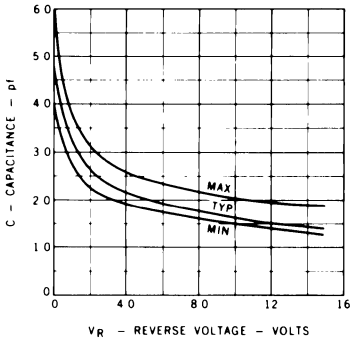
### FORWARD VOLTAGE VERSUS FORWARD CURRENT



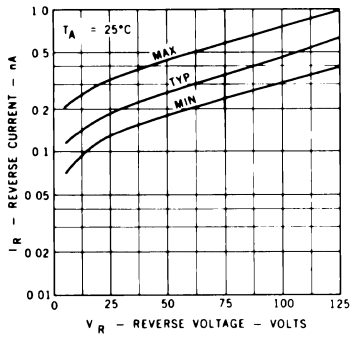

### FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



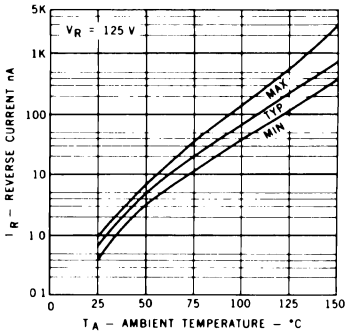

### CAPACITANCE VERSUS REVERSE VOLTAGE



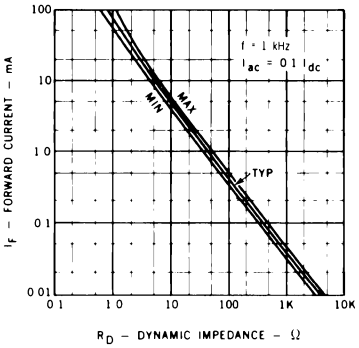

### REVERSE VOLTAGE VERSUS REVERSE CURRENT



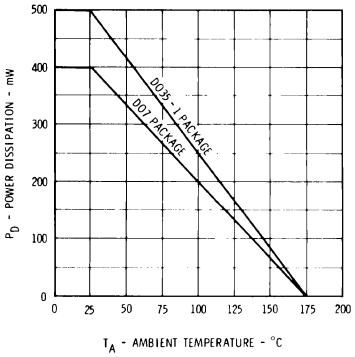

### REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



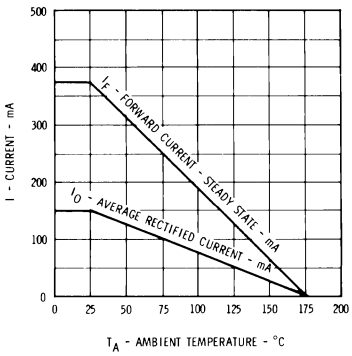

### DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



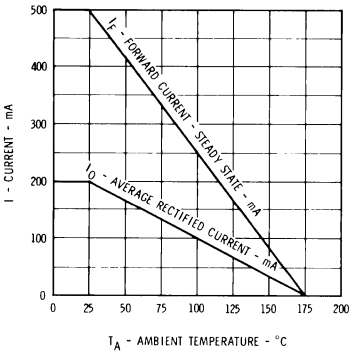

### POWER DERATING CURVE




### AVERAGE RECTIFIED CURRENT AND FORWARD CURRENT VERSUS AMBIENT TEMPERATURE DO7




### AVERAGE RECTIFIED CURRENT AND FORWARD CURRENT VERSUS AMBIENT TEMPERATURE DO35-1



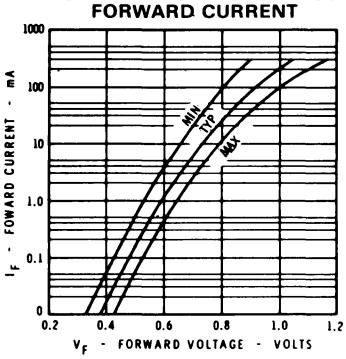

5

# CURVE SET NUMBER D6

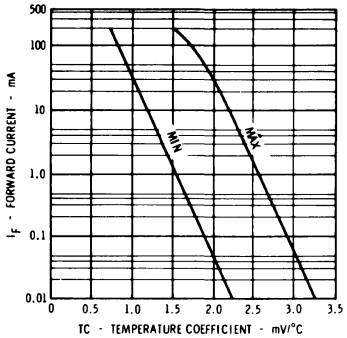
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

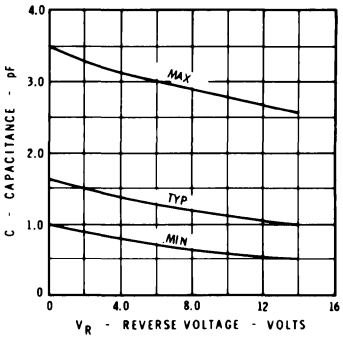
### FORWARD VOLTAGE VERSUS FORWARD CURRENT



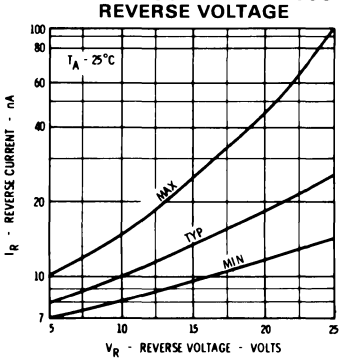

### FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



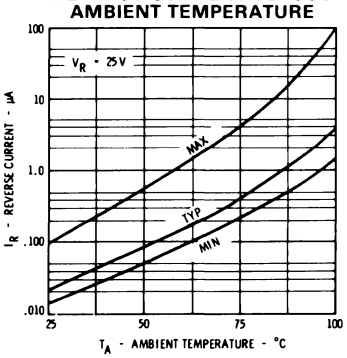

### CAPACITANCE VERSUS REVERSE VOLTAGE



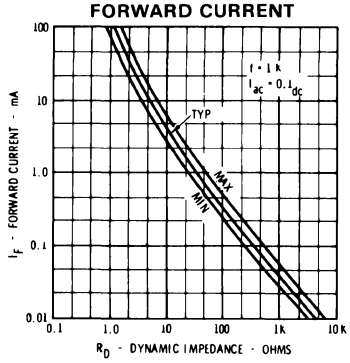

### REVERSE CURRENT VERSUS REVERSE VOLTAGE



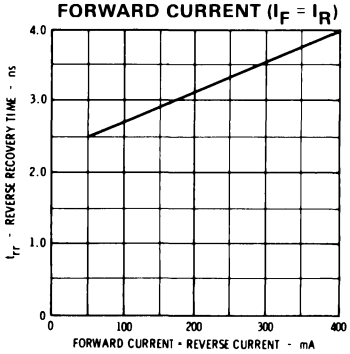

### REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



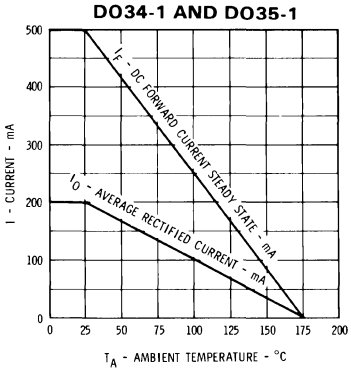

### DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



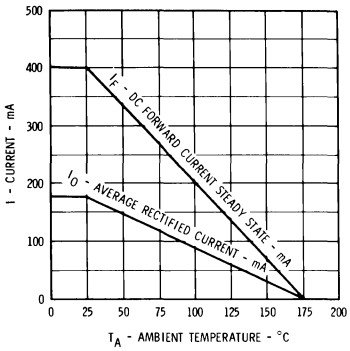

### REVERSE RECOVERY TIME VERSUS FORWARD CURRENT ($I_F = I_R$)



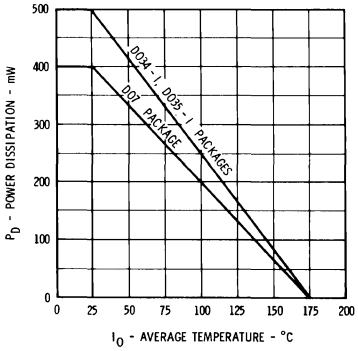

### AVERAGE RECTIFIED CURRENT AND FORWARD CURRENT VERSUS AMBIENT TEMPERATURE DO34-1 AND DO35-1




### AVERAGE RECTIFIED CURRENT AND FORWARD CURRENT VERSUS AMBIENT TEMPERATURE DO7




### POWER DERATING CURVE

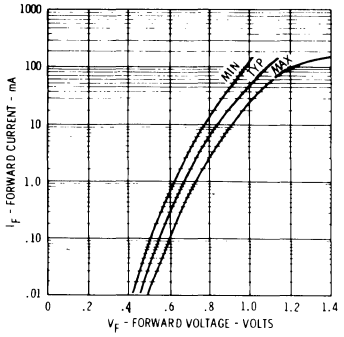


# CURVE SET NUMBER D7

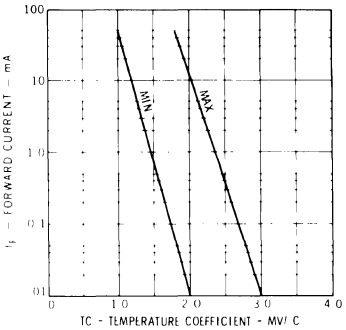
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

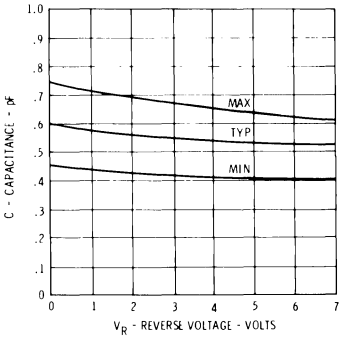
### FORWARD VOLTAGE VERSUS FORWARD CURRENT



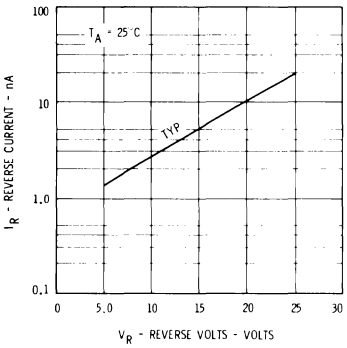

### FORWARD CURRENT VERSUS TEMPERATURE COEFFICIENT



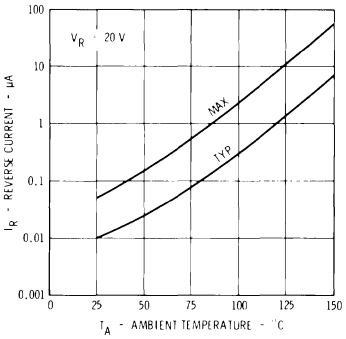

### CAPACITANCE VERSUS REVERSE VOLTAGE



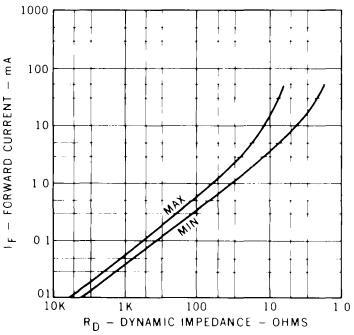

### REVERSE VOLTAGE VERSUS REVERSE CURRENT



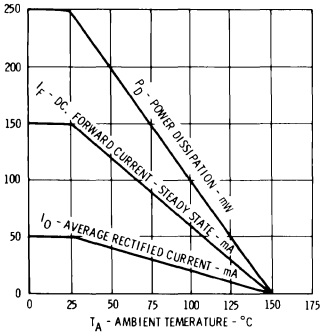

### REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



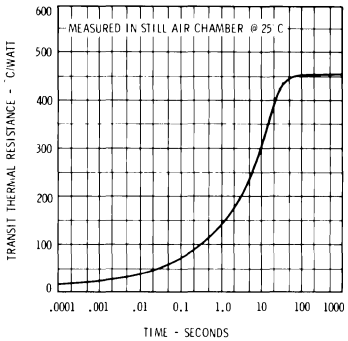

### DYNAMIC IMPEDANCE VERSUS FORWARD CURRENT



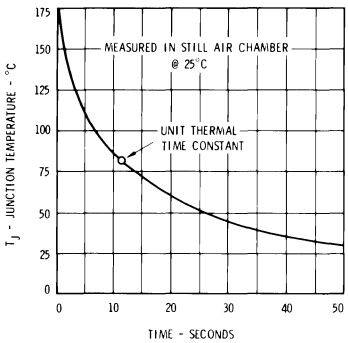

### POWER DISSIPATION, AVERAGE RECTIFIED CURRENT AND FORWARD CURRENT VERSUS AMBIENT TEMPERATURE




### TRANSIENT THERMAL RESISTANCE VERSUS TIME




### JUNCTION TEMPERATURE VERSUS TIME (COOLING CURVE)



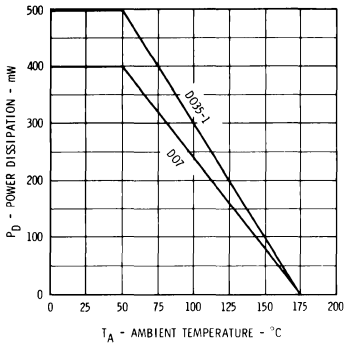

5

# CURVE SET NUMBER D8

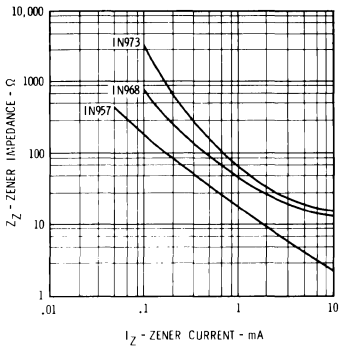
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

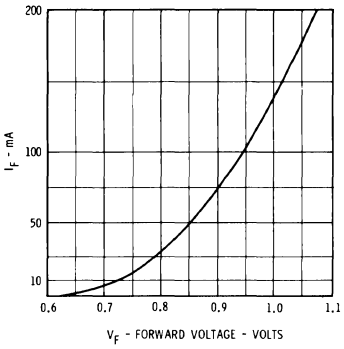
### POWER DERATING CURVE




### ZENER IMPEDANCE VERSUS REVERSE CURRENT




### FORWARD CURRENT VERSUS FORWARD VOLTAGE

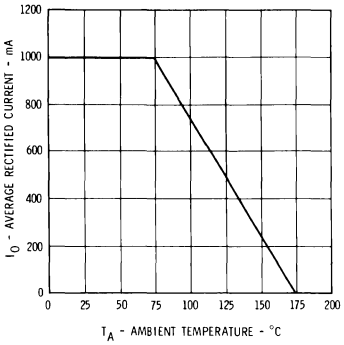



# CURVE SET NUMBER D10

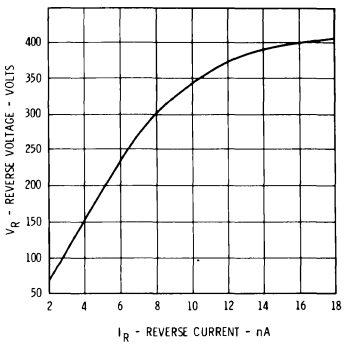
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

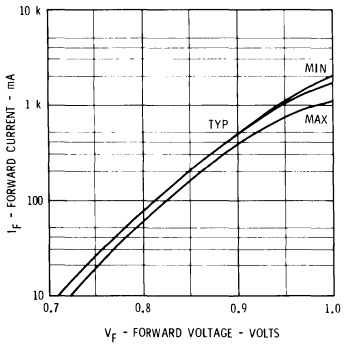
### FORWARD CURRENT VERSUS TEMPERATURE



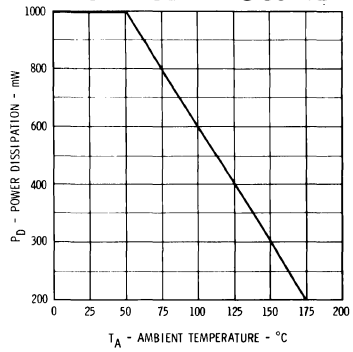

### REVERSE VOLTAGE VERSUS REVERSE CURRENT




### FORWARD VOLTAGE VERSUS FORWARD CURRENT




### POWER DERATING CURVE

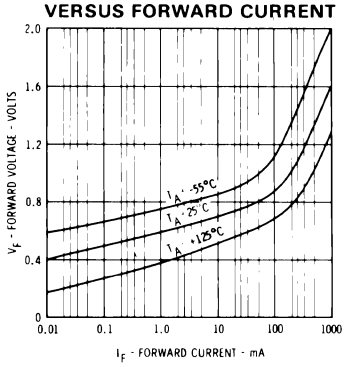


# CURVE SET NUMBER D11

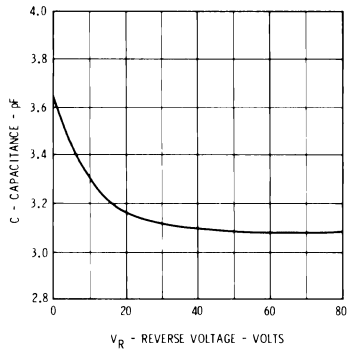
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

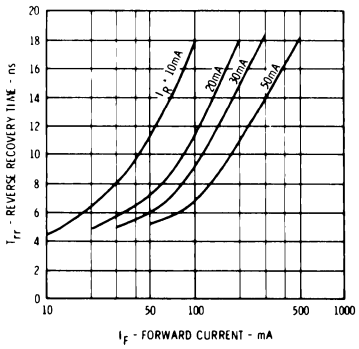
### FORWARD VOLTAGE VERSUS FORWARD CURRENT



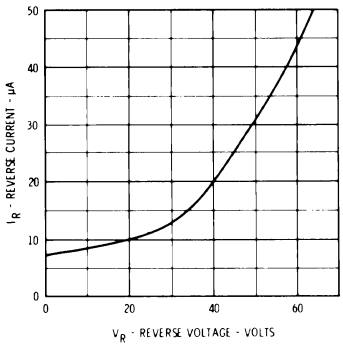

### CAPACITANCE VERSUS REVERSE VOLTAGE



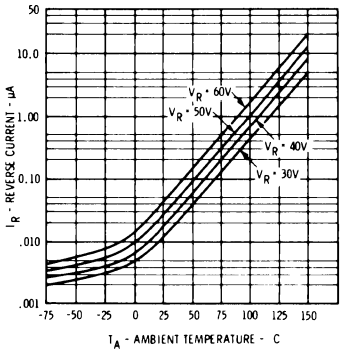

### REVERSE RECOVER TIME VERSUS FORWARD CURRENT




### REVERSE CURRENT VERSUS REVERSE VOLTAGE




### REVERSE CURRENT VERSUS AMBIENT TEMPERATURE

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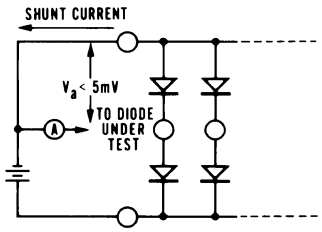
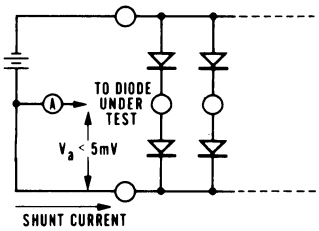
To measure reverse current of an individual diode, the following test circuits are used:

### COMMON CATHODE DIODES




### COMMON ANODE DIODES



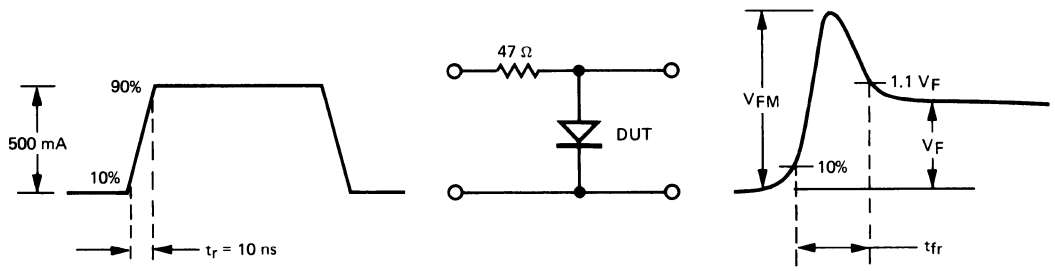

5

# CURVE SET NUMBER D11

## TEST CIRCUITS

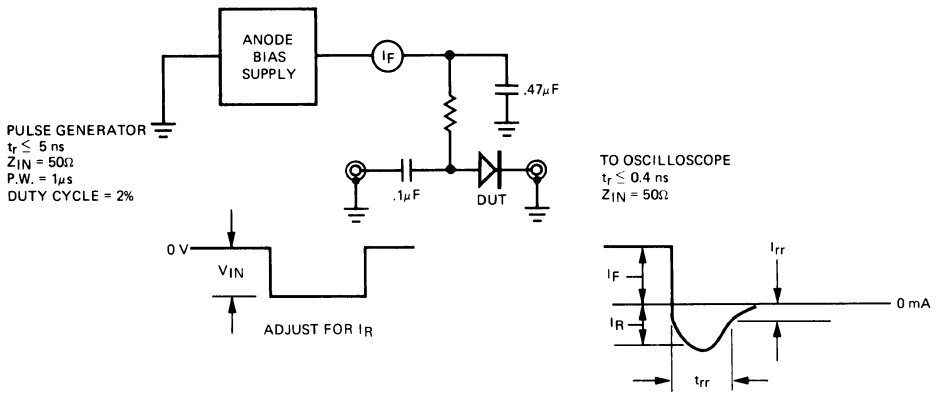
Test requirement for $V_{FM}$ and $t_{fr}$ is as shown below; all leads should be as short as possible.

**INPUT CURRENT PULSE** **OUTPUT VOLTAGE PULSE**

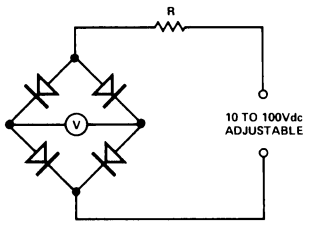



### $t_{rr}$ - REVERSE RECOVERY TIME TEST CIRCUIT

$I_f = I_r$, $I_{rr} = 0.1\ I_r$




### $\Delta V_F$ BRIDGE MATCHING CIRCUIT



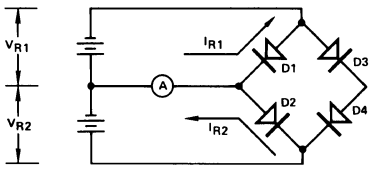

NOTES:

1. R Varies depending on the current range. For the most often used current ranges, R is as follows:

| Current Range (amperes) | R (ohms) |
|---|---|
| $10^{-5}$ to $10^{-4}$ | $10^6$ |
| $10^{-4}$ to $10^{-3}$ | $10^5$ |
| $10^{-3}$ to $10^{-2}$ | $10^4$ |
| or $10^{-n}$ to $10^{-n+1}$ | $10^{n+1}$ |

2. V indicates mismatch of assembly.

### $\Delta I_R$ BRIDGE MATCHING CIRCUIT




NOTES:

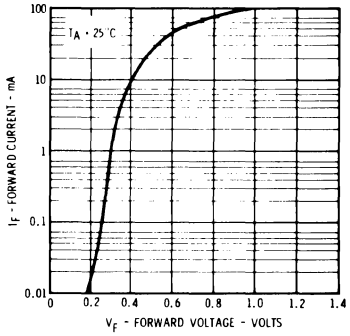
1. $V_{R2} = V_{R1}$ ±1%.
2. $I_{R2} - I_{R1} = \Delta I_R$ (difference in $I_R$ between diodes D1 & D2). To measure diodes D3 & D4, reverse cathode-anodeterminal connections.
3. A is a center reading μμ ammeter. $\Delta I_R$ indicated directly on A.

# CURVE SET NUMBER D12

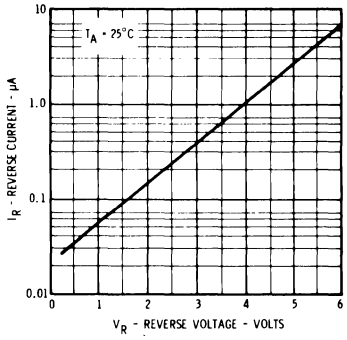
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

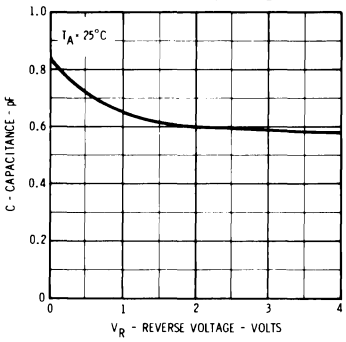
**FORWARD CURRENT VERSUS FORWARD VOLTAGE**

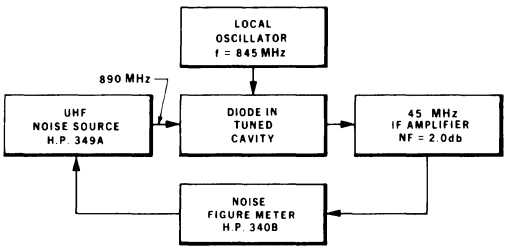



**REVERSE CURRENT VERSUS REVERSE VOLTAGE**




**CAPACITANCE VERSUS REVERSE VOLTAGE**




NOISE FIGURE TEST CIRCUIT

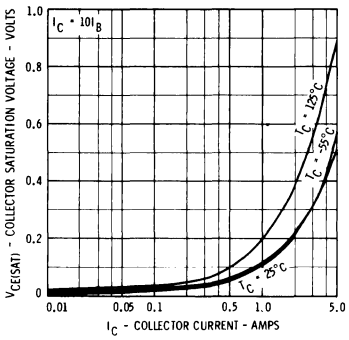
5

# CURVE SET NUMBER PWR1

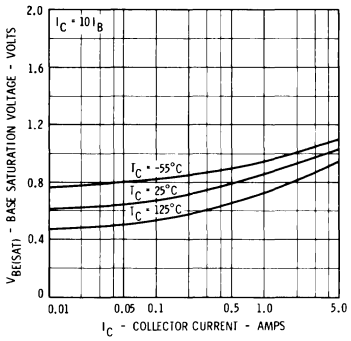
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

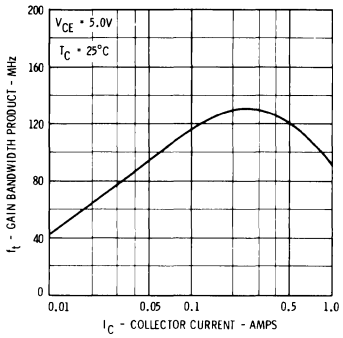
### COLLECTOR SATURATION VOLTAGE VERSUS PULSED COLLECTOR CURRENT



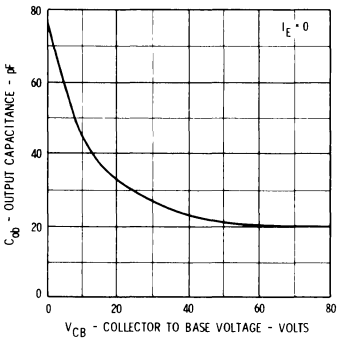

### BASE SATURATION VOLTAGE VERSUS PULSED COLLECTOR CURRENT



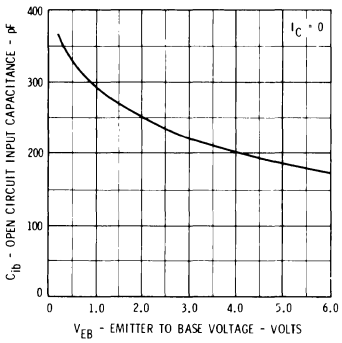

### GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT



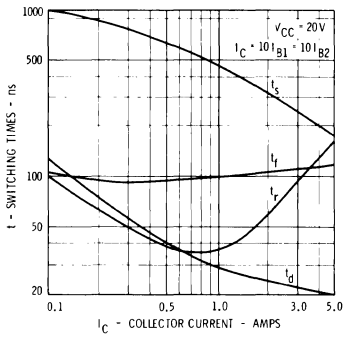

### OPEN CIRCUIT OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



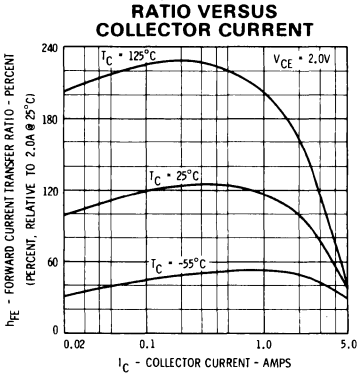

### OPEN CIRCUIT INPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



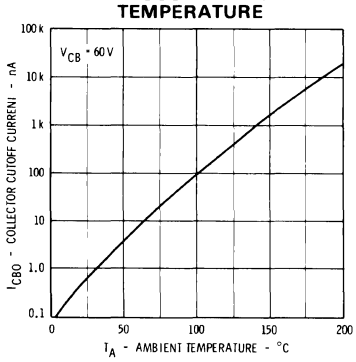

### SWITCHING TIMES VERSUS COLLECTOR CURRENT



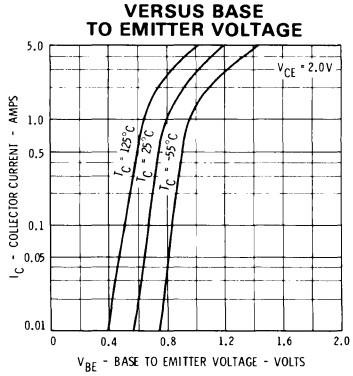

### FORWARD CURRENT TRANSFER RATIO VERSUS COLLECTOR CURRENT




### COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE

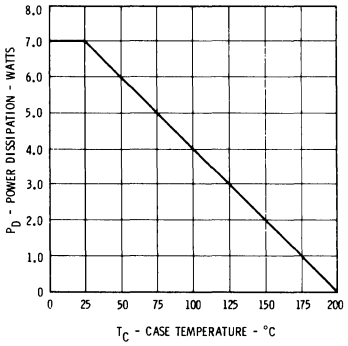



### COLLECTOR CURRENT VERSUS BASE TO EMITTER VOLTAGE

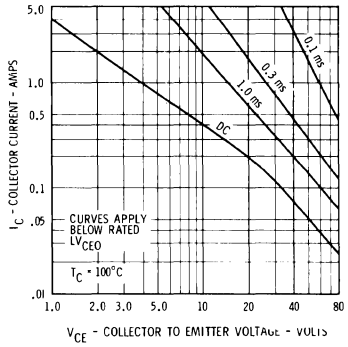



## MAXIMUM RATING CURVES

### POWER VERSUS TEMPERATURE DERATING CURVE




### FORWARD BIASED SAFE OPERATING AREA

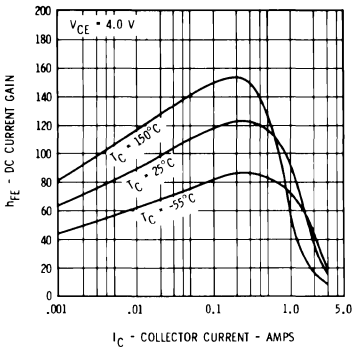


# CURVE SET NUMBER PWR2

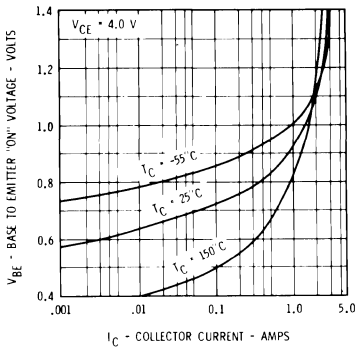
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

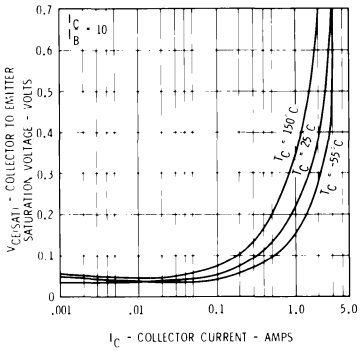
### CURRENT GAIN VERSUS COLLECTOR CURRENT



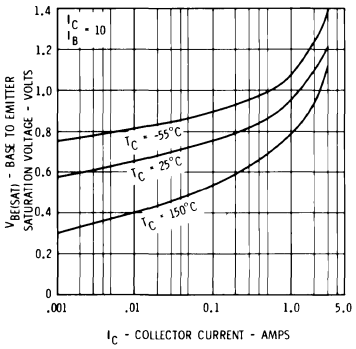

### BASE TO EMITTER 'ON' VOLTAGE VERSUS COLLECTOR CURRENT



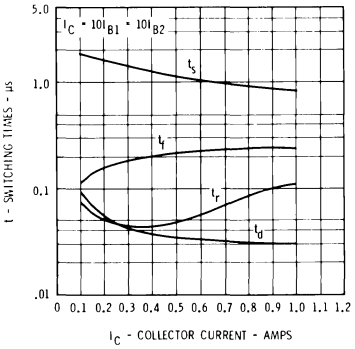

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT




### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

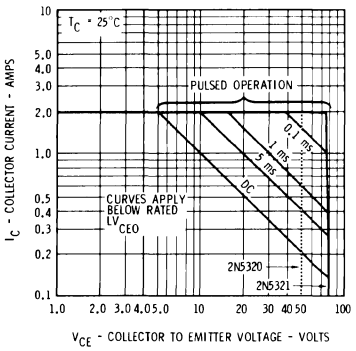



### SWITCHING CHARACTERISTICS VERSUS COLLECTOR CURRENT

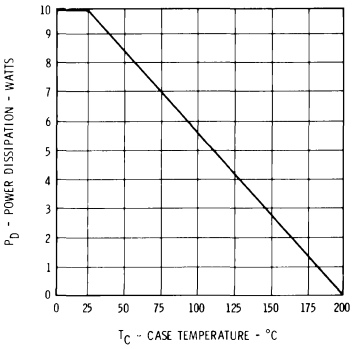



## MAXIMUM RATING CURVES

### SAFE OPERATING AREA




### POWER VERSUS TEMPERATURE DERATING CURVE



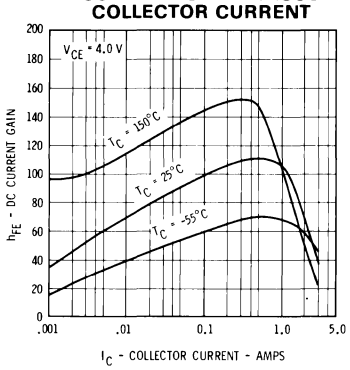

5

# CURVE SET NUMBER PWR3

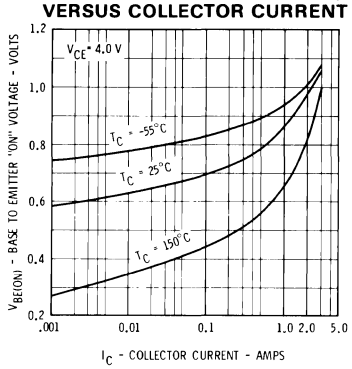
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

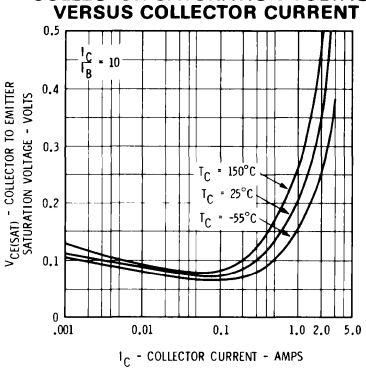
### CURRENT GAIN VERSUS COLLECTOR CURRENT



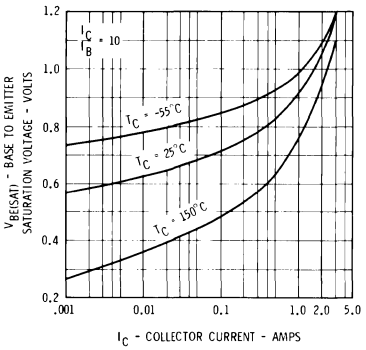

### BASE TO EMITTER 'ON' VOLTAGE VERSUS COLLECTOR CURRENT



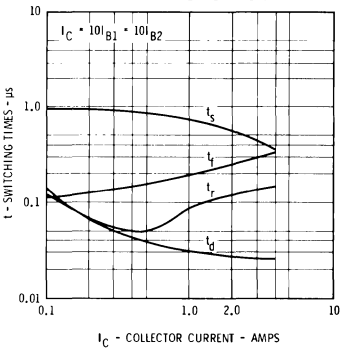

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT




### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

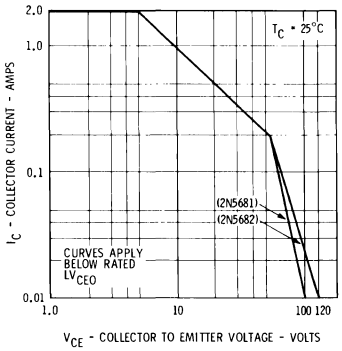



### SWITCHING CHARACTERISTICS VERSUS COLLECTOR CURRENT

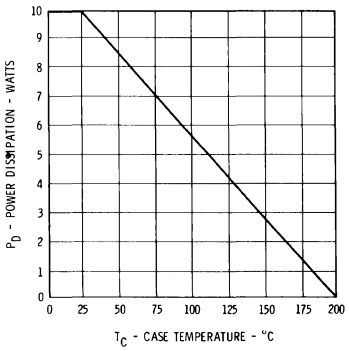



## MAXIMUM RATING CURVES

### DC SAFE OPERATING AREA




### POWER VERSUS TEMPERATURE DERATING CURVE

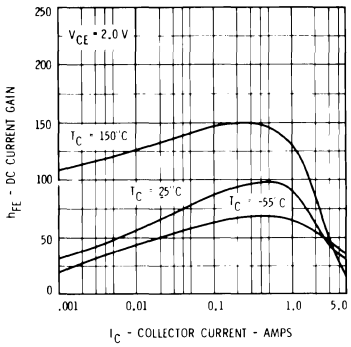


# CURVE SET NUMBER PWR4

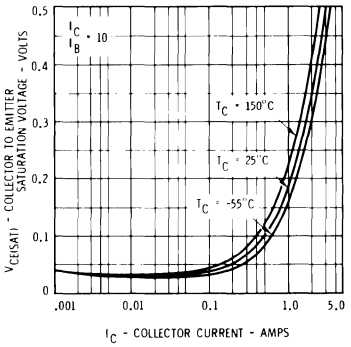
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

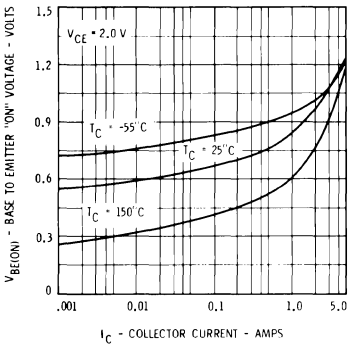
### CURRENT GAIN VERSUS COLLECTOR CURRENT



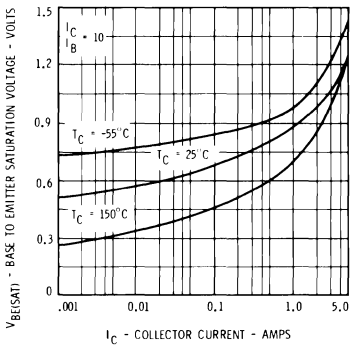

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT




### BASE TO EMITTER 'ON' VOLTAGE VERSUS COLLECTOR CURRENT

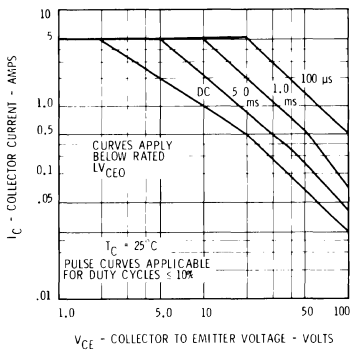



### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

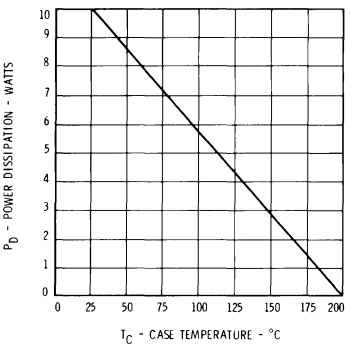



## MAXIMUM RATING CURVES

### SAFE OPERATING AREA




### POWER VERSUS TEMPERATURE DERATING CURVE



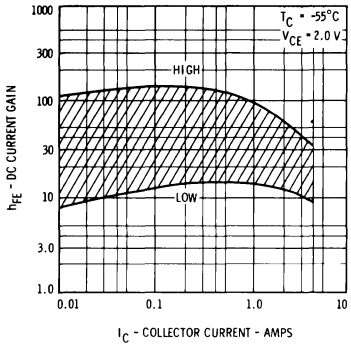

5

# CURVE SET NUMBER PWR5

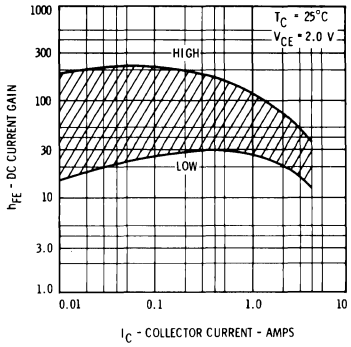
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

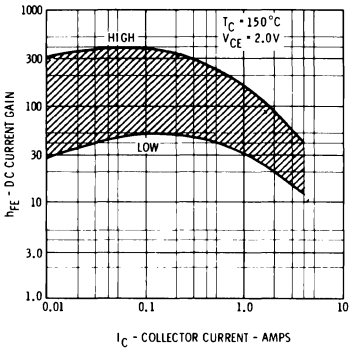
### DC CURRENT GAIN VERSUS COLLECTOR CURRENT



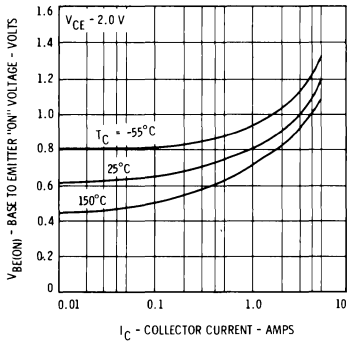

### DC CURRENT GAIN VERSUS COLLECTOR CURRENT



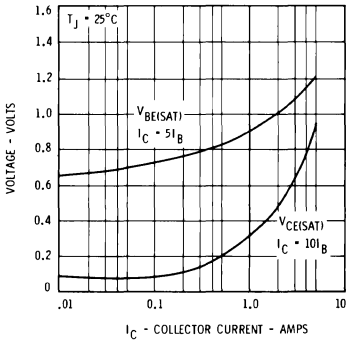

### DC CURRENT GAIN VERSUS COLLECTOR CURRENT



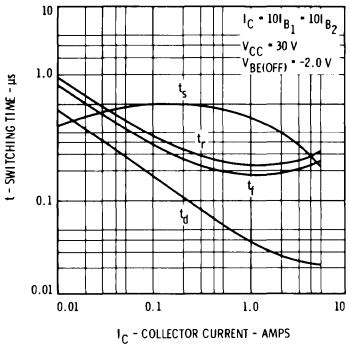

### BASE TO EMITTER 'ON' VOLTAGE VERSUS COLLECTOR CURRENT



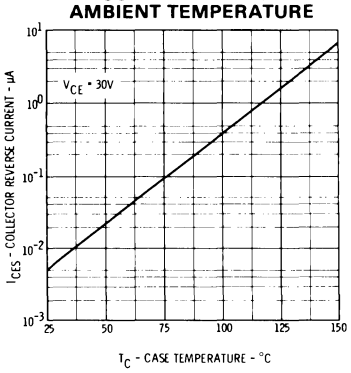

### SATURATION VOLTAGES VERSUS COLLECTOR CURRENT



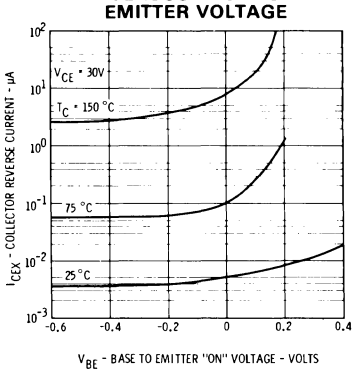

### SWITCHING TIMES VERSUS COLLECTOR CURRENT



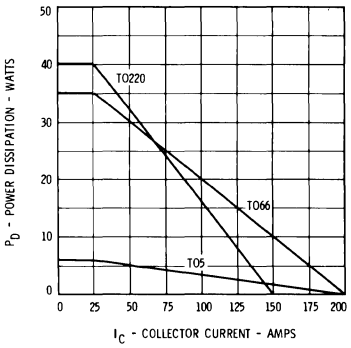

### COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



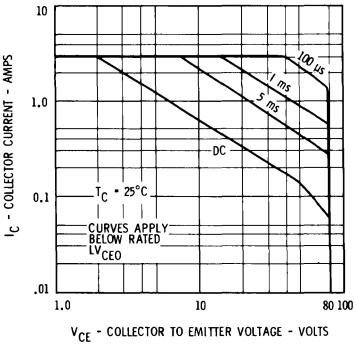

### COLLECTOR REVERSE CURRENT VERSUS BASE TO EMITTER VOLTAGE



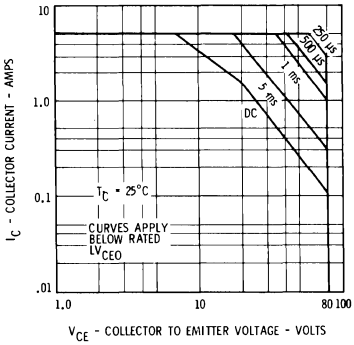

### POWER VERSUS TEMPERATURE DERATING CURVE



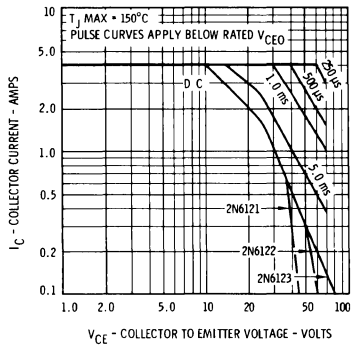

### ACTIVE REGION SAFE OPERATING AREA TO5




### ACTIVE REGION SAFE OPERATING AREA TO66




### ACTIVE REGION SAFE OPERATING AREA TO220

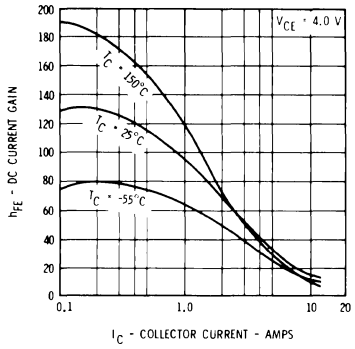


# CURVE SET NUMBER PWR6

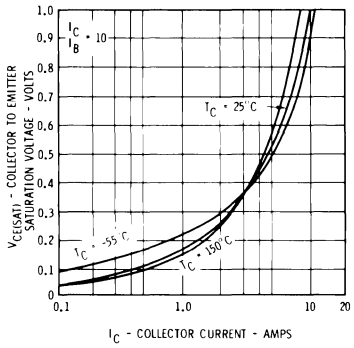
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

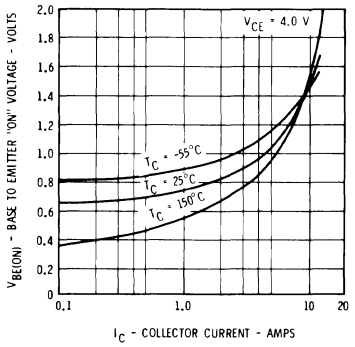
### CURRENT GAIN VERSUS COLLECTOR CURRENT



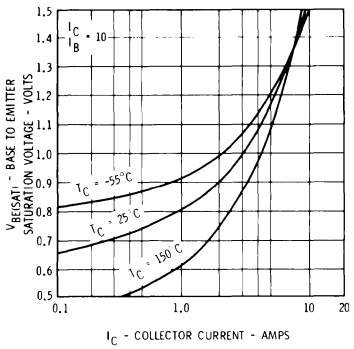

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT




### BASE TO EMITTER 'ON' VOLTAGE VERSUS COLLECTOR CURRENT

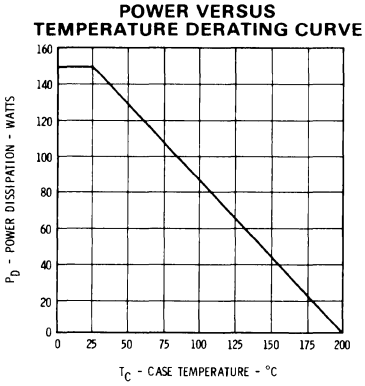



### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

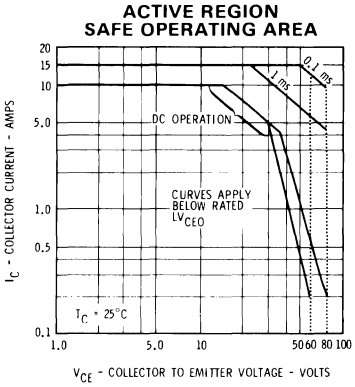



## MAXIMUM RATING CURVES

### POWER VERSUS TEMPERATURE DERATING CURVE




### ACTIVE REGION SAFE OPERATING AREA



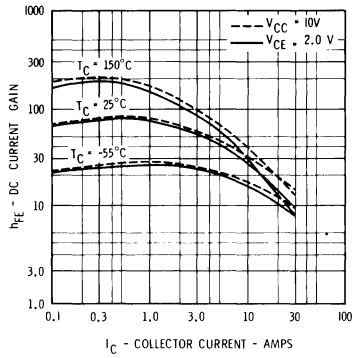

5

# CURVE SET NUMBER PWR7

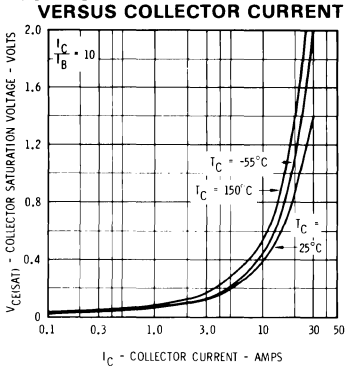
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

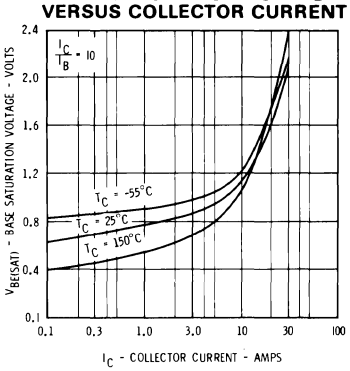
### DC CURRENT GAIN VERSUS COLLECTOR CURRENT



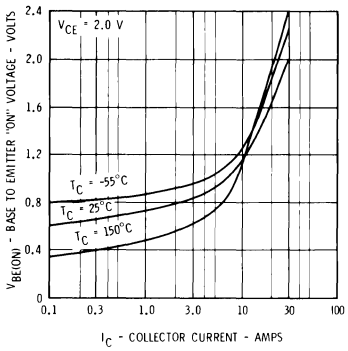

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



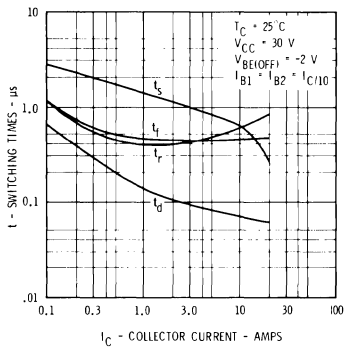

### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



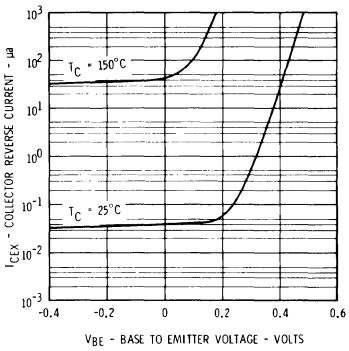

### BASE TO EMITTER 'ON' VOLTAGE VERSUS COLLECTOR CURRENT



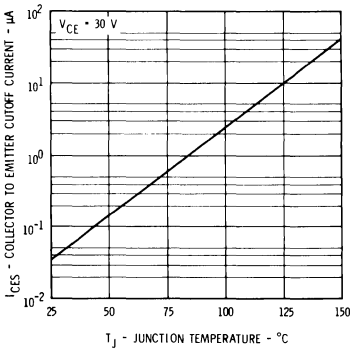

### SWITCHING TIME VERSUS COLLECTOR CURRENT



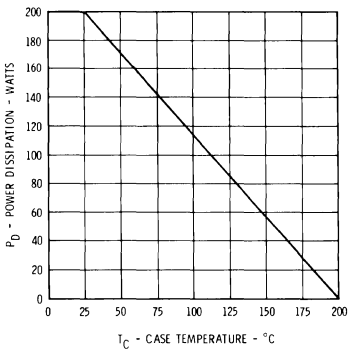

### COLLECTOR REVERSE CURRENT VERSUS BASE TO EMITTER VOLTAGE



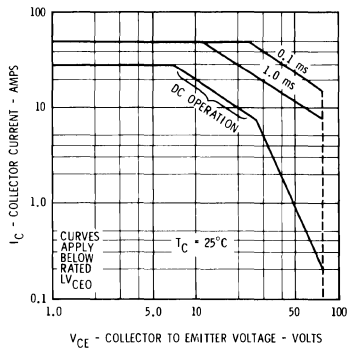

### COLLECTOR CUTOFF CURRENT VERSUS JUNCTION TEMPERATURE




### POWER VERSUS TEMPERATURE DERATING CURVE




### SAFE OPERATING AREA

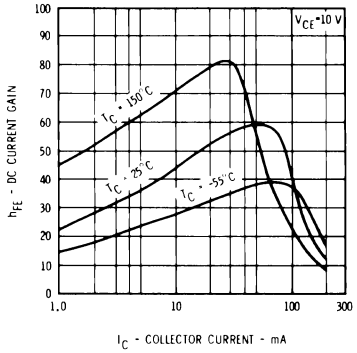


# CURVE SET NUMBER PWR8

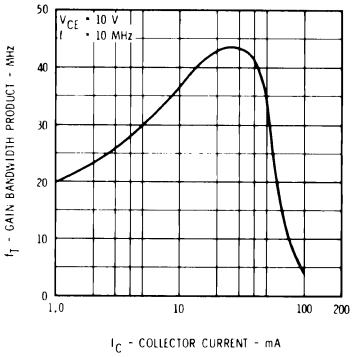
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

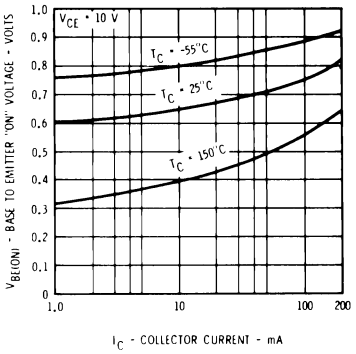
### CURRENT GAIN VERSUS COLLECTOR CURRENT



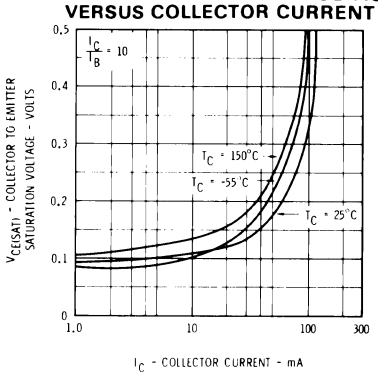

### GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT



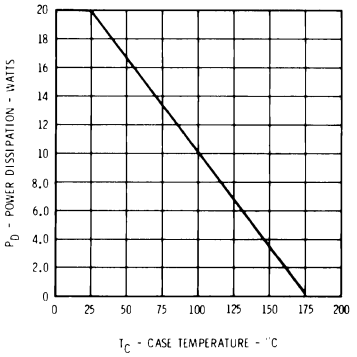

### BASE TO EMITTER 'ON' VOLTAGE VERSUS COLLECTOR CURRENT



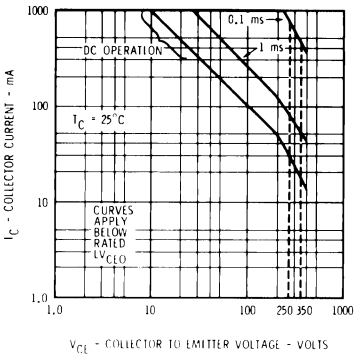

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



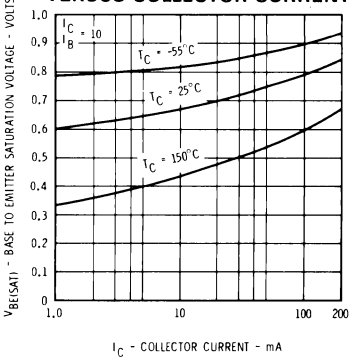

### POWER VERSUS TEMPERATURE DERATING CURVE TO66



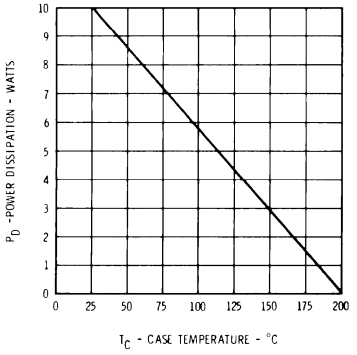

### SAFE OPERATING AREA TO5



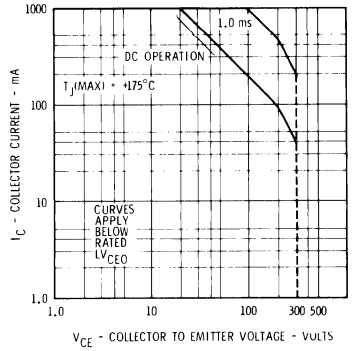

### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT




### POWER VERSUS TEMPERATURE DERATING CURVE TO5




### SAFE OPERATING AREA TO66



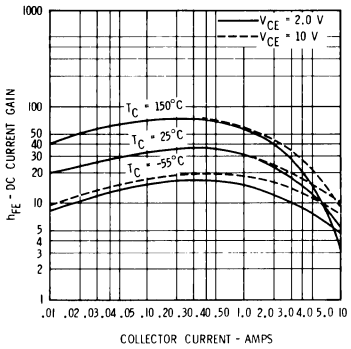

5

# CURVE SET NUMBER PWR9

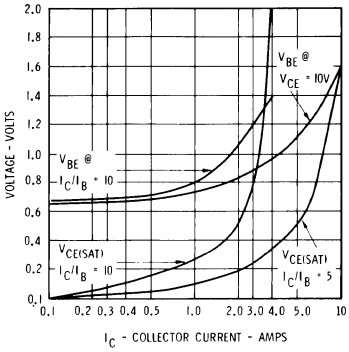
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

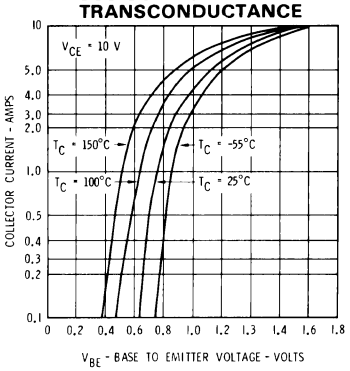
### DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



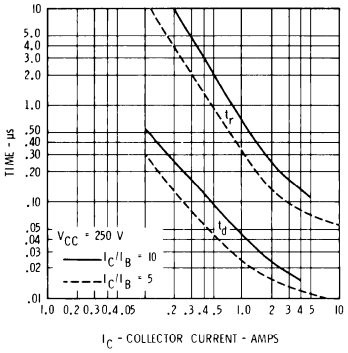

### COLLECTOR SATURATION AND BASE TO EMITTER VOLTAGE VERSUS COLLECTOR CURRENT



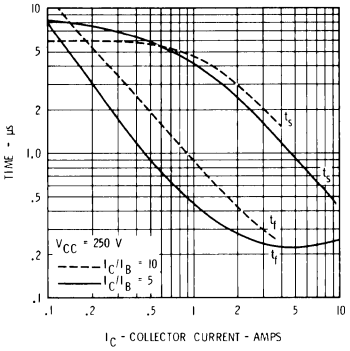

### BASE TO EMITTER VOLTAGE VERSUS COLLECTOR CURRENT TRANSCONDUCTANCE




### TURN ON TIME VERSUS COLLECTOR CURRENT

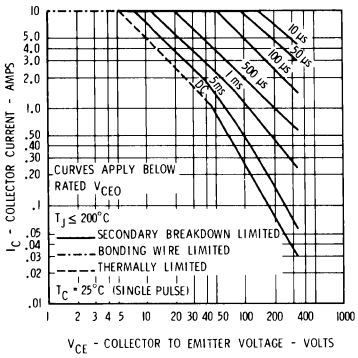



### TURN OFF TIME VERSUS COLLECTOR CURRENT

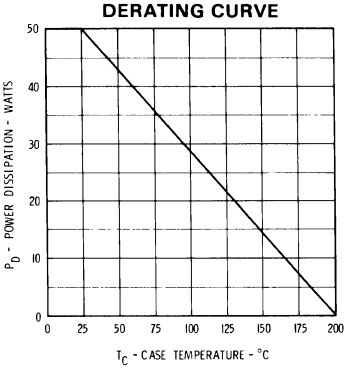



## MAXIMUM RATING CURVES

### ACTIVE REGION SAFE OPERATING AREA




### POWER VERSUS TEMPERATURE DERATING CURVE

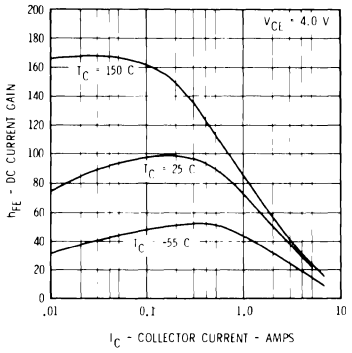


# CURVE SET NUMBER PWR10

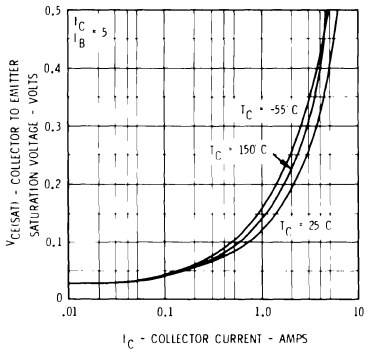
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

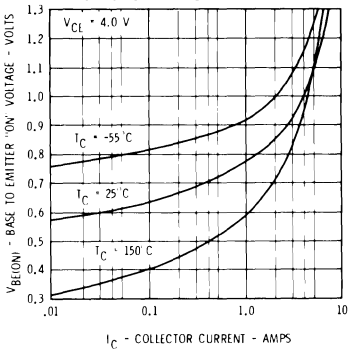
### CURRENT GAIN VERSUS COLLECTOR CURRENT



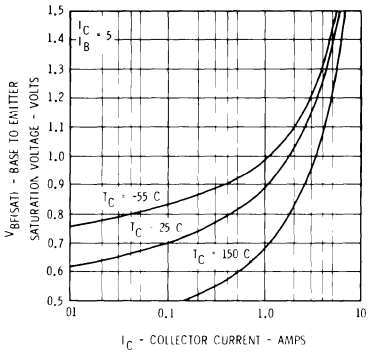

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



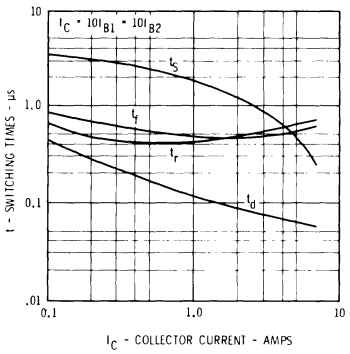

### BASE TO EMITTER 'ON' VOLTAGE VERSUS COLLECTOR CURRENT




### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

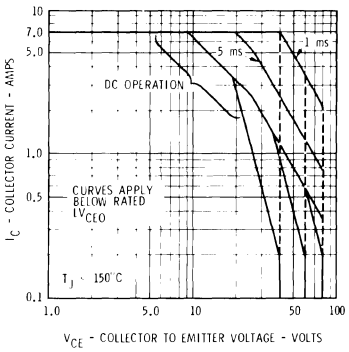



### SWITCHING CHARACTERISTICS VERSUS COLLECTOR CURRENT

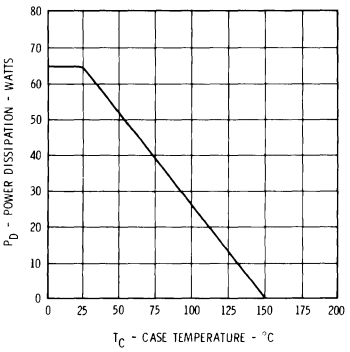



## MAXIMUM RATING CURVES

### SAFE OPERATING AREA




### POWER VERSUS TEMPERATURE DERATING CURVE

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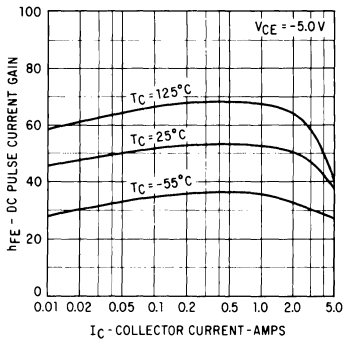
# CURVE SET NUMBER PWR11

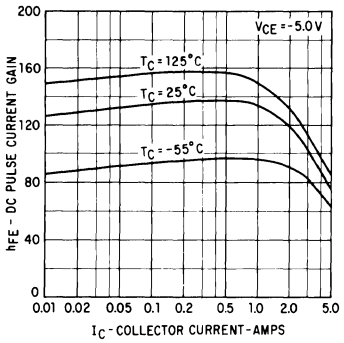
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

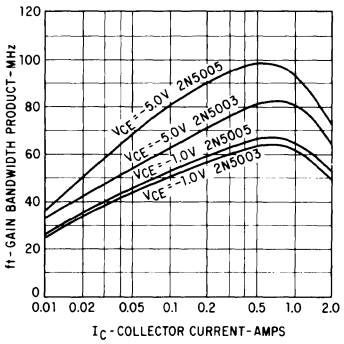
### DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT 2N5003



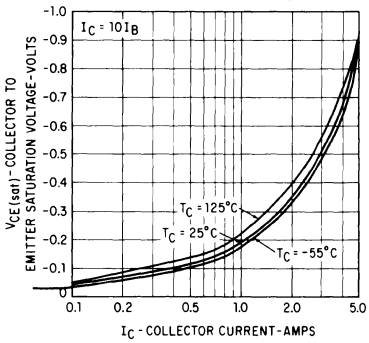

### DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT 2N5005



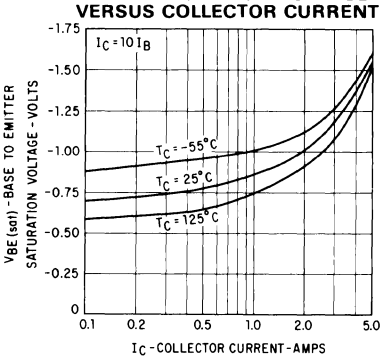

### GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT



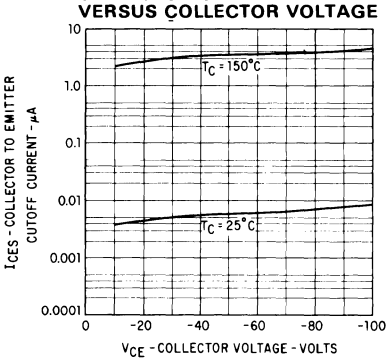

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



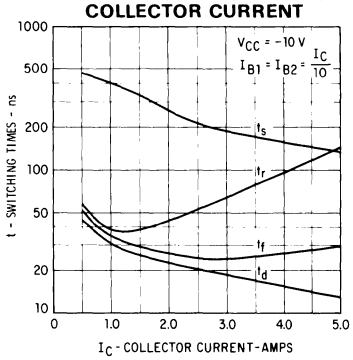

### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



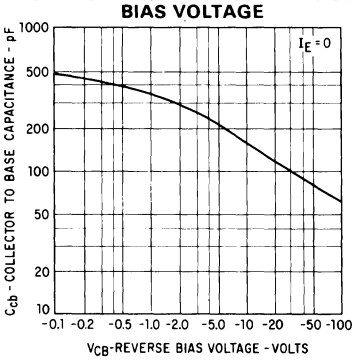

### COLLECTOR CUTOFF CURRENT VERSUS COLLECTOR VOLTAGE



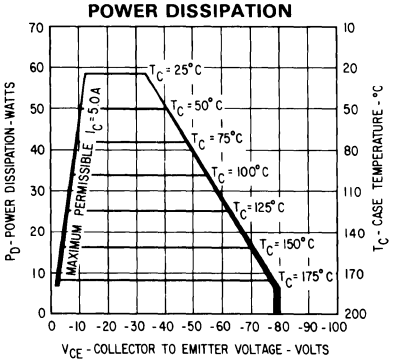

### SWITCHING TIMES VERSUS COLLECTOR CURRENT




### COLLECTOR TO BASE CAPACITANCE VERSUS REVERSE BIAS VOLTAGE




### MAXIMUM PERMISSIBLE DC FORWARD BIASED POWER DISSIPATION

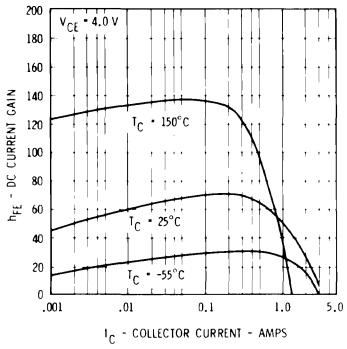


# CURVE SET NUMBER PWR12

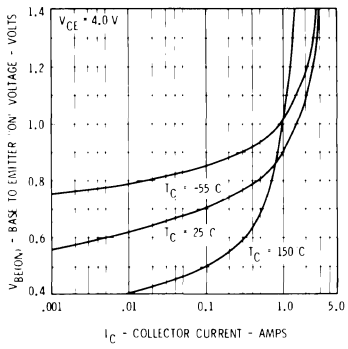
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

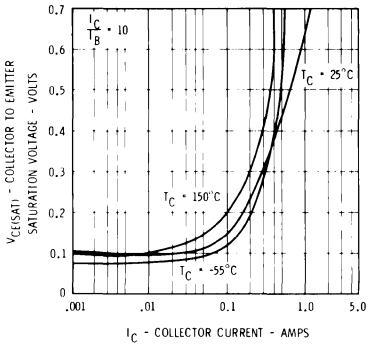
### CURRENT GAIN VERSUS COLLECTOR CURRENT



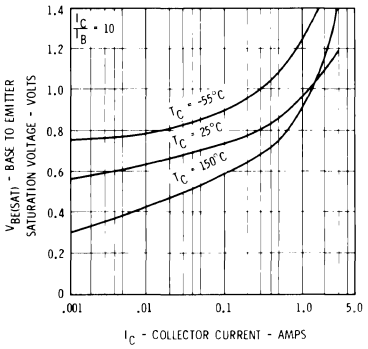

### BASE TO EMITTER 'ON' VOLTAGE VERSUS COLLECTOR CURRENT



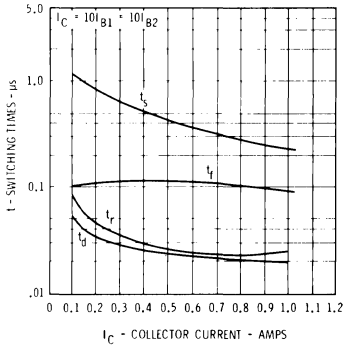

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT




### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

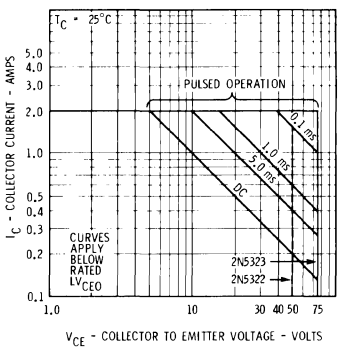



### SWITCHING CHARACTERISTICS VERSUS COLLECTOR CURRENT

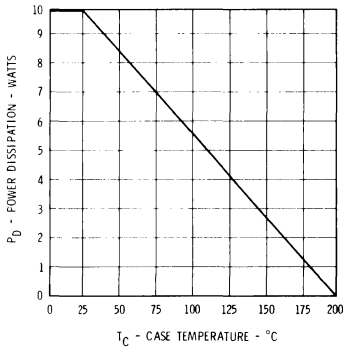



## MAXIMUM RATING CURVES

### SAFE OPERATING AREA




### POWER VERSUS TEMPERATURE DERATING CURVE



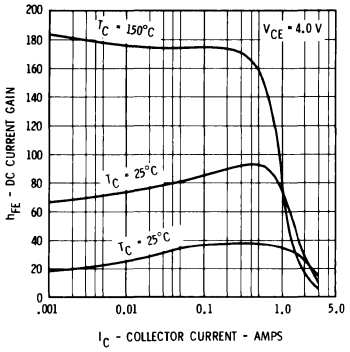

5

# CURVE SET NUMBER PWR13

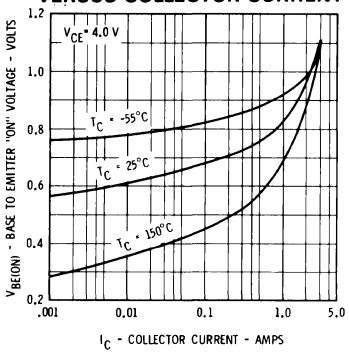
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

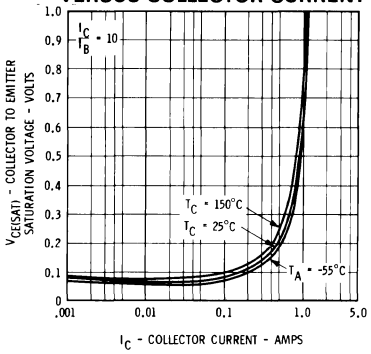
### CURRENT GAIN VERSUS COLLECTOR CURRENT



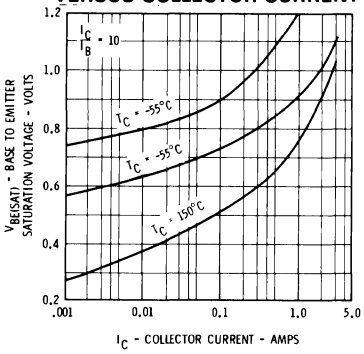

### BASE TO EMITTER 'ON' VOLTAGE VERSUS COLLECTOR CURRENT



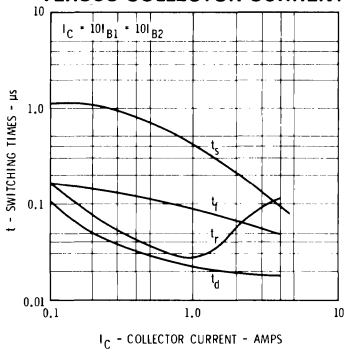

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT




### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

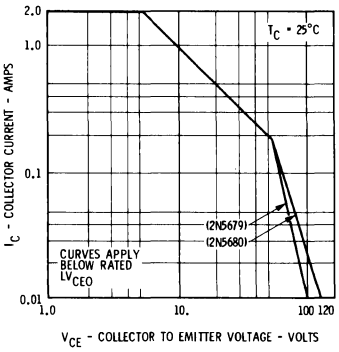



### SWITCHING CHARACTERISTICS VERSUS COLLECTOR CURRENT

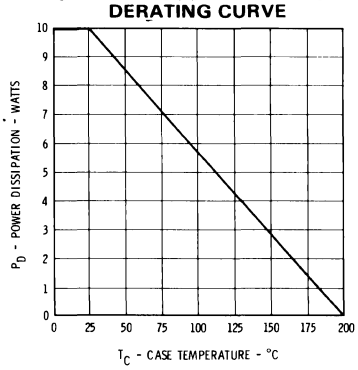



## MAXIMUM RATING CURVES

### DC SAFE OPERATING AREA




### POWER VERSUS TEMPERATURE DERATING CURVE

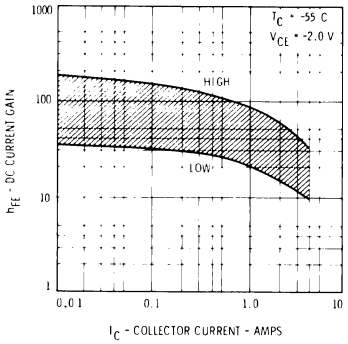


# CURVE SET NUMBER PWR14

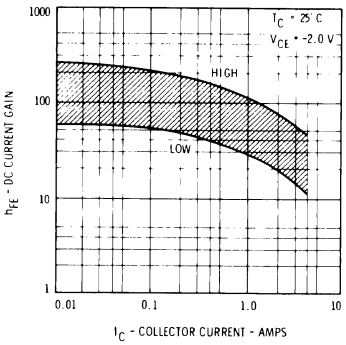
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

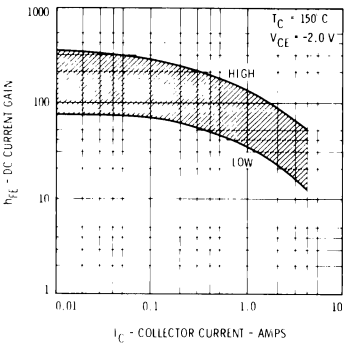
### TYPICAL DC CURRENT GAIN VERSUS COLLECTOR CURRENT



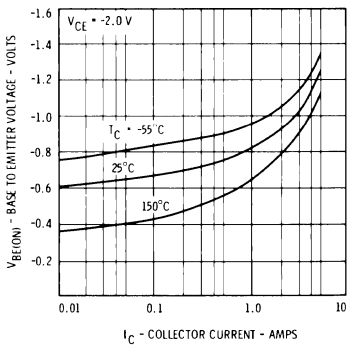

### TYPICAL DC CURRENT GAIN VERSUS COLLECTOR CURRENT



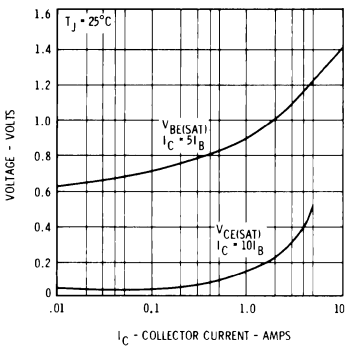

### TYPICAL DC CURRENT GAIN VERSUS COLLECTOR CURRENT



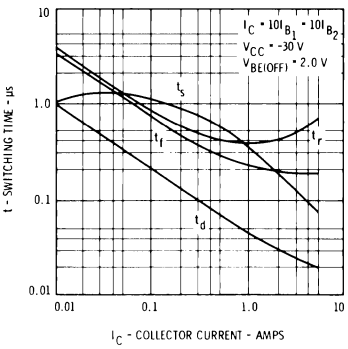

### BASE TO EMITTER 'ON' VOLTAGE VERSUS COLLECTOR CURRENT



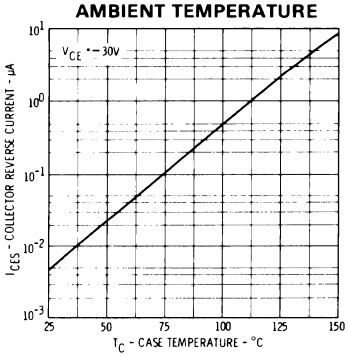

### SATURATION VOLTAGES VERSUS COLLECTOR CURRENT



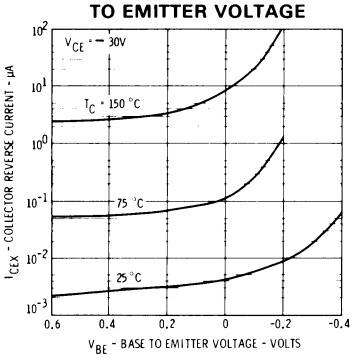

### SWITCHING TIMES VERSUS COLLECTOR CURRENT




### COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE




### COLLECTOR REVERSE CURRENT VERSUS BASE TO EMITTER VOLTAGE

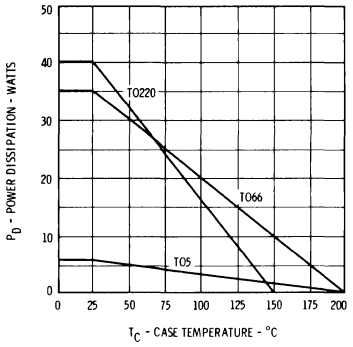



5

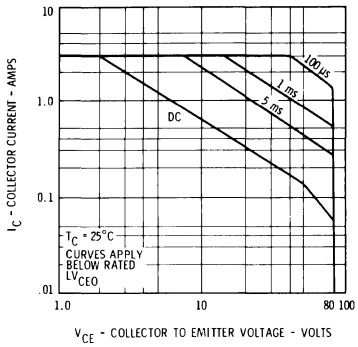
# CURVE SET NUMBER PWR14

## MAXIMUM RATING CURVES

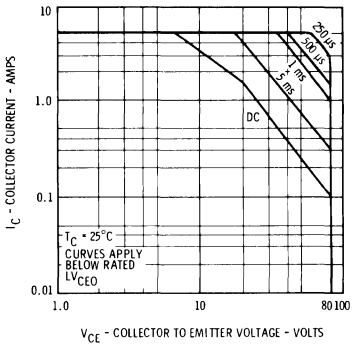
### POWER VERSUS TEMPERATURE DERATING CURVE



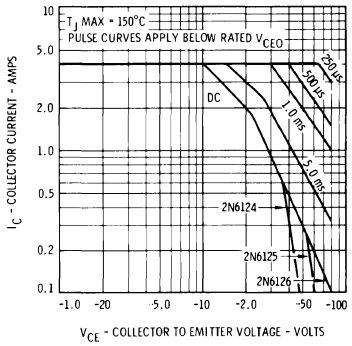

### ACTIVE REGION SAFE OPERATING AREA TO5




### ACTIVE REGION SAFE OPERATING AREA TO66




### ACTIVE REGION SAFE OPERATING AREA TO220

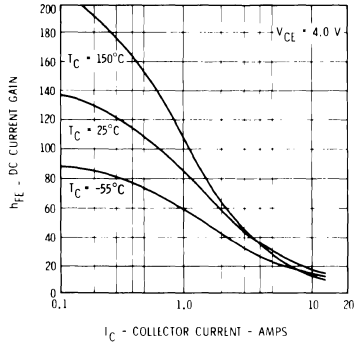


# CURVE SET NUMBER PWR15

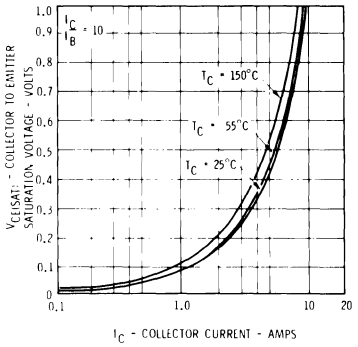
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

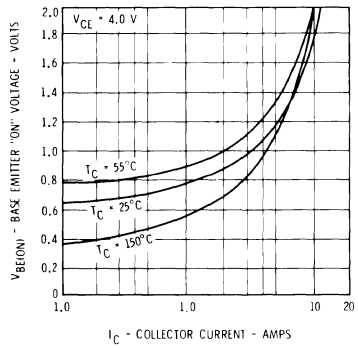
### CURRENT GAIN VERSUS COLLECTOR CURRENT



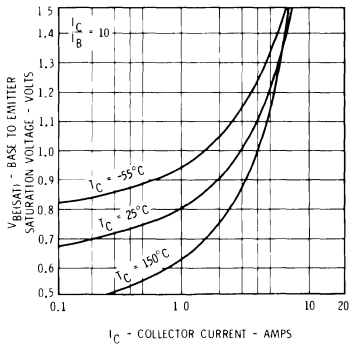

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT




### BASE TO EMITTER 'ON' VOLTAGE VERSUS COLLECTOR CURRENT

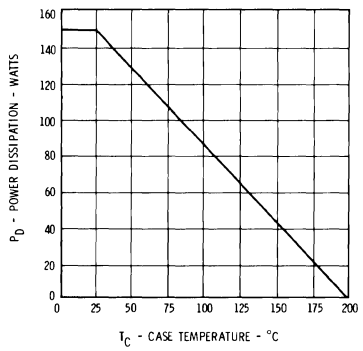



### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

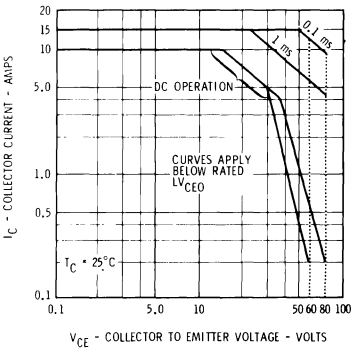



## MAXIMUM RATING CURVES

### POWER VERSUS TEMPERATURE DERATING CURVE




### ACTIVE REGION SAFE OPERATING AREA



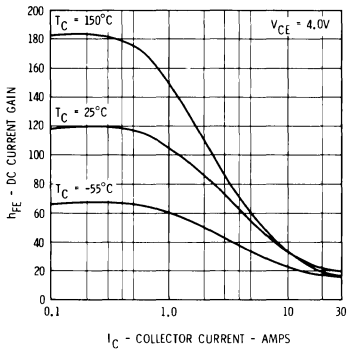

5

# CURVE SET NUMBER PWR16

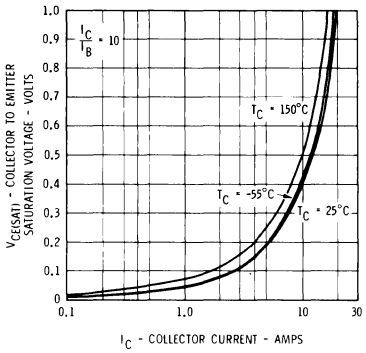
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

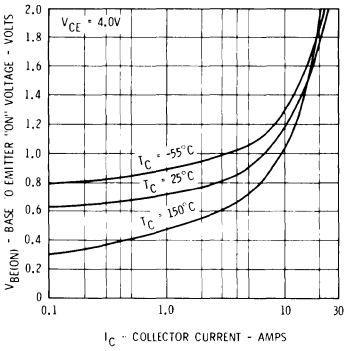
### CURRENT GAIN VERSUS COLLECTOR CURRENT



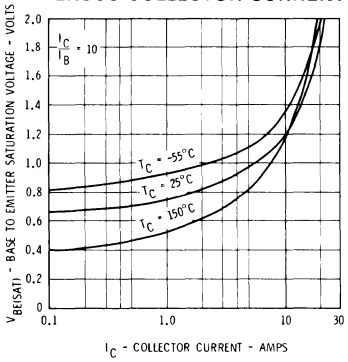

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT




### BASE TO EMITTER 'ON' VOLTAGE VERSUS COLLECTOR CURRENT

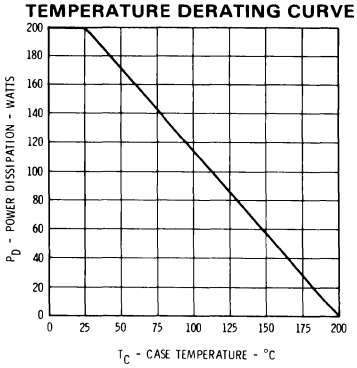



### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

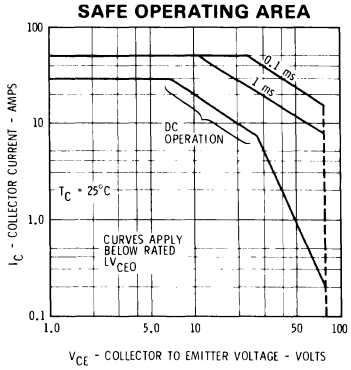



## MAXIMUM RATING CURVES

### POWER VERSUS TEMPERATURE DERATING CURVE




### SAFE OPERATING AREA

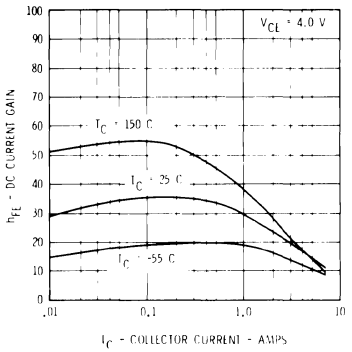


# CURVE SET NUMBER PWR17

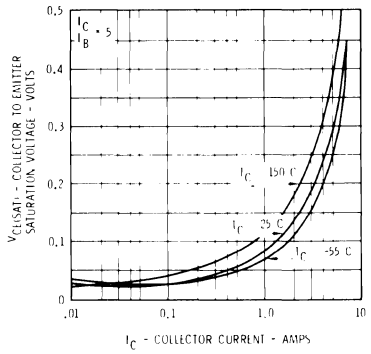
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

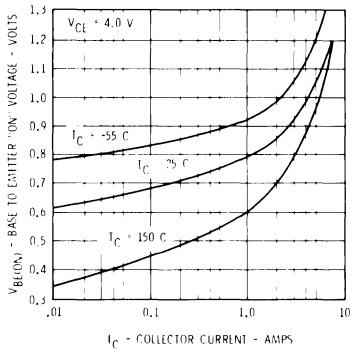
### CURRENT GAIN VERSUS COLLECTOR CURRENT



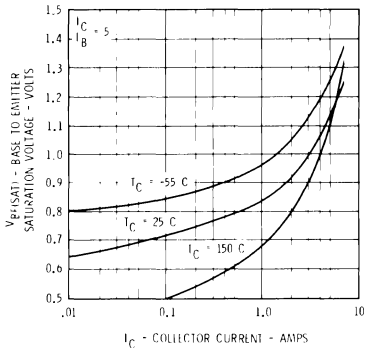

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



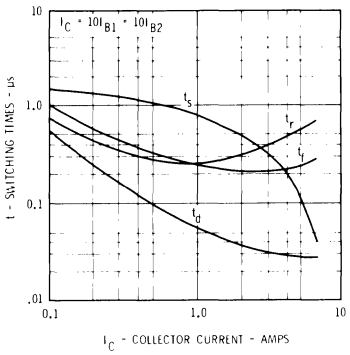

### BASE TO EMITTER 'ON' VOLTAGE VERSUS COLLECTOR CURRENT




### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

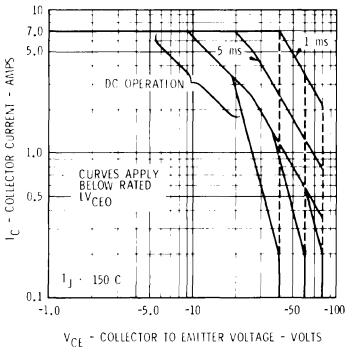



### SWITCHING CHARACTERISTICS VERSUS COLLECTOR CURRENT

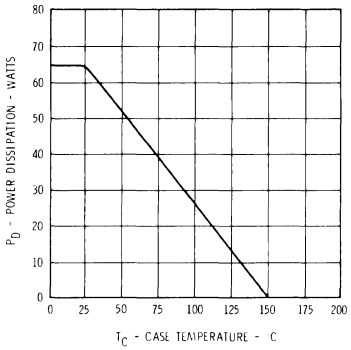



## MAXIMUM RATING CURVES

### SAFE OPERATING AREA




### POWER VERSUS TEMPERATURE DERATING CURVE



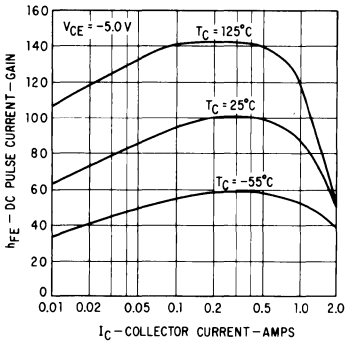

5

# CURVE SET NUMBER PWR18

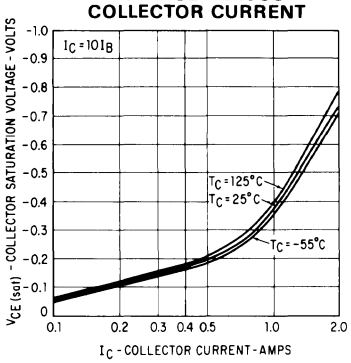
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

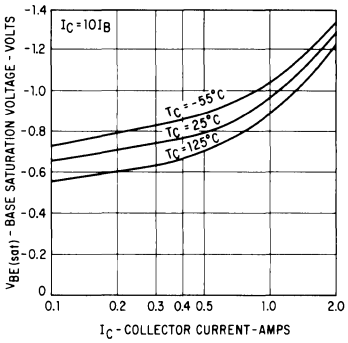
### DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



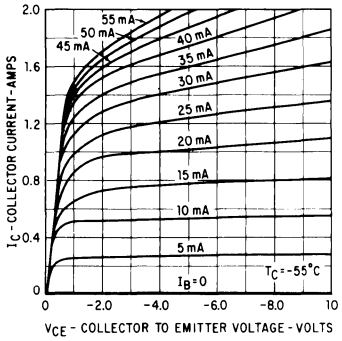

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



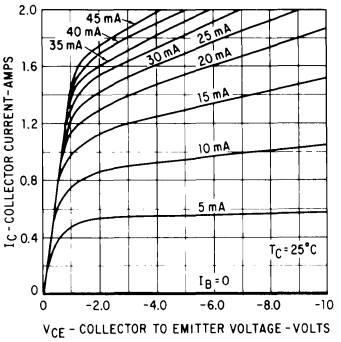

### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



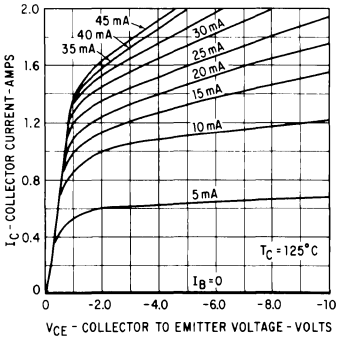

### COLLECTOR CHARACTERISTICS ACTIVE REGION



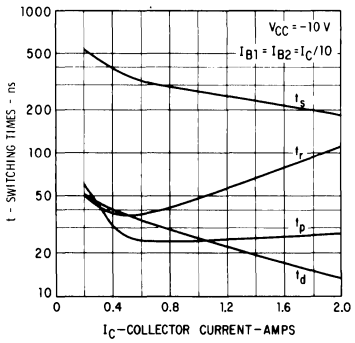

### COLLECTOR CHARACTERISTICS ACTIVE REGION



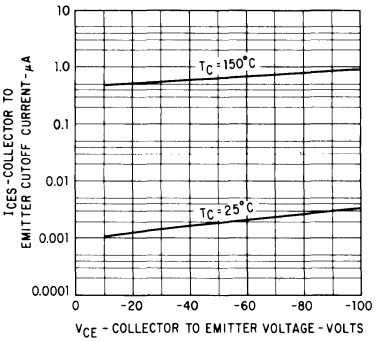

### COLLECTOR CHARACTERISTICS ACTIVE REGION



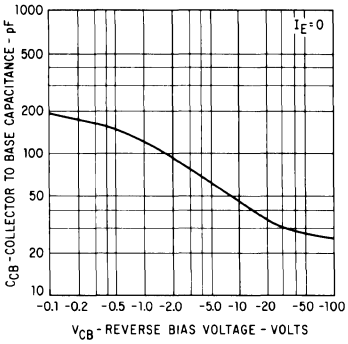

### SWITCHING TIMES VERSUS COLLECTOR CURRENT




### COLLECTOR CUTOFF CURRENT VERSUS COLLECTOR VOLTAGE

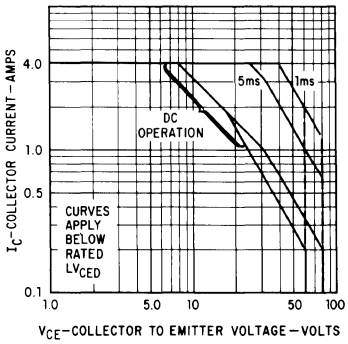



### COLLECTOR TO BASE CAPACITANCE VERSUS REVERSE BIAS VOLTAGE




## MAXIMUM RATING CURVE

### SAFE OPERATING AREA

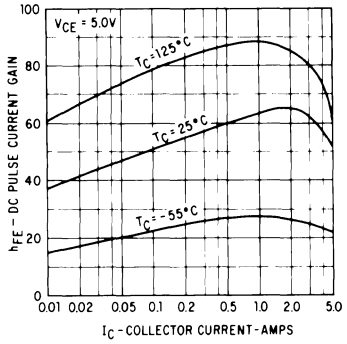


# CURVE SET NUMBER PWR19

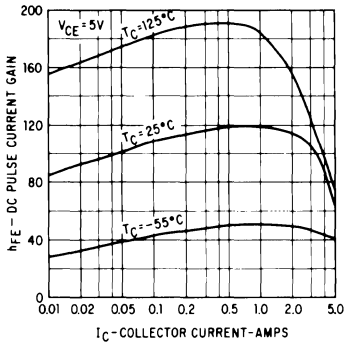
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

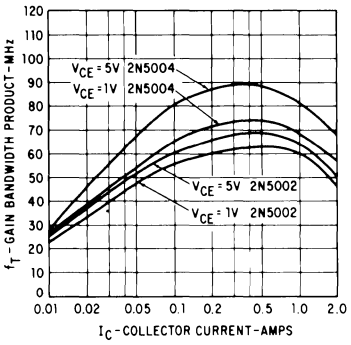
### DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT 2N5002



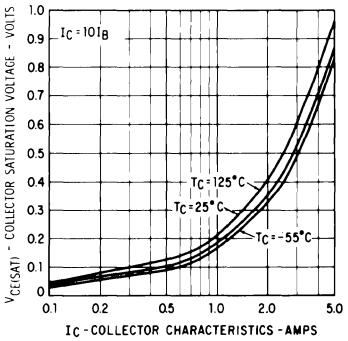

### DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT 2N5004



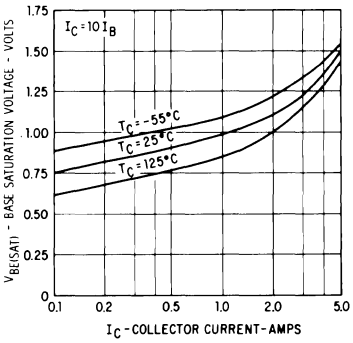

### GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT



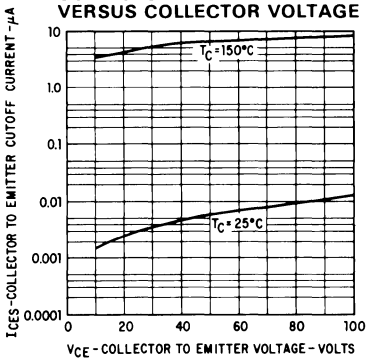

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



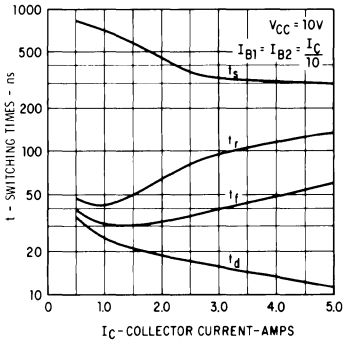

### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



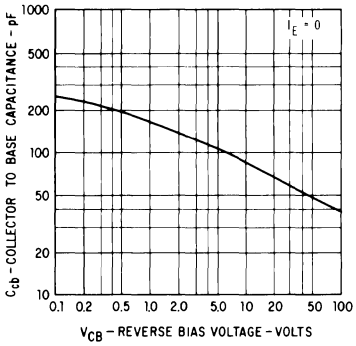

### COLLECTOR CUTOFF CURRENT VERSUS COLLECTOR VOLTAGE



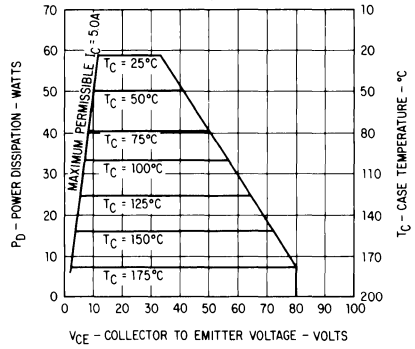

### SWITCHING TIMES VERSUS COLLECTOR CURRENT




### COLLECTOR TO BASE CAPACITANCE VERSUS REVERSE BIAS VOLTAGE




### MAXIMUM PERMISSIBLE DC FORWARD BIASED POWER DISSIPATION



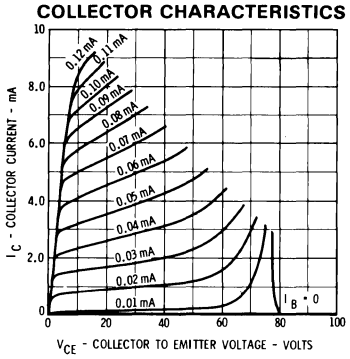

5

# CURVE SET NUMBER SS1

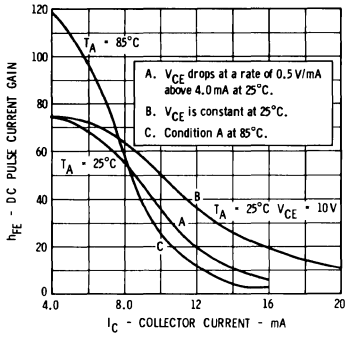
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

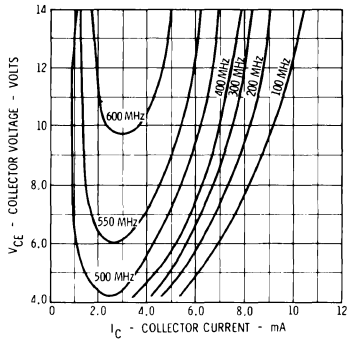
### COLLECTOR CHARACTERISTICS



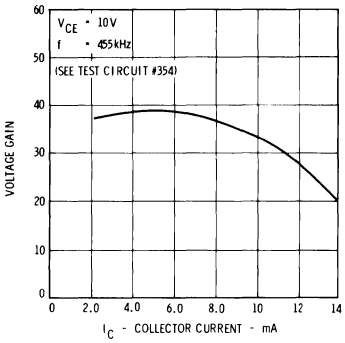

### DC CURRENT GAIN VERSUS COLLECTOR CURRENT



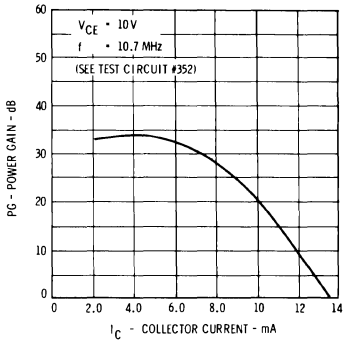

### CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT



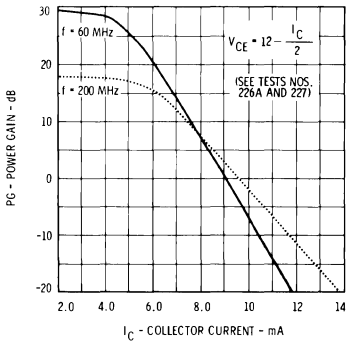

### VOLTAGE GAIN VERSUS COLLECTOR CURRENT



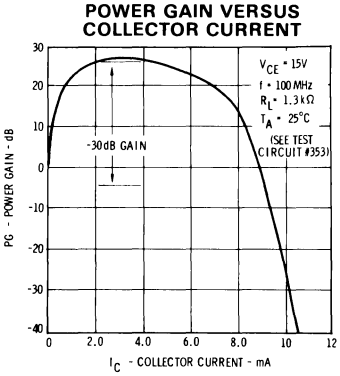

### POWER GAIN VERSUS COLLECTOR CURRENT



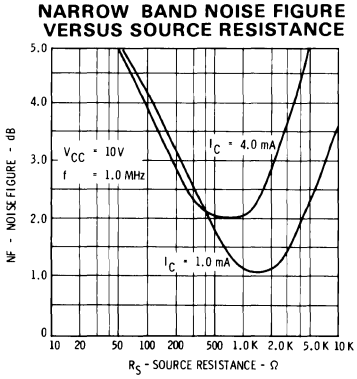

### POWER GAIN VERSUS COLLECTOR CURRENT



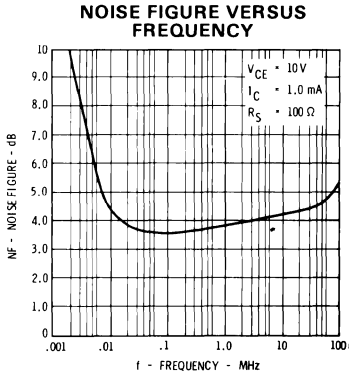

### POWER GAIN VERSUS COLLECTOR CURRENT



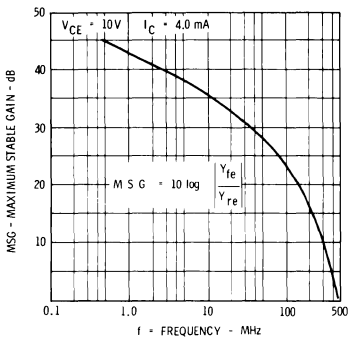

### NARROW BAND NOISE FIGURE VERSUS SOURCE RESISTANCE



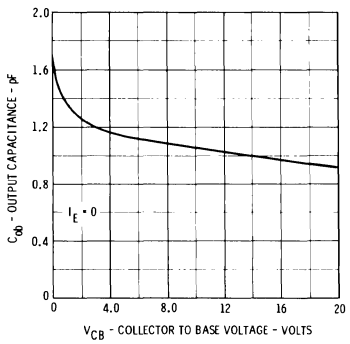

### NOISE FIGURE VERSUS FREQUENCY



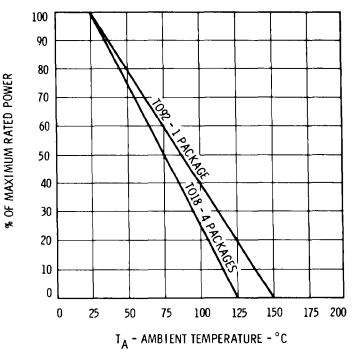

### MAXIMUM STABLE GAIN VERSUS FREQUENCY




### OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE




### ALLOWABLE POWER DISSIPATION VERSUS AMBIENT TEMPERATURE

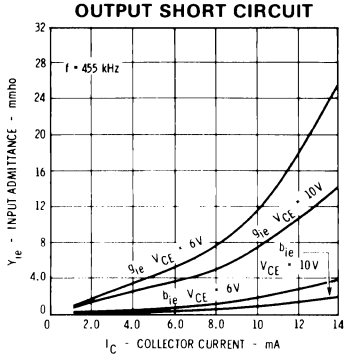


# CURVE SET NUMBER SS1

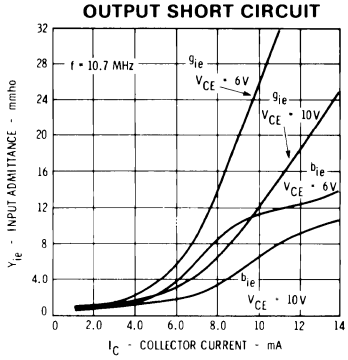
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

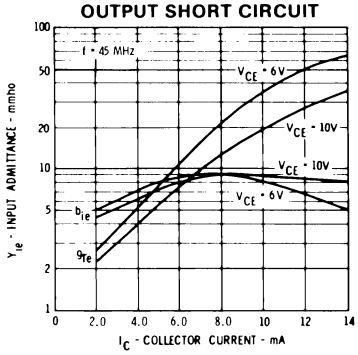
### 455 kHz INPUT ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



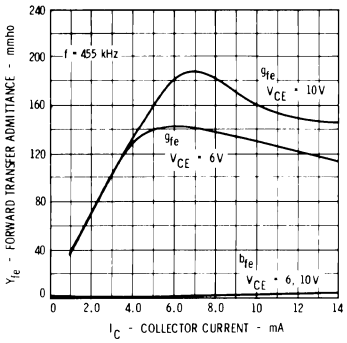

### 10.7 MHz INPUT ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



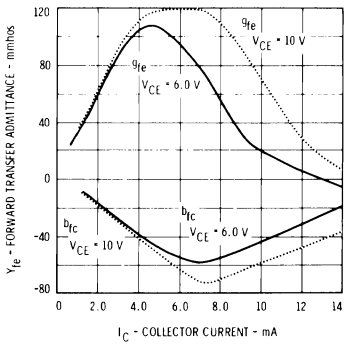

### 45 MHz INPUT ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



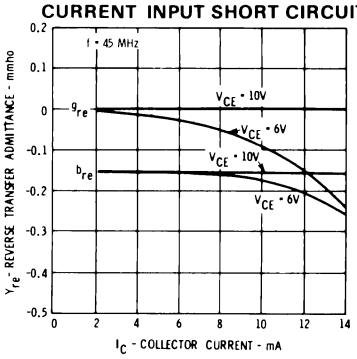

### 455 kHz FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



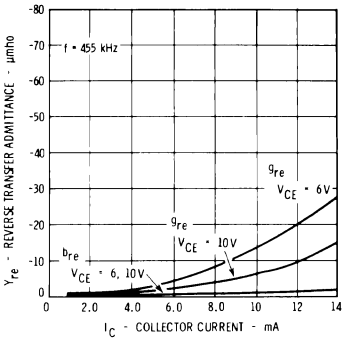

### 10.7 MHz FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



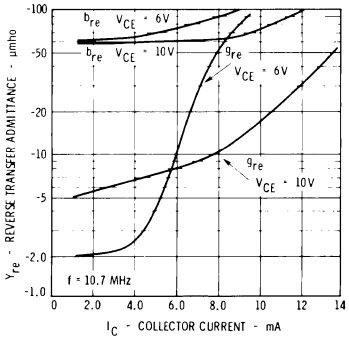

### 45 MHz REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT



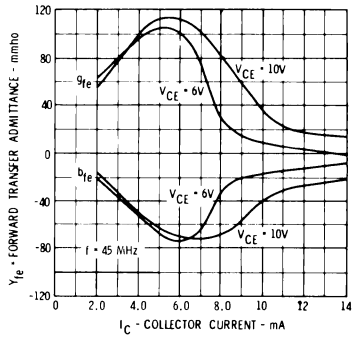

### 455 kHz REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT



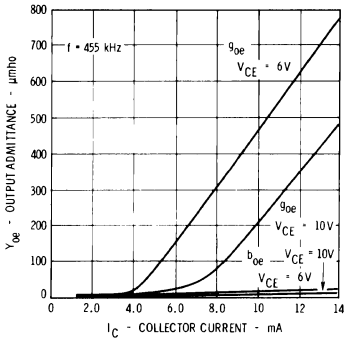

### 10.7 MHz REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT



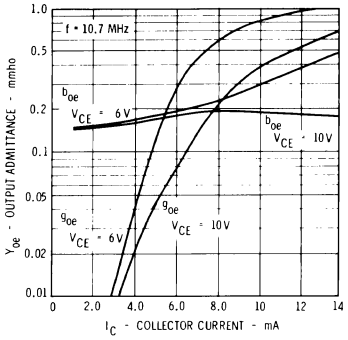

### 45 MHz FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



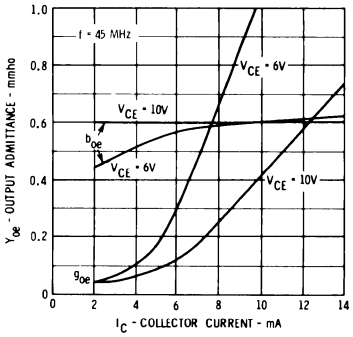

### 455 kHz OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT




### 10.7 MHz OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT




### 45 MHz OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT



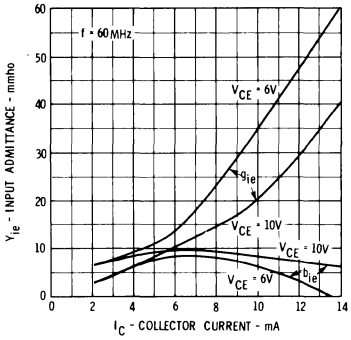

5

# CURVE SET NUMBER SS1

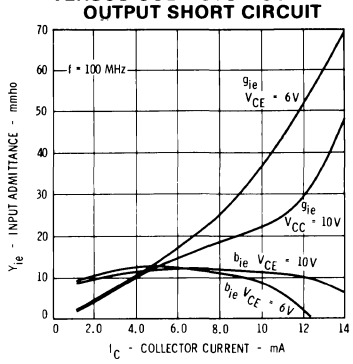
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

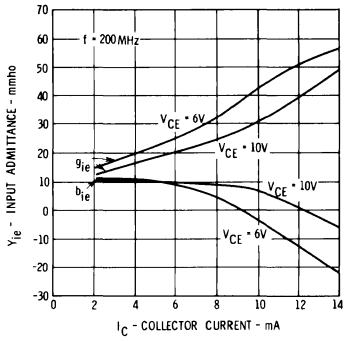
### 60 MHz INPUT ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



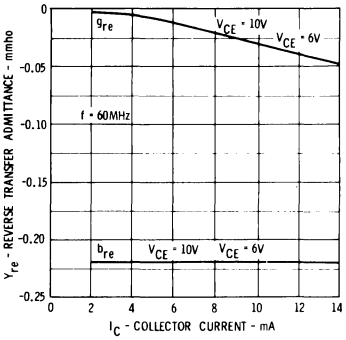

### 100 MHz INPUT ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



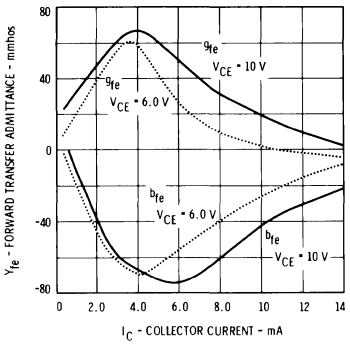

### 200 MHz INPUT ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



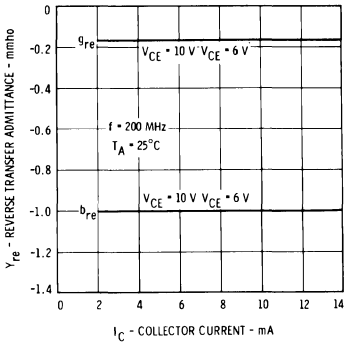

### 60 MHz REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT



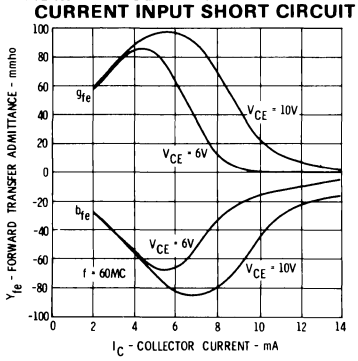

### 100 MHz FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



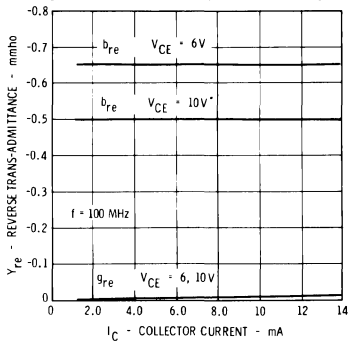

### 200 MHz REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT



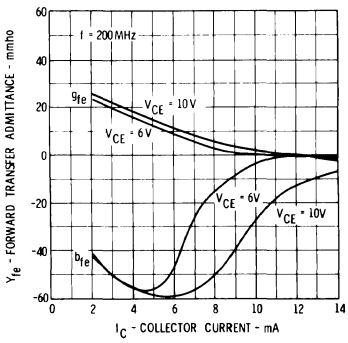

### 60 MHz FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT



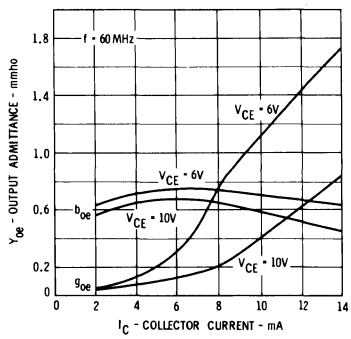

### 100 MHz REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT



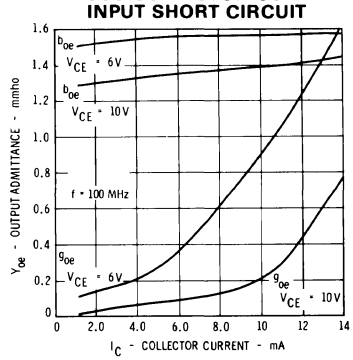

### 200 MHz FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT



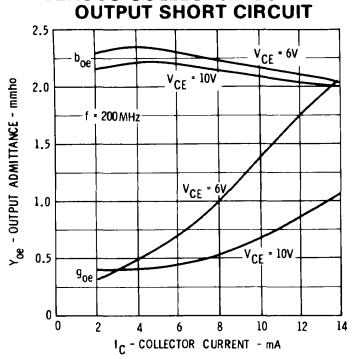

### 60 MHz OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT




### 100 MHz OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT




### 200 MHz OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT

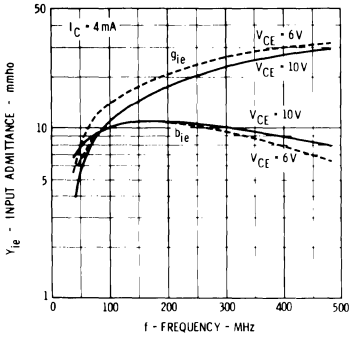


# CURVE SET NUMBER SS1

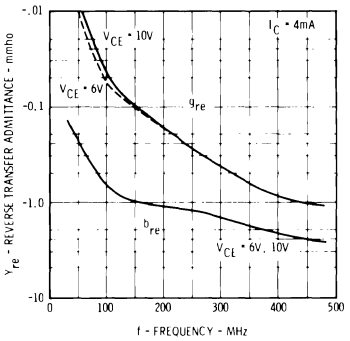
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

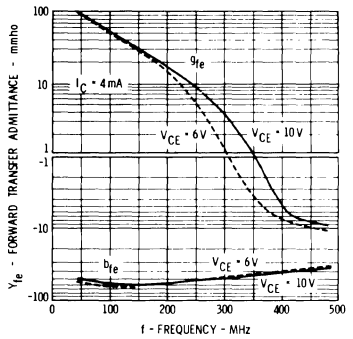
### INPUT ADMITTANCE VERSUS FREQUENCY OUTPUT SHORT CIRCUIT



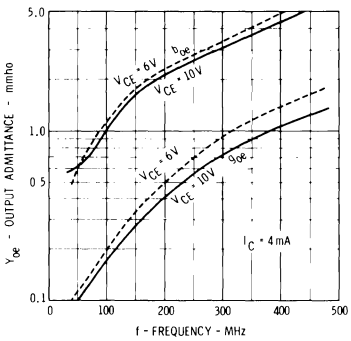

### REVERSE TRANSFER ADMITTANCE VERSUS FREQUENCY INPUT SHORT CIRCUIT




### FORWARD TRANSFER ADMITTANCE VERSUS FREQUENCY OUTPUT SHORT CIRCUIT




### OUTPUT ADMITTANCE VERSUS FREQUENCY INPUT SHORT CIRCUIT



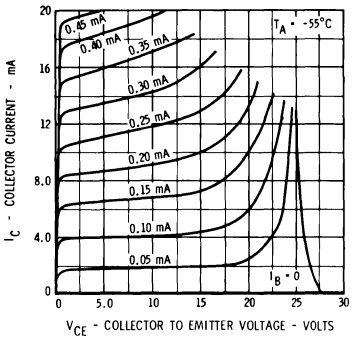

5

# CURVE SET NUMBER SS2

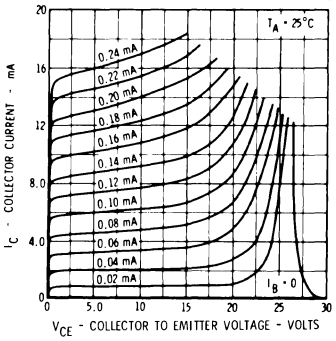
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

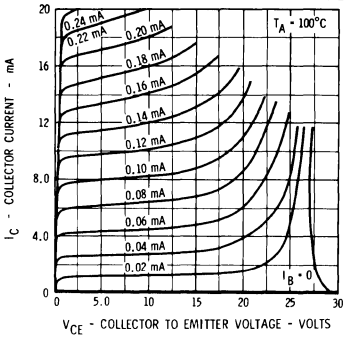
### COLLECTOR CHARACTERISTICS



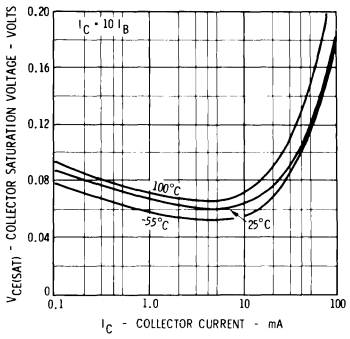

### COLLECTOR CHARACTERISTICS



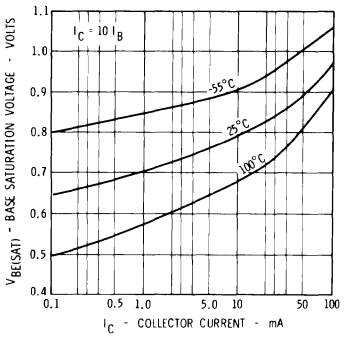

### COLLECTOR CHARACTERISTICS



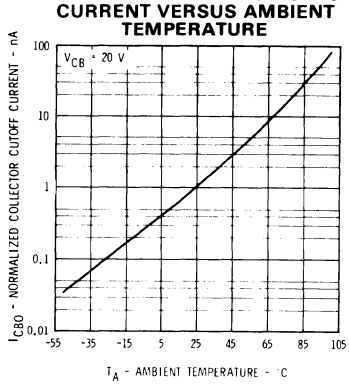

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



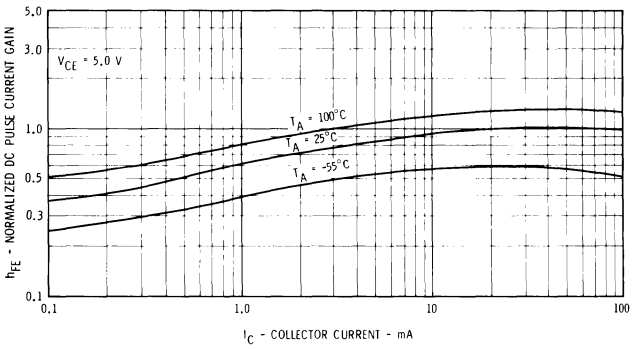

### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



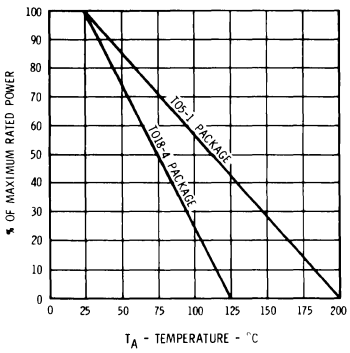

### NORMALIZED COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



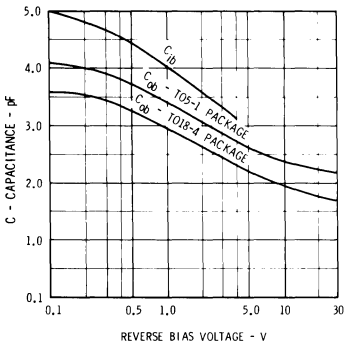

### NORMALIZED CURRENT GAIN VERSUS COLLECTOR CURRENT



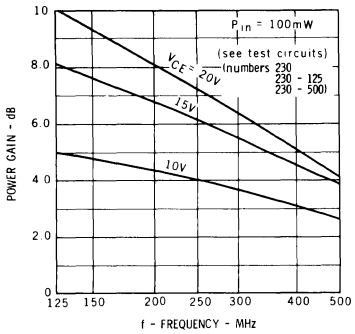

### ALLOWABLE POWER DISSIPATION VERSUS TEMPERATURE



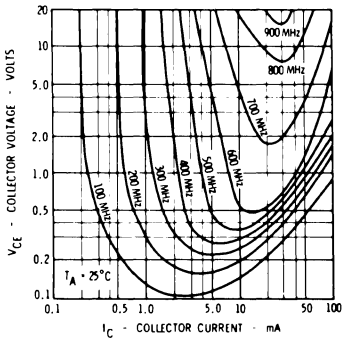

### INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE




### POWER GAIN VERSUS FREQUENCY




### CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT

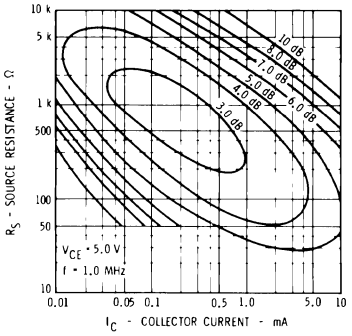


# CURVE SET NUMBER SS2

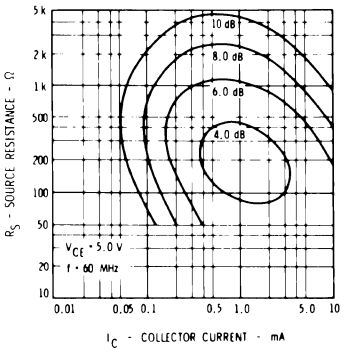
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

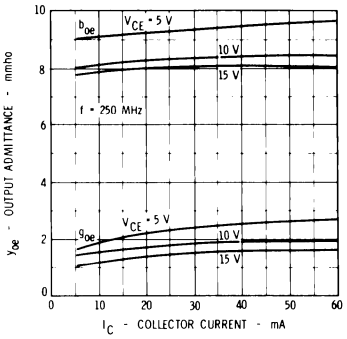
### CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



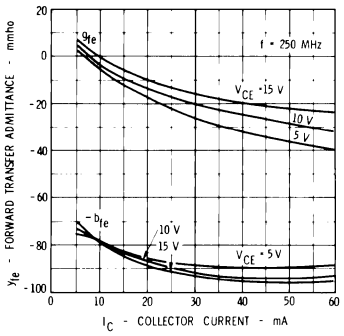

### CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



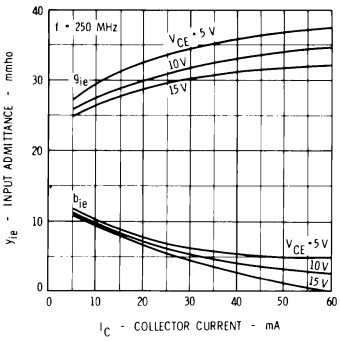

### OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT



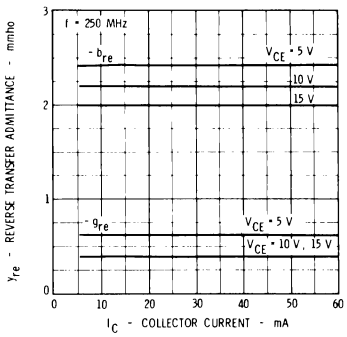

### FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



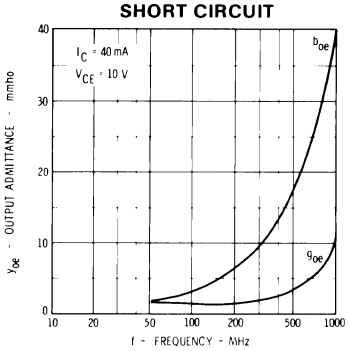

### INPUT ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



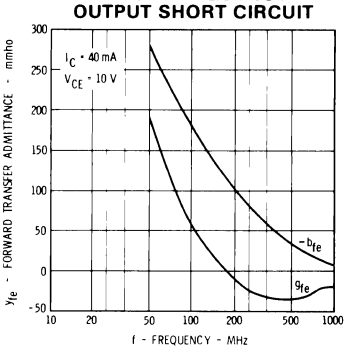

### REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT



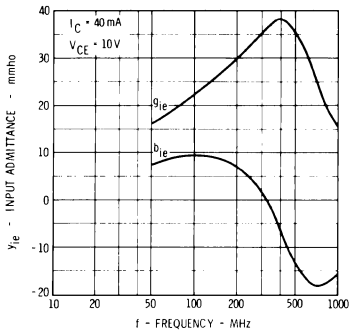

### OUTPUT ADMITTANCE VERSUS FREQUENCY INPUT SHORT CIRCUIT



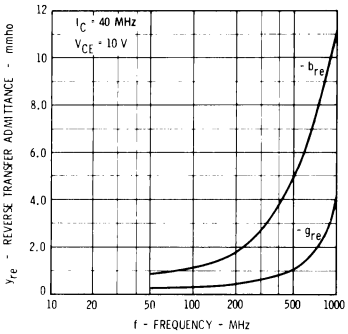

### FORWARD TRANSFER ADMITTANCE VERSUS FREQUENCY OUTPUT SHORT CIRCUIT




### INPUT ADMITTANCE VERSUS FREQUENCY OUTPUT SHORT CIRCUIT




### REVERSE TRANSFER ADMITTANCE VERSUS FREQUENCY INPUT SHORT CIRCUIT



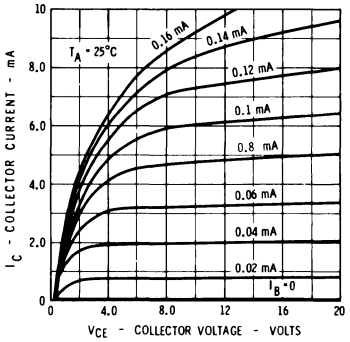

5

# CURVE SET NUMBER SS3

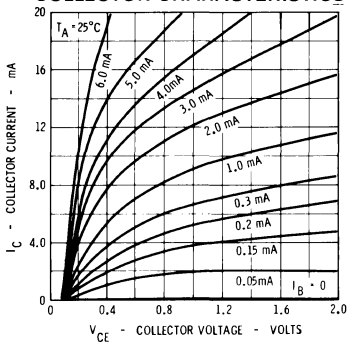
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

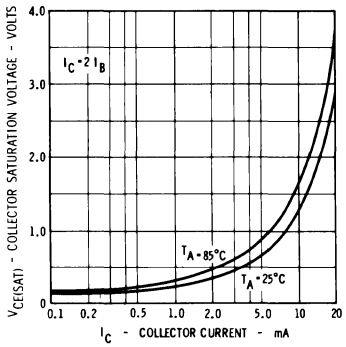
### COLLECTOR CHARACTERISTICS



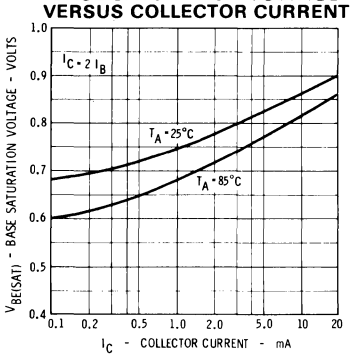

### COLLECTOR CHARACTERISTICS



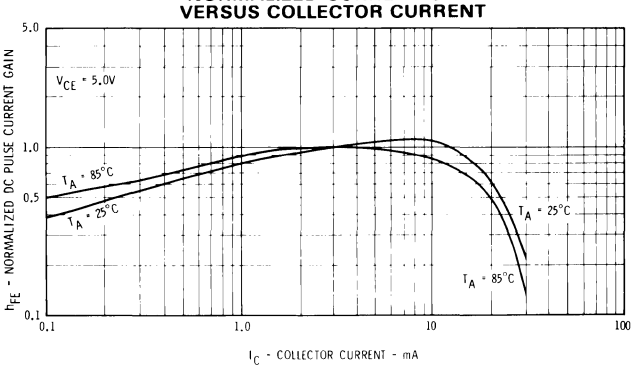

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



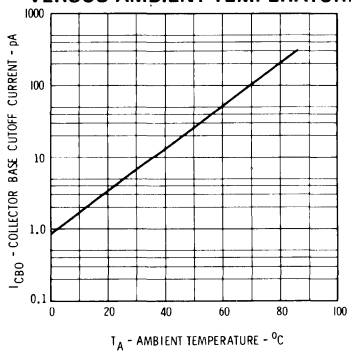

### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



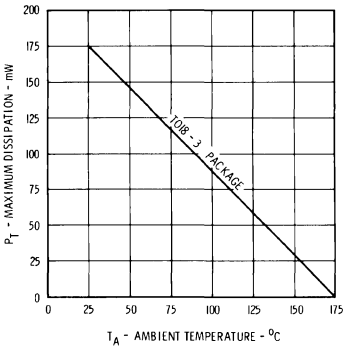

### NORMALIZED CURRENT GAIN VERSUS COLLECTOR CURRENT



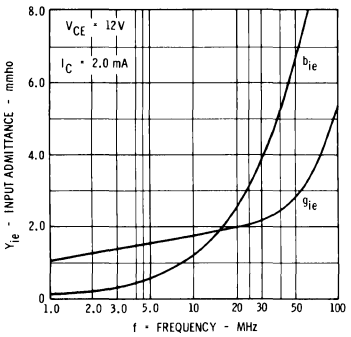

### COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



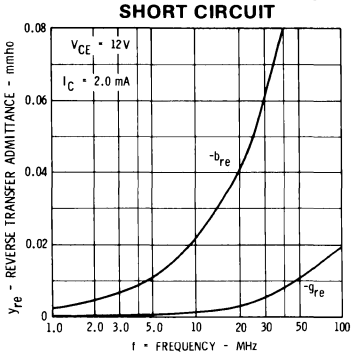

### MAXIMUM DISSIPATION VERSUS TEMPERATURE



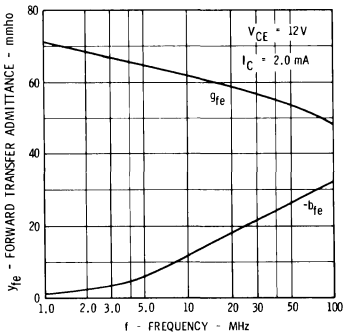

### INPUT ADMITTANCE VERSUS FREQUENCY OUTPUT SHORT CIRCUIT



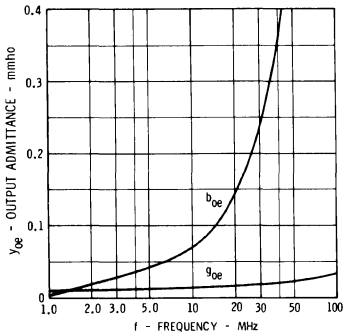

### REVERSE TRANSFER ADMITTANCE VERSUS FREQUENCY INPUT SHORT CIRCUIT




### FORWARD TRANSFER ADMITTANCE VERSUS FREQUENCY OUTPUT SHORT CIRCUIT




### OUTPUT ADMITTANCE VERSUS FREQUENCY INPUT SHORT CIRCUIT



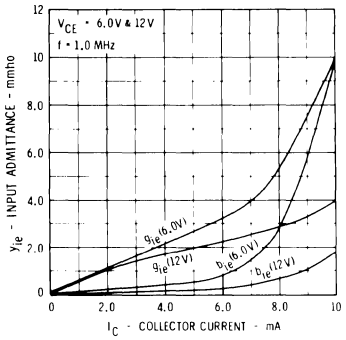
# CURVE SET NUMBER SS3

## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

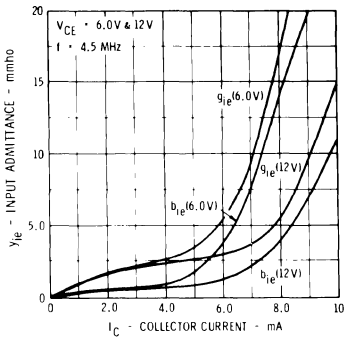
AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

f = 1.0 MHz | f = 4.5 MHz | f = 10.7 MHz

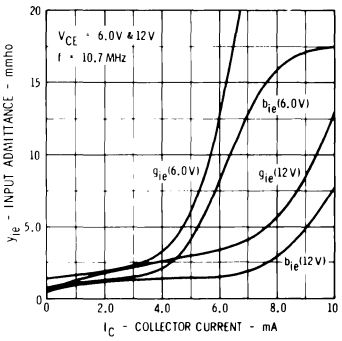
**INPUT ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT**



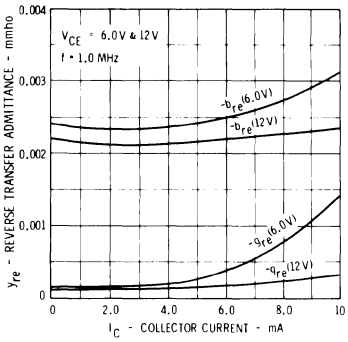

**INPUT ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT**



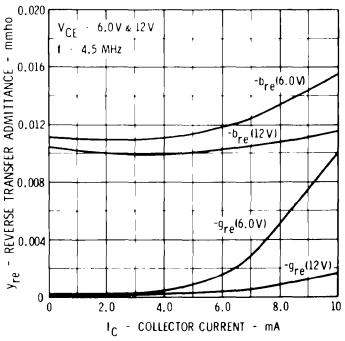

**INPUT ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT**



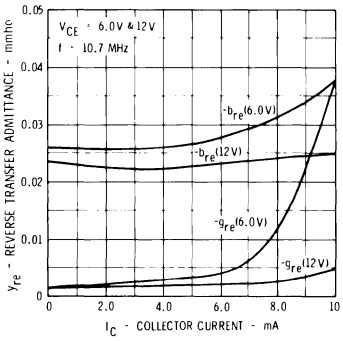

**REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT**



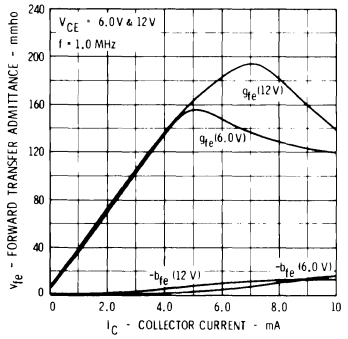

**REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT**



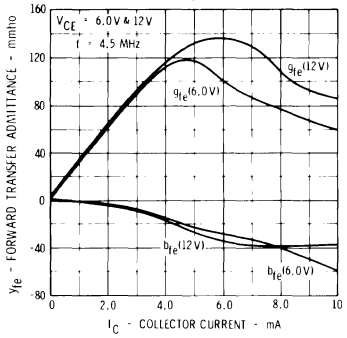

**REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT**



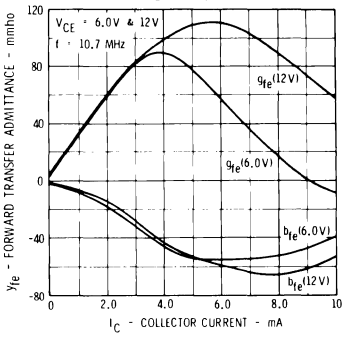

**FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT**



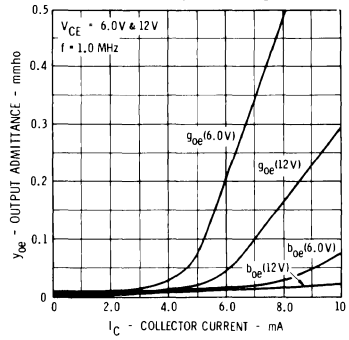

**FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT**



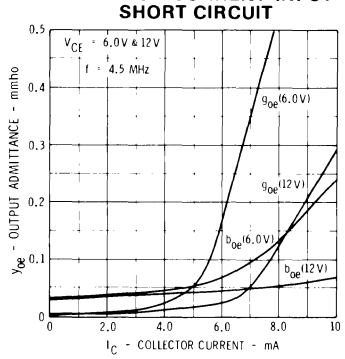

**FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT**



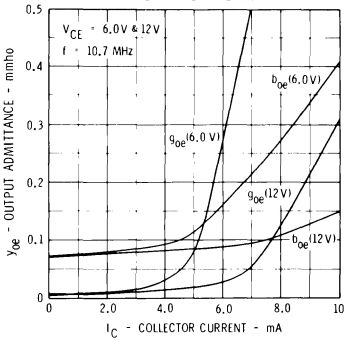

**OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT**




**OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT**




**OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT**




5

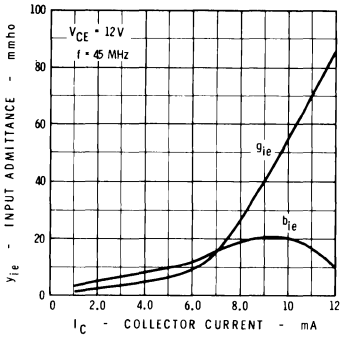
# CURVE SET NUMBER SS3

## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

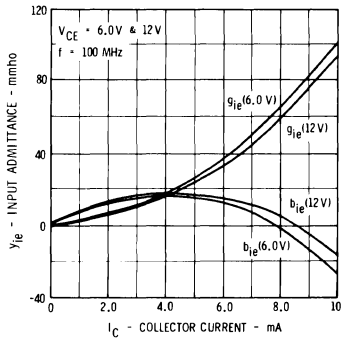
AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

f = 45 MHz | f = 100 MHz | f = 200 MHz

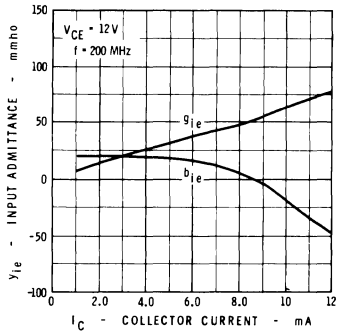
### INPUT ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



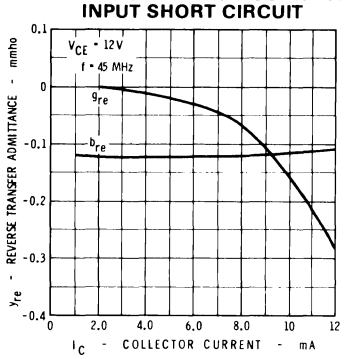

### INPUT ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



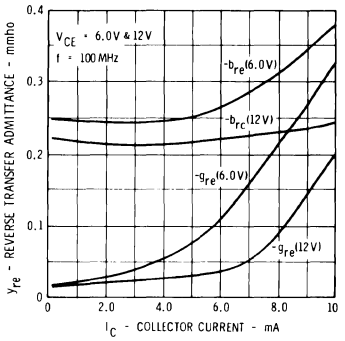

### INPUT ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



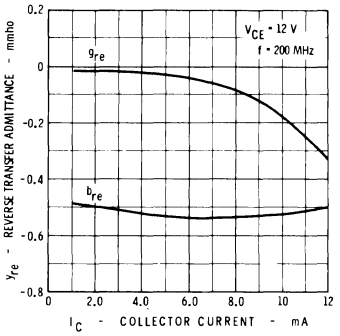

### REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT



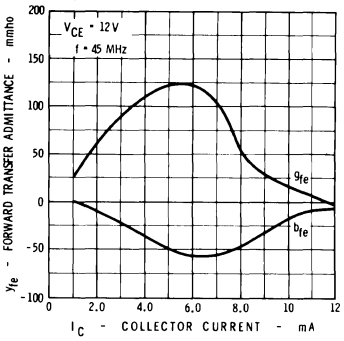

### REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT



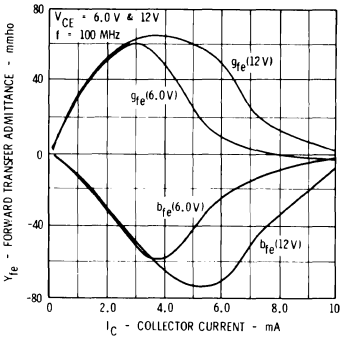

### REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT



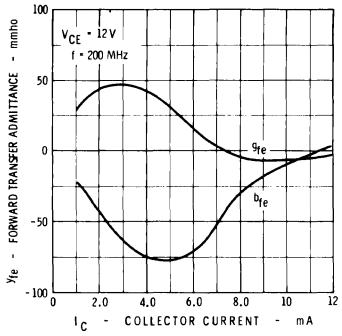

### FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



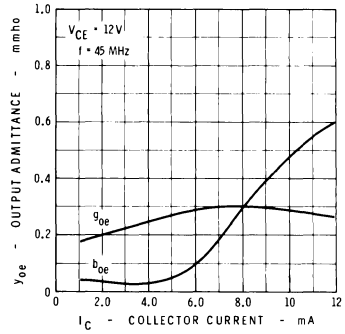

### FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



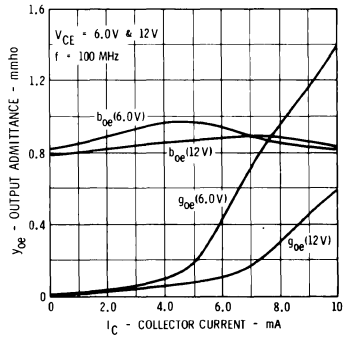

### FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



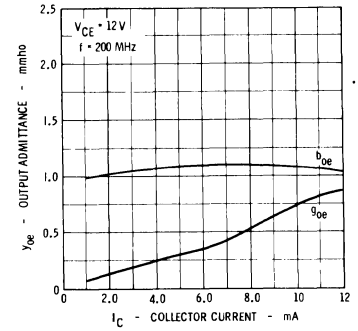

### OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT




### OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT




### OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT

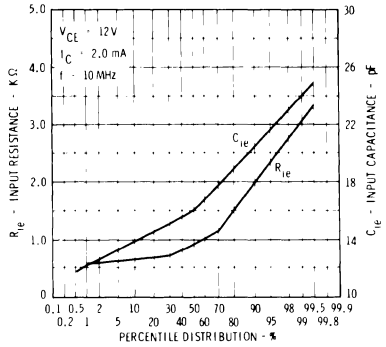


# CURVE SET NUMBER SS3

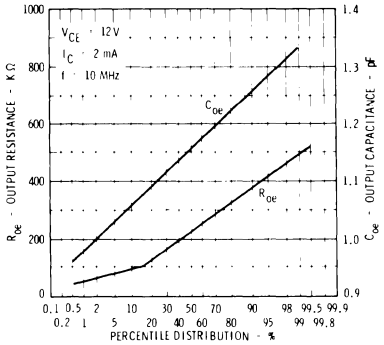
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

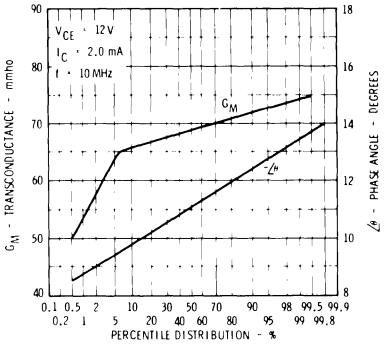
### DISTRIBUTION OF COMMON EMITTER INPUT RESISTANCE AND INPUT CAPACITANCE OUTPUT SHORT CIRCUIT



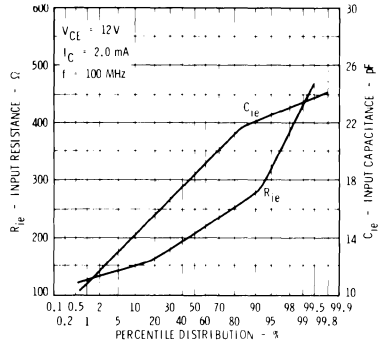

### DISTRIBUTION OF COMMON EMITTER OUTPUT RESISTANCE AND OUTPUT CAPACITANCE INPUT SHORT CIRCUIT



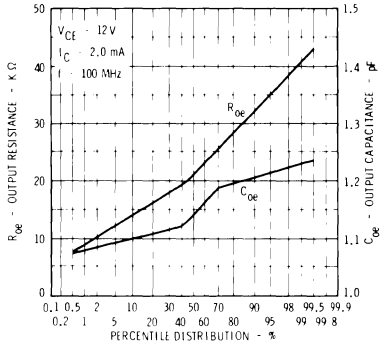

### DISTRIBUTION OF PHASE ANGLE AND TRANSCONDUCTANCE COMMON EMITTER CONFIGURATION OUTPUT SHORT CIRCUIT



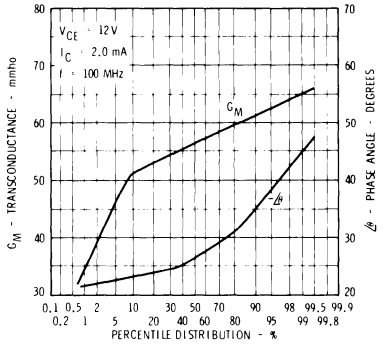

### DISTRIBUTION OF COMMON EMITTER INPUT RESISTANCE AND INPUT CAPACITANCE OUTPUT SHORT CIRCUIT



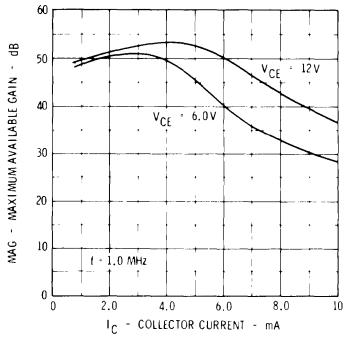

### DISTRIBUTION OF COMMON EMITTER OUTPUT RESISTANCE AND OUTPUT CAPACITANCE INPUT SHORT CIRCUIT



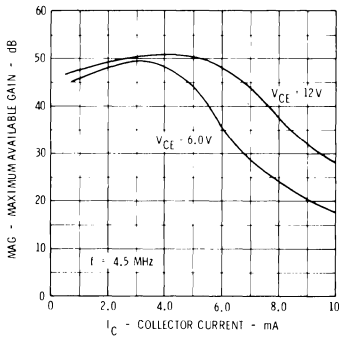

### DISTRIBUTION OF PHASE ANGLE AND TRANSCONDUCTANCE COMMON EMITTER CONFIGURATION OUTPUT SHORT CIRCUIT



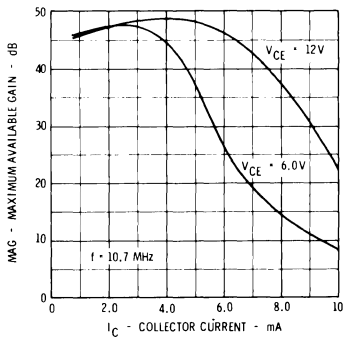

### MAXIMUM AVAILABLE GAIN VERSUS COLLECTOR CURRENT



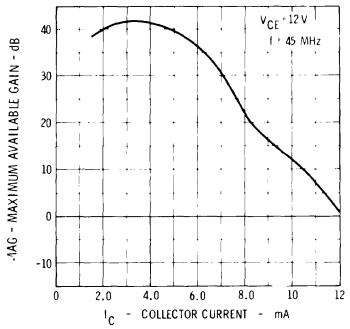

### MAXIMUM AVAILABLE GAIN VERSUS COLLECTOR CURRENT



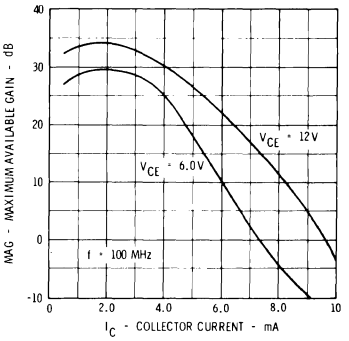

### MAXIMUM AVAILABLE GAIN VERSUS COLLECTOR CURRENT



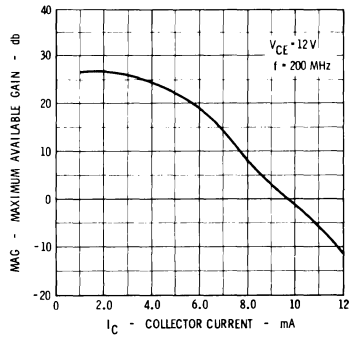

### MAXIMUM AVAILABLE GAIN VERSUS COLLECTOR CURRENT




### MAXIMUM AVAILABLE GAIN VERSUS COLLECTOR CURRENT




### MAXIMUM AVAILABLE GAIN VERSUS COLLECTOR CURRENT



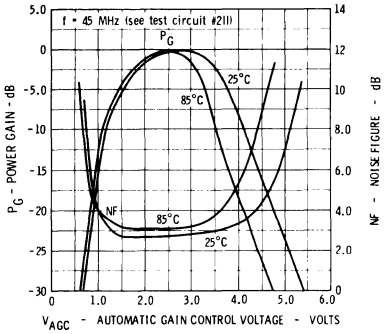

5

# CURVE SET NUMBER SS3

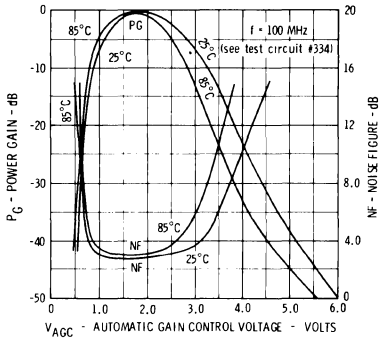
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

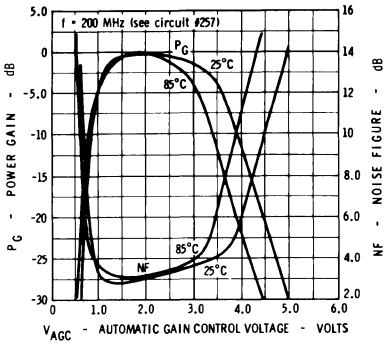
### POWER GAIN AND NOISE FIGURE VERSUS AUTOMATIC GAIN CONTROL VOLTAGE



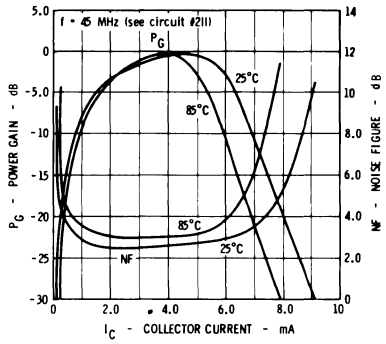

### POWER GAIN AND NOISE FIGURE VERSUS GAIN CONTROL VOLTAGE



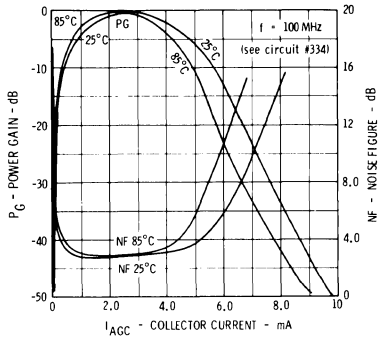

### POWER GAIN AND NOISE FIGURE VERSUS AUTOMATIC GAIN CONTROL VOLTAGE



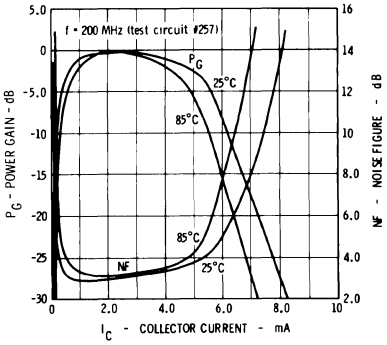

### POWER GAIN AND NOISE FIGURE VERSUS COLLECTOR CURRENT



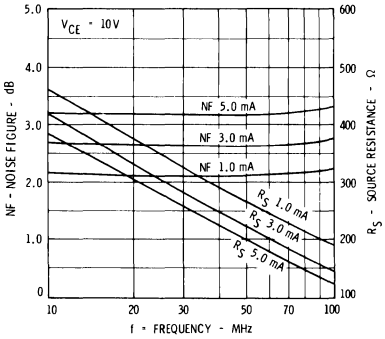

### POWER GAIN AND NOISE FIGURE VERSUS COLLECTOR CURRENT



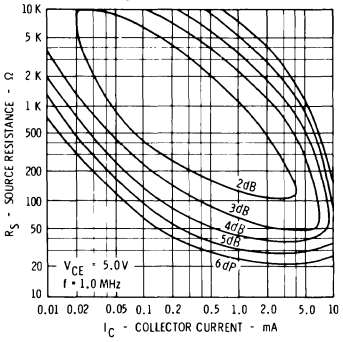

### POWER GAIN AND NOISE FIGURE VERSUS COLLECTOR CURRENT



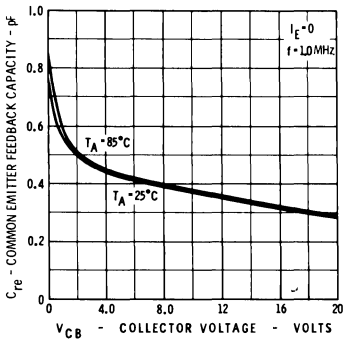

### SOURCE REISTANCE AND NOISE FIGURE VERSUS FREQUENCY AT VARIOUS VALUES OF COLLECTOR CURRENT



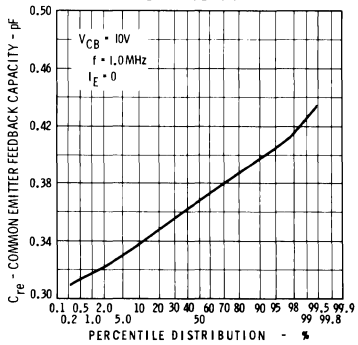

### CONTOURS OF CONSTANT NOISE FIGURE AT 1 MHz



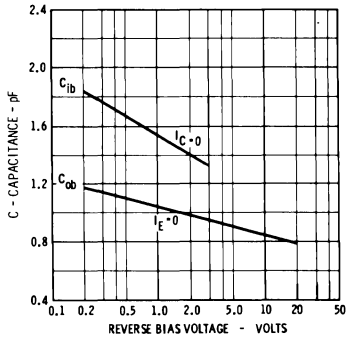

### COMMON EMITTER FEEDBACK CAPCITY VERSUS COLLECTOR VOLTAGE




### DISTRIBUTION OF COMMON EMITTER FEEDBACK CAPACITY




### INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE

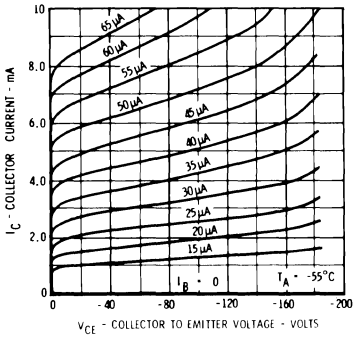


# CURVE SET NUMBER SS4

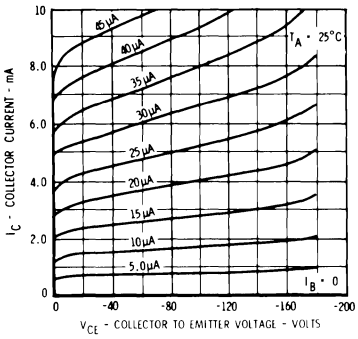
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

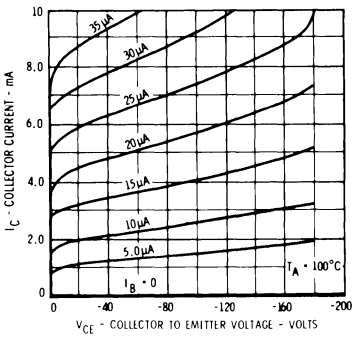
### COLLECTOR CHARACTERISTICS



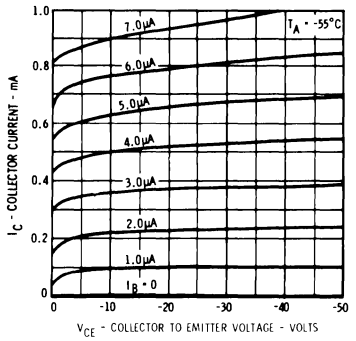

### COLLECTOR CHARACTERISTICS



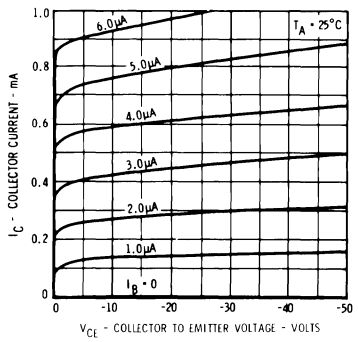

### COLLECTOR CHARACTERISTICS



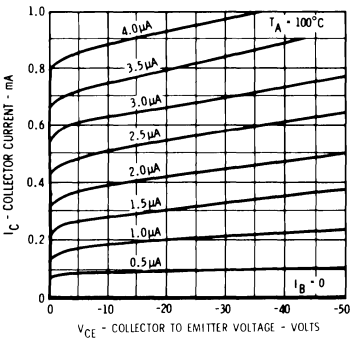

### COLLECTOR CHARACTERISTICS



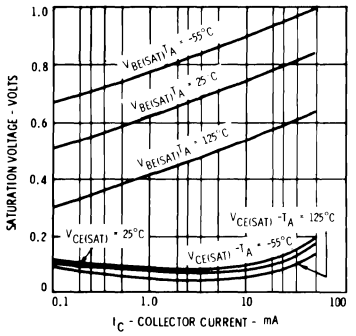

### COLLECTOR CHARACTERISTICS



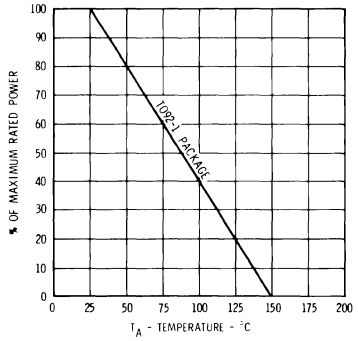

### COLLECTOR CHARACTERISTICS



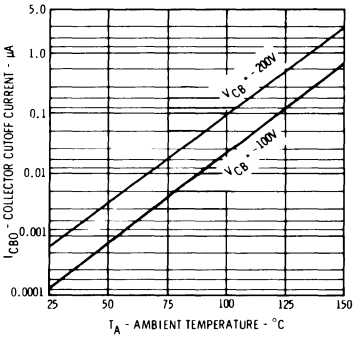

### COLLECTOR AND BASE SATURATION VOLTAGES VERSUS COLLECTOR CURRENT



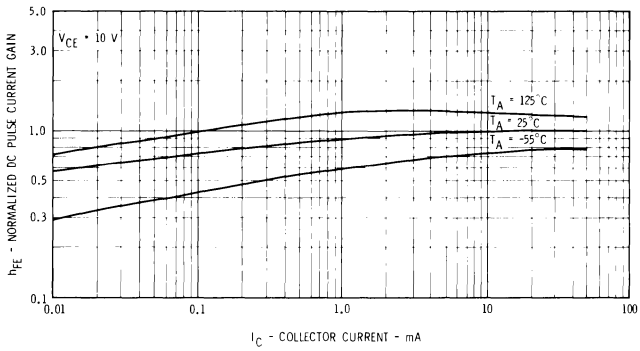

### ALLOWABLE POWER DISSIPATION VERSUS TEMPERATURE



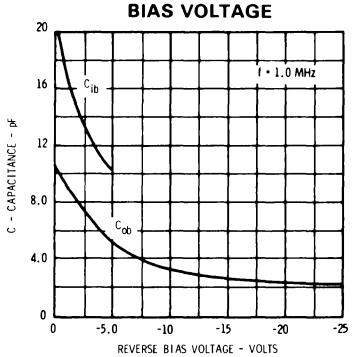

### COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE




### NORMALIZED CURRENT GAIN VERSUS COLLECTOR CURRENT




### INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE

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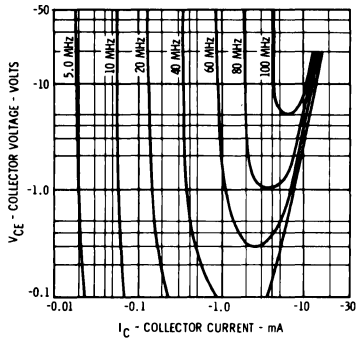
# CURVE SET NUMBER SS4

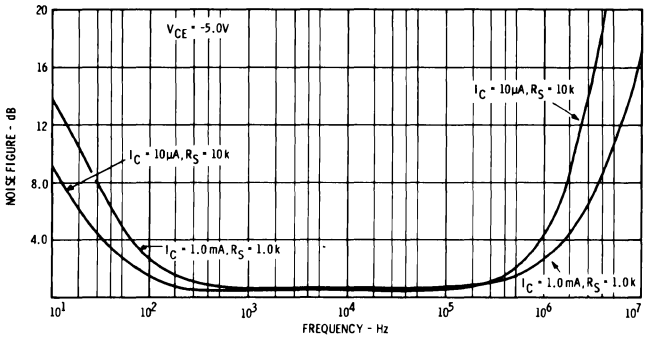
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

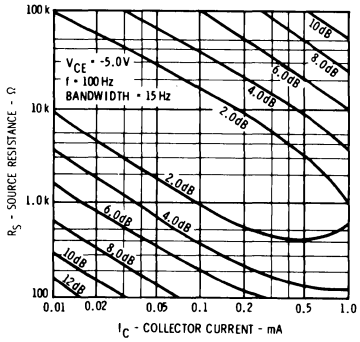
### CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT



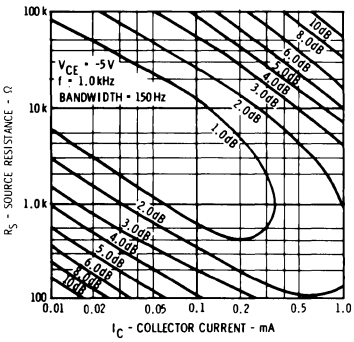

### SPOT NOISE FIGURE VERSUS FREQUENCY



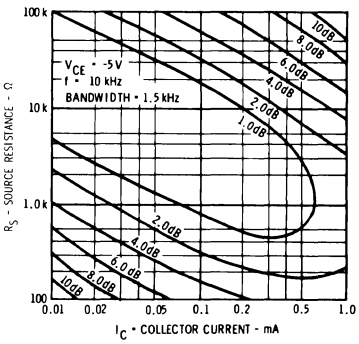

### CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



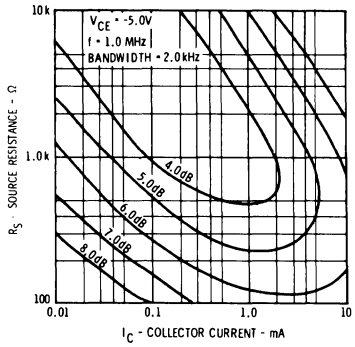

### CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



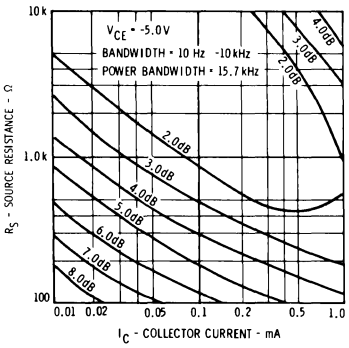

### CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



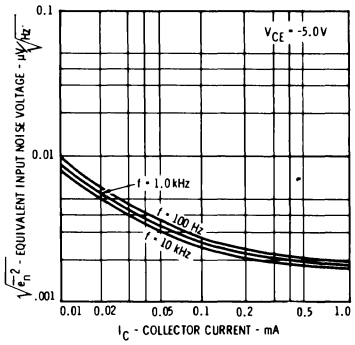

### CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



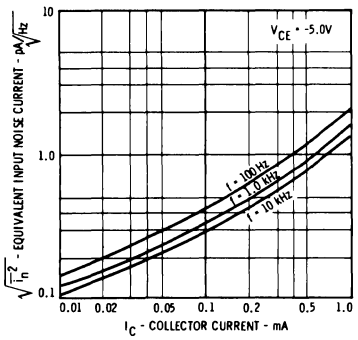

### CONTOURS OF CONSTANT WIDE BAND NOISE FIGURE



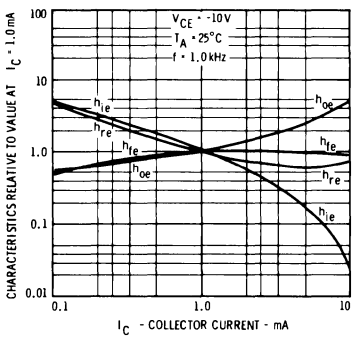

### EQUIVALENT INPUT NOISE VOLTAGE VERSUS COLLECTOR CURRENT



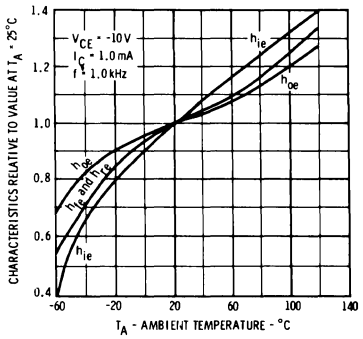

### EQUIVALENT INPUT NOISE CURRENT VERSUS COLLECTOR CURRENT




### COMMON EMITTER CHARACTERISTICS VERSUS COLLECTOR CURRENT




### COMMON EMITTER CHARACTERISTICS VERSUS AMBIENT TEMPERATURE

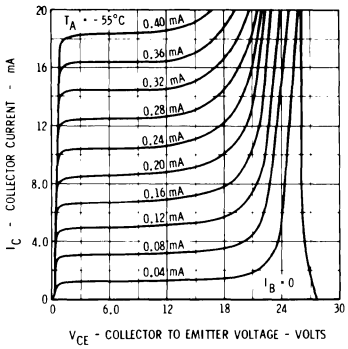


# CURVE SET NUMBER SS5

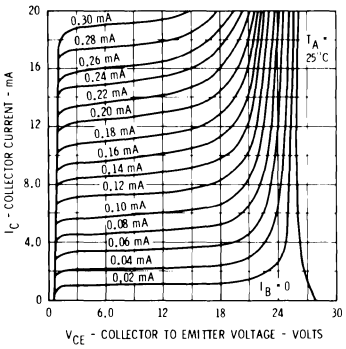
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

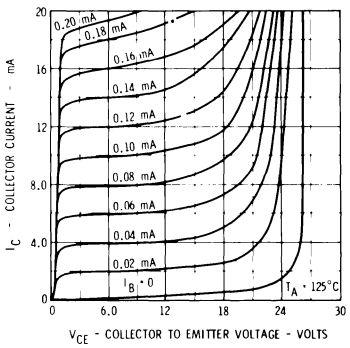
### COLLECTOR CURRENT VERSUS COLLECTOR TO EMITTER VOLTAGE



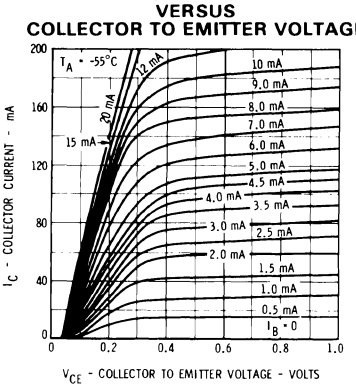

### COLLECTOR CURRENT VERSUS COLLECTOR TO EMITTER VOLTAGE



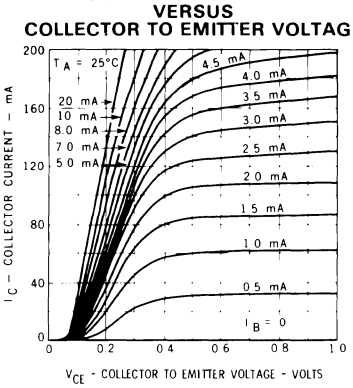

### COLLECTOR CURRENT VERSUS COLLECTOR TO EMITTER VOLTAGE



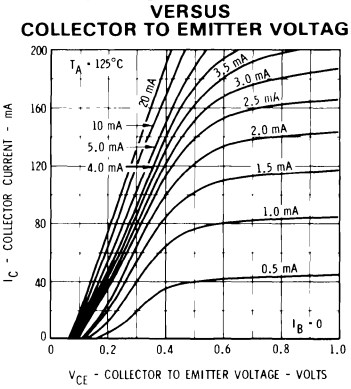

### COLLECTOR CURRENT VERSUS COLLECTOR TO EMITTER VOLTAGE



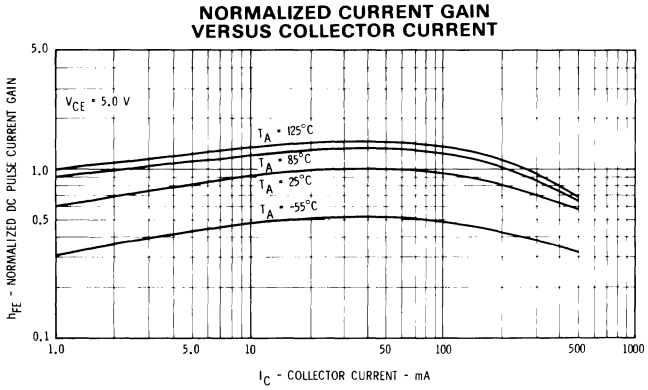

### COLLECTOR CURRENT VERSUS COLLECTOR TO EMITTER VOLTAGE



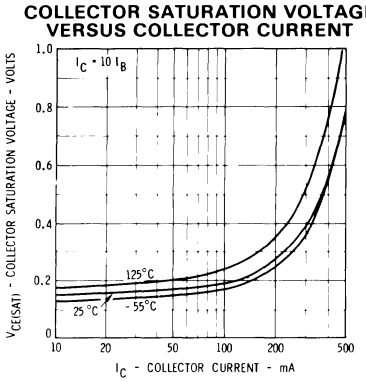

### COLLECTOR CURRENT VERSUS COLLECTOR TO EMITTER VOLTAGE




### NORMALIZED CURRENT GAIN VERSUS COLLECTOR CURRENT




### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

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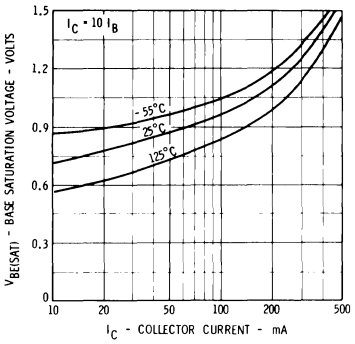
# CURVE SET NUMBER SS5

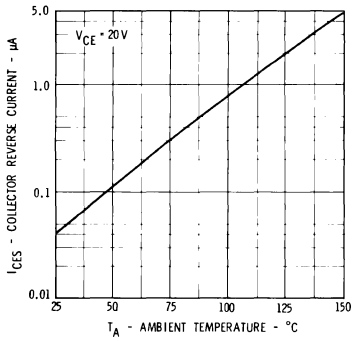
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

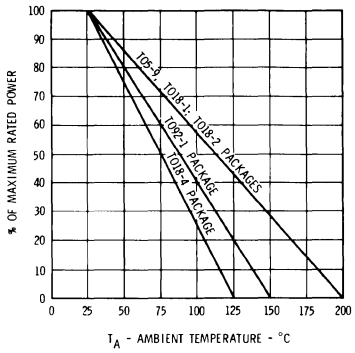
### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



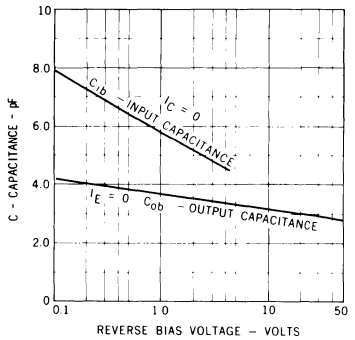

### COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



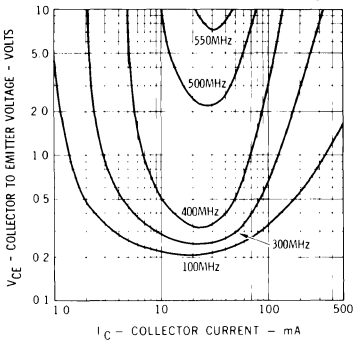

### ALLOWABLE POWER DISSIPATION VERSUS TEMPERATURE



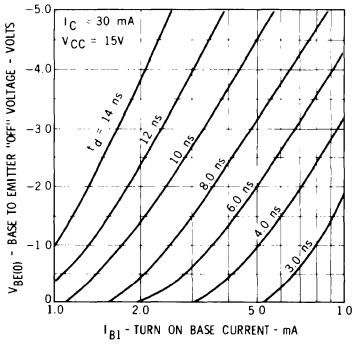

### INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



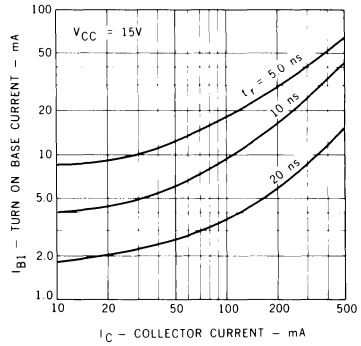

### CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT ($f_T$)



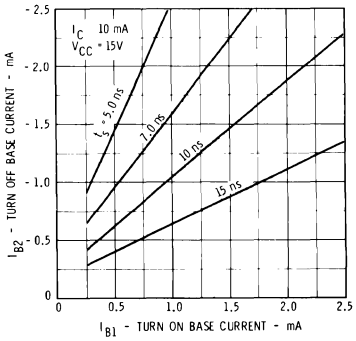

### DELAY TIME VERSUS BASE EMITTER OFF VOLTAGE AND TURN ON BASE CURRENT



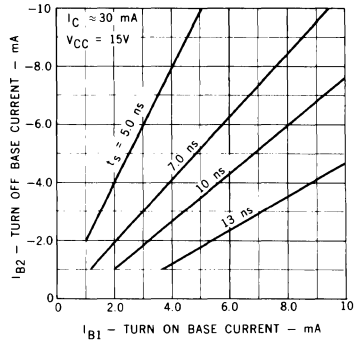

### RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS




### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS




### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

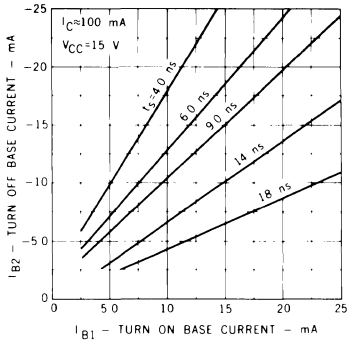


# CURVE SET NUMBER SS5

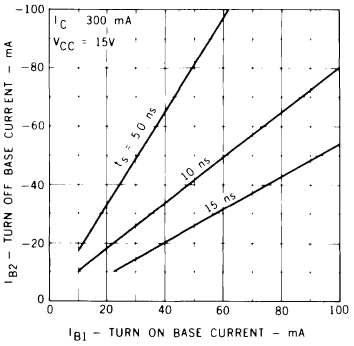
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

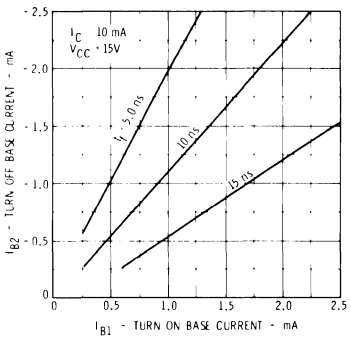
### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



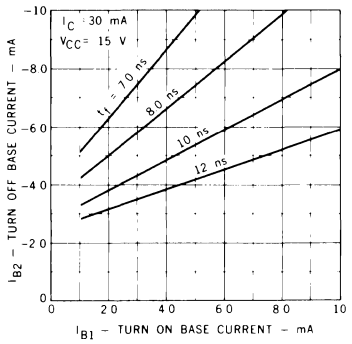

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



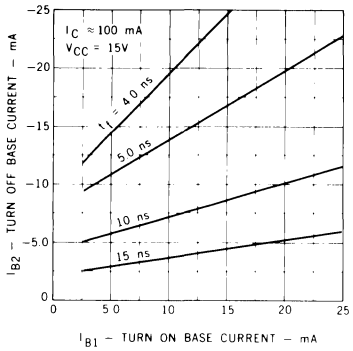

### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



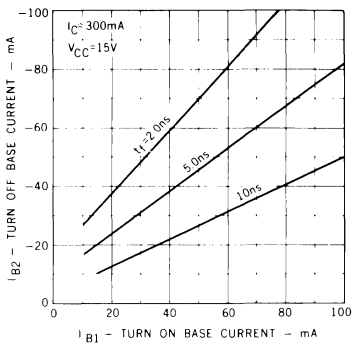

### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



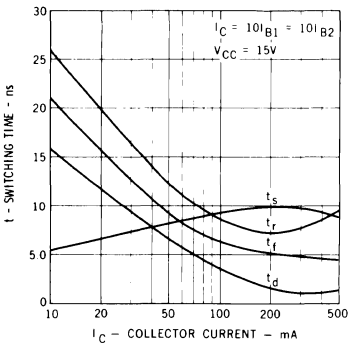

### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



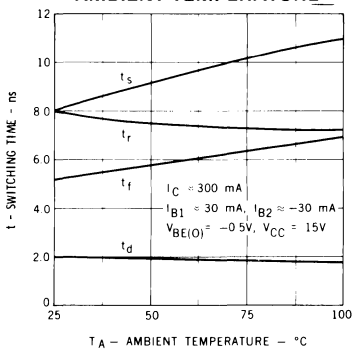

### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS




### SWITCHING TIMES VERSUS COLLECTOR CURRENT




### SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



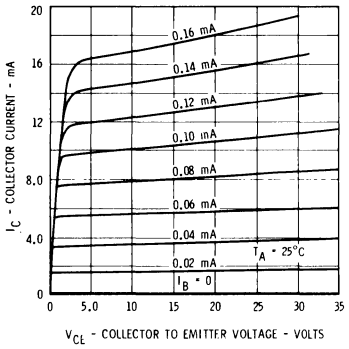

5

# CURVE SET NUMBER SS6

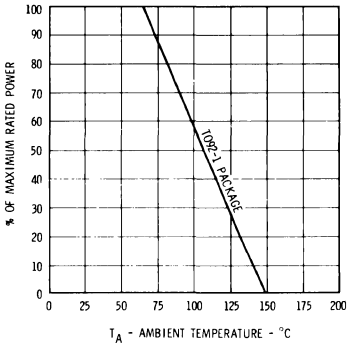
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

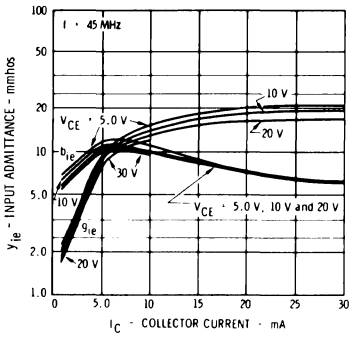
### COLLECTOR CHARACTERISTICS



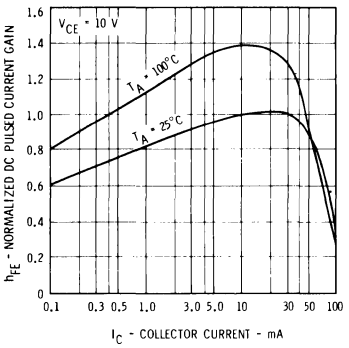

### ALLOWABLE POWER DISSIPATION VERSUS AMBIENT TEMPERATURE



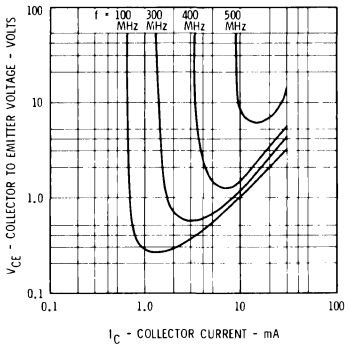

### INPUT ADMITTANCE VERSUS COLLECTOR CURRENT



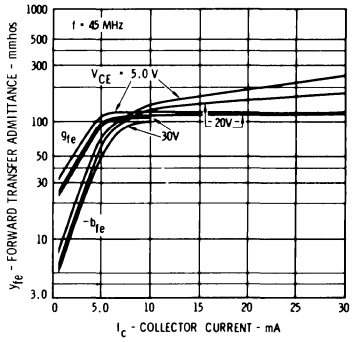

### NORMALIZED DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



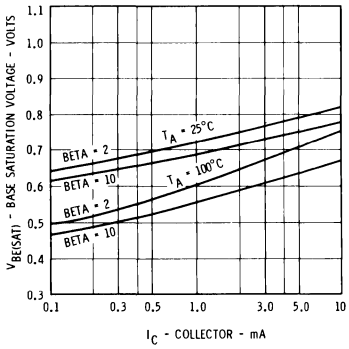

### CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT



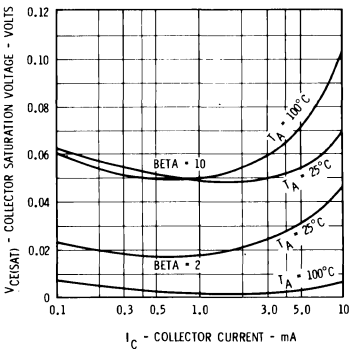

### FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT



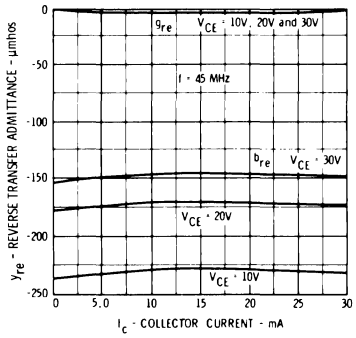

### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



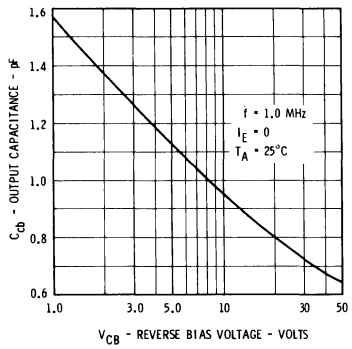

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



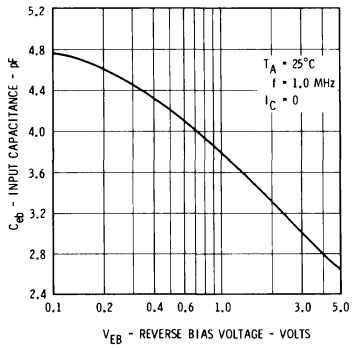

### REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT



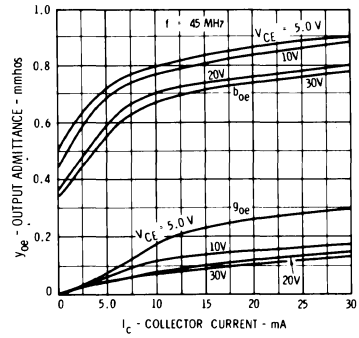

### OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE




### INPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE




### OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT

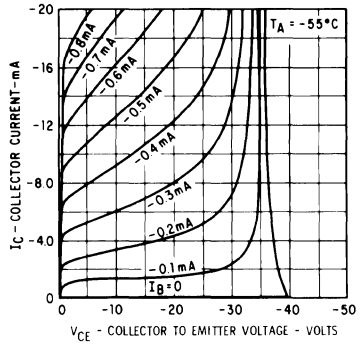


# CURVE SET NUMBER SS7

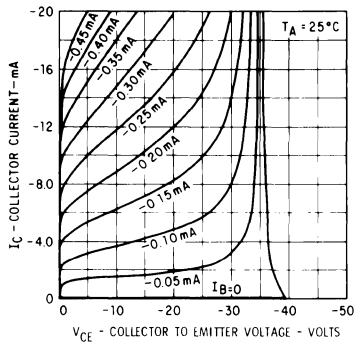
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

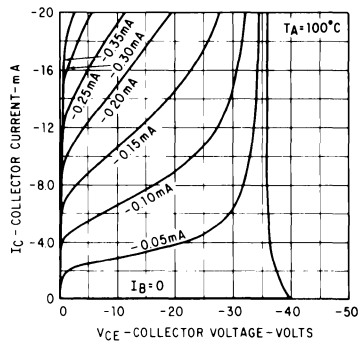
### COLLECTOR CHARACTERISTICS



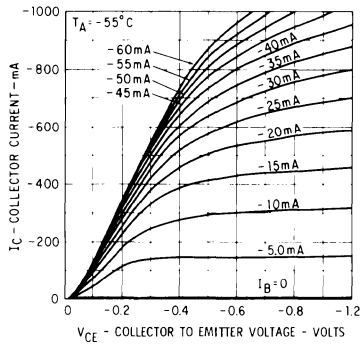

### COLLECTOR CHARACTERISTICS



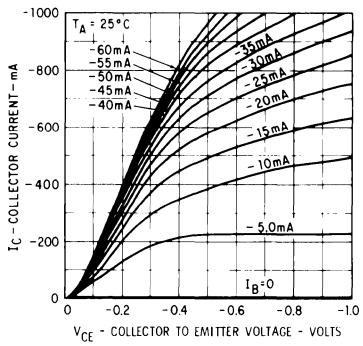

### COLLECTOR CHARACTERISTICS



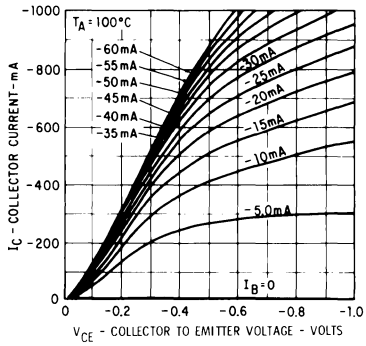

### COLLECTOR CHARACTERISTICS



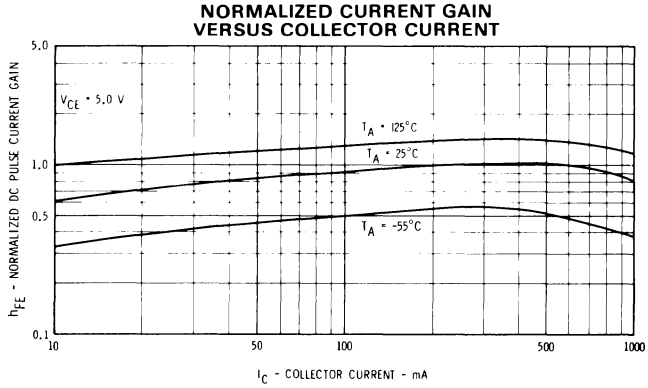

### COLLECTOR CHARACTERISTICS



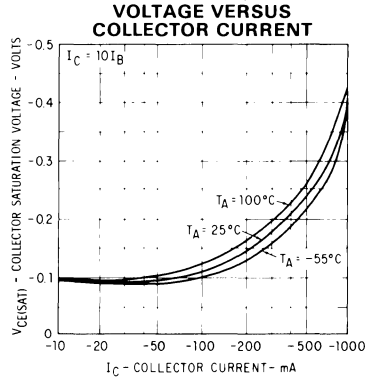

### COLLECTOR CHARACTERISTICS



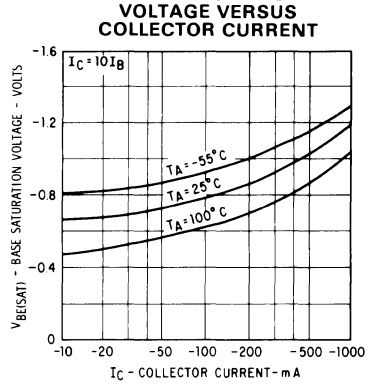

### NORMALIZED CURRENT GAIN VERSUS COLLECTOR CURRENT



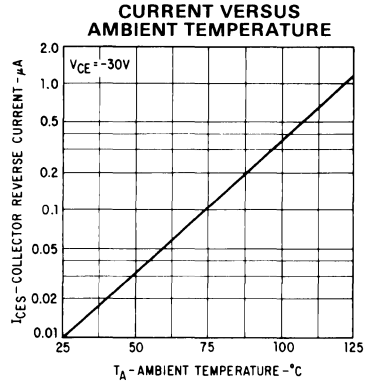

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



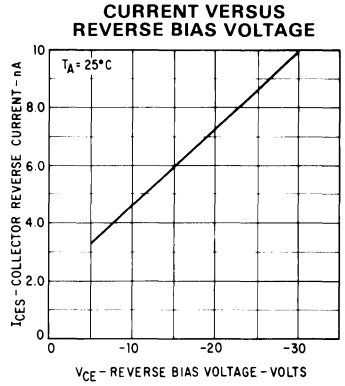

### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT




### COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE




### COLLECTOR REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



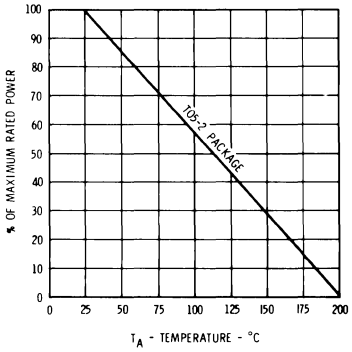

5

# CURVE SET NUMBER SS7

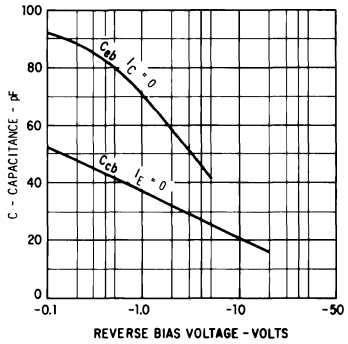
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

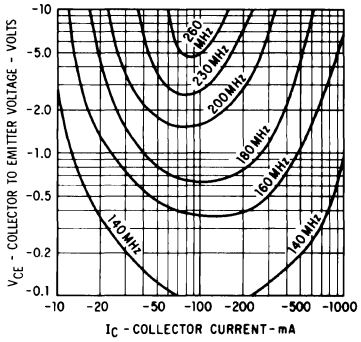
### ALLOWABLE POWER DISSIPATION VERSUS TEMPERATURE



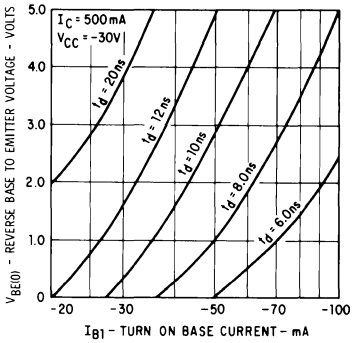

### INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



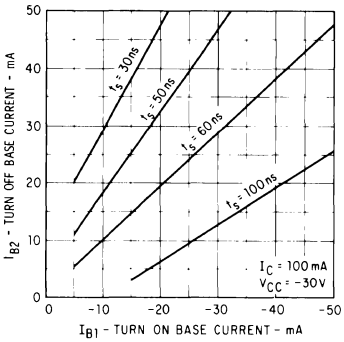

### CONTOURS OF CONSTANT BANDWIDTH PRODUCT



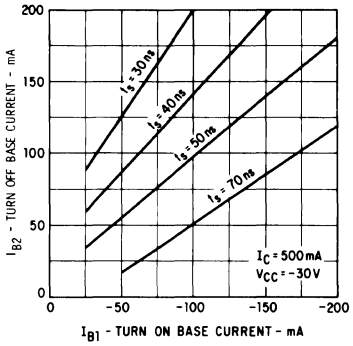

### DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



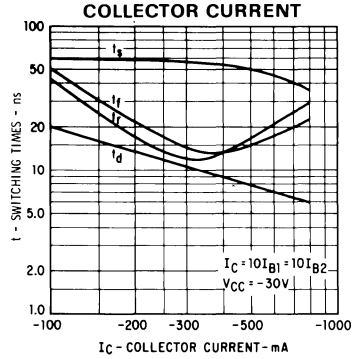

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



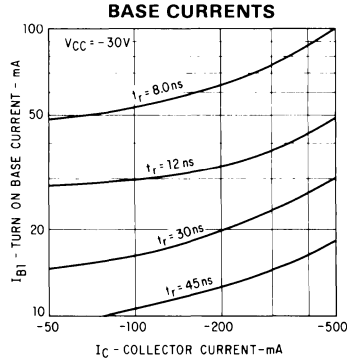

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



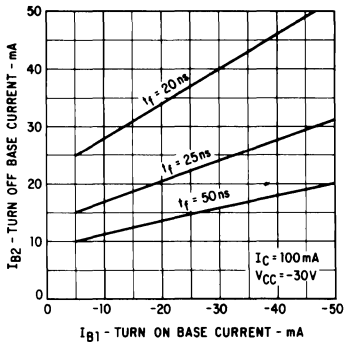

### SWITCHING TIMES VERSUS COLLECTOR CURRENT



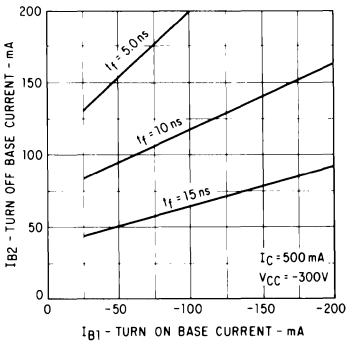

### RISE TIME VERSUS COLLECTOR CURRENT AND TURN ON BASE CURRENTS



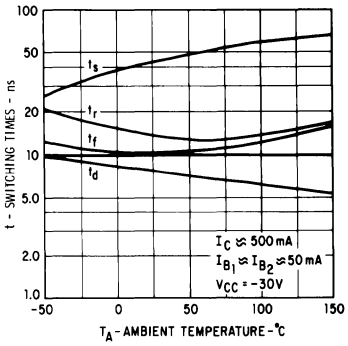

### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS




### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS




### SWITCHING TIMES VERSUS AMBIENT TEMPERATURE

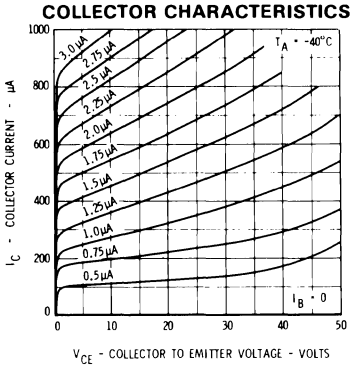


# CURVE SET NUMBER SS8

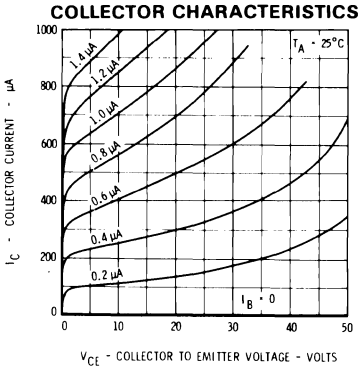
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

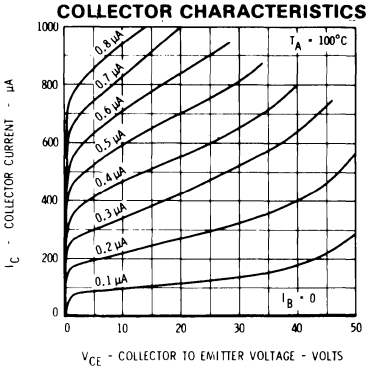
### COLLECTOR CHARACTERISTICS



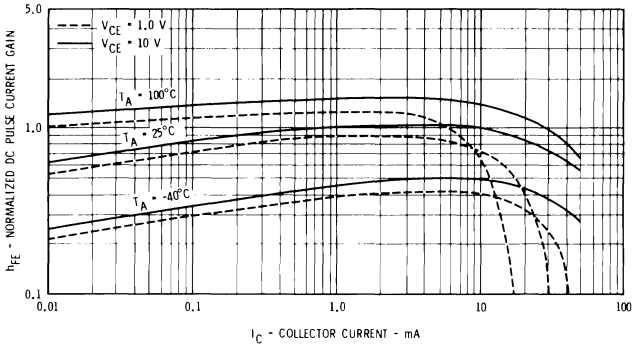

### COLLECTOR CHARACTERISTICS



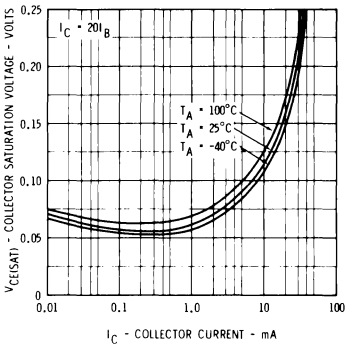

### COLLECTOR CHARACTERISTICS



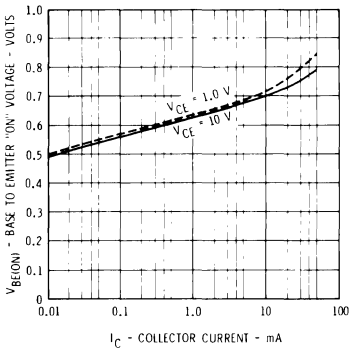

### NORMALIZED DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



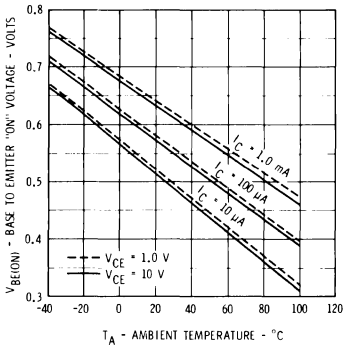

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



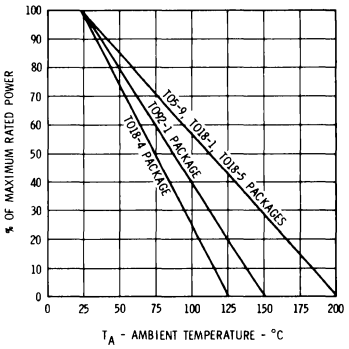

### BASE TO EMITTER 'ON' VOLTAGE VERSUS COLLECTOR CURRENT




### BASE TO EMITTER 'ON' VOLTAGE VERSUS AMBIENT TEMPERATURE




### ALLOWABLE POWER DISSIPATION VERSUS AMBIENT TEMPERATURE

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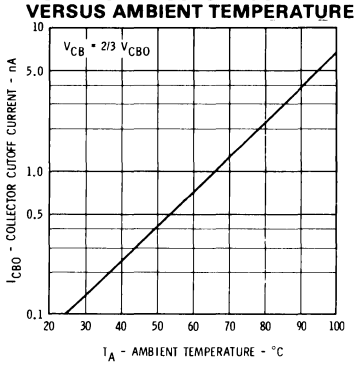
# CURVE SET NUMBER SS8

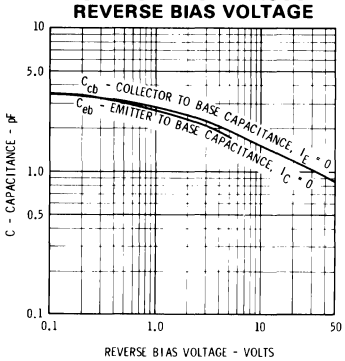
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

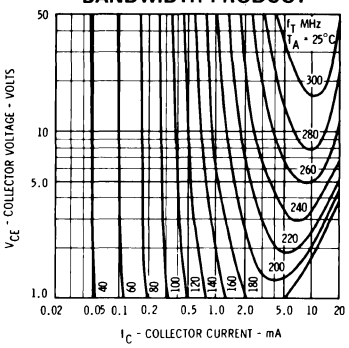
### COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



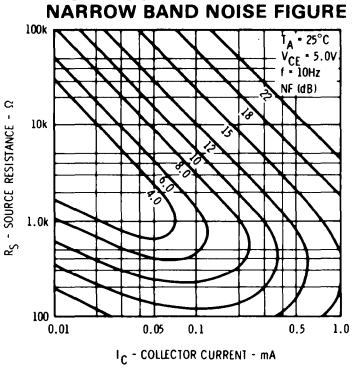

### CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



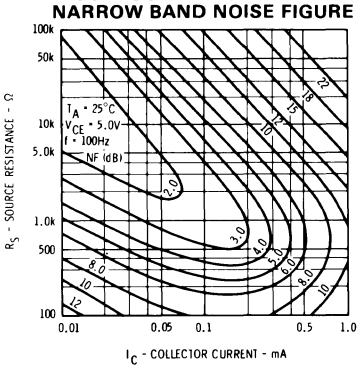

### CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT



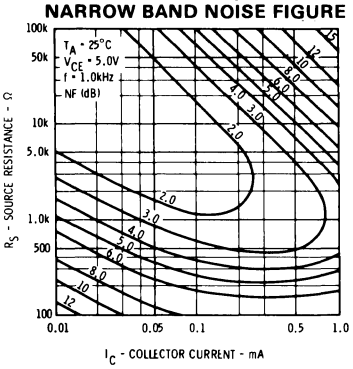

### CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



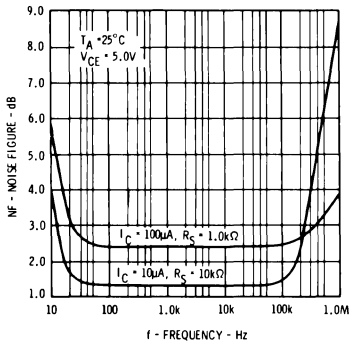

### CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE




### CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE




### NOISE FIGURE VERSUS FREQUENCY

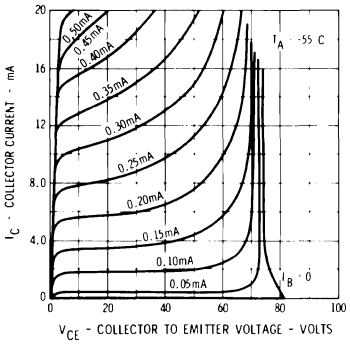


# CURVE SET NUMBER SS9

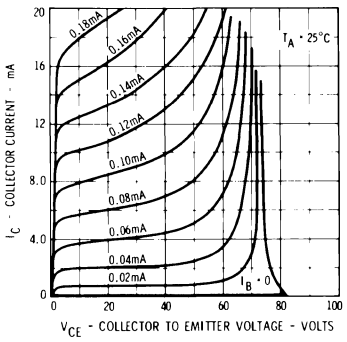
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

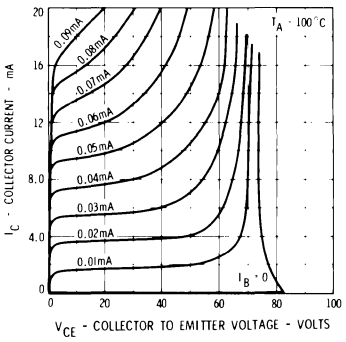
### COLLECTOR CHARACTERISTICS



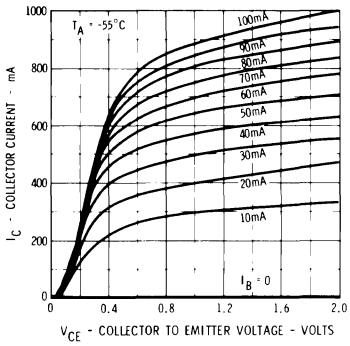

### COLLECTOR CHARACTERISTICS



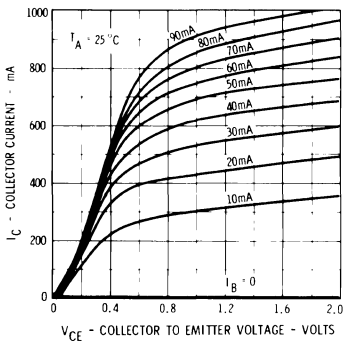

### COLLECTOR CHARACTERISTICS



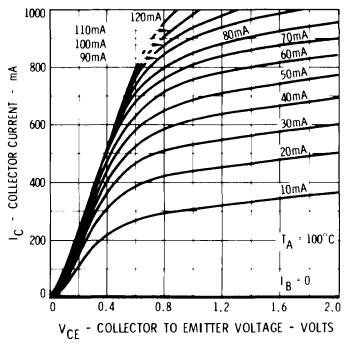

### COLLECTOR CHARACTERISTICS



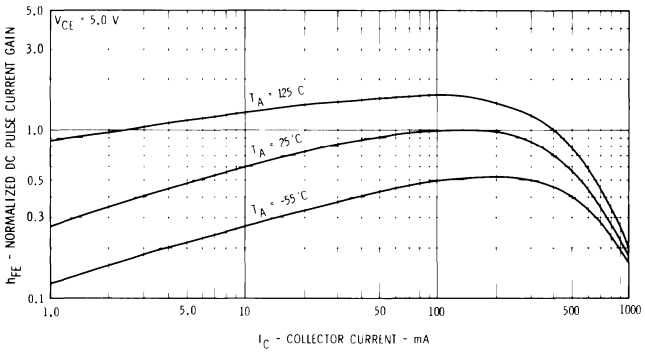

### COLLECTOR CHARACTERISTICS



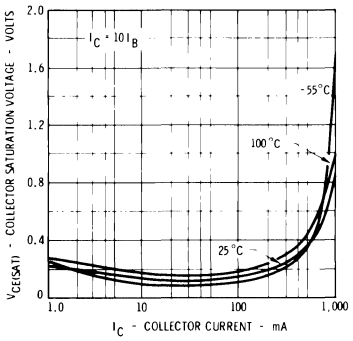

### COLLECTOR CHARACTERISTICS



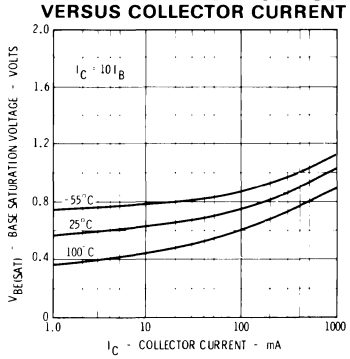

### NORMALIZED CURRENT GAIN VERSUS COLLECTOR CURRENT



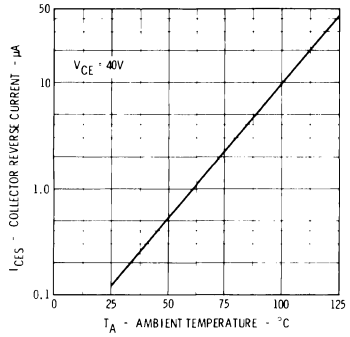

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



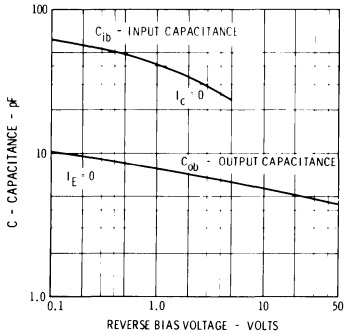

### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT




### COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE




### INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



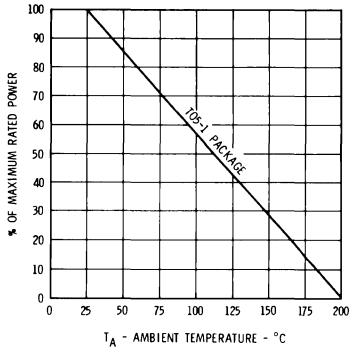

5

# CURVE SET NUMBER SS9

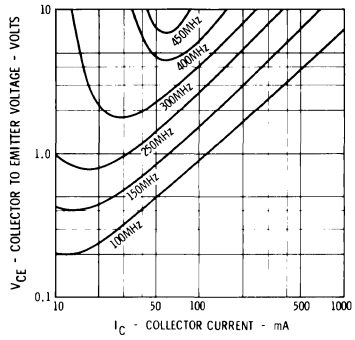
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

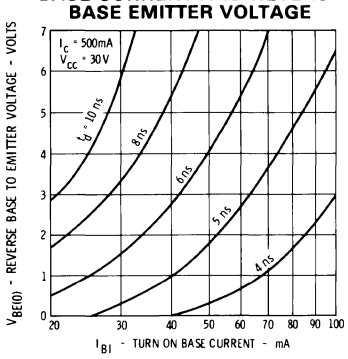
### ALLOWABLE POWER DISSIPATION VERSUS TEMPERATURE



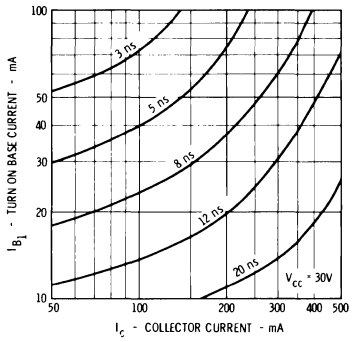

### CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT



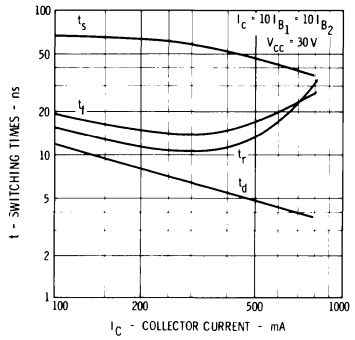

### DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



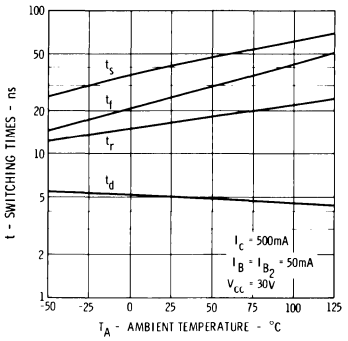

### RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENT



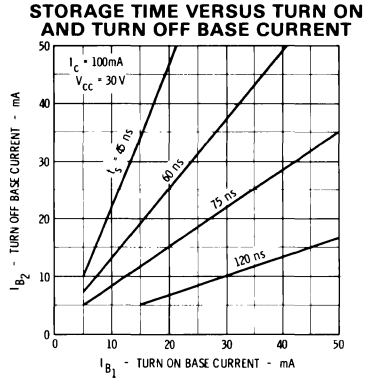

### SWITCHING TIMES VERSUS COLLECTOR CURRENT



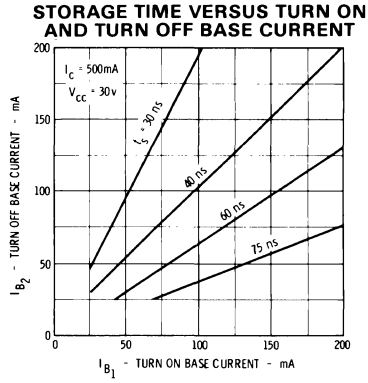

### SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



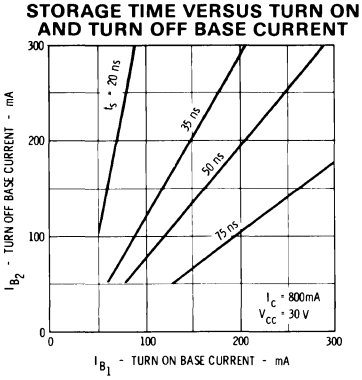

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



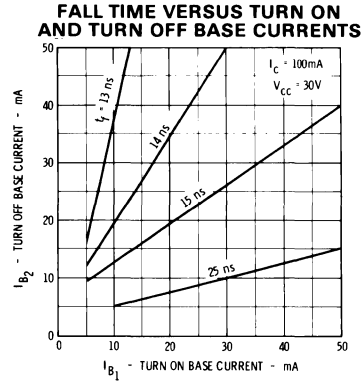

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



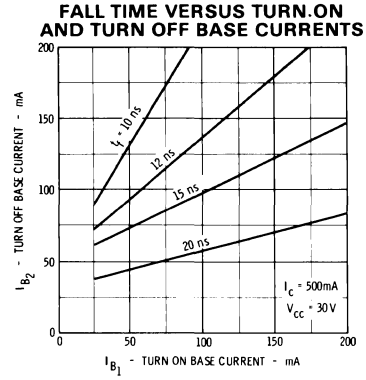

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



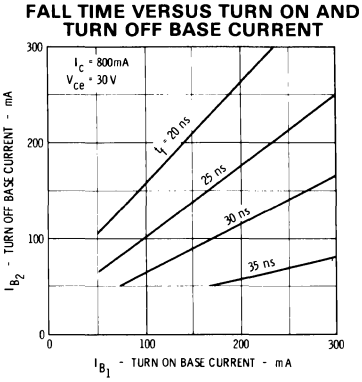

### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS




### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS




### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT

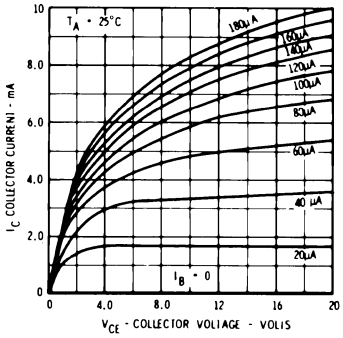


# CURVE SET NUMBER SS10

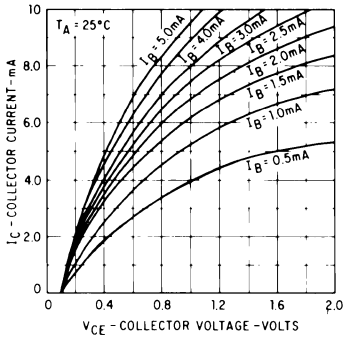
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

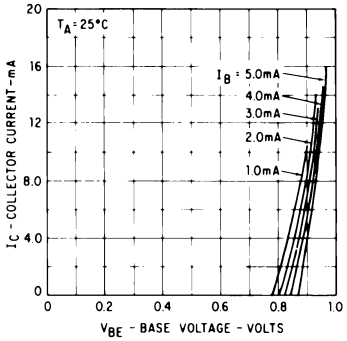
### COLLECTOR CHARACTERISTICS



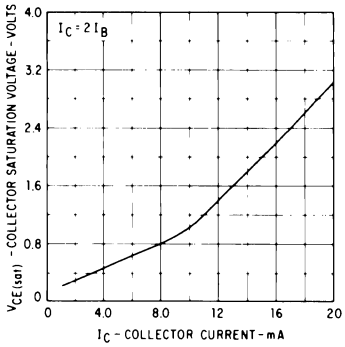

### COLLECTOR CHARACTERISTICS



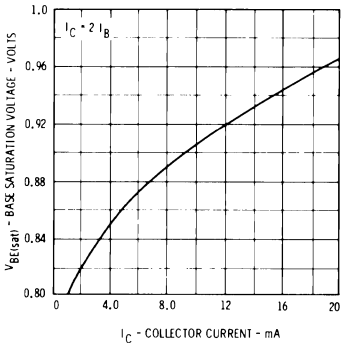

### BASE CHARACTERISTICS



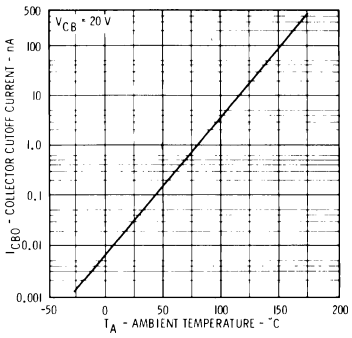

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



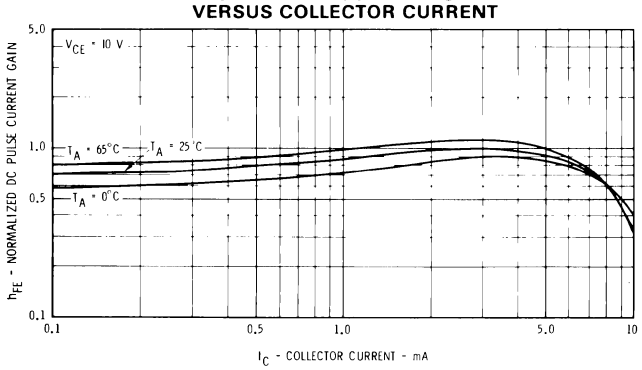

### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



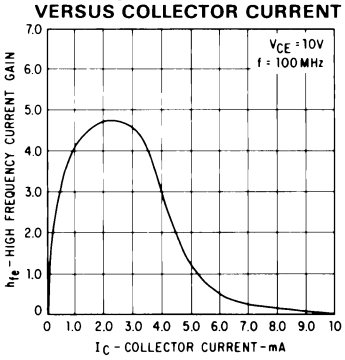

### COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



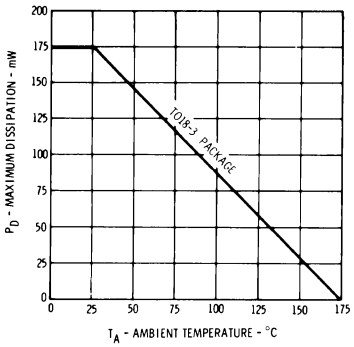

### NORMALIZED CURRENT GAIN VERSUS COLLECTOR CURRENT



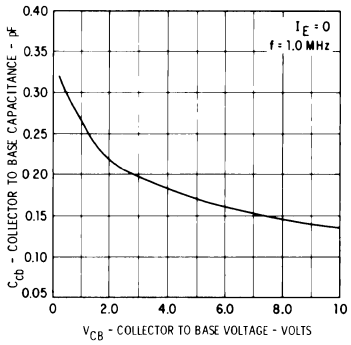

### HIGH FREQUENCY CURRENT GAIN VERSUS COLLECTOR CURRENT



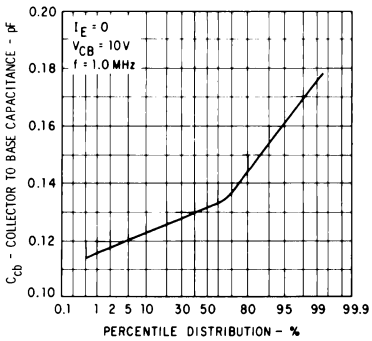

### MAXIMUM DISSIPATION VERSUS TEMPERATURE




### COLLECTOR TO BASE CAPACITANCE VERSUS COLLECTOR TO BASE VOLTAGE




### DISTRIBUTION OF COLLECTOR TO BASE CAPACITANCE



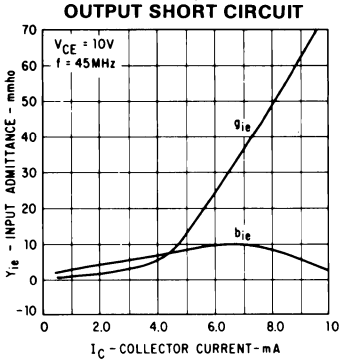

5

# CURVE SET NUMBER SS10

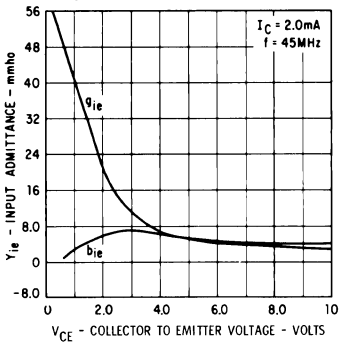
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

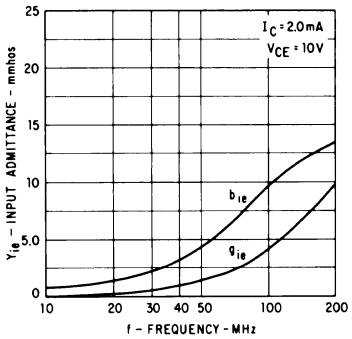
### INPUT ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



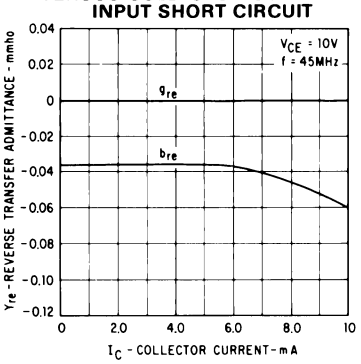

### INPUT ADMITTANCE VERSUS COLLECTOR VOLTAGE OUTPUT SHORT CIRCUIT



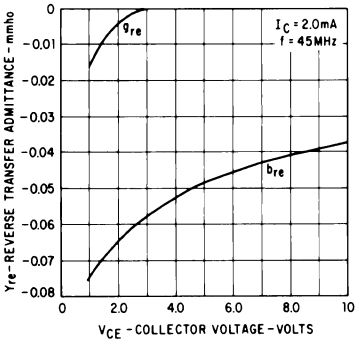

### INPUT ADMITTANCE VERSUS FREQUENCY OUTPUT SHORT CIRCUIT



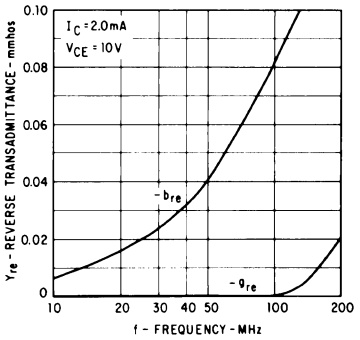

### REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT



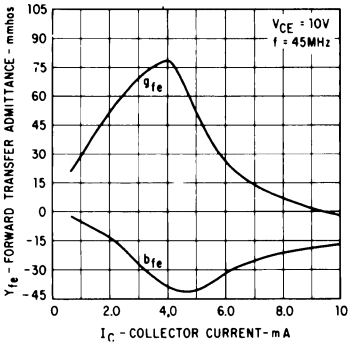

### REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR VOLTAGE INPUT SHORT CIRCUIT



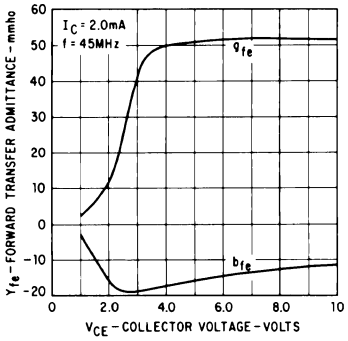

### REVERSE TRANSADMITTANCE VERSUS FREQUENCY INPUT SHORT CIRCUIT



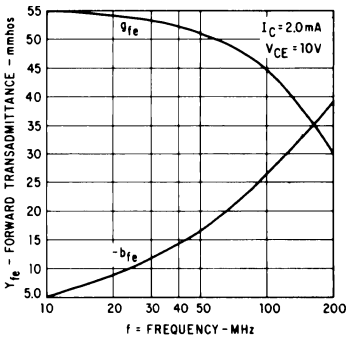

### FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



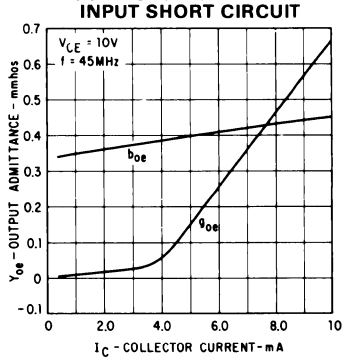

### FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR VOLTAGE OUTPUT SHORT CIRCUIT



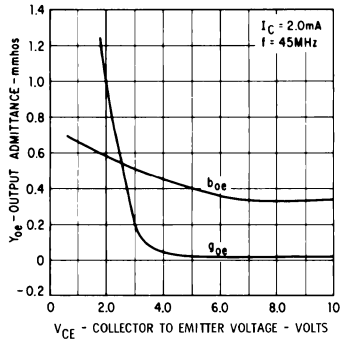

### FORWARD TRANSADMITTANCE VERSUS FREQUENCY OUTPUT SHORT CIRCUIT



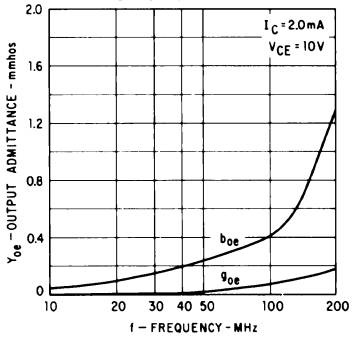

### OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT




### OUTPUT ADMITTANCE VERSUS COLLECTOR VOLTAGE INPUT SHORT CIRCUIT




### OUTPUT ADMITTANCE VERSUS FREQUENCY INPUT SHORT CIRCUIT

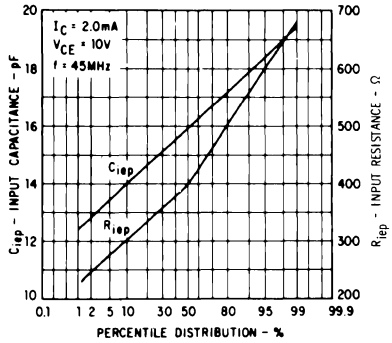


# CURVE SET NUMBER SS10

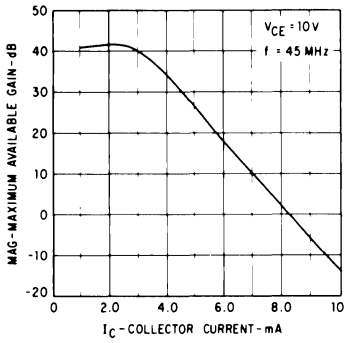
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

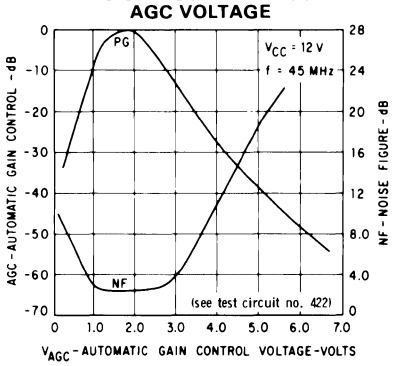
### DISTRIBUTION OF INPUT CAPACITANCE AND INPUT RESISTANCE OUTPUT SHORT CIRCUIT



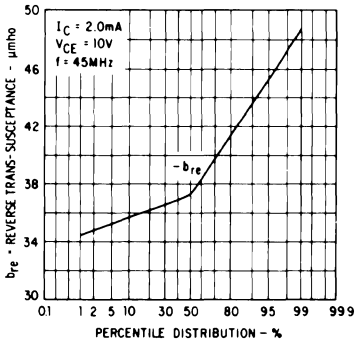

### MAXIMUM AVAILABLE GAIN VERSUS COLLECTOR CURRENT



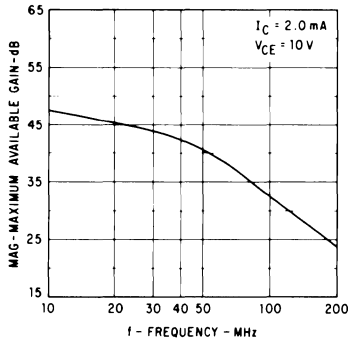

### AUTOMATIC GAIN CONTROL AND NOISE FIGURE VERSUS AGC VOLTAGE



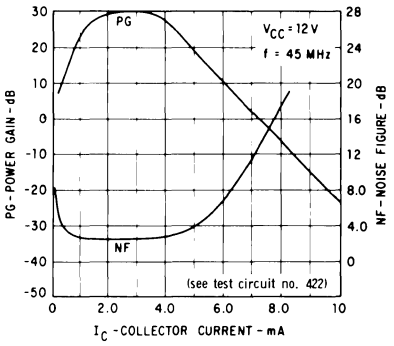

### DISTRIBUTION OF REVERSE TRANSADMITTANCE INPUT SHORT CIRCUIT



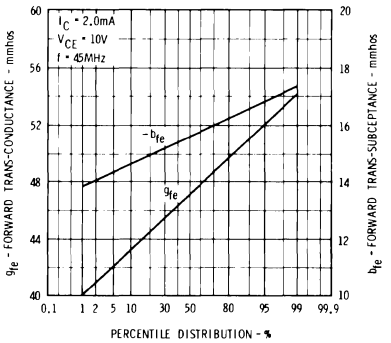

### MAXIMUM AVAILABLE GAIN VERSUS FREQUENCY



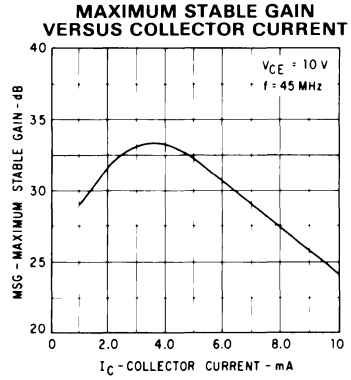

### POWER GAIN AND NOISE FIGURE VERSUS COLLECTOR CURRENT



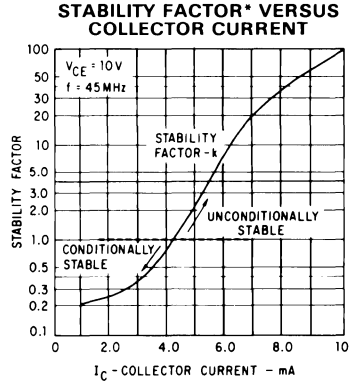

### DISTRIBUTION OF FORWARD TRANSFER ADMITTANCE OUTPUT SHORT CIRCUIT




### MAXIMUM STABLE GAIN VERSUS COLLECTOR CURRENT

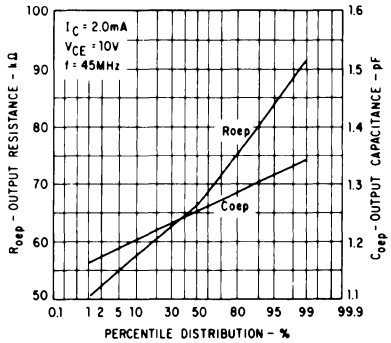



### STABILITY FACTOR* VERSUS COLLECTOR CURRENT

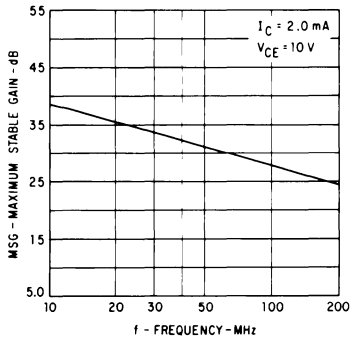



* Rollett stability factor k, where $k = \frac{2\ \text{gigo} - \text{Re}(Y_f Y_r)}{|Y_f Y_r|}$

### DISTRIBUTION OF OUTPUT CAPACITANCE AND OUTPUT RESISTANCE INPUT SHORT CIRCUIT




### MAXIMUM STABLE GAIN VERSUS FREQUENCY



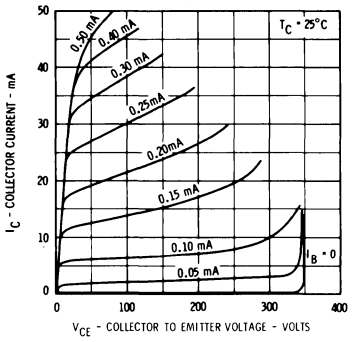

5

# CURVE SET NUMBER SS11

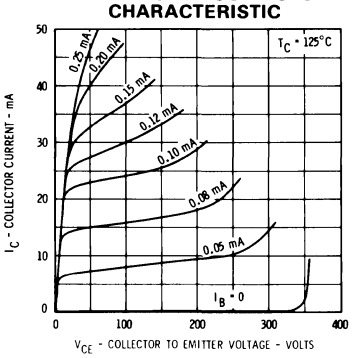
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

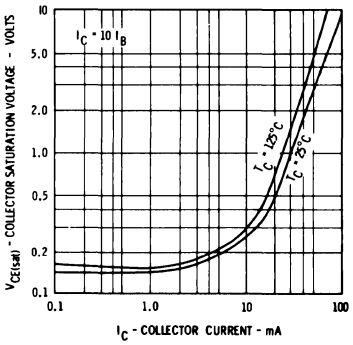
### LARGE SIGNAL COLLECTOR CHARACTERISTIC



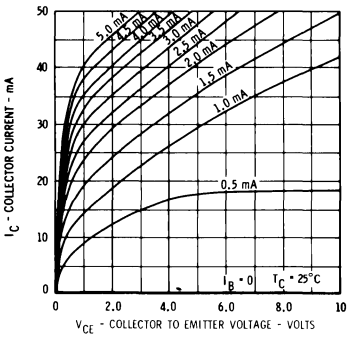

### LARGE SIGNAL COLLECTOR CHARACTERISTIC



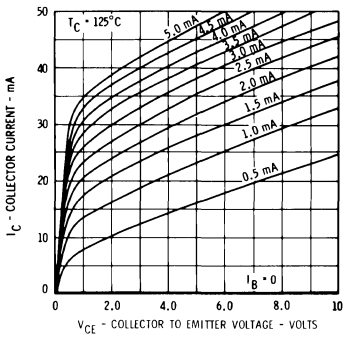

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



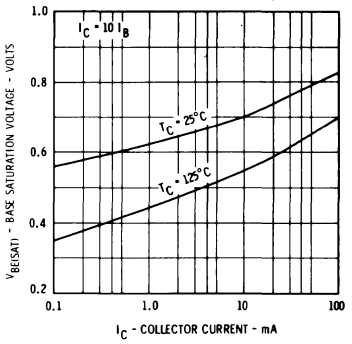

### COLLECTOR SATURATION CHARACTERISTICS



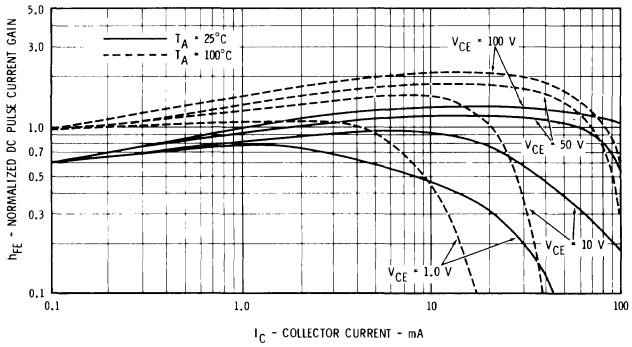

### COLLECTOR SATURATION CHARACTERISTICS



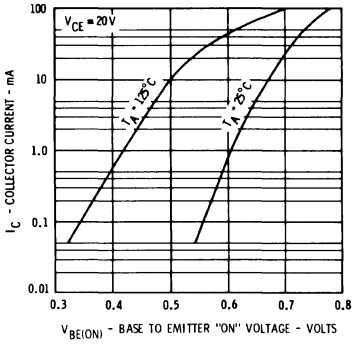

### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



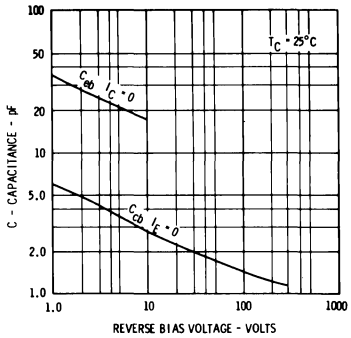

### NORMALIZED DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



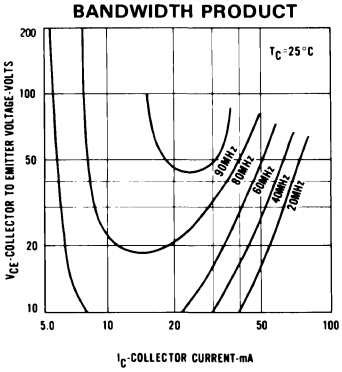

### COLLECTOR CURRENT VERSUS EMITTER TO BASE 'ON' VOLTAGE



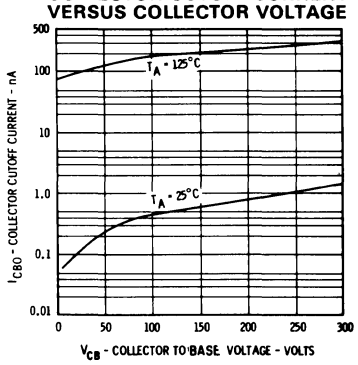

### COLLECTOR TO BASE AND EMITTER TO BASE CAPACITANCE VERSUS REVERSE BIAS VOLTAGE




### CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT




### COLLECTOR CUTOFF CURRENT VERSUS COLLECTOR VOLTAGE

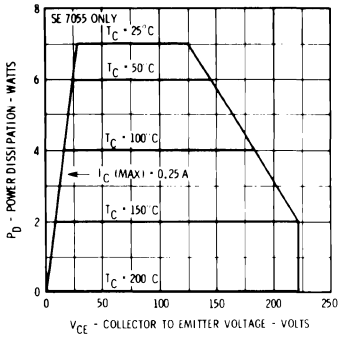


# CURVE SET NUMBER SS11

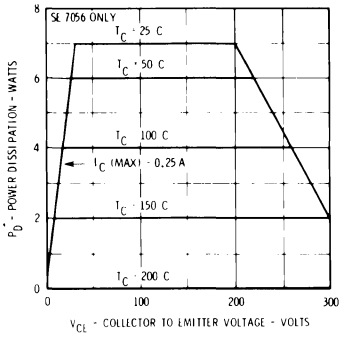
## MAXIMUM RATING CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

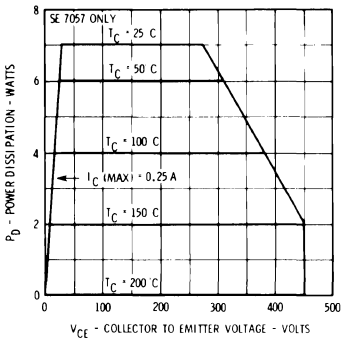
### GUARANTEED MAXIMUM DC POWER DISSIPATION VERSUS COLLECTOR TO EMITTER VOLTAGE



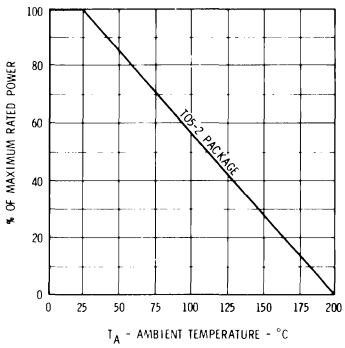

### GUARANTEED MAXIMUM DC POWER DISSIPATION VERSUS COLLECTOR TO EMITTER VOLTAGE




### GUARANTEED MAXIMUM DC POWER DISSIPATION VERSUS COLLECTOR TO EMITTER VOLTAGE




### ALLOWABLE POWER DISSIPATION VERSUS AMBIENT TEMPERATURE



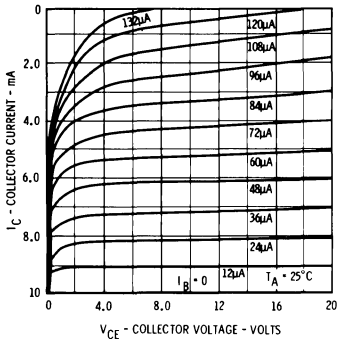

5

# CURVE SET NUMBER SS12

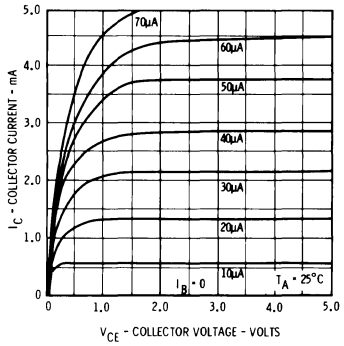
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

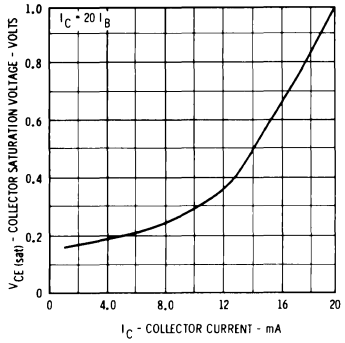
### COLLECTOR CHARACTERISTICS



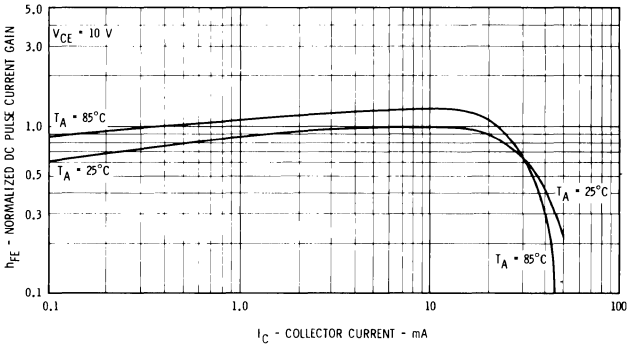

### COLLECTOR CHARACTERISTICS



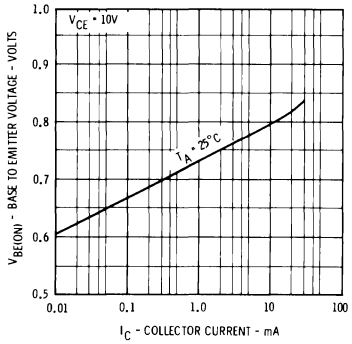

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



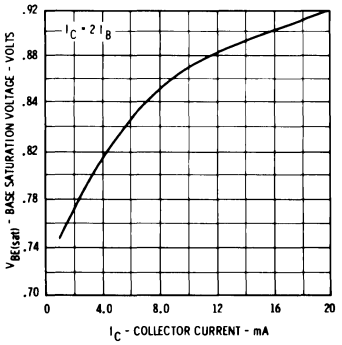

### NORMALIZED DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



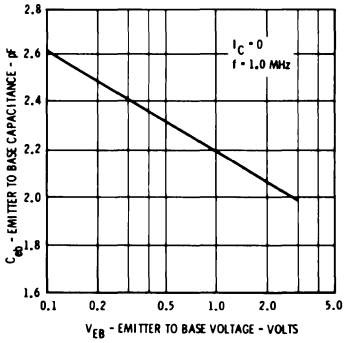

### BASE TO EMITTER 'ON' VOLTAGE VERSUS COLLECTOR CURRENT



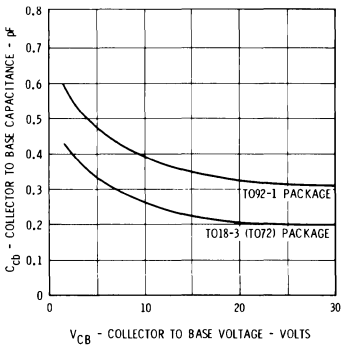

### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



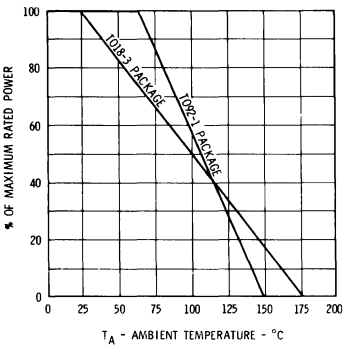

### EMITTER TO BASE CAPACITANCE VERSUS EMITTER TO BASE VOLTAGE



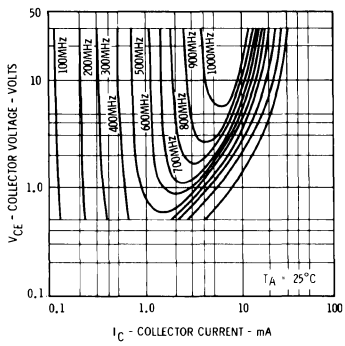

### COLLECTOR TO BASE CAPACITANCE VERSUS COLLECTOR TO BASE VOLTAGE



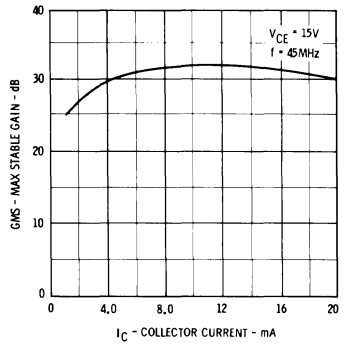

### ALLOWABLE POWER DISSIPATION VERSUS AMBIENT TEMPERATURE




### CONTOURS OF CONSTANT BANDWIDTH PRODUCT




### MAXIMUM STABLE GAIN VERSUS COLLECTOR CURRENT

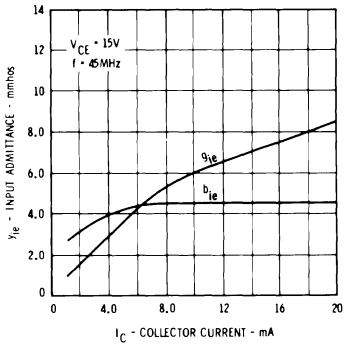


# CURVE SET NUMBER SS12

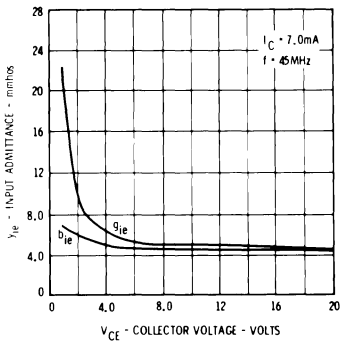
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

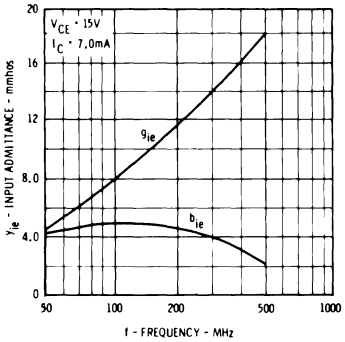
### INPUT ADMITTANCE VERSUS COLLECTOR CURRENT



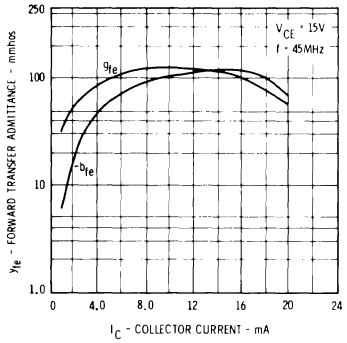

### INPUT ADMITTANCE VERSUS COLLECTOR VOLTAGE



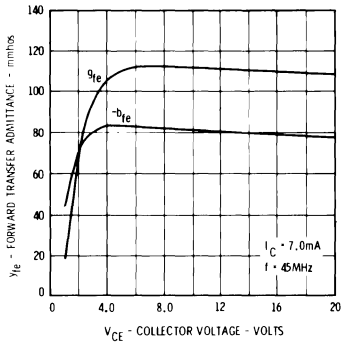

### INPUT ADMITTANCE VERSUS FREQUENCY



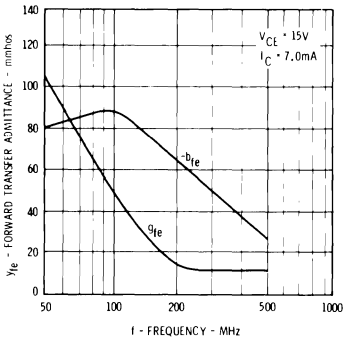

### FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT



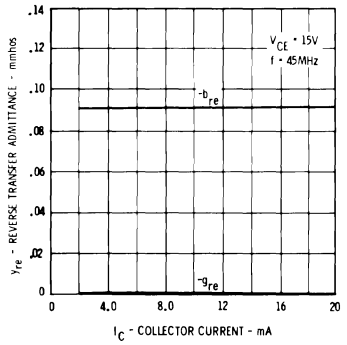

### FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR VOLTAGE



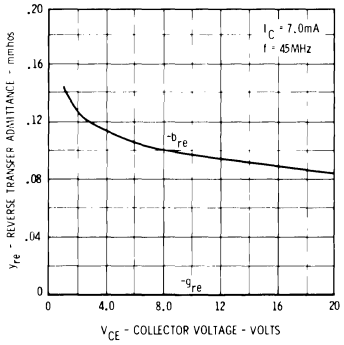

### FORWARD TRANSFER ADMITTANCE VERSUS FREQUENCY



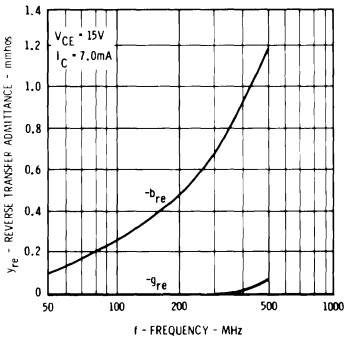

### REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT



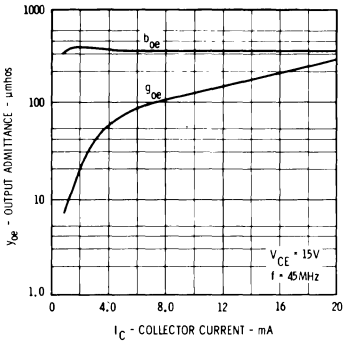

### REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR VOLTAGE



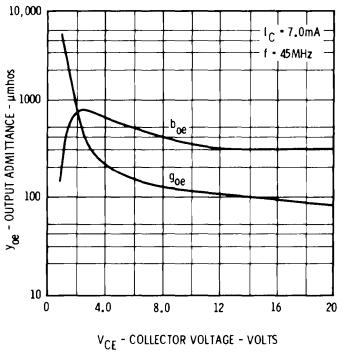

### REVERSE TRANSFER ADMITTANCE VERSUS FREQUENCY



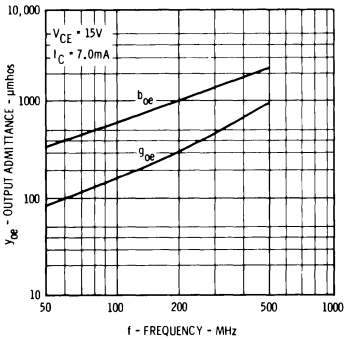

### OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT




### OUTPUT ADMITTANCE VERSUS COLLECTOR VOLTAGE




### OUTPUT ADMITTANCE VERSUS FREQUENCY



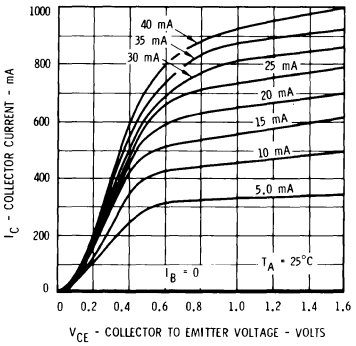

5

# CURVE SET NUMBER SS13

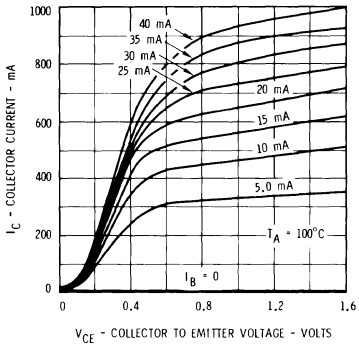
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

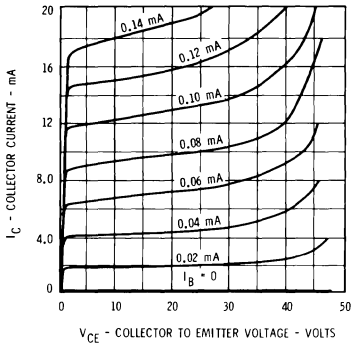
### COLLECTOR CHARACTERISTICS



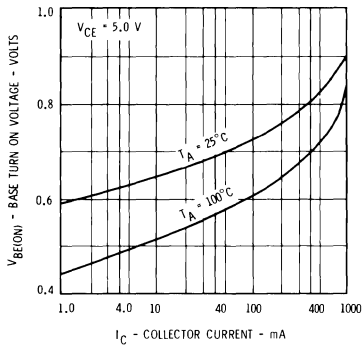

### COLLECTOR CHARACTERISTICS



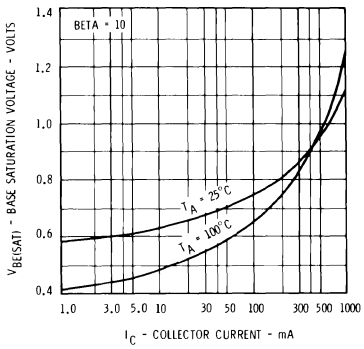

### COLLECTOR CHARACTERISTICS



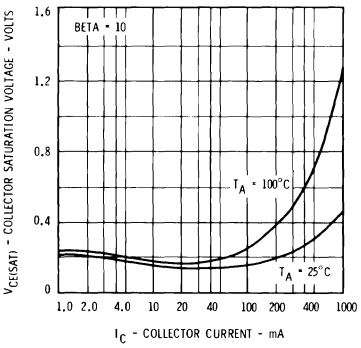

### BASE TURN ON VOLTAGE VERSUS COLLECTOR CURRENT



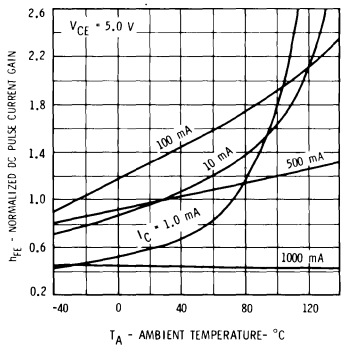

### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



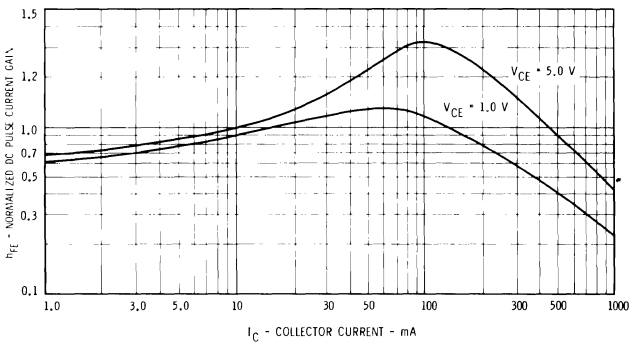

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



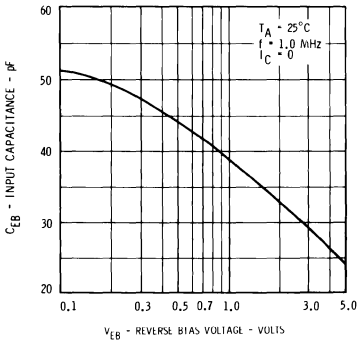

### NORMALIZED DC PULSED CURRENT GAIN VERSUS TEMPERATURE



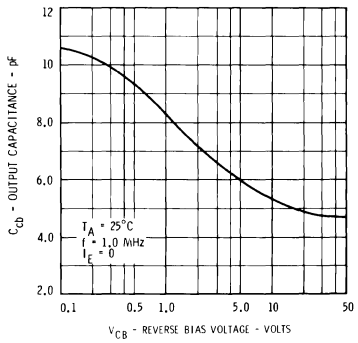

### NORMALIZED DC PULSED CURRENT GAIN VERSUS COLLECTOR CURRENT



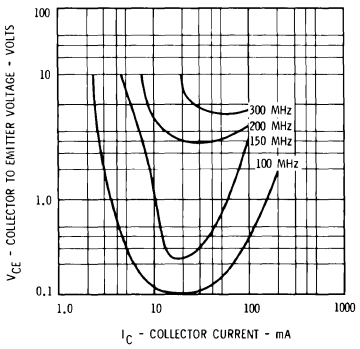

### INPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE




### OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE




### CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT

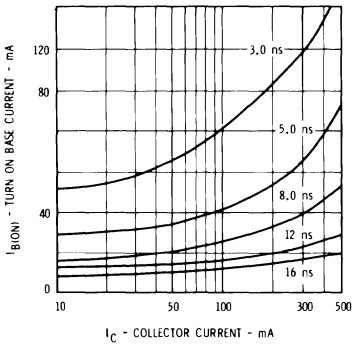


# CURVE SET NUMBER SS13

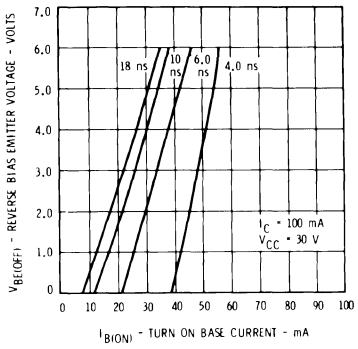
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

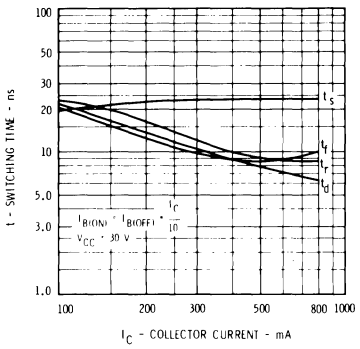
### RISE TIME VERSUS COLLECTOR CURRENT AND TURN ON BASE CURRENT



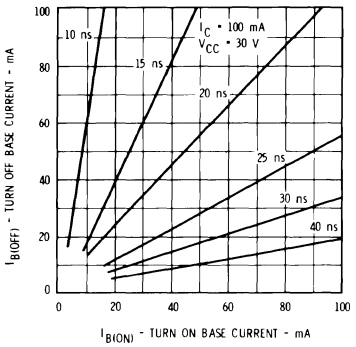

### DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE TO EMITTER VOLTAGE



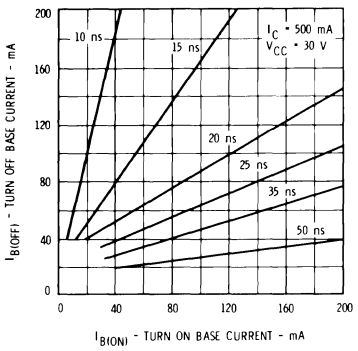

### SWITCHING TIME VERSUS COLLECTOR CURRENT



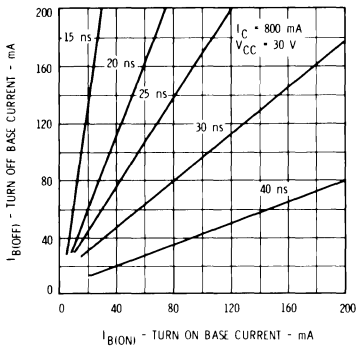

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



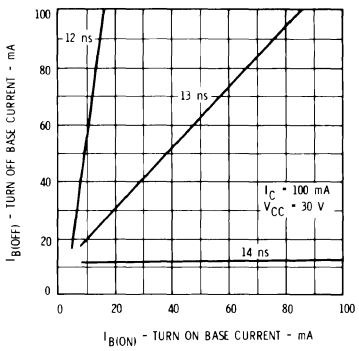

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



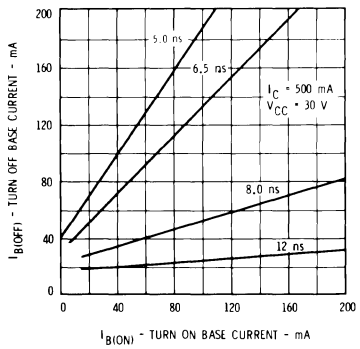

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



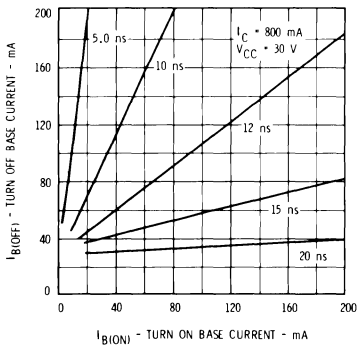

### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS




### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

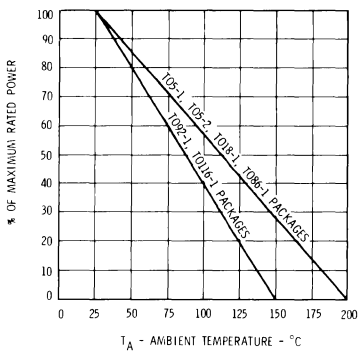



### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS




## MAXIMUM RATING CURVES

### ALLOWABLE POWER DISSIPATION VERSUS AMBIENT TEMPERATURE

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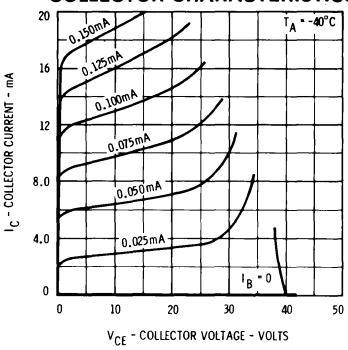
# CURVE SET NUMBER SS14

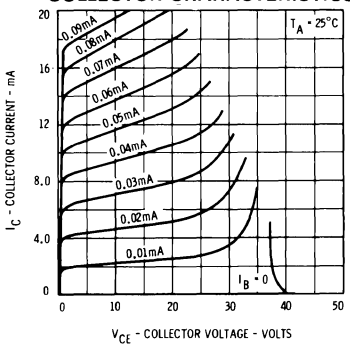
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

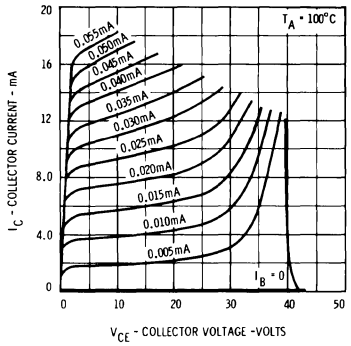
### COLLECTOR CHARACTERISTICS



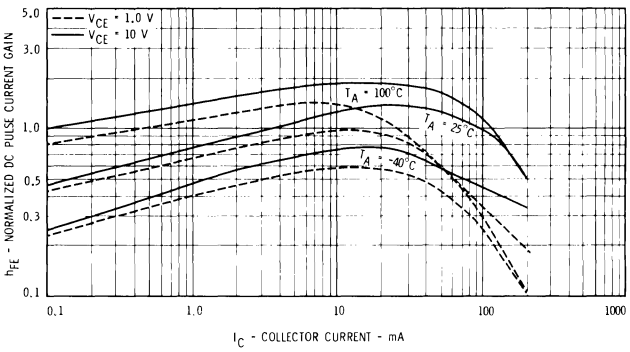

### COLLECTOR CHARACTERISTICS



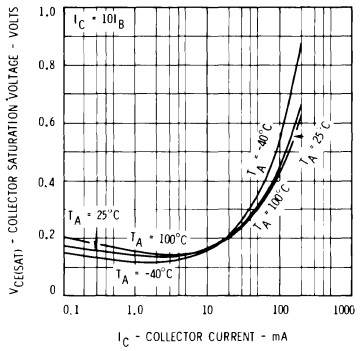

### COLLECTOR CHARACTERISTICS



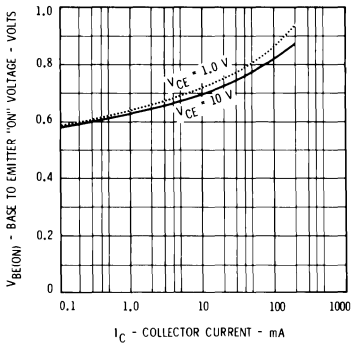

### NORMALIZED DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



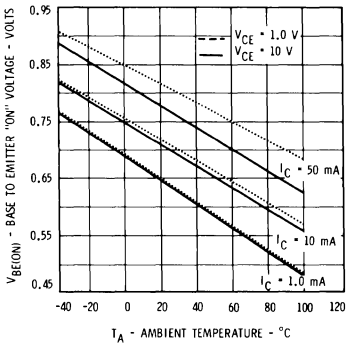

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



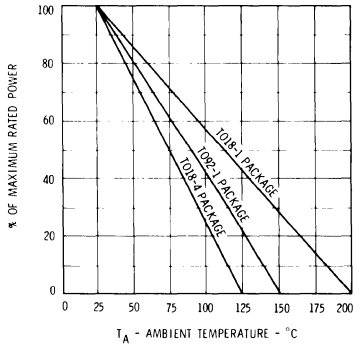

### BASE TO EMITTER 'ON' VOLTAGE VERSUS COLLECTOR CURRENT




### BASE TO EMITTER 'ON' VOLTAGE VERSUS AMBIENT TEMPERATURE




### ALLOWABLE POWER DISSIPATION VERSUS AMBIENT TEMPERATURE

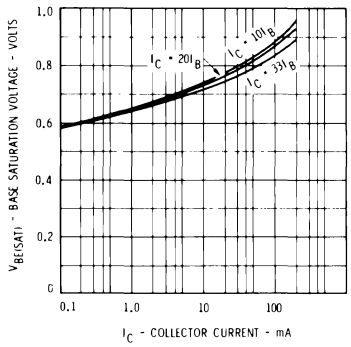


# CURVE SET NUMBER SS14

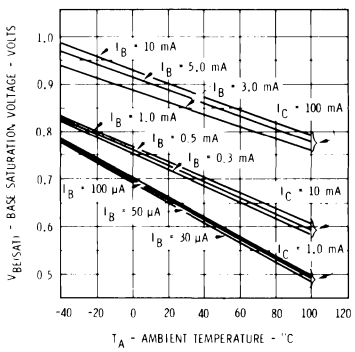
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

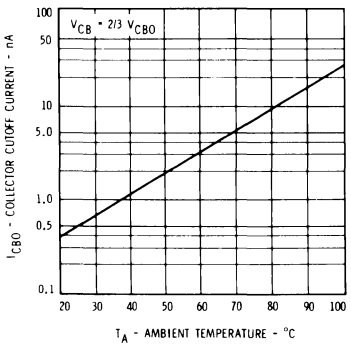
### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



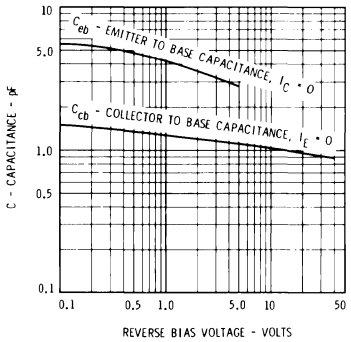

### BASE SATURATION VOLTAGE VERSUS AMBIENT TEMPERATURE



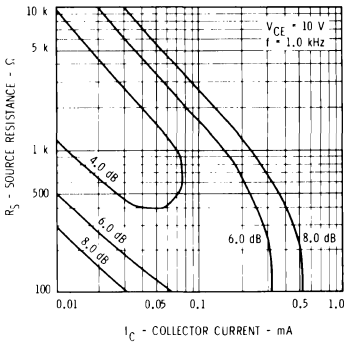

### COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



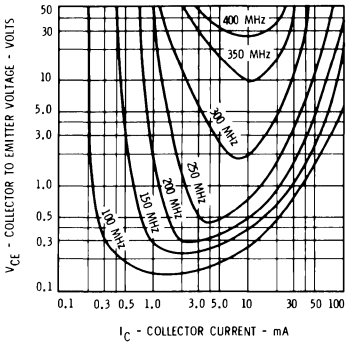

### CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



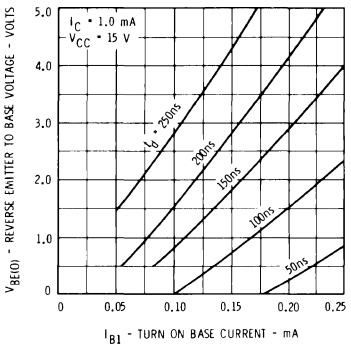

### CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



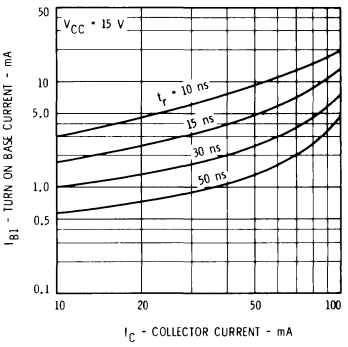

### CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT



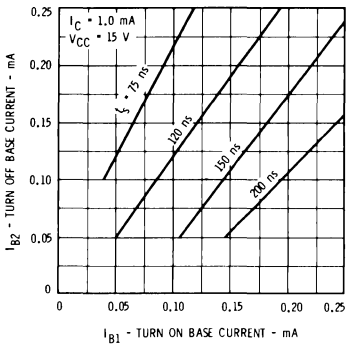

### DELAY TIME VERSUS REVERSE BASE TO EMITTER VOLTAGE AND TURN ON BASE CURRENTS




### RISE TIME VERSUS TURN ON BASE CURRENT AND COLLECTOR CURRENT




### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

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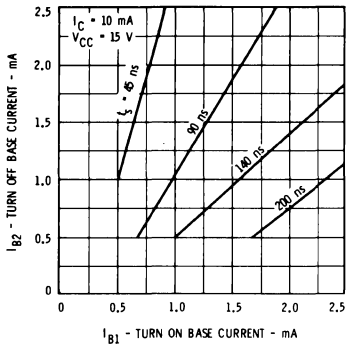
# CURVE SET NUMBER SS14

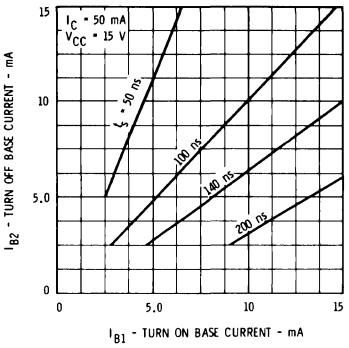
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

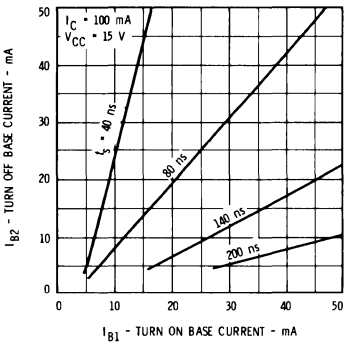
### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



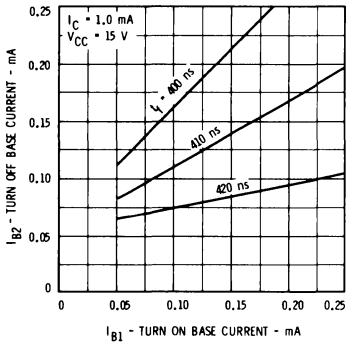

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



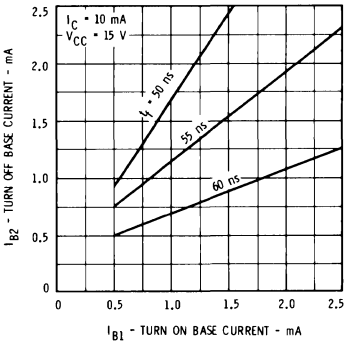

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



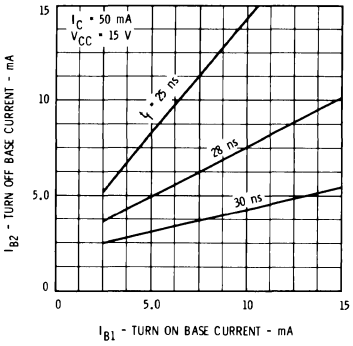

### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



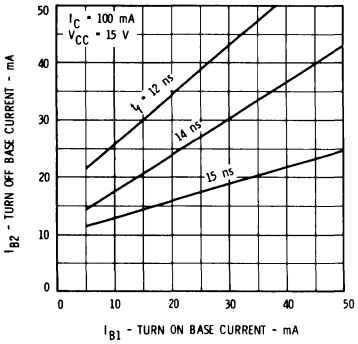

### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



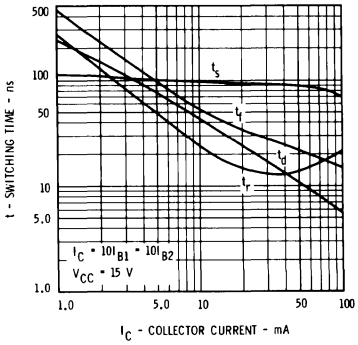

### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS




### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS




### SWITCHING TIME VERSUS COLLECTOR CURRENT

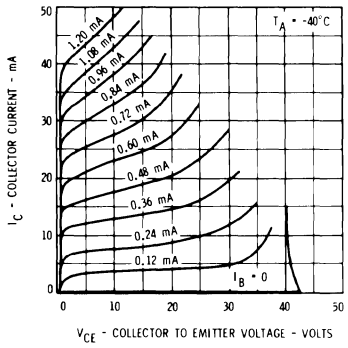


# CURVE SET NUMBER SS15

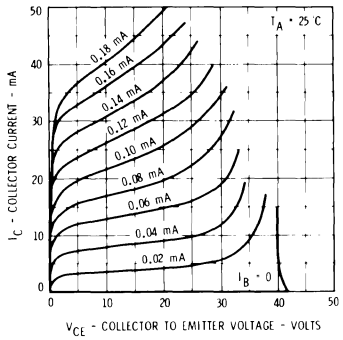
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

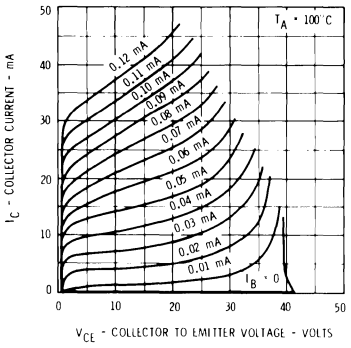
### COLLECTOR CHARACTERISTICS



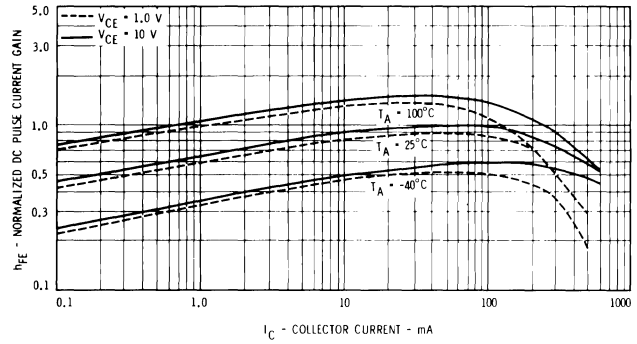

### COLLECTOR CHARACTERISTICS



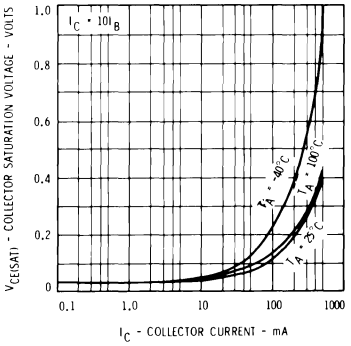

### COLLECTOR CHARACTERISTICS



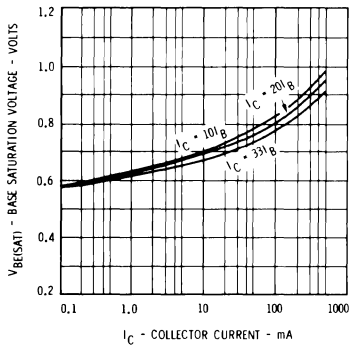

### NORMALIZED DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



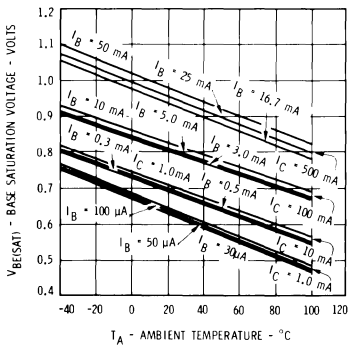

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



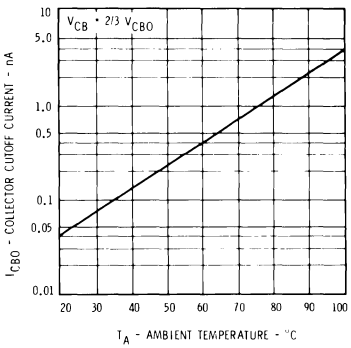

### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



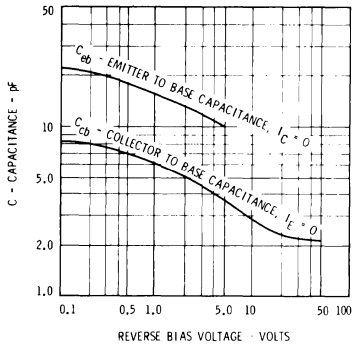

### BASE SATURATION VOLTAGE VERSUS AMBIENT TEMPERATURE



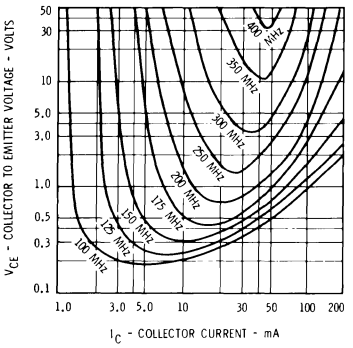

### COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



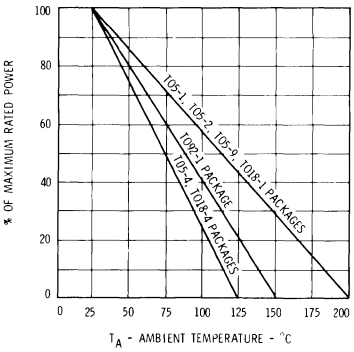

### CAPACITANCE VERSUS REVERSE BIAS VOLTAGE




### CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT




### ALLOWABLE POWER DISSIPATION VERSUS AMBIENT TEMPERATURE

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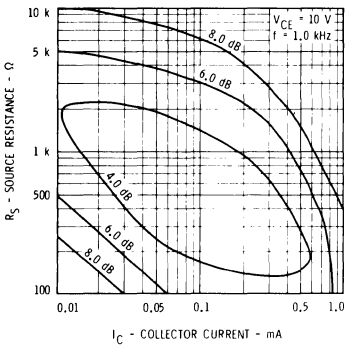
# CURVE SET NUMBER SS15

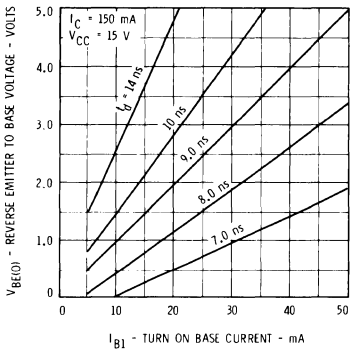
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

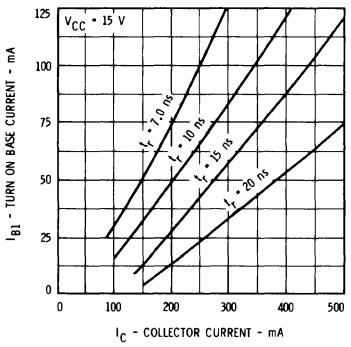
### CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



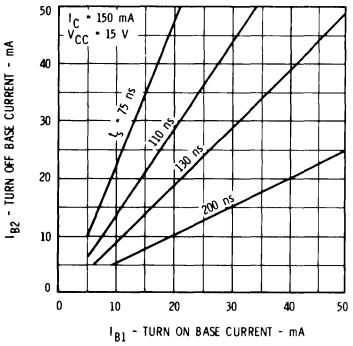

### DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



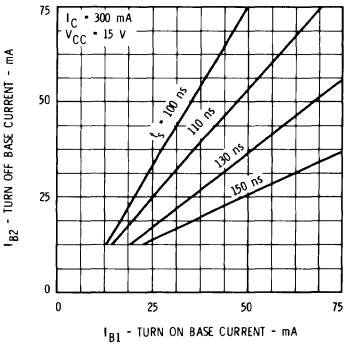

### RISE TIME VERSUS COLLECTOR CURRENT AND TURN ON BASE CURRENT



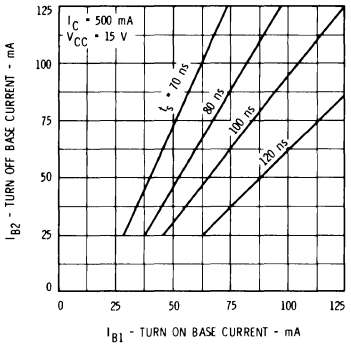

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



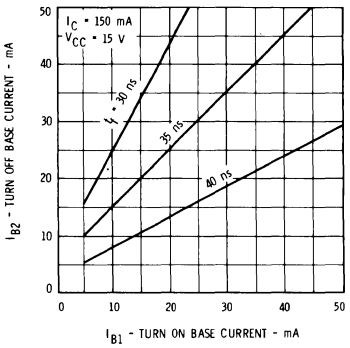

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



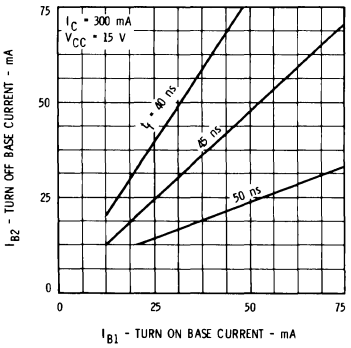

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



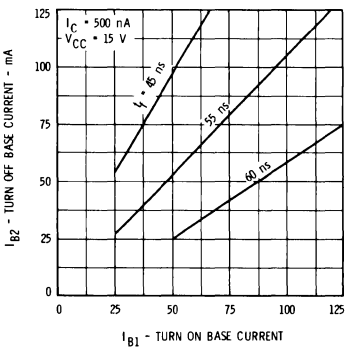

### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



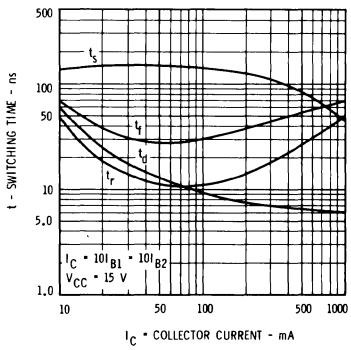

### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS




### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS




### SWITCHING TIME VERSUS COLLECTOR CURRENT

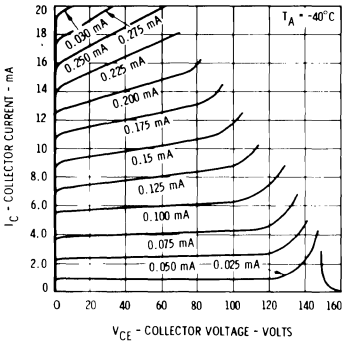


# CURVE SET NUMBER SS16

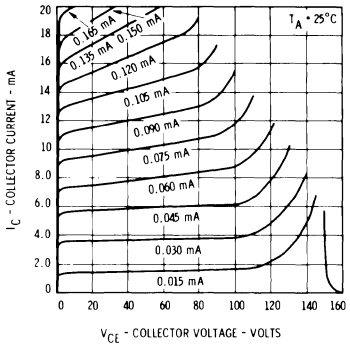
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

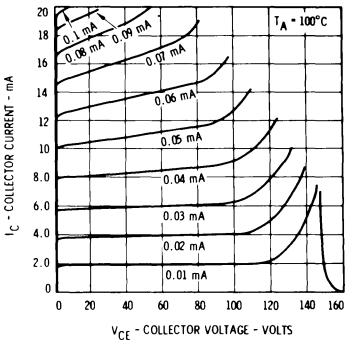
### COLLECTOR CHARACTERISTICS



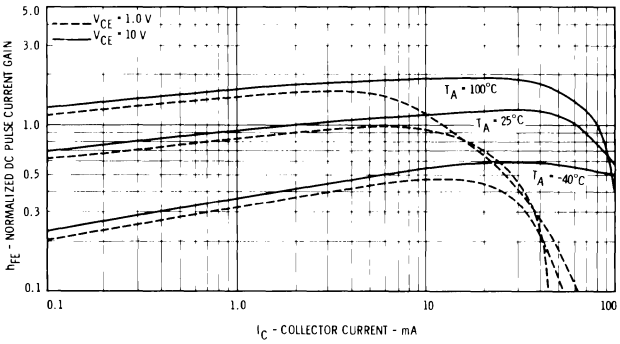

### COLLECTOR CHARACTERISTICS



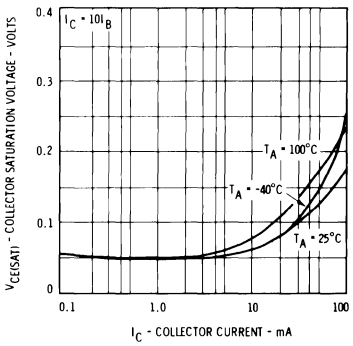

### COLLECTOR CHARACTERISTICS



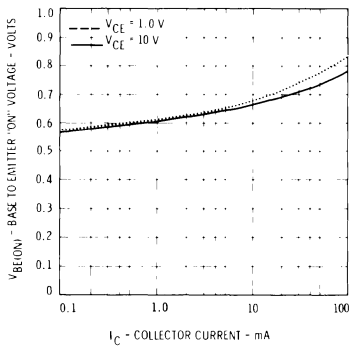

### NORMALIZED DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



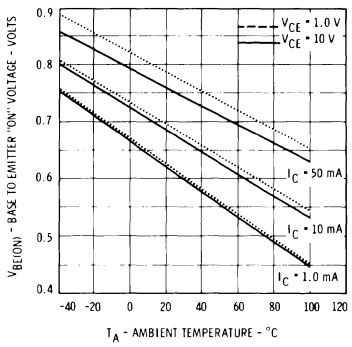

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



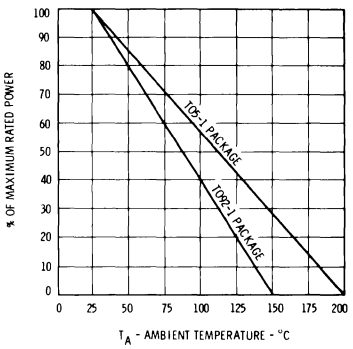

### BASE TO EMITTER 'ON' VOLTAGE VERSUS COLLECTOR CURRENT




### BASE TO EMITTER 'ON' VOLTAGE VERSUS AMBIENT TEMPERATURE




### ALLOWABLE POWER DISSIPATION VERSUS AMBIENT TEMPERATURE

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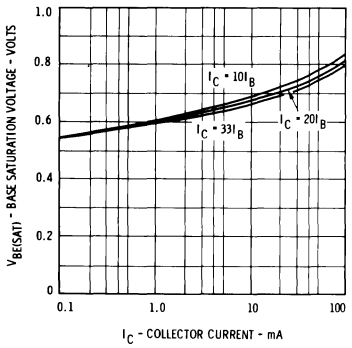
# CURVE SET NUMBER SS16

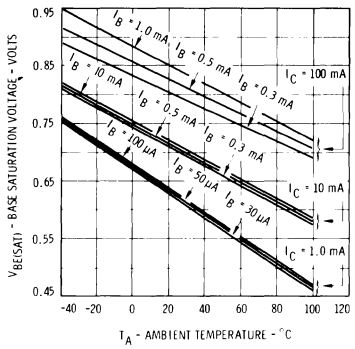
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

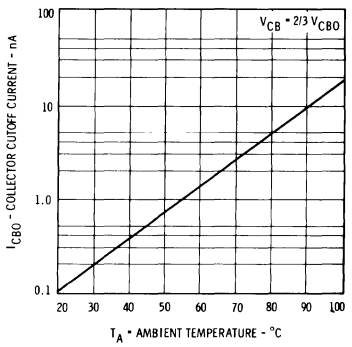
### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



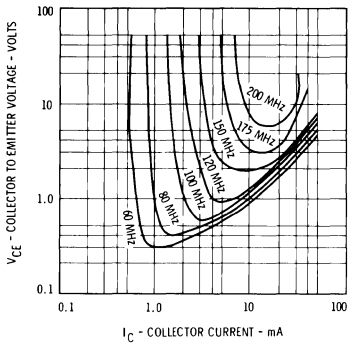

### BASE SATURATION VOLTAGE VERSUS AMBIENT TEMPERATURE



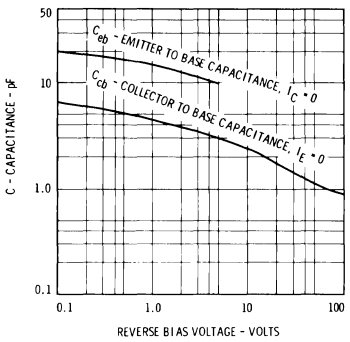

### COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



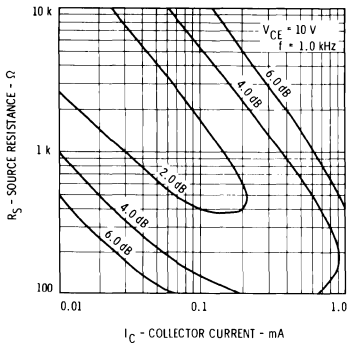

### CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT



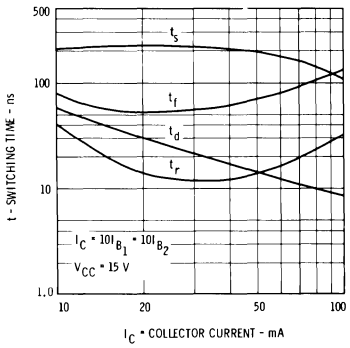

### CAPACITANCE VERSUS REVERSE BIAS VOLTAGE




### CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE




### SWITCHING TIME VERSUS COLLECTOR CURRENT

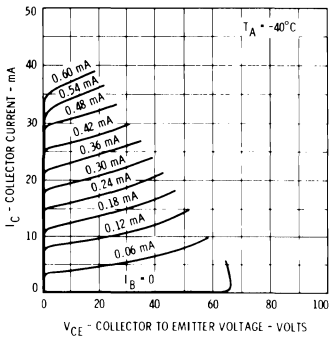


# CURVE SET NUMBER SS17

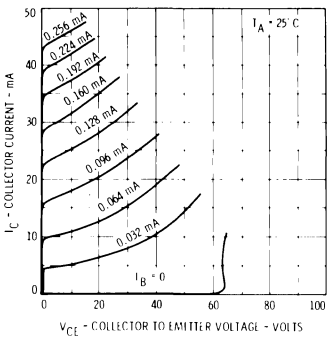
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

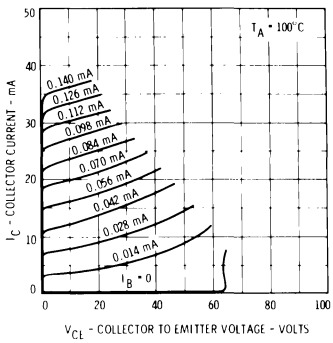
### ACTIVE REGION



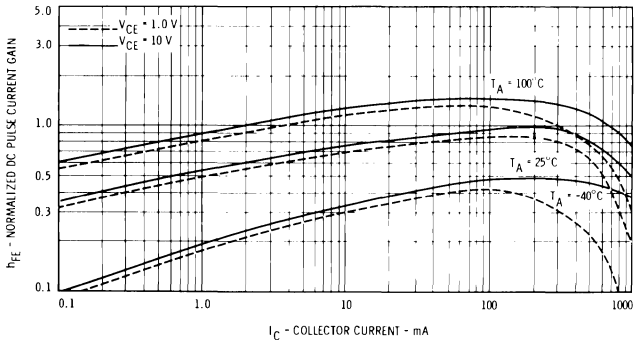

### ACTIVE REGION



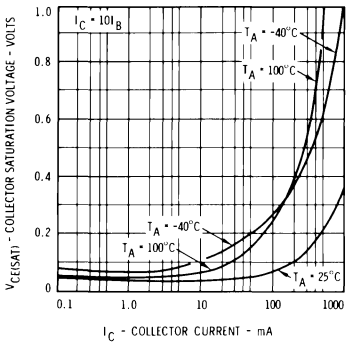

### ACTIVE REGION



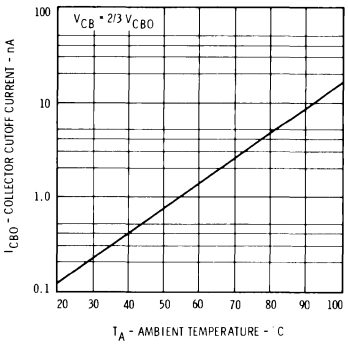

### NORMALIZED DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



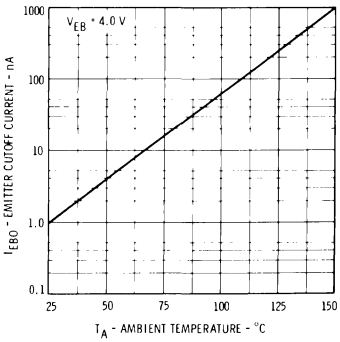

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



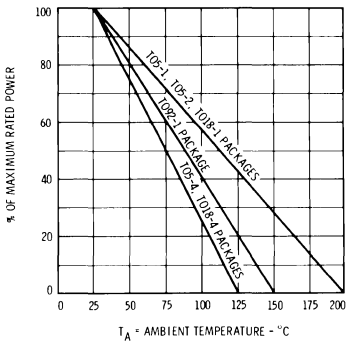

### COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE




### EMITTER CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE




### ALLOWABLE POWER DISSIPATION VERSUS AMBIENT TEMPERATURE



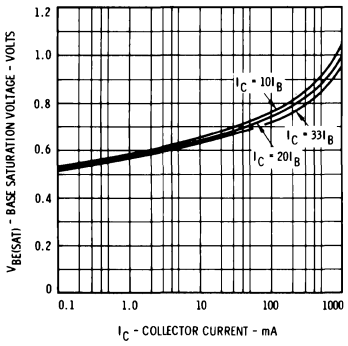

5

# CURVE SET NUMBER SS17

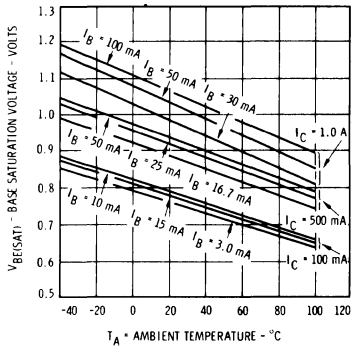
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

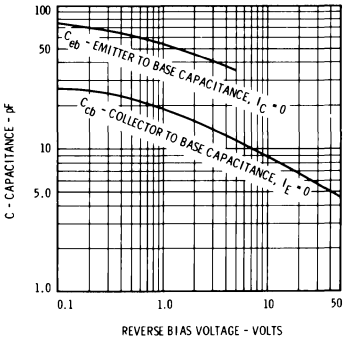
### BASE SATURATION VOLTAGE VERSUS AMBIENT TEMPERATURE



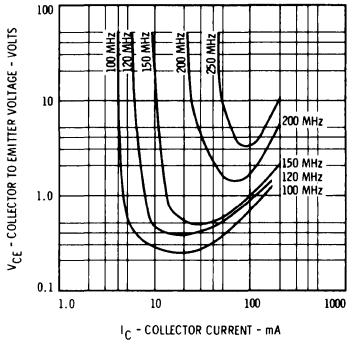

### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



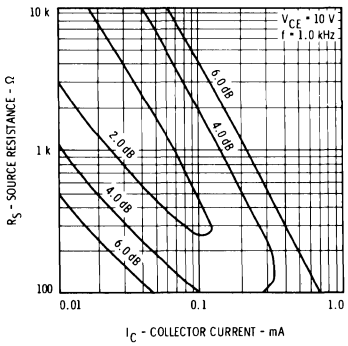

### CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



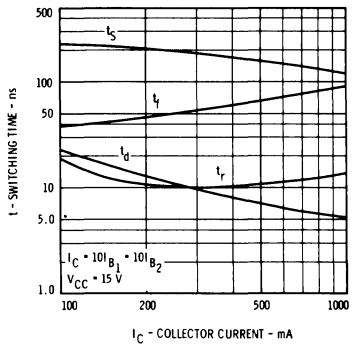

### CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT




### CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE




### SWITCHING TIME VERSUS COLLECTOR CURRENT

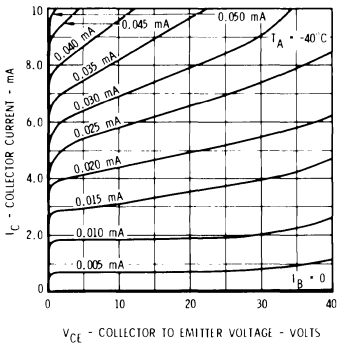


# CURVE SET NUMBER SS18

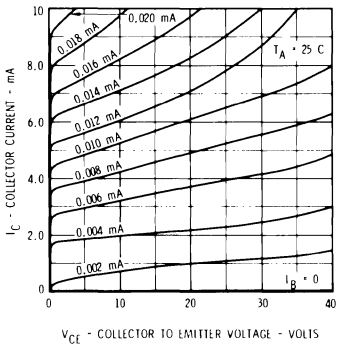
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

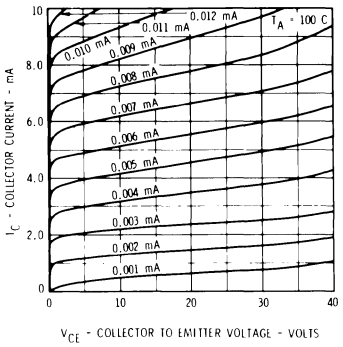
### COLLECTOR CHARACTERISTICS



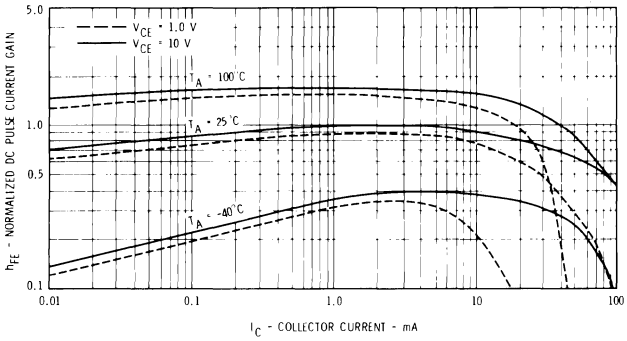

### COLLECTOR CHARACTERISTICS



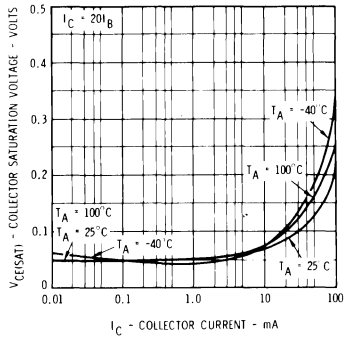

### COLLECTOR CHARACTERISTICS



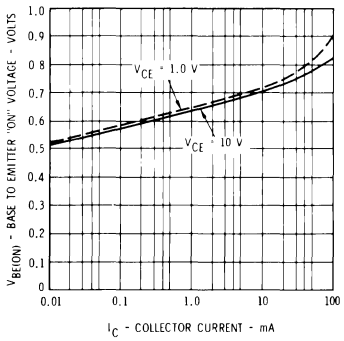

### NORMALIZED DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



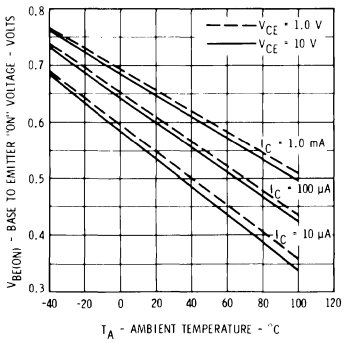

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



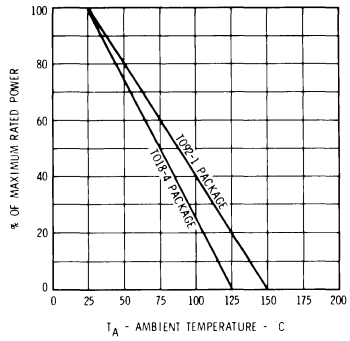

### BASE TO EMITTER 'ON' VOLTAGE VERSUS COLLECTOR CURRENT



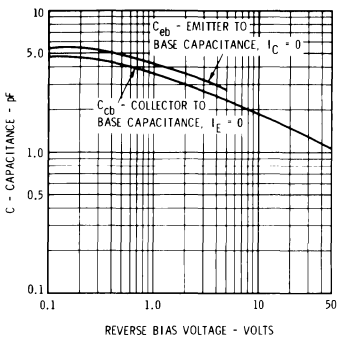

### BASE TO EMITTER 'ON' VOLTAGE VERSUS AMBIENT TEMPERATURE



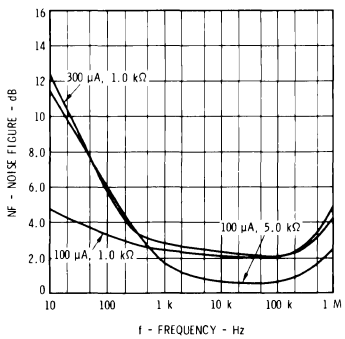

### ALLOWABLE POWER DISSIPATION VERSUS TEMPERATURE



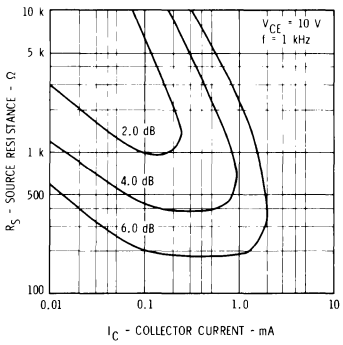

### CAPACITANCE VERSUS REVERSE BIAS VOLTAGE




### NOISE FIGURE VERSUS FREQUENCY




### CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE

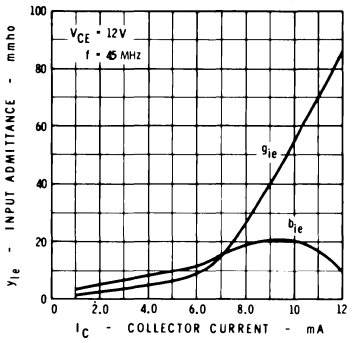


# CURVE SET NUMBER SS19

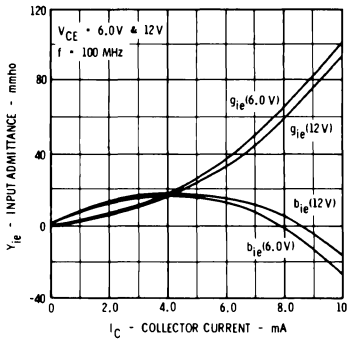
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

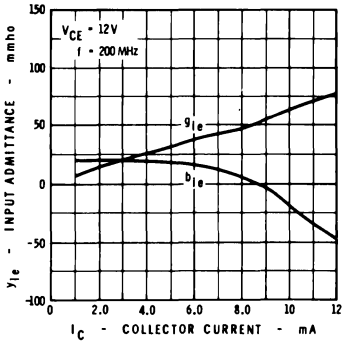
### INPUT ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



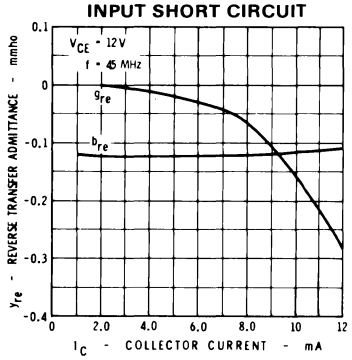

### INPUT ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



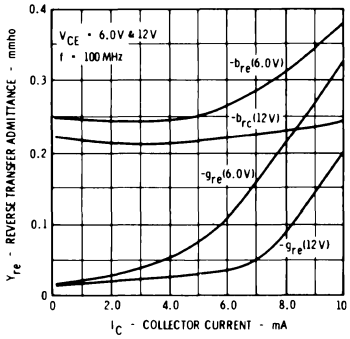

### INPUT ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



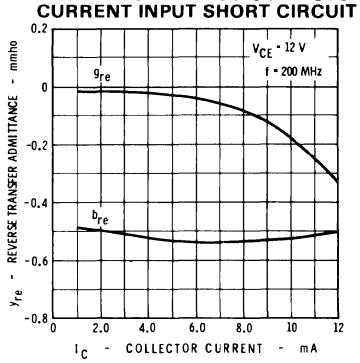

### REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT



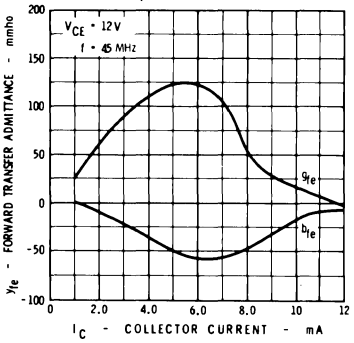

### REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT



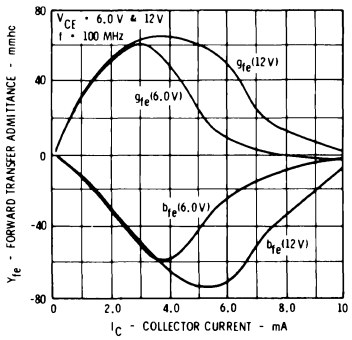

### REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT



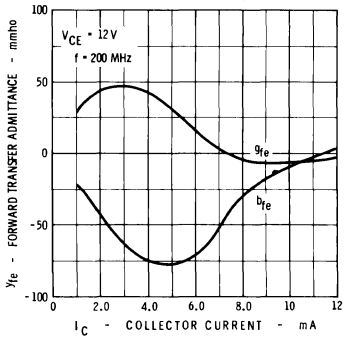

### FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



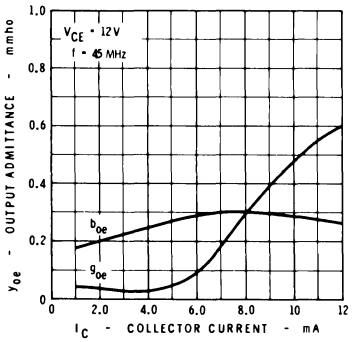

### FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



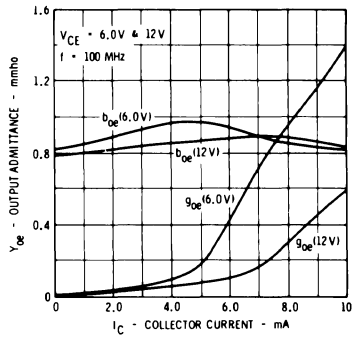

### FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



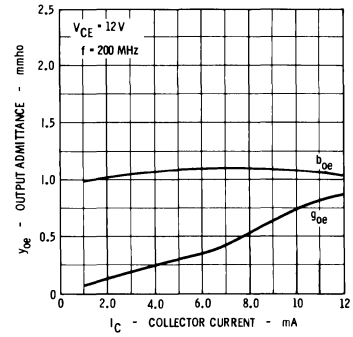

### OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT




### OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT




### OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT INPUT SHORT CIRCUIT

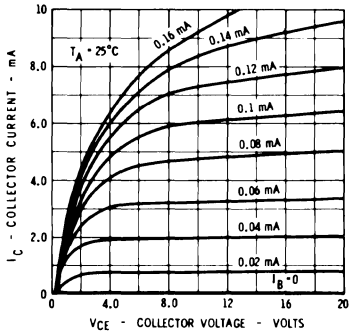


# CURVE SET NUMBER SS19

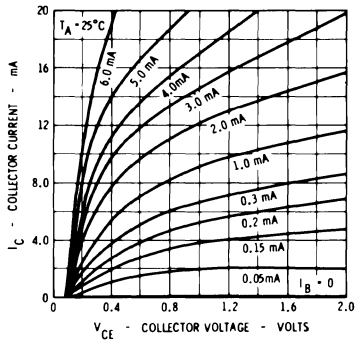
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

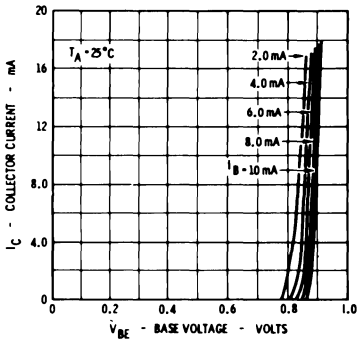
### COLLECTOR CHARACTERISTICS



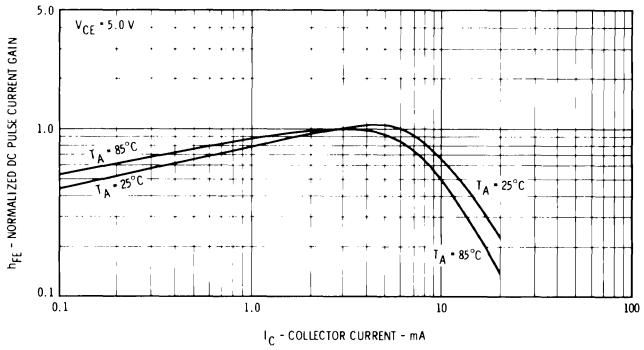

### COLLECTOR CHARACTERISTICS



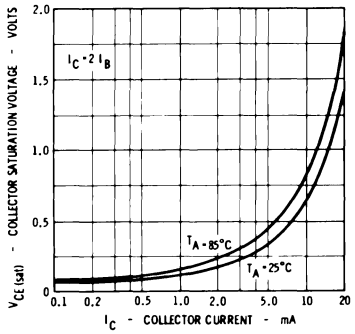

### BASE CHARACTERISTICS



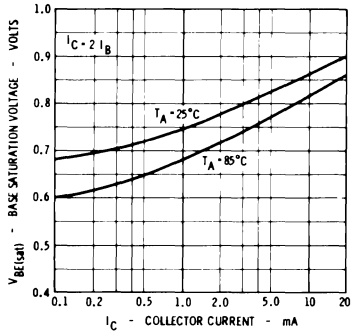

### NORMALIZED DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



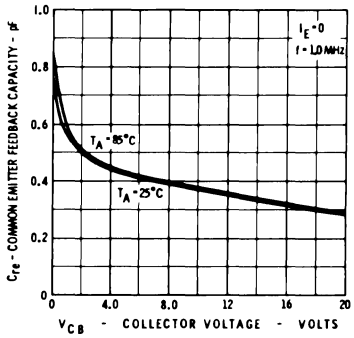

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



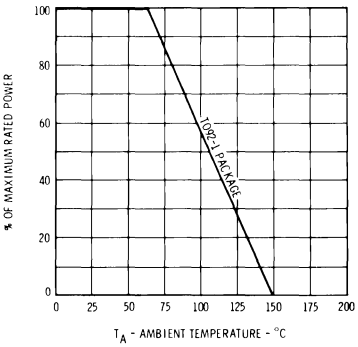

### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



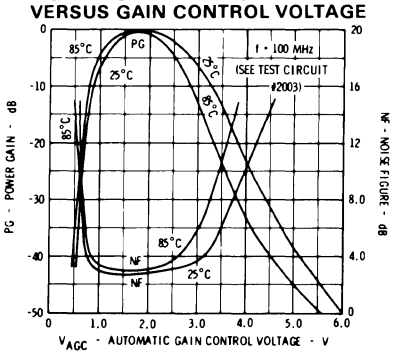

### COMMON EMITTER FEEDBACK CAPACITY VERSUS COLLECTOR VOLTAGE



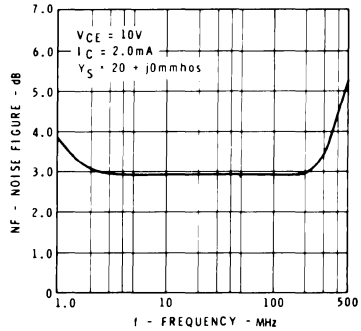

### ALLOWABLE POWER DISSIPATION VERSUS AMBIENT TEMPERATURE



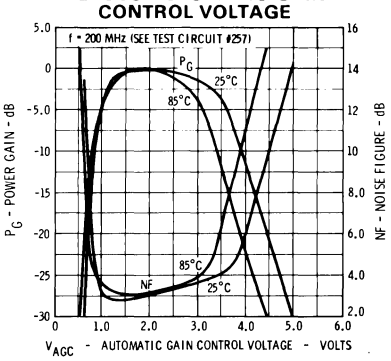

### POWER GAIN AND NOISE FIGURE VERSUS GAIN CONTROL VOLTAGE




### NOISE FIGURE VERSUS FREQUENCY




### POWER GAIN AND NOISE FIGURE VERSUS AUTOMATIC GAIN CONTROL VOLTAGE

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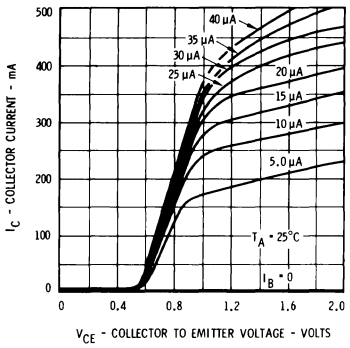
# CURVE SET NUMBER SS20

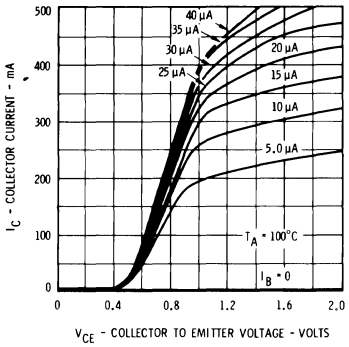
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

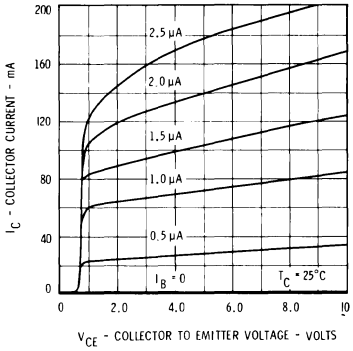
### COLLECTOR CHARACTERISTICS



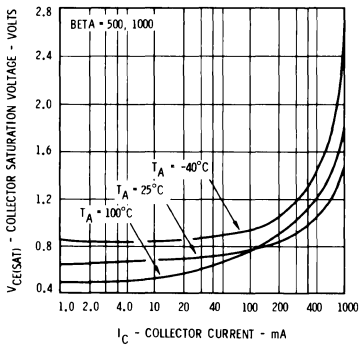

### COLLECTOR CHARACTERISTICS



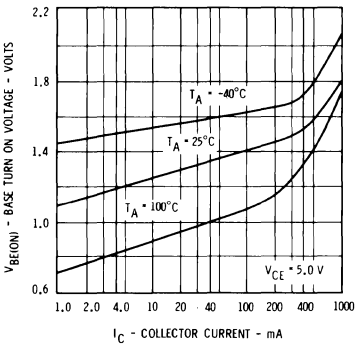

### COLLECTOR CHARACTERISTICS



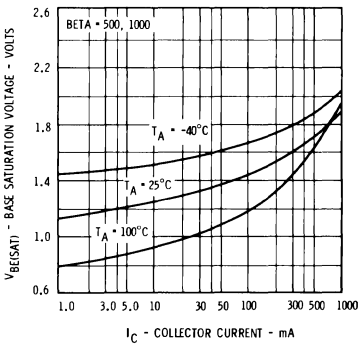

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



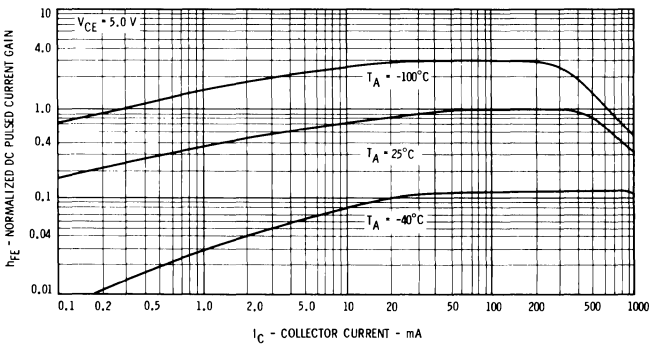

### BASE TURN ON VOLTAGE VERSUS COLLECTOR CURRENT



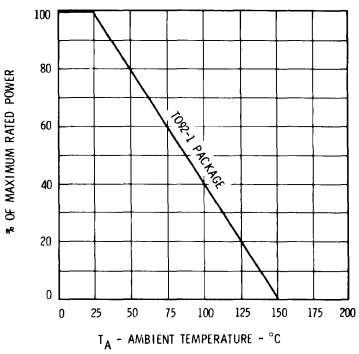

### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT




### NORMALIZED DC PULSED CURRENT GAIN VERSUS COLLECTOR CURRENT




### ALLOWABLE POWER DISSIPATION VERSUS AMBIENT TEMPERATURE

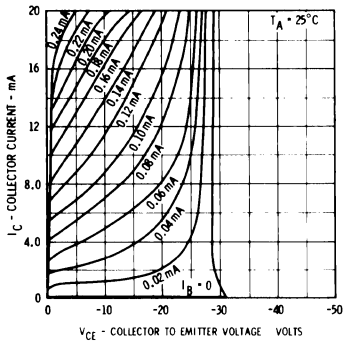


# CURVE SET NUMBER SS21

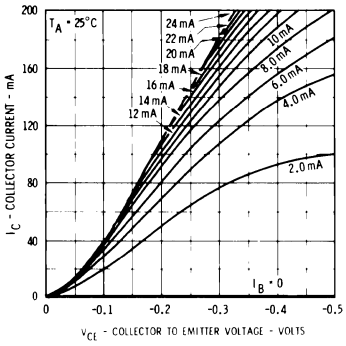
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

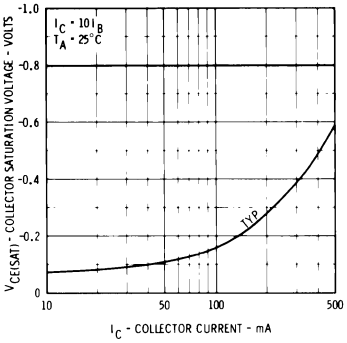
### TYPICAL COLLECTOR CHARACTERISTICS



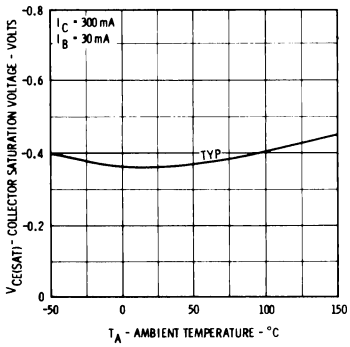

### TYPICAL COLLECTOR CHARACTERISTICS



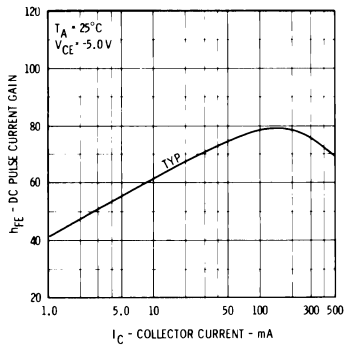

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



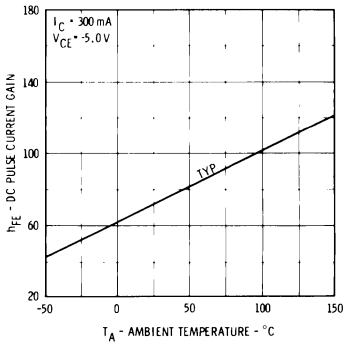

### COLLECTOR SATURATION VOLTAGE VERSUS AMBIENT TEMPERATURE



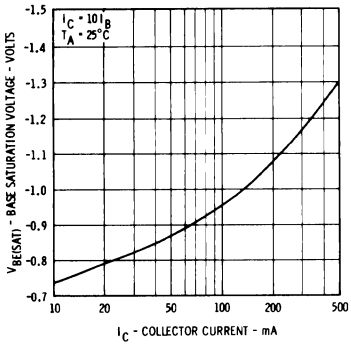

### DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



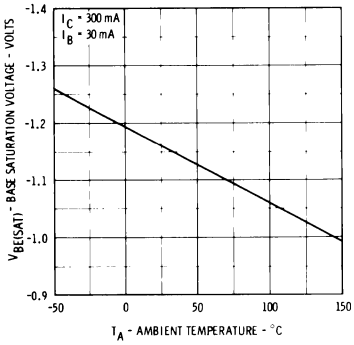

### DC PULSE CURRENT GAIN VERSUS AMBIENT TEMPERATURE



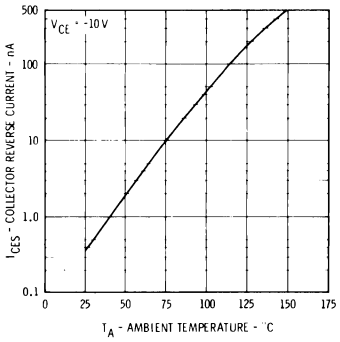

### TYPICAL BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



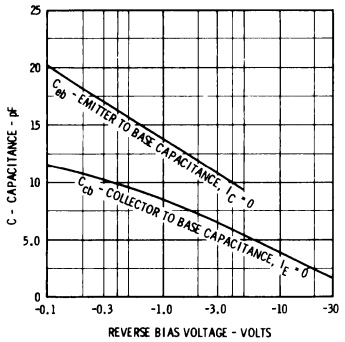

### TYPICAL BASE SATURATION VOLTAGE VERSUS AMBIENT TEMPERATURE



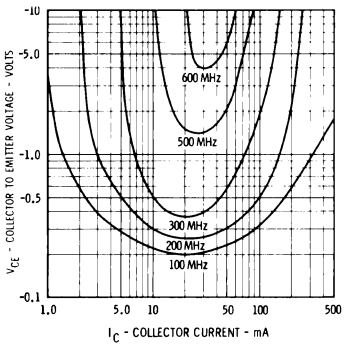

### COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



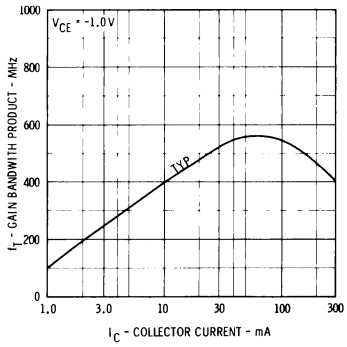

### CAPACITANCE VERSUS REVERSE BIAS VOLTAGE




### CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT




### GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT



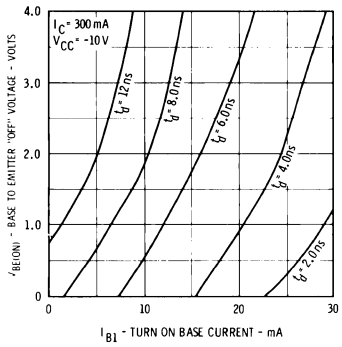

5

# CURVE SET NUMBER SS21

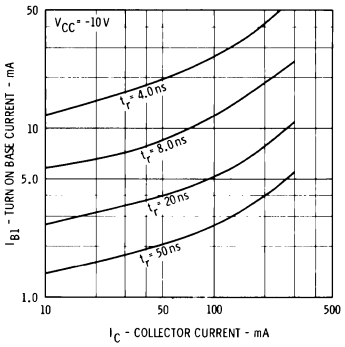
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

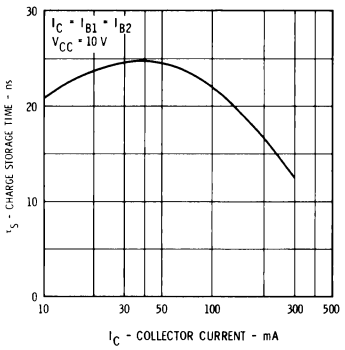
### DELAY TIME VERSUS BASE TO EMITTER 'OFF' VOLTAGE AND TURN ON BASE CURRENT



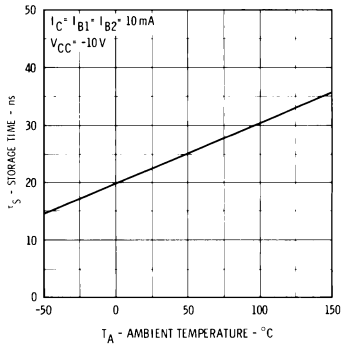

### RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS



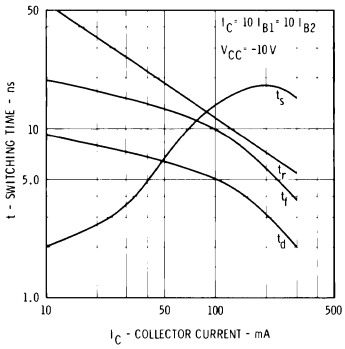

### CHARGE STORAGE TIME VERSUS COLLECTOR CURRENT



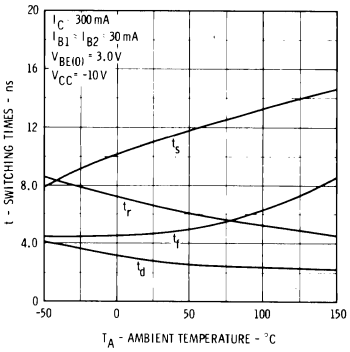

### CHARGE STORAGE TIME VERSUS AMBIENT TEMPERATURE



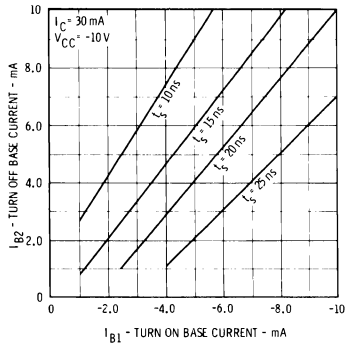

### SWITCHING TIMES VERSUS COLLECTOR CURRENT



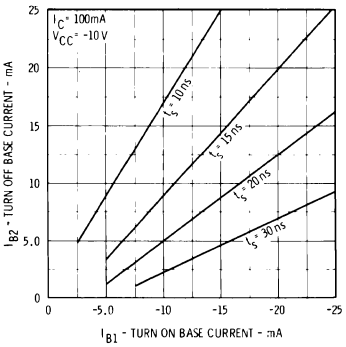

### SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



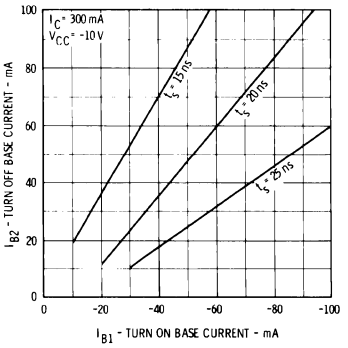

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



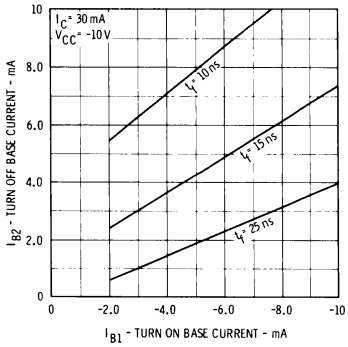

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



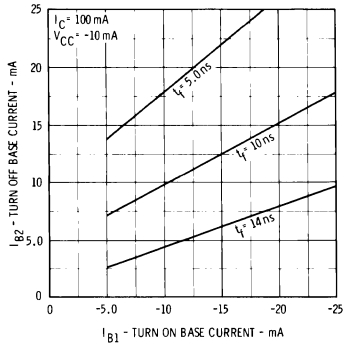

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



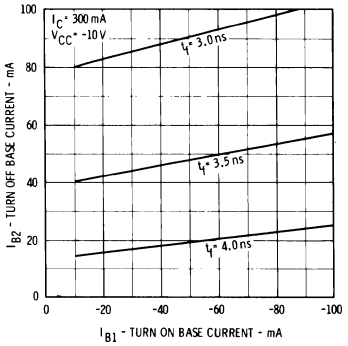

### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS




### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS




### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

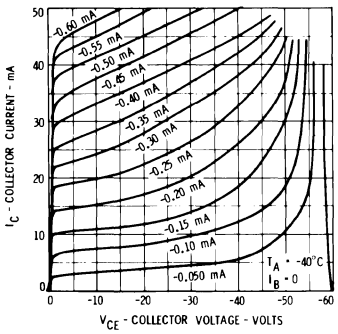


# CURVE SET NUMBER SS22

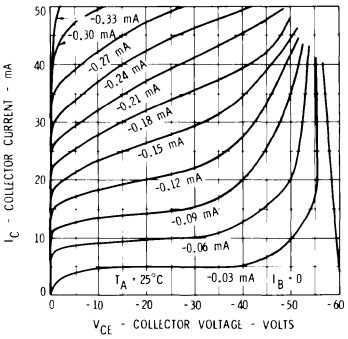
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

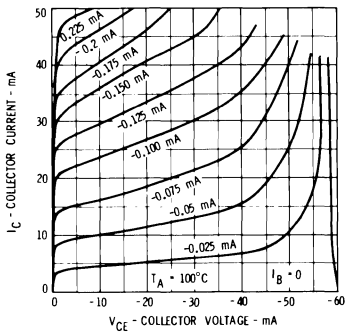
### COLLECTOR AND BASE CHARACTERISTICS ACTIVE REGION



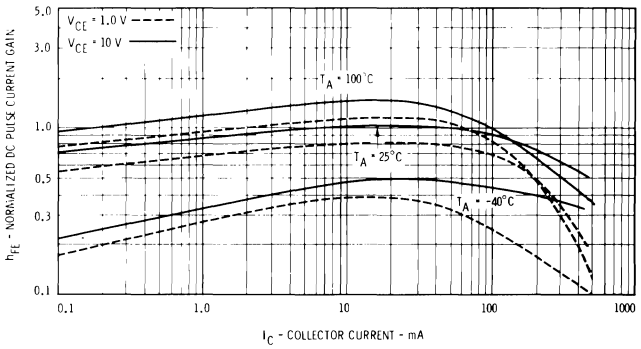

### COLLECTOR AND BASE CHARACTERISTICS ACTIVE REGION



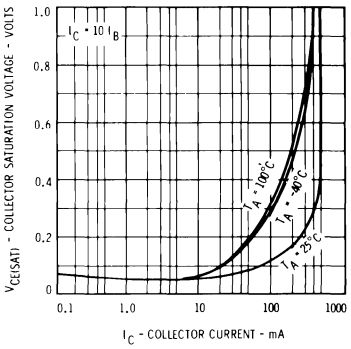

### COLLECTOR AND BASE CHARACTERISTICS ACTIVE REGION



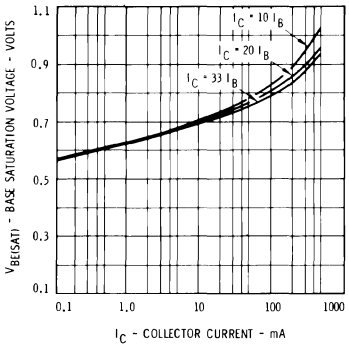

### NORMALIZED DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



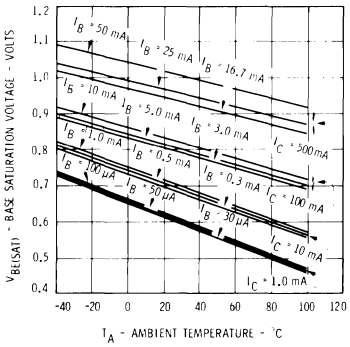

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



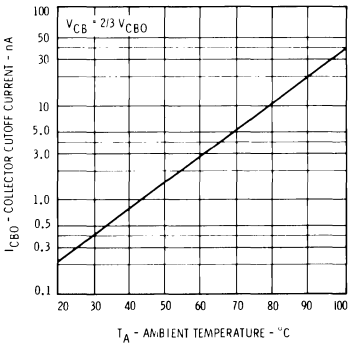

### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



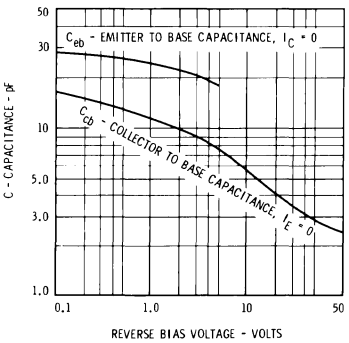

### BASE SATURATION VOLTAGE VERSUS AMBIENT TEMPERATURE



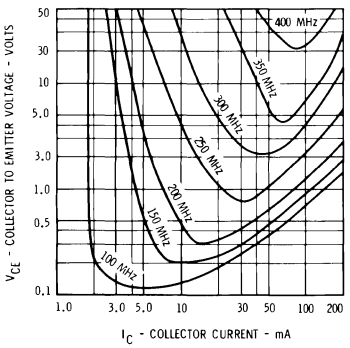

### COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



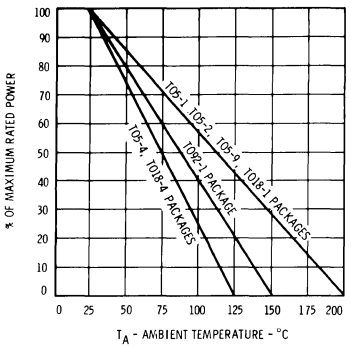

### CAPACITANCE VERSUS REVERSE BIAS VOLTAGE




### CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT




### ALLOWABLE POWER DISSIPATION VERSUS AMBIENT TEMPERATURE

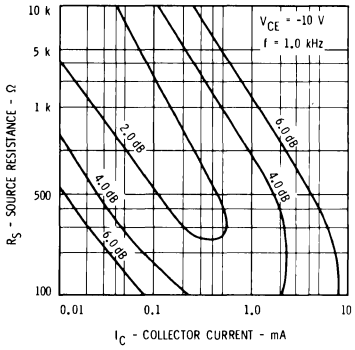


# CURVE SET NUMBER SS22

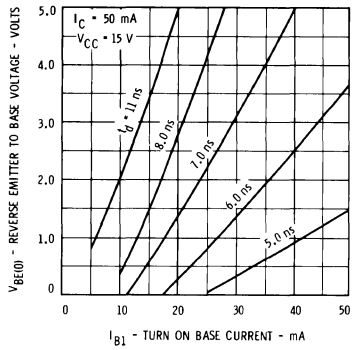
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

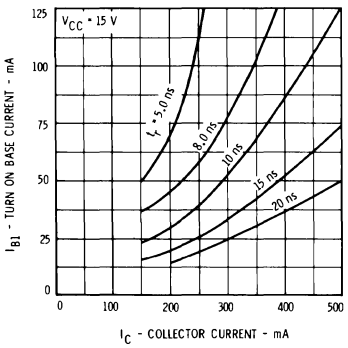
### CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



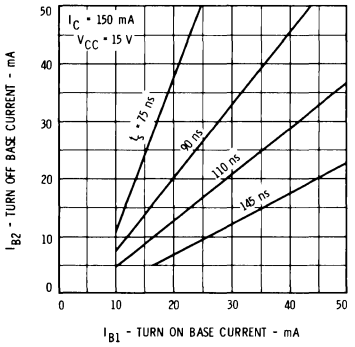

### DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE TO EMITTER VOLTAGE



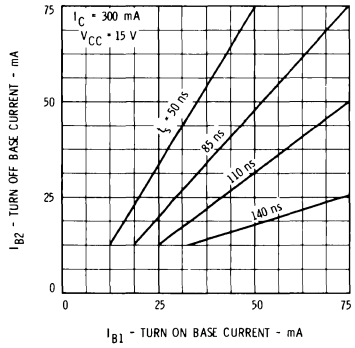

### RISE TIME VERSUS COLLECTOR CURRENT AND TURN ON BASE CURRENT



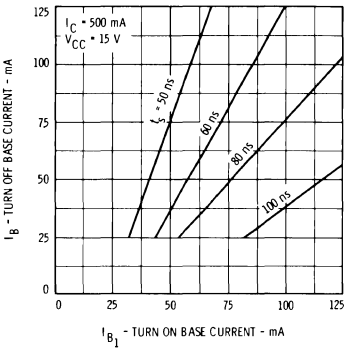

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



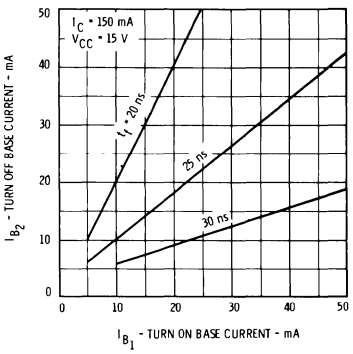

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



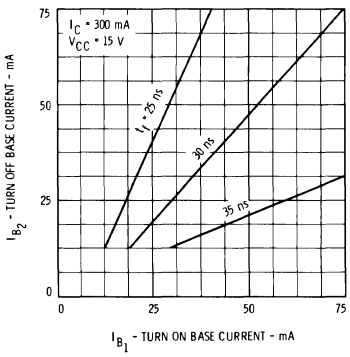

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



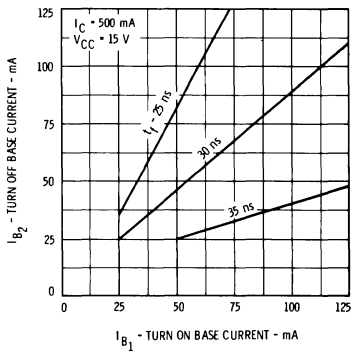

### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



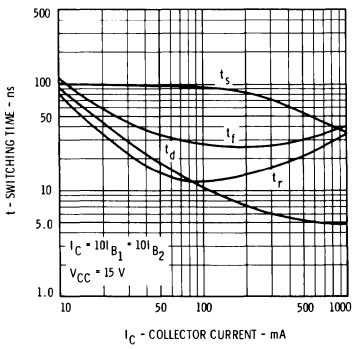

### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS




### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS




### SWITCHING TIME VERSUS COLLECTOR CURRENT

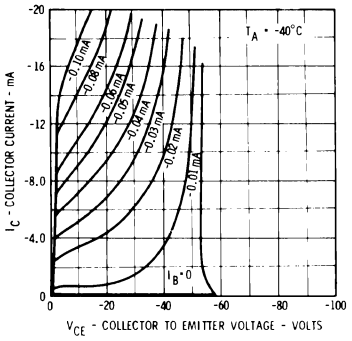


# CURVE SET NUMBER SS23

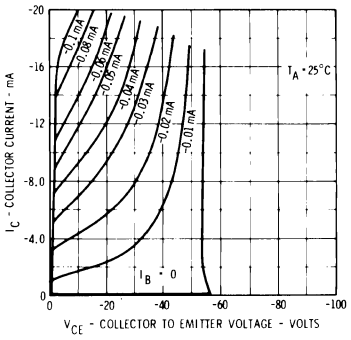
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

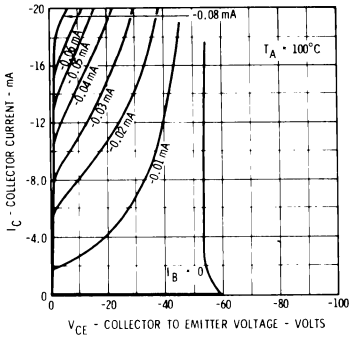
### COLLECTOR AND BASE CHARACTERISTICS ACTIVE REGION



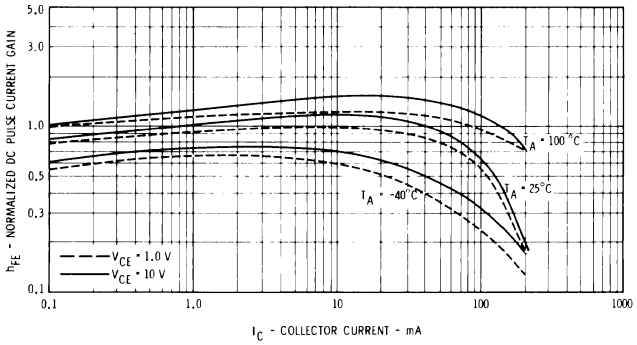

### COLLECTOR AND BASE CHARACTERISTICS ACTIVE REGION



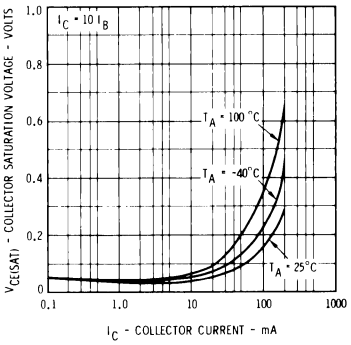

### COLLECTOR AND BASE CHARACTERISTICS ACTIVE REGION



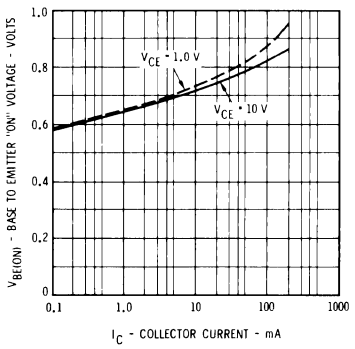

### NORMALIZED DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



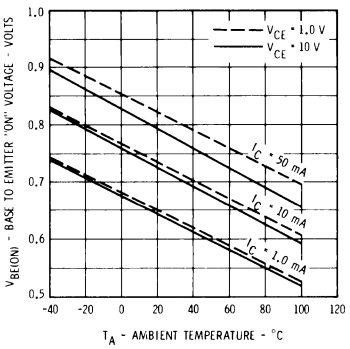

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



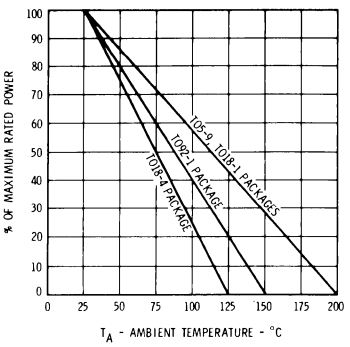

### BASE TO EMITTER 'ON' VOLTAGE VERSUS COLLECTOR CURRENT




### BASE TO EMITTER 'ON' VOLTAGE VERSUS AMBIENT TEMPERATURE




### ALLOWABLE POWER DISSIPATION VERSUS AMBIENT TEMPERATURE

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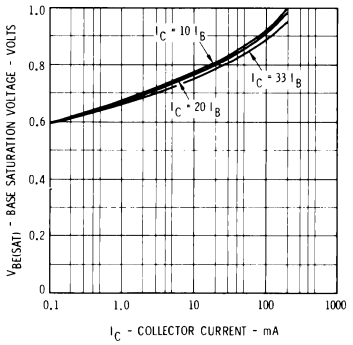
# CURVE SET NUMBER SS23

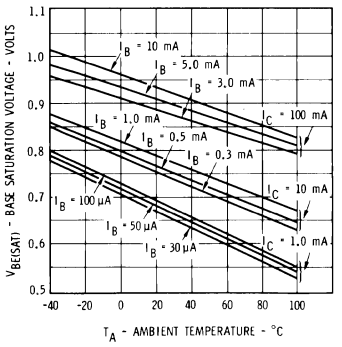
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

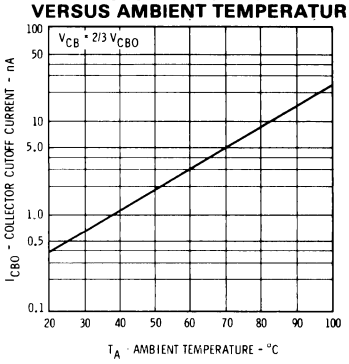
### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



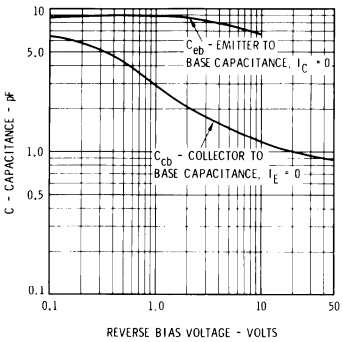

### BASE SATURATION VOLTAGE VERSUS AMBIENT TEMPERATURE



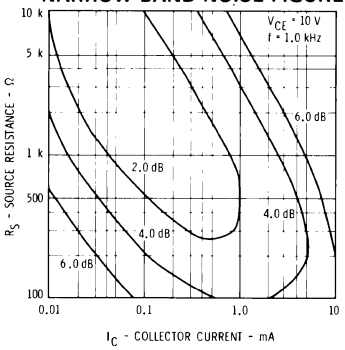

### COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



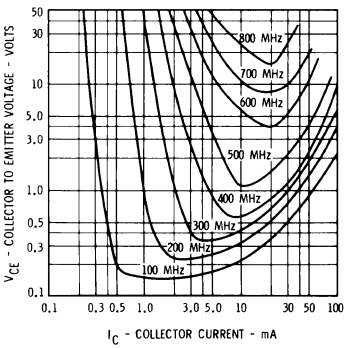

### CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



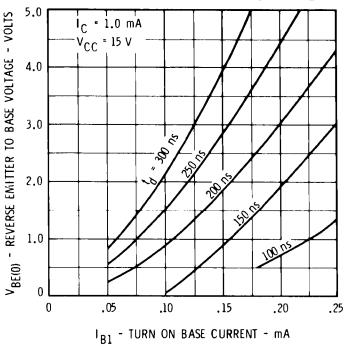

### CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



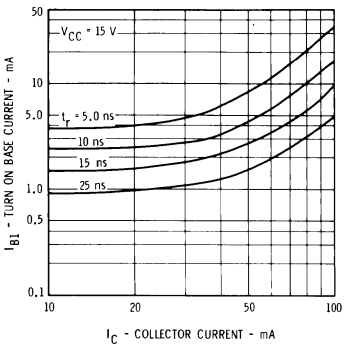

### CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT



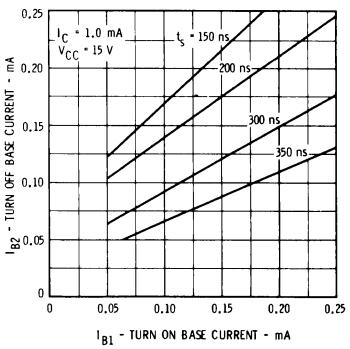

### DELAY TIME VERSUS TURN ON BASE CURRENTS AND REVERSE BASE TO EMITTER VOLTAGE




### RISE TIME VERSUS COLLECTOR CURRENT AND TURN ON BASE CURRENT




### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

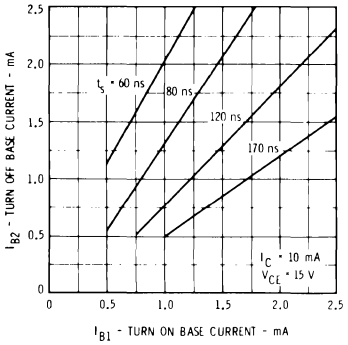


# CURVE SET NUMBER SS23

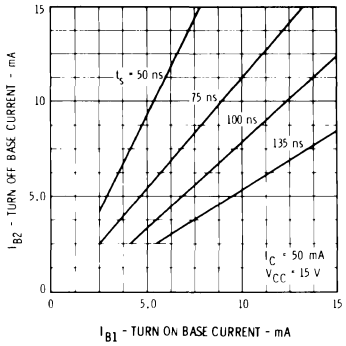
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

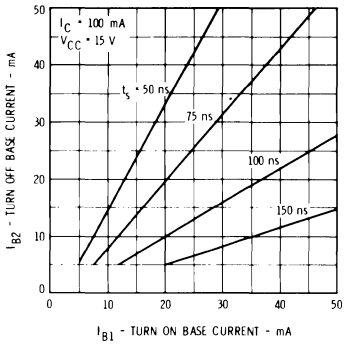
### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



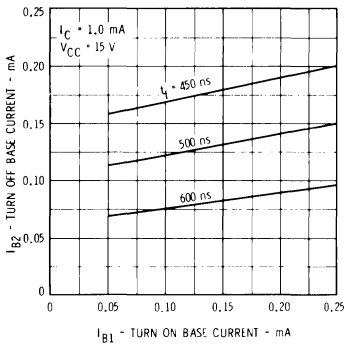

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



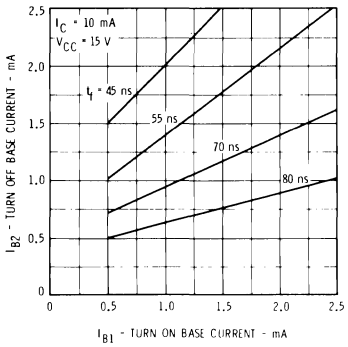

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



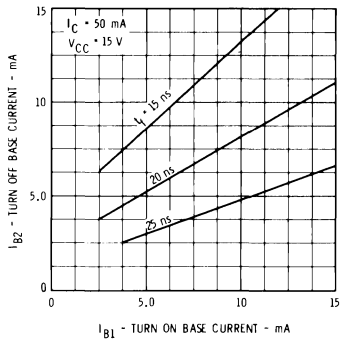

### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



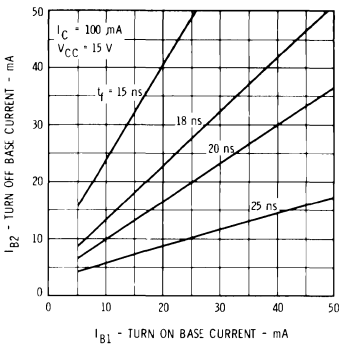

### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



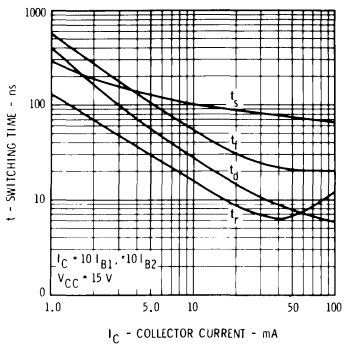

### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS




### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS




### SWITCHING TIME VERSUS COLLECTOR CURRENT



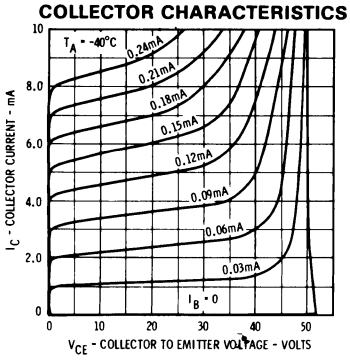

5

# CURVE SET NUMBER SS24

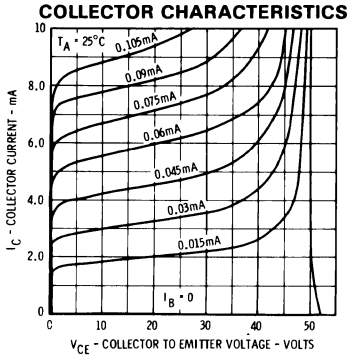
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

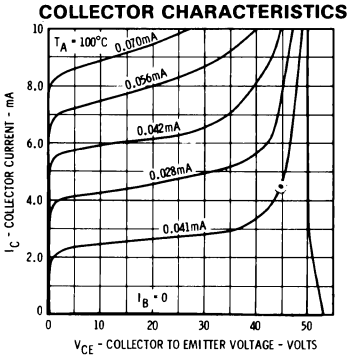
### ACTIVE REGION COLLECTOR CHARACTERISTICS



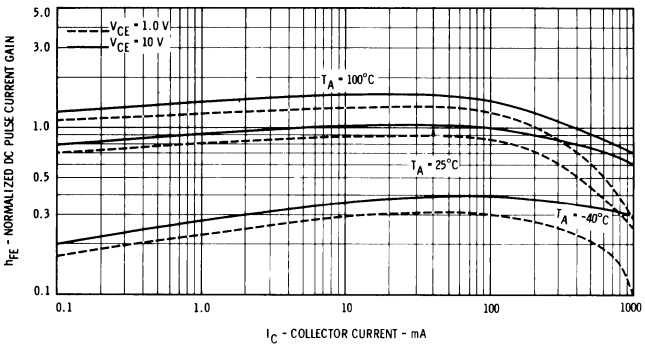

### ACTIVE REGION COLLECTOR CHARACTERISTICS



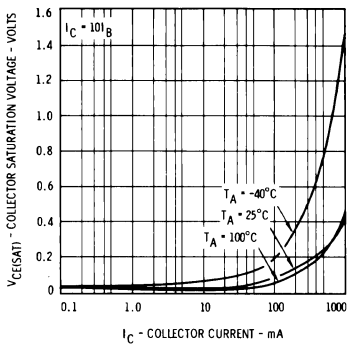

### ACTIVE REGION COLLECTOR CHARACTERISTICS



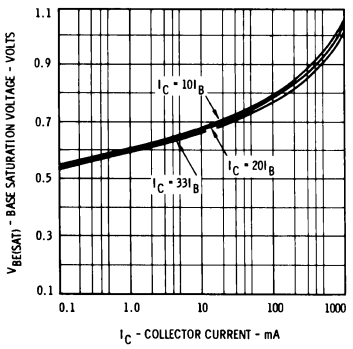

### NORMALIZED DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



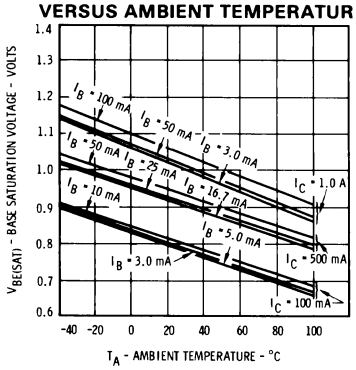

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT




### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT




### BASE SATURATION VOLTAGE VERSUS AMBIENT TEMPERATURE

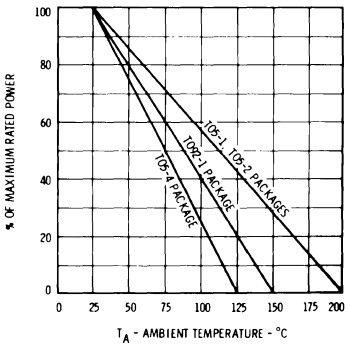


# CURVE SET NUMBER SS24

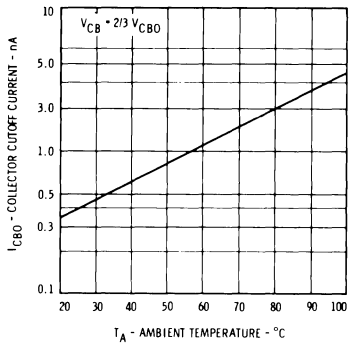
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

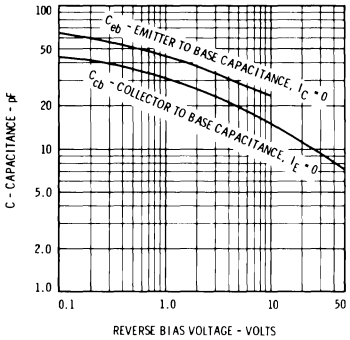
### ALLOWABLE POWER DISSIPATION VERSUS AMBIENT TEMPERATURE



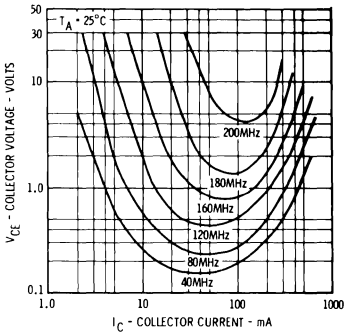

### COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



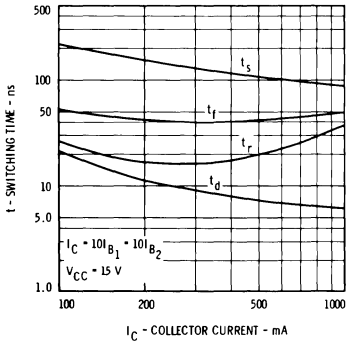

### CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



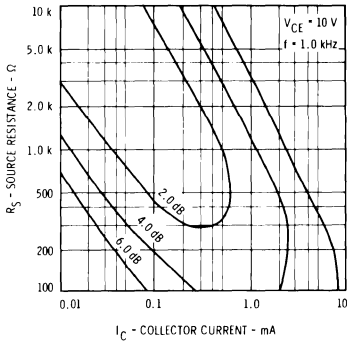

### CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT




### SWITCHING TIME VERSUS COLLECTOR CURRENT




### CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



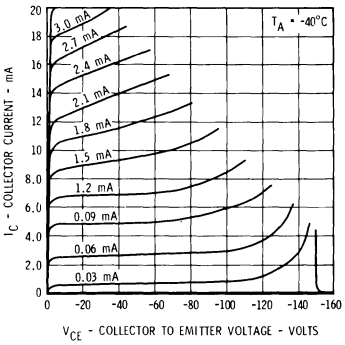

5

# CURVE SET NUMBER SS25

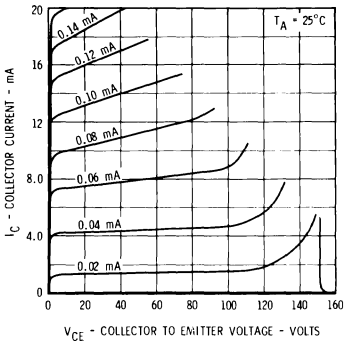
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

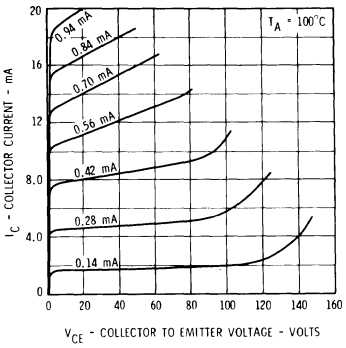
### COLLECTOR CHARACTERISTICS



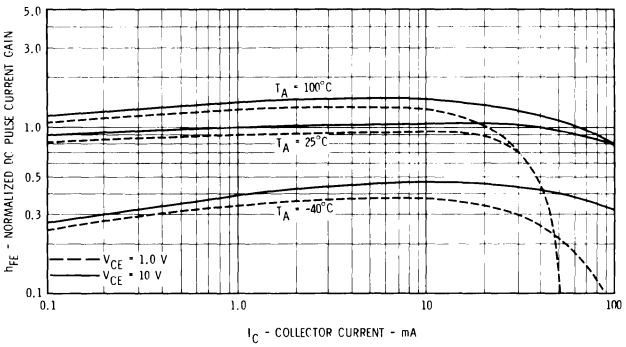

### COLLECTOR CHARACTERISTICS



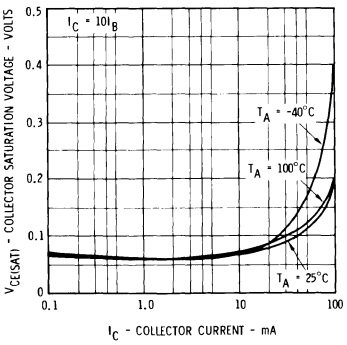

### COLLECTOR CHARACTERISTICS



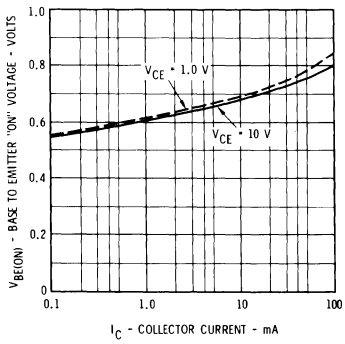

### NORMALIZED DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



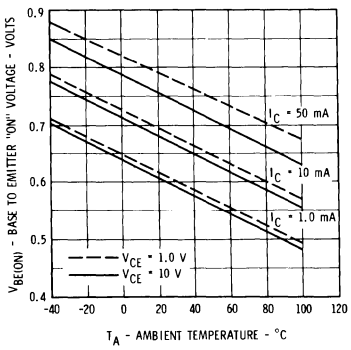

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



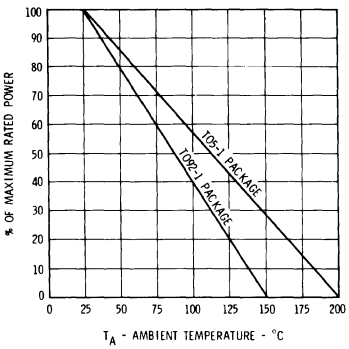

### BASE TO EMITTER 'ON' VOLTAGE VERSUS COLLECTOR CURRENT




### BASE TO EMITTER 'ON' VOLTAGE VERSUS AMBIENT TEMPERATURE




### ALLOWABLE POWER DISSIPATION VERSUS AMBIENT TEMPERATURE

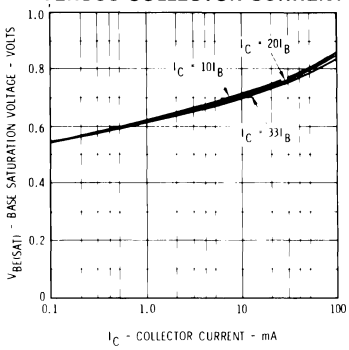


# CURVE SET NUMBER SS25

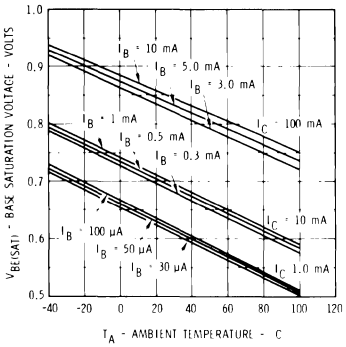
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

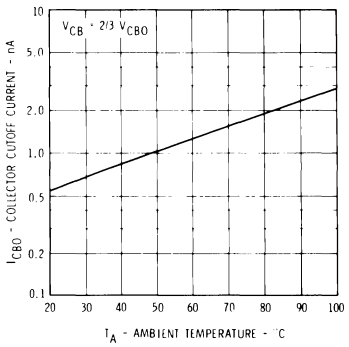
### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



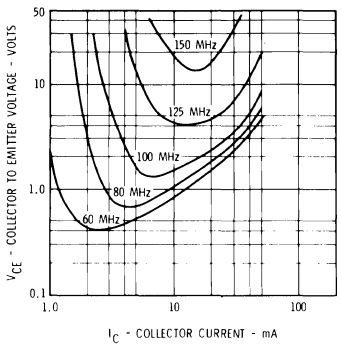

### BASE SATURATION VOLTAGE VERSUS AMBIENT TEMPERATURE



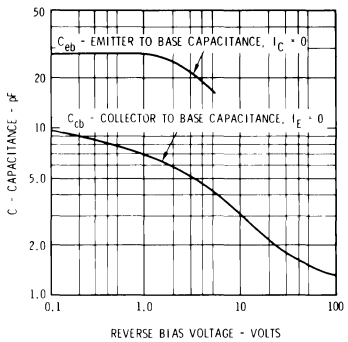

### COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



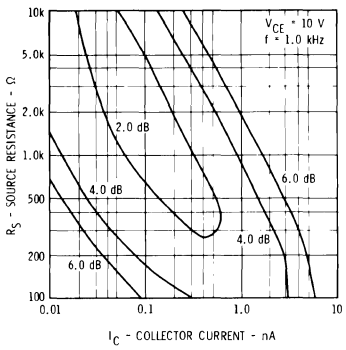

### CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT



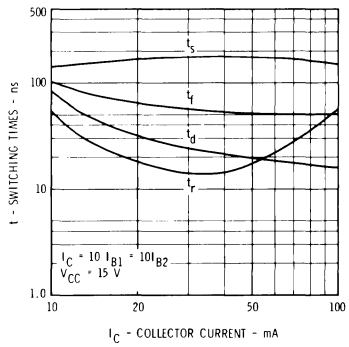

### CAPACITANCE VERSUS REVERSE BIAS VOLTAGE




### CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE




### SWITCHING TIME VERSUS COLLECTOR CURRENT

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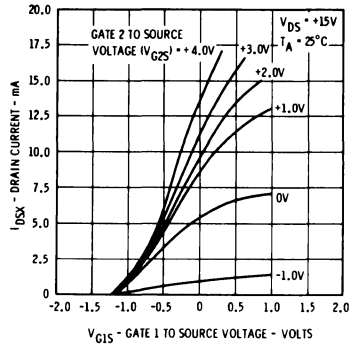
# CURVE SET NUMBER SS26

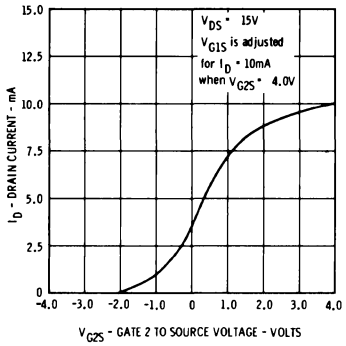
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

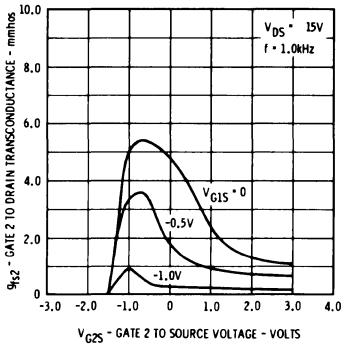
### TYPICAL DRAIN CHARACTERISTICS



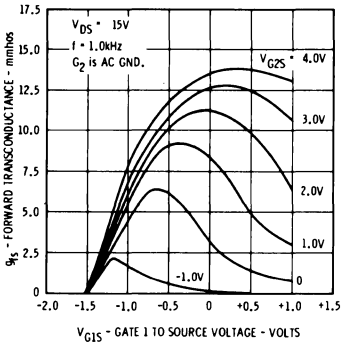

### DRAIN CURRENT VERSUS GATE 2 TO SOURCE VOLTAGE



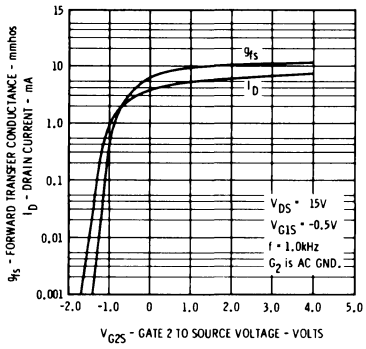

### GATE 2 TO DRAIN TRANSCONDUCTANCE VERSUS GATE 2 TO SOURCE VOLTAGE



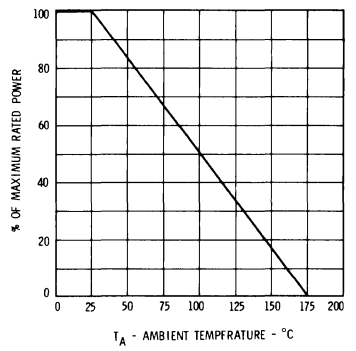

### FORWARD TRANSCONDUCTANCE VERSUS GATE 1 TO SOURCE VOLTAGE



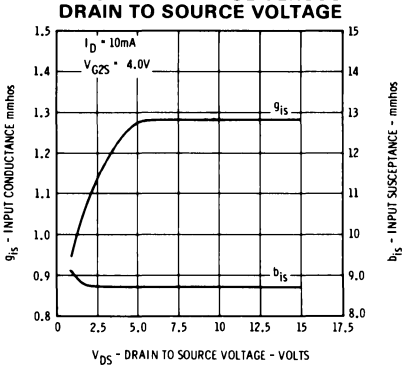

### FORWARD TRANSCONDUCTANCE AND DRAIN CURRENT VERSUS GATE 2 TO SOURCE DC VOLTAGE



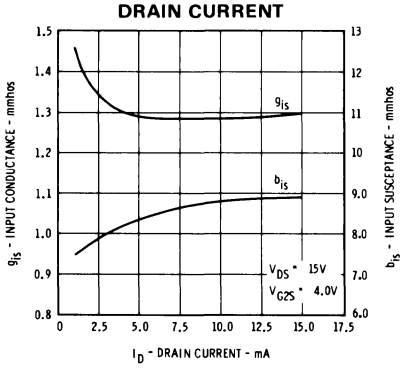

### ALLOWABLE POWER DISSIPATION VERSUS AMBIENT TEMPERATURE



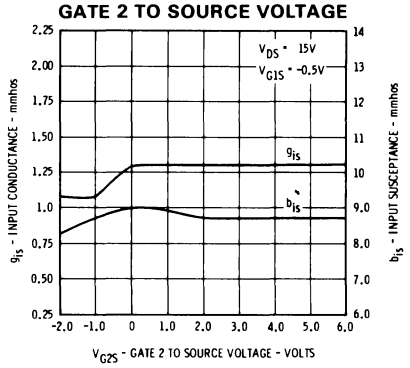

### INPUT ADMITTANCE VERSUS DRAIN TO SOURCE VOLTAGE



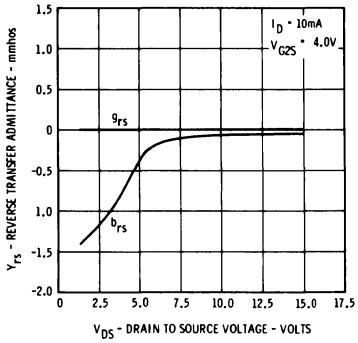

### INPUT ADMITTANCE VERSUS DRAIN CURRENT



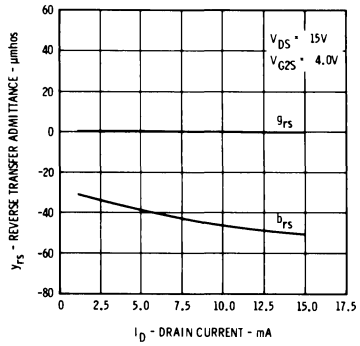

### INPUT ADMITTANCE VERSUS GATE 2 TO SOURCE VOLTAGE



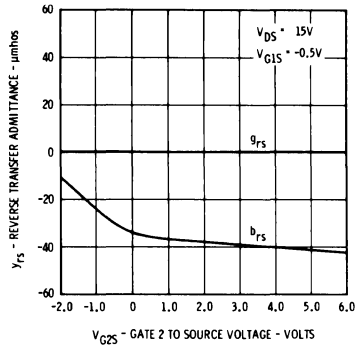

### REVERSE TRANSFER ADMITTANCE VERSUS DRAIN TO SOURCE VOLTAGE




### REVERSE TRANSFER ADMITTANCE VERSUS DRAIN CURRENT




### REVERSE TRANSFER ADMITTANCE VERSUS GATE 2 TO SOURCE VOLTAGE

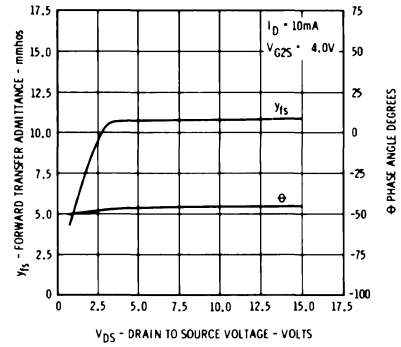


# CURVE SET NUMBER SS26

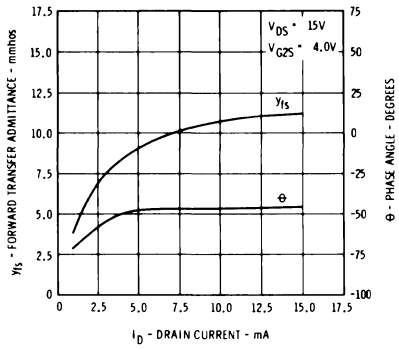
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

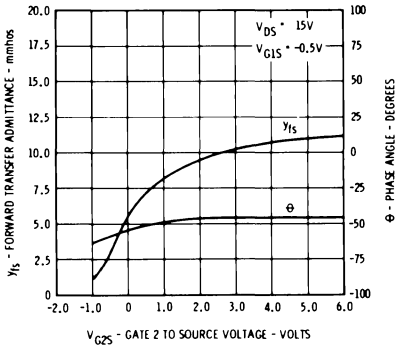
### FORWARD TRANSFER ADMITTANCE VERSUS DRAIN TO SOURCE VOLTAGE



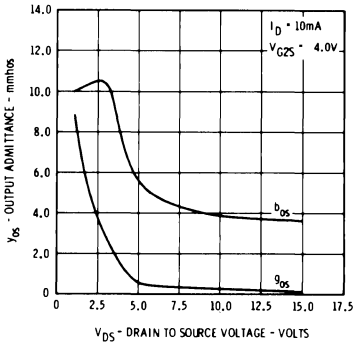

### FORWARD TRANSFER ADMITTANCE VERSUS DRAIN CURRENT



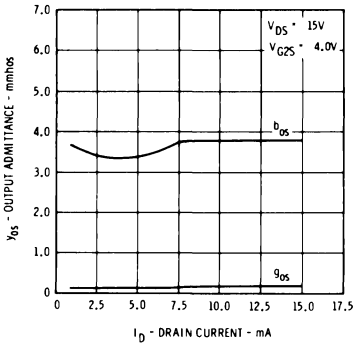

### FORWARD TRANSFER ADMITTANCE VERSUS GATE 2 TO SOURCE VOLTAGE



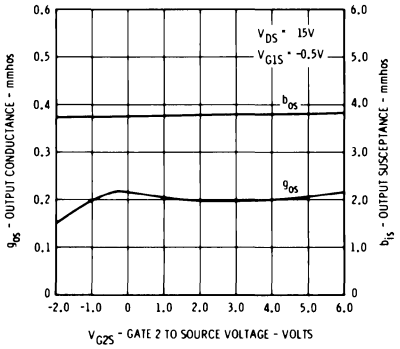

### OUTPUT ADMITTANCE VERSUS DRAIN TO SOURCE VOLTAGE



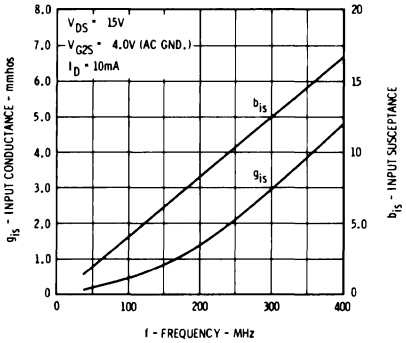

### OUTPUT ADMITTANCE VERSUS DRAIN CURRENT



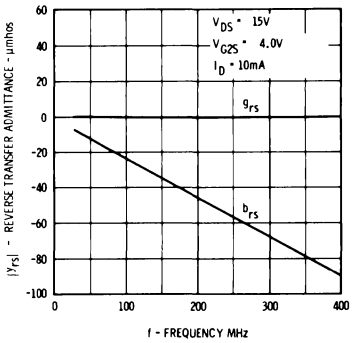

### OUTPUT ADMITTANCE VERSUS GATE 2 TO SOURCE VOLTAGE



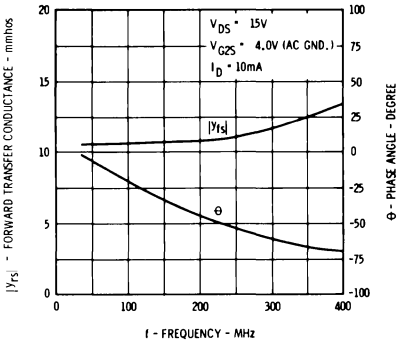

### INPUT ADMITTANCE VERSUS FREQUENCE OUTPUT SHORT CIRCUIT




### REVERSE TRANSFER ADMITTANCE VERSUS FREQUENCY INPUT SHORT CIRCUIT




### FORWARD TRANSFER ADMITTANCE VERSUS FREQUENCY OUTPUT SHORT CIRCUIT

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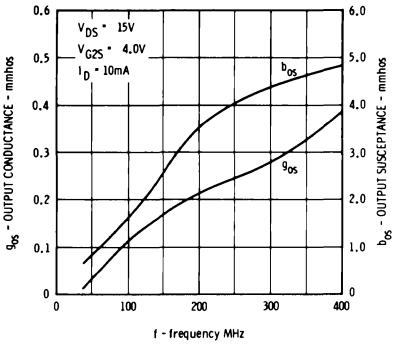
# CURVE SET NUMBER SS26

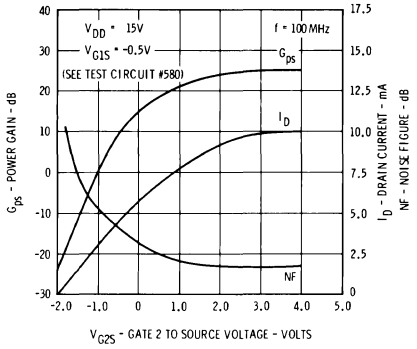
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

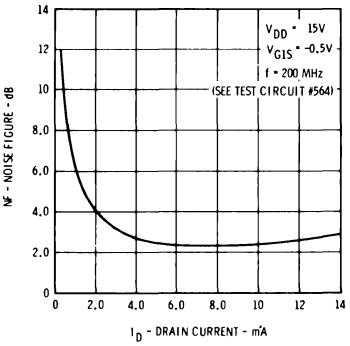
### OUTPUT ADMITTANCE VERSUS FREQUENCY INPUT SHORT CIRCUIT



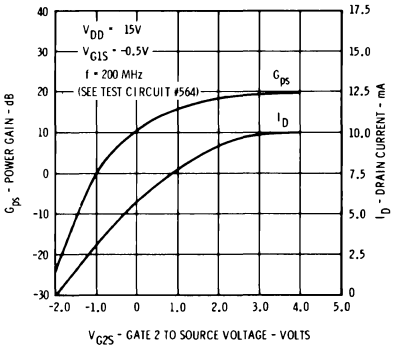

### PG, NF AND DRAIN CURRENT VERSUS GATE 2 TO SOURCE VOLTAGE*



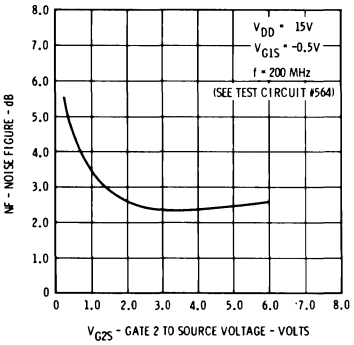

### NOISE FIGURE VERSUS DRAIN CURRENT



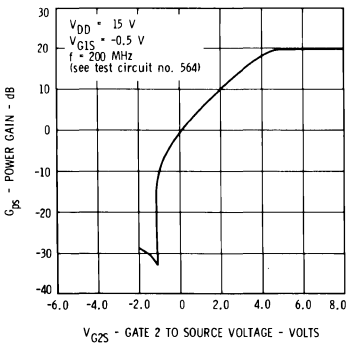

### POWER GAIN AND DRAIN CURRENT VERSUS GATE 2 TO SOURCE VOLTAGE




### NOISE FIGURE VERSUS GATE 2 SOURCE VOLTAGE




### POWER GAIN VERSUS GATE 2 TO SOURCE VOLTAGE



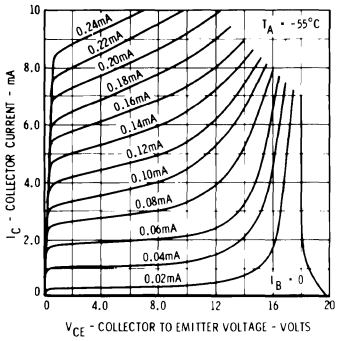

*For this graph, the gate self-bias (dc) circuits were disconnected and external supplies brought in as noted in the referenced test circuits.

# CURVE SET NUMBER SS27

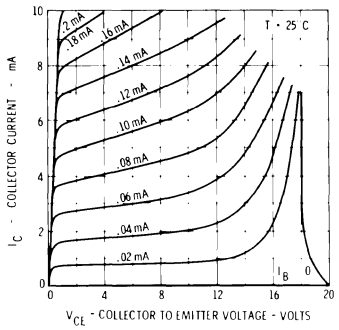
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

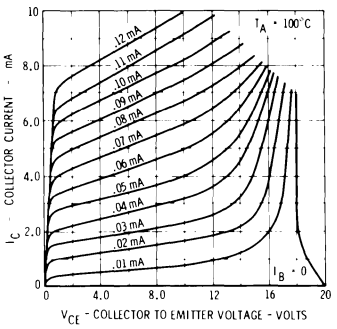
### COLLECTOR CHARACTERISTICS



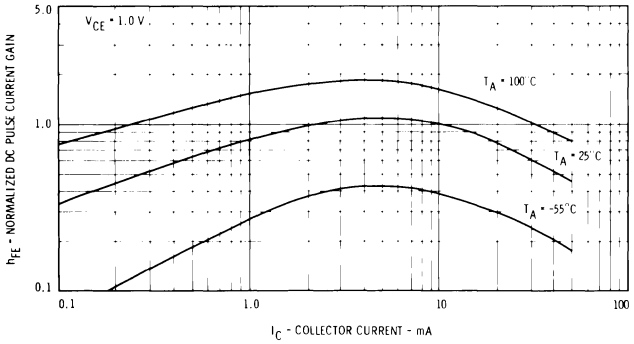

### COLLECTOR CHARACTERISTICS



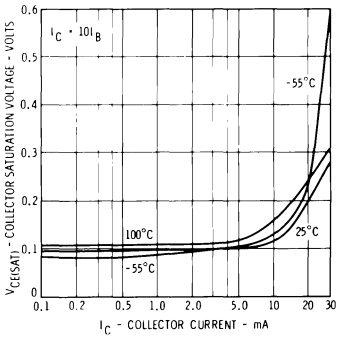

### COLLECTOR CHARACTERISTICS



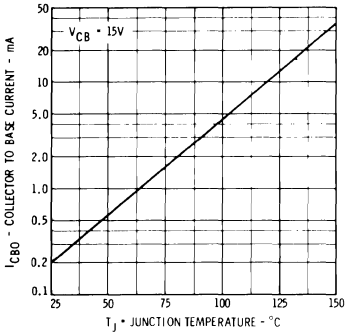

### NORMALIZED DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



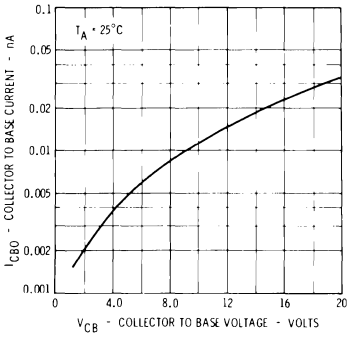

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



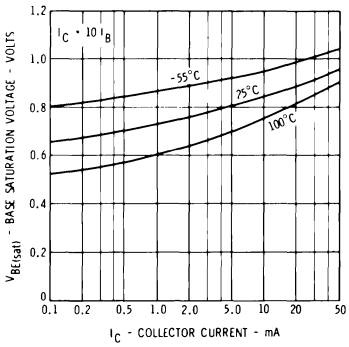

### COLLECTOR TO BASE DIODE REVERSE CURRENT VERSUS TEMPERATURE



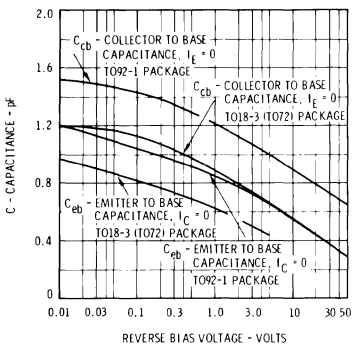

### COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE



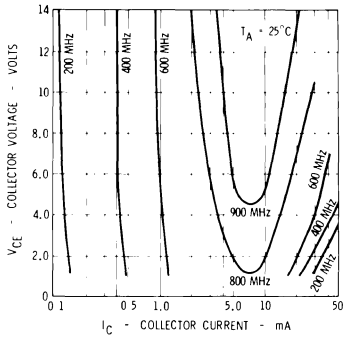

### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



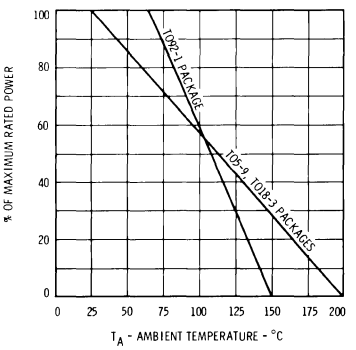

### CAPACITANCE VERSUS REVERSE BIAS VOLTAGE




### CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT




### ALLOWABLE POWER DISSIPATION VERSUS AMBIENT TEMPERATURE

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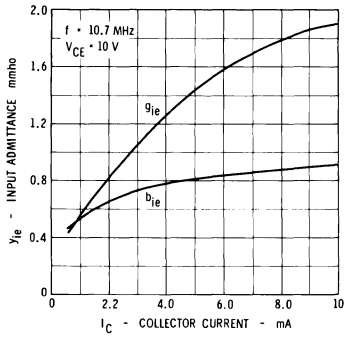
# CURVE SET NUMBER SS27

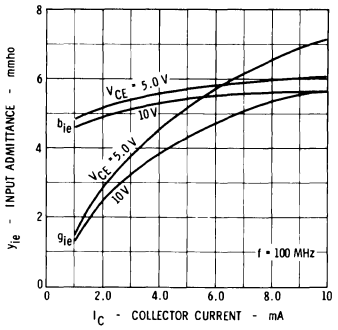
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

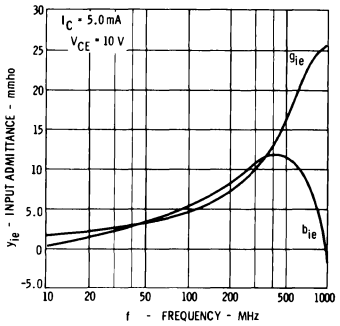
### 10.7 MHz INPUT ADMITTANCE OUTPUT SHORT CIRCUIT



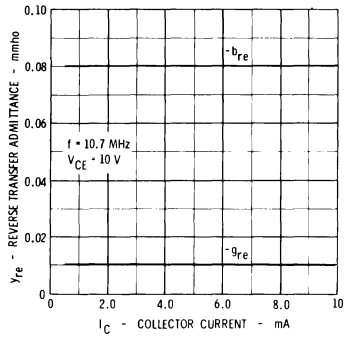

### 100 MHz INPUT ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



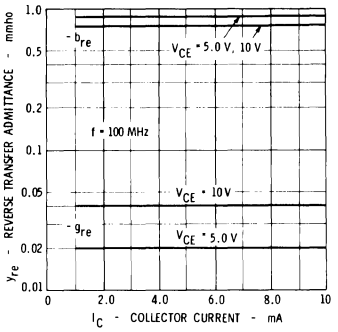

### INPUT ADMITTANCE VERSUS FREQUENCY OUTPUT SHORT CIRCUIT



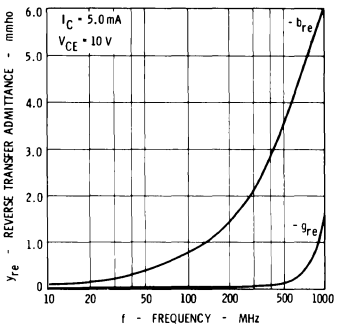

### 10.7 MHz REVERSE TRANSFER ADMITTANCE INPUT SHORT CIRCUIT



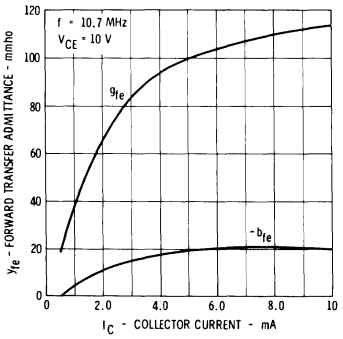

### 100 MHz REVERSE TRANSFER ADMITTANCE INPUT SHORT CIRCUIT



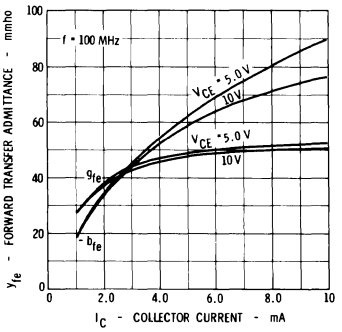

### REVERSE TRANSFER ADMITTANCE VERSUS FREQUENCY INPUT SHORT CIRCUIT




### 10.7 MHz FORWARD TRANSFER ADMITTANCE OUTPUT SHORT CIRCUIT




### 100 MHz FORWARD TRANSFER ADMITTANCE OUTPUT SHORT CIRCUIT

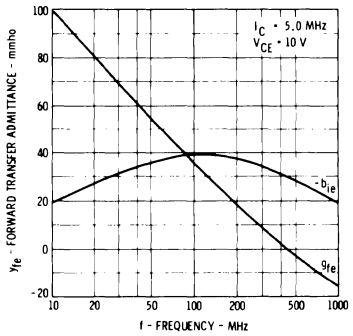


# CURVE SET NUMBER SS27

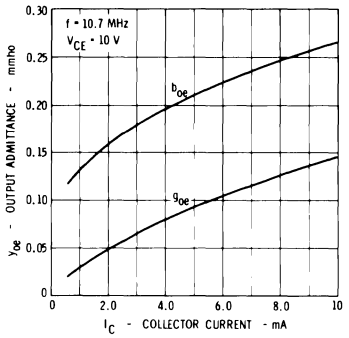
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

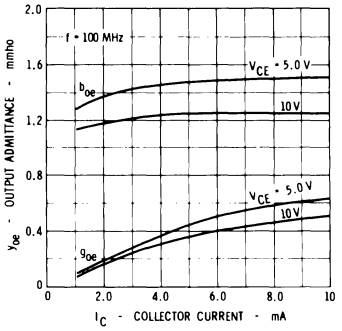
### FORWARD TRANSFER ADMITTANCE VERSUS FREQUENCY OUTPUT SHORT CIRCUIT



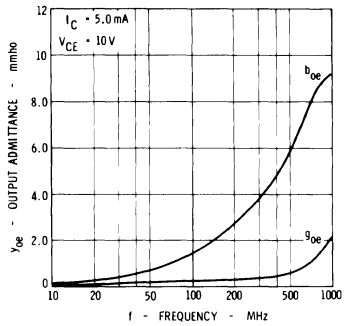

### 10.7 MHz OUTPUT ADMITTANCE INPUT SHORT CIRCUIT



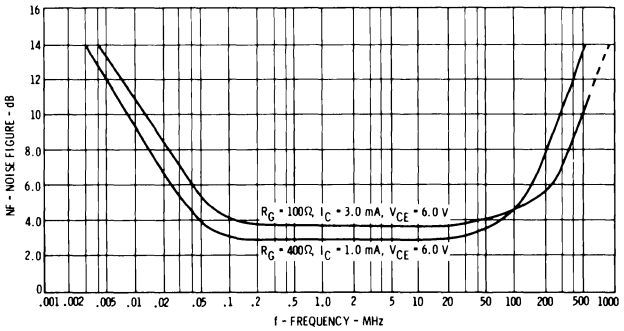

### 100 MHz OUTPUT ADMITTANCE INPUT SHORT CIRCUIT



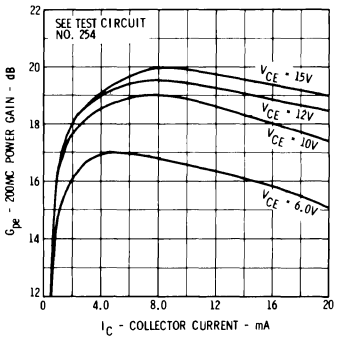

### OUTPUT ADMITTANCE VERSUS FREQUENCY INPUT SHORT CIRCUIT



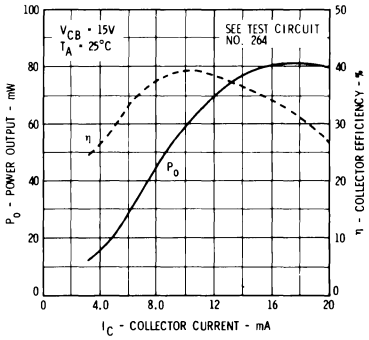

### NOISE FIGURE VERSUS FREQUENCY




### NEUTRALIZED 200 MHz POWER GAIN AMPLIFIER PERFORMANCE




### 500 MHz OSCILLATOR TYPICAL PERFORMANCE

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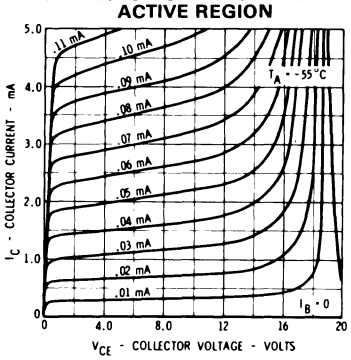
# CURVE SET NUMBER SS28

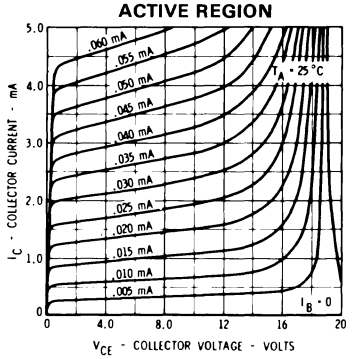
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

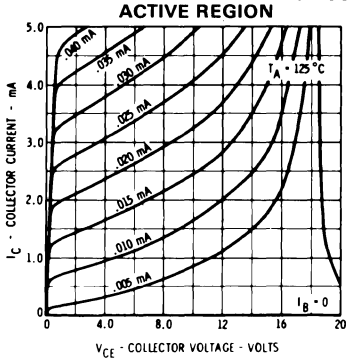
### COLLECTOR CHARACTERISTICS ACTIVE REGION



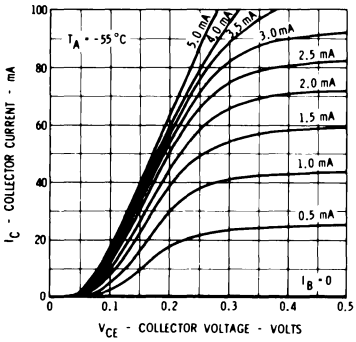

### COLLECTOR CHARACTERISTICS ACTIVE REGION



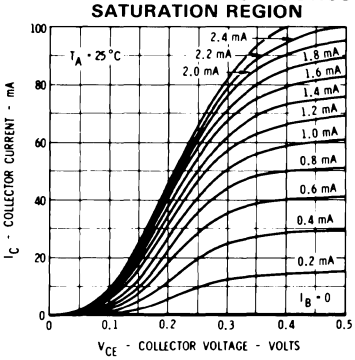

### COLLECTOR CHARACTERISTICS ACTIVE REGION



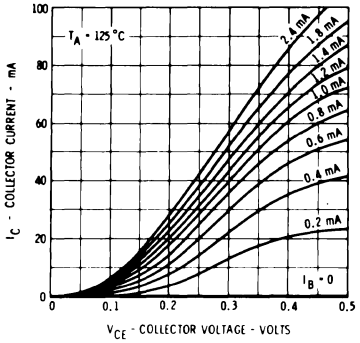

### COLLECTOR CHARACTERISTICS SATURATION REGION



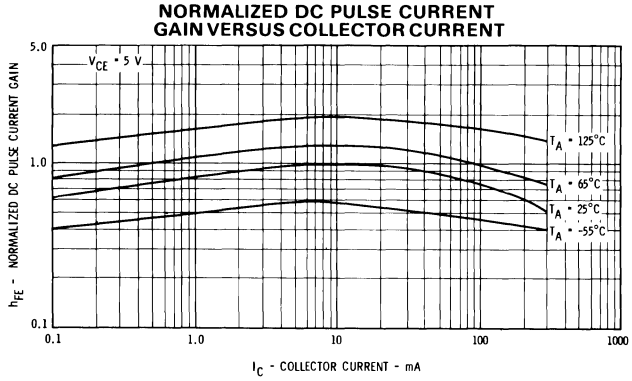

### COLLECTOR CHARACTERISTICS SATURATION REGION



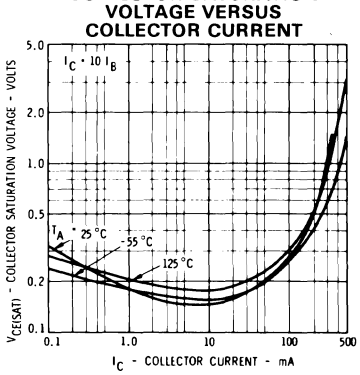

### COLLECTOR CHARACTERISTICS SATURATION REGION



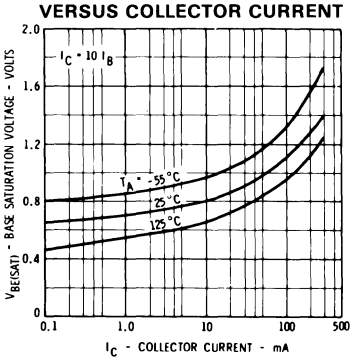

### NORMALIZED DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



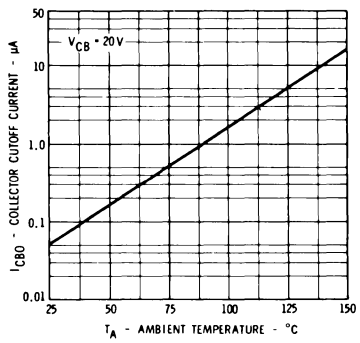

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



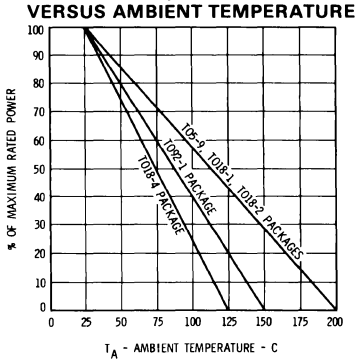

### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT




### COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE




### ALLOWABLE POWER DISSIPATION VERSUS AMBIENT TEMPERATURE

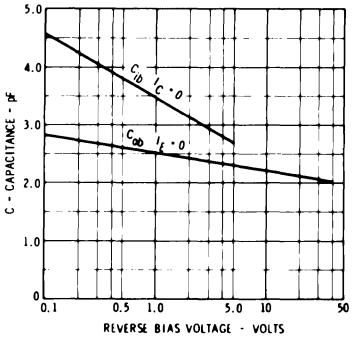


# CURVE SET NUMBER SS28

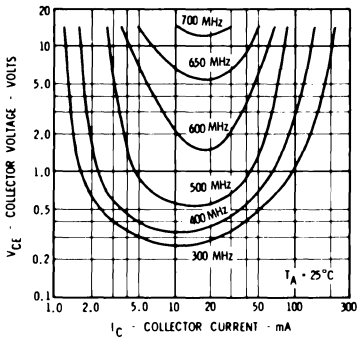
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

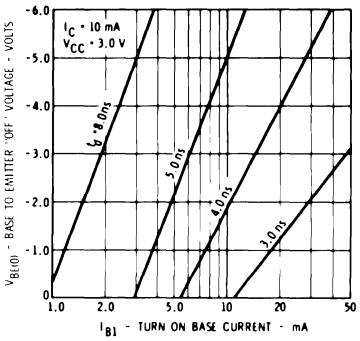
### EMITTER TRANSITION AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



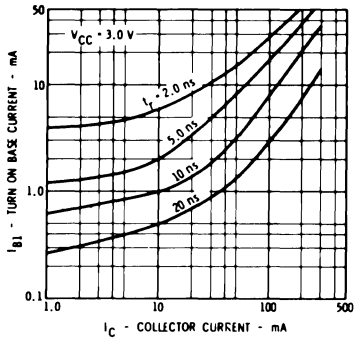

### CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT



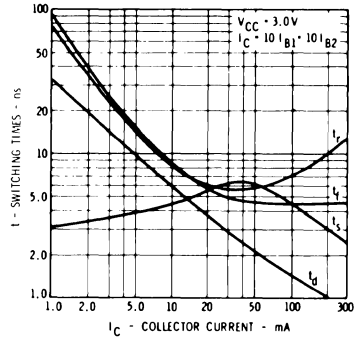

### DELAY TIME VERSUS BASE TO EMITTER 'OFF' VOLTAGE AND TURN ON BASE CURRENT



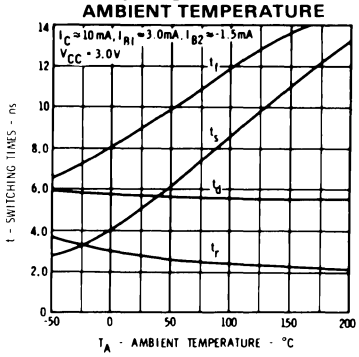

### RISE TIME VERSUS TURN ON BASE CURRENT AND COLLECTOR CURRENT



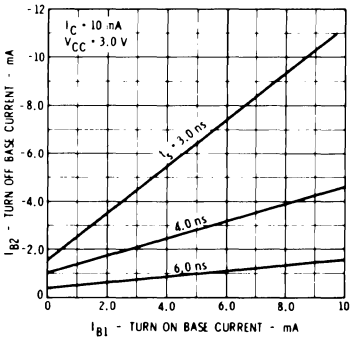

### SWITCHING TIMES VERSUS COLLECTOR CURRENT



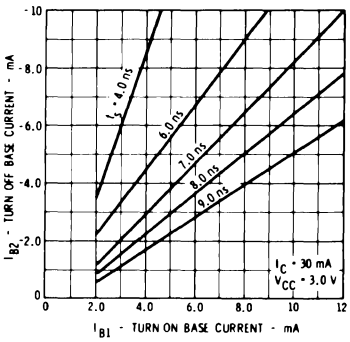

### SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



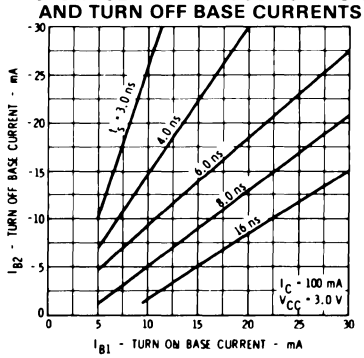

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



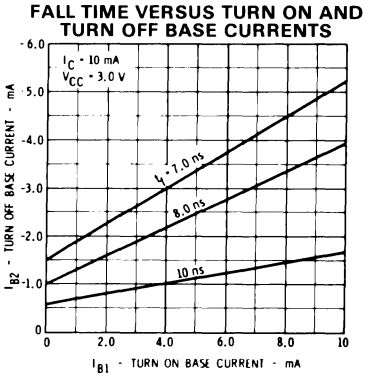

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



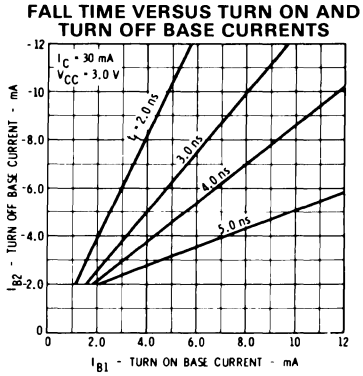

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



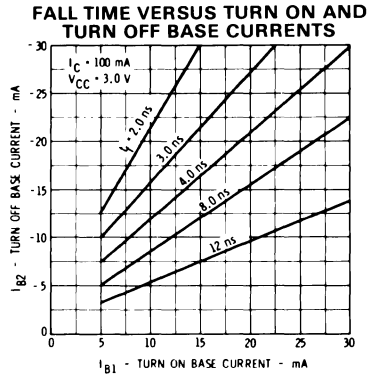

### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS




### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS




### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

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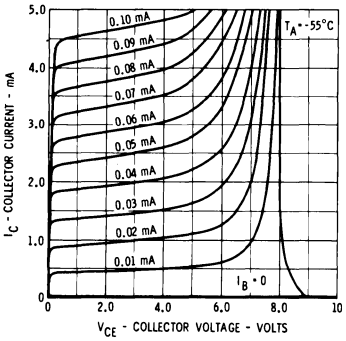
# CURVE SET NUMBER SS29

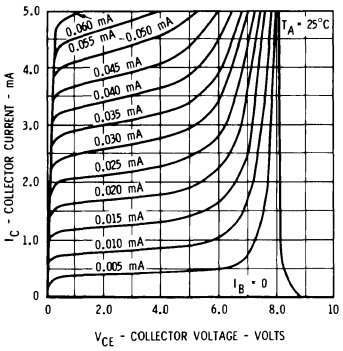
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

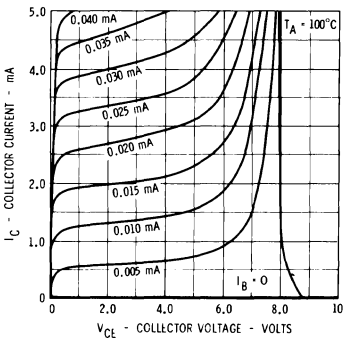
### COLLECTOR CHARACTERISTICS ACTIVE REGION



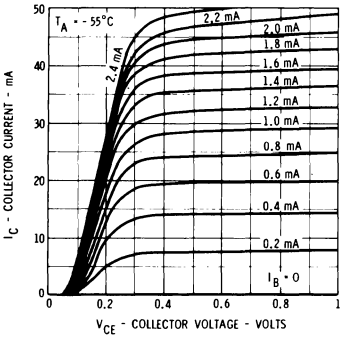

### COLLECTOR CHARACTERISTICS ACTIVE REGION



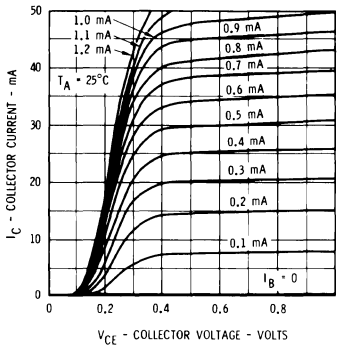

### COLLECTOR CHARACTERISTICS ACTIVE REGION



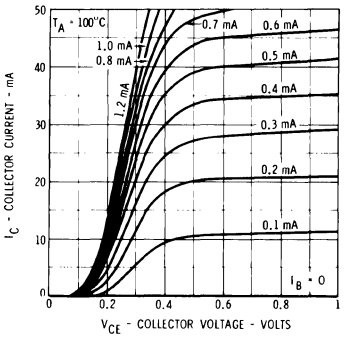

### COLLECTOR CHARACTERISTICS SATURATION REGION



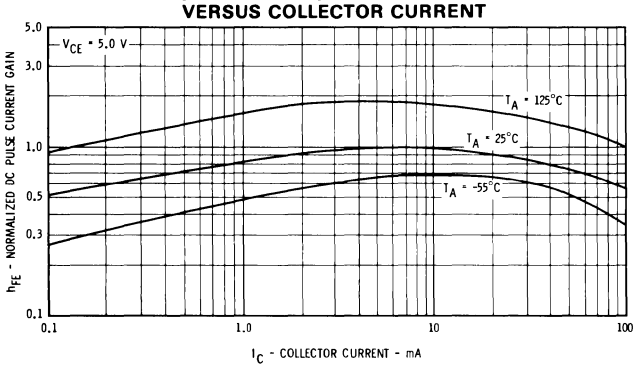

### COLLECTOR CHARACTERISTICS SATURATION REGION



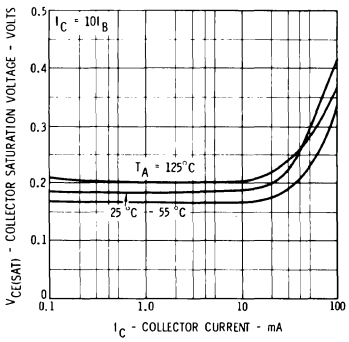

### COLLECTOR CHARACTERISTICS SATURATION REGION



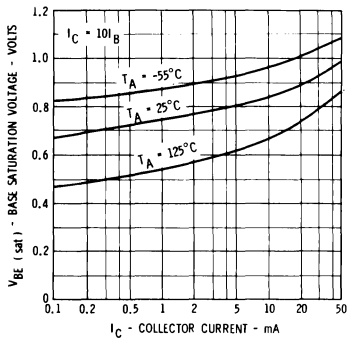

### NORMALIZED DC PULSE CURRENT VERSUS COLLECTOR CURRENT



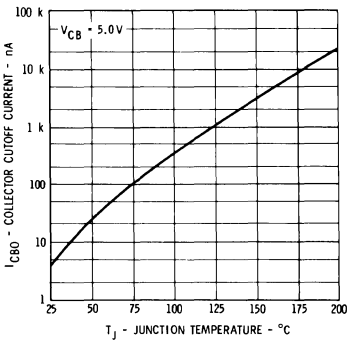

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



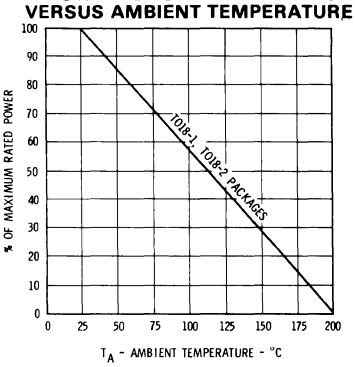

### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT




### COLLECTOR CUTOFF CURRENT VERSUS JUNCTION TEMPERATURE




### ALLOWABLE POWER DISSIPATION VERSUS AMBIENT TEMPERATURE

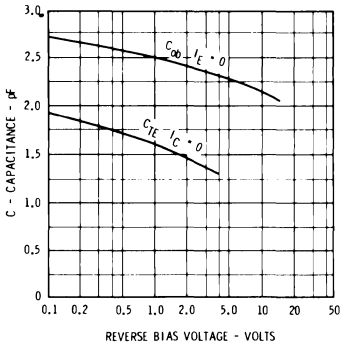


# CURVE SET NUMBER SS29

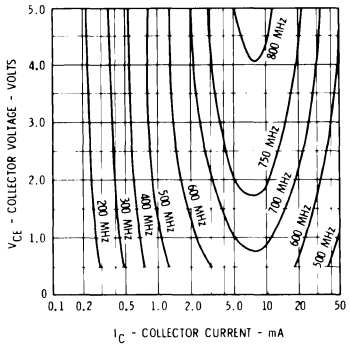
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

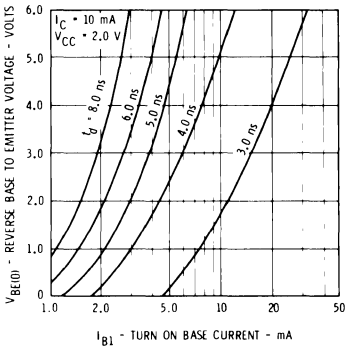
### EMITTER TRANSITION AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



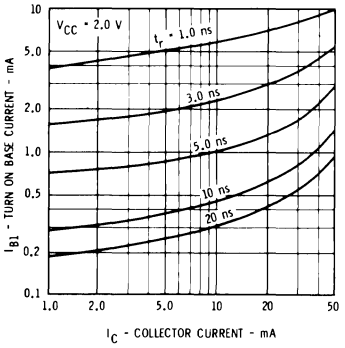

### CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT



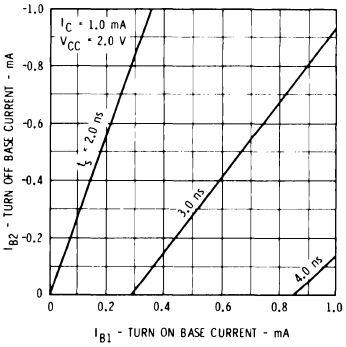

### DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE TO EMITTER VOLTAGE



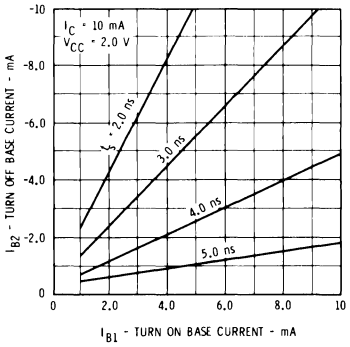

### RISE TIME VERSUS COLLECTOR AND TURN 'ON' BASE CURRENT



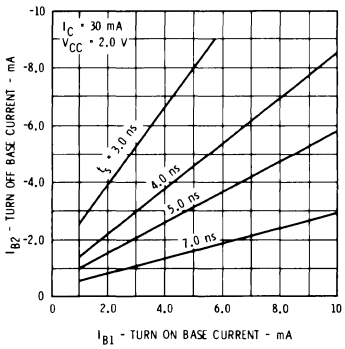

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



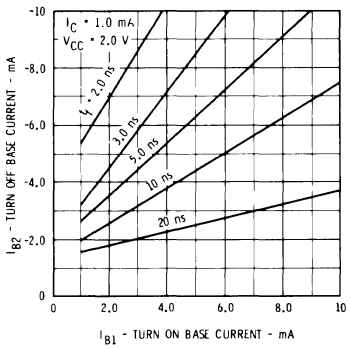

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



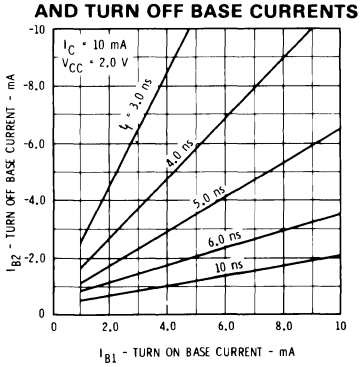

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



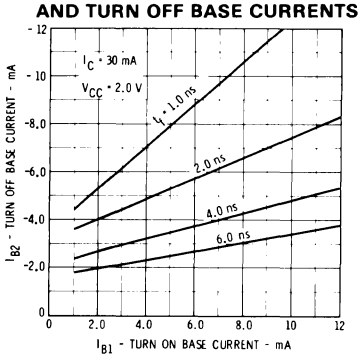

### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



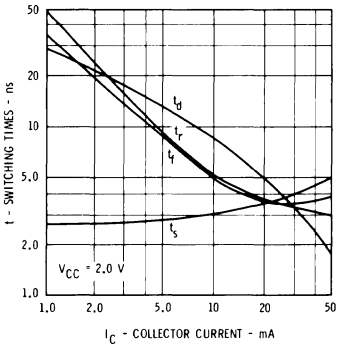

### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



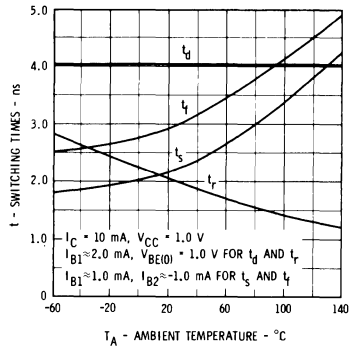

### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS




### SWITCHING TIMES VERSUS COLLECTOR CURRENT




### SWITCHING TIMES VERSUS AMBIENT TEMPERATURE

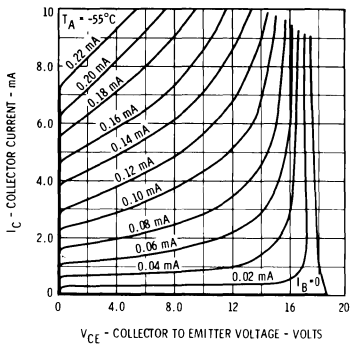


# CURVE SET NUMBER SS30

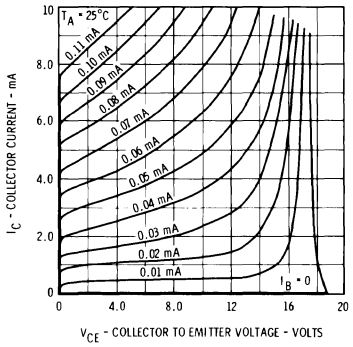
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

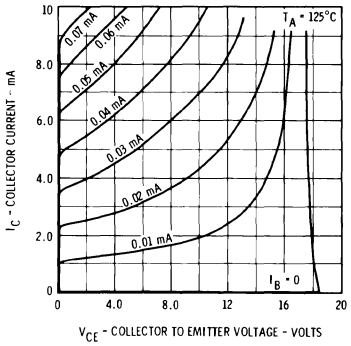
### COLLECTOR CHARACTERISTICS ACTIVE REGION



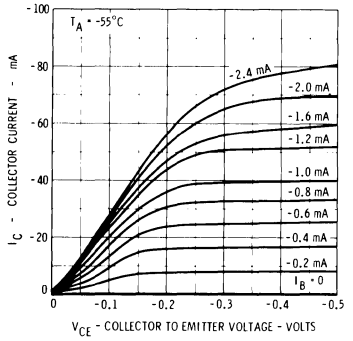

### COLLECTOR CHARACTERISTICS ACTIVE REGION



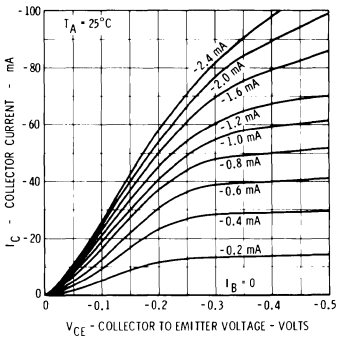

### COLLECTOR CHARACTERISTICS ACTIVE REGION



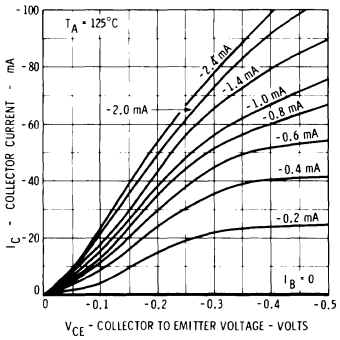

### COLLECTOR CHARACTERISTICS SATURATION REGION



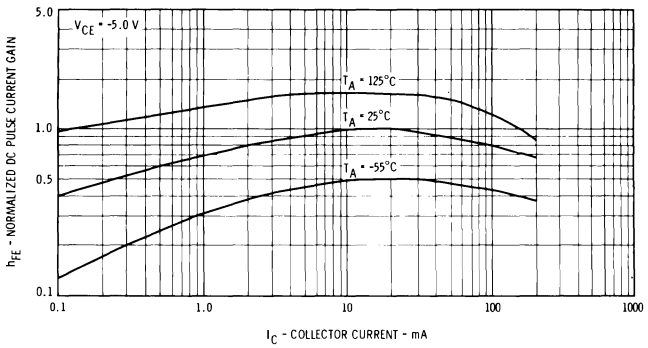

### COLLECTOR CHARACTERISTICS SATURATION REGION



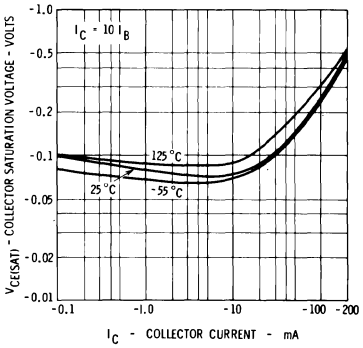

### COLLECTOR CHARACTERISTICS SATURATION REGION



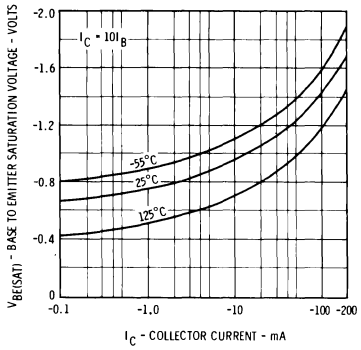

### NORMALIZED DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



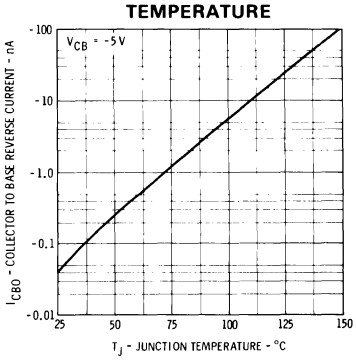

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



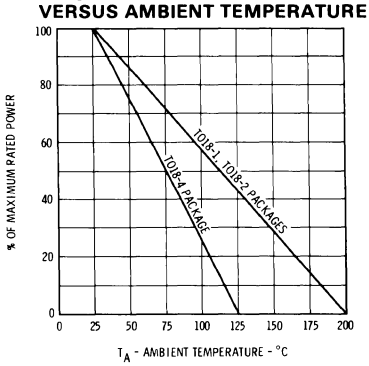

### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT




### COLLECTOR TO BASE DIODE REVERSE CURRENT VERSUS TEMPERATURE




### ALLOWABLE POWER DISSIPATION VERSUS AMBIENT TEMPERATURE

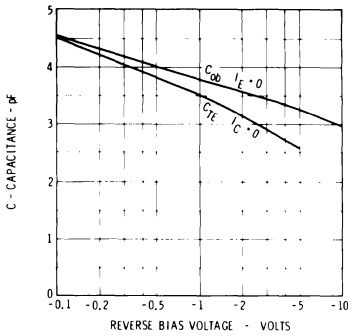


# CURVE SET NUMBER SS30

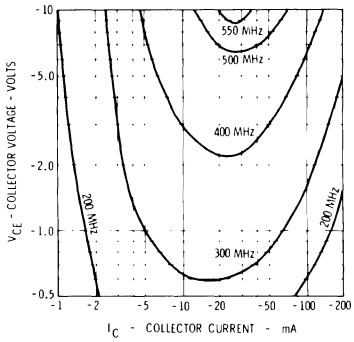
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

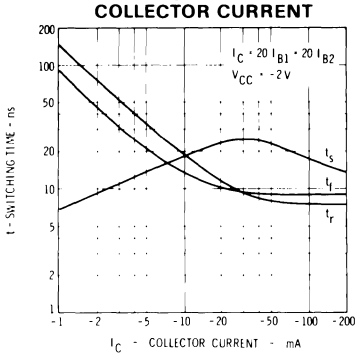
### INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



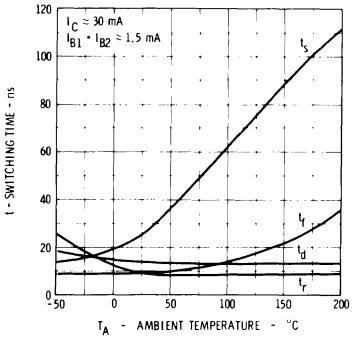

### CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT



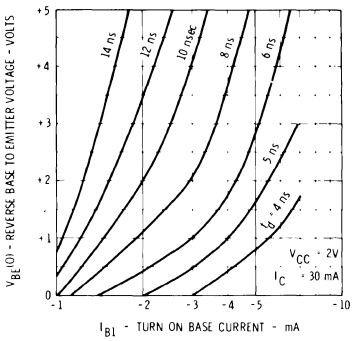

### SWITCHING TIMES VERSUS COLLECTOR CURRENT



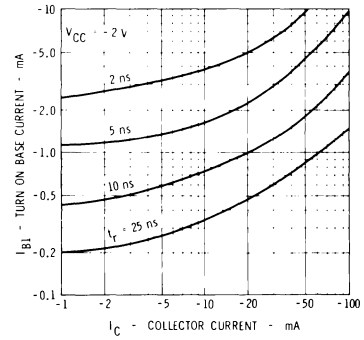

### SWITCHING TIMES VERSUS TEMPERATURE



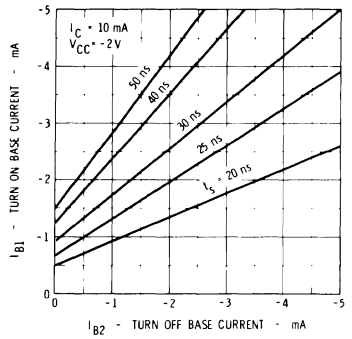

### DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



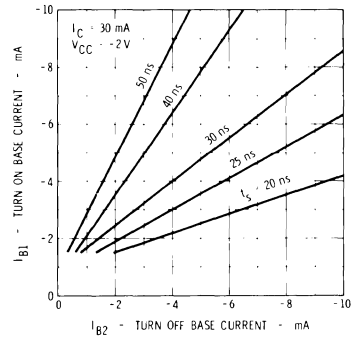

### RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS



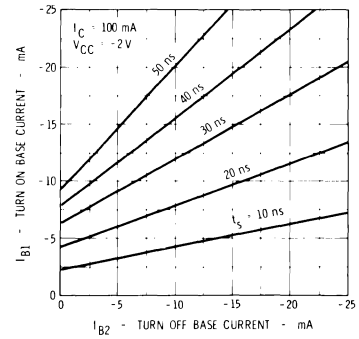

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



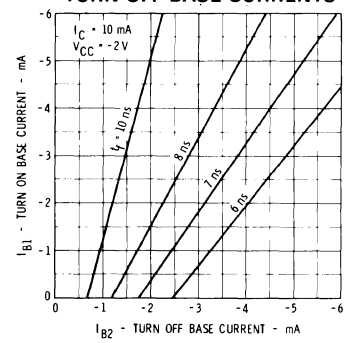

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



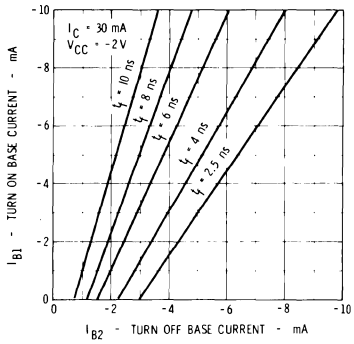

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



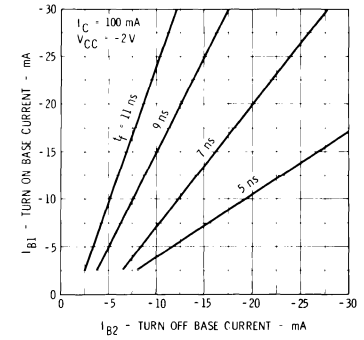

### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS




### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS




### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



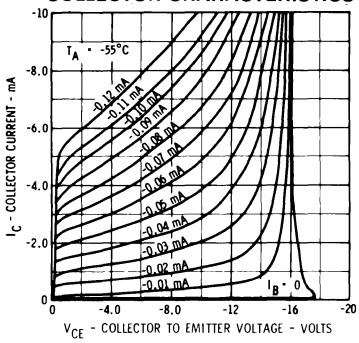

5

# CURVE SET NUMBER SS31

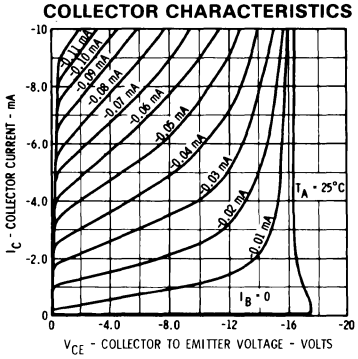
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

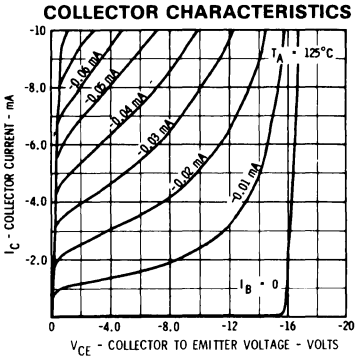
### COLLECTOR CHARACTERISTICS



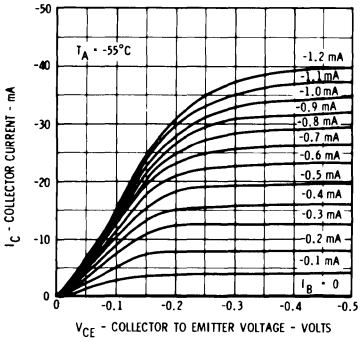

### COLLECTOR CHARACTERISTICS



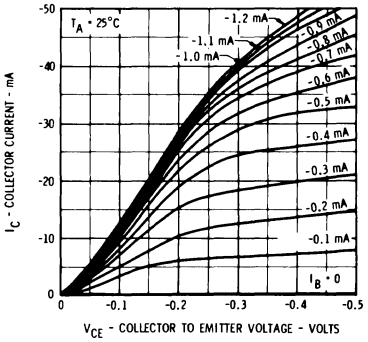

### COLLECTOR CHARACTERISTICS



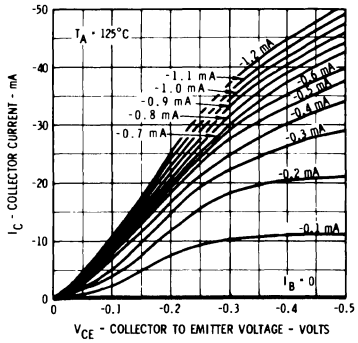

### COLLECTOR CHARACTERISTICS



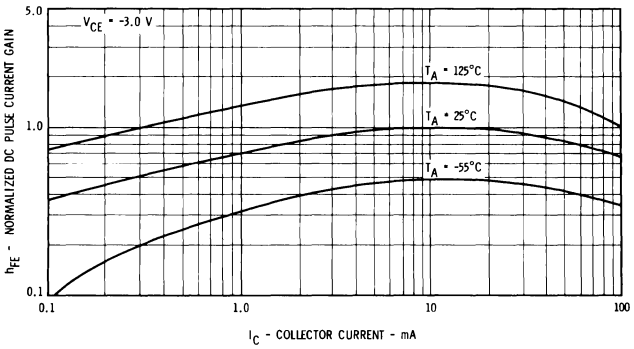

### COLLECTOR CHARACTERISTICS



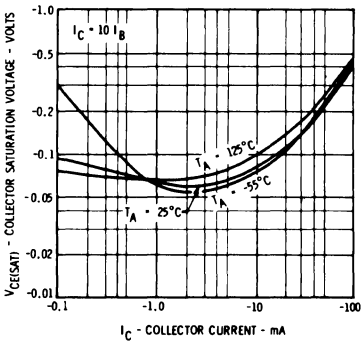

### COLLECTOR CHARACTERISTICS



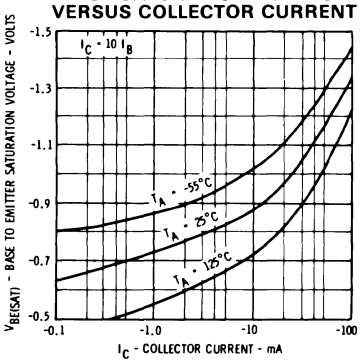

### NORMALIZED DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



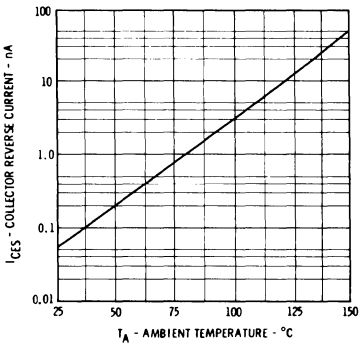

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



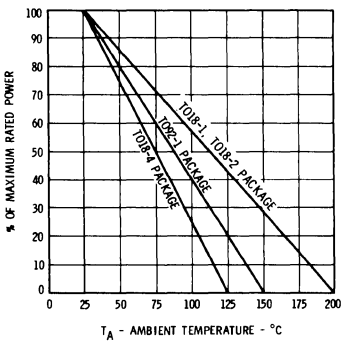

### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT




### COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE




### ALLOWABLE POWER DISSIPATION VERSUS AMBIENT TEMPERATURE

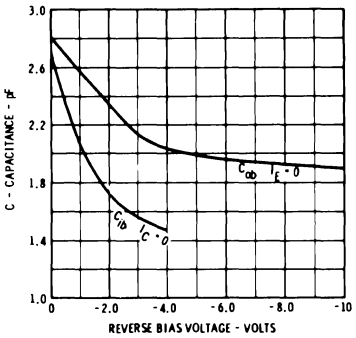


# CURVE SET NUMBER SS31

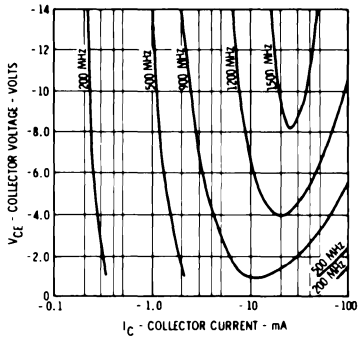
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

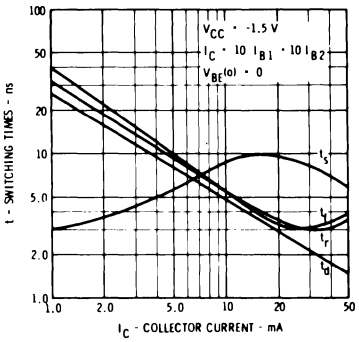
### INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



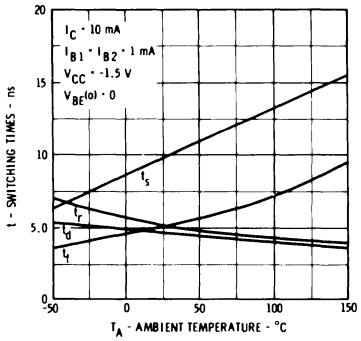

### CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT



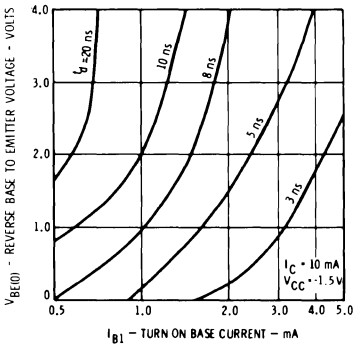

### SWITCHING TIMES VERSUS COLLECTOR CURRENT



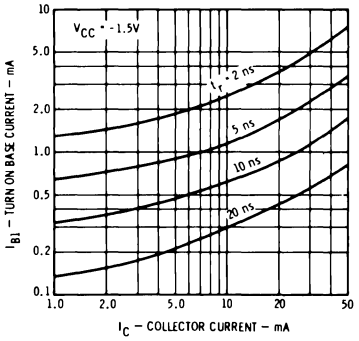

### SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



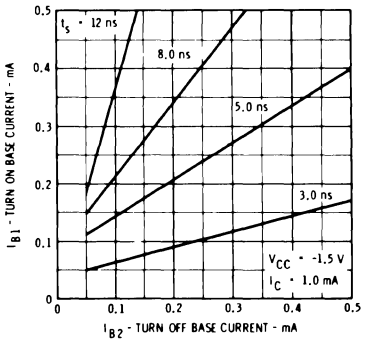

### DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



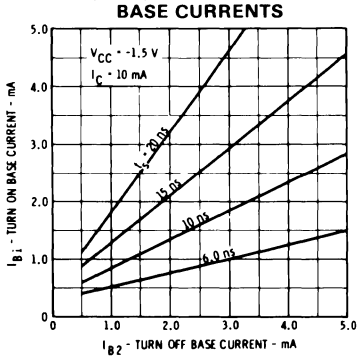

### RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS



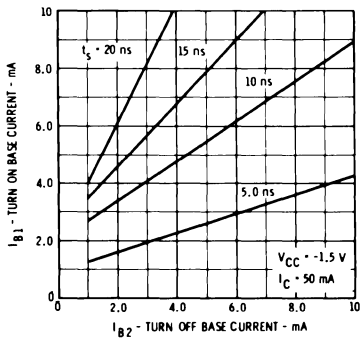

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



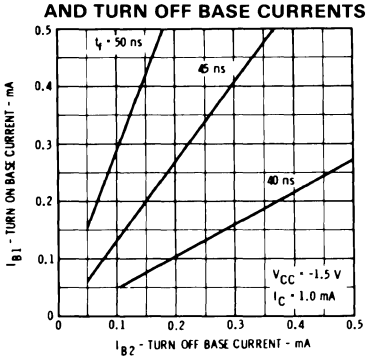

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



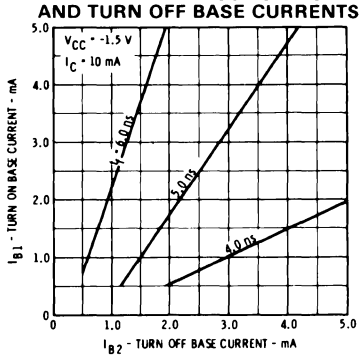

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



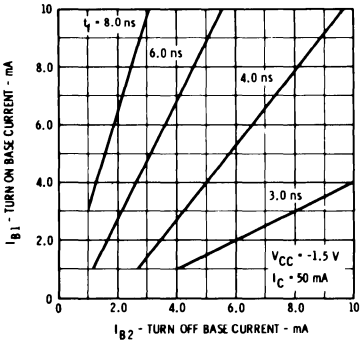

### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS




### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS




### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



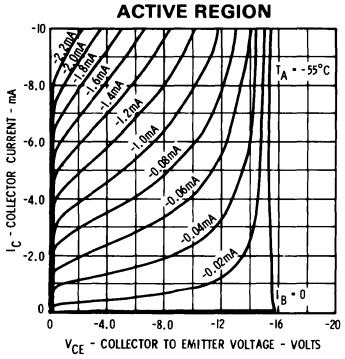

5

# CURVE SET NUMBER SS32

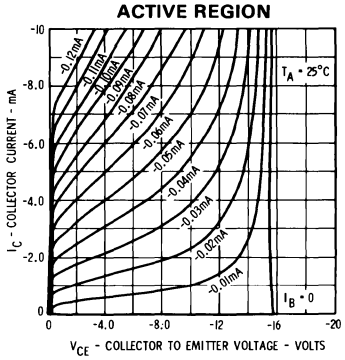
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

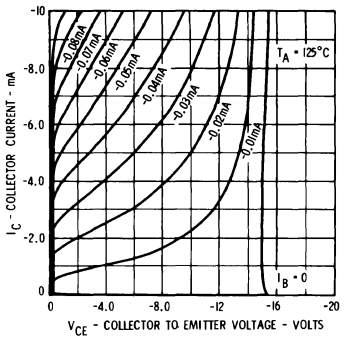
### COLLECTOR CHARACTERISTICS ACTIVE REGION



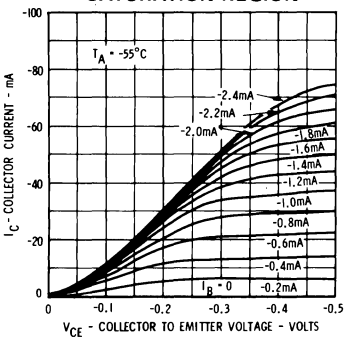

### COLLECTOR CHARACTERISTICS ACTIVE REGION



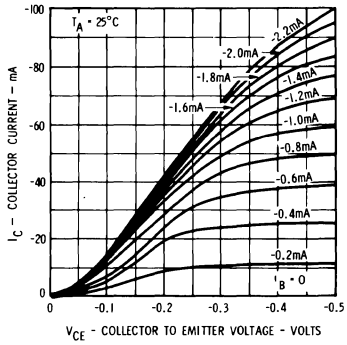

### COLLECTOR CHARACTERISTICS ACTIVE REGION



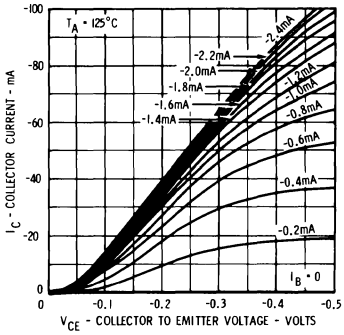

### COLLECTOR CHARACTERISTICS SATURATION REGION



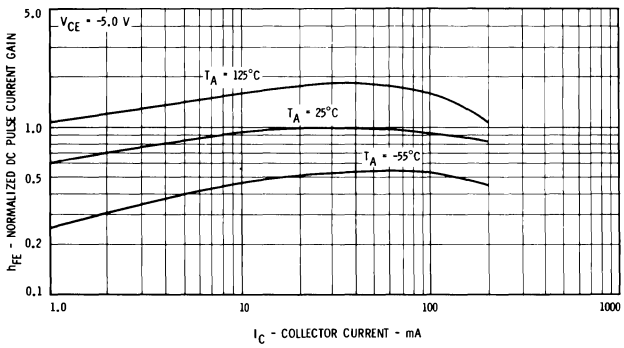

### COLLECTOR CHARACTERISTICS SATURATION REGION



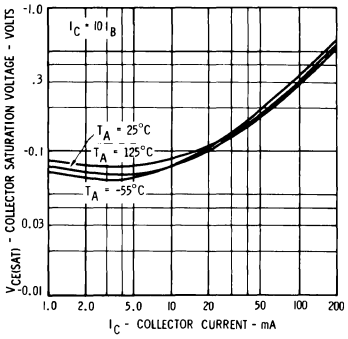

### COLLECTOR CHARACTERISTICS SATURATION REGION



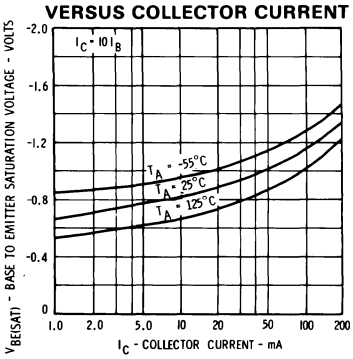

### NORMALIZED DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



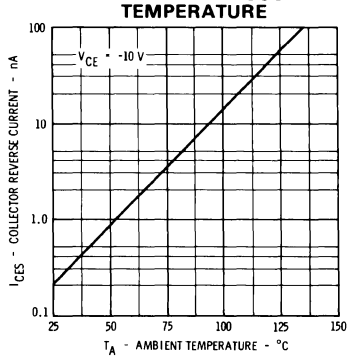

### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



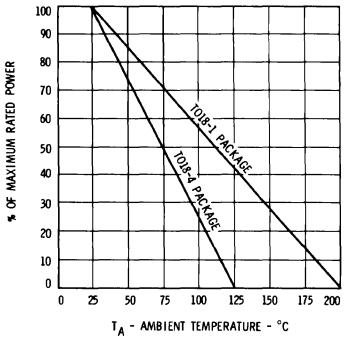

### BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT




### COLLECTOR REVERSE CURRENT VERSUS TEMPERATURE




### ALLOWABLE POWER DISSIPATION VERSUS AMBIENT TEMPERATURE

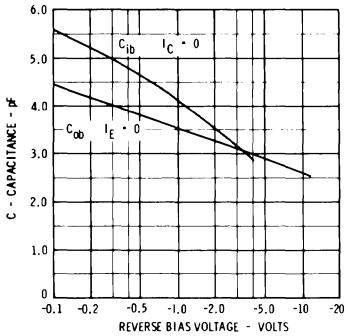


# CURVE SET NUMBER SS32

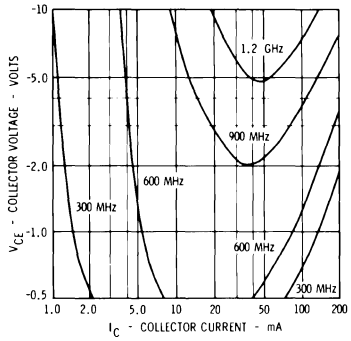
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

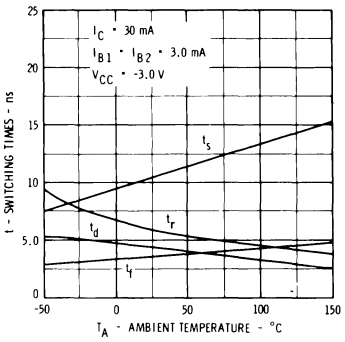
### INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



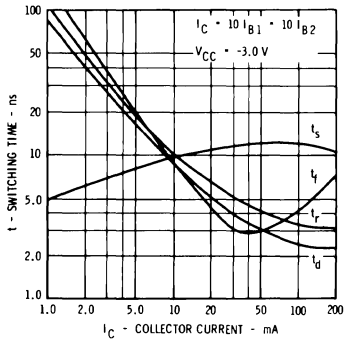

### CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT



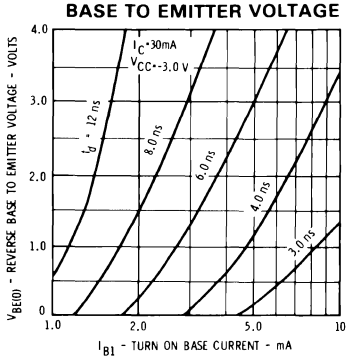

### SWITCHING TIMES VERSUS TEMPERATURE



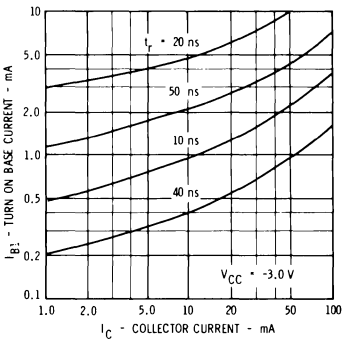

### SWITCHING TIMES VERSUS COLLECTOR CURRENT



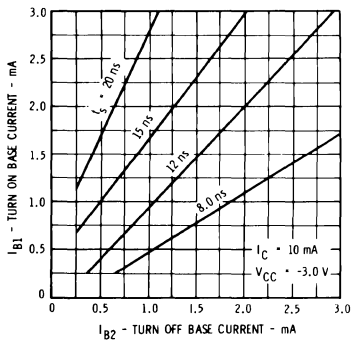

### DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE TO EMITTER VOLTAGE



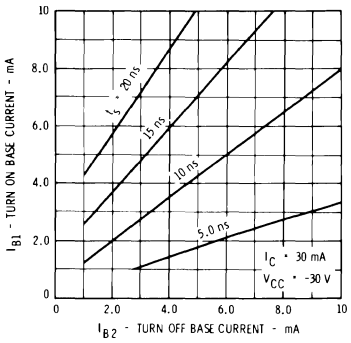

### RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS



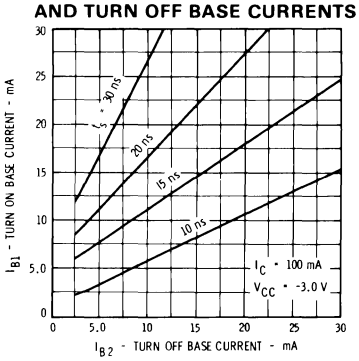

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



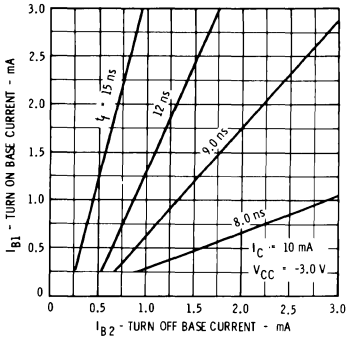

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



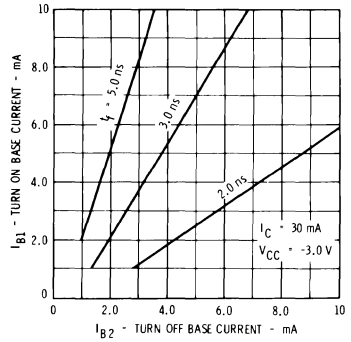

### STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



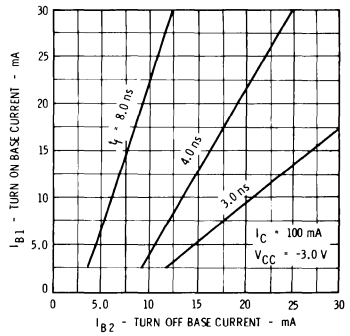

### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS




### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS




### FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



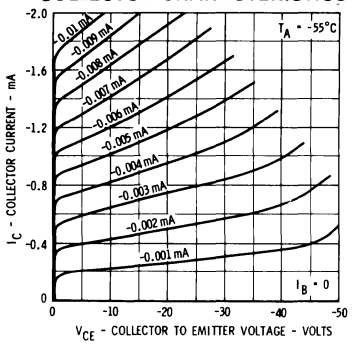

5

# CURVE SET NUMBER SS33

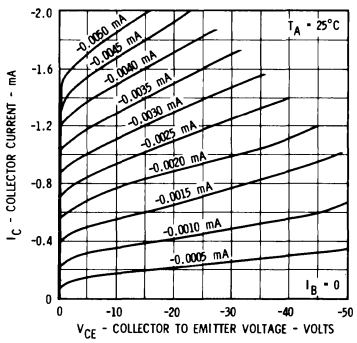
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

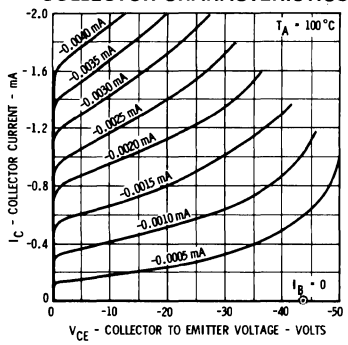
### COLLECTOR CHARACTERISTICS



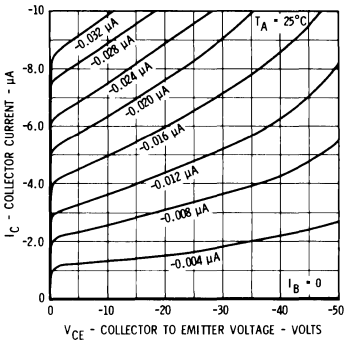

### COLLECTOR CHARACTERISTICS



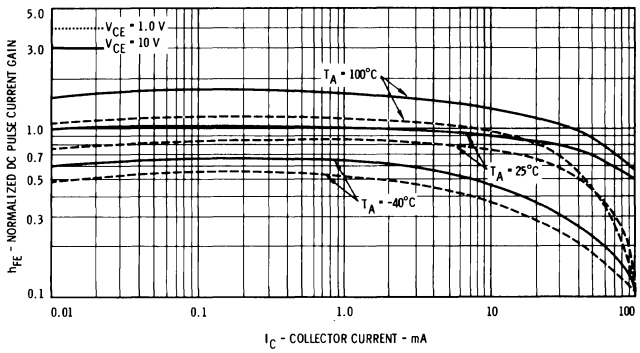

### COLLECTOR CHARACTERISTICS



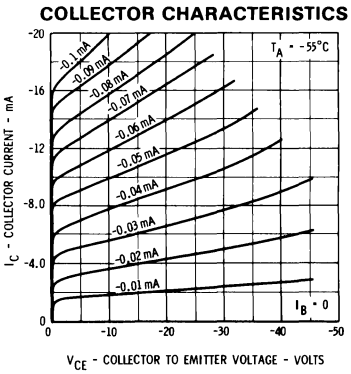

### COLLECTOR CHARACTERISTICS



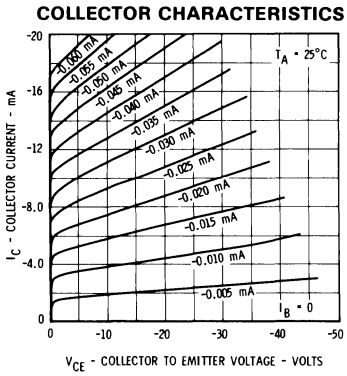

### DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



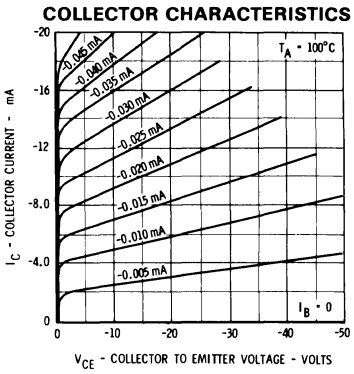

### COLLECTOR CHARACTERISTICS



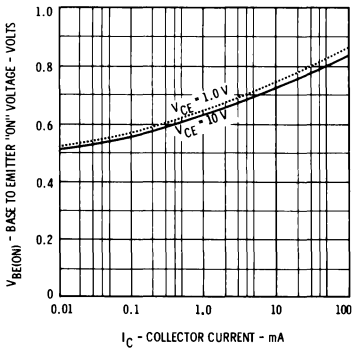

### COLLECTOR CHARACTERISTICS



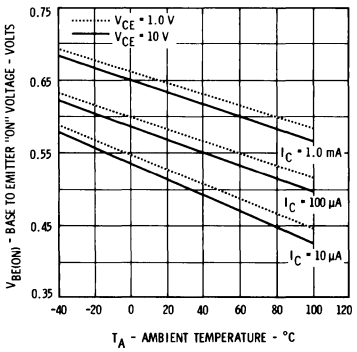

### COLLECTOR CHARACTERISTICS



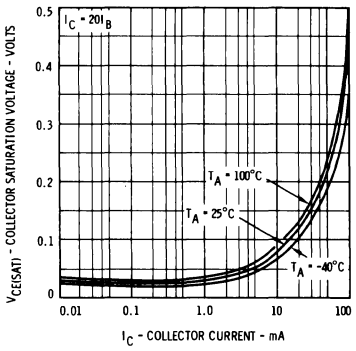

### BASE TO EMITTER 'ON' VOLTAGE VERSUS COLLECTOR CURRENT




### BASE TO EMITTER 'ON' VOLTAGE VERSUS AMBIENT TEMPERATURE




### COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

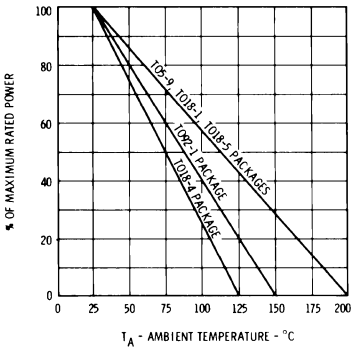


# CURVE SET NUMBER SS33

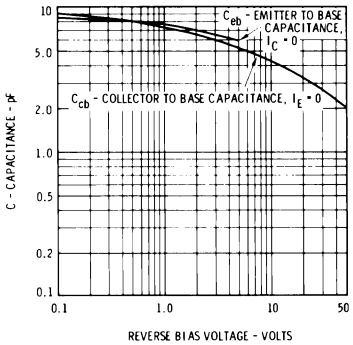
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

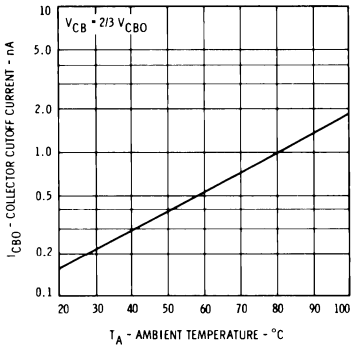
### ALLOWABLE POWER DISSIPATION VERSUS AMBIENT TEMPERATURE



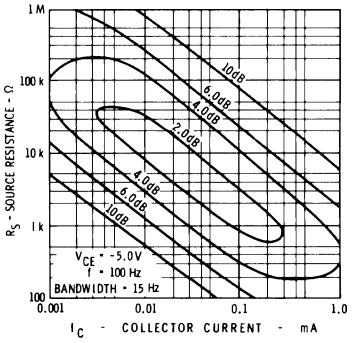

### CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



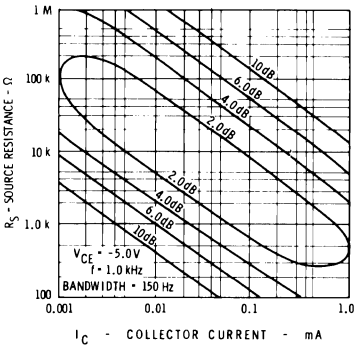

### COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



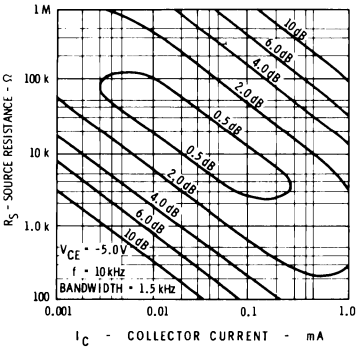

### CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



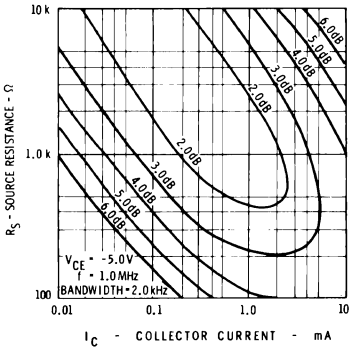

### CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



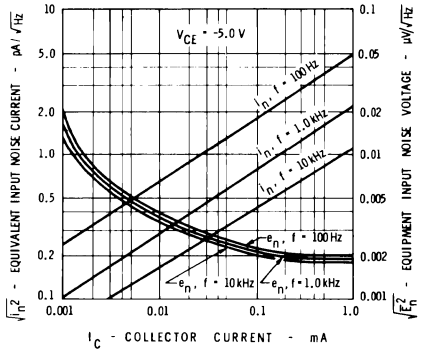

### CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



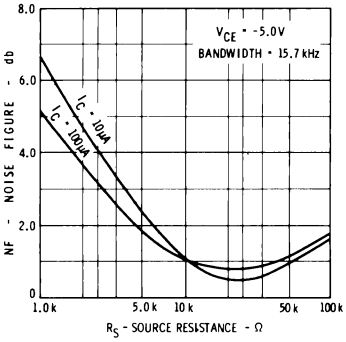

### CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



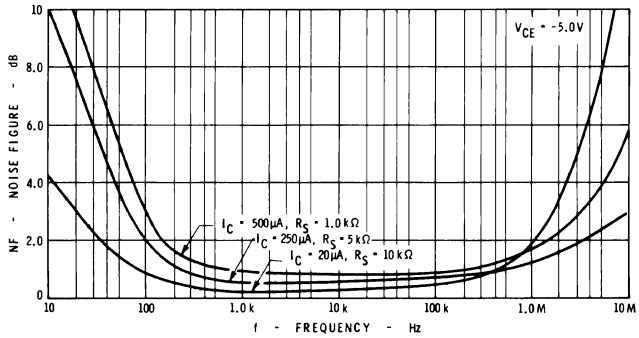

### EQUIVALENT INPUT NOISE VOLTAGE AND NOISE CURRENT VERSUS COLLECTOR CURRENT



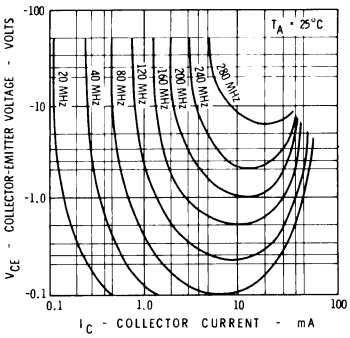

### WIDE BAND NOISE FIGURE VERSUS SOURCE RESISTANCE




### NOISE FIGURE VERSUS FREQUENCY




### CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT



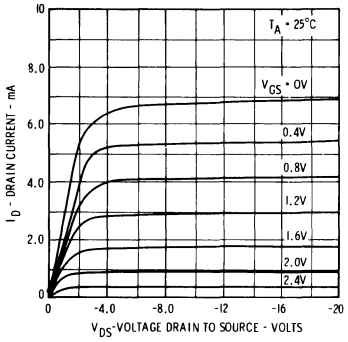

5

# CURVE SET NUMBER SS34

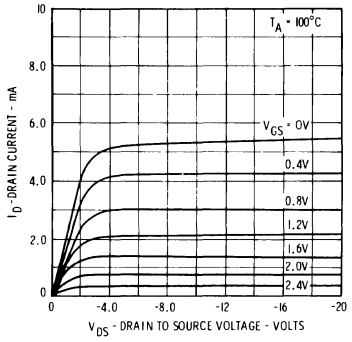
## TYPICAL ELECTRICAL CHARACTERISTIC CURVES

AT 25°C AMBIENT TEMPERATURE UNLESS OTHERWISE NOTED

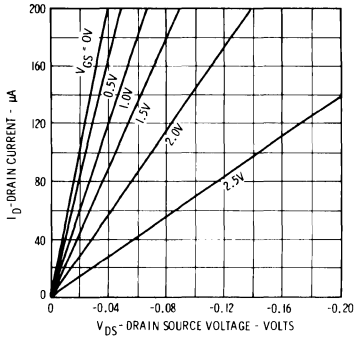
### DRAIN CHARACTERISTICS



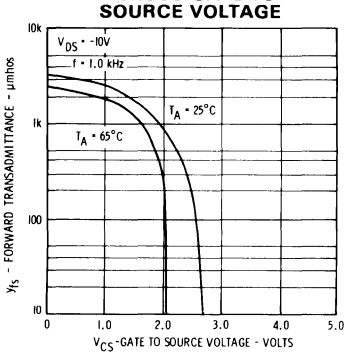

### DRAIN CHARACTERISTICS



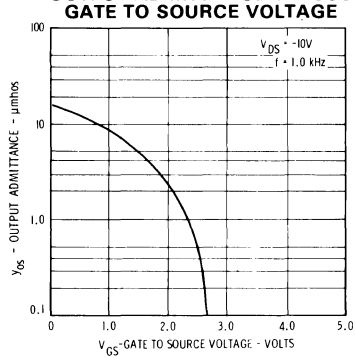

### LOW VOLTAGE DRAIN CHARACTERISTICS



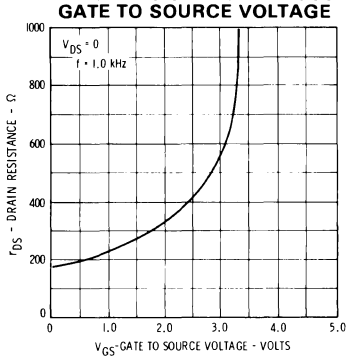

### FORWARD TRANSADMITTANCE VERSUS GATE TO SOURCE VOLTAGE



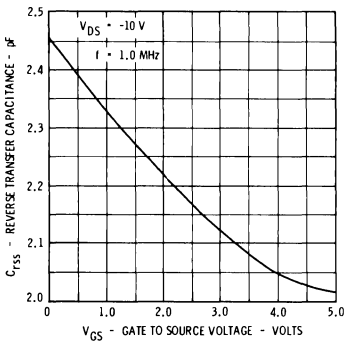

### OUTPUT ADMITTANCE VERSUS GATE TO SOURCE VOLTAGE



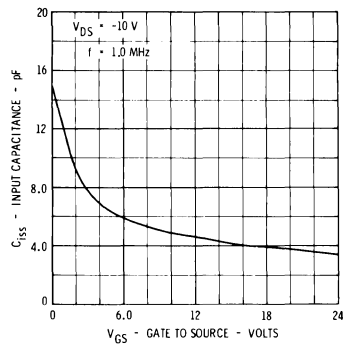

### DRAIN RESISTANCE VERSUS GATE TO SOURCE VOLTAGE



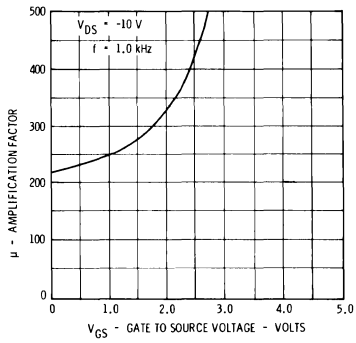

### REVERSE TRANSFER CAPACITANCE VERSUS GATE TO SOURCE VOLTAGE



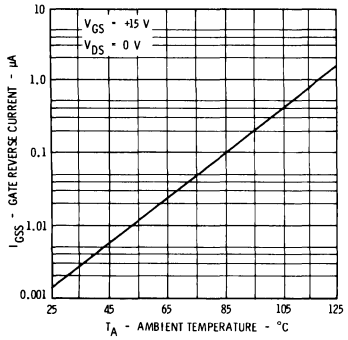

### INPUT CAPACITANCE VERSUS GATE TO SOURCE VOLTAGE



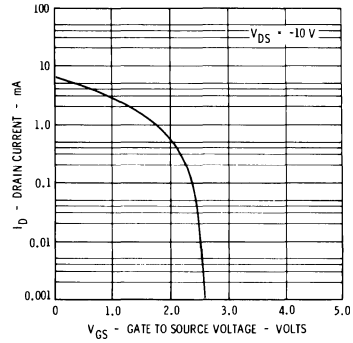

### AMPLIFICATION FACTOR VERSUS GATE TO SOURCE VOLTAGE



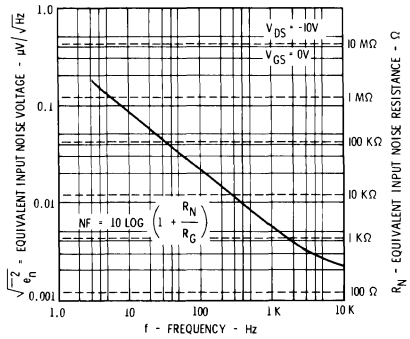

### GATE REVERSE CURRENT VERSUS AMBIENT TEMPERATURE




### DRAIN CURRENT VERSUS GATE TO SOURCE VOLTAGE




### EQUIVALENT INPUT NOISE VOLTAGE VERSUS FREQUENCY



# DISCRETE PRODUCTS

## CONTENTS AND SECTION SELECTOR

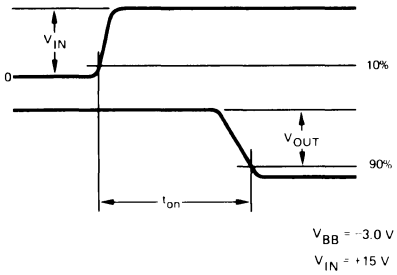
# INTRODUCTION

## TEST CIRCUITRY

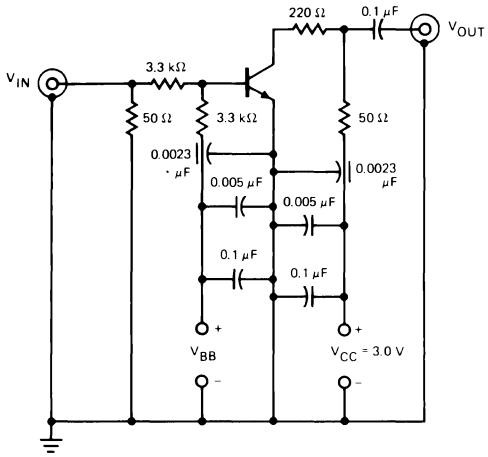
This section contains, in numeric order, the circuits used for special tests. The circuit number is indicated on the data sheet in the electrical characteristics table. These circuits will be useful to designers as an indication of optimum device conditions.

# TEST CIRCUITS

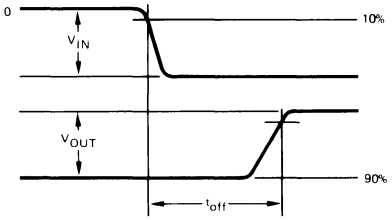
## 210




PULSE GENERATOR
$V_{IN}$ $t_r$ < 1.0 ns
SOURCE IMPEDANCE = 50 Ω
PW ≥ 300 ns
DC < 2%



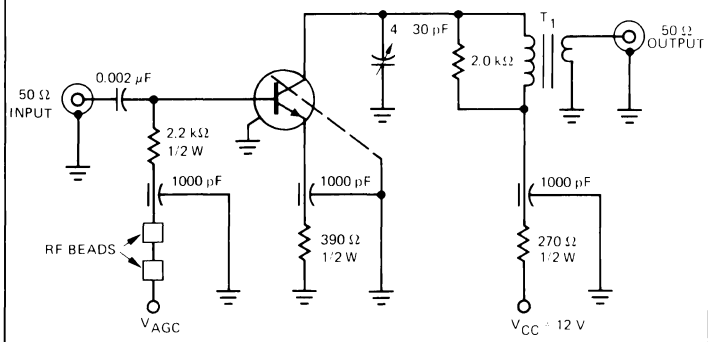

$t_{on}$ - $t_{off}$ SWITCHING




$t_{off}$
$V_{BB}$ = +12 V
$V_{IN}$ = −15 V

TO OSCILLOSCOPE
INPUT IMPEDANCE = 50 Ω
$t_r$ ≤ 1.0 ns

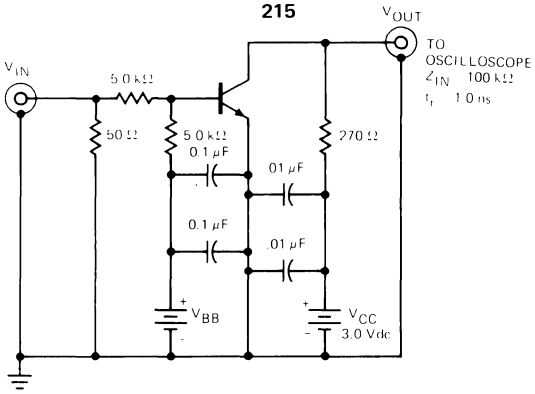
## 211



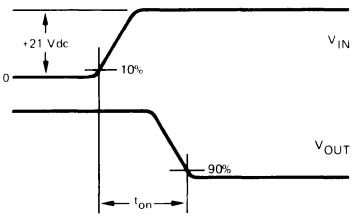

$T_1$ : $Q_3$ TOROID 4:1 RATIO
8T-PRI 2T-S } #22 WIRE

**45 MHz, AGC, POWER GAIN AND NOISE FIGURE TEST**

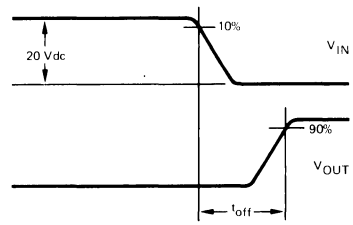
## 215




PULSE GENERATOR
SOURCE IMPEDANCE = 50 Ω



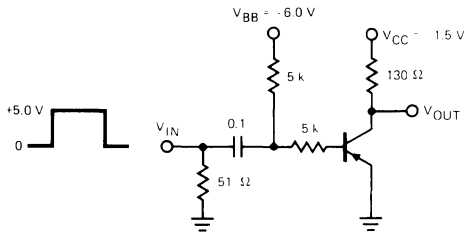

$t_{on}$
$V_{BB}$ = −4.0 Vdc
$V_{IN}$ = +21 Vp-p




$t_{off}$
$V_{BB}$ = −17 Vdc
$V_{IN}$ = −20 Vp-p

$t_{on}$ - $t_{off}$ SWITCHING

## 219




PW = 100 ns
$Z_{IN}$ = 50 Ω
$t_r$, $t_f$ < 1.0 ns

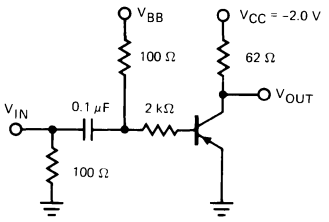
TO OSCILLOSCOPE
$Z_{IN}$ ≥ 100 kΩ
$t_r$ < 1.0 ns

$I_C$ ≈ 10 mA, $I_{B1}$ ≈ 0.5 mA, $I_{B2}$ ≈ −0.5 mA

$t_{on}$ - $t_{off}$ SWITCHING

# TEST CIRCUITS

**220**



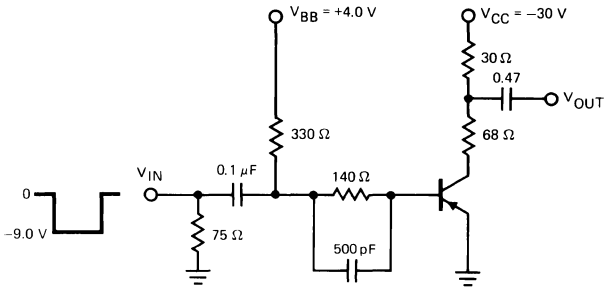

PULSE GENERATOR
$t_r \leqslant 1.0$ ns
PW = 400 ns
PPS = 150
$Z_{IN} = 50\ \Omega$

TO OSCILLOSCOPE
$t_r \leqslant 1.0$ ns
$Z_{IN} \geqslant 100\ k\Omega$

$t_{on}$ $V_{BB} = +3.0$ V, $V_{IN} = -7.0$ V
$t_{off}$ $V_{BB} = -4.0$ V, $V_{IN} = +6.0$ V

**SWITCHING TIME TEST**

**222**

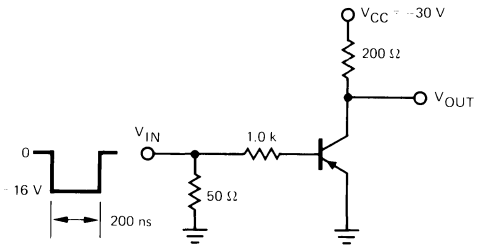



PULSE GENERATOR
$t_r, t_f \leqslant 6.0$ ns
PW = 0.5 μs
$Z_{IN} = 50\ \Omega$

TO OSCILLOSCOPE
$t_r < 1.0$ ns
$Z_{IN} \geqslant 0.1\ M\Omega$

**$t_{on}$ - $t_{off}$ SWITCHING**

**224**

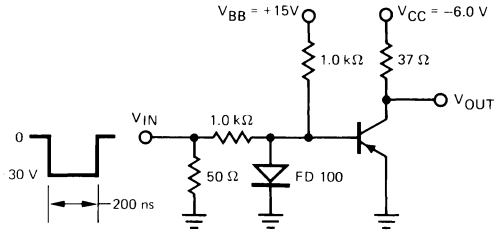



$Z_O = 50\ \Omega$
PRF = 150 PPS
$t_r \leqslant 2.0$ ns

TO OSCILLOSCOPE
$t_r \leqslant 5.0$ ns
$Z_{IN} = 10\ M\Omega$

**$t_d$ - $t_r$ SWITCHING**

**225**

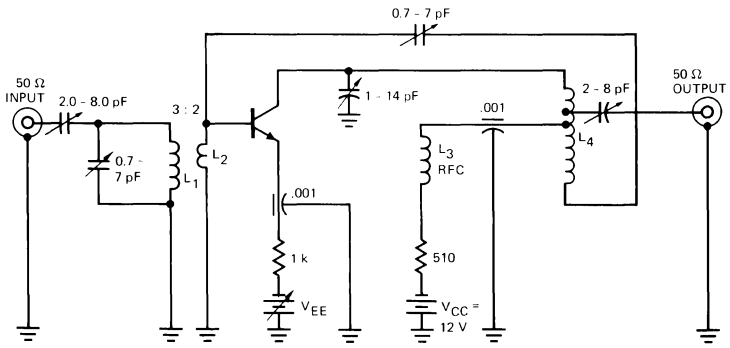



$Z_O = 50\ \Omega$
PRF = 150 PPS
$t_r \leqslant 2.0$ ns

TO OSCILLOSCOPE
$t_r \leqslant 5.0$ ns
$Z_{IN} = 10\ M\Omega$

**$t_s$ - $t_f$ SWITCHING**

**226A**



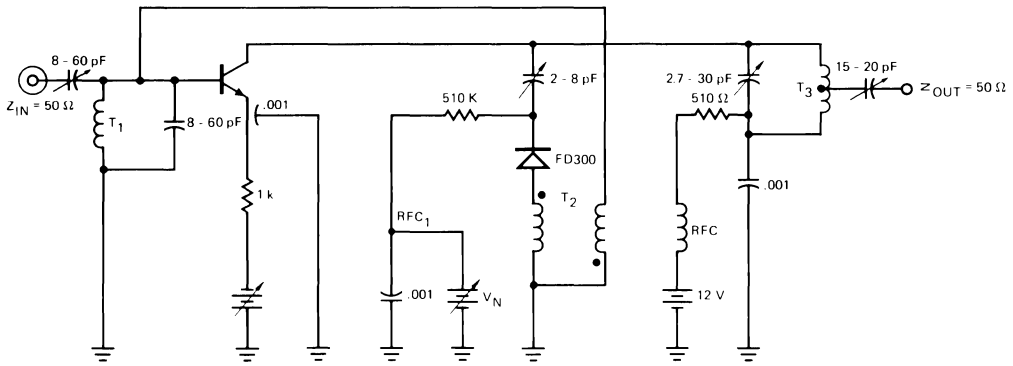

INPUT IMPEDANCE REFERRED TO TRANSISTOR IS 100 Ω.

$L_1$ = 3 TURNS #18 WIRE ON ¼" CERAMIC CORE
$L_2$ = 2 TURNS #18 WIRE INTERWOUND AT COLD END WITH $L_1$
$L_3$ = RFC
$L_4$ = 4 TURNS .076" DIAM. SILVER TUBING SPACE WOUND (3/8" I.D., NO CORE). OUTPUT TAP AT ½ TURN FROM COLLECTOR END GROUND TAP AT 2 TURNS FROM COLLECTOR END

**200 MHz AGC**

# TEST CIRCUITS

## 227




$T_1$ 8 TURNS #16 TINNED COPPER WIRE 1/4 INCH I.D. X 1/2 INCH LONG.

$T_2$ 7 TURNS #32 BIFILAR WIRE WOUND ON TOROID, I.D. = .120 INCH, O.D. = .230 INCH, .060 THICK.

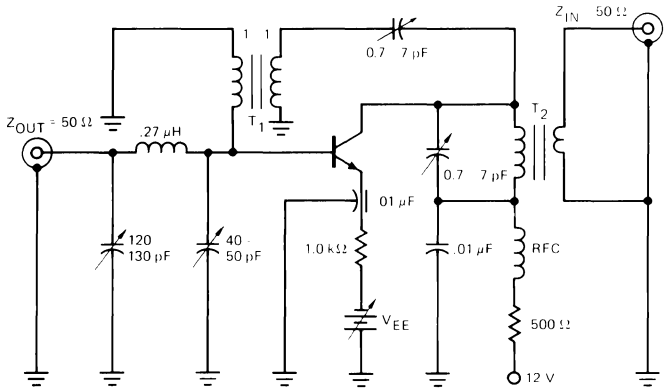
$\frac{1}{\mu_o Q}$ = .00017 AT 50 MHz $\mu_o$ = 40 AT 1 MHz

$T_3$ 8 1/2 TURNS #26 ENAMELED WIRE, CENTER TAPPED, WOUND ON TOROID, I.D. = .187 INCH, O.D. = .375 INCH, .125 THICK.

$\frac{1}{\mu_o Q}$ = .00042 AT 150 MHz $\mu_o$ = 16 AT 1MHz

**60 MHz AGC**

## 228A

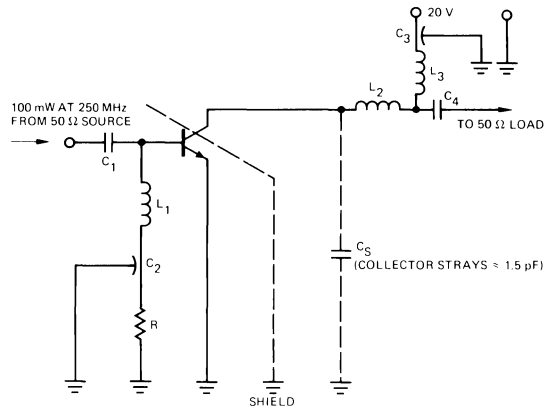



$T_1$: 12T #32 BIFILAR WIRE ON Q2 TOROID (μ = 115)

$T_2$: PRIMARY: 10T #36 ENAMELED WIRE WOUND ON MICROMETALS L 52 6 SHIELDED COIL FORM SECONDARY: 2T #36 ENAMELED WIRE TIGHTLY COUPLED TO PRIMARY

**45 MHz AGC**

## 230




$C_1$ = 120 pF

$C_2$, $C_3$, $C_4$ = 1000 pF BUTTON MICA

$C_S$ (COLLECTOR STRAYS) ≈ 1.5 pF

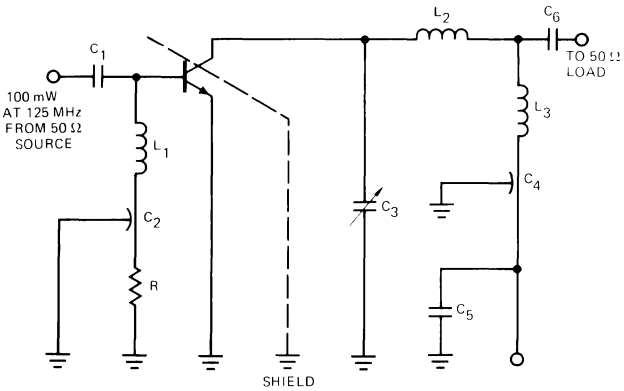
$L_1$ $L_3$ = .47 μH (RF CHOKE) fr = 250 MHz

$L_2$ = 5.5 pF

R = 200 Ω

**250 MHz POWER AMPLIFIER**

## 230-125




$C_1$, $C_2$, $C_4$, $C_6$ = 1000 pF BUTTON MICA

$C_3$ = 2 - 8 pF

$C_5$ = 6 μF AT 50 V

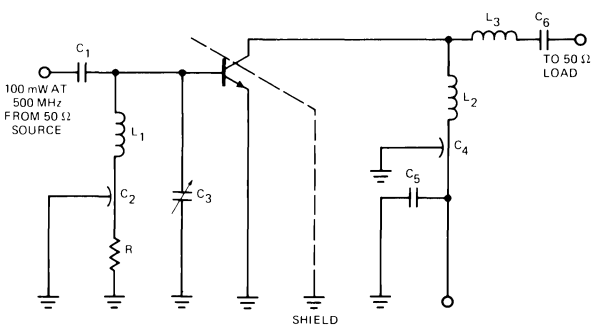
$L_1$, $L_3$ = RFC rf > 125 MHz

$L_2$ = 16 pF

R = 200 Ω

**125 MHz POWER AMPLIFIER**

## 230-500




$C_1$ = 10 pF

$C_2$, $C_4$, $C_6$ = 1000 pF BUTTON MICA

$C_5$ = 6 μF AT 50 V $C_3$ = 1 - 10 pF

$L_1$ = - 9 pF

$L_2$ = - 3.5 pF

$L_3$ = - 7.5 pF

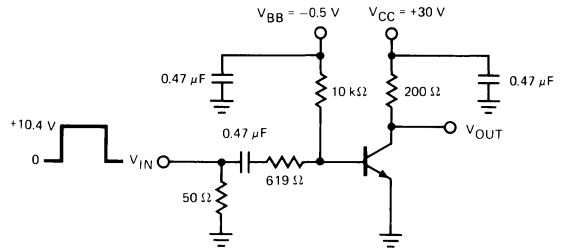
R = 20 Ω

**500 MHz POWER AMPLIFIER**

6

# TEST CIRCUITS

**231**

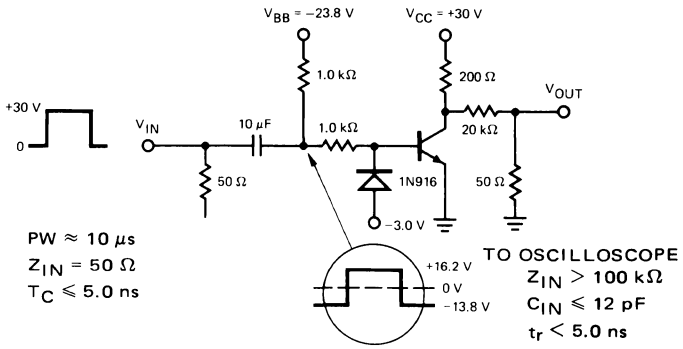



PW ≤ 200 ns
$t_r$ ≤ 2.0 ns
$Z_{IN}$ = 50 Ω

TO OSCILLOSCOPE
$Z_{IN}$ < 100 kΩ
$C_{IN}$ ≤ 12 pF
$t_r$ ≤ 5.0 ns

**$t_{on}$ SWITCHING**

**232**



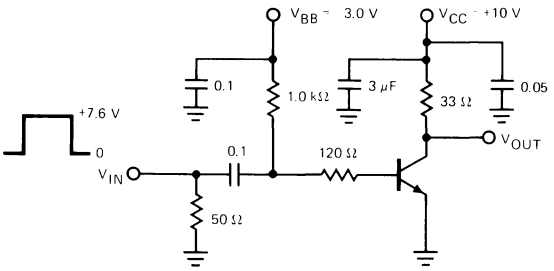

PW ≈ 10 μs
$Z_{IN}$ = 50 Ω
$T_C$ ≤ 5.0 ns

TO OSCILLOSCOPE
$Z_{IN}$ > 100 kΩ
$C_{IN}$ ≤ 12 pF
$t_r$ < 5.0 ns

The 20 kΩ and 50 Ω resistors on the output of the test circuit are normally omitted, due to the excessive attenuation of the collector waveform. The collector voltage is monitored directly with a high impedance oscilloscope probe.

**$t_{off}$ SWITCHING**

**233**

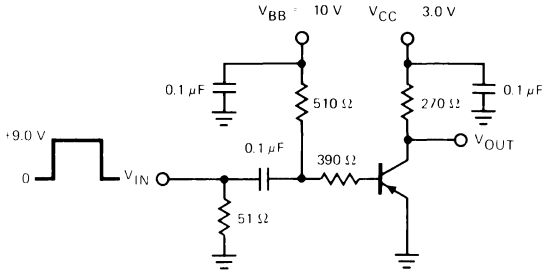



PW ≥ 240 ns
$t_r$, $t_f$ < 1.0 ns
$Z_{IN}$ = 50 Ω

TO OSCILLOSCOPE
$t_r$ < 1.0 ns
$Z_{IN}$ ≈ 100 kΩ

**$t_{on}$ - $t_{off}$ SWITCHING**

**234**



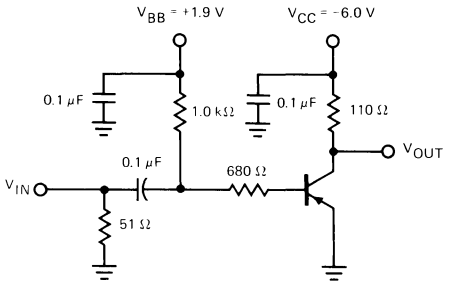

PW = 240 ns
$Z_{IN}$ = 50 Ω
$t_r$ ≤ 1.0 ns

TO OSCILLOSCOPE
$Z_{IN}$ ≥ 100 kΩ
$t_r$ < 1.0 ns

$I_C$ ≈ 10 mA, $I_{B1}$ ≈ 10 mA, $I_{B2}$ ≈ 10 mA

**CHARGE STORAGE TIME**

**235**



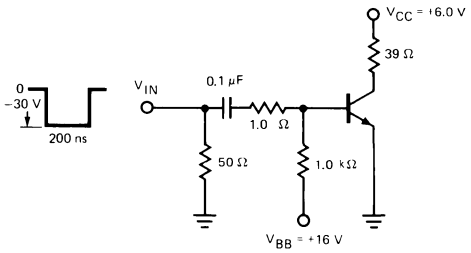

PULSE SOURCE
$t_r$ ≤ 1.0 ns
PW ≥ 100 ns
$Z_{IN}$ = 50 Ω
$t_r$ ≤ 1.0 ns

TO OSCILLOSCOPE
$Z_{IN}$ ≥ 100 kΩ
$t_r$ ≤ 1.0 ns

COLLECTOR CURRENT = 50 mA, $t_{on}$ AND $t_{off}$
BASE CURRENTS = 5.0 mA

**SWITCHING TIME**

**236**

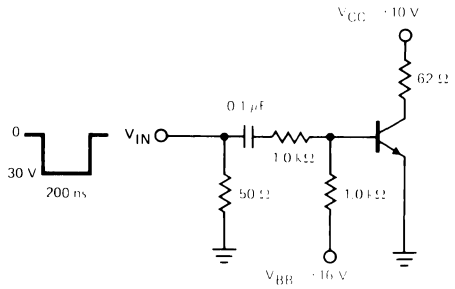



$t_r$ INPUT PULSE < 2.0 ns

**$t_{off}$ SWITCHING**

# TEST CIRCUITS

**237**

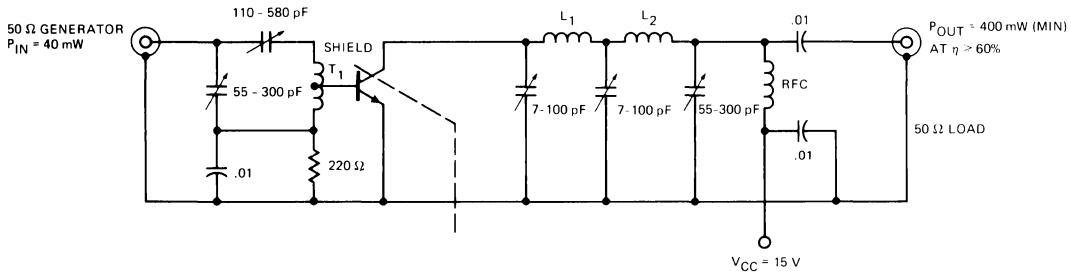



$t_r$ OF INPUT PULSE < 2.0 ns

**$t_{off}$ SWITCHING**

---

**238**




$T_1$ - 4 TURNS NO. 20 WIRE, 3/4" DIA. X ¼" LONG, MIDTAPPED.
$L_1$ AND $L_2$ - 4 TURNS NO. 20 WIRE, ½" DIA. X ¼" LONG.
VARIABLE CAPACITORS ARE COMPRESSION MICA.

**30 MHz AMPLIFIER**

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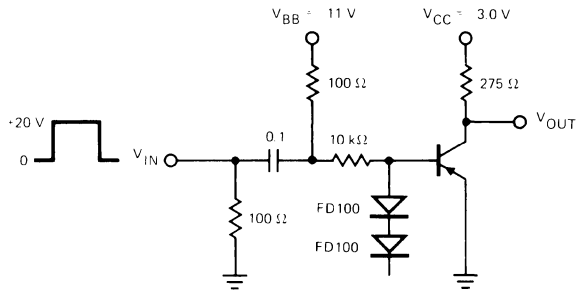
**239**

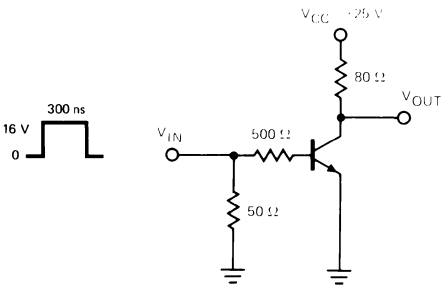



PW ≈ 300 ns
$t_r$ ≤ 1.0 ns
$Z_{IN}$ = 50 Ω

TO OSCILLOSCOPE
$t_r$ ≤ 1.0 ns
$Z_{IN}$ = 100 kΩ

**$t_{off}$ SWITCHING**

**241**




PULSE SOURCE
$t_r$ ≤ 1.0 ns
$Z_{IN}$ = 50 Ω

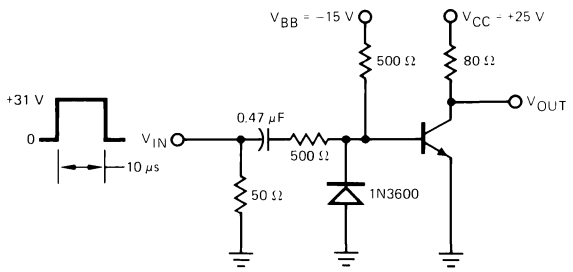
TO OSCILLOSCOPE
$t_r$ ≤ 1.0 ns
$Z_{IN}$ ≈ 100 kΩ

**$t_{on}$ SWITCHING**

6

# TEST CIRCUITS

**242**

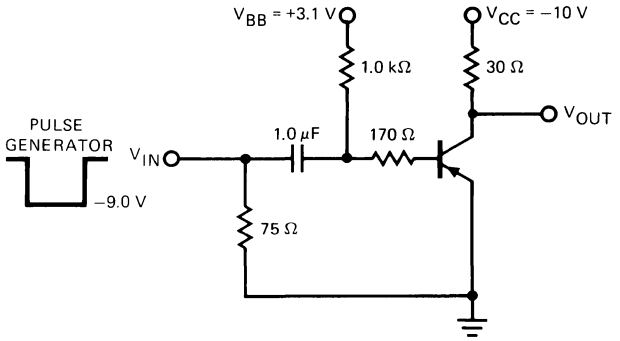



PULSE SOURCE
$t_r \leqslant 20$ ns
$Z_{IN} = 50\ \Omega$

TO OSCILLOSCOPE
$t_r \leqslant 1.0$ ns
$Z_{IN} \approx 100\ k\Omega$

**$t_{off}$ SWITCHING**

**245**

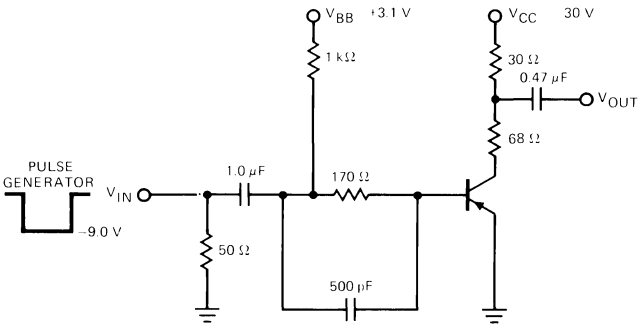



$t_r, t_f \leqslant 15$ns
PW = 0.5μs
$Z_{IN} = 50\Omega$

TO OSCILLOSCOPE
$t_r \leqslant 1.0$ ns
$Z_{IN} \geqslant 0.1\ m\Omega$

**$t_{on}$ - $t_{off}$ SWITCHING**

**246**

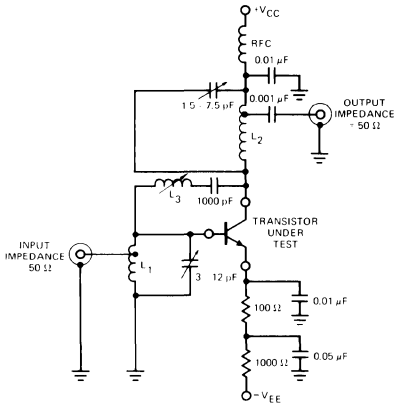



$t_r, t_f \leqslant 6$ns
PW = 0.5μs
$Z_{IN} = 50\Omega$

TO OSCILLOSCOPE
$t_r < 1.0$ ns
$Z_{IN} \geqslant 0.1\ M\Omega$

**$t_{on}$ - $t_{off}$**

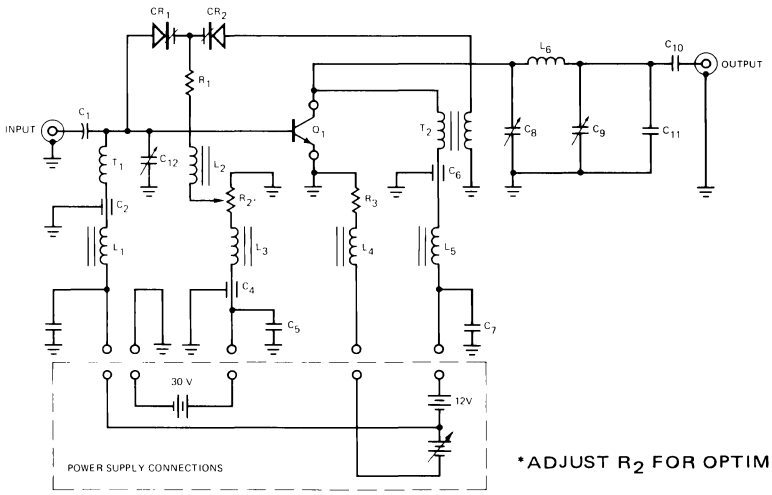
**254**




$L_1$ - 3.5 TURNS #16 WIRE; 5/16" DIA.; 7/16" LONG.
TURNS RATIO 4 TO 2
$L_2$ - 8 TURNS #16 WIRE; 1/8" DIA.; 7/8" LONG.
TURNS RATIO 8 TO 1
$L_3$ - 0.4-0.65 μH, ADJUSTABLE CORE

**GAIN AMPLIFIER**

**255**

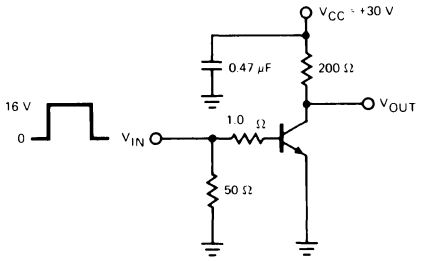



*ADJUST $R_2$ FOR OPTIMUM NEUTRALIZATION

**NEUTRALIZED 200 MHz POWER GAIN AMPLIFIER**

# TEST CIRCUITS

**256**

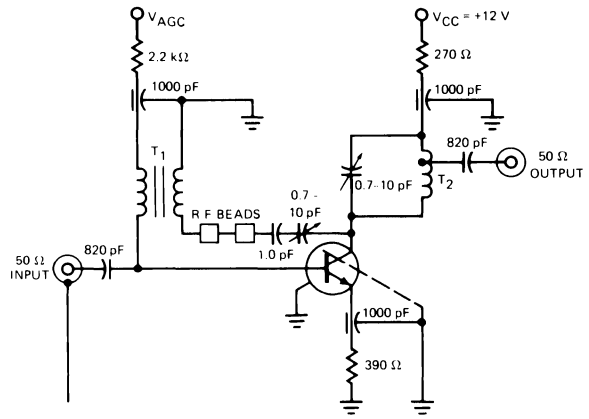



PW ≤ 200 ns
$Z_{IN}$ = 50 Ω
$t_r$ = ≤ 2.0 ns

TO OSCILLOSCOPE
$Z_{IN}$ = 10 MΩ
$t_r$ ≤ 1.0 ns

**$t_{on}$ SATURATED SWITCHING**

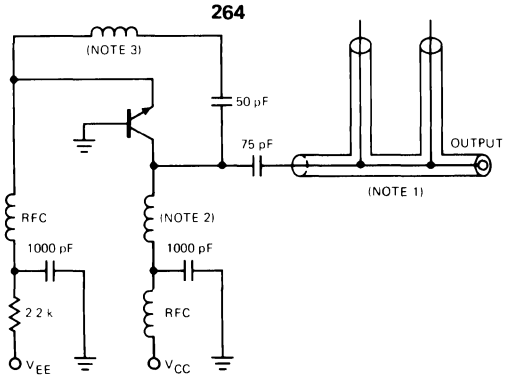
**257**




$T_1$ : FERRITE CORE INDIANA GEN. CORP. F-684-Q3
$T_2$ : 6 TURNS #16 BUSS WIRE ID = 1/4" L = 3/4"

**200 MHz AGC, POWER GAIN AND NOISE FIGURE TEST**

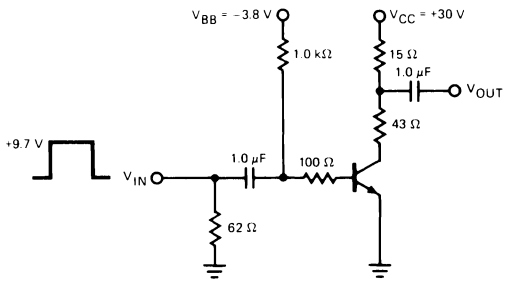
**264**




NOTES:
(1) COAX PLUMBING CONSISTS OF THE FOLLOWING GR AIR LINES:
2 TYPE 874 TEE
1 TYPE 874 - D20 ADJUSTABLE STUB
1 TYPE 874 - LA ADJUSTABLE LINE
1 TYPE 874 - WN3 SHORT - CIRCUIT TERMINATION
(2) 2 TURNS #16 AWG WIRE, 3/8 INCH OD, 1-1/4 INCH LONG
(3) 9 TURNS #22 AWG WIRE, 3/16 INCH OD, 1/2 INCH LONG

**500 MHz OSCILLATOR**

**265**



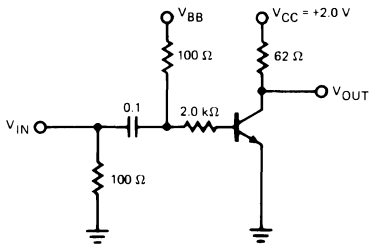

$t_r$ AND $t_f$ ≤ 1.0 ns
PW ≈ 1.0 μs
$Z_{IN}$ = 50 Ω
DC < 2%

TO OSCILLOSCOPE
$t_r$ < 1.0 ns
$Z_{IN}$ ≥ 100 kΩ

$I_C$ ≈ 500 mA, $I_{B_1}$ ≈ 50 mA, $I_{B_2}$ ≈50 mA

**SWITCHING TIME**

**286**




PULSE SOURCE
$t_r$ < 1.0 ns
PW > 200 ns
$Z_{IN}$ = 50 Ω

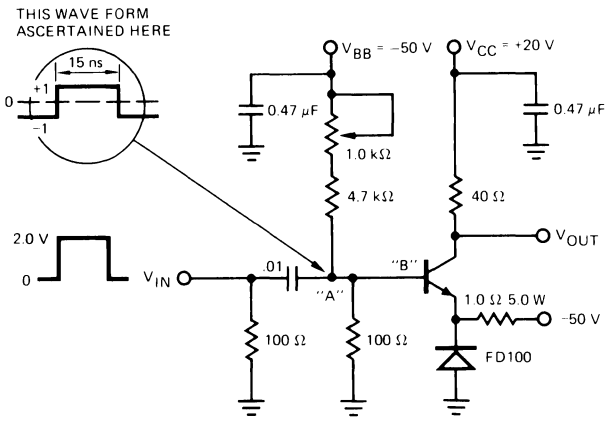
TO OSCILLOSCOPE
$t_r$ < 1.0 ns
$Z_{IN}$ ≈ 100 kΩ

$t_{on}$: $V_{CC}$ = 2.0 V
$V_{BB}$ GROUNDED
$V_{IN}$ = 7.0 V

$t_{off}$: $V_{CC}$ = 2.0 V
$V_{BB}$ = 7.0 V
$V_{IN}$ = −13 V

**$t_{on}$ - $t_{off}$ SWITCHING**

**287**




PW = 15 ns
$t_f$ ≤ 1.0 ns
$Z_{IN}$ = 50 Ω

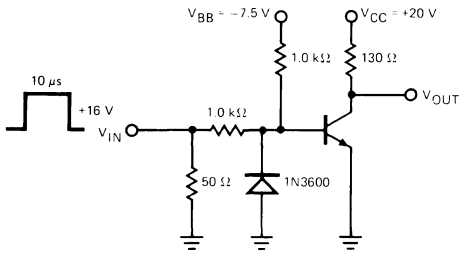
TO OSCILLOSCOPE
$t_r$ = < 1.0 ns
$Z_{IN}$ = 10 MΩ

**$t_{on}$ - $t_{off}$ SWITCHING**

6

# TEST CIRCUITS

## 288 A

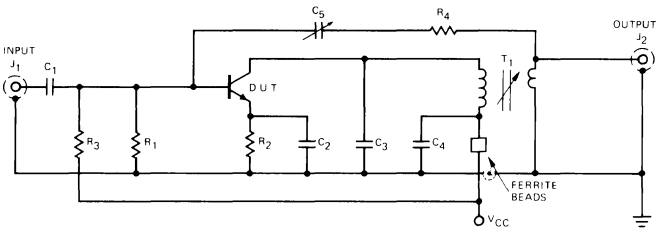



$t_r$ OF INPUT PULSE < 15 ns
$t_f$ OF INPUT PULSE < 15 ns

TO OSCILLOSCOPE
$t_r$ > 15 ns
$Z_{IN} \approx 100\ k\Omega$

**$t_{on}$ - $t_{off}$ SWITCHING**

## 320

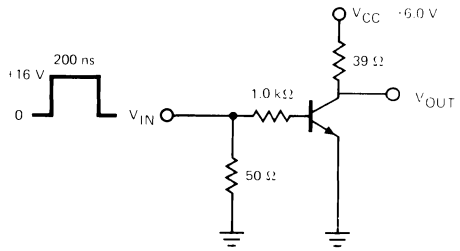



PARTS LIST

$C_1$, $C_2$ – .01 μF
$C_3$ – 27 pF (DURA MICA)
$C_4$ – .02 μF
$C_5$ – 0.7 TO 10 pF (JOHANSON – JMC 2951) VARIABLE CAPACITOR
$R_1$ – 470 Ω, ¼ W, 5%, CARBON
$R_2$ – 220 Ω, ¼ W, 5%, CARBON
$R_3$ – 1.5 kΩ, ¼ W, 5%, CARBON
$R_4$ – 30 Ω, ¼ W, 5%, CARBON
$J_1$, $J_2$ – BNC PANEL MOUNT CONNECTORS
$T_1$ – ¼" DIAMETER CERAMIC FORM. PRIMARY, 8 TURNS #26 WIRE CLOSE WOUND. SECONDARY, 2 TURNS #26 WIRE CLOSE WOUND IN CENTER OF PRIMARY. THE PRIMARY INDUCTANCE Lp = 0.4 TO 0.6 μH. CORE IS A WHITE DOT OR $Q_3$ FERRITE. SECONDARY IS INTERLACED WITH PRIMARY WINDING.

**THIRD VIDEO IF POWER GAIN**

## 327

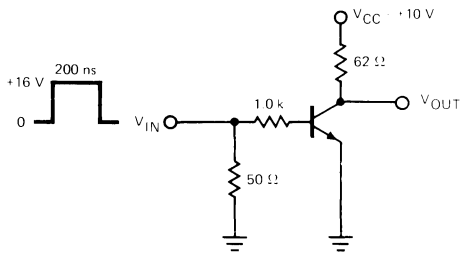



$t_r$ OF INPUT PULSE < 2.0 ns

OSCILLOSCOPE INPUT
IMPEDANCE ≈ 100 kΩ
$t_r$ < 2.0 ns

**$t_{on}$ SWITCHING**

## 328

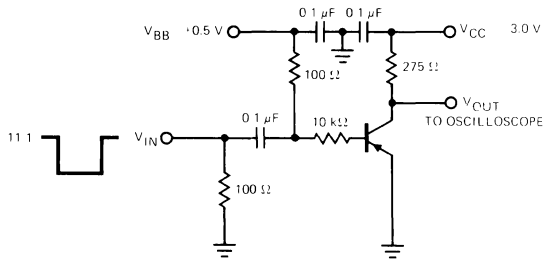



$t_r$ OF INPUT PULSE < 2.0 ns

OSCILLOSCOPE INPUT
IMPEDANCE ≈ 100 kΩ
$t_r$ < 2.0 ns

**$t_{on}$ SWITCHING**

## 333



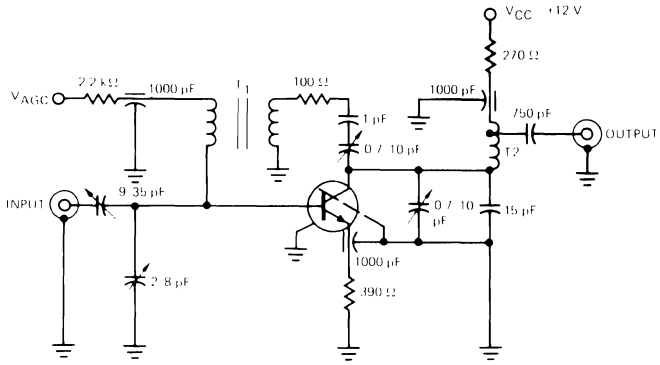

PW 300 ns
$t_r \leq 1.0$ ns
$Z_{IN}$ = 50 Ω

OSCILLOSCOPE INPUT
$t_r \leq 1.0$ ns
$Z_{IN}$ = 100 kΩ

**$t_{on}$ SWITCHING**

# TEST CIRCUITS

## 334

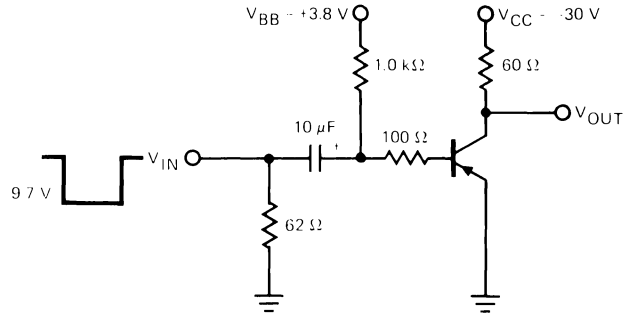



$T_1$ - BALLUN CORE
1T-PRI, 1T-SEC
#32 BIFILAR WIRE

$T_2$ - 1/4" I.D.
5-1/2T, TAPPED UP 1/2T
#16 BUSS WIRE

**100 MHz AGC, POWER GAIN, AND NOISE FIGURE**

## 341

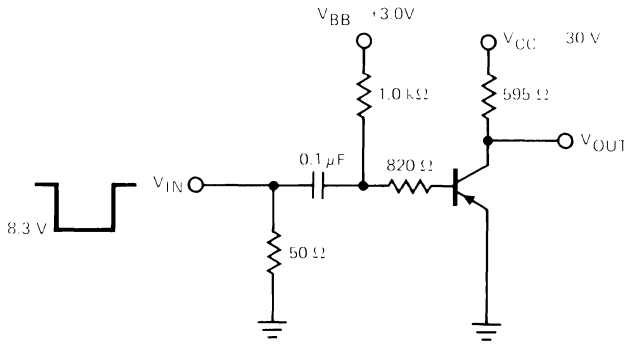



PULSE SOURCE
$t_r$, $t_f$ < 20 ns
$Z_{IN}$ = 50 Ω
PW = 10 μs
DC < 2%

TO OSCILLOSCOPE
$Z_{IN}$ > 100 kΩ
$t_r$ ≈ 10 ns

**$t_{on}$ - $t_{off}$ SWITCHING**

## 342

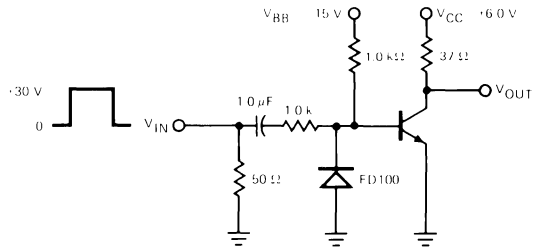



PW = 500 ns
$t_r$ AND $t_f$ = 1.0 ns
$Z_{IN}$ = 50 Ω

TO OSCILLOSCOPE
$t_r$ < 1.0 ns
$Z_{IN}$ ~ 100 kΩ

**SWITCHING TIME**

## 347

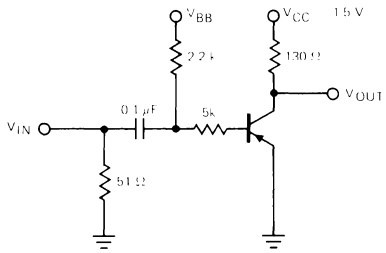



PW ≤ 200 ns
$t_r$ ≤ 2.0 ns
$Z_{IN}$ = 50 Ω
DC ≤ 2%

TO OSCILLOSCOPE
$Z_{IN}$ > 100 kΩ
$t_r$ ≤ 5.0 ns

**$t_{off}$ SWITCHING**

## 348




$I_C$ ≈ 10 mA, $I_{B1}$ ≈ 1.0 mA, $I_{B2}$ ≈ 1.0 mA

$V_{IN}$
PW = 240 ns
$Z_{IN}$ = 50 Ω
$t_r$ ≤ 1.0 ns

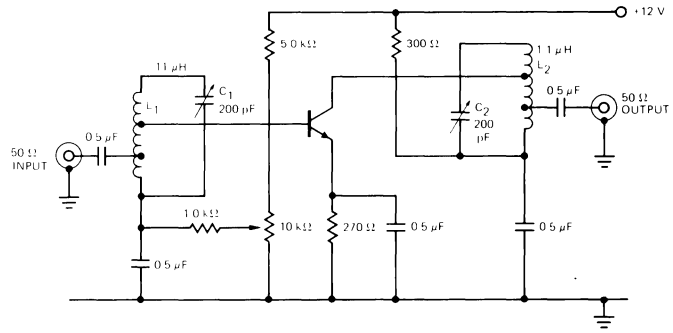
TO OSCILLOSCOPE
$Z_{IN}$ ≥ 100 kΩ
$t_r$ < 1.0 ns

$t_{off}$
$V_{BB}$ = −8.0 V
$V_{IN}$ = +9.8 V

$t_{on}$
$V_{BB}$ = GROUND
$V_{IN}$ = −5.8 V

**$t_{on}$ – $t_{off}$ SWITCHING**

## 352




$C_1$ AND $C_2$ ARCO #465
$L_1$ 11 μH (0.9 INCH OF #632 AIRDUX COIL)
INPUT TAP AT 2.9T FROM COLD SIDE
OUTPUT TAP AT 3.66T FROM COLD SIDE

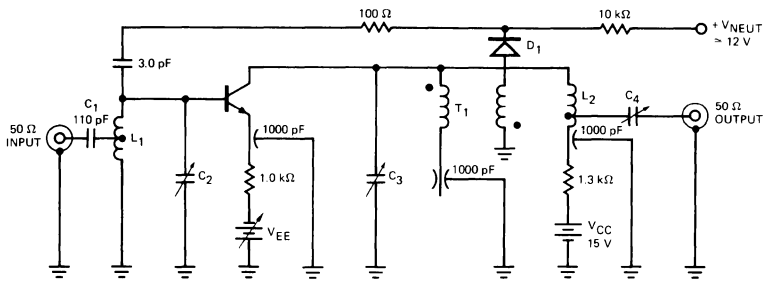
$L_2$ 1.1 μH (1.5 INCHES OF #608 AIRDUX COIL)
INPUT TAP AT 2.3T FROM COLD SIDE
OUTPUT TAP AT 0.5T FROM COLD SIDE
ALL RESISTORS ARE ½ W
TYPICAL GAIN AT IC 4 mA IS 34 dB

**10.7 MHz UNNEUTRALIZED AMPLIFIER**

6

# TEST CIRCUITS

## 353




$L_1$ = #14 BUSS WIRE – 3T – 3/8" I.D. – 5/12" LONG
TAP AT 1-1/2T FROM COLD END

$L_2$ = #18 ENAMELED – 5T – 3/8" I.D. – 5/16" LONG
TAP AT 1-1/2T FROM COLD END

$T_1$ = #36 BIFILAR – 1T IN BALUM CORE $Q_3$

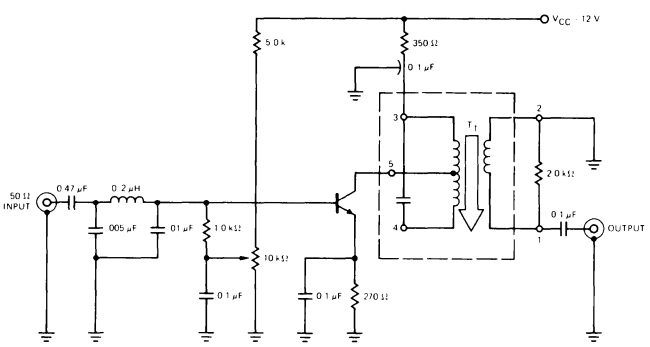
$C_2$ = 1 TO 35 pF JOHANSON #803 (OR EQUIVALENT)

$C_3$, $C_4$ = 1 TO 35 pF JOHANSON #803 (OR EQUIVALENT)

$D_1$ – FD 300

**100 MHz AGC AND NF**

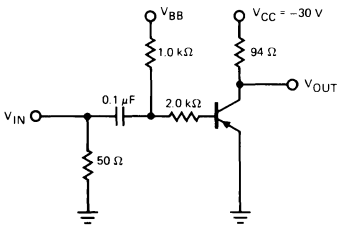
## 354




$T_1$ = TRW #17794R1

**455 kHz UNNEUTRALIZED AMPLIFIER**

## 378



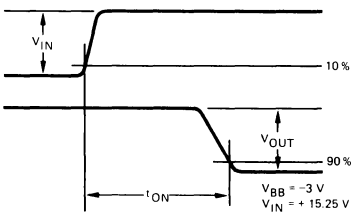

PULSE GENERATOR
$t_r \leqslant 1.0$ ns
PW = 400 ns
PPS = 150
$Z_{IN} = 50\ \Omega$

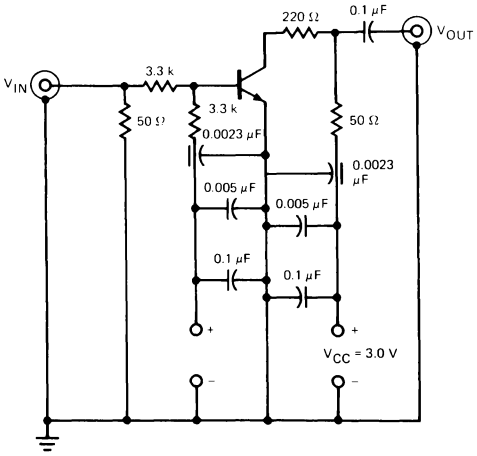
TO OSCILLOSCOPE
$t_r \leqslant 1.0$ ns
$Z_{IN} \geqslant 100\ k\Omega$

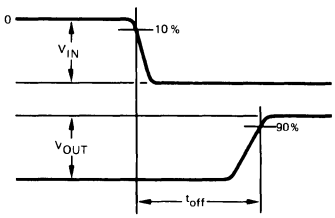
$t_{on}$ $V_{BB} = 0$, $V_{IN} = -6.85$ V
$t_{off}$ $V_{BB} = -9.85$ V, $V_{IN} = +11.7$ V

**SWITCHING TIME**

## 381




$t_{off}$ : $V_{BB} = +12$V
$V_{IN} = -20.9$V

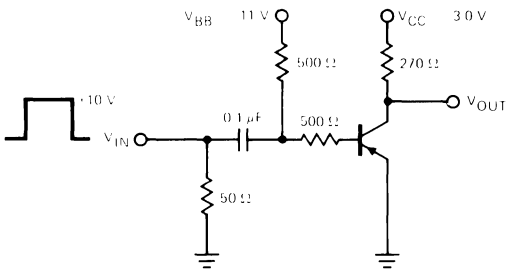
PULSE GENERATOR
$V_{IN} = t_r < 1.0$ ns
SOURCE IMPEDANCE = 50 Ω
PW ⩾ 300 ns
DC < 2%

**$t_{on}$ - $t_{off}$ SWITCHING**

TO OSCILLOSCOPE
$Z_{IN} = 50\ \Omega$
$t_r \leqslant 1.0$ ns

# TEST CIRCUITS

## 384

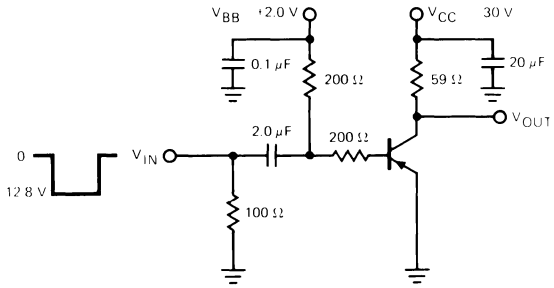



PULSE GENERATOR
$t_r \leqslant 1.0$ ns
PW = 400 ns
$Z_{IN} = 50\ \Omega$

TO OSCILLOSCOPE
$t_r \leqslant 1.0$ ns
$Z_{IN} \geqslant 100\ k\Omega$

**STORAGE TIME**

## 386

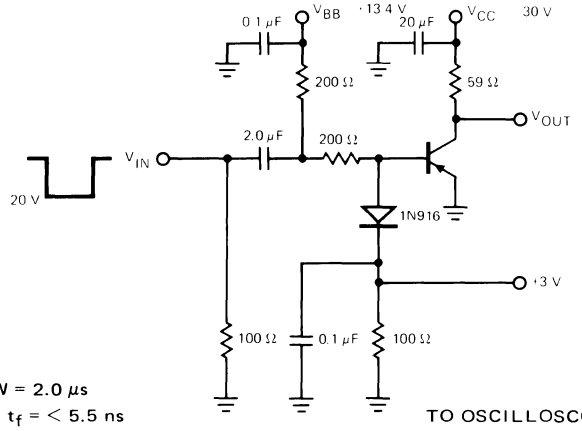



$t_r = < 1.0$ ns
PW = 250 ns
$Z_{IN} = 50\ \Omega$
DC < 2.0%

TO OSCILLOSCOPE
$t_r < 1.0$ ns
$Z_{IN} = 100\ k\Omega$

**$t_{on}$ SWITCHING**

## 387

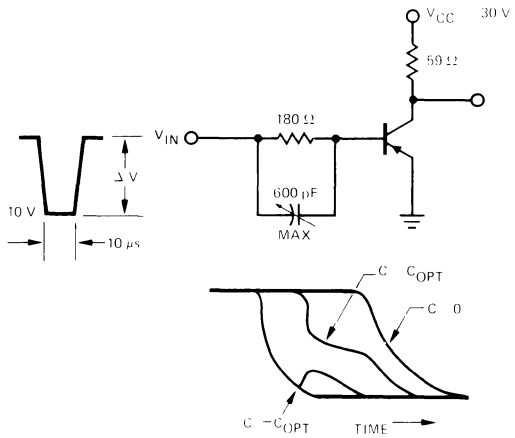



PW = 2.0 μs
$t_r, t_f = < 5.5$ ns
$Z_{IN} = 50\ \Omega$
DC < 2.0%

TO OSCILLOSCOPE
$t_r < 1.0$ ns
$Z_{IN} = 100\ k\Omega$

**$t_{off}$ SWITCHING TIME**

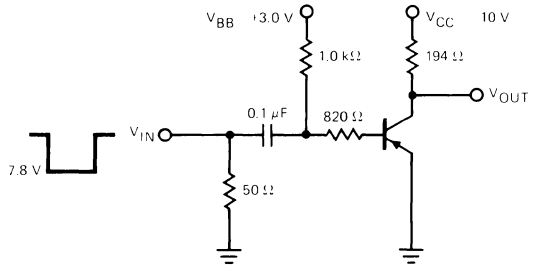
## 388




DC = 2%

**$Q_T$**

## 407

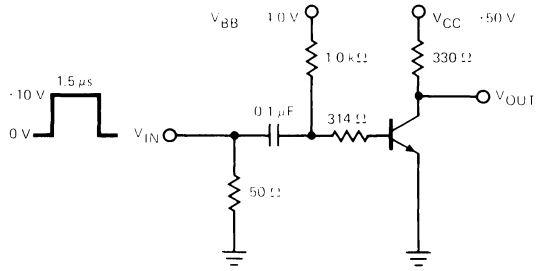



PW = 500 ns
$t_r$ AND $t_f = 1.0$ ns
$Z_{IN} = 50\ \Omega$

TO OSCILLOSCOPE
$t_r < 1.0$ ns
$Z_{IN} = 100\ k\Omega$

**SWITCHING TIME**

## 417




PULSE SOURCE
$t_r \leqslant 5.0$ ns
$t_f \leqslant 10$ ns

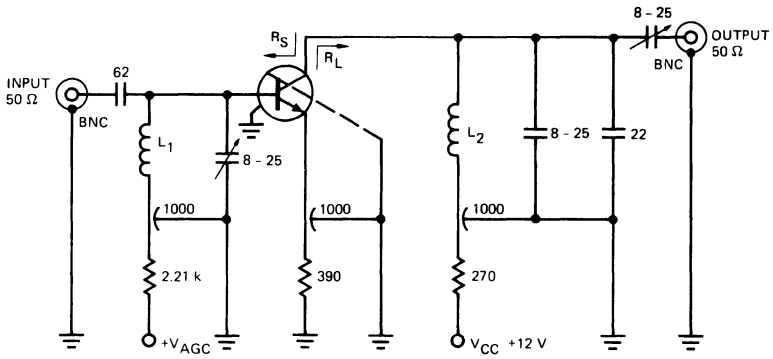
TO OSCILLOSCOPE
$t_r \leqslant 1.0$ ns
$Z_{IN} \approx 100\ k\Omega$

**$t_{on} - t_{off}$ SWITCHING**

6

# TEST CIRCUITS

## 422




$L_1$ – 7 TURNS NO. 16 BUSS WIRE
5/8" L X 5/16" I.D.

$L_2$ – 4 TURNS NO. 16 BUSS WIRE
1/2" L X 1/2" I.D.

ALL CAPACITIES IN pF.

ALL RESISTANCE IN Ω, 1/2 W, 1% TOL.

ERIE TUNEABLES P/N N300

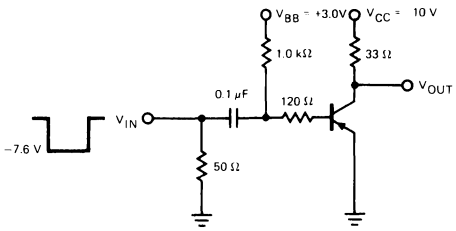
ERIE FEEDTHRU P/N 370CB102J

$R_g$ = 120 Ω

$R_L$ = 750 Ω

**45 MHz GAIN, NOISE FIGURE, AGC**

## 470

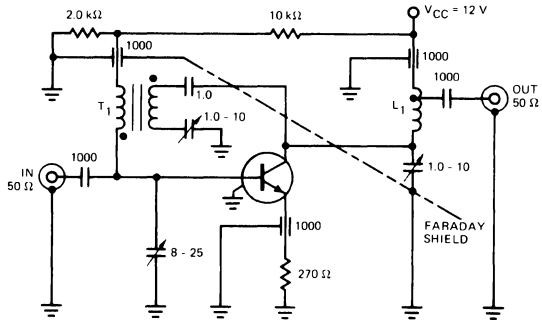



$t_r$, $t_f$ ≤ 1.0 ns
PW = 240 ns
DC ≤ 2%
$Z_{IN}$ = 50 Ω

TO OSCILLOSCOPE
$t_r$ ≤ 1.0 ns
$Z_{IN}$ = 10 mΩ

**$t_{on}$ - $t_{off}$ SWITCHING**

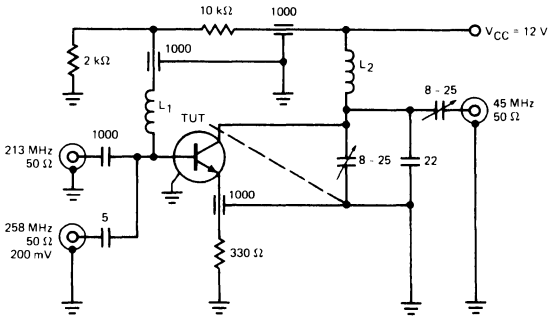
## 520




$L_1$ = 5T #14 WIRE, 5/16" I.D. X 1" L, TAPPED UP 1 TURN
TI = P-IT #18 FORMVAR
S-IT #14 WIRE INDIANA GENERAL
P/N F-684-Q3
$f_{bw}$ ≃ 10.0 MHz
ALL CAPACITIES IN pF

**200 MHz POWER GAIN FIXTURE**

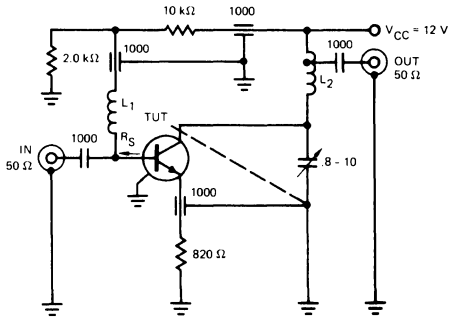
## 520-45




$L_1$ = OHMITE Z235 RF CHOKE
$L_2$ = 4T #14 WIRE, ½" I.D., ½" L
$f_{bw}$ = > 6.0 MHz
ALL CAPACITIES IN pF

**45 MHz CONVERSION GAIN**

## 520-200

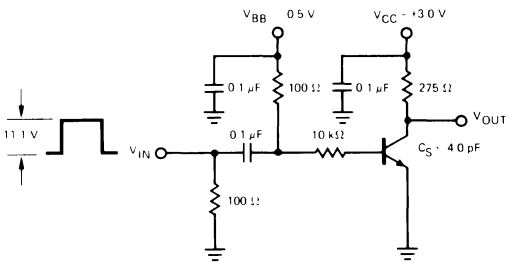



$L_1$ = OHMITE Z235 RF CHOKE
$L_2$ = 5T #14 WIRE, 5/16" I.D. X 1" L, TAPPED UP 1 TURN
$f_{bw}$ ≃ 6.0 MHz
$R_S$ = 75 Ω
ALL CAPACITIES IN pF

**200 MHz $G_{PE}$, NOISE FIGURE**

# TEST CIRCUITS

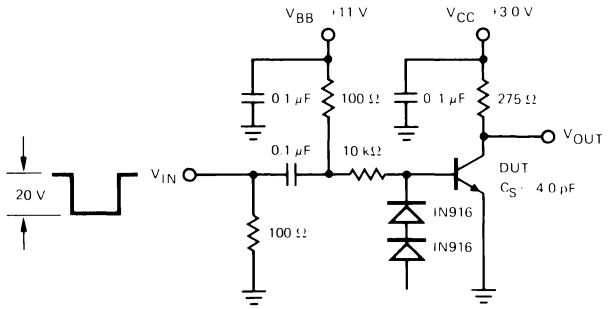
## 526




$t_r$ = < 1.0 ns
PW ⩾ 300 ns
DC = 2%

**$t_{on}$ SWITCHING**

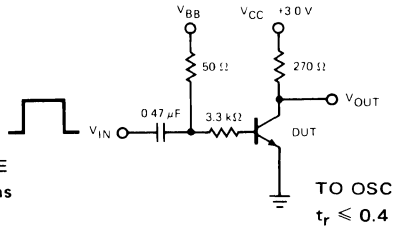
## 527




$t_r$ = < 9.0 ns
PW ⩾ 300 ns
DC = 2%

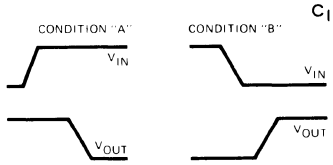
**$t_{off}$ SWITCHING**

## 531




INPUT PULSE
$t_r = t_f \leqslant 2.0$ ns
PW ≈ 300 ns
$Z_{IN}$ = 50 Ω
DC ≈ 2%

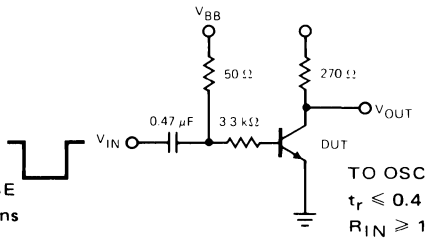
TO OSCILLOSCOPE
$t_r \leqslant 0.4$ ns
$R_{IN} \geqslant 100$ kΩ
$C_{IN} \leqslant 4.0$ pF




CONDITION "A" = $t_d$, $t_r$, $t_{on}$ 10/3 mA
$V_{BB}$ = −1.5 V $V_{IN}$ = +12.05 V
CONDITION "B" = $t_s$, $t_f$, $t_{off}$ 10/3/1.5 mA
$V_{BB}$ = −4.15 V $V_{IN}$ = +14.85 V
CONDITION "C" = $t_s$, $t_f$, $t_{off}$ 10/3/ 3 mA
$V_{BB}$ = −9.1 V $V_{IN}$ = +19.8 V

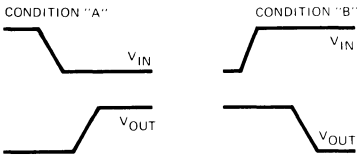
**$t_{on}$ - $t_{off}$ SWITCHING**

## 532




INPUT PULSE
$t_r = t_f \leqslant 2.0$ ns
PW ≈ 300 ns
$Z_{IN}$ = 50 Ω
DC ≈ 2%

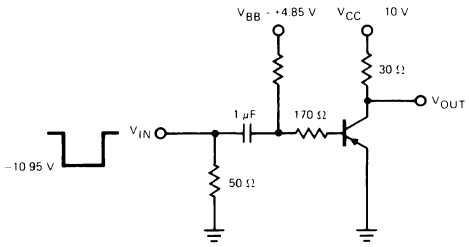
TO OSCILLOSCOPE
$t_r \leqslant 0.4$ ns
$R_{IN} \geqslant 100$ kΩ
$C_{IN} \leqslant 4.0$ pF




CONDITION "A" = $t_d$, $t_r$, $t_{on}$
$V_{BB}$ = +1.5 V $V_{IN}$ = −12.05 V
CONDITION "B" = $t_s$, $t_f$, $t_{off}$
$V_{BB}$ = +9.1 V $V_{IN}$ = −19.8 V

**$t_{on}$ - $t_{off}$ SWITCHING**

## 536




INPUT PULSE
$t_r$, $t_f$ < 6.0 ns
$Z_{IN}$ = 50 Ω
PW = 0.5 μs

300/30/30 mA

TO OSCILLOSCOPE
$t_r$ < 1.0 ns
$Z_{IN}$ ⩾ 100 kΩ

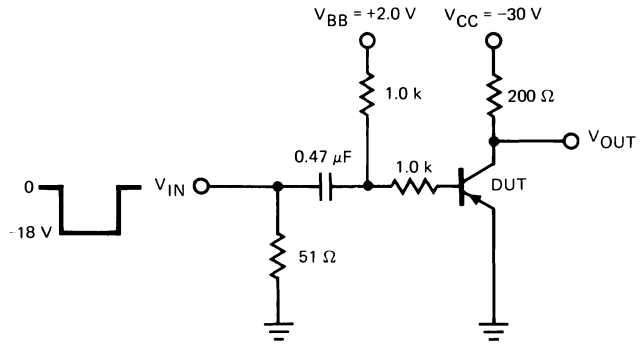
BASE CURRENTS WILL BE EXACT WHEN THE ABOVE VOLTAGES ARE USED. THESE VOLTAGES TAKE THE TERMINATING RESISTOR AND GENERATOR IMPEDANCE INTO ACCOUNT WHEN THE CURRENTS ARE CALCULATED. $V_{BE\,(sat)}$ IS A NOMINAL 1.0 V.

**$t_{on}$ - $t_{off}$ SWITCHING**

6

# TEST CIRCUITS

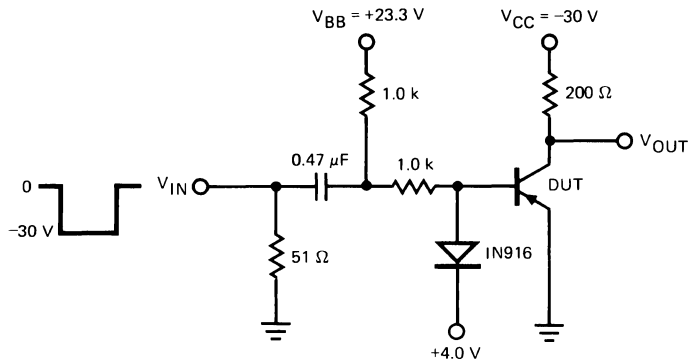
**557**




$t_r$ < 2.0 ns
PW = 1.0 μs
DC = 2%

**$t_{on}$ SWITCHING**

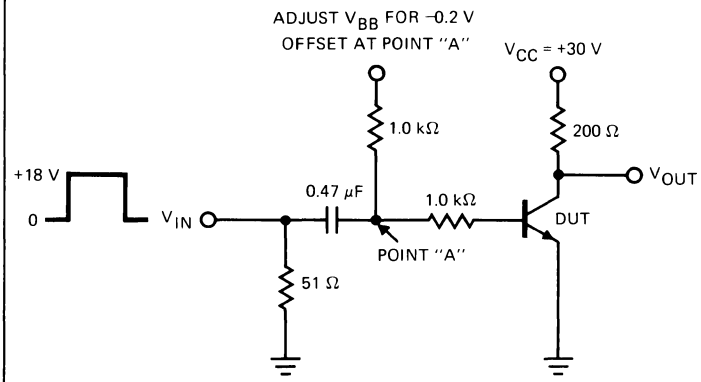
**558**




$t_r \leqslant$ 2.0 ns
PW $\geqslant$ 1.0 μs
DC = 2%

**$t_{off}$ SWITCHING**

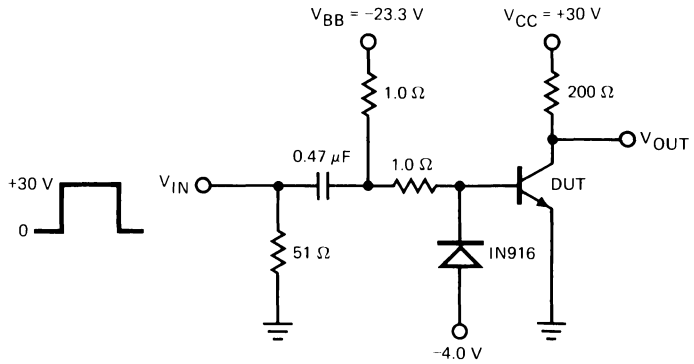
**559**




$t_r$ < 2.0 ns
PW = 1.0 μs
DC = 2%

**$t_{on}$ SWITCHING**

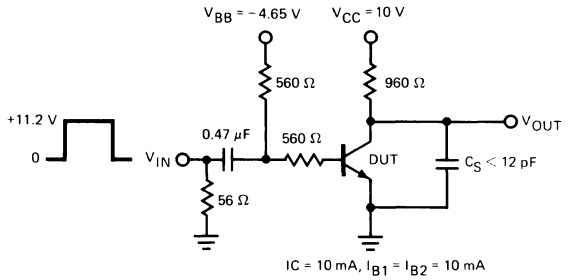
**560**




$t_r \leqslant$ 2.0 ns
PW = 1.0 μs
DC = 2%

**$t_{off}$ SWITCHING**

**561**



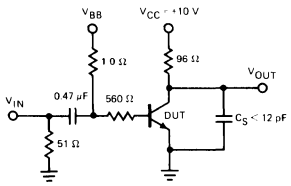

PW = 300 ns
$t_r$ < 2.0 ns
DC ≈ 2%
$Z_{IN}$ = 50 Ω

TO OSCILLOSCOPE
$t_r$ < 0.4 ns
$R_{IN} \geqslant$ 100 kΩ

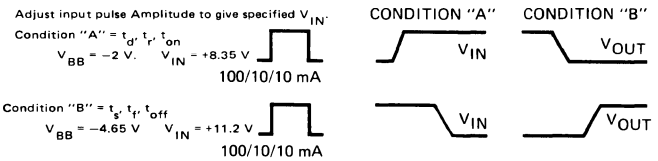
$I_C$ = 10 mA, $I_{B1}$ = $I_{B2}$ = 10 mA
**$\tau_s$ SWITCHING**

**562**

INPUT PULSE
$t_f \leqslant$ 2.0 ns
$t_r$ < 2.0 ns
PW = 300 ns
DC ≈ 2%
$Z_{IN}$ = 50 Ω



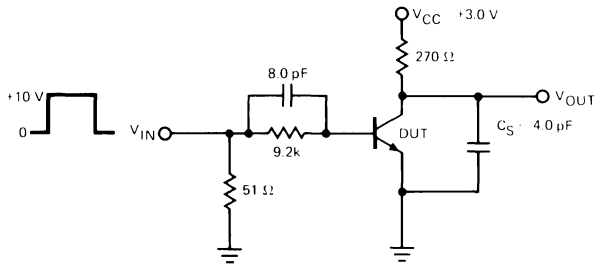

TO OSCILLOSCOPE
$t_r$ < 1.0 ns
$R_{IN} \geqslant$ 100 kΩ




**$t_{on}$ - $t_{off}$ SWITCHING**

# TEST CIRCUITS

**563**



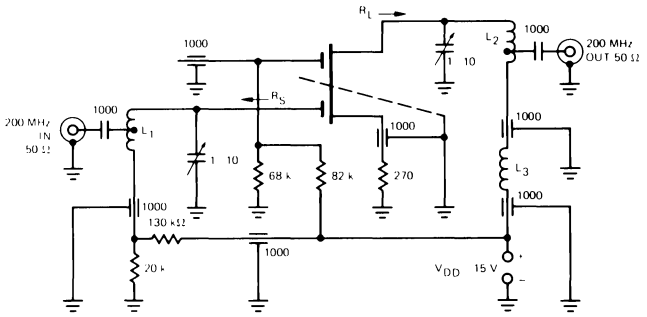

$I_C$ = 10 mA, $I_B$ = 1.0 mA

PW = 5 μs
DC = 2%
$t_f$ < 1.0 ns
$Z_{IN}$ = 50 Ω

TO OSCILLOSCOPE
$t_r$ < 1.0 ns
$R_{IN}$ ≥ 100 kΩ

**$Q_t$**

**564**



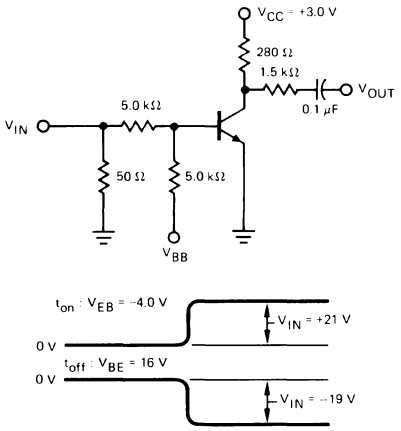

$R_S$ = 500 Ω
$R_L$ = 1.5 k

ALL CAPACITANCE IN pF.
ALL RESISTANCE IN Ω

$f_{bw}$ ≥ 12 MHz
$L_1$ = 2½ T #14 WIRE, TAPPED 1 T FROM COLD SIDE — ½" L
$L_2$ = 4½ T #14 WIRE, TAPPED 1 T FROM COLD SIDE — ¼" I.D.
$L_3$ = RFC, OHMITE Z-235 OR EQUIVALENT

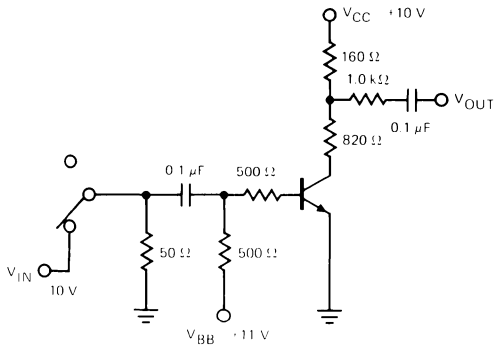
**POWER GAIN, NOISE FIGURE 200 MHz**

**566**



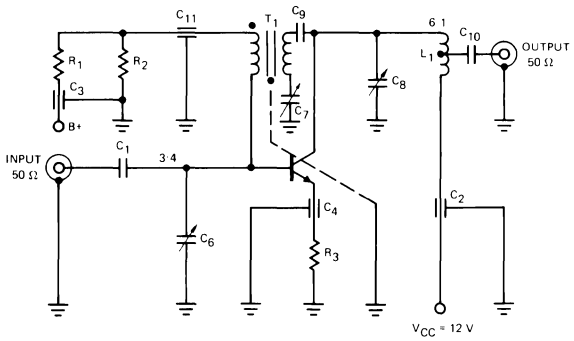

**$t_{on}$ - $t_{off}$ SWITCHING**

**567**




**CHARGE STORAGE TIME**

**573**




$C_1$, $C_{10}$ = 1000 pF DURAMICA
$C_2$, $C_3$, $C_4$, $C_5$, $C_{11}$ = 1000 pF FEEDTHRU
$C_6$ = 8 - 25 pF
$C_7$, $C_8$ = 0.7 - 10 pF
$C_9$ = 2.0 pF DURAMICA

$R_1$ = 10 kΩ
$R_2$ = 2.0 kΩ
$R_3$ = 270 Ω
$L_1$ = 5 TURNS #14 WIRE, 5/16" I.D. X 1" LONG

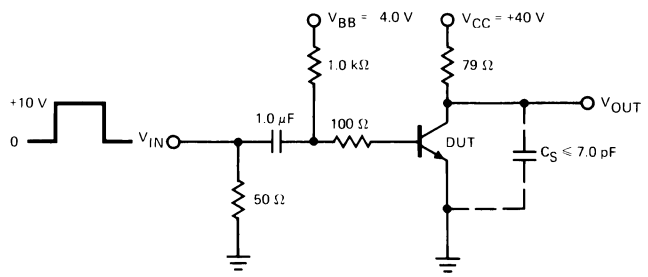
$T_1$ = 1 TURN #14 WIRE–PRIMARY
1 TURN #16 WIRE ENAMEL, SECONDARY.
WOUND ON BALUN FORM FERRITE CORE
INDIANA GEN. CORP.
F-684-Q3

**200 MHz POWER GAIN**

6

# TEST CIRCUITS

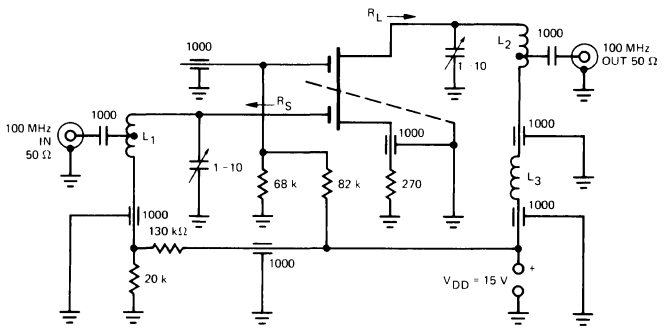
**579**




$t_r \leq$ 2.0 ns
PW = 1.0 μs
DC = 2%

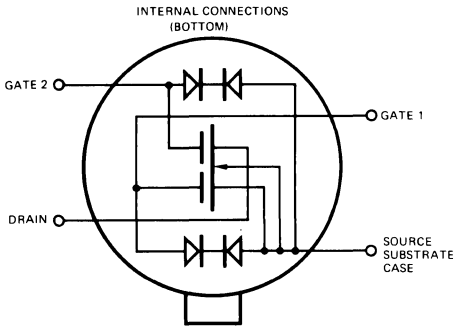
**$t_{on}$ - $t_{off}$ SWITCHING**

**580**



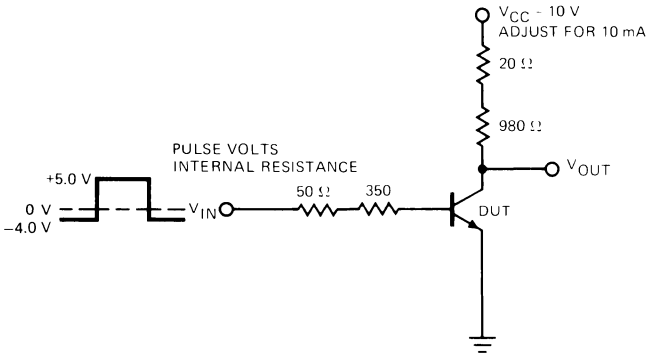

$R_S$ = 1.0 kΩ
$R_L$ = 2.0 kΩ
ALL CAPACITANCE IN pF.
ALL RESISTANCE IN Ω

$L_1$ = 3½ T #14 WIRE, TAPPED 1 T FROM COLD SIDE ½" L
$L_2$ = 6½ T #14 WIRE, TAPPED 1 T FROM COLD SIDE ¾" I.D.
$L_3$ = RFC, OHMITE Z-144 OR EQUIVALENT




**POWER GAIN, NOISE FIGURE 100 MHz**

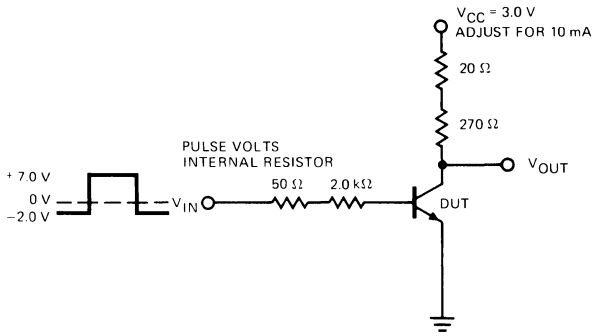
**588**




TYPE R SAMPLING RESISTOR
$I_C$ = 10 mA, $I_{B1}$ = $I_{B2}$ = 10 mA

**$\tau_s$ SWITCHING**

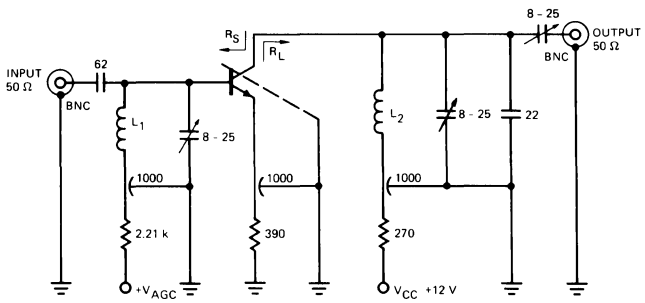
**589**




TYPE R SAMPLING RESISTOR
$I_C$ = 10 mA, $I_{B1}$ = 3.0 mA, $I_{B2}$ = 1.5 mA

**$t_{on}$ – $t_{off}$ SWITCHING**

**592**




$L_1$ – 7 TURNS NO. 16 BUSS WIRE
5/8" L X 5/16" I.D.
$L_2$ – 4 TURNS NO. 16 BUSS WIRE
½" L X ½" I.D.

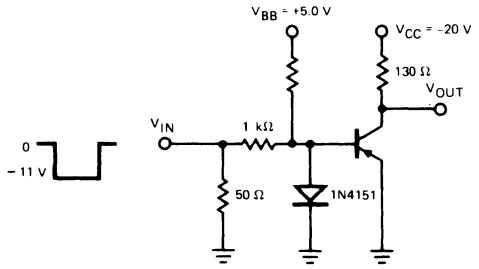
ALL CAPACITIES IN pF
$R_S$ = 120 Ω
$R_L$ = 750 Ω

ALL RESISTANCE IN Ω, ½ W, 1% TOL.

**45 MHz GAIN, NOISE FIGURE**

# TEST CIRCUITS

## 593



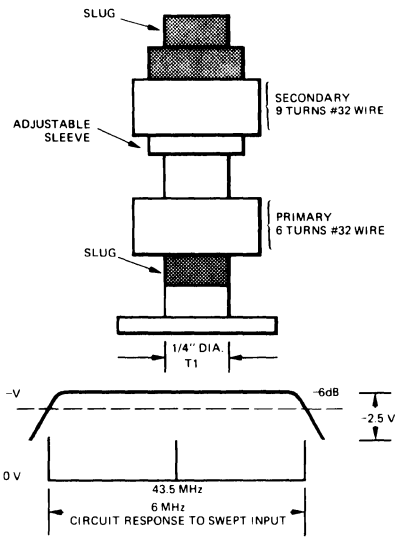

PW = 10 μs
$t_r = t_f \leq 15$ ns
$Z_{IN}$ = 50Ω

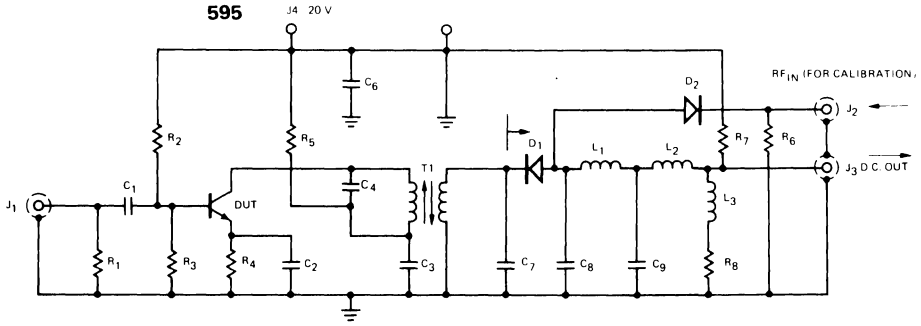
TO OSCILLOSCOPE
$t_r$ = 15 ns
$Z_{IN}$ = 100 kΩ

**$t_{on}$ - $t_{off}$ SWITCHING**

---

## 595




| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $C_1$ | .002 μF | $L_1$ | 15 μH | COILCRAFT LPFS TYPE III | $R_1$ | 51 Ω | $J_1$ | |
| $C_2$ | .002 μF | $L_2$ | 5 μH | COILCRAFT LPFS TYPE III | $R_2$ | 7.5 kΩ | $J_2$ | BNC PANELMOUNT |
| $C_3$ | .002 μF | $L_3$ | 180 μH | COILCRAFT LPFS TYPE III | $R_3$ | 1.8 kΩ | $J_3$ | |
| $C_4$ | 24 pF | $D_1$ | | | $R_4$ | 390 Ω | $J_4$ | BANANA JACK – RED |
| $C_6$ | .002 μF | $D_2$ | FH1100 | | $R_5$ | 100 Ω | $J_5$ | BANANA JACK – BLACK |
| $C_7$ | 12 pF | | | | $R_6$ | 51 Ω | | |
| $C_8$ | 10 pF | | | | $R_7$ | 180 kΩ | | |
| $C_9$ | 10 pF | | | | $R_8$ | 3.9 kΩ | | |

**THIRD VIDEO IF VOLTAGE GAIN AND DISTORTION**

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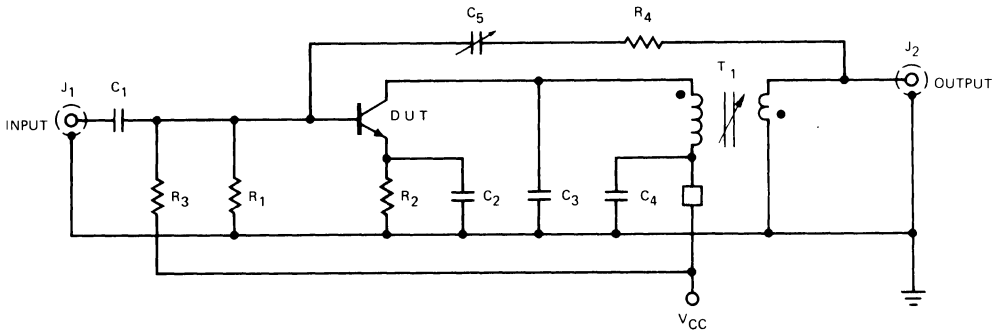
## 596



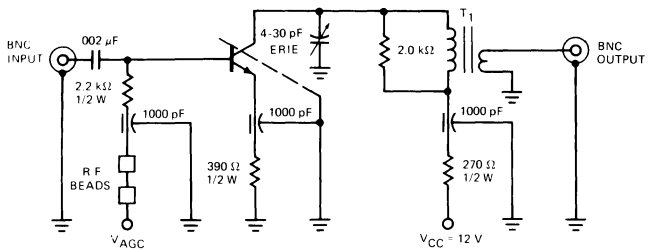

| | | | | | |
|---|---|---|---|---|---|
| $C_1$ | .01 μF | $R_1$ | 470 Ω, 1/4 W, 5%, CARBON | $T_1$ | 1/4" DIAMETER CERAMIC FORM. PRIMARY, 8 TURNS NO. 26 WIRE CLOSE WOUND. SECONDARY, 2 TURNS NO. 26 WIRE CLOSE WOUND IN CENTER OF PRIMARY. THE PRIMARY INDUCTANCE $L_p$ = 0.4 TO 0.6 μH. CORE IS A WHITE DOT OR $Q_3$ FERRITE. SECONDARY IS INTERLACED WITH PRIMARY WINDING. |
| $C_2$ | .01 μF | $R_2$ | 220 Ω, 1/4 W, 5%, CARBON | | |
| $C_3$ | 27 pF (DURA MICA) | $R_3$ | 1.5 kΩ, 1/4 W, 5%, CARBON | | |
| $C_4$ | .02 μF | $R_4$ | 30 Ω, 1/4 W, 5%, CARBON | | |
| $C_5$ | 0.7 TO 10 pF (JOHANSON – JMC 2951) VARIABLE CAPACITOR | $J_1$ | BNC PANEL MOUNT CONNECTORS | | |
| | | $J_2$ | BNC PANEL MOUNT CONNECTORS | | |

**THIRD VIDEO IF POWER GAIN**

6

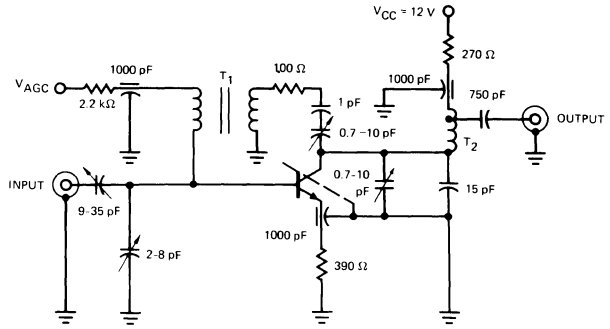
# TEST CIRCUITS

## 2003




**45 MHz AGC AND NOISE FIGURE**

## 2009

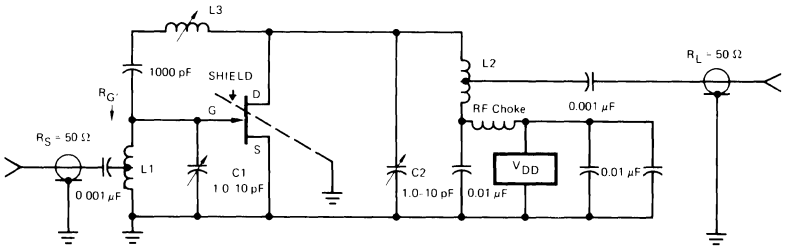



$T_1$ - BALLUN CORE
1T-PRI, 1T-SEC
#32 BIFILAR WIRE

$T_2$ - 1/4" I.D.
5-1/2T, TAPPED UP 1/2T
#16 BUSS WIRE

**100 MHz AGC, POWER GAIN, AND NOISE FIGURE**

## 2010



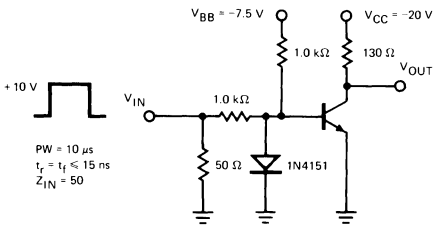

$L_1$ ≈ 8.5 TURNS OF #14 AWG TINNED COPPER, DIA. ≈ 3/8", ≈ 0.9" LONG. TAPPED AT ≈ 2-1/2 TURNS (ADJUST TO GIVE $R_G$ ≈ 1.0 kΩ). PARALLEL RESISTANCE ≈ 40 kΩ, TUNES AT ≈ 8.0 pF.

$L_2$ ≈ 13.5 TURNS #16 AWG TINNED COPPER, DIA. ≈ 3/8", ≈ 1.2" LONG TAPPED AT ≈ 5 TURNS, PARALLEL RESISTANCE ≈ 40 kΩ. TUNES AT ≈ 4.0 pF

$L_3$ ≈ 17 TURNS OF #28 AWG ENAMELED COPPER WIRE, CLOSE WOUND ON 9/32" CERAMIC FORM, TUNING PROVIDED BY A POWERED IRON SLUG.

**100 MHz, POWER GAIN AND NOISE FIGURE**

## 2011

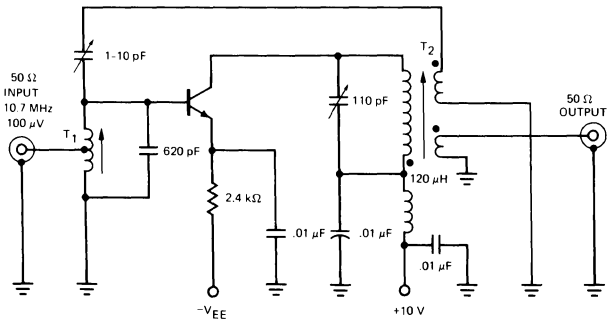



PW = 10 μs
$t_r = t_f \leq 15$ ns
$Z_{IN}$ = 50Ω

TO OSCILLOSCOPE
$t_r$ = 15 ns
$Z_{IN}$ = 100 kΩ

**$t_{on}$ - $t_{off}$ SWITCHING**

## 2012




ADJUST FOR 7.0 mA $I_C$

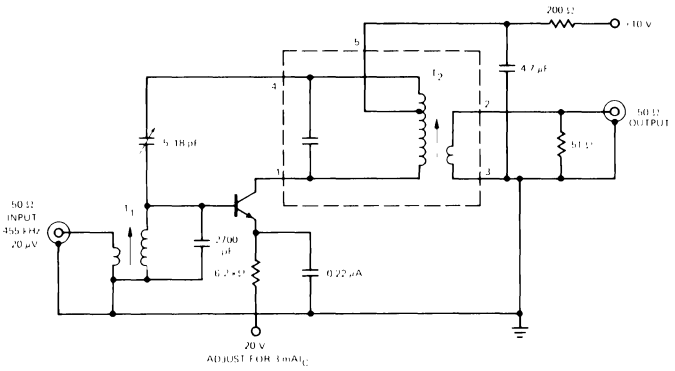
$T_1$ MILLER COIL FORM
MILLER CORE NO. 30-106
4 TURNS NO. 28 ENAMELED WIRE TAPPED 1.5 TURNS FROM GND.

$T_2$ MILLER COIL FORM
MILLER CORE NO. 30-106
PRIMERY . . . 10 TURNS NO. 36 ENAMELED WIRE.
NEUT. SEC . . . 5 TURNS NO. 36 ENAMELED WIRE (BIFILAR).
OUTPUT SEC . . . 1.33 TURNS NO. 28 ENAMELED WIRE (OVERWIND).

**10.7 MHz NEUTRALIZED POWER GAIN**

# TEST CIRCUITS

## 2013




$T_1$ 13 T PRIMARY NO. 26 NYCLAD
54 T SECONDARY NO. 36 NYCLAD MILLER NO. 30 106 CORE
.043 mH

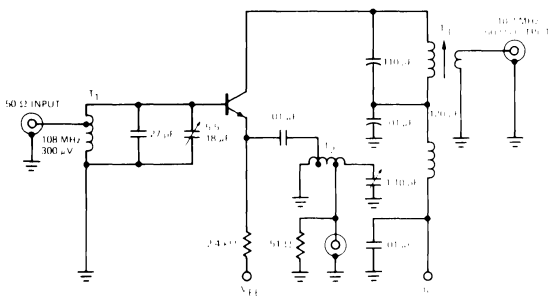
$T_2$ MILLER MIN. IF TRANSFORMER NO. 2032

TYPICAL GAIN = 55 dB

**$I_C$ = 3.0 mA** **$V_{CE}$ = 10 V**

**455 kHz NEUTRALIZED AM IF AMPLIFIER**

## 2014




$T_1$ 2.5 TURNS NO. 16 TINNED COPPER WIRE TAPPED 2 TURNS FROM GND. COIL DIA 3/8" (INSIDE DIA.)

$T_2$ 4 TURNS NO. 16 TINNED COPPER WIRE TAPPED 3/4 TURN FROM GND. AND 1 1/4 TURNS FROM GND. COIL DIA 1/4" (INSIDE DIA.)

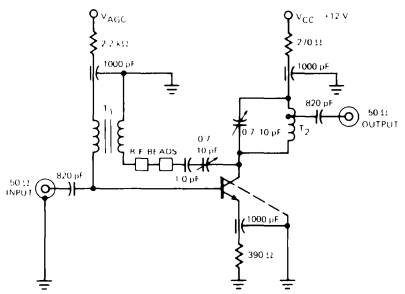
$T_3$ MILLER COIL FORM MILLER CORE NO. 30 106 PRIMERY 10 TURNS NO. 36 ENAMELED WIRE SECONDARY 1 1/3 TURNS NO. 28 ENAMELED WIRE

TYPICAL CONVERSION GAIN = 20 dB

**$I_C$ = 7.0 mA** **$V_{CE}$ = 10 V**

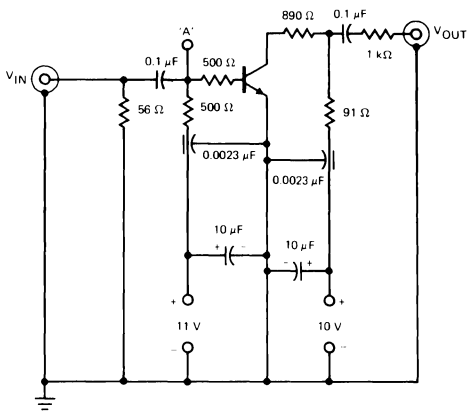
**108 MHz TO 10.7 MHz CONVERSION GAIN**

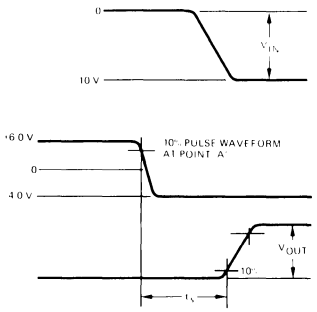
## 2015




**200MHz AGC, POWER GAIN AND NOISE FIGURE TEST**

## 3111



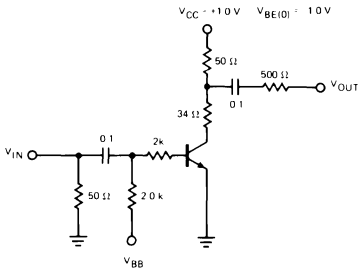



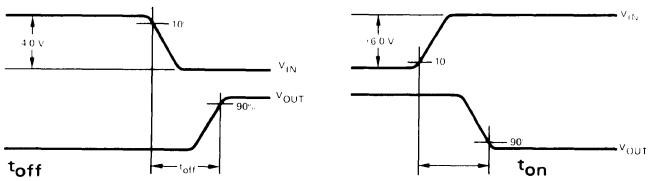

TO OSCILLOSCOPE
$Z_{IN}$ = 50 Ω
$t_r \leqslant$ 1.0 ns

PULSE GENERATOR
$V_{IN}$ $t_r$ < 1.0 ns
SOURCE IMPEDANCE = 50 Ω
PW ⩾ 300 ns
DC < 2.0%

**CHARGE STORAGE TIME**

## 3161



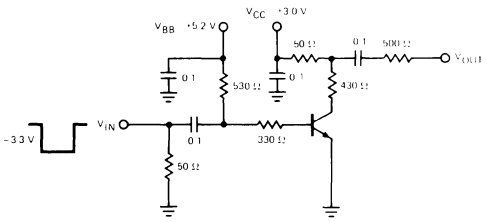

$t_{off}$
$V_{BB}$ = +5.0 V
$V_{IN}$ = −4.0 V

$V_{IN}$ $t_r \leqslant$ 1.0 ns

$t_{on}$
$V_{BB}$ = −1.0 V
$V_{IN}$ = +6.0 V

**$t_{on}$ - $t_{off}$ SWITCHING**

## 3162




MERCURY TYPE PULSER
$t_r$ < 1.0 ns
$Z_{OUT}$ = 50 Ω
PW ⩾ 200 ns

TO OSCILLOSCOPE
$t_r$ = 0.4 ns
$Z_{IN}$ = 50 Ω

**CHARGE STORAGE TIME**

6

# DISCRETE PRODUCTS

## CONTENTS AND SECTION SELECTOR

# INTRODUCTION

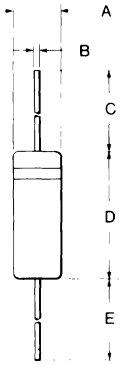
## PACKAGE OUTLINES AND ORDER INFORMATION

This section contains package outlines with dimensions given in inches and millimeters. Also included are the standard lead bends for packages commonly requiring lead forming. Designers will save money and delivery time if they purchase units with standard bends.

The final page of this section contains information for ordering Fairchild devices.

# PHYSICAL DIMENSIONS

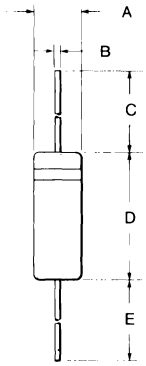
## DO7-1 in accordance with JEDEC (DO-7) outline
## Glass Diode




| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | | | 0.105 | | | 2.67 |
| B | | 0.02 | | | 0.508 | |
| C | 1.0 | | | 25.40 | | |
| D | 0.230 | | 0.300 | 5.84 | | 7.62 |
| E | 1.0 | | | 25.40 | | |

NOTES: See table for dimensions in inches and millimeters
.020 diameter dumet leads, tinned or gold-plated
Hermetically sealed glass
Package weight is 0.25 grams

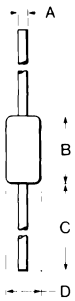
## DO7-2 in accordance with JEDEC (DO-7) outline
## Glass Diode




| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | | | 0.105 | | | 2.67 |
| B | | 0.02 | | | 0.508 | |
| C | 1.0 | | | 25.40 | | |
| D | | | 0.300 | | | 7.62 |
| E | 1.0 | | | 25.40 | | |

NOTES: See table for dimensions in inches amd millimeters
.020 diameter dumet leads, tinned or gold-plated
Hermetically sealed glass
Package weight is 0.25 grams

## DO34-1 in accordance with JEDEC (DO-34) outline
## FDN Glass Nanodiode

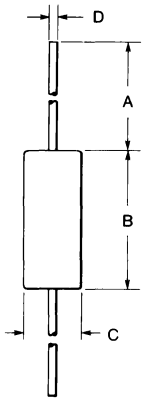



| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | | .02 | | | .508 | |
| B | | | .120 | | | 3.05 |
| C | 1.0 | | | 25.40 | | |
| D | | | .065 | | | 1.65 |

NOTES: See table for dimensions in inches and millimeters
.020 diameter dumet leads, tinned or gold-plated
Hermetically sealed glass
Package weight is 0.12 grams

# PHYSICAL DIMENSIONS

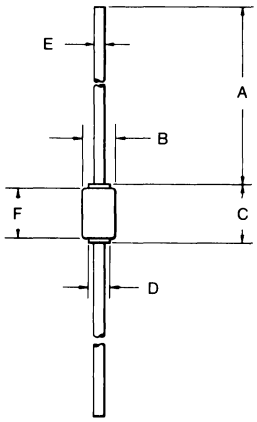
## DO35-1 in accordance with JEDEC (DO-35) outline
## FDH Glass Microdiode




| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | 1.0 | | | 25.40 | | |
| B | | | .180 | | | 4.57 |
| C | | | .075 | | | 1.91 |
| D | | .020 | | | 0.508 | |

NOTES: See table for dimensions in inches and millimeters
.020 diameter dumet leads, tinned or gold-plated
Hermetically sealed glass
Package weight is 0.14 grams

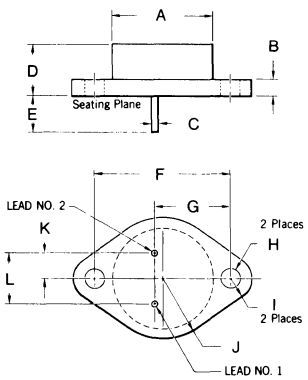
## DO41-1 in accordance with JEDEC (DO-41) outline




| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | 1.10 | | 1.20 | 27.9 | | 30.5 |
| B | .090 | | .100 | 2.29 | | 2.54 |
| C | .165 | | .175 | 4.19 | | 4.45 |
| D | .055 | | .057 | 1.40 | | 1.45 |
| E | .029 | | .031 | .737 | | .787 |
| F | .145 | | .155 | 3.68 | | 3.94 |

NOTES: See table for dimensions in inches and millimeters
Dumet leads, tinned or gold-plated
Hermetically sealed glass
Package weight is 0.14 grams

## TO3-1 in accordance with JEDEC (TO-3) outline

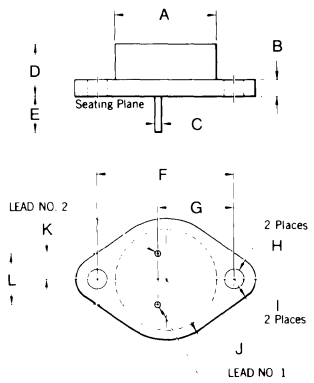



| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .805 | | .835 | 20.45 | | 31.21 |
| B | | | .135 | | | 3.43 |
| C | .038 | | .048 | 0.965 | | 1.12 |
| D | .205 | | .225 | 5.20 | | 5.71 |
| E | .312 | | | 7.92 | | |
| F | 1.177 | | 1.197 | 29.90 | | 30.40 |
| G | .655 | | .675 | 16.64 | | 17.15 |
| H | .151 | | .161 | 3.79 | | 3.84 |
| I | | | .188 | | | 4.78 |
| J | | | .525 | | | 13.34 |
| K | .205 | | .225 | 5.20 | | 5.71 |
| L | .420 | | .440 | 9.67 | | 10.08 |

NOTES: See table for dimensions in inches and millimeters
Leads 1 and 2 electrically isolated from case
Case is third electrical connection
Leads are gold-plated copper cored kovar
Aluminum package with copper slug
Package weight is 7.4 grams

# PHYSICAL DIMENSIONS

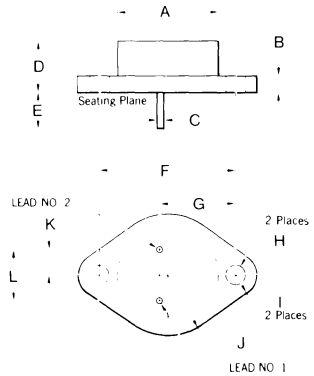
## TO3-2 in accordance with JEDEC (TO-3) outline




| DIM. | INCHES MIN. | TYP. | MAX. | MILLIMETERS MIN. | TYP. | MAX. |
|---|---|---|---|---|---|---|
| A | .870 | | .880 | 22.10 | | 22.35 |
| B | | | .135 | | | 3.43 |
| C | .038 | | .043 | 0.965 | | 1.09 |
| D | .250 | | .325 | 6.35 | | 8.26 |
| E | .312 | | | 7.92 | | |
| F | 1.177 | | 1.197 | 29.90 | | 30.40 |
| G | .655 | | .675 | 16.64 | | 17.15 |
| H | .151 | | .161 | 3.79 | | 3.84 |
| I | | | .188 | | | 4.78 |
| J | | | .525 | | | 13.34 |
| K | .205 | | .225 | 5.20 | | 5.71 |
| L | .420 | | .440 | 9.67 | | 10.08 |

NOTES: See table for dimensions in inches and millimeters
Leads 1 and 2 electrically isolated from case
Case is third electrical connection
Copper base with soldered in pins
Leads are nickel alloy
Aluminum cap
Package weight is 17.9 grams

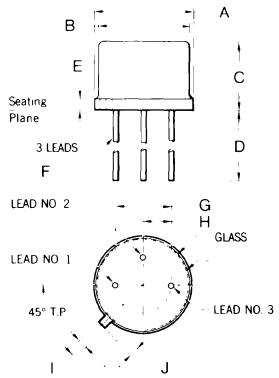
## TO3-3 in accordance with JEDEC (TO-3) outline




| DIM. | INCHES MIN. | TYP. | MAX. | MILLIMETERS MIN. | TYP. | MAX. |
|---|---|---|---|---|---|---|
| A | | | .875 | | | 22.23 |
| B | | | .135 | | | 3.43 |
| C | .038 | | .043 | 0.965 | | 1.09 |
| D | .250 | | .450 | 6.35 | | 11.43 |
| E | .312 | | | 7.92 | | |
| F | 1.177 | | 1.197 | 29.90 | | 30.40 |
| G | .655 | | .675 | 16.64 | | 17.15 |
| H | .151 | | .161 | 3.79 | | 3.84 |
| I | | | .188 | | | 4.78 |
| J | | | .525 | | | 13.34 |
| K | .205 | | .225 | 5.20 | | 5.71 |
| L | .420 | | .440 | 9.67 | | 10.08 |

NOTES: See table for dimensions in inches and millimeters
Leads 1 and 2 electrically isolated from case
Case is third electrical connection
Leads are nickel alloy
Copper base with 400 mil diameter moly disc, soldered in pins
Package weight is 18.0 grams

## TO5-1 in accordance with JEDEC (TO-39) outline (15 mil kovar header)

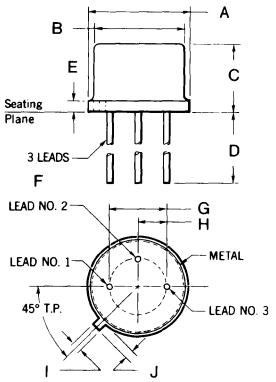



| DIM. | INCHES MIN. | TYP. | MAX. | MILLIMETERS MIN. | TYP. | MAX. |
|---|---|---|---|---|---|---|
| A | .350 | | .370 | 8.51 | | 9.39 |
| B | .315 | | .335 | 8.00 | | 8.51 |
| C | .240 | | .260 | 6.10 | | 6.60 |
| D | .500 | | | 12.70 | | |
| E | | | .030 | | | 0.762 |
| F | .016 | | .019 | 0.406 | | 0.483 |
| G | | .200 | | | 5.08 | |
| H | | .100 | | | 2.54 | |
| I | .028 | | .034 | 0.711 | | 0.864 |
| J | .029 | | .040 | 0.737 | | 1.02 |

NOTES: See table for dimensions in inches and millimeters
Leads are gold-plated kovar
Lead No. 3 connected to case
Package weight is 1.11 grams

# PHYSICAL DIMENSIONS

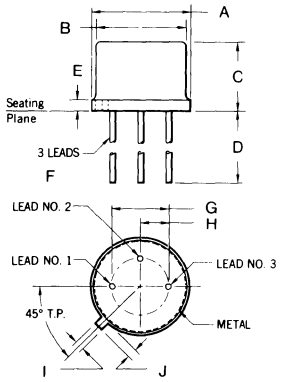
## TO5-2 in accordance with JEDEC (TO-39) outline




| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .350 | | .370 | 8.51 | | 9.39 |
| B | .315 | | .335 | 8.00 | | 8.51 |
| C | .240 | | .260 | 6.10 | | 6.60 |
| D | .500 | | | 12.70 | | |
| E | | | .030 | | | 0.762 |
| F | .016 | | .019 | 0.406 | | 0.483 |
| G | | .200 | | | 5.08 | |
| H | | .100 | | | 2.54 | |
| I | .028 | | .034 | 0.711 | | 0.864 |
| J | .029 | | .040 | 0.737 | | 1.02 |

NOTES: See table for dimensions in inches and millimeters
Leads are gold-plated over nickel-flash on steel
Lead No. 3 connected to case
Low RTH
Package weight is 0.76 grams
This is a standard package and does not fall into the special classification

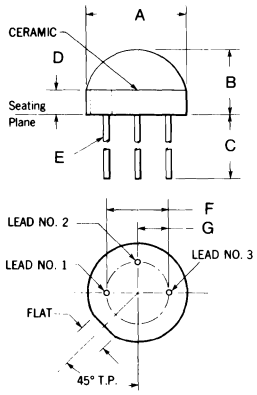
## TO5-3 in accordance with JEDEC (TO-5) outline (60 mil steel header)




| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .335 | | .370 | 8.51 | | 9.39 |
| B | .305 | | .335 | 7.75 | | 8.51 |
| C | .240 | | .260 | 6.10 | | 6.60 |
| D | .500 | | | 12.70 | | |
| E | | | .030 | | | 0.762 |
| F | .016 | | .019 | 0.406 | | 0.483 |
| G | | .200 | | | 5.08 | |
| H | | .100 | | | 2.54 | |
| I | .028 | | .034 | 0.711 | | 0.864 |
| J | .029 | | .045 | 0.737 | | 1.14 |

NOTES: See table for dimensions in inches and millimeters
Leads are gold-plated kovar
Lead No. 3 connected to case
Moly disc
High reliability, low thermal resistance
Package weight is 2.9 grams

## TO5-4 in accordance with JEDEC (TO-105) outline Plastic Package

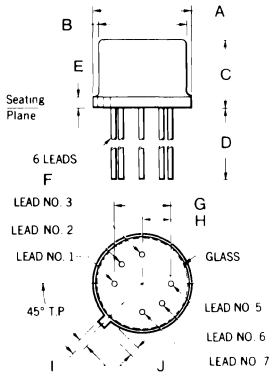



| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .305 | | .325 | 7.75 | | 8.25 |
| B | | | .220 | | | 5.58 |
| C | .500 | | | 12.70 | | |
| D | | .080 | | | 2.032 | |
| E | .016 | | .019 | 0.406 | | 0.483 |
| F | | .200 | | | 5.08 | |
| G | | .100 | | | 2.54 | |
| H | | .080 | | | 2.032 | |

NOTES: See table for dimensions in inches and millimeters
Internal lead No. 3 length is H
Leads 1 and 2 are gold-plated nickel
Lead No. 3 is gold-plated kovar
Package weight is 0.5 grams

# PHYSICAL DIMENSIONS

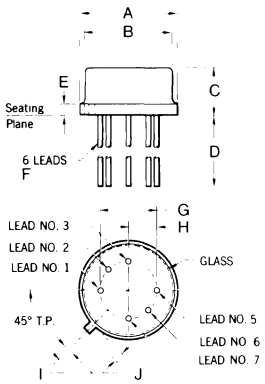
## TO5-7 in accordance with JEDEC (TO-77) outline (15 mil kovar header) Adjacent Two Island Package




| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .335 | | .370 | 8.51 | | 9.39 |
| B | .305 | | .335 | 7.75 | | 8.51 |
| C | .240 | | .260 | 6.10 | | 6.60 |
| D | .500 | | | 12.70 | | |
| E | | | .040 | | | 0.916 |
| F | .016 | | .019 | 0.406 | | 0.483 |
| G | | .200 | | | 5.08 | |
| H | | .100 | | | 2.54 | |
| I | .028 | | .034 | 0.711 | | 0.864 |
| J | .029 | | .045 | 0.737 | | 1.14 |

NOTES: See table for dimensions in inches and millimeters
Leads No. 4 and 8 are omitted
Lead No. 1 internally connected to one island,
Lead No. 7 internally connected to other island
Leads are gold-plated kovar
Kovar island thickness = 15 mils
Package weight is 1.23 grams

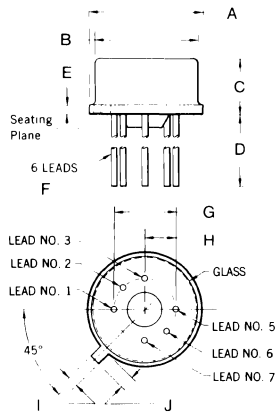
## TO5-8 in accordance with JEDEC (TO-78) outline (15 mil kovar header) Adjacent Two Island Package




| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .335 | | .370 | 8.51 | | 9.39 |
| B | .305 | | .335 | 7.75 | | 8.51 |
| C | .165 | | .185 | 4.19 | | 4.69 |
| D | .500 | | | 12.70 | | |
| E | | | .040 | | | 0.916 |
| F | .016 | | .019 | 0.406 | | 0.483 |
| G | | .200 | | | 5.08 | |
| H | | .100 | | | 2.54 | |
| I | .028 | | .034 | 0.711 | | 0.864 |
| J | .029 | | .045 | 0.737 | | 1.14 |

NOTES: See table for dimensions in inches and millimeters
Leads 4 and 8 omitted
Lead No. 1 internally connected to one island
Lead No. 2 internally connected to other island
Leads are gold-plated kovar
Kovar island thickness = 15 mils
Package weight is 1.08 grams

## TO5-9 Similar* to JEDEC (TO-78) outline (15 mil kovar header) Adjacent Two Island Package

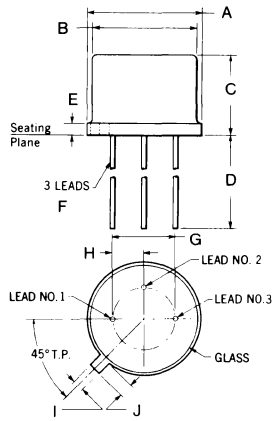



| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .335 | | .370 | 8.51 | | 9.39 |
| B | .305 | | .335 | 7.75 | | 8.51 |
| C | .165 | | .260 | 4.19 | | 6.60 |
| D | .500 | | | 12.70 | | |
| E | | | .040 | | | 0.916 |
| F | .016 | | .019 | 0.406 | | 0.483 |
| G | | .200 | | | 5.08 | |
| H | | .100 | | | 2.54 | |
| I | .028 | | .034 | 0.711 | | 0.864 |
| J | .029 | | .045 | 0.737 | | 1.14 |

NOTES: See table for dimensions in inches and millimeters
Leads 4 and 8 are omitted
Lead No. 1 internally connected to one island
Lead No. 7 internally connected to other island
Leads are gold-plated kovar
Kovar island thickness = 15 mils
Package weight is 1.08 grams
*Dimensions similar to JEDEC TO-78 except for lead length

# PHYSICAL DIMENSIONS

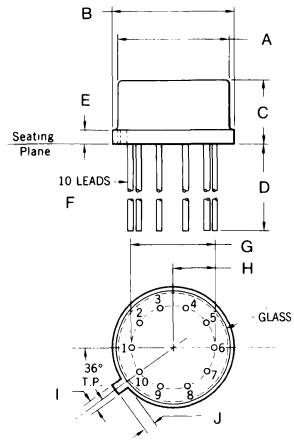
## TO5-10 in accordance with JEDEC (TO-5) outline (15 mil kovar header)




| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .335 | | .370 | 8.51 | | 9.39 |
| B | .305 | | .335 | 7.75 | | 8.51 |
| C | .240 | | .260 | 6.10 | | 6.60 |
| D | 1.5 | | | 38.1 | | |
| E | | | .030 | | | 0.762 |
| F | .016 | | .019 | 0.406 | | 0.483 |
| G | | .200 | | | 5.08 | |
| H | | .100 | | | 2.54 | |
| I | .028 | | .034 | 0.711 | | 0.864 |
| J | .029 | | .045 | 0.737 | | 1.14 |

NOTES: See table for dimensions in inches and millimeters
Leads are gold-plated kovar
Lead No. 3 connected to case
Package weight is 1.11 grams

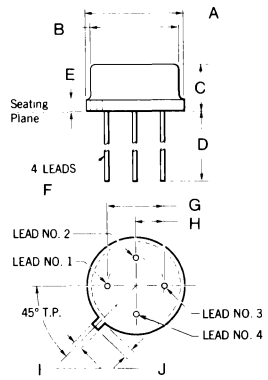
## TO5-11 Similar* to JEDEC (TO-96) outline (15 mil kovar header)




| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .335 | | .370 | 8.51 | | 9.39 |
| B | .305 | | .335 | 7.75 | | 8.51 |
| C | .165 | | .185 | 6.10 | | 6.60 |
| D | .500 | | | 12.70 | | |
| E | | | .040 | | | 0.916 |
| F | .016 | | .019 | 0.406 | | 0.483 |
| G | | .230 | | | 5.84 | |
| H | | .115 | | | 2.94 | |
| I | .028 | | .034 | 0.711 | | 0.864 |
| J | .029 | | .045 | 0.737 | | 1.14 |

NOTES: See table for dimensions in inches and millimeters
Leads are gold-plated kovar
No leads connected to case
*Dimensions similar to JEDEC TO-96 except for can height

## TO5-12 Similar* to JEDEC (TO-33) outline

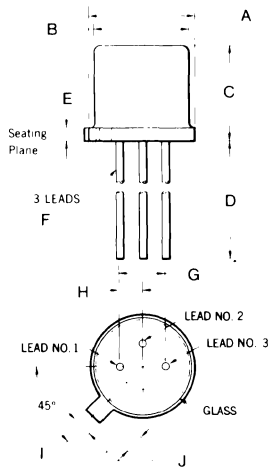



| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .335 | | .370 | 8.51 | | 9.39 |
| B | .305 | | .335 | 7.75 | | 8.51 |
| C | .165 | | .185 | 4.19 | | 4.69 |
| D | 0.5 | | | 12.70 | | |
| E | | | .040 | | | 1.02 |
| F | .016 | | .019 | 0.406 | | 0.483 |
| G | | .230 | | | 5.84 | |
| H | | .115 | | | 2.94 | |
| I | .028 | | .034 | 0.711 | | 0.864 |

NOTES: See table for dimensions in inches and millimeters
Leads are gold-plated kovar
Package weight is 1.22 grams
*Dimensions similar to JEDEC (TO-33) except for can height

# PHYSICAL DIMENSIONS

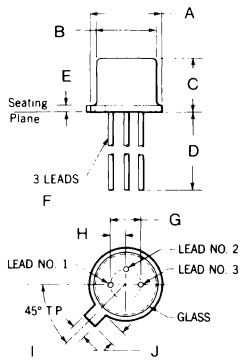
## TO18-1 in accordance with JEDEC (TO-18) outline (8 mil kovar header)




| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .209 | | .230 | 5.31 | | 5.84 |
| B | .178 | | .195 | 4.52 | | 4.95 |
| C | .170 | | .210 | 4.32 | | 5.33 |
| D | .500 | | | 12.70 | | |
| E | | | 030 | | | 0.762 |
| F | .016 | | .019 | 0.406 | | 0.483 |
| G | | .100 | | | 2.54 | |
| H | | .050 | | | 1.27 | |
| I | .036 | | .046 | 0.914 | | 1.17 |
| J | .028 | | .048 | 0.711 | | 1.22 |

NOTES: See table for dimensions in inches and millimeters
Leads are gold-plated kovar
Lead No. 3 connected to case
Package weight is 0.44 grams

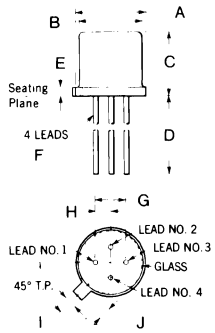
## TO18-2 in accordance with JEDEC (TO-52) outline (8 mil kovar header)




| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .209 | | .230 | 5.31 | | 5.84 |
| B | .178 | | .195 | 4.52 | | 4.95 |
| C | .115 | | .150 | 2.95 | | 3.81 |
| D | .500 | | | 12.70 | | |
| E | | | .030 | | | 0.762 |
| F | .016 | | .019 | 0.406 | | 0.483 |
| G | | .100 | | | 2.54 | |
| H | | .050 | | | 1.27 | |
| I | .036 | | .046 | 0.914 | | 1.17 |
| J | .028 | | .048 | 0.711 | | 1.22 |

NOTES: See table for dimensions in inches and millimeters
Leads are gold-plated kovar
Lead No. 3 connected to case
Package weight is 0.31 grams

## TO18-3 in accordance with JEDEC (TO-72) outline (8 mil kovar header)

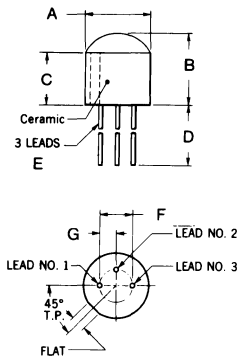



| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .209 | | .230 | 5.31 | | 5.84 |
| B | .178 | | .195 | 4.52 | | 4.95 |
| C | .170 | | .210 | 4.32 | | 5.33 |
| D | .500 | | | 12.70 | | |
| E | | | .030 | | | 0.762 |
| F | .016 | | .019 | 0.406 | | 0.483 |
| G | | .100 | | | 2.54 | |
| H | | .050 | | | 1.27 | |
| I | .036 | | .046 | 0.914 | | 1.70 |
| J | .028 | | .048 | 0.711 | | 1.22 |

NOTES: See table for dimensions in inches and millimeters
Lead No. 4 connected to case
Leads are gold-plated kovar
Collector electrically isolated from case
Package weight is 0.36 grams

# PHYSICAL DIMENSIONS

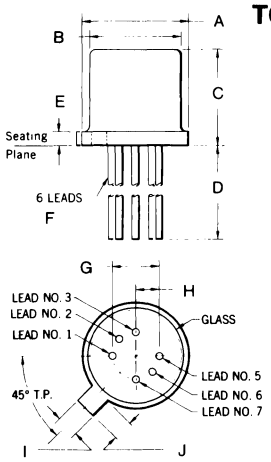
## TO18-4 in accordance with JEDEC (TO-106) outline
## Plastic Package




| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .192 | | .222 | 4.88 | | 5.64 |
| B | | | .240 | | | 5.90 |
| C | .100 | | .120 | 2.54 | | 3.05 |
| D | .500 | | | 12.40 | | |
| E | .016 | | .019 | 0.406 | | 0.483 |
| F | | .100 | | | 2.54 | |
| G | | .050 | | | 1.27 | |

NOTES: See table for dimensions in inches and millimeters
Leads 4 and 8 omitted
Internal lead No. 3 length is 110 mils
Lead No. 3 club head length is 85 mils
Leads 1 and 2 are gold-plated nickel
Lead No. 3 is gold-plated copper alloy
Packaged weight is 0.31 grams

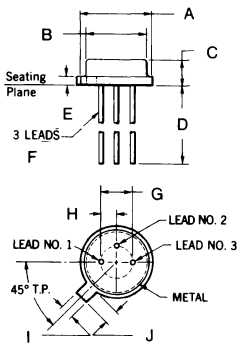
## TO18-5 in accordance with JEDEC (TO-71) outline
## (8 mil kovar header)
## Opposed Two Island Package




| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .209 | | .230 | 5.31 | | 5.84 |
| B | .178 | | .195 | 4.45 | | 4.95 |
| C | .170 | | .210 | 4.32 | | 5.33 |
| D | .500 | | | 12.70 | | |
| E | | | .030 | | | 0.762 |
| F | .016 | | .019 | 0.406 | | 0.483 |
| G | | .100 | | | 2.54 | |
| H | | .050 | | | 1.27 | |
| I | .036 | | .046 | 0.914 | | 1.17 |
| J | .028 | | .048 | 0.711 | | 1.22 |

NOTES: See table for dimensions in inches and millimeters
Lead No. 3 internally connected to one island
Lead No. 7 internally connected to other island
Leads are gold plated kovar
Kovar island thickness = 15 mils
Package weight is 0.60 grams

## TO18-6 in accordance with JEDEC (TO-46) outline
## (45 mil kovar header)

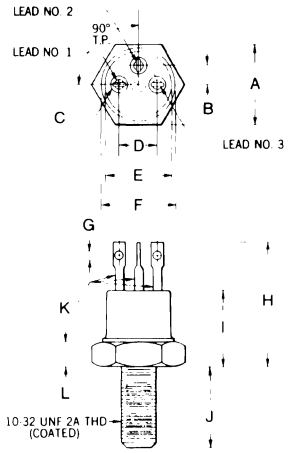



| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .209 | | .230 | 5.31 | | 5.84 |
| B | .178 | | .195 | 4.52 | | 4.94 |
| C | .065 | | .085 | 1.65 | | 2.16 |
| D | .500 | | | 12.70 | | |
| E | | | .030 | | | 0.762 |
| F | .012 | | .019 | 0.305 | | 0.483 |
| G | | .100 | | | 2.54 | |
| H | | .050 | | | 1.27 | |
| I | .036 | | .046 | 0.914 | | 1.17 |
| J | .028 | | .048 | 0.711 | | 1.22 |

NOTES: See table for dimensions in inches and millimeters
Lead No. 3 connected to case
Leads are gold-plated kovar
Package weight is 0.35 grams

# PHYSICAL DIMENSIONS

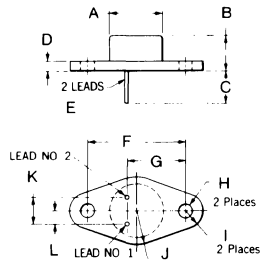
## TO59-1 in accordance with JEDEC (TO-59) outline
## Isolated Collector (Lead no. 3)




| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .424 | | .437 | 10.77 | | 11.10 |
| B | .090 | | .110 | 2.29 | | 2.79 |
| C | .079 | | .105 | 2.01 | | 2.67 |
| D | .185 | | .215 | 4.70 | | 5.46 |
| E | .318 | | .380 | 8.08 | | 9.65 |
| F | .380 | | .437 | 9.65 | | 11.10 |
| G | .040 | | .065 | 1.02 | | 1.65 |
| H | .570 | | .763 | 14.48 | | 19.38 |
| I | .320 | | .468 | 8.13 | | 11.89 |
| J | .400 | | .455 | 10.16 | | 10.56 |
| K | .038 | | .065 | .965 | | 1.65 |
| L | .090 | | .150 | 2.29 | | 3.81 |

NOTES: See table for dimensions in inches and millimeters
Stud and header are gold-plated copper
Cap is gold-plated kovar
All leads electrically isolated from case by beryllia disc
Package weight is 5.45 grams

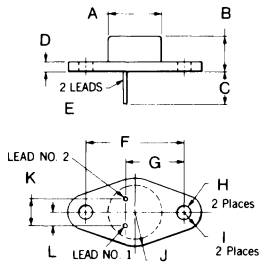
## TO66-1 in accordance with JEDEC (TO-66) outline




| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .470 | | .500 | 11.94 | | 12.70 |
| B | .250 | | .340 | 6.35 | | 8.64 |
| C | .360 | | | 9.14 | | |
| D | .050 | | .075 | 1.27 | | 1.91 |
| E | .028 | | .034 | 0.710 | | 0.864 |
| F | .958 | | .962 | 24.33 | | 24.43 |
| G | .570 | | .590 | 14.48 | | 14.99 |
| H | .142 | | .152 | 3.61 | | 3.86 |
| I | | | .145 | | | 3.68 |
| J | | | .350 | | | 8.89 |
| K | .190 | | .210 | 4.83 | | 5.33 |
| L | .093 | | .107 | 2.36 | | 2.72 |

NOTES: See table for dimensions in inches and millimeters
Leads are gold-plated kovar
Leads 1 and 2 electrically isolated from case
Case is third electrical connection
Nickel-plated steel base and cap
Package weight is 6.5 grams

## TO66-2 in accordance with JEDEC (TO-66) outline

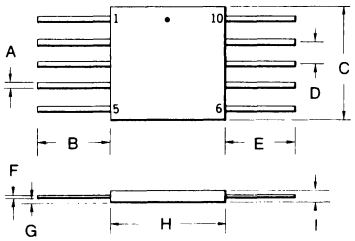



| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .470 | | .500 | 11.94 | | 12.70 |
| B | .250 | | .340 | 6.35 | | 8.64 |
| C | .360 | | | 9.14 | | |
| D | .050 | | .075 | 1.27 | | 1.91 |
| E | .028 | | .034 | 0.710 | | 0.864 |
| F | .958 | | .962 | 24.33 | | 24.43 |
| G | .570 | | .590 | 14.48 | | 14.99 |
| H | .142 | | .152 | 3.61 | | 3.86 |
| I | | | .145 | | | 3.68 |
| J | | | .350 | | | 8.89 |
| K | .190 | | .210 | 4.83 | | 5.33 |
| L | .093 | | .107 | 2.36 | | 2.72 |

NOTES: See table for dimensions in inches and millimeters
Leads are gold-plated kovar
Leads 1 and 2 electrically isolated from case
Case is third electrical connection
Nickel-plated steel base and cap
Package weight is 6.6 grams

# PHYSICAL DIMENSIONS

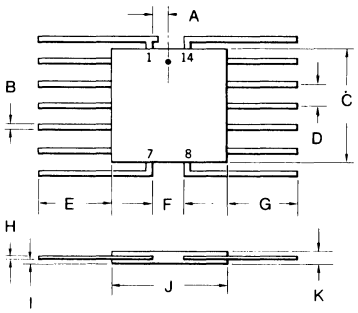
## TO85-1 Similar* to JEDEC (TO-85) outline
## 10 Lead CERPAK




| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .015 | | .019 | .381 | | .483 |
| B | .250 | | .370 | 6.35 | | 9.39 |
| C | .240 | | .260 | 6.10 | | 6.60 |
| D | | .050 | | | 1.27 | |
| E | .250 | | .370 | 6.35 | | 9.39 |
| F | .004 | | .006 | .092 | | .152 |
| G | | .035 | | | .889 | |
| H | .240 | | .260 | 6.10 | | 6.60 |
| I | .067 | | .090 | 1.70 | | 2.28 |

NOTES: See table for dimensions in inches and millimeters
Alternate marking of dot in upper left hand corner is also acceptable
Leads are gold-plated kovar
Package weight is 0.26 grams
*Dimensions similar to JEDEC TO-91 except for package thickness

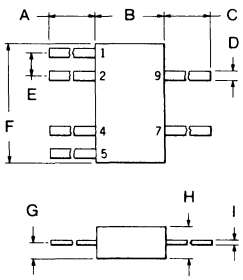
## TO86-1 Similar* to JEDEC (TO-86) outline
## 14 Lead CERPAK




| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | | .016 | | | .406 | |
| B | .015 | | .019 | .381 | | .483 |
| C | .240 | | .260 | 6.10 | | 6.60 |
| D | | .050 | | | 1.27 | |
| E | .250 | | .370 | 6.35 | | 9.39 |
| F | .045 | | .055 | 1.04 | | 1.40 |
| G | .250 | | .370 | 6.35 | | 9.39 |
| H | .004 | | .006 | .092 | | .152 |
| I | | .035 | | | .889 | |
| J | .240 | | .260 | 6.10 | | 6.60 |
| K | .067 | | .090 | 1.70 | | 2.28 |

NOTES: See table for dimensions in inches and millimeters
Alternate marking of dot in upper left hand corner is also acceptable
Leads are gold-plated kovar
Package weight is 0.26 grams
*Dimensions similar to JEDEC TO-86 except for package thickness

## TO89-1 Similar* to JEDEC (TO-89) outline
## Network Package

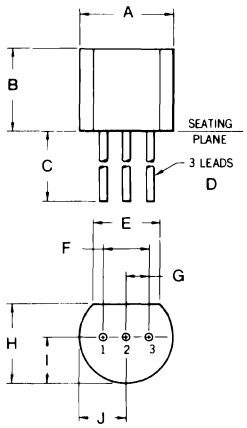



| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .070 | | | 1.78 | | |
| B | .120 | | .150 | 3.05 | | 3.81 |
| C | .070 | | | 1.78 | | |
| D | .010 | | .019 | .254 | | .482 |
| E | .045 | | .055 | 1.04 | | 1.40 |
| F | .240 | | .290 | 6.10 | | 7.36 |
| G | .005 | | .035 | .127 | | .889 |
| H | .030 | | .070 | .762 | | 1.78 |
| I | .003 | | .006 | .076 | | .152 |

NOTES: See table for dimensions in inches and millimeters
Leads are nickel-gold-plated kovar
Base material is nickel-gold-plated kovar
4 mils in thickness. Chips are mounted on a 4 mil thick nickel-gold-plated kovar slab which is separated from the base material by a 10 to 12 mil alumina insulator
Package weight is 0.09 grams
*Dimensions similar to JEDEC TO-89 except package width

# PHYSICAL DIMENSIONS

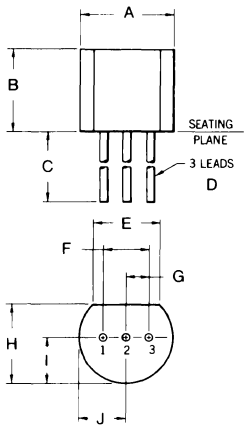
## TO92-1 in accordance with JEDEC (TO-92) outline




| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .175 | | .205 | 4.45 | | 5.20 |
| B | .170 | | .210 | 4.32 | | 5.33 |
| C | .500 | | | 12.70 | | |
| D | .016 | | .019 | 0.406 | | 0.483 |
| E | .135 | | | .343 | | |
| F | | .100 | | | 2.54 | |
| G | | .050 | | | 1.27 | |
| H | .125 | | .165 | 3.18 | | 4.19 |
| I | .080 | | .105 | 2.03 | | 2.67 |
| J | .080 | | .105 | 2.03 | | 2.67 |

NOTES: See table for dimensions in inches and millimeters
Leads are tin-plated copper
Package material is transfer molded thermosetting plastic
Package weight is 0.25 grams

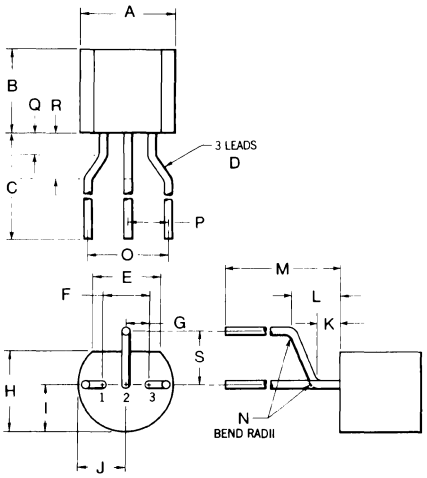
## TO92-2 in accordance with JEDEC (TO-92) outline




| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .175 | | .205 | 4.45 | | 5.20 |
| B | .170 | | .210 | 4.32 | | 5.33 |
| C | .500 | | | 12.70 | | |
| D | .016 | | .019 | 0.406 | | 0.483 |
| E | .135 | | | .343 | | |
| F | | .100 | | | 2.54 | |
| G | | .050 | | | 1.27 | |
| H | .125 | | .165 | 3.18 | | 4.19 |
| I | .080 | | .105 | 2.03 | | 2.67 |
| J | .080 | | .105 | 2.03 | | 2.67 |

NOTES: See table for dimensions in inches and millimeters
Leads are nickel-plated
Package material is transfer molded thermosetting plastic
Package weight is 0.25 grams

## TO92-5 in accordance with JEDEC (TO-92) outline

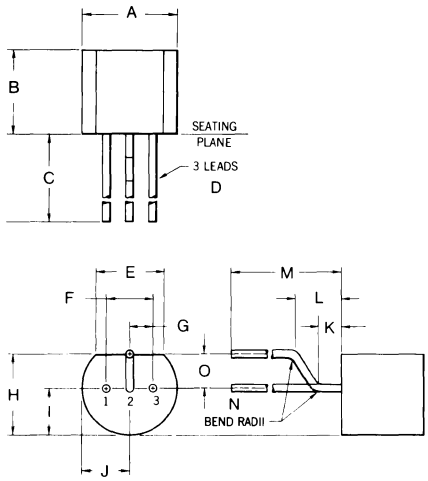



| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .175 | | .205 | 4.45 | | 5.20 |
| B | .170 | | .210 | 4.32 | | 5.33 |
| C | .500 | | | 12.70 | | |
| D | .016 | | .019 | 0.406 | | 0.483 |
| E | .135 | | | .343 | | |
| F | | .100 | | | 2.54 | |
| G | | .050 | | | 1.27 | |
| H | .125 | | .165 | 3.18 | | 3.19 |
| I | .080 | | .105 | 2.03 | | 2.67 |
| J | .080 | | .105 | 2.03 | | 2.67 |
| K | | .030 | | | .762 | |
| L | | .090 | | | 2.29 | |
| M | .200 | | .750 | 5.08 | | 19.1 |
| N | .010 | | | .254 | | |
| O | | .200 | | | 5.08 | |
| P | | .100 | | | 2.54 | |
| Q | | .030 | | | .762 | |
| R | | .040 | | | 2.29 | |
| S | | .100 | | | 2.54 | |

NOTES: See table for dimensions in inches and millimeters
Package material is transfer molded thermosetting plastic
Package weight is 0.25 grams

# PHYSICAL DIMENSIONS

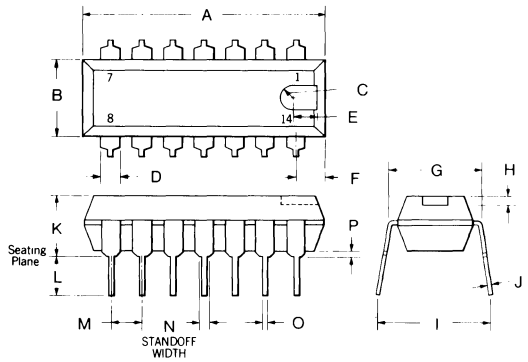
## TO92-18 in accordance with JEDEC (TO-92) outline




| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .175 | | .205 | 4.45 | | 5.20 |
| B | .170 | | .210 | 4.32 | | 5.33 |
| C | .500 | | | 12.70 | | |
| D | .016 | | .019 | 0.406 | | 0.483 |
| E | .135 | | | .343 | | |
| F | | .100 | | | 2.54 | |
| G | | .050 | | | 1.27 | |
| H | .125 | | .165 | 3.18 | | 4.19 |
| I | .080 | | .105 | 2.03 | | 2.67 |
| J | .080 | | .105 | 2.03 | | 2.67 |
| K | | .030 | | | .762 | |
| L | | .090 | | | 2.29 | |
| M | .200 | | .750 | 5.08 | | 19.1 |
| N | .010 | | | 2.54 | | |
| O | | .050 | | | 1.25 | |

NOTES: See table for dimensions in inches and millimeters
Package material is transfer molded thermosetting plastic
Package weight is 0.25 grams

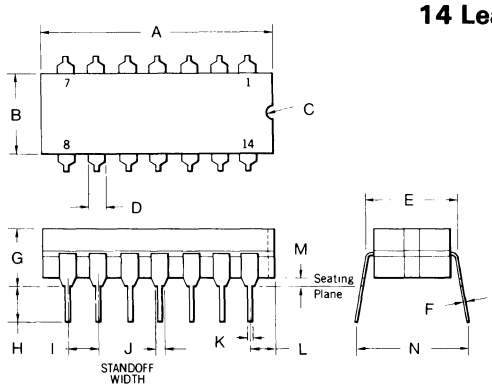
## TO-116-1 in accordance with JEDEC (TO-116) outline
## 14 Lead Silicone Dual In-line




| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .740 | | .760 | 18.96 | | 19.30 |
| B | .240 | | .260 | 6.10 | | 6.60 |
| C | .035 | | .045 | .889 | | .104 |
| D | .045 | | .065 | 1.04 | | 1.65 |
| E | .075 | | .085 | 1.91 | | 2.16 |
| F | .070 | | .080 | 1.78 | | 2.03 |
| G | .290 | | .310 | 7.37 | | 7.87 |
| H | .010 | | .020 | .254 | | .508 |
| I | | .375 | | | 9.52 | |
| J | .009 | | .011 | .229 | | .279 |
| K | | | .200 | | | 5.08 |
| L | .100 | | .150 | 2.54 | | 3.81 |
| M | .090 | .110 | | 2.29 | 2.79 | |
| N | .025 | | .037 | .686 | | .940 |
| O | .016 | | .020 | .406 | | .508 |
| P | | .015 | | | .381 | |

NOTES: See table for dimensions in inches and millimeters
Leads are intended for insertion in hole rows .300" centers
They are purposely shipped with a "positive" misalignment to facilitate insertion
Board drilling dimensions should equal your practice for a .030" diameter lead
Leads are tin-plated kovar
Package weight is 0.9 grams

## TO116-2 in accordance with JEDEC (TO-116) outline
## 14 Lead SSI Dual In-line

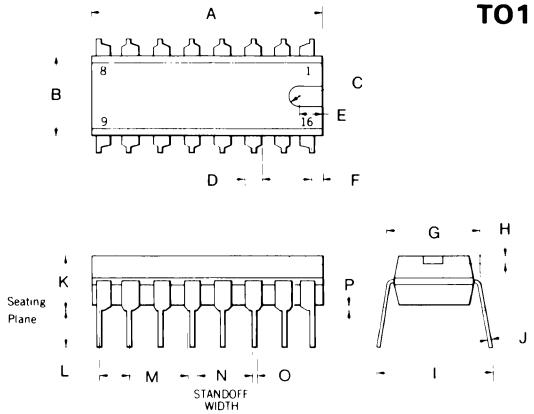



| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .750 | | .785 | 19.05 | | 19.94 |
| B | .245 | | .271 | 6.12 | | 6.88 |
| C | | .025 | | | .635 | |
| D | .045 | | .065 | 1.04 | | 1.65 |
| E | .290 | | .310 | 7.37 | | 7.87 |
| F | .009 | | .011 | .229 | | .279 |
| G | | | .200 | | | 5.08 |
| H | .100 | | .165 | 2.54 | | 4.19 |
| I | .090 | .110 | | 2.29 | 2.79 | |
| J | .027 | | .037 | .686 | | .940 |
| K | .016 | | .020 | .406 | | .508 |
| L | .065 | | .095 | 1.65 | | 2.41 |
| M | .015 | | | .381 | | |
| N | | .375 | | | 9.52 | |

NOTES: See table for dimensions in inches and millimeters
Leads are intended for insertion in hole rows on .300" centers
They are purposely shipped with "positive" misalignment to facilitate insertion
Board drilling dimensions should equal your practice for .020" diameter lead
Hermetically sealed alumina ceramic package
Leads are tin-plated kovar
Package weight is 2.0 grams

# PHYSICAL DIMENSIONS

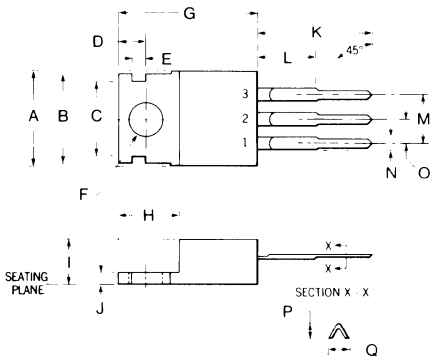
## TO116-3 16 Lead DIP




| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .740 | | .760 | 18.96 | | 19.30 |
| B | .240 | | .260 | 6.10 | | 6.60 |
| C | .035 | | .045 | .889 | | .104 |
| D | .045 | | .065 | 1.04 | | 1.65 |
| E | .075 | | .085 | 1.91 | | 2.16 |
| F | | .025 | | | .635 | |
| G | | .300 | | | 7.62 | |
| H | .010 | | .020 | .254 | | .508 |
| I | | .375 | | | 9.52 | |
| J | .009 | | .011 | .229 | | .279 |
| K | | | .200 | | | 5.08 |
| L | .100 | | .150 | 2.54 | | 3.81 |
| M | .090 | .110 | | 2.29 | 2.79 | |
| N | .025 | | .037 | .686 | | .940 |
| O | .016 | | .020 | .406 | | .508 |
| P | | .015 | | | .381 | |

NOTES: See table for dimensions in inches and millimeters
Leads are intended for insertion in hole rows on .300" centers
They are purposely shipped with "positive" misalignment to facilitate insertion
Board drilling dimensions should equal your practice for a .020" diameter lead
Leads are tin-plated kovar
Package weight is 0.9 grams
*The .037/.027 dimension does not apply to the corner leads

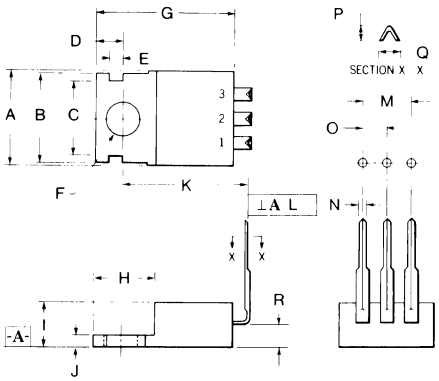
## TO220-00 in accordance with JEDEC (TO-220) outline *Plastic Power Package




| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .395 | | .410 | 10.03 | | 10.41 |
| B | .365 | | .385 | 9.27 | | 9.77 |
| C | .300 | | .320 | 7.62 | | 8.13 |
| D | .100 | | .120 | 2.54 | | 3.05 |
| E | .040 | | .060 | 1.02 | | 1.52 |
| F | .141 | | .145 | 3.58 | | 3.68 |
| G | .575 | | .600 | 14.6 | | 15.24 |
| H | .235 | | .265 | 5.97 | | 6.73 |
| I | .160 | | .190 | 4.06 | | 4.83 |
| J | .020 | | .055 | .508 | | 1.40 |
| K | .500 | | | 12.70 | | |
| L | | | .250 | | | 6.35 |
| M | .190 | | .210 | 4.83 | | 5.33 |
| N | .045 | | .055 | 1.05 | | 1.40 |
| O | .095 | | .105 | 2.41 | | 2.66 |
| P | .015 | | .030 | .381 | | .762 |
| Q | .020 | | .045 | .508 | | 1.43 |

NOTES: See table for dimensions in inches and millimeters
Center lead is electrical contact with the mounting tab
Package weight is silicone plastic with nickel-plated copper tab and leads
Package weight is 2.1 grams
*Mechanically interchangeable with TO66

## TO220-01 in accordance with JEDEC (TO-220) outline *Plastic Power Package

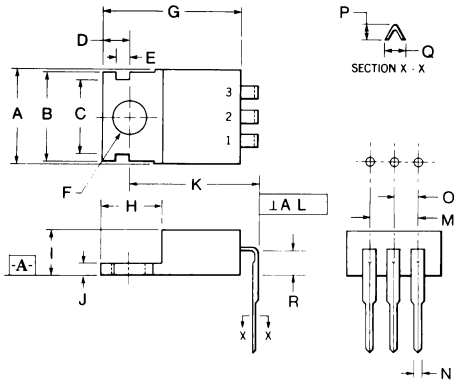



| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .395 | | .410 | 10.03 | | 10.41 |
| B | .365 | | .385 | 9.27 | | 9.77 |
| C | .300 | | .320 | 7.62 | | 8.13 |
| D | .100 | | .120 | 2.54 | | 3.05 |
| E | .040 | | .060 | 1.02 | | 1.52 |
| F | .141 | | .145 | 3.58 | | 3.68 |
| G | .575 | | .600 | 14.6 | | 15.24 |
| H | .235 | | .265 | 5.97 | | 6.73 |
| I | .160 | | .190 | 4.06 | | 4.83 |
| J | .020 | | .055 | .508 | | 1.40 |
| K | .580 | | .610 | 14.7 | | 15.5 |
| L | | .005 | | | .127 | |
| M | | .200 | | | 5.08 | |
| N | .045 | | .055 | 1.05 | | 1.40 |
| O,R | | .100 | | | 2.54 | |
| P | .015 | | .030 | .381 | | .762 |
| Q | .020 | | .045 | .508 | | 1.43 |

NOTES: See table for dimensions in inches and millimeters
Center lead is electrical contact with the mounting tab
Package weight is silicone plastic with nickel-plated copper tab and leads
Package weight is 2.1 grams
*Mechanically interchangeable with TO66

# PHYSICAL DIMENSIONS

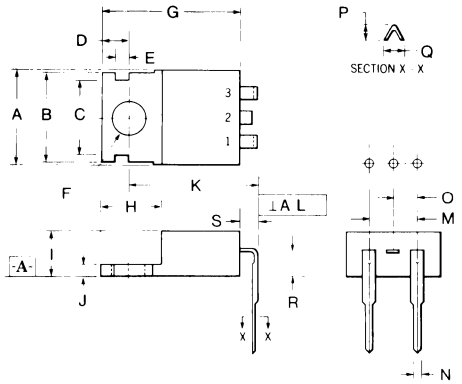
## TO220-02 in accordance with JEDEC (TO-220) outline
## *Plastic Power Package




| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .395 | | .410 | 10.03 | | 10.41 |
| B | .365 | | .385 | 9.27 | | 9.77 |
| C | .300 | | .320 | 7.62 | | 8.13 |
| D | .100 | | .120 | 2.54 | | 3.05 |
| E | .040 | | .060 | 1.02 | | 1.52 |
| F | .141 | | .145 | 3.58 | | 3.68 |
| G | .575 | | .600 | 14.6 | | 15.24 |
| H | .235 | | .265 | 5.97 | | 6.73 |
| I | .160 | | .190 | 4.06 | | 4.83 |
| J | .020 | | .055 | .508 | | 1.40 |
| K | .580 | | .610 | 14.7 | | 15.5 |
| L,R | | .005 | | | .127 | |
| M | | .200 | | | 5.08 | |
| N | .045 | | .055 | 1.05 | | 1.40 |
| O | | .100 | | | 2.54 | |
| P | .015 | | .030 | .381 | | .762 |
| Q | .020 | | .045 | .508 | | 1.43 |

NOTES: See table for dimensions in inches and millimeters
Center lead is electrical contact with the mounting tab
Package weight is silicone plastic with nickel-plated copper tab and leads
Package weight is 2.1 grams
*Mechanically interchangeable with TO66

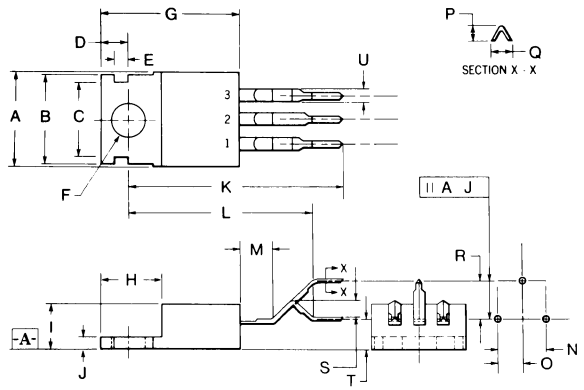
## TO220-03 in accordance with JEDEC (TO-220) outline
## *Plastic Power Package




| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .395 | | .410 | 10.03 | | 10.41 |
| B | .365 | | .385 | 9.27 | | 9.77 |
| C | .300 | | .320 | 7.62 | | 8.13 |
| D | .100 | | .120 | 2.54 | | 3.05 |
| E | .040 | | .060 | 1.02 | | 1.52 |
| F | .141 | | .145 | 3.58 | | 3.68 |
| G | .575 | | .600 | 14.6 | | 15.24 |
| H | .235 | | .265 | 5.97 | | 6.73 |
| I | .160 | | .190 | 4.06 | | 4.83 |
| J | .020 | | .055 | .508 | | 1.40 |
| K | .580 | | .610 | 14.7 | | 15.5 |
| L | | .005 | | | .127 | |
| M | | .200 | | | 5.08 | |
| N | .045 | | .055 | 1.05 | | 1.40 |
| O,R | | .100 | | | 2.54 | |
| P | .015 | | .030 | .381 | | .762 |
| Q | .020 | | .045 | .508 | | 1.43 |
| S | | .080 | | | 2.03 | |

NOTES: See table for dimensions in inches and millimeters
Center lead is electrical contact with the mounting tab
Package weight is silicone plastic with nickel-plated copper tab and leads
Package weight is 2.1 grams
*Mechanically interchangeable with TO66

## TO220-04 in accordance with JEDEC (TO-220) outline
## *Plastic Power Package

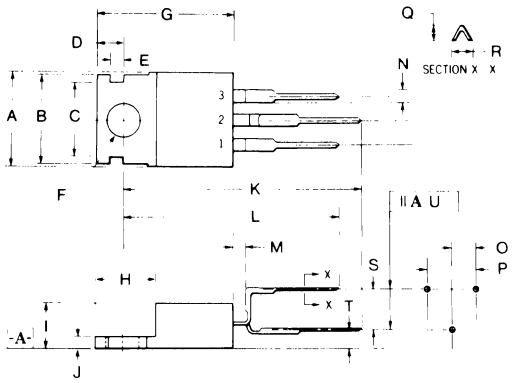



| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .395 | | .410 | 10.03 | | 10.41 |
| B | .365 | | .385 | 9.27 | | 9.77 |
| C | .300 | | .320 | 7.62 | | 8.13 |
| D | .100 | | .120 | 2.54 | | 3.05 |
| E | .040 | | .060 | 1.02 | | 1.52 |
| F | .141 | | .145 | 3.58 | | 3.68 |
| G | .575 | | .600 | 14.6 | | 15.24 |
| H | .235 | | .265 | 5.97 | | 6.73 |
| I | .160 | | .190 | 4.06 | | 4.83 |
| J | .020 | | .055 | .508 | | .140 |
| K | .910 | | | 23.11 | | |
| L | | | .800 | | | 20.32 |
| M | | .130 | | | 3.30 | |
| N | | .200 | | | 5.08 | |
| O,T | | .100 | | | 2.54 | |
| P | .015 | | .030 | .381 | | .762 |
| Q | .020 | | .045 | .508 | | 1.43 |
| R | | .150 | | | 3.81 | |
| S | .032 | | | .813 | | |
| U | .045 | | .055 | 1.05 | | 1.40 |

NOTES: See table for dimensions in inches and millimeters
Center lead is electrical contact with the mounting tab
Package weight is silicone plastic with nickel-plated copper tab and leads
Package weight is 2.1 grams
*Mechanically interchangeable with TO66

# PHYSICAL DIMENSIONS

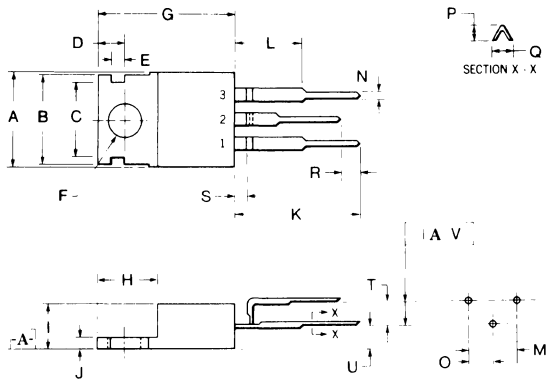
## TO220-05 in accordance with JEDEC (TO-220) outline
## *Plastic Power Package




| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .395 | | .410 | 10.03 | | 10.41 |
| B | .365 | | .385 | 9.27 | | 9.77 |
| C | .300 | | .320 | 7.62 | | 8.13 |
| D | .100 | | .120 | 2.54 | | 3.05 |
| E | .040 | | .060 | 1.02 | | 1.52 |
| F | .141 | | .145 | 3.58 | | 3.68 |
| G | .575 | | .600 | 14.6 | | 15.24 |
| H | .235 | | .265 | 5.97 | | 6.73 |
| I | .160 | | .190 | 4.06 | | 4.83 |
| J | .020 | | .055 | .508 | | .140 |
| K | | 1.013 | | | 25.73 | |
| L | | .915 | | | 23.24 | |
| M | | .113 | | | 2.87 | |
| N | .045 | | .055 | 1.05 | | 1.40 |
| O | | .100 | | | 2.54 | |
| P | | .200 | | | 5.08 | |
| Q | .015 | | .030 | .381 | | .762 |
| R | .020 | | .045 | .508 | | 1.43 |
| S | .190 | | .210 | 4.83 | | 5.33 |
| T | | .050 | | | 1.27 | |
| U | | .005 | | | .127 | |

NOTES: See table for dimensions in inches and millimeters
Center lead is electrical contact with the mounting tab
Package weight is silicone plastic with nickel-plated copper tab and leads
Package weight is 2.1 grams
*Mechanically interchangeable with TO66

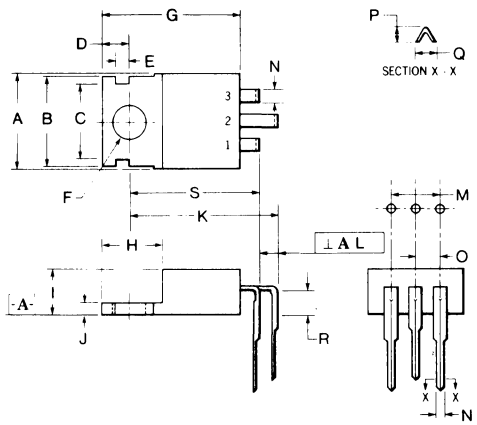
## TO220-06 in accordance with JEDEC (TO-220) outline
## *Plastic Power Package




| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .395 | | .410 | 10.03 | | 10.41 |
| B | .365 | | .385 | 9.27 | | 9.77 |
| C | .300 | | .320 | 7.62 | | 8.13 |
| D | .100 | | .120 | 2.54 | | 3.05 |
| E | .040 | | .060 | 1.02 | | 1.52 |
| F | .141 | | .145 | 3.58 | | 3.68 |
| G | .575 | | .600 | 14.6 | | 15.24 |
| H | .235 | | .265 | 5.97 | | 6.73 |
| I | .160 | | .190 | 4.06 | | 4.83 |
| J | .020 | | .055 | .508 | | 1.40 |
| K | .500 | | | 12.70 | | |
| L | | | .250 | | | 6.35 |
| M | | .200 | | | 5.08 | |
| N | .045 | | .055 | 1.05 | | 1.40 |
| O,T,U | | .100 | | | 2.54 | |
| P | .015 | | .030 | .381 | | .762 |
| Q | .020 | | .045 | .508 | | 1.43 |
| R | | | .051 | | | 1.30 |
| S | .1025 | | | 2.60 | | |
| V | | .005 | | | .127 | |

NOTES: See table for dimensions in inches and millimeters
Center lead is electrical contact with the mounting tab
Package weight is silicone plastic with nickel-plated copper tab and leads
Package weight is 2.1 grams
*Mechanically interchangeable with TO66

## TO220-07 in accordance with JEDEC (TO-220) outline
## *Plastic Power Package

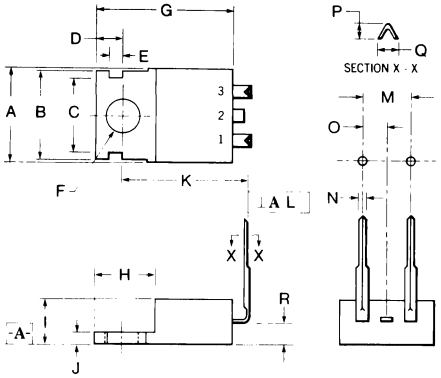



| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .395 | | .410 | 10.03 | | 10.41 |
| B | .365 | | .385 | 9.27 | | 9.77 |
| C | .300 | | .320 | 7.62 | | 8.13 |
| D | .100 | | .120 | 2.54 | | 3.05 |
| E | .040 | | .060 | 1.02 | | 1.52 |
| F | .141 | | .145 | 3.58 | | 3.68 |
| G | .575 | | .600 | 14.6 | | 15.24 |
| H | .235 | | .265 | 5.97 | | 6.73 |
| I | .160 | | .190 | 4.06 | | 4.83 |
| J | .020 | | .055 | .508 | | 1.40 |
| K | .620 | | .650 | 15.7 | | 16.5 |
| L | | .005 | | | .127 | |
| M | | .200 | | | 5.08 | |
| N | .045 | | .055 | 1.05 | | 1.40 |
| O,R | | .100 | | | 2.54 | |
| P | .015 | | .030 | .381 | | .762 |
| Q | .020 | | .045 | .508 | | 1.43 |
| S | .580 | | .610 | 14.7 | | 15.5 |

NOTES: See table for dimensions in inches and millimeters
Center lead is electrical contact with the mounting tab
Package weight is silicone plastic with nickel-plated copper tab and leads
Package weight is 2.1 grams
*Mechanically interchangeable with TO66

# PHYSICAL DIMENSIONS

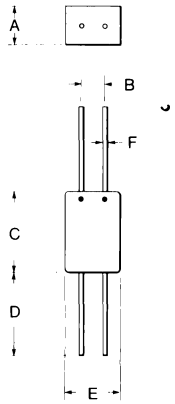
## TO220-08 in accordance with JEDEC (TO-220) outline
## *Plastic Power Package




| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .395 | | .410 | 10.03 | | 10.41 |
| B | .365 | | .385 | 9.27 | | 9.77 |
| C | .300 | | .320 | 7.62 | | 8.13 |
| D | .100 | | .120 | 2.54 | | 3.05 |
| E | .040 | | .060 | 1.02 | | 1.52 |
| F | .141 | | .145 | 3.58 | | 3.68 |
| G | .575 | | .600 | 14.6 | | 15.24 |
| H | .235 | | .265 | 5.97 | | 6.73 |
| I | .160 | | .190 | 4.06 | | 4.83 |
| J | .020 | | .055 | 508 | | .140 |
| K | .580 | | .610 | 14.7 | | 15.5 |
| L | | .005 | | | .127 | |
| M | | .200 | | | 5.08 | |
| N | .045 | | .055 | 1.05 | | 1.40 |
| O,R | | .100 | | | 2.54 | |
| P | .015 | | .030 | .381 | | .762 |
| Q | .020 | | .045 | .508 | | 1.43 |

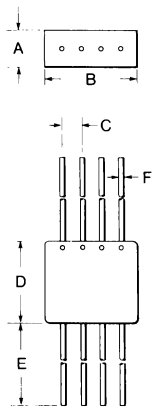
NOTES: See table for dimensions in inches and millimeters
Center lead is electrical contact with the mounting tab
Package weight is silicone plastic with nickel-plated copper tab and leads
Package weight is 2.1 grams
*Mechanically interchangeable with TO66

## TO308-1




| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .162 | | .182 | 4.11 | | 4.62 |
| B | .104 | | .112 | 2.64 | | 2.84 |
| C | .435 | | .455 | 10.05 | | 10.56 |
| D | 1.00 | | | 25.40 | | |
| E | .280 | | .300 | 7.11 | | 7.62 |
| F | .019 | | .021 | .483 | | .533 |

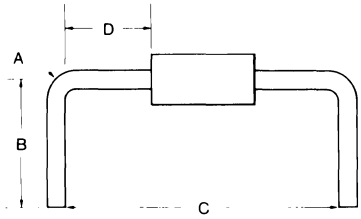
## TO310-1




| DIM. | INCHES MIN. | INCHES TYP. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS TYP. | MILLIMETERS MAX. |
|---|---|---|---|---|---|---|
| A | .162 | | .182 | 4.11 | | 4.62 |
| B | .480 | | .500 | 10.12 | | 12.70 |
| C | .104 | | .112 | 2.64 | | 2.84 |
| D | .435 | | .455 | 10.05 | | 10.56 |
| E | 1.0 | | | 25.40 | | |
| F | .019 | | .021 | .483 | | .533 |

# PACKAGING

## TYPICAL FORMED DIODE




| | DO34-1 | | | | DO35-1/DO41-1 | | | | DO7-1/DO7-2 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | INCHES | | MILLIMETERS | | INCHES | | MILLIMETERS | | INCHES | | MILLIMETERS | |
| DIM. | MIN. | MAX. | MIN. | MAX | MIN. | MAX. | MIN. | MAX. | MIN. | MAX. | MIN. | MAX. |
| A | .040 | | .916 | | .040 | | .916 | | .040 | | .916 | |
| B* | .187 | | 4.75 | | .500 | | 12.70 | | .750 | | 19.05 | |
| C** | .220 | | 5.59 | | .275 | | 6.99 | | .395 | | 10.03 | |
| Tolerance "C" | +.030 -.015 | | +.762 -.381 | | +.040 -.020 | | +.916 -.508 | | +.060 -.030 | | +1.52 -.762 | |
| D*** | | .060 | | 1.52 | | .060 | | 1.52 | | .060 | | 1.52 |

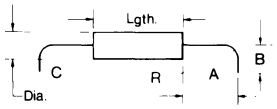
*Tolerance + .020/ + .508
**Tolerance of C depends on length of "B" dimension
***Tolerance + .015/ + .381

## POSSIBLE FORMED DIODES

### SERIES "200"

All Dimensions are I.D.

**STYLE C BEND**



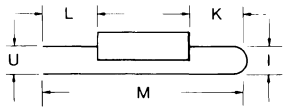

| | INCHES | | | | | |
|---|---|---|---|---|---|---|
| | A | A1 | B | R | Dia. | Lgth. |
| Min. | .090 | .050 | .187 | .040 | .090 | .218 |
| Max. | Adj. | Adj. | Adj. | | 1.00 | 2.00 |

| | MILLIMETERS | | | | | |
|---|---|---|---|---|---|---|
| | A | A1 | B | R | Dia. | Lgth. |
| Min. | 2.28 | 1.27 | 4.79 | .916 | 2.28 | 5.54 |
| Max. | Adj. | Adj. | Adj. | | 25.40 | 50.80 |

.125-A-Min. on all components with over 5/16 body diameter.

3.18-A-Min. on all components with over 7.94 body diameter.

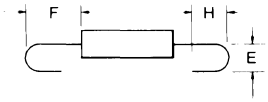
**STYLE V BEND**




| | INCHES | | | | |
|---|---|---|---|---|---|
| | I | K | L | M | U |
| Min. | .062 | .135 | .187 | 1¼xI | .062 |
| Max. | .125 | Adj. | Adj. | Adj. | Adj. |

| | MILLIMETERS | | | | |
|---|---|---|---|---|---|
| | I | K | L | M | U |
| Min. | 1.57 | 3.42 | 4.79 | 31.75xI | 1.57 |
| Max. | 3.18 | Adj. | Adj. | Adj. | Adj. |

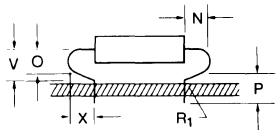
**STYLE J BEND**




| | INCHES | | | |
|---|---|---|---|---|
| | E | F | H | C |
| Min. | .062 | .135 | 1¼xE | Adjustable |
| Max. | .125 | Adj. | Adj. | to 180° |

| | MILLIMETERS | | | |
|---|---|---|---|---|
| | E | F | H | C |
| Min. | 1.57 | 3.42 | 31.75xE | Adjustable |
| Max. | 3.18 | Adj. | Adj. | to 180° |

**STYLE A BEND**

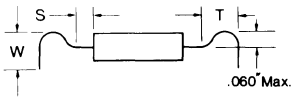



| | INCHES | | | | |
|---|---|---|---|---|---|
| | N | P | P | X | $R_1$ |
| Min. | .125 | .125 | .125 | Adj. | .125 |
| Max. | Adj. | Adj. | .350 | | |

| | MILLIMETERS | | | | |
|---|---|---|---|---|---|
| | N | P | P | X | $R_1$ |
| Min. | 3.18 | 3.18 | 3.18 | Adj. | 3.18 |
| Max. | Adj. | Adj. | 8.89 | | |

Optional Anvils : Anvils made to your specifications. Examples shown below.

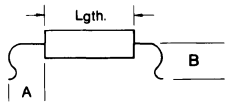
**STYLE D BEND**




| | INCHES | | |
|---|---|---|---|
| | S | S+T | W |
| Min. | .125 | .210 | .187 |
| Max. | Adj. | Adj. | Adj. |

| | MILLIMETERS | | |
|---|---|---|---|
| | S | S+T | W |
| Min. | 3.18 | 5.33 | 4.79 |
| Max. | Adj. | Adj. | Adj. |

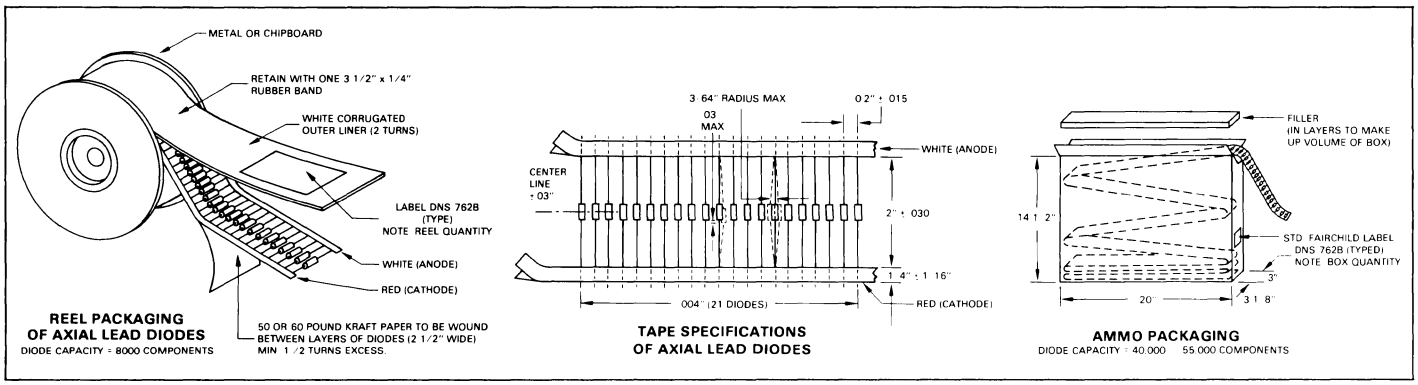
**SNAP-IN**




The "snap-in" configuration can be formed on axial leads up to .030-inch in diameter.

The "snap-in" configuration can be formed on axial leads up to .762-inch in diameter.

# PACKAGING




# ORDER INFORMATION

## DIODES

**Ordering Information:**
Diodes may be purchased only in increments of minimum quantities.

**Military Approved Devices:**
All Fairchild devices, which indicate military approval, are qualified to the current revisions of Military Specification 19500.

**Mixing Privileges:**
There is no Diode mixing privilege for price advantage.

## TRANSISTORS

**Ordering Information:**
Devices may be purchased only in increments of minimum quantities.

**Military Approved Devices:**
All Fairchild devices, which indicate military approval, are approved to the current revisions of Military Specification 19500.

**Transistor Dice:**
Transistor dice are packaged in cavity packs of 25 and 100 units. All orders must be in multiples of 25. Special packaging is available on request.

**Lead Forming on TO92 Plastic Transistors:**
Lead forming to TO5 or TO18 outline dimensions is available on all standard small signal plastic TO92 transistors for a price adder of $.01 per unit. To order lead formed devices, simply add a dash five (-5) or dash eighteen (-18) to the standard device type number. For example, a 2N3906-18 would be a 2N3906 with the leads formed to the TO18 outline.

**Diode Family Designations:**
FD.4,5, 6 & 7 = Switching Diode Families
FD 3 = Low Leakage Diode
HCD = Hot Carrier Diode
MONO = Monolithic Array
R = Reference Diode
RF = Radio Frequency Band Switching Diode
VVC = Voltage Variable Capacitor
Z = Zener Diode

**Transistor Abbreviations:**
DIE = Unencapsulated transistor (chip)
DARL = Darlington
DU = Dual Transistor
CD = Core Driver
NJF = N-Channel Junction Field Effect Transistor
PJF = P-Channel Junction Field Effect Transistor
GPA = General Purpose Amplifier
MET = Metal
PLA = Plastic
PWR = Power
R&I = RF & IF Amplifier
SW = Switch

# DISCRETE PRODUCTS

## CONTENTS AND SECTION SELECTOR

# INTRODUCTION

## FAIRCHILD TO92 THERMAL CONSIDERATIONS

Included is a short description of the thermal characteristics of the TO92 package. A complete App Note will soon be available.

The Fairchild TO92 plastic package has a very high thermal dissipation capability due to the low thermal resistance lead material and lead-frame design. While thermal resistance is normally specified for the device mounted 1.0 cm above an infinite heat sink, options are available to improve on the conservatively rated thermal capability.

First, it is necessary to explain the thermal paths and relative magnitudes of the fixed and variable resistances of the TO92 plastic package. Secondly, a simple thermal model of the package-chip combination serves as an example in presenting two independent ways of achieving maximum thermal dissipation. The designer will then have a tool to determine the thermal stress he may apply to Fairchild TO92 devices in his circuit and no longer have to rely on rules of thumb or rough assumptions.

## THERMAL RESISTANCES

When a transistor die is attached directly to the base of a metal package, the thermal equivalent circuit is often represented simply as a series connection of the junction to case thermal resistance $\theta_{JC}$ and the case to ambient thermal resistance $\theta_{CA}$.

The electrical analog is completed by a current source equivalent to the thermal energy source and referring to the existing temperatures as equivalent to a voltage in the analog. This is illustrated in *Figure 1.*

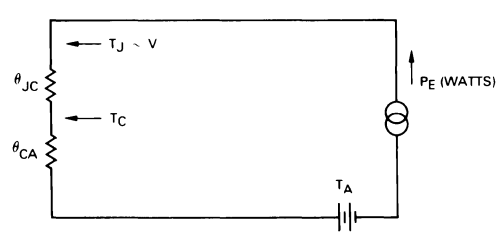



**Fig. 1. Thermal Equivalent Circuit (Die Attached to Metal Package Base)**

Power dissipations are then determined by inserting the manufacturer's data into the thermal equation:

$$T_J - T_A = \theta \cdot Pwr = (\theta_{JC} + \theta_{CA})\ Pwr$$

The thermal equivalent circuit of a TO92 package is somewhat more complex. In addition to the thermal path through the molding compound to the ambient air, there is a parallel path through the collector lead. The thermal equivalent circuit for a TO92 package is approximated in *Figure 2.*

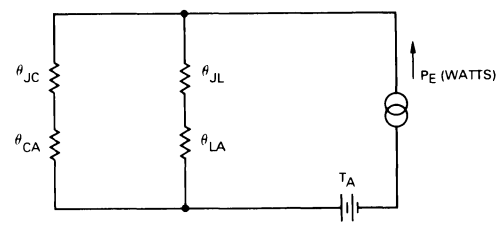



**Fig. 2. TO92 Thermal Equivalent Circuit**

Here, the lead cooling path is shown as parallel to the cooling path through the molding compound. In this configuration, two segments of the lead cooling path are identified. The first, $\theta_{JL}$, is the thermal resistance between the junction and a point on the collector lead $\simeq$ 0.06" below the body of the transistor. The second resistance, $\theta_{LA}$, is the thermal resistance from this point to a point on the collector lead 0.4" (1.0 cm) below the body of the transistor. Note that this circuit approach implies that the collector lead is attached 0.4" from the body to an infinite heat sink held at ambient temperature.

When the transistor is inserted into a socket or a circuit board which is not at ambient temperature, another resistance must be added to the collector lead resistance string. This is shown in *Figure 3* where $\theta_{SA}$ is the thermal resistance of the socket and $\theta_{LS}$ is the thermal resistance of the lead between package and socket.

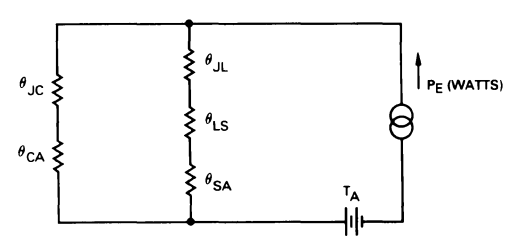



**Fig. 3. TO92 Thermal Equivalent Circuit (Other than Ambient Temperature)**

The basic heat flow control problem now is indeterminate unless the relative values of the thermal resistances are known.

Since $\theta_{JC}$ and $\theta_{JL}$ are internal to the device, and neither can be affected by the circuit designer or production engineer, the variability of $\theta_{CA}$, $\theta_{LS}$, and $\theta_{SA}$ must be examined. Fortunately, in the Fairchild TO92 package, all but the low power, small chips have relatively small $\theta_{JC}$s and $\theta_{JL}$s. To illustrate the point, *Figure 4* shows an experimental device with typical values of thermal resistances and $\theta_{LA} = \theta_{LS} + \theta_{SA}$.

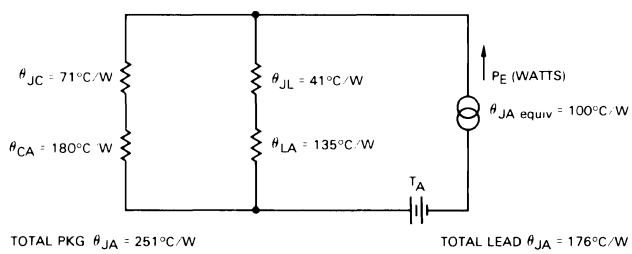



**Fig. 4. Thermal Equivalent Circuit, Experimental Device**

The two most significant thermal resistances, $\theta_{CA}$ and $\theta_{LA}$, are outside the package and controllable by the user. For instance, $\theta_{CA}$ can be changed from 180°C/W to as low as 45°C/W by using a commercial heat sink for an inserted cost of 1.5 to 3.0 cents. Similarly, by pushing the transistor extremely close to the circuit board, $\theta_{LA}$ can be reduced in direct proportion to the change in lead length. An alternative technique for lowering the junction temperature is to insert the leads into a hollow rivet in the P.C. board. The increased metal mass aids in the heat transfer and effectively lowers $\theta_{SA}$.

The use of a socket in high dissipation applications can work against the designer since the thermal resistance of the socket is not specified or known by the manufacturer. One socket type was measured as high as 270°C/W in the Fairchild laboratories.

Once the above information is known, what can a designer do, since most data sheets assume a "normal" application with 0.4" of collector lead length? While requiring either the transistor to be no more than 0.2" off the circuit board or putting a commercial heat sink on the package will decrease the die temperature for a fixed power level, the actual gain in dissipation capability is unknown, since the amount of heat loss through the collector lead is not known. Following is a discussion of a practical technique for evaluating designs and readily determining the amount of heat sinking required for each socket. The optimum approach would require the designer to know the thermal equivalent circuit of each device being evaluated. These values would be unique to each vendor's part and therefore the alternate suppliers' devices should also be evaluated in the application—a minor inconvenience relative to the design confidence achieved.

## THE GENERAL MODEL

For general purposes, a model for all Fairchild devices covering the typical case requiring a high dissipation was selected. It becomes a more conservative model as chip size increases. *Figure 5* illustrates the relative values for the case and lead cooling paths.

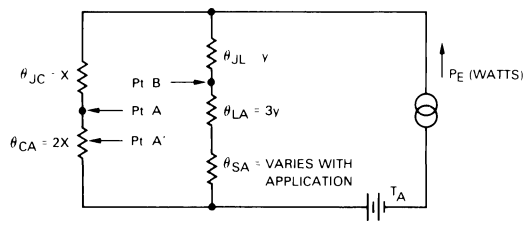



**Fig. 5. Thermal Equivalent Circuit, General Model**

The technique requires a measurement of the case temperature at Pt. A without a case heat sink. This is assumed to be 67% of the junction temperature. Lead cooling methods, such as increasing the area of P.C. board copper in the collector circuit, or reducing the distance between the P.C. board and the transistor can be used to achieve the lowest possible case temperature. Next, the collector lead temperature is measured at a point approximately 0.06" below the case — Pt. B in *Figure 5*. $\theta_{CA}$ is then varied by using heat sinks such as the Staver F1-7 or F5 series. The percent change in temperature at Pt. B is equal to the percent change of the junction temperature. Thus, the operating junction temperature can be determined in all practical applications and the effectiveness of all proposed heat sinking methods evaluated. Life test thermal stresses can also be evaluated by reading the case temperature. The effect of the socket thermal impedances can also be determined. Obviously, as $\theta_{SA}$ goes from the zero implied in the ratings to a very high value, the effective total thermal resistance will approach the significantly higher value of $\theta_{JC} + \theta_{CA}$ only. Case temperature measurements can be made with a thermocouple, using 30 guage or finer wire, attached to a 93 mil diameter copper disc secured to the top surface of the package. Securing the

copper disc to the top of the package effectively moves the monitor point from Pt. A to Pt. $A^1$ in *Figure 5.* The advantage of this consistent and convenient measuring point requires the establishment of a ratio of $T_J$ to $T_C$ based upon this point.

## EXAMPLE

Using the above technique, the following steps are taken to evaluate a Fairchild MPS6562 in an 800 mW application.

1. *Compute maximum allowable case temperature.* The case temperature increase above ambient is 50% of the temperature *gradient* in the model. Using 150°C maximum junction temperature as given on the Fairchild data sheet, the maximum allowable case temperature at Pt. A is 0.5 (150°C – 25°C) = 6.25°C ( Delta above base temperature. )

   $\therefore T_C$ allowable = 62.5°C + 25°C = 87.5°C.

2. *Measure the actual case temperature and calculate the junction temperature.* The measured case temperature is proportional to the junction to ambient temperature differential. The proportionality factor is 0.5 in the general case. The measured case temperature in this example was 105°C. The junction temperature is then calculated by the following equation:

$$T_C = 0.5\,(T_J - T_A) + T_A$$
$$105°C = 0.5\,(T_J - 25°C) + 25°C$$
$$T_J = \frac{92.5}{0.5}$$
$$T_J = 185°C$$

With a junction temperature 35°C above the maximum rating of the Fairchild MPS6562, the designer is faced with the problem of reducing the junction temperature by improved heat dissipation.

With the Fairchild TO92 product line's superior thermal dissipation capabilities, the power dissipation can be greater then the registered 500 mW without exceeding the 150°C maximum junction temperature rating. This is good engineering practice since device reliability is a function of junction temperature, and junction temperature is limited by the physical properties of the package for encapsulated transistors. The maximum power rating reflects, then, the thermal resistance of the package and the limitations of the molding compounds and die attach methods. Phenolics deteriorate before silicones, and solder die attach degrades at much lower temperatures than gold-silicon eutectic.

3. *Reduce the junction temperature.*
   a) Vary the collector lead length.
   The first and simplest approach is to insert the device farther into the P.C. board and repeat the measurement in Step 2. The output load is a heat sink and should be attached during these measurements. Since the external resistance is relatively high, the transistor will be sensitive to production *variation* of the collector lead as inserted into the P.C. board. If the production tolerances do not permit sufficiently short collector lead and, therefore, low junction temperature to be obtained, proceed to Step b.

   b) Add an external heat sink.
   Since at least a 35°C drop in the collector junction temperature is required, an external heat sink must be added and its effect evaluated. The temperature at Pt. B is proportional to the junction temperature *(Figure 5);* therefore, an X% change in junction temperature will produce an X% change in Pt. B temperature. The equation is

$$\frac{(T_{B1} - 25) - (T_{B2} - 25)}{T_{B1} - 25} = \frac{(T_{J1} - 25) - (T_{J2} - 25)}{T_{J1} - 25}$$

Various heat sinks were slipped over the case of the transistor to measure the effect of each on junction temperature. The Staver F1-7 gave the best results with a $T_J$ of 132°C. This heat sink has a thermal resistance of 72°C/W replacing the original 180°C/W of the package. Thus, new thermal resistance $\theta_{CA}$ is 72°C/W, 40% of the effective case to ambient thermal resistance.

The exact change in junction temperature is calculated by reading the lead temperature at Pt. B before and after applying the heat sink and performing the indicated math. The measured values of $T_{B1}$ and $T_{B2}$ are 158°C and 114°C respectively.

$$\text{Percent change} = \frac{(T_{B1} - 25) - (T_{B2} - 25)}{T_{B1} - 25} \times 100 = \frac{(T_{J1} - 25) - (T_{J2} - 25)}{T_{J1} - 25} \times 100\,;$$

$$\frac{133 - 89}{133} = \frac{160 - (T_{J2} - 25)}{160}$$

$$-T_{J2} = (0.331 \times 160) - 185$$
$$-T_{J2} = 53 - 185$$
$$T_{J2} = 132°C$$

This example shows how easy it is to change the collector junction temperature and to evaluate the amount of change. With this method, the optimum price/performance trade off can be determined for every socket design in a matter of a few hours. The heat sink in the illustration has a $\theta_{SA}$ of 72°C/W, is inexpensive and yet permits a 53°C drop in the junction temperature. The designer could obviously get a greater *drop* in $T_J$ with a heat sink rated at 45°C/W. He is, in either case, faced with the pleasant choice of designing for higher power output or being content with the higher reliability of his design due to the lower junction temperature.

A thorough analysis of the above example shows that the circuit board contributes at least 350°C/W to the lead cooling path. While this is not significant in illustrating the technique, it is important to realize that this parasitic thermal resistance can range from 50° to 350°C/W and is controllable by the design engineer. Through these techniques, the designer can, for instance, achieve significantly higher power dissipation in the device without exceeding the maximum ratings.

# DISCRETE PRODUCTS

CONTENTS AND SECTION SELECTOR

# INTRODUCTION

## DICE SECTION

All information necessary when ordering dice is contained in this section. Included are the available device types, short form information, geometry layouts, packaging methods and a IN/2N versus dice cross reference chart.

## PURPOSE

This document covers the general requirements for the procurement of unencapsulated silicon small signal transistors and diodes.

## GENERAL INFORMATION:

The small signal transistor and diode chips described in this document have the following characteristics:

- All are of silicon planar construction
- Topside metalization is aluminum approximately 1 micron thick - excellent for all wire bonding techniques
- Backside metalization is gold approximately 8,000 angstroms - offers ease of die bonding with good thermal characteristics
- Die thickness is 3.5 mils ± .5 mils

## VISUAL INSPECTION:

Fairchild transistor and diode dice go through extensive visual inspection during die processing (see flow chart). Die are visualed at 40X to 100X magnification using Fairchild's standard visual inspection criteria and Mil-Standard 883 Method 2010 depending on the packaging method. Copies of the visual inspection documents are available upon request.

## OPTIONS:

All transistor and diode dice can be procured in any one of the three following forms

1. CAVITY PACK - wafers are 100% tested, reject dice are inked and removed. Good dice are cleaned, visualed, and shipped in individual cavities (see Figure 1)
2. VIAL PACK - wafers are tested, dice are cleaned, visualed, and poured into a FREON* filled vial (see Figure 2)
3. WAFER PACK - wafer is tested, reject dice are inked, wafer is scribed and fractured. Entire wafer is shipped in wafer form (see Figure 3)

## STANDARD DICE SPECIFICATIONS:

Twenty four popular JEDEC device types were selected to cover hybrid microcircuit applications. The Transistors bear a "DN" nomenclature and diodes bear a "FDC" nomenclature. The dice are identical to those used in the corresponding Fairchild assembled device.

The summary charts will give you a brief description from which to select the device type suited for your application. The parameters and limits shown are 25°C low level dc parameters identical to those on the corresponding JEDEC 1N and 2N specification. For more detailed characteristic data, please refer to the corresponding Fairchild data sheet.

## PARAMETER GUARANTEES:

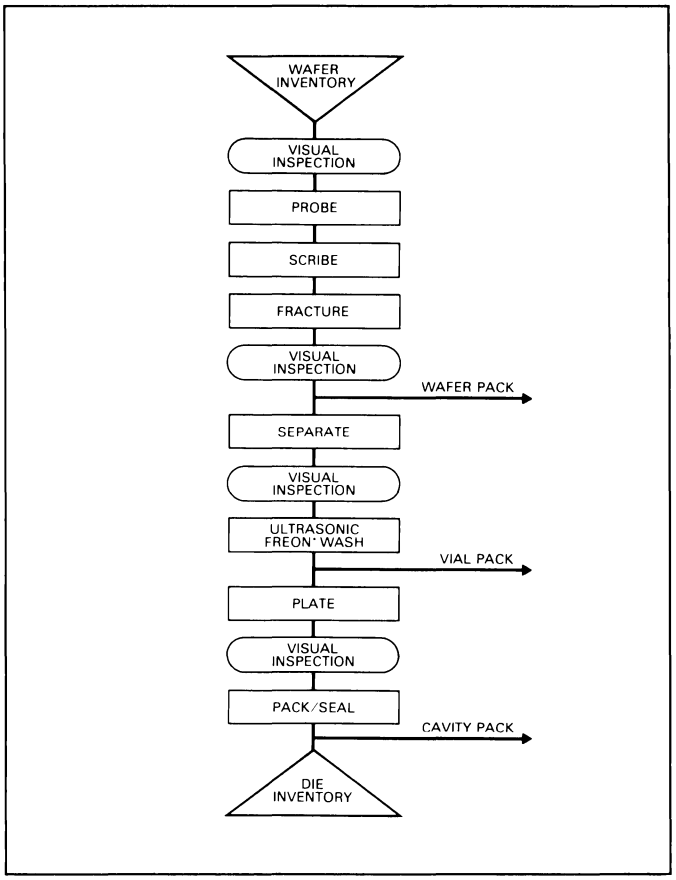
Probing in die form limits testing to 25°C low level dc parameters only. The dc parameters shown in the charts are identical to those of the corresponding JEDEC type and are guaranteed to an LTPD of 10%.

The ac parameters which are similar to those in the standard Fairchild data sheets, have been correlated to selected dc probe parameters and are guaranteed to an LTPD of 20%.

## STANDARD DICE PROCESSING:

The small signal transistor and diode dice listed are produced on the same well-proven production lines that produce Fairchild's standard encapsulated devices.

The following flow chart will show the additional steps that are done once a wafer is selected for processing in die form:




## ORDERING INFORMATION:

When ordering, be sure to call out the DN and/or FDC number —not the 2N and/or 1N number. Just specify the device type, quantity and the packaging method preferred.

## HANDLING PRECAUTIONS:

Extreme care must be used in handling unencapsulated semiconductors to avoid damage to the chip surface. The following precautions apply:

1. WAFER PACK - Wafers should only be handled near the edge with round ended stainless steel or teflon tweezers.
2. VIAL PACK - Dice and FREON* should be poured out onto filter paper. Dice should be handled with a smooth tipped vacuum wand only. Do not use tweezers.
3. CAVITY PACK - Lid and anti-static mylar should be removed slowly and with extreme care to avoid disturbing the position of the dice. Dice should be handled with a smooth tipped vacuum wand only. Do not use tweezers.

In addition, devices should be stored in an environment of not more than 30% relative humidity. Die and wire bonding should not exceed 400°C in an inert atmosphere or 100°C in a non-inert atmosphere.

*DuPont's registered trademark for its fluorocarbon solvent

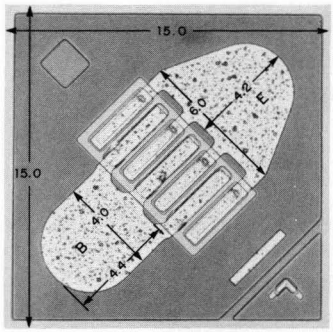
## TRANSISTOR DICE SELECTION GUIDE (BY ASCENDING $V_{CEO}$)

| Device Type | Polarity | Geometry | $V_{CEO}$ (MIN) @$I_C$ | $BV_{CBO}$ (MIN) @$I_C$ | $BV_{EBO}$ (MIN) @$I_E$ | $I_{CBO}$ (MAX) @$V_{CB}$ | $h_{FE}$ (MIN) @$I_C$, $V_{CE}$ | $h_{FE}$ (MIN-MAX) @$I_C$, $V_{CE}$ | $h_{FE}$ (MIN-MAX) @$I_C$, $V_{CE}$ | APPLICATION |
|---|---|---|---|---|---|---|---|---|---|---|
| DN2369A | NPN | 1312 | 15V 10mA | 40V 10μA | 4.5V 10μA | 400nA 20V | | 40-120 10mA, 1V | 20-100mA, 1V | HIGH SPEED SAT SWITCH |
| DN4209 | PNP | 1902 | 15V 3mA | 15V 100μA | 4.5V 100μA | 20nA 8V | 35 1mA, 1V | | | |
| DN3014 | NPN | 0062 | 20V 10mA | 40V 100μA | 5V 100μA | 300nA 20V | 25 10mA, 1V | 30-120 30mA, 1V | 25-100mA, 1V | HIGH SPEED SAT SWITCH |
| DN5455 | PNP | 0204 | 20V 10mA | 20V 100μA | 4.5V 100μA | 50nA 15V | 20 10mA, 1V | 30-120 30mA, 1V | 30-100mA, 1V | |
| DN918 | PNPN | 1211 | 15V 3mA | 30V 1μA | 3V 10μA | 20nA 15V | 20 3mA, 1V | | | RF AMPLIFIER |
| DN3250 | PNP | 0215 | 40V 10mA | 50V 10μA | 5V 10μA | 20nA 40V | | 50-300 10mA, 1V | | |
| DN3904 | NPN | 0144 | 40V 1mA | 60V 10μA | 6V 10μA | 50nA 30V | 40 0.1mA, 1V | 100-300 10mA, 1V | 30-100mA, 1V | GENERAL PURPOSE AMPLIFIER |
| DN3906 | PNP | 0215 | 40V 1mA | 40V 10μA | 5V 10μA | 50nA 30V | 60 0.1mA, 1V | 100-300 10mA, 1V | 30-100mA, 1V | |
| DN2222A | NPN | 0145 | 40V 10mA | 75V 10μA | 6V 10μA | 20nA 60V | 35 0.1mA, 10V | 75 10mA, 10V | 100-300 100mA, 10V | GENERAL PURPOSE AMPLIFIER AND SWITCH |
| DN2907 | PNP | 0212 | 40V 10mA | 60V 10μA | 5V 10μA | 20nA 50V | 35 0.1mA, 10V | 75 10mA, 10V | 100-300 100mA, 10V | |
| DN3725 | NPN | 0139 | 50V 10mA | 80V 10μA | 6V 10μA | 1700nA 60V | 30 10mA, 1V | 60-150 100mA, 1V | | HI CURRENT CORE DRIVER |
| DN3468 | PNP | 0064 | 50V 10mA | 50V 10μA | 5V 10μA | 100nA 30V | 25 100mA, 1V | | | |
| DN2484 | NPN | 0107 | 60V 10mA | 60V 10μA | 6V 10μA | 20nA 45V | 175 0.1mA, 5V | 250-1mA, 5V | -800 10mA, 5V | LOW LEVEL LOW NOISE HIGH GAIN AMPLIFIER |
| DN3962 | PNP | 2019 | 60V 5mA | 60V 10μA | 6V 10μA | 20nA 50V | 100 0.1mA, 5V | 100-450 1mA, 5V | | |
| DN3019 | NPN | 0149 | 80V 10mA | 140V 100μA | 7V 100μA | 20nA 90V | 50 0.1mA, 5V | 100-300 100mA, 5V | | GENERAL PURPOSE AMPLIFIER AND SWITCH |
| DN4033 | PNP | 0224 | 80V 10mA | 80V 10μA | 5V 10μA | 50nA 60V | 75 0.1mA, 5V | 100-300 100mA, 5V | | |
| DN3923 | NPN | 0147 | 150V 10mA | 150V 100μA | 6V 100μA | 20nA 100V | 15 0.1mA, 10V | 30-120 25mA, 10V | | HI VOLT AMPLIFIER AND SWITCH |
| DN3930 | PNP | 0232 | 180V 2mA | 180V 10μA | 6V 10μA | 20nA 100V | | 80-300 10mA, 10V | | |

## DIODE DICE SELECTION GUIDE (BY ASCENDING $B_V$)

| Device | Geometry | $B_V$ (MIN) @$I_R$ | $I_R$ (MIN) @$V_R$ | $V_F$ (MIN-MAX) @$I_F$ | $V_F$ (MAX) @$I_F$ | $T_{RR}$ (TYP) @$I_F$=$I_R$ | $C_O$ (TYP) @$V_R$ | APPLICATION |
|---|---|---|---|---|---|---|---|---|
| FDC4376 | 1700 | 20V 5μA | 100nA 10V | .77-.88V 10mA | 1.1V 50mA | 0.8ns 10mA | 1.2pF 0 | ULTRA HIGH SPEED SWITCHING DIODE |
| FDC3600 | 1600 | 75V 5μA | 100nA 50V | .66-.74V 10mA | 1.0V 100mA | 4ns 10mA | 2.5pF 0 | GENERAL PURPOSE SWITCHING DIODE |
| FDC485B | 1500 | 200V 100μA | 25nA 175V | .66-.80V 10mA | 1.0V 100mA | 500ns 10mA | 5.0pF 0 | HIGH VOLTAGE LOW LEAKAGE DIODE |
| FDC3070 | 1400 | 200V 100μA | 100nA 175V | .66-.74V 10mA | 1.0V 100mA | 50ns 10mA | 2.5pF 0 | HIGH VOLTAGE GENERAL PURPOSE SWITCHING DIODE |

## GEOMETRY LAYOUTS

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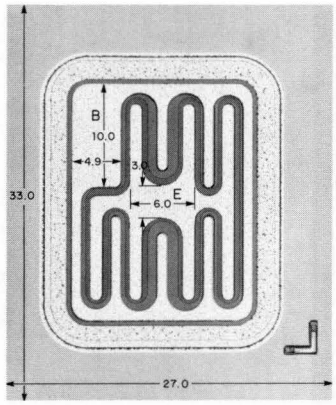


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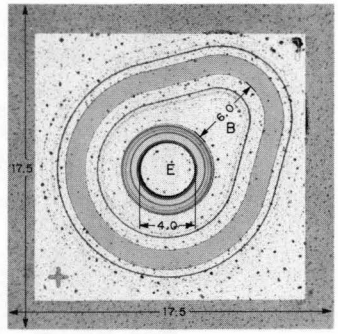


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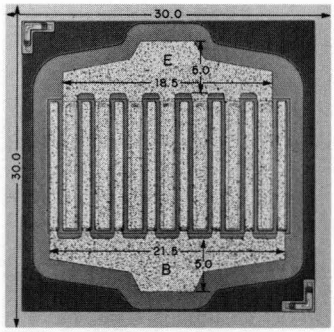


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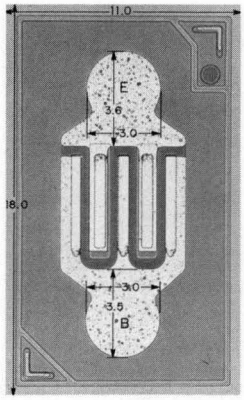


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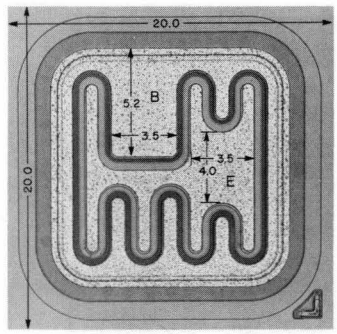


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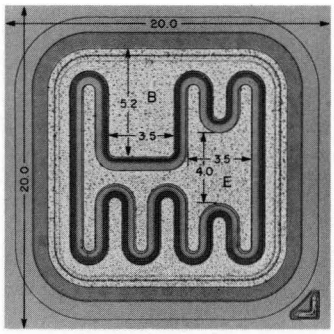


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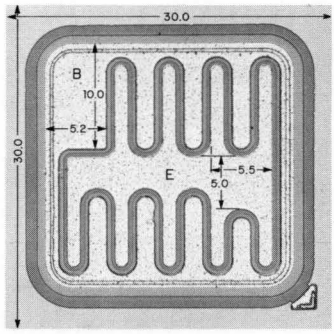


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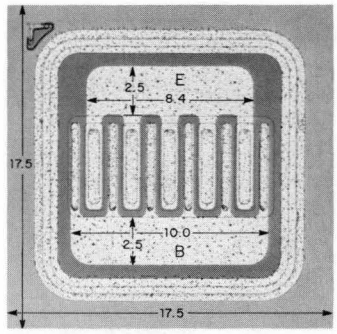


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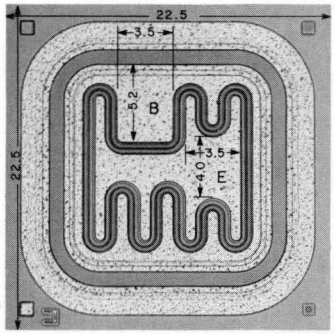


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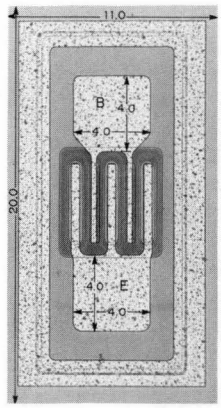
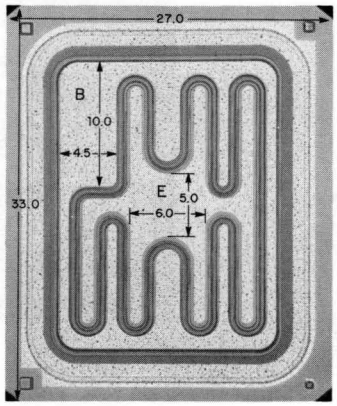



0215

NOTE: Fairchild reserves the right to improve device geometries and manufacturing processes as required. These improvements may result in slight geometry changes. However, they will not affect the electrical specifications as published in this catalog.

## GEOMETRY LAYOUTS

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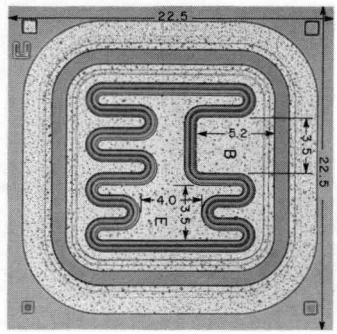


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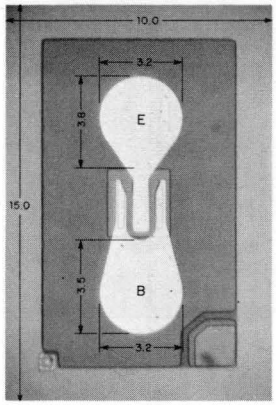


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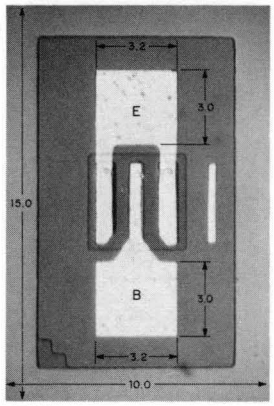


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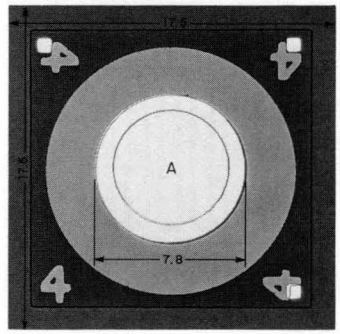


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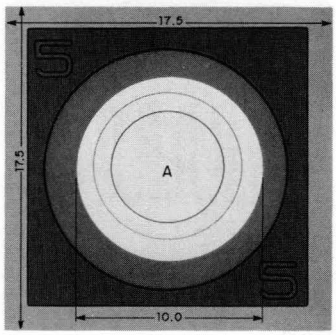


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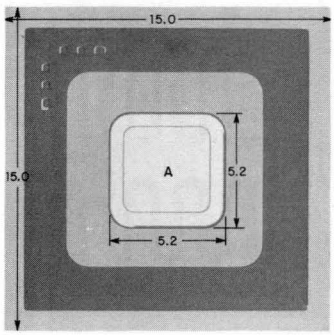


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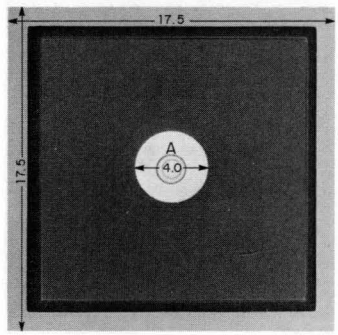


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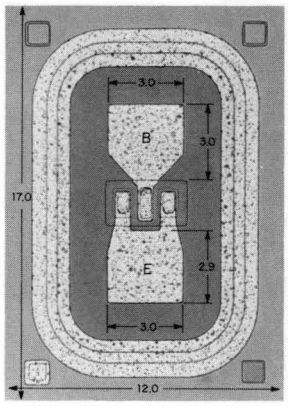


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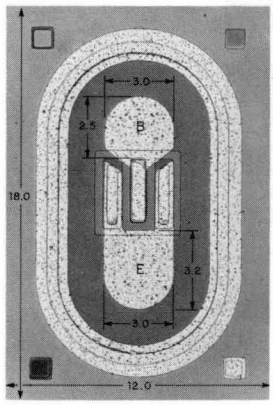


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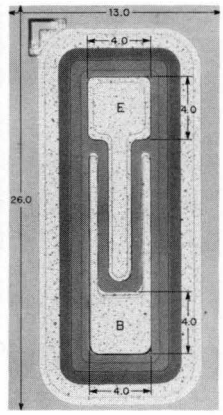


2019

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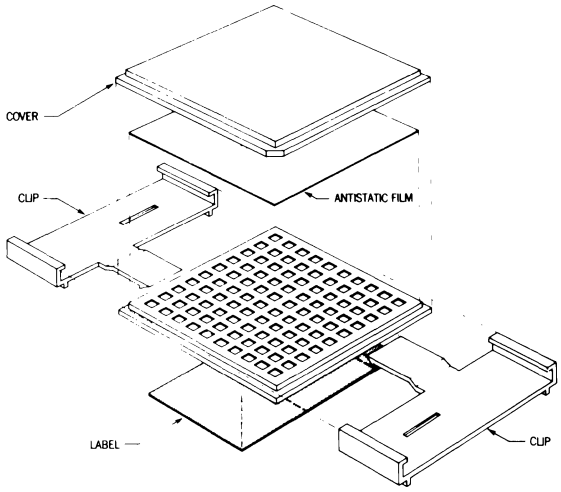


Fig. 1. CAVITY PACK

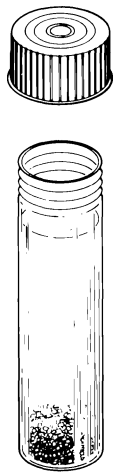

Fig. 2. VIAL PACK

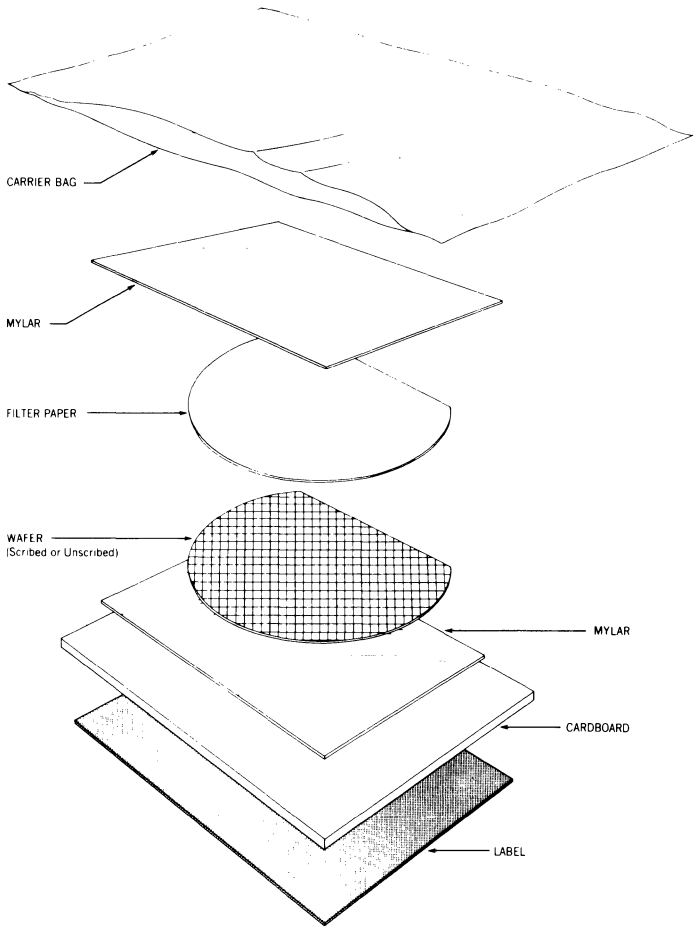


Fig. 3. WAFER PACK

**Fig. 1.** **CAVITY PACK - Dice are Placed in Individual Compartments. The Plastic Snap Clips Permit Inspection and Resealing.**

**Fig. 2.** **VIAL PACK - The Vial is Filled with FREON TF and a Plastic Cap Seals the Vial. The Freon Acts as a Motion Retarder and Cleansing Agent.**

**Fig. 3.** **WAFER PACK - Entire Wafer is Sandwiched Between Two Pieces of Mylar and Vacuum Sealed in a Plastic Envelope.**

## 1N DICE CROSS REFERENCE GUIDE

This chart references the closest die device type for the popular JEDEC devices. In each case, the closest die type is referenced based on the device function.

| 1N DEVICE | RECOMMENDED FDC DEVICE | 1N DEVICE | RECOMMENDED FDC DEVICE | 1N DEVICE | RECOMMENDED FDC DEVICE |
|---|---|---|---|---|---|
| 1N457 | FDC485B | 1N483 | FDC485B | 1N3064 | FDC3600 |
| 1N457A | FDC485B | 1N483A | FDC485B | 1N3070 | FDC3070 |
| 1N458 | FDC485B | 1N483B | FDC485B | 1N3595 | FDC485B |
| 1N458A | FDC485B | 1N485 | FDC485B | 1N3600 | FDC3600 |
| 1N459 | FDC485B | 1N485A | FDC485B | 1N4148 | FDC3600 |
| 1N459A | FDC485B | 1N485B | FDC485B | 1N4151 | FDC3600 |
| 1N463 | FDC485B | 1N643 | FDC3070 | 1N4152 | FDC3600 |
| 1N463A | FDC485B | 1N914 | FDC3600 | 1N4376 | FDC4376 |
| 1N464 | FDC485B | 1N914A | FDC3600 | 1N4448 | FDC3600 |
| 1N464A | FDC485B | 1N914B | FDC3600 | 1N4454 | FDC3600 |

## 2N DICE CROSS REFERENCE GUIDE

This chart references the closest die device type for the popular JEDEC devices. In each case, the closest die type is referenced based on the device function.

| 2N DEVICE | RECOMMENDED DN DEVICE | 2N DEVICE | RECOMMENDED DN DEVICE | 2N DEVICE | RECOMMENDED DN DEVICE |
|---|---|---|---|---|---|
| 2N656 | DN3019 | 2N918 | DN918 | 2N2369A | DN2369A |
| 2N656A | DN3019 | 2N929 | DN2484 | 2N2410 | DN3725 |
| 2N657 | DN3019 | 2N929A | DN2484 | 2N2411 | DN3250 |
| 2N657A | DN3019 | 2N930 | DN2484 | 2N2412 | DN3250 |
| 2N696 | DN2222A | 2N930A | DN2484 | 2N2481 | DN2369A |
| 2N696A | DN2222A | 2N930B | DN2484 | 2N2484 | DN2484 |
| 2N697 | DN2222A | 2N956 | DN2222A | 2N2501 | DN3014 |
| 2N697A | DN2222A | 2N995 | DN3250 | 2N2605 | DN3962 |
| 2N698 | DN3019 | 2N1131 | DN2907 | 2N2845 | DN3725 |
| 2N699 | DN3019 | 2N1131A | DN2907 | 2N2846 | DN3725 |
| 2N699A | DN3019 | 2N1132 | DN2907 | 2N2847 | DN3725 |
| 2N699B | DN3019 | 2N1132A | DN2907 | 2N2848 | DN3725 |
| 2N706 | DN2369A | 2N1132B | DN2907 | 2N2894 | DN4209 |
| 2N706A | DN2369A | 2N1420 | DN2222A | 2N2894A | DN4209 |
| 2N706B | DN2369A | 2N1613 | DN2222A | 2N2904 | DN2907 |
| 2N706C | DN2369A | 2N1613A | DN2222A | 2N2904A | DN2907 |
| 2N708 | DN2369A | 2N1711 | DN2222A | 2N2905 | DN2907 |
| 2N708A | DN2369A | 2N1711A | DN2222A | 2N2905A | DN2907 |
| 2N709 | DN2369A | 2N1711B | DN2222A | 2N2906 | DN2907 |
| 2N709A | DN2369A | 2N1890 | DN3019 | 2N2906A | DN2907 |
| 2N718 | DN2222A | 2N1893 | DN3019 | 2N2907 | DN2907 |
| 2N718A | DN2222A | 2N1893A | DN3019 | 2N2907A | DN2907 |
| 2N720 | DN3019 | 2N1990 | DN3019 | 2N3009 | DN3014 |
| 2N720A | DN3019 | 2N1991 | DN2907 | 2N3010 | DN2369A |
| 2N722 | DN2907 | 2N2192 | DN2222A | 2N3011 | DN2369A |
| 2N722A | DN2907 | 2N2193 | DN2222A | 2N3012 | DN2894A |
| 2N743 | DN2369A | 2N2194 | DN2222A | 2N3013 | DN3014 |
| 2N743A | DN2369A | 2N2195 | DN2222A | 2N3014 | DN3014 |
| 2N744 | DN2369A | 2N2217 | DN2222A | 2N3019 | DN3019 |
| 2N744A | DN2369A | 2N2218 | DN2222A | 2N3020 | DN3019 |
| 2N834 | DN2369A | 2N2218A | DN2222A | 2N3053 | DN3019 |
| 2N834A | DN2369A | 2N2219 | DN2222A | 2N3117 | DN2484 |
| 2N835 | DN3014 | 2N2219A | DN2222A | 2N3250 | DN3250 |
| 2N869 | DN5455 | 2N2221 | DN2222A | 2N3250A | DN3250 |
| 2N869A | DN5455 | 2N2221A | DN2222A | 2N3251 | DN3250 |
| 2N870 | DN3019 | 2N2222 | DN2222A | 2N3251A | DN3250 |
| 2N871 | DN3019 | 2N2222A | DN2222A | 2N3252 | DN3725 |
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| 2N914A | DN3014 | 2N2303 | DN2907 | 2N3301 | DN2222A |
| 2N915 | DN3904 | 2N2368 | DN2369 | 2N3302 | DN2222A |
| 2N916 | DN3904 | 2N2369 | DN2369A | 2N3303 | DN3725 |

## 2N DICE CROSS REFERENCE GUIDE

This chart references the closest die device type for the popular JEDEC devices. In each case, the closest die type is referenced based on the device function.

| 2N DEVICE | RECOMMENDED DN DEVICE | 2N DEVICE | RECOMMENDED DN DEVICE | 2N DEVICE | RECOMMENDED DN DEVICE |
|---|---|---|---|---|---|
| 2N3304 | DN4209 | 2N3640 | DN4209 | 2N4047 | DN3725 |
| 2N3402 | DN3904 | 2N3641 | DN2222A | 2N4122 | DN3906 |
| 2N3403 | DN2484 | 2N3642 | DN2222A | 2N4123 | DN3904 |
| 2N3405 | DN3904 | 2N3643 | DN2222A | 2N4124 | DN3904 |
| 2N3406 | DN2484 | 2N3644 | DN2907 | 2N4125 | DN3906 |
| 2N3414 | DN3904 | 2N3645 | DN2907 | 2N4126 | DN3906 |
| 2N3415 | DN2484 | 2N3646 | DN3014 | 2N4208 | DN4209 |
| 2N3416 | DN3904 | 2N3693 | DN3904 | 2N4209 | DN4209 |
| 2N3417 | DN2484 | 2N3694 | DN3904 | 2N4248 | DN3962 |
| 2N3426 | DN3725 | 2N3722 | DN3725 | 2N4249 | DN3962 |
| 2N3444 | DN3725 | 2N3723 | DN3725 | 2N4265 | DN2369A |
| 2N3467 | DN3468 | 2N3724 | DN3725 | 2N4275 | DN2369A |
| 2N3468 | DN3468 | 2N3725 | DN3725 | 2N4354 | DN4033 |
| 2N3485 | DN2907 | 2N3903 | DN3904 | 2N4355 | DN4033 |
| 2N3485A | DN2907 | 2N3904 | DN3904 | 2N4400 | DN2222A |
| 2N3486 | DN2907 | 2N3905 | DN3906 | 2N4401 | DN2222A |
| 2N3486A | DN2907 | 2N3906 | DN3906 | 2N4402 | DN2907 |
| 2N3494 | DN3930 | 2N3923 | DN3923 | 2N4403 | DN2907 |
| 2N3495 | DN3930 | 2N3930 | DN3930 | 2N4409 | DN3923 |
| 2N3496 | DN3930 | 2N3931 | DN3930 | 2N4410 | DN3923 |
| 2N3497 | DN3930 | 2N3962 | DN3962 | 2N5022 | DN3468 |
| 2N3498 | DN3923 | 2N3963 | DN3962 | 2N5023 | DN3468 |
| 2N3500 | DN3923 | 2N3964 | DN3962 | 2N5086 | DN3962 |
| 2N3501 | DN3923 | 2N3965 | DN3962 | 2N5087 | DN3962 |
| 2N3502 | DN2907 | 2N4013 | DN3725 | 2N5088 | DN2484 |
| 2N3503 | DN2907 | 2N4014 | DN3725 | 2N5089 | DN2484 |
| 2N3504 | DN2907 | 2N4026 | DN4033 | 2N5200 | DN2484 |
| 2N3505 | DN2907 | 2N4027 | DN4033 | 2N5210 | DN2484 |
| 2N3565 | DN2484 | 2N4028 | DN4033 | 2N5455 | DN5455 |
| 2N3567 | DN2222A | 2N4029 | DN4033 | 2N5769 | DN2369A |
| 2N3568 | DN3919 | 2N4030 | DN4033 | 2N5771 | DN4209 |
| 2N3569 | DN2222A | 2N4031 | DN4033 | 2N5845 | DN3725 |
| 2N3638 | DN2907 | 2N4032 | DN4033 | 2N5845A | DN3725 |
| 2N3638A | DN2907 | 2N4033 | DN4033 | 2N5910 | DN4209 |
| 2N3639 | DN4209 | 2N4046 | DN3725 | | |

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Printed in U.S.A./2011-12-0001-023/65M