

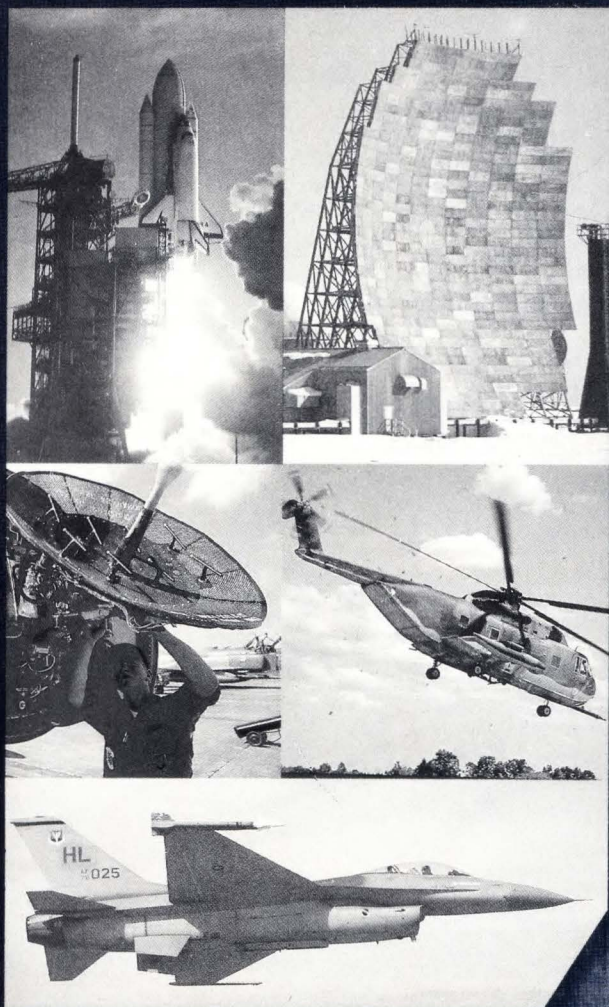
# RF/IF signal processing components guide



finding new ways . . .  
setting higher standards

 **Mini-Circuits**





at Mini-Circuits  
we're dedicated to pursue  
product innovations and  
improvements to satisfy  
our customers' current  
and future needs.

**finding new ways...**

such as a proprietary HTRB  
diode-screening technique,  
computer-automated performance  
data (CAPD) documentation  
and off-the-shelf TX mixers.

**setting higher standards**

with the industry's only 3-year  
guaranteed mixers,  
-55 dB guaranteed third-order IM mixers,  
highest output (1000 mv) phase detectors,  
widest bandwidth directional couplers  
...just to name a few.

Our commitment to  
the customer never ends.

finding new ways ...  
setting higher standards

 **Mini-Circuits**



# Table of Contents

## general information

|                                                           |     |
|-----------------------------------------------------------|-----|
| Ordering information and warranty                         | 3   |
| Model Index <b>specs &amp; performance data</b>           | 4   |
| How to use this guide                                     | 5   |
| Reliability and Quality Control                           | 6-7 |
| Environmental specifications and absolute maximum ratings | 7   |

|                                                |       |
|------------------------------------------------|-------|
| "Eliminating guesswork in Systems design CAPD" | 8-13  |
| <b>Outline drawings</b>                        | 14-18 |

## specifications and performance data

### amplifiers

|                          |            |
|--------------------------|------------|
| general information      | 86         |
| 50mW (10MHz to 2000MHz)  | 90         |
| 1 Watt (50KHz to 4.2GHz) | 85, 87, 89 |
| 2 Watt (5MHz to 800MHz)  | 86         |

### attenuators, fixed

|                  |    |
|------------------|----|
| pin models       | 98 |
| connector models | 99 |

### attenuators/switches, electronic

|                          |    |
|--------------------------|----|
| pin and connector models | 94 |
| pin diode models         | 95 |

### directional couplers

|                  |    |
|------------------|----|
| pin models       | 82 |
| connector models | 83 |

### frequency doublers

|                  |    |
|------------------|----|
| pin models       | 96 |
| connector models | 97 |

### limiters

|            |    |
|------------|----|
| pin models | 93 |
|------------|----|

### phase detectors

|            |    |
|------------|----|
| pin models | 92 |
|------------|----|

### frequency mixers

|                                   |       |
|-----------------------------------|-------|
| general information               | 19    |
| "Mastering the mixer maze"        | 20-21 |
| level 7 pin models                | 22-23 |
| level 7 connector models          | 24-25 |
| level 10, broadband               | 26    |
| level 13, broadband               | 27    |
| level 17, very high dynamic range | 28-29 |
| level 17S, very low distortion    | 30-31 |
| level 23, ultra low distortion    | 32    |
| level 23S, ultra low distortion   | 33    |
| level 27, ultra low distortion    | 33    |
| performance data                  | 34-66 |

### power splitter/combiners

|                     |       |
|---------------------|-------|
| general information | 68-69 |
| 2 Way-0°            | 70-71 |
| 2 Way-90°           | 72    |
| 2 Way-180°          | 73    |
| 3 Way-0°            | 74    |
| 4 Way-0°            | 75    |
| 5 Way-0°            | 76    |
| 6 Way-0°            | 77    |
| 8 Way-0°            | 78    |
| 12 Way-0°           | 79    |
| 16 Way-0°           | 80    |
| 24 Way-0°           | 81    |
| 48 Way-0°           | 81    |

### transformers, RF

|                          |    |
|--------------------------|----|
| general information      | 90 |
| pin and connector models | 91 |

## ordering information

Federal supply code: 15542

### how to order

Your local representative or distributor is the contact for both sales and service assistance for products listed in this catalog. These local offices have the latest price and delivery information on all models. They can also provide details on ordering procedures, service information and application engineering data. Your order may be sent directly to Mini-Circuits or to any of the local sales offices listed.

Prices listed in this catalog are domestic F.O.B. Brooklyn, New York. Mini-Circuits reserves the right to change specifications, models, prices or designs without prior notice and without liability for such changes.

### shipping instructions

Shipments can be made by either air or surface carriers. If specific shipping instructions do not accompany the order, Mini-Circuits will specify the carrier to be used.

### terms

Net 30 days from date of invoice. If credit is not established with Mini-Circuits, shipments will be made C.O.D. (cash on delivery) or prepaid. When sending prepayments, please include freight.

### warranty

Scientific Components Corporation, Mini-Circuits division, warrants each product manufactured by Mini-Circuits to meet all published specifications and to be free from defects in material and workmanship. The Company's liability under this warranty is limited to repair, adjustment and/or replacement of defective parts returned, freight paid by Buyer, to the factory within a period of one year from date of shipment from the factory unless a shorter period is specified. International customers may ship to the Company's nearest Distributor.

Damage by misuse or abnormal conditions of operation, or evidence of partial or complete disassembly voids this warranty.

SINCE MINI-CIRCUITS HAS NO CONTROL OVER CONDITIONS OF USE, NO WARRANTY IS MADE OR IMPLIED AS TO SUITABILITY FOR CUSTOMER'S INTENDED USE, BEYOND SUCH PERFORMANCE SPECIFICATIONS AS ARE MADE A PART OF THE PURCHASE ORDER. Equipment shipped F.O.B. Mini-Circuits' plant shall become the property of the Buyer upon delivery to carrier. Damage in shipment should be handled by the Buyer directly with the carrier by immediately requesting carrier's inspection upon evidence of damage in shipment.

A fee will be charged to the Buyer to cover the costs of inspection and test of units returned under this warranty and subsequently found to meet specifications or to be faulty for reasons which are not Mini-Circuits' responsibility. This warranty excludes all other warranties expressed or implied. Mini-Circuits shall not be liable for any special, indirect or consequential damages.



# Model Index specs & performance data\*

## amplifiers, broadband

|          |    |
|----------|----|
| ZFL-2000 | 88 |
| ZHL-1A   | 85 |
| ZHL-1-2W | 86 |
| ZHL-2    | 87 |
| ZHL-2-8  | 87 |
| ZHL-2-12 | 87 |
| ZHL-3A   | 85 |
| ZHL-7-2W | 86 |
| ZHL-32A  | 85 |
| ZHL-42   | 89 |

## directional couplers

|              |    |
|--------------|----|
| PDC-10-1     | 82 |
| PDC-10-1-75  | 82 |
| PDC-10-2     | 82 |
| PDC-10-21    | 82 |
| PDC-10-22    | 82 |
| PDC-15-6     | 82 |
| PDC-15-6-75  | 82 |
| PDC-20-1     | 82 |
| PDC-20-3     | 82 |
| PDC-20-3-75  | 82 |
| TDC-10-1     | 82 |
| ZDC-10-1     | 88 |
| ZDC-10-1-75  | 88 |
| ZDC-10-2     | 88 |
| ZDC-15-6     | 88 |
| ZDC-15-6-75  | 88 |
| ZDC-20-1     | 88 |
| ZDC-20-3     | 88 |
| ZDC-20-3-75  | 88 |
| ZDC-2375     | 88 |
| ZEDC-10-2    | 88 |
| ZEDC-15-2    | 88 |
| ZFDC-10-1    | 88 |
| ZFDC-10-2    | 88 |
| ZFDC-10-21   | 88 |
| ZFDC-10-22   | 88 |
| ZFDC-15-6    | 88 |
| ZFDC-15-6-75 | 88 |
| ZFDC-20-3    | 88 |
| ZFDC-20-4    | 88 |
| ZFDC-20-5    | 88 |
| ZMDC-10-1    | 88 |
| ZMDC-10-2    | 88 |
| ZMDC-15-6    | 88 |
| ZMDC-20-1    | 88 |
| ZMDC-20-3    | 88 |
| ZMDC-30-1    | 88 |

## electronic attenuator/switch

|           |    |
|-----------|----|
| PAS-1     | 94 |
| PAS-2     | 94 |
| PAS-3     | 94 |
| PSW-1111  | 94 |
| PSW-1211  | 94 |
| ZAS-1     | 94 |
| ZAS-3     | 94 |
| ZFAS-15   | 94 |
| ZMAS-1    | 94 |
| ZMAS-3    | 94 |
| ZMSW-1111 | 95 |
| ZMSW-1211 | 95 |

## fixed attenuators

|         |    |
|---------|----|
| AT-3    | 98 |
| AT-3-75 | 98 |
| AT-6    | 98 |
| AT-6-75 | 98 |

| model     | specs | data |
|-----------|-------|------|
| AT-10     | 98    |      |
| AT-10-75  | 98    |      |
| AT-20     | 98    |      |
| AT-20-75  | 98    |      |
| AT-30     | 98    |      |
| AT-40     | 98    |      |
| CAT-3     | 99    |      |
| CAT-3-75  | 99    |      |
| CAT-6     | 99    |      |
| CAT-6-75  | 99    |      |
| CAT-10    | 99    |      |
| CAT-10-75 | 99    |      |
| CAT-20    | 99    |      |
| CAT-20-75 | 99    |      |
| CAT-30    | 99    |      |
| CAT-40    | 99    |      |

|        |    |  |
|--------|----|--|
| MAT-3  | 98 |  |
| MAT-6  | 98 |  |
| MAT-9  | 98 |  |
| MAT-10 | 98 |  |
| MAT-12 | 98 |  |
| MAT-15 | 98 |  |
| MAT-20 | 98 |  |
| MAT-30 | 98 |  |
| NAT-3  | 99 |  |
| NAT-6  | 99 |  |
| NAT-10 | 99 |  |
| NAT-20 | 99 |  |
| NAT-30 | 99 |  |
| NAT-40 | 99 |  |
| TAT-3  | 99 |  |
| TAT-6  | 99 |  |
| TAT-10 | 99 |  |
| TAT-20 | 99 |  |
| TAT-30 | 99 |  |
| TAT-40 | 99 |  |
| SAT-3  | 99 |  |
| SAT-6  | 99 |  |
| SAT-9  | 99 |  |
| SAT-10 | 99 |  |
| SAT-12 | 99 |  |
| SAT-15 | 99 |  |
| SAT-20 | 99 |  |
| SAT-30 | 99 |  |

## frequency doublers

|      |    |  |
|------|----|--|
| AK-2 | 96 |  |
| FD-2 | 97 |  |
| FK-5 | 97 |  |
| GK-2 | 97 |  |
| GK-3 | 97 |  |
| GK-5 | 97 |  |
| MK-2 | 97 |  |
| MK-3 | 97 |  |
| MK-5 | 97 |  |
| RK-2 | 96 |  |
| RK-3 | 96 |  |
| RK-6 | 96 |  |
| SK-2 | 96 |  |

## limiters

|       |    |  |
|-------|----|--|
| PLS-1 | 93 |  |
| PLS-2 | 93 |  |
| PLS-6 | 93 |  |

## mixers

|         |    |    |
|---------|----|----|
| ASK-1   | 23 |    |
| GRA-1   | 22 | 34 |
| GRA-3   | 22 | 36 |
| GRA-6   | 22 | 38 |
| GRA-8   | 22 | 40 |
| GRA-1H  | 28 |    |
| GRA-3H  | 28 |    |
| GRA-6H  | 28 |    |
| LMX-113 | 23 |    |
| LXM-123 | 26 |    |

|           |    |  |
|-----------|----|--|
| LMX-124   | 23 |  |
| LMX-125MH | 27 |  |
| LMX-148   | 26 |  |
| LMX-149   | 23 |  |
| PAM-42    | 23 |  |
| RAY-1     | 32 |  |
| RAY-2     | 32 |  |
| RAY-3     | 32 |  |
| RAY-6     | 32 |  |
| SAM-1     | 23 |  |
| SAM-2     | 23 |  |
| SAM-3     | 23 |  |
| SAM-4     | 23 |  |
| SAM-5     | 23 |  |

|          |    |    |
|----------|----|----|
| SAY-1    | 33 |    |
| SAY-2    | 33 |    |
| SAY-11   | 33 |    |
| SBL-1    | 22 |    |
| SBL-1MH  | 27 |    |
| SBL-1X   | 22 |    |
| SRA-1    | 22 | 34 |
| SRA-1TX  | 22 | 34 |
| SRA-1-1  | 22 | 42 |
| SRA-1W   | 22 | 44 |
| SRA-2    | 22 | 46 |
| SRA-2CM  | 22 |    |
| SRA-3    | 22 | 36 |
| SRA-4    | 22 |    |
| SRA-5    | 22 |    |
| SRA-6    | 22 | 38 |
| SRA-8    | 22 | 40 |
| SRA-11   | 22 | 48 |
| SRA-12   | 22 |    |
| SRA-1H   | 28 |    |
| SRA-1WH  | 28 |    |
| SRA-2H   | 28 |    |
| SRA-3H   | 28 |    |
| SRA-11H  | 28 |    |
| SRA-1MH  | 27 |    |
| SRA-3MH  | 27 |    |
| SRA-215  | 26 |    |
| SRA-220  | 26 |    |
| SRA-173H | 28 | 62 |
| SRA-2000 | 22 | 50 |

|         |    |    |
|---------|----|----|
| TAK-5   | 22 |    |
| TAK-5R  | 22 |    |
| TAK-6   | 22 |    |
| TAK-6R  | 22 |    |
| TAK-7   | 22 |    |
| TAK-1H  | 30 |    |
| TAK-1WH | 30 |    |
| TAK-3H  | 30 |    |
| TFM-2   | 23 | 56 |
| TFM-3   | 23 | 58 |
| TFM-4   | 23 |    |
| TFM-11  | 23 |    |
| TFM-12  | 23 |    |
| TFM-15  | 26 | 60 |
| TFM-150 | 26 |    |
| TFM-1MH | 27 |    |
| TFM-3MH | 27 |    |
| TFM-1H  | 30 | 64 |
| TFM-2H  | 30 |    |
| TFM-3H  | 30 |    |
| TFM-4H  | 30 |    |

|       |    |  |
|-------|----|--|
| TSM-1 | 23 |  |
| TSM-3 | 23 |  |

|       |    |  |
|-------|----|--|
| VAY-1 | 33 |  |
|-------|----|--|

|         |    |    |
|---------|----|----|
| ZAD-1   | 24 | 34 |
| ZAD-1-1 | 24 | 42 |
| ZAD-1W  | 24 | 44 |
| ZAD-2   | 24 | 46 |
| ZAD-3   | 24 | 36 |
| ZAD-4   | 24 |    |
| ZAD-6   | 24 | 38 |
| ZAD-8   | 24 | 40 |
| ZAD-11  | 24 | 48 |
| ZAD-12  | 24 |    |
| ZAD-1H  | 28 |    |
| ZAD-1WH | 28 |    |

|          |    |    |
|----------|----|----|
| ZAD-2H   | 28 |    |
| ZAD-3H   | 28 |    |
| ZAD-11H  | 28 |    |
| ZAD-1SH  | 31 | 64 |
| ZAD-1WSH | 31 |    |
| ZAD-3SH  | 31 |    |
| ZAM-42   | 25 |    |
| ZAY-1    | 32 | 66 |
| ZAY-2    | 32 |    |
| ZAY-3    | 32 |    |
| ZEM-2    | 25 | 56 |
| ZFM-1W   | 25 |    |
| ZFM-2    | 25 | 56 |
| ZFM-3    | 25 | 58 |
| ZFM-4    | 25 |    |
| ZFM-11   | 25 |    |
| ZFM-12   | 25 |    |
| ZFM-15   | 26 | 60 |
| ZFM-150  | 26 |    |
| ZFM-1H   | 31 | 64 |
| ZFM-2H   | 31 |    |
| ZFM-3H   | 31 |    |
| ZFM-2000 | 25 | 50 |
| ZFM-4212 | 25 |    |
| ZFY-1    | 33 |    |
| ZFY-2    | 33 |    |
| ZFY-11   | 33 |    |
| ZLW-1    | 24 | 34 |
| ZLW-1-1  | 24 | 42 |
| ZLW-1W   | 24 | 44 |
| ZLW-2    | 24 | 56 |
| ZLW-3    | 24 | 36 |
| ZLW-5    | 24 |    |
| ZLW-6    | 24 | 38 |
| ZLW-8    | 24 | 40 |
| ZLW-11   | 24 | 48 |
| ZLW-12   | 24 |    |
| ZLW-1H   | 28 |    |
| ZLW-1WH  | 28 |    |
| ZLW-2H   | 28 |    |
| ZLW-3H   | 28 |    |
| ZLW-11H  | 28 |    |
| ZLW-1SH  | 31 | 64 |
| ZLW-1WSH | 31 |    |
| ZLW-3SH  | 31 |    |
| ZMA-2    | 24 |    |
| ZMA-3    | 24 |    |
| ZMY-1    | 32 | 86 |
| ZMY-2    | 32 |    |
| ZMY-3    | 32 |    |
| ZP-10514 | 24 |    |

## power splitter/combiners

|              |    |  |
|--------------|----|--|
| LPS-109      | 70 |  |
| MSC-2-1      | 70 |  |
| MSC-2-1W     | 70 |  |
| PSC-2-1      | 70 |  |
| PSC-2-1-75   | 70 |  |
| PSC-2-1W     | 70 |  |
| PSC-2-2      | 70 |  |
| PSC-2-4      | 70 |  |
| PSC-2-375    | 70 |  |
| PSC-3-1      | 74 |  |
| PSC-3-1-75   | 74 |  |
| PSC-3-1-75-2 | 74 |  |
| PSC-3-1W     | 74 |  |
| PSC-3-2      | 74 |  |
| PSC-3-13     | 74 |  |
| PSC-4-1      | 75 |  |
| PSC-4-1-75   | 75 |  |
| PSC-4-3      | 75 |  |
| PSC-4A-4     | 75 |  |
| PSC-4-6      | 75 |  |
| PSC-5-1      | 76 |  |
| PSC-5-1-75   | 76 |  |
| PSC-6-1      | 77 |  |
| PSC-6-1-75   | 77 |  |
| PSC-8-1      | 78 |  |
| PSC-8-1-75   | 78 |  |
| PSC-8A-4     | 78 |  |
| PSC-8-6      | 78 |  |

|               |    |  |
|---------------|----|--|
| PSC-8A4-75    | 78 |  |
| PSCJ-2-1      | 73 |  |
| PSCJ-2-2      | 73 |  |
| PSCQ2-1.5     | 72 |  |
| PSCQ2-3.4     | 72 |  |
| PSCQ2-6.4     | 72 |  |
| PSCQ2-7.5     | 72 |  |
| PSCQ2-10.5    | 72 |  |
| PSCQ2-13      | 72 |  |
| PSCQ2-14      | 72 |  |
| PSCQ2-21.4    | 72 |  |
| PSCQ2-40      | 72 |  |
| PSCQ2-50      | 72 |  |
| PSCQ2-70      | 72 |  |
| PSCQ2-90      | 72 |  |
| PSCQ2-120     | 72 |  |
| PSCQ2-180     | 72 |  |
| PSCQ2-250     | 72 |  |
| PSCQ2-400     | 72 |  |
| PSCQ2-450     | 72 |  |
| TSC2-1        | 70 |  |
| ZAPD-1        | 71 |  |
| ZAPD-2        | 71 |  |
| ZAPD-4        | 71 |  |
| ZAPD-21       | 71 |  |
| ZAPDQ-2       | 72 |  |
| ZAPDQ-4       | 72 |  |
| ZA3PD-1       | 74 |  |
| ZA3PD-1.5     | 74 |  |
| ZA3PD-2       | 74 |  |
| ZA3PD-4       | 74 |  |
| ZA4PD-2       | 75 |  |
| ZA4PD-4       | 75 |  |
| ZB4PD-4       | 75 |  |
| ZB4PD-42      | 75 |  |
| ZB8PD-2       | 78 |  |
| ZB8PD-4       | 78 |  |
| ZFSC-2-1      | 71 |  |
| ZFSC-2-1W     | 71 |  |
| ZFSC-2-1-75   | 71 |  |
| ZFSC-2-2      | 71 |  |
| ZFSC-2-4      | 71 |  |
| ZFSC-2-5      | 71 |  |
| ZFSC-2-6      | 71 |  |
| ZFSC-2-6-75   | 71 |  |
| ZFSC-3-1      | 74 |  |
| ZFSC-3-1W     | 74 |  |
| ZFSC-3-13     | 74 |  |
| ZFSC-4-1      | 75 |  |
| ZFSC-4-1W     | 75 |  |
| ZFSC-4375     | 75 |  |
| ZFSC-4-3      | 75 |  |
| ZFSC-4-2-75-1 | 75 |  |
| ZFSC-6-1      | 77 |  |
| ZFSC-6-1-75   | 77 |  |
| ZFSC-8-1      | 78 |  |
| ZFSC-8-1-75   | 78 |  |
| ZFSC-8375     | 78 |  |
| ZFSC-8-4      | 78 |  |
| ZFSC-8-6      | 78 |  |
| ZFSC-84-75    | 78 |  |
| ZFSC-8-43     | 78 |  |
| ZFSC-12-1     | 79 |  |
| ZFSC-12-11    | 79 |  |
| ZFSC-16-1     | 80 |  |
| ZFSC-16-3     | 80 |  |
| ZFSC-16-675   | 80 |  |
| ZFSC-16-12    | 80 |  |
| ZFSC-24-1     | 81 |  |
| ZFSC-24-6     | 81 |  |
| ZFSC-24-11    | 81 |  |
| ZFSC-48-1     | 81 |  |
| ZFSC-48-1-75  | 81 |  |
| ZFSCJ-2-1     | 73 |  |
| ZFSCJ-2-3     | 73 |  |
| ZMSC-2-1      | 71 |  |
| ZMSC-2-1W     | 71 |  |
| ZMSC-2-2      | 71 |  |
| ZMSC-3-1      | 74 |  |
| ZMSC-3-2      | 74 |  |
| ZMSC-4-1      | 75 |  |
| ZMSC-4-2      | 75 |  |
| ZMSC-4-3      | 75 |  |
| ZMSCJ-2-1     | 73 |  |
| ZMSCJ-2-2     | 73 |  |
| ZMSCQ-2-50    | 72 |  |
| ZMSCQ-2-90    | 72 |  |



## model specs

|             |    |
|-------------|----|
| ZMSCQ-2-180 | 72 |
| ZSC-2-1     | 71 |
| ZSC-2-1-75  | 71 |
| ZSC-2-1W    | 71 |
| ZSC-2-2     | 71 |
| ZSC-2-4     | 71 |
| ZSC-2375    | 71 |
| ZSC-3-1     | 74 |
| ZSC-3-1-75  | 74 |
| ZSC-3-2     | 74 |
| ZSC-3-2-75  | 74 |
| ZSC-4-1     | 75 |
| ZSC-4-1-75  | 75 |
| ZSC-4-2     | 75 |
| ZSC-4-3     | 75 |
| ZSCJ-2-1    | 73 |
| ZSCJ-2-2    | 73 |
| ZSCQ-2-50   | 72 |
| ZSCQ-2-90   | 72 |
| ZSCQ-180    | 72 |

## transformers, RF

|           |    |
|-----------|----|
| FT1.5-1   | 90 |
| FTB1-1    | 90 |
| FTB1-6    | 90 |
| FTB1-1-75 | 90 |
| T1-1      | 90 |
| T1-1H     | 90 |
| T1-1T     | 90 |
| T1.5-1    | 90 |
| T1.5-6    | 90 |
| T1-6      | 90 |
| T1-6T     | 90 |
| T2-1      | 90 |
| T2-1T     | 90 |
| T2.5-6    | 90 |
| T2.5-6T   | 90 |
| T3-1      | 90 |
| T3-1T     | 90 |
| T4-1      | 90 |
| T4-2      | 90 |
| T4-6      | 90 |
| T4-1H     | 90 |
| T5-1T     | 90 |
| T8-1      | 90 |
| T9-1      | 90 |
| T9-1H     | 90 |
| T13-1T    | 90 |
| T14-1     | 90 |
| T16-1     | 90 |
| T16-1H    | 90 |
| T16-6T    | 90 |
| T36-1     | 90 |
| TT1-6     | 90 |
| TT1.5-1   | 90 |
| TT2.5-6   | 90 |
| TT4-1     | 90 |
| TT25-1    | 90 |
| TTMO1-1   | 90 |
| TMO1-1    | 90 |
| TMO1-1T   | 90 |
| TMO1.5-1  | 90 |
| TMO2-1    | 90 |
| TMO2-1T   | 90 |
| TMO2.5-6  | 90 |
| TMO2.5-6T | 90 |
| TMO3-1    | 90 |
| TMO3-1T   | 90 |
| TMO4-1    | 90 |
| TMO4-2    | 90 |
| TMO4-6    | 90 |
| TMO5-1T   | 90 |
| TMO8-1    | 90 |
| TMO9-1    | 90 |
| TMO13-1T  | 90 |
| TMO14-1   | 90 |
| TMO16-1   | 90 |

## phase detectors

|       |    |
|-------|----|
| RPD-1 | 92 |
| MPD-1 | 92 |

\*For performance data not given please consult factory.

## how to use this guide

Over 1,000 RF/microwave signal-processing components are available to the design engineer from Mini-Circuits. This guide has been organized to simplify the process of selecting the component best suited to your application and need, to speed location of specs for a particular model, and to provide helpful application assistance.

**A complete listing of all the product family groups**—from frequency mixers to power splitters to RF transformers—plus warranty and ordering details are found on page 3.

**Looking for data on a specific model?** Page 4 contains a list of all models in alphabetical/numerical order, available from Mini-Circuits with reference to specific data pages.

**For a concise production/test flow diagram** illustrating Mini-Circuits quality-control procedures, turn to pages 6 and 7. Also detailed information on our Hi-Rel, HTRB and TX products for your military, space or rugged industrial applications.

### Computer-automated- performance data (CAPD)

is a Mini-Circuits' innovation offering the most complete database for RF signal-processing components. What's involved in CAPD and its benefits towards your new designs are described on pages 8-13.



### "Mastering the Mixer Maze" . . .

Mixer selection, with hundreds of models to choose from, can be confusing. The penalty for improper selection? Overspecify and pay extra; underspecify and face marginal performance. Read pages 20-21 for a clearly-detailed procedure for choosing the optimum mixer for your needs.

**Data pages.** Each data page is organized by series within the product line and by models within the series.

Information given includes CAPD data, National Stock Numbers (NSN), equivalent MIL—part numbers, pin connection designations; case styles, and notes to the tables.

Full technical data for each model is given in table form. The tables are arranged by sequence of model number for each series. The various models within a series differentiate from each other by the frequency range they cover. Frequency range is defined in the tables by the lowest frequency  $f_L$  to the highest frequency  $f_u$ . For most models, the frequency range is further subdivided into three segments; L = low range, M = mid range, and U = upper range. Each range L, M, U is defined at the bottom of each table in terms of  $f_L$  and  $f_u$ .

Mixer selection is primarily determined by selecting a mixer level suitable for the application. Therefore, to aid the designers, frequency mixers are organized in sequence of mixer level—Level 7, 10, 13, 17, 17S, 23, 23S and 27. At Level 7 mixer operates with +7 dBm LO drive, a level 13 mixer operates with +13 dBm LO drive, etc. For each level mixer, a maximum RF input level for linear operation is specified.

Power splitters are organized in numerical sequence of split; from 2 way 0°, 2 way 90°, 2 way 180°, 3-, 4-, 5-, 6-, 8-, 12-, 24-, to 48 way 0°.

**Case style and dimensions are easy to find . . .** each data page includes a photo of the particular case style for each series and, within the data, there is reference to case style number and outline drawing letter. Turn to pages 14 to 18 for case style dimensions, tolerances and bracket options where applicable.

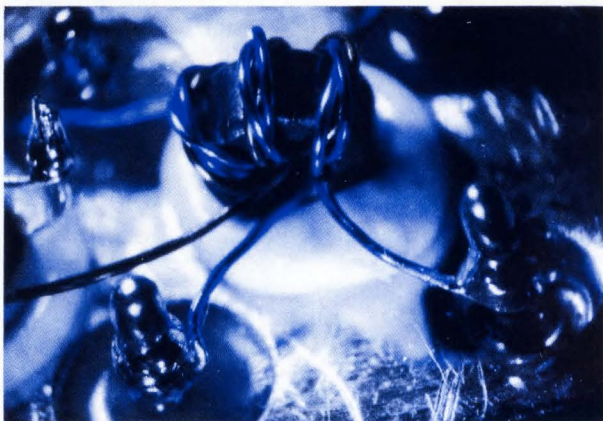
For example, the SRA-1 mixer detailed on page 22 calls for case A01. The dimensions and outline drawing are given in the table on page 14 and figure A on page 15.

**Need Mini-Circuits components in a hurry?** Refer to the rep listing in this directory for Mini-Circuits' worldwide network of sales representatives and distributors ready to serve your needs, supply your orders, and answer your questions promptly and courteously.



All Mini-Circuits' RF signal-processing components are subjected to rigid quality control procedures starting from raw material procurement through product production and final inspection; the objective—to supply our customers with the finest RF signal-processing components available. Here's a list of some of the procedures taken to insure high-quality performance and product reliability:

- A. 100% testing of each diode.
- B. 100% testing of each unit.
- C. 100% inspection of every solder connection.
- D. All transformers bonded to the header for protection against severe shock and vibration.
- E. All diodes, resistors and capacitors bonded to the header for protection against severe shock and vibration conditions.
- F. Diode and resistor power dissipation derated greater than 50%.
- G. All components rated for greater than + 125°C.
- H. All transformer leads double wrapped.
- I. Heavy coated wire insulation for HiPot/altitude.
- J. Completely encapsulated for protection against mechanical shock and vibration as well as temperature shock.
- K. Permanent case marking of model number cannot be removed by cleaning agents.
- L. Cupro-Nickel case for long-lasting finish especially under salt atmosphere conditions.



Every unit shipped from Mini-Circuits carries a full-year guarantee; in fact, our industry-standard SRA-1 mixer offers an exclusive three-year guarantee.

## hi-rel components

High-temperature, Reverse-bias (HTRB) testing is an accelerated-life screening test generally reserved for space applications. Here the Schottky and PIN diodes are subjected to a one-volt negative bias at 150°C for 168 hours. The objective of this accelerated aging stress is to force time/temperature-related failures and thus screen out potentially unreliable devices; in conventional "baking" processes, the diode does not experience anywhere near the stress imposed by the HTRB program. The result: highly-reliable Schottky and PIN diodes ready for wiring into assemblies.

Next, the assembled units are subjected to additional testing procedures including

- (1) burn-in for 96 hours at 100°C with 8 ma at 1 KHz
- (2) thermal shock per MIL-STD 202, Method 107
- (3) Gross and fine leak tests according to MIL-STD 202, Test Method 112B, Conditions A and C

As a consequence of the above HTRB, final seal, and burn-in testing, Mini-Circuits components offer an unprecedented high level of reliability. In fact, Mini-Circuits' industry-standard SRA-1 is the only double-balanced mixer in the world to be offered with an exclusive *three-year* guarantee.

## TX mixers

For the most critical space, military or industrial applications in hostile environments, Mini-Circuits offers TX mixers. Stringent screening and stressing are applied to the TX mixers which employ TX hermetically-sealed diodes that have passed the following tests per MIL-STD-750:

- (1) high-temperature storage for 340 hours at 150°C, Method 1032; (2) thermal shock, Method 1051, Test Condition C (– 65°C to + 150°C, 10 cycles); (3) constant acceleration, Method 2006, Y1 orientation, 20,000 G's; (4) fine leak, Method 1071, Condition H; (5) gross leak, Method 1071, Condition C; (6) burn-in for 96 hours at 25°C, 75mW/junction at 60 Hz, Method 1038, Condition B.

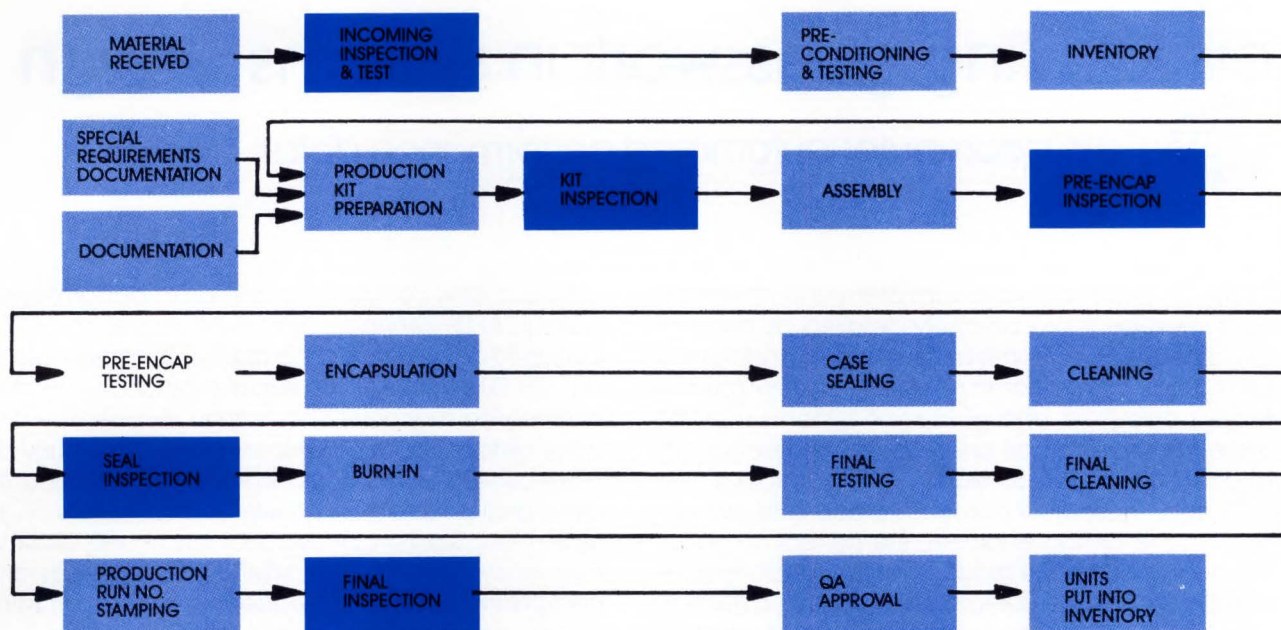
Those diodes that pass these rigid tests are then electrically tested to ensure that they meet specifications. They are then assembled into TX mixers which are then further exposed to these stress tests: (1) thermal shock, MIL-STD 202, Method 107; (2) burn-in for 96 hours at 100°C, with 8 ma at 1 KHz; (3) gross and fine leak, MIL-STD 202, Method 112B, Conditions A and C

The SRA-1TX is the first off-the-shelf TX mixer in the industry available for immediate delivery. All other Mini-Circuits' mixers are available with TX screening and testing.



# quality control

## how Mini-Circuits achieves high reliability



## environmental specifications

All MCL components are manufactured under exacting quality assurance and control standards. They will meet or exceed published specifications over the operating temperature range of  $-54^{\circ}\text{C}$  to  $+100^{\circ}\text{C}$ , and after being subjected to any or all of the following physical or environmental tests of MIL-STD 202E which are applicable.

|                                            |       |
|--------------------------------------------|-------|
| TEMPERATURE CYCLING:                       |       |
| $-65^{\circ}$ to $+125^{\circ}\text{C}$    | 102 C |
| ALTITUDE: 656,000 feet                     | 105 G |
| (2) HUMIDITY: 90% RH, $65^{\circ}\text{C}$ | 106   |

|                                                 |       |
|-------------------------------------------------|-------|
| THERMAL SHOCK:                                  |       |
| $-65^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ | 107 B |
| (1) (2) SEAL: Less than $10^5$ Atm. cc/sec      | 112 A |
| DROP: Random, 45 min.                           | 203   |
| VIBRATION:                                      |       |
| 2 to 2,000 cps, 20g, 12 hrs.                    | 204 D |
| SOLDER HEAT: $260^{\circ}\text{C}$ , 10 sec.    | 210 B |
| (1) SOLDERABILITY: 95% coverage                 | 208   |
| TERMINAL TENSILE STRENGTH:                      |       |
| 4½ lbs., 10 sec.                                | 211 A |
| (1) TERMINAL FATIGUE: 2 lbs., 3 cycles          | 211 C |
| MECHANICAL SHOCK: 100g, 6ms                     | 213 I |
| SOLVENT RESISTANCE:                             |       |
| Alcohol, Trichloroethan, Freon                  | 215   |

### NOTE:

(1) These specifications do not apply to coaxial connector models.

(2) Exceptions are non-hermetic case styles 6, 38, 46.

## absolute maximum ratings

OPERATING AND STORAGE TEMPERATURE  $-55^{\circ}\text{C}$  to  $+100^{\circ}\text{C}$



# eliminating guesswork in systems design



**CAPD (computer-automated performance data)**

Today, RF and Microwave subsystem and system designs must be more precisely detailed as performance demands become more stringent. Radars must be more accurate, communications systems must be more noise-free, and guidance systems must be more rigorous, and all are required to meet quality and reliability levels considered unattainable a decade ago. These new demands place a heavy burden on the design engineer, the project manager, the quality assurance group...and the suppliers of the components to be assembled into these systems. In addition to the stricter performance and reliability specs, the designer faces escalating costs if, at the last stages before system delivery, unexpected surprises occur in the form of spurious signals, high VSWR or other pitfalls not anticipated.

Until now, the designer selected his RF/Microwave components, such as mixers, power splitters, and amplifiers, using manufacturers' data sheets to provide detailed specs, performance curves, and environmental ratings. Indeed, the design engineer did receive a workable package of information to see how his design might proceed...but it was not a detailed, close-up look. The reason is simple—it has just been too expensive to take an enormous number of test points, at a considerable number of specific frequencies, tabulate the results and then repeat at other input levels.

As an example, a two-tone intermodulation distortion chart for mixer performance would require at least 100 measurement points plus 10 additional calibration points and would take an experienced technician at least a half-day to complete.

For those customers who required their data at specific frequencies or under conditions other than is offered on the manufacturers' data sheets, extra charges were justifiably added to offset the additional labor costs.

Now, a new computer-automated performance data (CAPD) service offered exclusively by Mini-Circuits to its customers at no additional charge. Based on over 20 years of RF test experience and six years of engineering manpower-hours, the CAPD service provides detailed specs never available previously on mixer conversion loss, isolation, VSWR and intermod; for directional couplers and power splitters, details on insertion loss, isolation, phase unbalance and VSWR vs. frequency; for amplifiers, VSWR, gain changes and compression point vs frequency. In fact, all Mini-Circuits' products are available with CAPD specs.

## test setup is self checking

The heavy investment in CAPD, using a Hewlett-Packard Model 85 computer and HP8566A spectrum analyzer as key elements, allows the previously-mentioned, two-tone IM test to be completed in less than ten minutes compared with the manually performed sequence requiring 4-5 hours. Here's how stringent the computer-automated set up dictates each measurement: each point is measured three times, with a maximum allowable deviation of less than 0.05 dB between the three; otherwise the test is repeated. Before each measurement is taken, the computer checks the reference voltage level for any variation due to line voltage, temperature, etc., changes and compensates as required. Similarly, frequency is monitored before each test and any drift is automatically corrected. Such continuous and rapid inspection and correction ensure highly-reliable CAPD data. And, by using a large number of closely-spaced frequency points for component measurement, effects of narrow-band suck-outs or resonances (often missed with manual test procedures) are immediately identified.

 **Mini-Circuits**

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## a close-up view of performance

What's the significance of CAPD to the designer? Is it a sales "gimmick" or is it truly a design tool? Review these points and judge for yourself.

A competent RF/Microwave design engineer, drawing on his experience and expertise over years of varied projects, still must be concerned with unforeseen problems when the prototype is first turned on. Generation of spurious signals, changes in dc offset level, affects of LO drive variations and other vexing problems often become evident to extend delivery time and escalate costs. In many instance, a more precise definition of the component specs could have pinpointed the potential problem areas; with CAPD, it's now possible.

Let's assume you are specifying a double-balanced mixer for a wideband front-end design. Here are a number of profound questions you face:

- In a wideband design, the local oscillator (LO) output might vary over the band and could fall below the level required by the mixer spec. Should you spend additional money to flatten LO output or do you boost LO output if it is not sufficient?... Wouldn't it be valuable to know exactly how performance will be affected since you might find performance acceptable without any additional investment? with CAPD, a close point-by-point printout of key parameters as a function of LO level is available (fig. 1) — now you can make your decision based on a close-up, view of LO drive effects on mixer performance.
- How about VSWR over the full range of receiver specs? Generally, mixer VSWR specs are given at one particular frequency. With manual-test procedures, it's a time-consuming task for the components manufacturer or systems house; with CAPD it's available at no extra charge (fig. 2).
- How does the filter in the design match the mixer IF output and what is the impedance match in-band as well as out-of-band where spurious responses become a threat? CAPD VSWR data tells it all. How will the mixer conversion loss affect receiver sensitivity over the full frequency range? And, how will flatness of conversion loss affect the degree of image rejection in an image-reject mixer? CAPD data (fig. 1) will pinpoint these details.  
If the mixer is being used as a phase detector, it may be critical to know how dc offset voltage varies with frequency. Most mixer specs list dc offset at only one frequency; with CAPD, this parameter is given over the full range of frequency (fig. 4).
- Harmonic and intermod signals invariably plague your final design. The effects of, for example, a 4th

harmonic of the LO mixing with the 5th harmonic of the RF is given on many spec sheets, but at a specific LO and RF level. The effects of LO level changes might be crucial to your design; with manual point-by-point testing, extensive and costly technician test time would be demanded or, more likely, such tests just won't be performed. With CAPD capabilities, such intricate interactions are quickly run, and made available to the designer (fig. 3).

If you are specifying directional couplers and/or power splitter/combiners in your systems, you can now closely examine how VSWR, insertion loss, isolation and amplitude/phase unbalance vary at closely-spaced points over the frequency range of interest, (fig. 5). You can now evaluate the effects of the VSWR of the termination at the S-port and, another industry-first, inspect intermod data of a power splitter caused by saturation of the cores within the unit.

Amplifier performance is clearly shown with CAPD data as a function of dc power supply changes, (fig. 6). You'll be able to closely examine how VSWR, compression point and gain are influenced by dc supply fluctuations; this could reduce your power-supply costs, since it will conveniently point to the degree of voltage regulation required to meet the amplifier performance needed. Also, it's common to furnish amplifier specs over the frequency band of interest, but CAPD testing offers an opportunity to examine the amplifier characteristics, outside the band to foresee the effects of harmonic and spurious signals; for example, an amplifier that is flat to 1200 MHz offers what gain and what VSWR for second-harmonic 2400 MHz signals? Knowing these details can thwart potential systems problems.

Even a relatively common component such as an RF transformer is now available with CAPD data, (fig. 7). The significance...previously insertion loss vs frequency was considered flat over a specified frequency range. With closely spaced CAPD test prints, even slight variations which could affect systems performance become apparent.

## CAPD is your microscope

Look at CAPD as a microscope, revealing the "real world" details affecting your design decisions. Most important, CAPD was involved with one uppermost objective—to assist you, the design engineer, in producing a more effective end product. To accomplish this, you may require CAPD data at very specific frequency points not provided by our programmed steps. Not to worry...just furnish us with precise needs for your specific application. Be assured we'll do our best to comply.



# eliminating guesswork in systems design



CAPD (computer-automated performance data)

SRA-1 mixer

## mixer conversion loss and isolation

| RF<br>(MHz) | RF-Level<br>(dBm) | LO<br>(MHz) | C-LOSS (dB) |             |             |              | L-R (dB)    |             |             |              | L-I (dB)    |             |             |              |
|-------------|-------------------|-------------|-------------|-------------|-------------|--------------|-------------|-------------|-------------|--------------|-------------|-------------|-------------|--------------|
|             |                   |             | LO<br>+1dBm | LO<br>+4dBm | LO<br>+7dBm | LO<br>+10dBm | LO<br>+1dBm | LO<br>+4dBm | LO<br>+7dBm | LO<br>+10dBm | LO<br>+1dBm | LO<br>+4dBm | LO<br>+7dBm | LO<br>+10dBm |
| 10.00       | -14.97            | 40.00       | 6.84        | 6.21        | 5.48        | 5.73         | 48.83       | 51.66       | 56.57       | 56.14        | 48.48       | 51.72       | 56.14       | 55.84        |
| 35.78       | -14.92            | 65.78       | 7.32        | 6.68        | 5.71        | 5.91         | 49.28       | 51.47       | 54.93       | 54.83        | 48.04       | 50.90       | 54.75       | 53.93        |
| 61.56       | -14.97            | 91.56       | 6.96        | 6.30        | 5.82        | 5.76         | 49.31       | 50.86       | 53.42       | 51.81        | 48.16       | 49.62       | 52.86       | 51.92        |
| 87.34       | -14.96            | 57.34       | 6.99        | 6.38        | 5.77        | 5.86         | 49.40       | 51.62       | 54.58       | 55.74        | 48.70       | 50.97       | 54.02       | 54.69        |
| 113.12      | -14.96            | 83.12       | 6.65        | 6.73        | 5.66        | 6.01         | 49.23       | 51.39       | 54.09       | 52.15        | 48.11       | 50.40       | 53.81       | 52.37        |
| 138.90      | -14.95            | 108.90      | 6.10        | 5.52        | 5.81        | 5.05         | 49.03       | 50.58       | 52.04       | 50.35        | 48.10       | 48.84       | 51.56       | 50.73        |
| 164.68      | -14.96            | 134.68      | 6.49        | 5.56        | 5.77        | 5.16         | 48.24       | 49.50       | 48.19       | 48.13        | 47.47       | 48.08       | 48.20       | 48.64        |
| 190.46      | -15.02            | 160.46      | 6.14        | 5.41        | 5.62        | 5.01         | 47.61       | 48.20       | 46.85       | 46.44        | 46.51       | 47.18       | 46.27       | 46.53        |
| 216.24      | -14.96            | 186.24      | 6.03        | 5.49        | 5.85        | 5.11         | 47.27       | 45.80       | 44.88       | 45.34        | 44.96       | 46.25       | 44.72       | 45.78        |
| 242.02      | -14.99            | 212.02      | 7.11        | 6.53        | 5.91        | 6.05         | 46.49       | 44.25       | 43.74       | 43.47        | 44.64       | 44.80       | 43.20       | 43.56        |
| 267.80      | -14.92            | 237.80      | 6.88        | 6.33        | 5.79        | 5.87         | 45.17       | 43.44       | 42.49       | 42.93        | 44.18       | 44.21       | 42.27       | 43.21        |
| 293.58      | -14.96            | 263.58      | 7.08        | 6.61        | 6.01        | 6.17         | 42.69       | 42.29       | 40.93       | 40.87        | 42.63       | 42.74       | 40.33       | 40.79        |
| 319.36      | -15.00            | 289.36      | 6.97        | 6.41        | 6.03        | 6.04         | 41.59       | 40.77       | 38.59       | 39.64        | 41.75       | 41.10       | 39.70       | 39.51        |
| 345.14      | -14.97            | 315.14      | 7.41        | 6.71        | 5.99        | 6.26         | 39.60       | 39.02       | 37.93       | 37.84        | 41.39       | 40.74       | 38.97       | 38.82        |
| 370.92      | -14.95            | 340.92      | 7.58        | 6.91        | 6.62        | 6.17         | 40.15       | 38.78       | 37.22       | 37.21        | 41.67       | 39.80       | 39.26       | 37.44        |
| 396.70      | -15.00            | 366.70      | 8.22        | 7.42        | 6.93        | 6.39         | 39.81       | 38.10       | 36.79       | 35.84        | 40.85       | 38.81       | 37.86       | 37.46        |
| 422.48      | -14.97            | 392.48      | 8.46        | 6.99        | 7.27        | 5.57         | 39.50       | 38.16       | 36.76       | 35.79        | 38.93       | 36.27       | 34.74       | 36.69        |
| 448.26      | -14.96            | 418.26      | 9.44        | 7.80        | 7.76        | 6.22         | 39.02       | 37.60       | 36.14       | 36.29        | 38.29       | 36.00       | 34.76       | 33.54        |
| 474.04      | -15.02            | 444.04      | 10.04       | 8.03        | 8.13        | 6.49         | 39.39       | 38.03       | 37.53       | 36.73        | 36.78       | 34.93       | 35.30       | 33.84        |
| 500.00      | -14.92            | 470.00      | 10.31       | 8.43        | 8.10        | 6.84         | 41.24       | 40.71       | 40.19       | 40.14        | 36.15       | 34.30       | 33.89       | 33.63        |

FIG. 1

## mixer VSWR

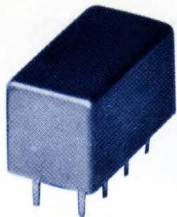
| Freq.<br>(MHz) | VSWR, RF port |             |              | VSWR, LO port |             |              | VSWR, IF port |             |              |
|----------------|---------------|-------------|--------------|---------------|-------------|--------------|---------------|-------------|--------------|
|                | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm |
| 500            | 2.57          |             | 2.52         | 3.57          |             | 3.82         | 1.37          |             | 1.07         |
| 5.000          | 1.16          |             |              | 2.28          |             |              | 1.16          |             |              |
| 26.789         | 1.06          | 1.08        | 1.25         | 1.41          | 2.28        | 3.09         | 1.43          | 1.19        | 1.09         |
| 53.079         | 1.12          | 1.13        | 1.24         | 1.33          | 2.10        | 2.99         | 1.41          | 1.24        | 1.14         |
| 79.368         | 1.18          | 1.18        | 1.27         | 1.37          | 2.08        | 3.24         | 1.46          | 1.29        | 1.21         |
| 105.658        | 1.30          | 1.23        | 1.43         | 1.37          | 2.13        | 2.82         | 1.73          | 1.37        | 1.37         |
| 131.947        | 1.35          | 1.29        | 1.46         | 1.42          | 2.16        | 3.01         | 1.77          | 1.47        | 1.45         |
| 158.237        | 1.41          | 1.35        | 1.49         | 1.47          | 2.12        | 3.07         | 1.82          | 1.54        | 1.47         |
| 184.526        | 1.48          | 1.42        | 1.53         | 1.46          | 2.12        | 2.73         | 1.96          | 1.67        | 1.59         |
| 210.816        | 1.53          | 1.47        | 1.57         | 1.53          | 2.16        | 2.83         | 2.09          | 1.74        | 1.67         |
| 237.105        | 1.78          | 1.53        | 1.80         | 1.53          | 2.19        | 2.77         | 2.67          | 1.82        | 1.99         |
| 263.395        | 1.81          | 1.62        | 1.84         | 1.57          | 2.19        | 2.61         | 2.60          | 1.95        | 2.00         |
| 289.684        | 1.65          | 1.70        | 1.66         | 1.64          | 2.19        | 2.72         | 2.23          | 2.07        | 1.83         |
| 315.974        | 1.82          | 1.76        | 1.78         | 1.67          | 2.22        | 2.52         | 2.74          | 2.16        | 2.08         |
| 342.263        | 1.88          | 1.83        | 1.84         | 1.79          | 2.32        | 2.55         | 2.94          | 2.25        | 2.21         |
| 368.553        | 1.96          | 1.87        | 1.90         | 1.77          | 2.40        | 2.56         | 3.15          | 2.29        | 2.35         |
| 394.842        | 2.00          | 1.92        | 1.91         | 1.70          | 2.43        | 2.44         | 3.11          | 2.36        | 2.31         |
| 421.132        | 1.75          | 2.02        | 1.71         | 1.66          | 2.43        | 2.54         | 2.47          | 2.48        | 2.00         |
| 447.421        | 1.91          | 2.04        | 1.85         | 1.61          | 2.40        | 2.44         | 3.15          | 2.41        | 2.35         |
| 473.710        | 2.06          | 2.03        | 1.94         | 1.57          | 2.35        | 2.39         | 3.56          | 2.35        | 2.47         |
| 500.000        | 1.94          | 2.07        | 1.85         | 1.47          | 2.32        | 2.37         | 3.12          | 2.37        | 2.30         |

FIG. 2

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## mixer harmonic intermodulation

(Relative to desired IF Output)

| Harmonic RF Order | RF CAL | LO at +4dBm       |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|-------------------|--------|-------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|                   |        | 0                 | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 |
| 0                 | 0      | —                 | 36 | 17 | 24 | 24 | 29 | 33 | 45 | 49 | 49 | 65 | 57 | 59 | 60 | 65 |
| 1                 | 0      | 18                | —  | 33 | 18 | 35 | 31 | 45 | 40 | 52 | 50 | 55 | 58 | 49 | 63 | 54 |
| 2                 | 74     | 42                | 49 | 41 | 63 | 45 | 57 | 57 | 58 | 55 | 67 | 69 | 72 | 72 | 71 | 70 |
| 3                 | 78     | 66                | 40 | 51 | 35 | 54 | 38 | 57 | 57 | 69 | 63 | 70 | 70 | 72 | 72 | 71 |
| 4                 | 79     | 68                | 72 | 66 | 69 | 63 | 69 | 63 | 69 | 71 | 72 | 67 | 71 | 70 | 70 | 71 |
| 5                 | 78     | 72                | 71 | 72 | 65 | 68 | 59 | 60 | 59 | 71 | 70 | 70 | 70 | 71 | 71 | 72 |
| 6                 | 77     | 70                | 71 | 71 | 72 | 73 | 72 | 73 | 72 | 71 | 71 | 72 | 71 | 70 | 71 | 70 |
| 7                 | 78     | 71                | 69 | 71 | 71 | 71 | 72 | 71 | 71 | 71 | 71 | 72 | 71 | 72 | 70 | 70 |
| 8                 | 78     | 72                | 71 | 71 | 70 | 71 | 71 | 70 | 71 | 72 | 71 | 72 | 71 | 71 | 70 | 72 |
| 9                 | 80     | 72                | 72 | 68 | 70 | 71 | 71 | 72 | 72 | 71 | 71 | 72 | 71 | 71 | 71 | 72 |
| 10                | 80     | 71                | 72 | 71 | 70 | 72 | 71 | 71 | 72 | 73 | 71 | 70 | 72 | 72 | 71 | 72 |
| 11                | 79     | 71                | 72 | 72 | 72 | 71 | 70 | 70 | 71 | 72 | 72 | 71 | 73 | 72 | 72 | 71 |
| 12                | 79     | 71                | 71 | 72 | 71 | 72 | 71 | 71 | 71 | 71 | 71 | 72 | 71 | 71 | 71 | 70 |
| 13                | 78     | 71                | 71 | 71 | 70 | 72 | 71 | 71 | 71 | 70 | 71 | 70 | 72 | 71 | 71 | 72 |
| 14                | 80     | 72                | 71 | 72 | 71 | 71 | 71 | 71 | 71 | 70 | 71 | 71 | 71 | 72 | 71 | 72 |
| 15                | 73     | 66                | 73 | 71 | 71 | 71 | 71 | 72 | 72 | 72 | 70 | 70 | 71 | 71 | 73 | 71 |
|                   |        | 0                 | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 |
|                   |        | Harmonic LO Order |    |    |    |    |    |    |    |    |    |    |    |    |    |    |

| Harmonic RF Order | RF CAL | LO at +7dBm       |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|-------------------|--------|-------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|                   |        | 0                 | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 |
| 0                 | 0      | —                 | 31 | 17 | 27 | 22 | 28 | 30 | 39 | 49 | 46 | 58 | 57 | 58 | 59 | 66 |
| 1                 | 0      | 17                | —  | 37 | 11 | 33 | 37 | 47 | 36 | 50 | 53 | 60 | 58 | 59 | 62 | 61 |
| 2                 | 74     | 48                | 47 | 50 | 52 | 49 | 60 | 56 | 58 | 50 | 69 | 65 | 72 | 73 | 72 | 71 |
| 3                 | 78     | 66                | 56 | 58 | 46 | 57 | 44 | 68 | 60 | 64 | 58 | 72 | 69 | 72 | 74 | 72 |
| 4                 | 79     | 71                | 71 | 72 | 70 | 73 | 69 | 70 | 72 | 73 | 73 | 71 | 72 | 71 | 73 | 72 |
| 5                 | 78     | 73                | 73 | 72 | 73 | 73 | 71 | 72 | 68 | 72 | 73 | 72 | 72 | 71 | 73 | 72 |
| 6                 | 77     | 73                | 71 | 72 | 71 | 73 | 73 | 73 | 73 | 72 | 73 | 72 | 74 | 73 | 73 | 71 |
| 7                 | 78     | 73                | 71 | 72 | 71 | 73 | 73 | 73 | 73 | 72 | 73 | 72 | 74 | 73 | 73 | 71 |
| 8                 | 78     | 74                | 72 | 72 | 71 | 74 | 74 | 73 | 71 | 72 | 73 | 72 | 72 | 73 | 73 | 72 |
| 9                 | 80     | 74                | 72 | 73 | 72 | 72 | 72 | 73 | 73 | 73 | 72 | 73 | 72 | 74 | 73 | 72 |
| 10                | 80     | 73                | 74 | 73 | 71 | 73 | 73 | 73 | 73 | 72 | 73 | 73 | 74 | 72 | 73 | 74 |
| 11                | 79     | 71                | 73 | 73 | 72 | 72 | 72 | 71 | 73 | 72 | 74 | 73 | 73 | 73 | 75 | 72 |
| 12                | 79     | 73                | 73 | 72 | 74 | 72 | 73 | 72 | 72 | 73 | 74 | 72 | 71 | 72 | 73 | 73 |
| 13                | 78     | 73                | 73 | 73 | 73 | 72 | 73 | 73 | 71 | 72 | 72 | 72 | 73 | 72 | 73 | 71 |
| 14                | 80     | 73                | 72 | 73 | 73 | 73 | 73 | 73 | 71 | 72 | 72 | 71 | 72 | 73 | 73 | 72 |
| 15                | 73     | 66                | 73 | 72 | 73 | 73 | 73 | 73 | 73 | 73 | 72 | 71 | 71 | 73 | 73 | 72 |
|                   |        | 0                 | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 |
|                   |        | Harmonic LO Order |    |    |    |    |    |    |    |    |    |    |    |    |    |    |

| Harmonic RF Order | RF CAL | LO at +10dBm      |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|-------------------|--------|-------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|                   |        | 0                 | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 |
| 0                 | 0      | —                 | 26 | 13 | 25 | 16 | 21 | 21 | 34 | 43 | 38 | 61 | 48 | 54 | 50 | 54 |
| 1                 | 0      | 19                | —  | 42 | 10 | 30 | 30 | 39 | 34 | 49 | 50 | 52 | 58 | 57 | 59 | 60 |
| 2                 | 74     | 63                | 53 | 71 | 59 | 58 | 62 | 58 | 59 | 54 | 71 | 66 | 71 | 73 | 73 | 74 |
| 3                 | 78     | 69                | 63 | 70 | 69 | 73 | 64 | 72 | 72 | 70 | 63 | 71 | 71 | 73 | 74 | 74 |
| 4                 | 79     | 72                | 73 | 74 | 72 | 73 | 73 | 74 | 73 | 72 | 72 | 71 | 72 | 73 | 72 | 73 |
| 5                 | 78     | 72                | 72 | 74 | 74 | 74 | 72 | 73 | 73 | 72 | 72 | 72 | 73 | 73 | 73 | 72 |
| 6                 | 77     | 71                | 72 | 73 | 72 | 73 | 73 | 72 | 73 | 74 | 73 | 72 | 72 | 72 | 72 | 73 |
| 7                 | 78     | 72                | 72 | 71 | 73 | 72 | 73 | 73 | 74 | 73 | 73 | 74 | 72 | 71 | 73 | 72 |
| 8                 | 78     | 72                | 71 | 72 | 72 | 72 | 74 | 73 | 73 | 73 | 73 | 73 | 71 | 72 | 73 | 73 |
| 9                 | 80     | 74                | 71 | 71 | 71 | 72 | 73 | 73 | 71 | 73 | 73 | 71 | 73 | 73 | 72 | 73 |
| 10                | 80     | 73                | 73 | 72 | 72 | 74 | 72 | 73 | 71 | 74 | 74 | 73 | 74 | 71 | 74 | 73 |
| 11                | 79     | 73                | 73 | 72 | 73 | 73 | 73 | 71 | 70 | 74 | 73 | 72 | 72 | 74 | 74 | 73 |
| 12                | 79     | 73                | 73 | 73 | 73 | 73 | 73 | 72 | 71 | 73 | 74 | 73 | 73 | 72 | 72 | 71 |
| 13                | 78     | 73                | 73 | 74 | 72 | 73 | 72 | 73 | 72 | 72 | 71 | 73 | 74 | 72 | 73 | 73 |
| 14                | 80     | 72                | 73 | 72 | 74 | 74 | 74 | 73 | 71 | 72 | 73 | 71 | 72 | 72 | 74 | 73 |
| 15                | 73     | 66                | 73 | 73 | 73 | 72 | 73 | 73 | 73 | 72 | 73 | 73 | 72 | 72 | 73 | 72 |
|                   |        | 0                 | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 |
|                   |        | Harmonic LO Order |    |    |    |    |    |    |    |    |    |    |    |    |    |    |

### test conditions

RF = 400.1 MHz at -10dBm

LO = 370.01 MHz

For other test frequencies, contact factory.

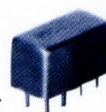
FIG 3



# eliminating guesswork in systems design



CAPD (computer-automated performance data)



SRA-1 mixer

## mixer phase detection (+7 dBm) model SRA-1

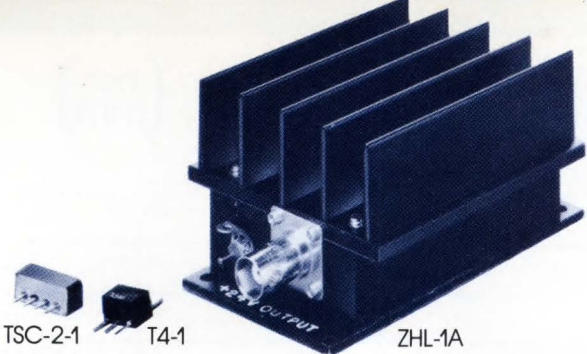
max. output/DC offset Vs. freq.

output voltage Vs. phase, 10 MHz

| Freq.<br>(MHz) | max. DC output<br>mV | DC offset<br>mV | Phase,<br>degrees | output,<br>mV |
|----------------|----------------------|-----------------|-------------------|---------------|
| 10.00          | -262.53              | - .57           | 0 deg.            | -262 mVOLT    |
| 30.42          | -263.46              | - .54           | 10 deg.           | -258 mVOLT    |
| 50.83          | -260.71              | - .54           | 20 deg.           | -246 mVOLT    |
| 71.25          | -260.38              | - .51           | 30 deg.           | -227 mVOLT    |
| 91.67          | -264.70              | - .46           | 40 deg.           | -200 mVOLT    |
| 112.08         | -265.05              | - .42           | 50 deg.           | -168 mVOLT    |
| 132.50         | -266.23              | - .38           | 60 deg.           | -131 mVOLT    |
| 152.92         | -263.79              | - .34           | 70 deg.           | -89 mVOLT     |
| 173.33         | -263.92              | - .34           | 80 deg.           | -45 mVOLT     |
| 193.75         | -268.92              | - .37           | 90 deg.           | 0.6 mVOLT     |
| 214.17         | -274.08              | - .32           | 100 deg.          | 46 mVOLT      |
| 234.58         | -276.75              | - .33           | 110 deg.          | 90 mVOLT      |
| 255.00         | -275.81              | - .53           | 120 deg.          | 132 mVOLT     |
| 275.42         | -270.65              | - .63           | 130 deg.          | 169 mVOLT     |
| 295.83         | -266.67              | - .35           | 140 deg.          | 202 mVOLT     |
| 316.25         | -256.71              | - .52           | 150 deg.          | 228 mVOLT     |
| 336.67         | -251.84              | - .82           | 160 deg.          | 247 mVOLT     |
| 357.08         | -236.17              | - .63           | 170 deg.          | 259 mVOLT     |
| 377.50         | -228.06              | -1.01           | 180 deg.          | 263 mVOLT     |
| 397.92         | -217.55              | -1.38           | 190 deg.          | 259 mVOLT     |
| 418.33         | -214.55              | -1.88           | 200 deg.          | 247 mVOLT     |
| 438.75         | -214.43              | -1.58           | 210 deg.          | 228 mVOLT     |
| 459.17         | -210.65              | -1.86           | 220 deg.          | 292 mVOLT     |
| 479.58         | -206.27              | -2.74           | 230 deg.          | 169 mVOLT     |
| 500.00         | -204.64              | -2.69           | 240 deg.          | 132 mVOLT     |
|                |                      |                 | 250 deg.          | 90 mVOLT      |
|                |                      |                 | 260 deg.          | 46 mVOLT      |
|                |                      |                 | 270 deg.          | 0.6 mVOLT     |
|                |                      |                 | 280 deg.          | -45 mVOLT     |
|                |                      |                 | 290 deg.          | -89 mVOLT     |
|                |                      |                 | 300 deg.          | -131 mVOLT    |
|                |                      |                 | 310 deg.          | -168 mVOLT    |
|                |                      |                 | 320 deg.          | -200 mVOLT    |
|                |                      |                 | 330 deg.          | -227 mVOLT    |
|                |                      |                 | 340 deg.          | -246 mVOLT    |
|                |                      |                 | 350 deg.          | -258 mVOLT    |
|                |                      |                 | 360 deg.          | -262 mVOLT    |

FIG. 4





## power splitter/combiners

model TSC-2-1

Insertion loss,  
Amplitude Unbalance, Isolation

| MHz    | REF. (dBm) | S-1 (dB) | S-2 (dB) | Unbal. (dB) | ISO (dB) |
|--------|------------|----------|----------|-------------|----------|
| 1.00   | -4.99      | 3.25     | 3.21     | -.04        | 36.02    |
| 22.00  | -4.95      | 3.20     | 3.20     | 0.00        | 46.30    |
| 43.00  | -4.97      | 3.24     | 3.21     | -.03        | 40.42    |
| 64.00  | -4.99      | 3.25     | 3.25     | 0.00        | 36.77    |
| 85.00  | -4.92      | 3.30     | 3.29     | -.01        | 34.79    |
| 106.00 | -4.99      | 3.28     | 3.28     | 0.00        | 33.30    |
| 127.00 | -5.06      | 3.29     | 3.32     | .03         | 32.27    |
| 148.00 | -5.02      | 3.31     | 3.33     | .02         | 31.51    |
| 169.00 | -5.02      | 3.31     | 3.36     | .05         | 30.95    |
| 190.00 | -5.08      | 3.30     | 3.40     | .10         | 30.64    |
| 211.00 | -4.91      | 3.30     | 3.44     | .14         | 30.51    |
| 232.00 | -4.91      | 3.30     | 3.47     | .17         | 30.62    |
| 253.00 | -4.99      | 3.33     | 3.49     | .16         | 31.06    |
| 274.00 | -4.96      | 3.34     | 3.52     | .18         | 31.94    |
| 295.00 | -5.03      | 3.32     | 3.57     | .25         | 33.35    |
| 316.00 | -4.95      | 3.39     | 3.62     | .23         | 35.36    |
| 337.00 | -5.02      | 3.39     | 3.67     | .28         | 39.90    |
| 358.00 | -4.95      | 3.40     | 3.78     | .38         | 45.13    |
| 379.00 | -5.00      | 3.44     | 3.83     | .39         | 40.23    |
| 400.00 | -4.00      | 3.49     | 3.97     | .48         | 32.15    |

VSWR

| MHz    | S    | 1    | 2    |
|--------|------|------|------|
| 5.00   | 1.12 | 1.12 | 1.12 |
| 25.78  | 1.13 | 1.11 | 1.11 |
| 46.56  | 1.13 | 1.10 | 1.10 |
| 67.34  | 1.12 | 1.09 | 1.09 |
| 88.12  | 1.12 | 1.09 | 1.09 |
| 108.90 | 1.12 | 1.09 | 1.09 |
| 129.68 | 1.11 | 1.08 | 1.10 |
| 150.46 | 1.11 | 1.08 | 1.10 |
| 171.24 | 1.10 | 1.08 | 1.11 |
| 192.02 | 1.10 | 1.08 | 1.12 |
| 212.80 | 1.09 | 1.08 | 1.14 |
| 233.58 | 1.10 | 1.09 | 1.16 |
| 254.36 | 1.11 | 1.11 | 1.16 |
| 275.14 | 1.12 | 1.13 | 1.18 |
| 295.92 | 1.15 | 1.15 | 1.21 |
| 316.70 | 1.18 | 1.18 | 1.24 |
| 337.48 | 1.22 | 1.21 | 1.28 |
| 358.26 | 1.27 | 1.24 | 1.31 |
| 379.04 | 1.32 | 1.28 | 1.35 |
| 400.00 | 1.39 | 1.33 | 1.40 |

FIG. 5

## RF transformers

model T4-1

Insertion loss

| MHz     | REF. (dBm) | I.L. (dB) |
|---------|------------|-----------|
| .200    | -14.95     | 3.29      |
| .350    | -14.92     | 2.34      |
| 2.001   | -15.03     | 1.58      |
| 18.612  | -14.97     | 1.21      |
| 37.021  | -14.99     | 1.30      |
| 55.433  | -15.03     | 1.37      |
| 73.843  | -14.99     | 1.39      |
| 92.253  | -15.02     | 1.49      |
| 100.001 | -14.99     | 1.50      |
| 110.661 | -14.96     | 1.67      |
| 129.070 | -15.06     | 1.71      |
| 147.480 | -14.98     | 1.73      |
| 165.890 | -15.09     | 1.85      |
| 184.310 | -14.93     | 2.04      |
| 202.720 | -15.00     | 2.07      |
| 221.131 | -15.09     | 2.12      |
| 239.540 | -14.94     | 2.29      |
| 257.850 | -15.06     | 2.43      |
| 276.359 | -14.93     | 2.49      |
| 294.770 | -15.03     | 2.54      |
| 299.999 | -15.03     | 2.59      |
| 313.180 | -15.03     | 2.71      |
| 331.590 | -15.09     | 2.79      |
| 350.000 | -14.96     | 2.81      |

REMARK: 2 units connected back to back

FIG. 7

## power amplifiers

model ZHL-1A

| FREQ. (MHz) | GAIN (dB) |       |       |       | REVERSE GAIN (dB) |       |       |       | VSWR (IN) |       |      |      | VSWR (OUT) |      |      |      |
|-------------|-----------|-------|-------|-------|-------------------|-------|-------|-------|-----------|-------|------|------|------------|------|------|------|
|             | 12V       | 15V   | 20V   | 24V   | 12V               | 15V   | 20V   | 24V   | 12V       | 15V   | 20V  | 24V  | 12V        | 15V  | 20V  | 24V  |
| 2.00        | 17.90     | 18.27 | 18.46 | 18.52 | 29.03             | 29.07 | 28.96 | 28.88 | 1.09      | 1.13  | 1.14 | 1.14 | 1.10       | 1.16 | 1.15 | 1.15 |
| 28.21       | 17.88     | 18.27 | 18.48 | 18.52 | 29.53             | 29.72 | 29.54 | 29.24 | 1.09      | 1.11  | 1.13 | 1.14 | 1.20       | 1.19 | 1.19 | 1.18 |
| 54.42       | 17.88     | 18.33 | 18.54 | 18.59 | 29.57             | 29.62 | 29.58 | 29.39 | 1.12      | 1.12  | 1.13 | 1.14 | 1.24       | 1.24 | 1.24 | 1.24 |
| 80.63       | 17.94     | 18.41 | 18.65 | 18.70 | 29.91             | 29.78 | 29.64 | 29.56 | 1.19      | 1.17  | 1.16 | 1.16 | 1.30       | 1.29 | 1.30 | 1.30 |
| 106.84      | 17.90     | 18.41 | 18.69 | 18.78 | 29.85             | 30.12 | 29.97 | 29.75 | 1.31      | 1.24  | 1.21 | 1.21 | 1.36       | 1.36 | 1.37 | 1.37 |
| 133.05      | 17.91     | 18.42 | 18.75 | 18.83 | 30.02             | 30.06 | 30.15 | 29.87 | 1.42      | 1.32  | 1.28 | 1.27 | 1.41       | 1.41 | 1.42 | 1.44 |
| 159.26      | 17.68     | 18.34 | 18.71 | 18.81 | 30.25             | 30.32 | 30.03 | 30.00 | 1.56      | 1.42  | 1.36 | 1.34 | 1.46       | 1.48 | 1.50 | 1.52 |
| 185.47      | 17.64     | 18.34 | 18.78 | 18.84 | 30.50             | 30.36 | 30.12 | 29.99 | 1.71      | 1.553 | 1.45 | 1.43 | 1.50       | 1.53 | 1.57 | 1.60 |
| 211.68      | 17.52     | 18.25 | 18.74 | 18.82 | 30.50             | 30.64 | 30.19 | 30.05 | 1.83      | 1.63  | 1.52 | 1.50 | 1.51       | 1.56 | 1.63 | 1.67 |
| 237.89      | 17.46     | 18.20 | 18.73 | 18.81 | 30.85             | 30.64 | 30.35 | 30.32 | 1.96      | 1.72  | 1.59 | 1.57 | 1.52       | 1.58 | 1.67 | 1.73 |
| 264.10      | 17.34     | 18.09 | 18.66 | 18.74 | 30.99             | 30.75 | 30.40 | 30.43 | 2.04      | 1.79  | 1.64 | 1.62 | 1.48       | 1.56 | 1.66 | 1.75 |
| 290.31      | 17.28     | 18.03 | 18.58 | 18.69 | 31.08             | 30.89 | 30.66 | 30.58 | 2.14      | 1.86  | 1.69 | 1.66 | 1.44       | 1.53 | 1.66 | 1.76 |
| 316.52      | 17.33     | 18.08 | 18.69 | 18.79 | 30.64             | 30.77 | 30.51 | 30.49 | 2.16      | 1.88  | 1.70 | 1.67 | 1.40       | 1.50 | 1.64 | 1.75 |
| 342.73      | 17.32     | 18.06 | 18.69 | 18.79 | 30.50             | 30.44 | 30.41 | 30.44 | 2.17      | 1.87  | 1.69 | 1.65 | 1.33       | 1.43 | 1.59 | 1.71 |
| 368.94      | 17.30     | 18.04 | 18.71 | 18.77 | 30.09             | 30.23 | 30.24 | 30.27 | 2.09      | 1.81  | 1.63 | 1.59 | 1.27       | 1.35 | 1.49 | 1.62 |
| 395.15      | 17.23     | 18.02 | 18.67 | 18.82 | 29.81             | 29.95 | 29.91 | 30.18 | 2.03      | 1.75  | 1.57 | 1.53 | 1.24       | 1.28 | 1.41 | 1.55 |
| 421.36      | 17.32     | 18.13 | 18.83 | 18.98 | 29.19             | 29.36 | 29.52 | 29.85 | 1.96      | 1.68  | 1.49 | 1.44 | 1.32       | 1.29 | 1.36 | 1.50 |
| 447.57      | 17.37     | 18.23 | 18.96 | 19.08 | 28.50             | 28.79 | 29.05 | 29.22 | 1.90      | 1.61  | 1.41 | 1.36 | 1.47       | 1.36 | 1.34 | 1.43 |
| 473.78      | 17.17     | 18.10 | 18.90 | 19.08 | 27.94             | 28.28 | 28.64 | 28.82 | 1.93      | 1.64  | 1.42 | 1.37 | 1.68       | 1.51 | 1.39 | 1.42 |
| 500.00      | 17.07     | 18.14 | 19.06 | 19.26 | 27.68             | 27.17 | 28.22 | 28.50 | 2.07      | 1.79  | 1.57 | 1.54 | 1.01       | 1.79 | 1.61 | 1.58 |

FIG. 6



# case style outline dimensions (inch mm)

| case no. | A              | B              | C             | D             | E             | F              | G            | H              | J             | K            | L            | M              | N             | P            | Q             | R             | S            | T | wt. grams | NOTES*                     |
|----------|----------------|----------------|---------------|---------------|---------------|----------------|--------------|----------------|---------------|--------------|--------------|----------------|---------------|--------------|---------------|---------------|--------------|---|-----------|----------------------------|
| A01      | .770<br>19.56  | .800<br>20.32  | .385<br>9.78  | .400<br>10.16 | .370<br>9.40  | .400<br>10.16  | .200<br>5.08 | .20<br>5.08    | .14<br>3.56   | .031<br>.79  |              |                |               |              |               |               |              |   | 5.2       | A1                         |
| A03      | .480<br>12.20  | .500<br>12.70  | .390<br>9.91  | .405<br>10.29 | .210<br>5.34  | .230<br>5.85   | .100<br>2.54 | .20<br>5.08    | .14<br>3.56   | .020<br>.51  |              |                |               |              |               |               |              |   | 2.3       | A1                         |
| A04      | .770<br>19.56  | .800<br>20.32  | .200<br>5.08  | .210<br>5.33  | .370<br>9.40  | .400<br>10.16  | .200<br>5.08 | .20<br>5.08    | .14<br>3.56   | .031<br>.79  |              |                |               |              |               |               |              |   | 3.7       | A1                         |
| A05      | .770<br>19.56  | .800<br>20.32  | .240<br>6.10  | .250<br>6.35  | .370<br>9.40  | .400<br>10.16  | .200<br>5.08 | .20<br>5.08    | .14<br>3.56   | .031<br>.79  |              |                |               |              |               |               |              |   | 3.7       | A1                         |
| A06      | .770<br>19.56  | .800<br>20.32  | .285<br>7.24  | .310<br>7.88  | .370<br>9.40  | .400<br>10.16  | .200<br>5.08 | .20<br>5.08    | .14<br>3.56   | .031<br>.79  |              |                |               |              |               |               |              |   | 5.2       | A1                         |
| A11      | .480<br>12.20  | .500<br>12.70  | .240<br>6.10  | .255<br>6.48  | .210<br>5.34  | .230<br>5.85   | .100<br>2.54 | .20<br>5.08    | .14<br>3.56   | .020<br>.51  |              |                |               |              |               |               |              |   | 1.9       | A1                         |
| B02      | .480<br>12.20  | .500<br>12.70  | .240<br>6.10  | .255<br>6.48  | .210<br>5.34  | .230<br>5.85   | .16<br>4.07  | .100<br>2.54   | .14<br>3.56   | .20<br>5.08  | .020<br>.51  |                |               |              |               |               |              |   | 1.9       | A1                         |
| B13      | .480<br>12.20  | .500<br>12.70  | .390<br>9.91  | .405<br>10.29 | .210<br>5.34  | .230<br>5.85   | .16<br>4.07  | .100<br>2.54   | .14<br>3.56   | .20<br>5.08  | .020<br>.51  |                |               |              |               |               |              |   | 2.3       | A1                         |
| C07      | .770<br>19.56  | .810<br>20.58  | .380<br>9.66  | .410<br>10.42 | .030<br>.77   | .200<br>5.08   | .20<br>5.08  | .14<br>3.56    |               |              |              |                |               |              |               |               |              |   | 11.0      | A1                         |
| D08      | 1.000<br>25.40 | 1.025<br>26.04 | .390<br>9.91  | .430<br>10.93 | .500<br>12.70 | .525<br>13.34  | .025<br>.64  | .300<br>7.62   | .200<br>5.08  | .09<br>2.29  | .13<br>3.31  | .150<br>3.81   | .20<br>5.08   | .14<br>3.56  |               |               |              |   | 8.5       | A1                         |
| D09      | 1.000<br>25.40 | 1.025<br>26.04 | .240<br>6.10  | .280<br>7.12  | .500<br>12.70 | .525<br>13.34  | .025<br>.64  | .300<br>7.62   | .200<br>5.08  | .09<br>2.29  | .13<br>3.31  | .150<br>3.81   | .20<br>5.08   | .14<br>3.56  |               |               |              |   | 7.5       | A1                         |
| E10      | 1.540<br>39.12 | 1.620<br>41.15 | .380<br>9.66  | .410<br>10.42 | .770<br>19.56 | .810<br>20.58  | .030<br>.77  | .200<br>5.08   | .10<br>2.54   | .20<br>5.08  | .14<br>3.56  |                |               |              |               |               |              |   | 23.0      | A1                         |
| F14      | 2.00<br>50.80  | 2.00<br>50.80  | .75<br>19.05  | 1.00<br>25.40 | .25<br>6.35   | 1.500<br>38.10 | .13<br>3.31  | .39<br>9.91    |               |              |              |                |               |              |               |               |              |   | 170.0     | A4, B1, D2                 |
| F53      | 2.00<br>50.80  | 2.00<br>50.80  | .75<br>19.05  | 1.00<br>25.40 | .13<br>3.31   | 1.750<br>44.45 | .13<br>3.31  | .39<br>9.91    |               |              |              |                |               |              |               |               |              |   | 170.0     | A4, B1, D2                 |
| G15      | 1.25<br>31.75  | 1.25<br>31.75  | .75<br>19.05  | .63<br>16.01  | .38<br>9.66   | .63<br>16.01   | —            | .800<br>20.32  | .800<br>20.32 | .76<br>19.31 | .125<br>3.18 | 1.688<br>42.88 | 2.18<br>55.38 | .75<br>19.05 | .07<br>1.78   |               |              |   | 85.0      | A4, B1, D1                 |
| H16      | 1.25<br>31.75  | 1.25<br>31.75  | .75<br>19.05  | .63<br>16.01  | .38<br>9.66   | 1.000<br>25.40 | .125<br>3.18 | 1.000<br>25.40 | —             | —            | .125<br>3.18 | 1.688<br>42.88 | 2.18<br>55.38 | .75<br>19.05 | .07<br>1.78   |               |              |   | 70.0      | A4, A5, B1<br>D2, D3, D4   |
| J17      | 1.25<br>31.75  | 1.25<br>31.75  | .75<br>19.05  | .63<br>16.01  | .38<br>9.66   | 1.000<br>25.40 | .125<br>3.18 | 1.000<br>25.40 | —             | —            | .125<br>3.18 | 1.688<br>42.88 | 2.18<br>55.38 | .75<br>19.05 | .07<br>1.78   |               |              |   | 75.0      | A4 or A5<br>B1, D2, D3     |
| K18      | 1.25<br>31.75  | 1.25<br>31.75  | .75<br>19.05  | .63<br>16.01  | .38<br>9.66   | 1.000<br>25.40 | .125<br>3.18 | 1.000<br>25.40 | —             | —            | .125<br>3.18 | 1.688<br>42.88 | 2.18<br>55.38 | .75<br>19.05 | .07<br>1.78   |               |              |   | 70.0      | A4 or A5<br>B1, C1, D2, D3 |
| L19      | 1.50<br>38.10  | 1.13<br>28.70  | .97<br>24.64  | .50<br>12.70  | .155<br>3.94  | 2.345<br>59.57 | .138<br>3.51 | .987<br>25.07  | 2.50<br>63.50 | .10<br>2.54  | .31<br>7.88  | 1.19<br>30.23  | —             | .66<br>16.77 | —             | —             | .150<br>3.81 |   | 37.0      | A4 or A6<br>B2, D6         |
| L20      | 2.25<br>57.15  | 1.38<br>35.05  | 1.21<br>30.74 | .50<br>12.70  | .150<br>3.81  | 3.100<br>78.74 | .138<br>3.51 | 1.238<br>31.45 | 3.25<br>82.55 | .10<br>2.54  | .40<br>10.16 | 1.86<br>47.25  | —             | .64<br>16.26 | —             | —             | .150<br>3.81 |   | 74.0      | A4 or A6<br>B2, D5         |
| M21      | 1.50<br>38.10  | 1.13<br>28.70  | .97<br>24.64  | .50<br>12.70  | .155<br>3.94  | 2.345<br>59.57 | .138<br>3.51 | .987<br>25.07  | 2.50<br>63.50 | .10<br>2.54  | .31<br>7.88  | .75<br>19.05   | 1.19<br>30.23 | .66<br>16.76 | —             | —             | .150<br>3.81 |   | 40.0      | A4 or A6<br>B2, C1, D6     |
| M22      | 2.25<br>57.15  | 1.38<br>35.05  | 1.21<br>30.74 | .50<br>12.70  | .150<br>3.81  | 3.100<br>78.74 | .138<br>3.51 | 1.238<br>31.45 | 3.25<br>82.55 | .10<br>2.54  | .40<br>10.16 | 1.15<br>29.21  | 1.86<br>47.25 | .64<br>16.26 | —             | —             | .150<br>3.81 |   | 74.0      | A4 or A6<br>B2, C1, D5     |
| M23      | 2.25<br>57.15  | 1.38<br>35.05  | 1.21<br>30.74 | .50<br>12.70  | .150<br>3.81  | 3.100<br>78.74 | .138<br>3.51 | 1.238<br>31.45 | 3.25<br>82.55 | .10<br>2.54  | .63<br>16.00 | 1.06<br>26.93  | 1.63<br>41.40 | .69<br>17.53 | —             | —             | .150<br>3.81 |   | 70.0      | A4 or A6<br>B2, C1, D6     |
| N24      | 1.50<br>38.10  | 1.13<br>28.70  | .97<br>24.64  | .50<br>12.70  | .155<br>3.94  | 2.345<br>59.57 | .138<br>3.51 | .987<br>25.07  | 2.50<br>63.50 | .10<br>2.54  | .32<br>8.13  | .75<br>19.05   | 1.18<br>29.97 | .31<br>7.88  | .56<br>14.23  | .81<br>20.58  | .150<br>3.81 |   | 45.0      | A4 or A6<br>B2, D6         |
| N27      | 2.25<br>57.15  | 1.38<br>35.05  | 1.21<br>30.74 | .50<br>12.70  | .150<br>3.81  | 3.100<br>78.74 | .138<br>3.51 | 1.238<br>31.45 | 3.25<br>82.55 | .10<br>2.54  | .42<br>10.67 | 1.13<br>28.70  | 1.84<br>46.74 | .38<br>9.65  | .69<br>17.53  | 1.00<br>25.40 | .150<br>3.81 |   | 92.0      | A4 or A6<br>B2, D7         |
| P25      | 2.25<br>57.15  | 1.38<br>35.05  | 1.21<br>30.74 | .50<br>12.70  | .150<br>3.81  | 3.100<br>78.74 | .138<br>3.51 | 1.238<br>31.45 | 3.25<br>82.55 | .10<br>2.54  | .78<br>19.81 | 1.47<br>37.34  | —             | .38<br>9.65  | 1.00<br>25.40 | —             | .150<br>3.81 |   | 86.0      | A4 or A6<br>B2, D7         |
| P26      | 1.50<br>38.10  | 1.13<br>28.70  | .97<br>24.64  | .50<br>12.70  | .155<br>3.94  | 2.345<br>59.57 | .138<br>3.51 | .987<br>25.07  | 2.50<br>63.50 | .10<br>2.54  | .50<br>12.70 | 1.00<br>25.40  | —             | .31<br>7.88  | .81<br>20.58  | —             | .150<br>3.81 |   | 42.5      | A4 or A6<br>B2, D6         |
| Q28      | 40.6<br>103.13 | 1.60<br>40.64  | 1.50<br>38.10 | 3.56<br>90.43 | .25<br>6.35   | .88<br>22.35   | .36<br>9.15  | .160<br>4.07   | .40<br>10.16  | .69<br>17.53 | .58<br>14.73 | .66<br>16.77   | 3.13<br>79.50 | .81<br>20.58 | .06<br>1.53   |               |              |   | 300.0     | A5, D8                     |

tolerance  $x \pm .1$   $xx \pm .03$   $xxx \pm .015$

oz. = grams x .0353

## \*NOTES:

### MATERIAL & FINISH

A1. Header material CRS; Pin material: #52 alloy.

Finish: electro tin hot-oil flowed, Cover material: cupro-nickel.

A4. Case material aluminum. Finish: iridite.

A5. Case material CRS. Finish: baked grey enamel over hot-tin dip.

A6. Case material aluminum. Finish: blue baked enamel over phosphoric etch per MIL-C-15328.

### MOUNTING

B1. Mounting bracket available on request. Add suffix B to part number.

B2. Mounting bracket available on request. Add suffix B to part number. Add \$1.50 to unit cost.

### MARKING

C1. For port markings 1, 2, and 3 see specification data sheet.

### CONNECTORS

D1. Connectors: SMA Standard. BNC on request (no charge). Male SMA on request (add \$5.00 to unit cost).

D2. Connectors: please specify, unless otherwise noted; BNC is standard, TNC no charge, SMA and Type N add \$5.00 per unit. (ZAPD only, Dash - 4 units not available with BNC).

D3. For Type N or TNC connectors this dimension, "C", changes from 0.75 to 0.94 inches.

D4. Isolated BNC connectors are standard, FTB models only.

D5. Connectors: BNC standard, TNC on request (no charge).

D6. Connectors: Female SMA only. Male SMA available on request, consult factory.

D7. Connectors: BNC only.

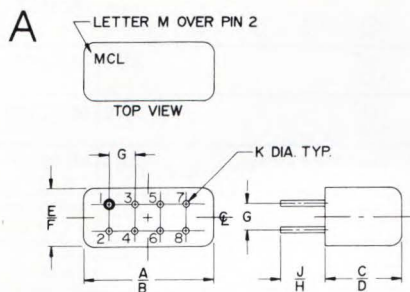
D8. Connectors: BNC standard, TNC on request (add \$10.00 to unit cost), Female SMA on request (add \$15.00 to unit cost).

D9. Male BNC, Male N available: (add \$2.00 to unit price. Specify ports for Male connectors).

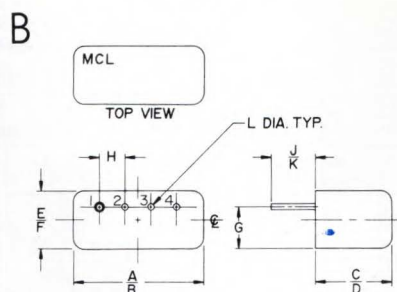


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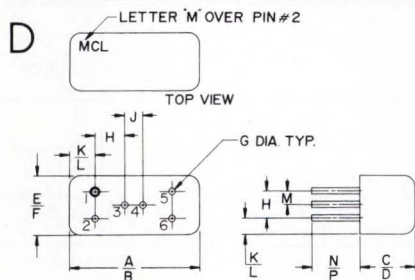
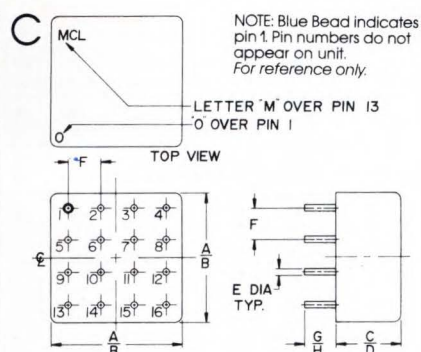




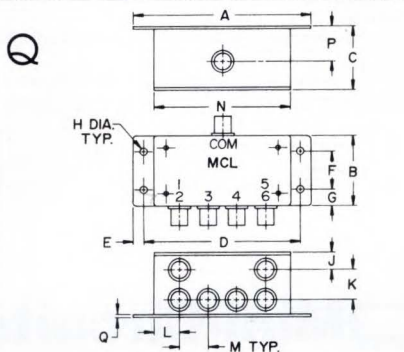
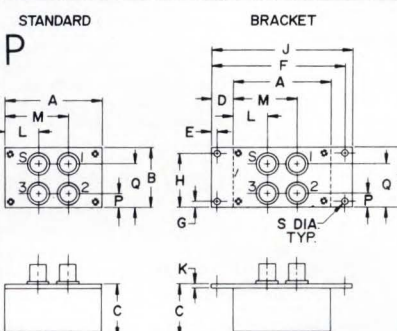
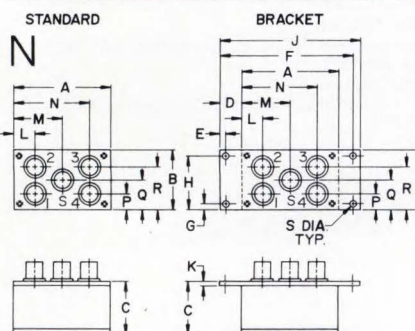
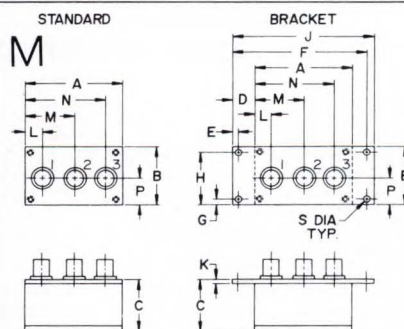
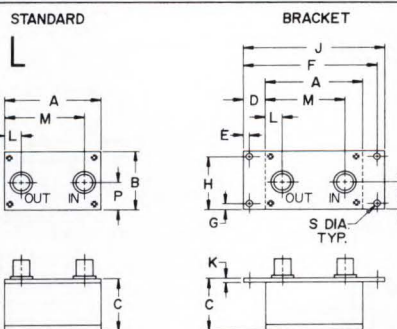
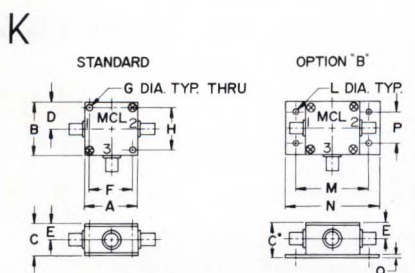
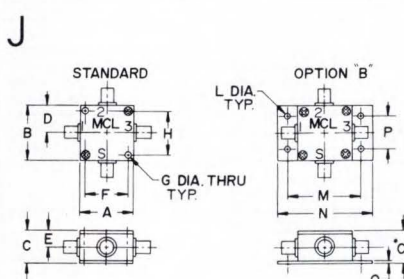
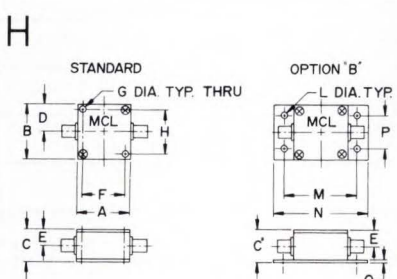
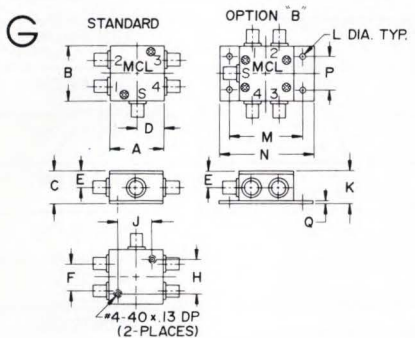
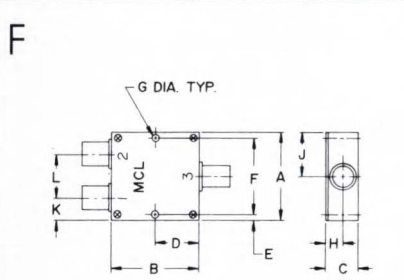
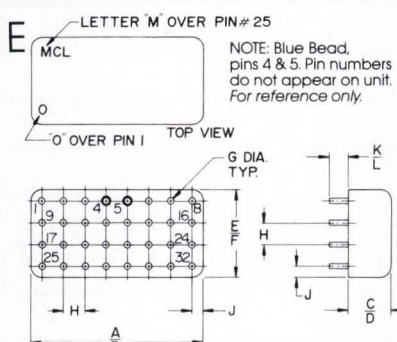
NOTE: Blue Bead indicates pin 1. Pin numbers do not appear on unit. For reference only.



NOTE: Blue Bead indicates pin 1. Pin numbers do not appear on unit. For reference only.



NOTE: Blue Bead indicates pin 1. Pin numbers do not appear on unit. For reference only.





# case style outline dimensions (inch mm)

| case no. | A              | B             | C             | D              | E               | F               | G               | H              | J              | K             | L             | M              | N              | P             | Q            | R              | S             | T              | wt. grams. | NOTES*      |
|----------|----------------|---------------|---------------|----------------|-----------------|-----------------|-----------------|----------------|----------------|---------------|---------------|----------------|----------------|---------------|--------------|----------------|---------------|----------------|------------|-------------|
| R 29     | 4.06<br>103.13 | 1.60<br>40.64 | 1.50<br>38.10 | 3.56<br>90.43  | .25<br>6.35     | .88<br>22.35    | .36<br>9.15     | .160<br>4.07   | .40<br>10.16   | .69<br>17.53  | .58<br>14.73  | .66<br>16.77   | 3.13<br>79.50  | .81<br>20.58  | .06<br>1.53  |                |               |                | 300.0      | A1, C2, D9  |
| R 30     | 6.69<br>169.93 | 1.60<br>40.64 | 1.50<br>38.10 | 6.22<br>157.99 | .25<br>6.35     | .88<br>22.35    | .36<br>9.15     | .160<br>4.07   | .40<br>10.16   | .69<br>17.53  | .55<br>13.97  | .66<br>16.77   | 5.72<br>145.29 | .81<br>20.58  | .06<br>1.53  |                |               |                | 500.0      | A5, C2, D10 |
| R 31     | 9.31<br>236.98 | 1.60<br>40.64 | 1.50<br>38.10 | 8.84<br>224.54 | .25<br>6.35     | .88<br>22.35    | .36<br>9.15     | .160<br>4.07   | .40<br>10.16   | .69<br>17.53  | .54<br>13.72  | .66<br>16.77   | 8.34<br>211.84 | .81<br>20.58  | .06<br>1.53  |                |               |                | 700.0      | A5, C2, D11 |
| R 67     | 6.69<br>169.93 | 1.60<br>40.64 | 1.50<br>38.10 | 6.22<br>157.99 | .25<br>6.35     | .88<br>22.35    | .36<br>9.15     | .160<br>4.07   | .40<br>10.16   | .69<br>17.53  | 1.22<br>30.99 | .66<br>16.77   | 5.72<br>145.29 | .81<br>20.58  | .06<br>1.53  |                |               |                | 500.0      | A5, C2, D12 |
| S 32     | 3.75<br>95.25  | 2.00<br>50.80 | 1.8<br>45.7   | 4.83<br>123.17 | 3.375<br>85.73  | .19<br>4.83     | 1.625<br>41.28  | .144<br>3.66   | .6<br>15.24    | .4<br>10.16   | .5<br>12.7    | 1.30<br>33.02  | .09<br>2.29    |               |              |                |               |                | 220.0      | A7<br>D20   |
| T 34     | 4.75<br>120.65 | 2.00<br>50.80 | 2.21<br>56.14 | .19<br>4.83    | 4.375<br>111.13 | .23<br>5.84     | 1.540<br>39.12  | .144<br>3.66   | .58<br>14.73   | .34<br>8.64   | .50<br>12.70  | 1.50<br>38.10  | 1.00<br>25.40  | .09<br>2.29   | .38<br>9.65  | 4.00<br>101.60 | 30<br>7.62    | 2.60<br>66.04  | 440.0      | A8<br>D20   |
| T 35     | 4.75<br>120.65 | 2.00<br>50.80 | 2.46<br>62.49 | .19<br>4.83    | 4.375<br>111.13 | .23<br>5.84     | 1.540<br>39.12  | .144<br>3.66   | .58<br>14.73   | .34<br>8.64   | .50<br>12.70  | 1.50<br>38.10  | 1.00<br>25.40  | .09<br>2.29   | .38<br>9.65  | 4.00<br>101.60 | 1.50<br>38.10 | 5.00<br>127.00 | 700.0      | A8<br>D20   |
| U 36     | 7.00<br>177.80 | 3.25<br>82.55 | 2.13<br>54.10 | .25<br>6.35    | 6.500<br>165.10 | .38<br>9.65     | 2.500<br>63.50  | .156<br>3.97   | .88<br>22.35   | .73<br>18.54  | .63<br>16.01  | 1.13<br>28.70  | 2.23<br>56.64  | .125<br>3.18  | .50<br>12.70 | 6.00<br>152.40 |               |                | 900.0      | A8<br>D6    |
| V 37     | .80<br>20.32   | .80<br>20.32  | .75<br>19.05  | .40<br>10.16   | .38<br>9.65     | .485<br>12.32   | .110<br>2.79    | .485<br>12.32  |                |               |               |                |                |               |              |                |               |                | 33.0       | A5, C1, D6  |
| W 38     | .30<br>7.62    | .27<br>6.86   | .23<br>5.84   | .010<br>.25    | .042<br>1.07    | .020<br>.51     | .100<br>2.54    | .05<br>1.27    | .09<br>2.29    | .37<br>9.40   |               |                |                |               |              |                |               |                | .50        | A3          |
| X 65     | .30<br>7.62    | .27<br>6.86   | .23<br>5.84   | .010<br>.25    | .042<br>1.07    | .020<br>.51     | .100<br>2.54    | .05<br>1.27    | .04<br>1.02    | .12<br>3.05   | .300<br>7.62  | .35<br>8.89    |                |               |              |                |               |                | .50        | A3          |
| Y 39     | 1.25<br>31.75  | 1.25<br>31.75 | .75<br>19.05  | .63<br>16.01   | .36<br>9.15     | 1.000<br>25.40  | 1.000<br>25.40  | .125<br>3.18   | .125<br>3.18   | .46<br>11.69  | 2.18<br>55.38 | 1.688<br>42.88 | .07<br>1.78    | .750<br>19.05 | .50<br>12.70 | .80<br>20.32   | .45<br>11.43  | .29<br>7.37    | 50.0       | A4, B1, D6  |
| Z 40     | 7.06<br>179.32 | 3.13<br>79.50 | .88<br>22.35  | .65<br>16.51   | 1.750<br>44.45  | 5.310<br>134.87 | 6.810<br>172.97 | .312<br>7.92   | 2.875<br>73.03 | .144<br>3.66  | 3.53<br>89.66 | .44<br>11.18   | .415<br>10.54  | .89<br>22.61  |              |                |               |                | 800.0      | A4 or D14   |
| AA 46    | .830<br>21.08  | .580<br>14.73 | .265<br>6.73  | .13<br>3.30    | .415<br>10.54   | .340<br>8.64    | .025<br>.64     | .50<br>12.70   |                |               |               |                |                |               |              |                |               |                | 6.4        | A2          |
| BB 48    | .50<br>12.70   | .39<br>9.91   | .225<br>5.72  | .025<br>.64    | .07<br>1.79     | .100<br>2.54    | .250<br>6.35    | .350<br>8.89   | .06<br>1.53    | .31<br>7.87   |               |                |                |               |              |                |               |                | 3.0        | A1          |
| CC 51    | 2.00<br>50.80  | 2.00<br>50.80 | .75<br>19.05  | .938<br>23.83  | .13<br>3.30     | 1.750<br>44.45  | .125<br>3.18    | .375<br>9.53   | 1.00<br>25.40  | 1.25<br>31.75 |               |                |                |               |              |                |               |                | 120.0      | A4, D14     |
| DD 52    | 2.00<br>50.80  | 2.00<br>50.80 | .75<br>19.05  | .900<br>22.86  | .156<br>3.96    | 1.688<br>42.88  | .125<br>3.18    | .392<br>9.96   | 1.00<br>25.40  | 1.25<br>31.75 |               |                |                |               |              |                |               |                | 225.0      | A4, D14     |
| EE 54    | 3.50<br>88.90  | 2.13<br>54.10 | .88<br>22.35  | .250<br>6.35   | 1.750<br>44.45  | 3.250<br>82.55  | .250<br>6.35    | 1.813<br>46.05 | .125<br>3.18   | .44<br>11.18  | .415<br>10.54 | .89<br>22.61   |                |               |              |                |               |                | 250.00     | A4, D14     |
| FF 55    | 1.40<br>35.56  | .58<br>14.73  | .73<br>18.54  | 2.59<br>65.79  | —               | —               | —               | —              | —              | —             | —             | —              | —              | —             | —            | —              | —             | —              | 40.0       | A9, D15     |
| FF 56    | .98<br>24.89   | .43<br>10.92  | .47<br>11.94  | 1.70<br>43.18  | —               | —               | —               | —              | —              | —             | —             | —              | —              | —             | —            | —              | —             | —              | 18.0       | A9, D16     |
| FF 57    | 1.54<br>39.12  | .72<br>18.92  | .81<br>20.58  | 3.05<br>77.47  | .82<br>20.83    | —               | —               | —              | —              | —             | —             | —              | —              | —             | —            | —              | —             | —              | 90.0       | A9, D17     |
| FF 58    | 1.40<br>35.56  | .58<br>14.73  | .61<br>15.50  | 2.59<br>65.79  | .64<br>16.26    | —               | —               | —              | —              | —             | —             | —              | —              | —             | —            | —              | —             | —              | 45.0       | A9, D18     |

tolerance  $x \pm .1$   $xx \pm .03$   $xxx \pm .015$

oz. = grams x .0353

## \*NOTES:

### MATERIAL & FINISH

- A1. Header material CRS; Pin material; #52 alloy.
- Finish: electro tin hot-oil flowed. Cover material; cupro-nickel.
- A2. Case material CRS; Pin material; #52 alloy; Covers stainless steel.
- Finish: gold flash per MIL-G-45204.
- A3. Case material plastic. Pin material; iron-nickel alloy.
- Finish: bright tin-plate per MIL-T-10727.
- A4. Case material aluminum. Finish; iridite.
- A5. Case material CRS. Finish; baked grey enamel over hot-tin dip.
- A7. Case material aluminum. Finish; black enamel. Heat Sink; black anodize.
- A8. Case material aluminum. Finish; iridite. Heat sink; black anodize.
- A9. Case material brass. Finish; nickel plate.

### MOUNTING

- B1. Mounting bracket available on request. Add suffix B to part number.

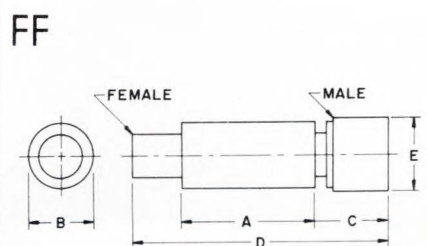
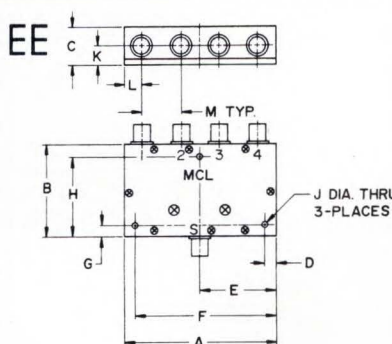
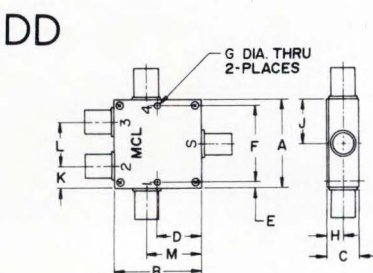
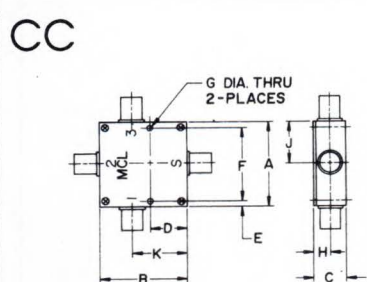
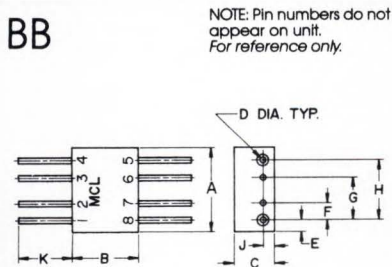
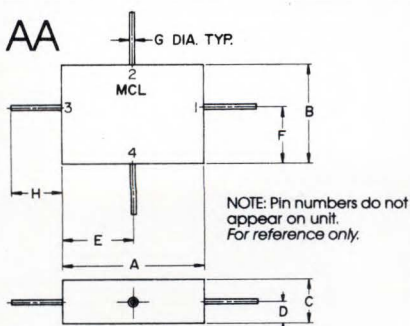
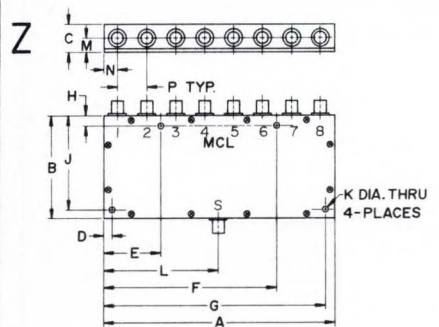
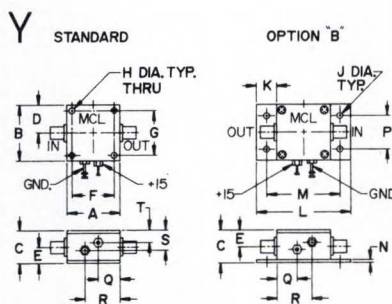
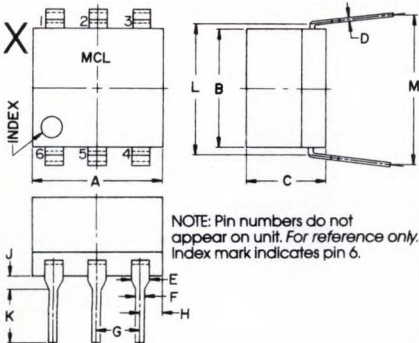
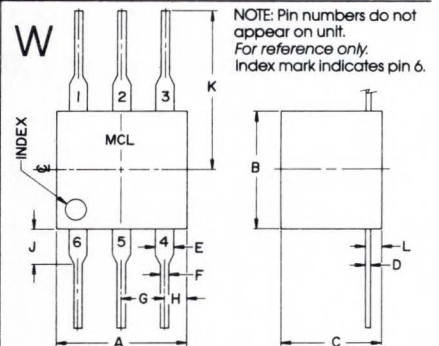
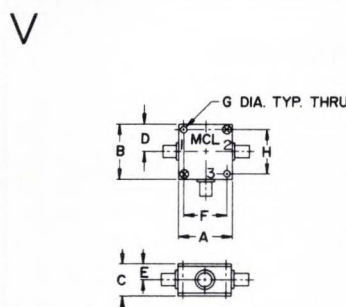
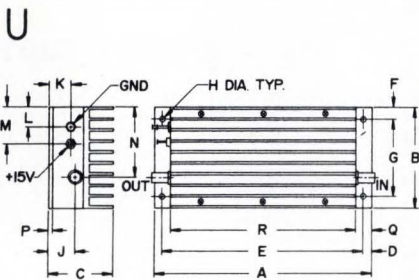
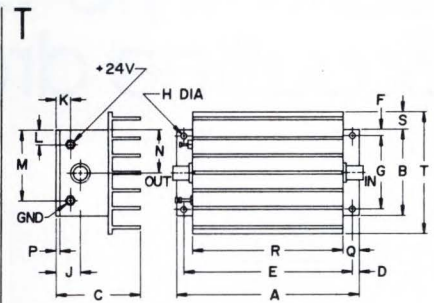
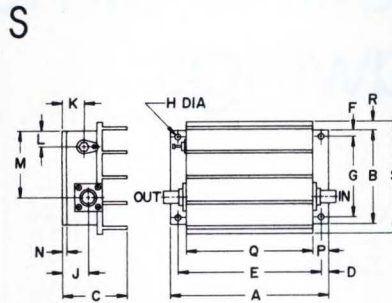
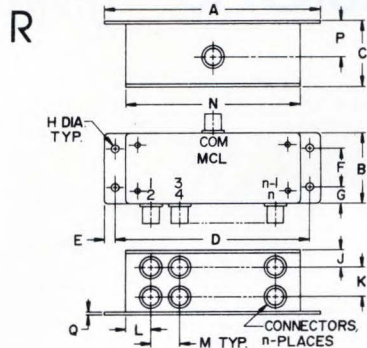
### MARKING

- C1. For port markings 1, 2, and 3 see specification data sheet.
- C2. Consecutive marking, n = no. of way power splitter.

### CONNECTORS

- D6. Connectors: Female SMA only. Male SMA available on request, consult factory.
- D9. Connectors: BNC standard, TNC on request (add \$10.00 to unit cost).
- Female SMA on request (add \$25.00 to unit cost).
- D10. Connectors: BNC standard, TNC on request (add \$20.00 to unit cost).
- SMA on request (add \$45.00 to unit cost).
- D11. Connectors: BNC standard, TNC on request (add \$35.00 to unit cost).
- SMA on request (add \$65.00 to unit cost).
- D12. Connectors: BNC standard, TNC on request (add \$15.00 to unit cost).
- SMA on request (add \$35.00 to unit cost).
- D14. Connectors: Please specify: Type N or SMA
- D15. Connectors: male BNC, female BNC standard. Other combinations with SMA available on request (add \$2.00 to unit cost).
- D16. Connectors: male SMA, Female SMA only.
- D17. Connectors: male N, female N standard. Combinations with BNC, SMA, TNC available on request (add \$3.00 to unit cost).
- D18. Connectors: male TNC, Female TNC only.
- D20. Connectors: please specify, unless otherwise noted. BNC is standard, TNC, SMA or Type N (add \$10.00 to unit cost).







# case style outline dimensions & outline drawings

(inch  
mm)

| case no. | A              | B             | C             | D              | E              | F              | G            | H             | J             | K            | L            | M            | N              | P           | Q            | R            | S            | T            | wt. grams. | NOTES*  |
|----------|----------------|---------------|---------------|----------------|----------------|----------------|--------------|---------------|---------------|--------------|--------------|--------------|----------------|-------------|--------------|--------------|--------------|--------------|------------|---------|
| GG 60    | 2.31<br>58.68  | 1.20<br>30.48 | .60<br>15.24  | .125<br>3.18   | 2.062<br>52.38 | .30<br>7.62    | .53<br>13.46 | .63<br>16.00  |               |              |              |              |                |             |              |              |              |              | 75.0       | A4, D19 |
| HH 68    | 9.31<br>236.47 | 1.60<br>40.64 | 3.57<br>90.68 | 9.84<br>224.54 | .25<br>6.35    | .88<br>22.35   | .36<br>9.14  | .160<br>4.06  | .34<br>8.37   | .69<br>17.53 | .54<br>13.72 | .66<br>16.76 | 8.34<br>211.84 | .33<br>8.38 | .06<br>1.52  |              |              |              | 1090.0     | A5, D13 |
| JJ77     | 1.50<br>38.10  | 1.13<br>28.70 | .97<br>24.64  | .50<br>12.70   | .155<br>3.94   | 2.345<br>59.57 | .14<br>3.55  | .850<br>21.60 | 2.50<br>63.50 | .10<br>2.54  | .44<br>11.17 | .75<br>19.05 | .63<br>16.00   | .37<br>9.39 | .54<br>13.71 | .43<br>10.92 | .150<br>3.81 | .73<br>18.54 | 50.0       | D6      |
| KK 81    | .30<br>7.62    | .27<br>6.86   | .23<br>5.84   | .010<br>.25    | .042<br>1.07   | .020<br>.51    | .100<br>2.54 | .05<br>1.27   | .05<br>1.27   | .035<br>.88  | .036<br>.91  | .26<br>6.60  | .575<br>14.60  |             |              |              |              |              | 50         | A3      |

tolerance  $x \pm .1$   $xx \pm .03$   $xxx \pm .015$

oz. = grams x .0353

## \*NOTES:

### MATERIAL & FINISH

A4. Case material aluminum. Finish: iridite.

A5. Case material CRS. Finish: baked grey enamel over hot-tin dip.

A3. Case material plastic. Pin material: iron-nickel alloy. Finish: bright tin-plate per MIL-T-10727.

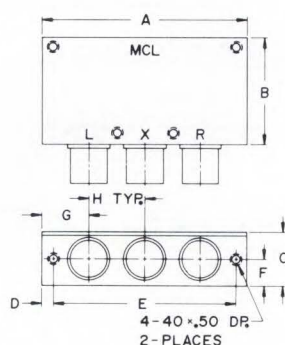
### CONNECTORS

D6. Connectors: Female SMA only Male SMA available on request.

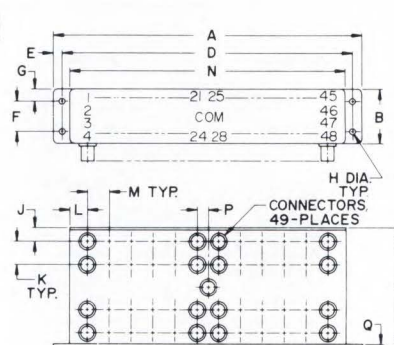
D13. Connectors: BNC standard, SMA on request (add \$130.00 to unit cost).

D19. Connectors: BNC standard, SMA on request (add \$15.00 to unit cost).

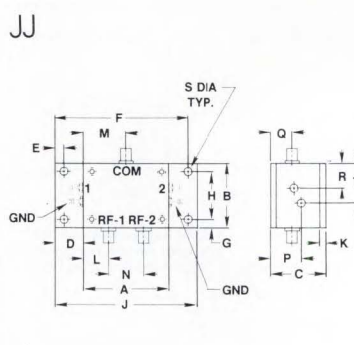
GG



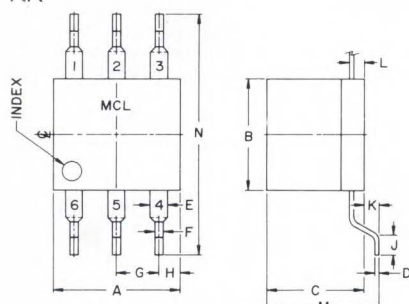
HH



JJ



KK

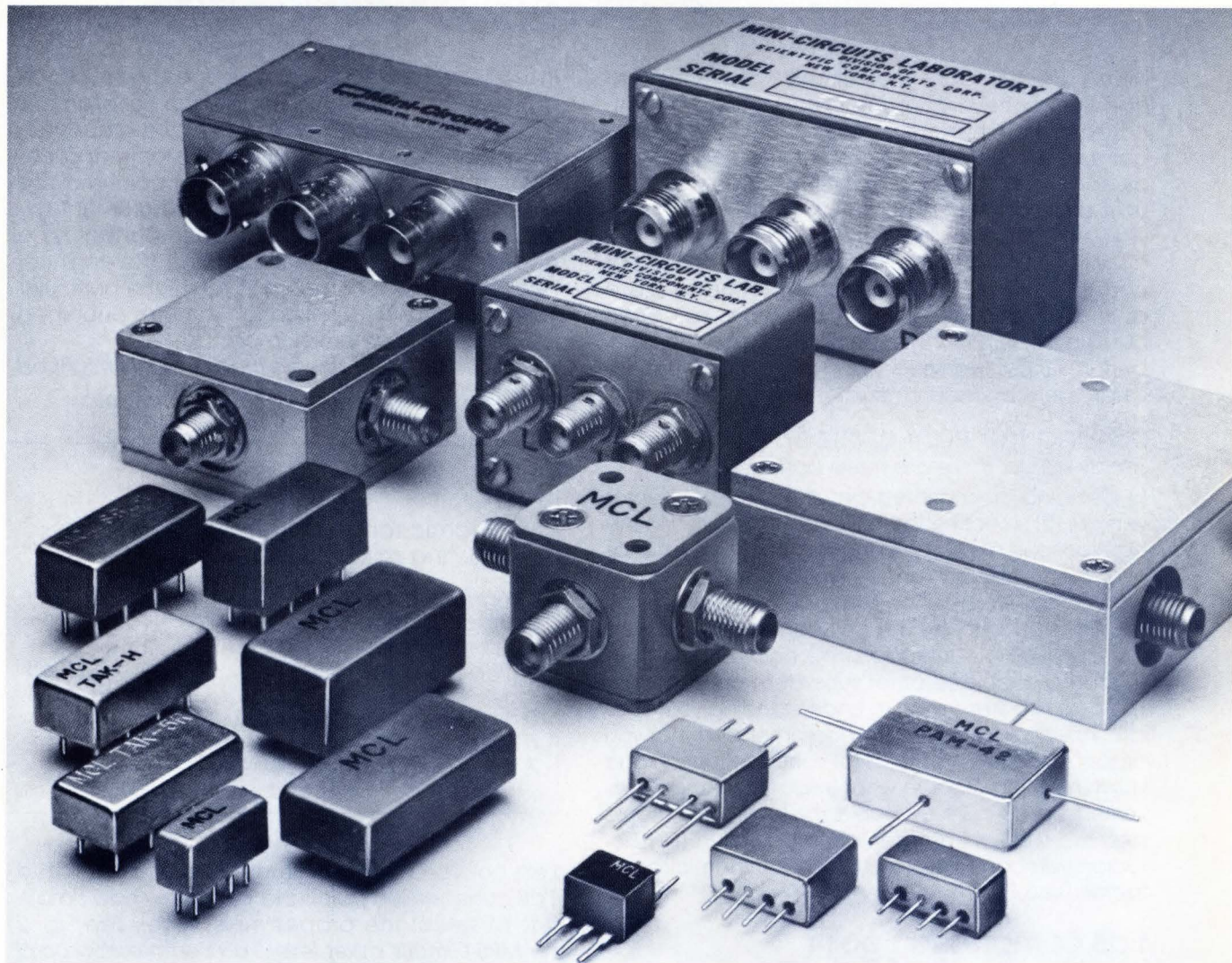




world's largest selection of

# Frequency Mixers

500 Hz to 4.2 GHz



## LEVEL 7 to LEVEL 27 (+7dBm LO, to 27dBm LO)

As the world's largest supplier of frequency mixers, Mini-Circuits' mixers are used by over 4000 customers in well over 1000 military, space, and industrial applications including telecommunications, CATV, telephone links, satellite broadcasting, medical equipment and instrumentation.

The units offered cover 500 Hz to 4.2 GHz, and operate with the world's largest selection of LO drives ranging from +7 to +27 dBm. Available in a range of case styles from the world's smallest mixer (ASK series) to the rugged, low-cost SBL series, to the hermetically sealed TFM and compact SRA series. For high reliability, check the listing of MIL-M-28837/1A\* equivalents shown on the data pages. Also check the Hi-Rel SRA-1, the industry standard... with an unprecedented 3-year guarantee. Connectorized mixers are available in various configurations, types, and connector arrangements to match your system needs.

All models shown are available from stock for immediate delivery.  
\*units are not QPL listed.

**Mini-Circuits**

P.O. BOX 166, Brooklyn, New York 11235 (718) 934-4500



# mastering the mixer maze...

or selecting the right model for your application.



Mixers are abundant in electronic systems ranging from inexpensive consumer products to sophisticated military hardware. You'll find them in video games, TV sets and video cassette recorders as well as communications gear, test instruments, radar units and countermeasure systems. Mini-circuits offers well over a hundred different off-the-shelf models with thousands of variations. Different connector configurations, tighter specs, Hi-Rel options are available on request. Improper mixer selection bears a penalty—underspecify and face marginal performance; overspecify and pay extra for unnecessary performance characteristics.

## making the right choice

*Simply stated, there are three basic steps—*

(1) deciding on a printed-circuit (PC) or connector version, (2) selecting the mixer level required in the applications, and (3) picking a model that extends over the frequency range involved. Sounds simple enough so let's examine some of the details.

The first step involves the decision on whether the mixer will be mounted to a PC board or be connected by cable to other subsystem components. The next two steps require understanding your specific needs; so it is strongly recommended that you organize the requirements for your application and put it in writing. Decide what frequency range is involved, the LO drive available, the level of harmonic and two-tone, third-order intermodulation (IM) distortion you can tolerate and other dynamic range factors, see Fig. 1.

## 1 dB compression point key to mixer level

*What does the 1 dB compression point signify?* As RF input level is increased, IF output should follow in a linear manner. However, after a certain point, IF output increases at a lower rate until mixer output becomes fairly constant. The point at which IF output deviates from linearity with RF input 1 dB is termed the 1 dB compression point. This figure is useful in comparing dynamic range, maximum output and two-tone performance of various mixers. It is a basis on which mixer level is established.

The 1 dB compression point, which defines the linearity of a mixer at high RF input levels, is relatively simple to test and thus this parameter is included on data sheets supplied by all mixer manufacturers. But,

in real life, mixer linearity may be specified in accordance with the intended application. For example, in a receiver application, two-tone, third-order intermod may be the critical parameter; for TV applications, percent distortion or intercept point may be specified; and in an attenuator measurement system, compression point may be important for a given RF input level. With this in mind, the engineer needs a convenient means to relate the particular parameter for his application with the published spec, the 1 dB compression point.

*Fig. 1 lists the various ways mixer linearity might be specified.*

FIG. 1

### Dynamic range parameters affecting mixer selection

1. maximum RF input level anticipated
2. percent distortion acceptable
3. intercept point
4. Two-tone, 3rd order IM \_\_\_\_\_ dB  
at \_\_\_\_\_ dBm, RF input
5. 1 dB RF input compression level
6. LO power available
7. none of the above specified

Let's convert every parameter with the published 1 dB compression point and then show how simple it is to select the proper mixer level, see Fig. 2 for Mini-Circuits' mixer level/1 dB compression point chart.

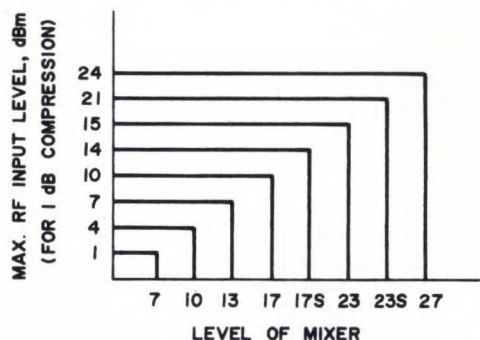


FIG. 2

THE 1 dB COMPRESSION POINT AS A FUNCTION OF THE LEVEL OF MIXER.



**1. Maximum RF input level anticipated.** If you know this parameter, simply select the lowest level mixer whose maximum RF input level exceeds your requirement. For example, if the maximum encountered RF level is +5 dBm, select a Level 13 mixer, rated at +7 dBm maximum RF input for 1 dB compression point.

**2. Percent distortion.** The percent distortion is usually specified in voltage. Thus, a 0.1% distortion figure means 0.999 of the input voltage appears at the mixer output. Next, convert this voltage ratio to a power ratio in dB by squaring and taking ten times the log. The resultant figure is the amount of compression for the specified RF input level. Now this must be extrapolated to 1 dB compression for a corresponding RF input level. As a rule of thumb, extrapolation may be achieved by assuming a linear relationship, in dB, between compression and RF input level. So a ten-times increase in compression corresponds to a ten-times increase in RF input level.

Let's illustrate with an example using a 0.1 percent distortion spec at -10 dBm RF input level. The 0.1 percent corresponds to a 0.999 voltage output; squaring this yields 0.998 power ratio or 0.009 dB. We, therefore, know that 0.1% distortion at -10 dBm input means the maximum allowable compression is 0.009 dB. Extrapolating, using the rule-of-thumb relationship, states that 0.09 dB compression corresponds to an allowable RF of 0 dBm, and further extrapolating results in 0.9 dB compression at a maximum allowable RF input level of 10 dBm. So which mixer level is appropriate? A Level 17S, with +13 dBm RF input level at the 1 dB compression point, see Fig. 2.

### **3. Intercept point.**

This parameter is a figure of merit corresponding to the amount of intermodulation products generated relative to the desired IF output. An intercept point can be defined for a second order, third order, fifth order, product, etc. As a rule-of-thumb, two-tone third order intercept point is approximately 15 dB above the 1 dB compression point. So, if the intercept point figure is given, merely subtract 15 dB from this figure and pick a mixer which meets the 1 dB compression point spec, see Fig. 2.

### **4. Two-tone, third-order intermodulation (IM).**

When a two-tone, third-order IM spec is given, the intercept point can be calculated. Remember that for each 10 dB increase in signal level, there is a 20 dB degradation in two-tone, third-order product. Once the intercept point is calculated, simply subtract 15 dB from the figure to find the 1 dB compression point and select the appropriate mixer.

### **5. 1dB Rf input compression level.**

This key parameter is listed on mixer spec sheets so merely choose the lowest level mixer that will meet the requirement.

### **6. LO drive.**

The LO drive is critical since the function of the LO drive is to switch the mixer diodes fully on and off for

lowest distortion. So, for optimum performance, select the mixer level to match the LO drive. Mini-Circuits conveniently identifies its mixer levels by the LO drive requirement; thus a Level 7 mixer refers to a LO drive level of +7 dBm. If there are constraints on the LO power available, select the lowest level mixer closest to the available LO power. For example, if +12 dBm LO drive is available, select a Level 10 mixer.

### **7. No particular spec to meet.**

Choose a Level 7 mixer. Why? Because it is the most popular and it offers the widest choice of models at lowest cost.

## **Freq. range last deciding factor**

Once the mixer level has been decided, you may find a wide variety of models to exercise your decision making. You may notice models within a series with overlapping frequency ranges. Why? So you can choose the optimum mixer for your requirement. Each model within a series has a different low-frequency limit. Select a mixer with the highest low frequency limit and whose mid-band range best covers your application.

Specs on the data sheets are given in three ranges. The lower frequency range, L, covers the lowest specified frequency to one decade higher; the upper frequency range, U, covers the highest frequency to one octave lower and mid-range, M, covers the frequency between L and U. Thus, a mixer specified from 0.5 to 500 MHz could offer a low-frequency range of 0.5 to 5 MHz, an upper frequency range of 250 to 500 MHz, and a mid-range of 5 MHz to 250 MHz.

## **What about "Specials"?**

Although most Mini-Circuits mixers are 50 ohm devices, models are available in 75 ohms. Need connector types different than those listed for standard models? No problem. Some applications require matched mixer pairs that must be amplitude (conversion loss) and phase matched. Most Mini-Circuits mixers are tested to within 0.2 dB for the entire production run. Not tight enough? Let us know your exact requirement and we'll screen and test to meet it.

In summary, contact us about "specials" and we'll do our best to satisfy your needs without excessive cost or delivery date extensions. Sometimes, "special" means shipping a quantity of mixers within a very short time span; since Mini-Circuits is the largest manufacturer of mixers in the world, this may hardly be considered "special" and you may be pleasantly surprised. Try us.

## **order Mini-Circuits Q&A No. 4 Now...**

There's lots more to mixer specs, applications and testing. Phone or write for Mini-Circuits' Q&A #4 for a provocative question-and-answer exchange on these topics.



most widely-used

# Frequency Mixers

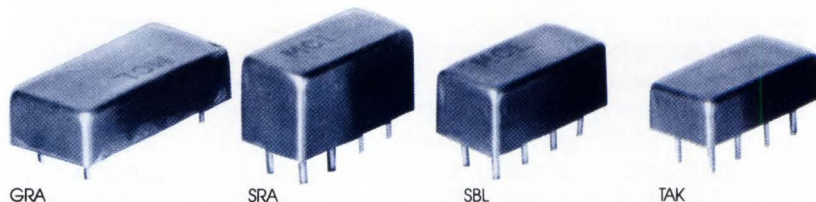
LEVEL 7 (+7 dBm LO, up to +1 dBm RF)

performance data

curves, tables, page 4 Model Index

case style selection

outline drawings see page 3



|                      | MODEL NO. | FREQUENCY MHz |         | CONVERSION LOSS dB |      |             |      | LO-RF ISOLATION, dB |      |      |      |      |      | LO-IF ISOLATION, dB |      |      |      |      |      | PRICE, \$ |         |
|----------------------|-----------|---------------|---------|--------------------|------|-------------|------|---------------------|------|------|------|------|------|---------------------|------|------|------|------|------|-----------|---------|
|                      |           | LO/RF         | IF      | Mid-Band m         |      | Total Range |      | L                   |      | M    |      | U    |      | L                   |      | M    |      | U    |      | Ea.       | Qty.    |
|                      |           | $f_L$ - $f_U$ |         | Typ.               | Max. | Typ.        | Max. | Typ.                | Min. | Typ. | Min. | Typ. | Min. | Typ.                | Min. | Typ. | Min. | Typ. | Min. |           |         |
| GRA<br>case D09      | GRA-1     | .5-500        | DC-500  | 5.5                | 7.0  | 6.5         | 8.5  | 50                  | 45   | 45   | 30   | 35   | 25   | 45                  | 35   | 40   | 25   | 30   | 20   | 12.95     | (6-49)  |
|                      | GRA-3     | .025-200      | DC-200  | 5.5                | 7.5  | 6.5         | 8.5  | 60                  | 50   | 45   | 35   | 35   | 25   | 45                  | 35   | 40   | 30   | 30   | 20   | 15.95     | (6-49)  |
|                      | GRA-6     | .003-100      | DC-100  | 5.5                | 7.5  | 6.5         | 8.5  | 60                  | 50   | 45   | 30   | 35   | 25   | 60                  | 45   | 40   | 25   | 30   | 20   | 22.95     | (5-24)  |
|                      | GRA-8     | .0005-10      | DC-10   | 6.5                | 7.5  | 7.0         | 8.5  | 60                  | 50   | 50   | 40   | 45   | 35   | 60                  | 50   | 50   | 40   | 45   | 35   | 25.95     | (5-24)  |
| SRA<br>case A01      | SRA-1     | .5-500        | DC-500  | 5.5                | 7.0  | 6.5         | 8.5  | 50                  | 45   | 45   | 30   | 35   | 25   | 45                  | 35   | 40   | 25   | 30   | 20   | 11.95     | (1-49)  |
|                      | SRA-1TX   | .5-500        | DC-500  | 5.5                | 7.0  | 6.5         | 8.5  | 50                  | 45   | 45   | 30   | 35   | 25   | 45                  | 35   | 40   | 25   | 30   | 20   | 49.95     | (1-49)  |
|                      | SRA-1W    | 1-750         | DC-750  | 5.5                | 7.5  | 6.5         | 8.5  | 50                  | 45   | 45   | 30   | 35   | 25   | 45                  | 30   | 40   | 25   | 30   | 20   | 14.95     | (5-24)  |
|                      | SRA-1-1   | .1-500        | DC-500  | 5.5                | 7.5  | 6.5         | 8.5  | 50                  | 45   | 45   | 30   | 35   | 25   | 45                  | 30   | 40   | 25   | 30   | 20   | 13.95     | (5-24)  |
|                      | SRA-2     | 1-1000        | .5-500  | 5.5                | 7.5  | 6.5         | 8.5  | 45                  | 30   | 35   | 20   | 30   | 20   | 45                  | 30   | 30   | 20   | 30   | 20   | 14.95     | (5-24)  |
|                      | SRA-2CM   | 5-1000        | DC-1000 | 6.0                | 7.0  | 6.5         | 8.5  | 60                  | 50   | 35   | 30   | 30   | 25   | 50                  | 45   | 30   | 25   | 25   | 20   | 14.95     | (1-49)  |
|                      | SRA-3     | .025-200      | DC-200  | 5.5                | 7.5  | 6.5         | 8.5  | 60                  | 50   | 45   | 35   | 35   | 25   | 45                  | 35   | 40   | 30   | 30   | 20   | 14.95     | (5-24)  |
|                      | SRA-4     | .5-1250       | .5-500  | 5.5                | 7.5  | 6.5         | 8.5  | 50                  | 40   | 40   | 20   | 30   | 20   | 50                  | 40   | 40   | 20   | 30   | 20   | 16.95     | (5-24)  |
|                      | SRA-5     | 5-1500        | 10-600  | 7.0                | 8.0  | 7.5         | 8.5  | 50                  | 45   | 35   | 30   | 30   | 20   | 45                  | 40   | 30   | 25   | 25   | 15   | 21.95     | (5-24)  |
|                      | SRA-6     | .003-100      | DC-100  | 5.5                | 7.5  | 6.5         | 8.5  | 60                  | 50   | 45   | 30   | 35   | 25   | 60                  | 45   | 40   | 25   | 30   | 20   | 21.95     | (5-24)  |
|                      | SRA-8     | .0005-10      | DC-10   | 6.5                | 7.5  | 7.0         | 8.5  | 60                  | 50   | 50   | 40   | 45   | 35   | 60                  | 50   | 50   | 40   | 45   | 35   | 26.95     | (5-24)  |
|                      | SRA-11    | 5-2000        | 10-600  | 7.0                | 8.5  | 7.5         | 9.0  | 50                  | 45   | 35   | 25   | 30   | 20   | 45                  | 40   | 30   | 20   | 25   | 15   | 26.95     | (5-24)  |
| SRA-2000<br>case A06 | SRA-12    | 800-1250      | 50-90   | —                  | —    | 6.0         | 7.5  | 32                  | 25   | 35   | 25   | 35   | 25   | 30                  | 20   | 30   | 20   | 30   | 20   | 24.95     | (5-24)  |
|                      | SRA-2000  | 100-2000      | DC-600  | 6.0                | 8.0  | 7.0         | 9.5  | —                   | —    | 37   | 20   | —    | —    | —                   | —    | —    | —    | 30   | 20   | 31.95     | (1-24)  |
| SBL<br>case A06      | SBL-1     | 1-500         | DC-500  | 5.5                | 7.5  | 6.5         | 8.5  | 50                  | 35   | 45   | 30   | 35   | 25   | 45                  | 30   | 40   | 25   | 30   | 20   | 4.50      | (10-49) |
|                      | SBL-1X    | 10-1000       | 5-500   | 6.0                | 7.5  | 7.0         | 9.0  | 50                  | 35   | 40   | 25   | 30   | 20   | 45                  | 30   | 35   | 20   | 25   | 20   | 5.95      | (10-49) |
| TAK<br>case A04      | TAK-5     | .01-250       | DC-250  | 5.5                | 7.0  | 6.5         | 8.5  | 60                  | 50   | 50   | 35   | 40   | 35   | 55                  | 45   | 45   | 30   | 35   | 25   | 18.95     | (1-4)   |
|                      | TAK-5R    | .05-200       | DC-200  | 5.5                | 6.5  | 6.5         | 8.0  | 55                  | 50   | 45   | 35   | 45   | 35   | 50                  | 45   | 40   | 30   | 40   | 30   | 15.95     | (5-24)  |
|                      | TAK-6     | .5-600        | DC-600  | 5.5                | 7.5  | 6.5         | 8.5  | 60                  | 50   | 50   | 30   | 40   | 25   | 55                  | 45   | 45   | 30   | 30   | 20   | 18.95     | (1-4)   |
|                      | TAK-6R    | 5-500         | DC-500  | 6.0                | 7.0  | 6.5         | 8.0  | 55                  | 50   | 45   | 30   | 35   | 40   | 45                  | 40   | 40   | 25   | 30   | 25   | 15.95     | (5-24)  |
|                      | TAK-7     | 2-1000        | 5-500   | 5.5                | 7.5  | 6.5         | 8.5  | 45                  | 30   | 35   | 20   | 30   | 20   | 45                  | 30   | 35   | 20   | 30   | 20   | 20.95     | (1-4)   |

L = low range ( $f_L$  to  $10 f_L$ )

M = mid range ( $10 f_L$  to  $f_U/2$ )

U = upper range ( $f_U/2$  to  $f_U$ )

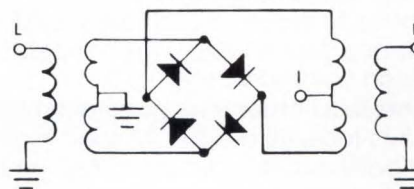
m = mid band ( $2 f_L$  to  $f_U/2$ )

## NOTES:

- HTRB tested, 3 year guarantee

- For typical characteristics, compression level, phase detection and electronic attenuation, see "Mixer Technical Section."
- For Quality Control procedures, see page 6.
- For environmental specifications see page 7.
- For High-Rel and TX description, see page 6.
- Absolute Maximum Ratings:  
RF power 50 mW, peak IF current 40 mA, see pg. 7.
- Prices and specifications subject to change without notice.
- PAM-42 protected under patent 4,430,758.

## schematic



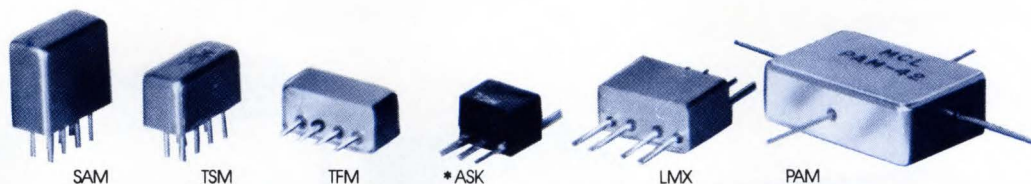
## pin connections

see case style outline drawing

| Series   | GRA        | SRA                      |          |          |             |                  |         | SBL     |     | TAK      |         |         |         |
|----------|------------|--------------------------|----------|----------|-------------|------------------|---------|---------|-----|----------|---------|---------|---------|
| models   | all models | -1<br>-1TX<br>-1-1<br>-3 | -2<br>-4 | -6<br>-8 | -1W<br>-2cm | -5<br>-11<br>-12 |         | -1      | -1X | -5<br>-6 | -7      | -5R     | -6R     |
| LO       | 1          | 8                        | 8        | 8        | 8           | 8                | 8       | 8       |     | 8        | 8       | 8       | 1       |
| RF       | 6          | 1                        | 3,4      | 1        | 1           | 1                | 1       | 3,4     |     | 1        | 3,4     | 1       | 8       |
| IF       | 4          | 3,4*                     | 1        | 3,4*     | 3,4*        | 3                | 3,4*    | 1       |     | 3,4*     | 1       | 3,4*    | 5,6*    |
| GND      | 2,3,5      | 2,5,6,7                  | 2,5,6,7  | 2,5,6,7  | 2,5,6,7     | 2,5,6,7          | 2,5,6,7 | 2,5,6,7 |     | 2,5,6,7  | 2,5,6,7 | 2,5,6,7 | 2,3,4,7 |
| CASE GND | —          | 2                        | 2,5,6,7  | —        | 2,5,6,7     | 2,5,6,7          | —       | 2,5,6,7 |     | 2        | 2,5,6,7 | —       | 3,4,7   |

\*pins must be connected together externally





| MODEL NO.        | FREQUENCY MHz                  |            | CONVERSION LOSS dB |      |             |      | LO-RF ISOLATION, dB |      |      |          |          |      | LO-IF ISOLATION, dB |      |      |          |          |      | PRICE, \$ |       |         |
|------------------|--------------------------------|------------|--------------------|------|-------------|------|---------------------|------|------|----------|----------|------|---------------------|------|------|----------|----------|------|-----------|-------|---------|
|                  | LO/RF                          | IF         | Mid-Band m         |      | Total Range |      | L                   |      | M    |          | U        |      | L                   |      | M    |          | U        |      | Ea.       | Qty.  |         |
|                  | f <sub>L</sub> -f <sub>U</sub> |            | Typ.               | Max. | Typ.        | Max. | Typ.                | Min. | Typ. | Min.     | Typ.     | Min. | Typ.                | Min. | Typ. | Min.     | Typ.     | Min. |           |       |         |
| SAM<br>case A03  | SAM-1                          | 1-600      | DC-600             | 5.5  | 7.0         | 6.5  | 8.5                 | 55   | 45   | 45       | 30       | 35   | 20                  | 50   | 40   | 40       | 25       | 30   | 20        | 15.95 | (1-24)  |
|                  | SAM-2                          | 1-1000     | DC-1000            | 6.0  | 7.5         | 7.0  | 9.5                 | 55   | 45   | 40       | 25       | 35   | 20                  | 50   | 40   | 40       | 25       | 30   | 25        | 17.95 | (1-24)  |
|                  | SAM-3                          | 0.1-500    | DC-500             | 5.5  | 7.0         | 6.5  | 8.5                 | 60   | 50   | 50       | 35       | 35   | 30                  | 50   | 40   | 45       | 30       | 30   | 20        | 17.95 | (1-24)  |
|                  | SAM-4                          | 5-1250     | 0.5-1000           | 6.5  | 8.5         | 6.5  | 8.5                 | 55   | 40   | 35       | 25       | 30   | 20                  | 50   | 40   | 35       | 25       | 30   | 20        | 19.95 | (1-24)  |
|                  | SAM-5                          | 5-1500     | 0.5-1000           | 6.5  | 7.5         | 6.5  | 8.5                 | 55   | 40   | 35       | 25       | 30   | 20                  | 50   | 40   | 35       | 25       | 30   | 20        | 24.95 | (1-24)  |
| TSM<br>case A11  | TSM-1                          | 1-500      | DC-500             | 6.0  | 7.5         | 6.5  | 8.5                 | 60   | 45   | 45       | 35       | 35   | 25                  | 55   | 45   | 40       | 30       | 35   | 25        | 17.95 | (5-24)  |
|                  | TSM-3                          | 0.1-400    | DC-400             | 5.3  | 7.5         | 6.5  | 8.5                 | 60   | 50   | 50       | 35       | 35   | 25                  | 55   | 45   | 45       | 30       | 35   | 25        | 19.95 | (5-24)  |
| TFM<br>case B02  | TFM-2                          | 1-1000     | DC-1000            | 6.0  | 7.5         | 7.0  | 8.5                 | 50   | 45   | 40       | 25       | 30   | 25                  | 45   | 40   | 35       | 25       | 25   | 20        | 11.95 | (1-49)  |
|                  | TFM-3                          | 0.04-400   | DC-400             | 5.3  | 7.0         | 6.0  | 8.0                 | 60   | 50   | 50       | 35       | 35   | 25                  | 55   | 40   | 45       | 30       | 35   | 25        | 19.95 | (5-49)  |
|                  | TFM-4                          | 5-1250     | DC-1250            | 6.0  | 7.5         | 7.5  | 8.5                 | 50   | 45   | 40       | 30       | 30   | 25                  | 45   | 40   | 35       | 25       | 25   | 20        | 21.95 | (5-49)  |
| case B13         | TFM-11                         | 1-2000     | 5-600              | 7.0  | 8.5         | 7.5  | 9.0                 | 50   | 45   | 35       | 25       | 25   | 10                  | 45   | 40   | 27       | 20       | 25   | 20        | 39.95 | (1-24)  |
|                  | TFM-12                         | 800-1250   | 50-90              | —    | —           | 6.0  | 7.5                 | 35   | 25   | 35       | 25       | 35   | 25                  | 30   | 20   | 30       | 20       | 30   | 20        | 39.95 | (1-24)  |
| ASK<br>case W38  | ASK-1                          | 1-600      | DC-600             | 5.5  | 7.0         | 6.0  | 8.5                 | 50   | 40   | 35       | 25       | 30   | 20                  | 45   | 35   | 30       | 20       | 25   | 15        | 5.95  | (10-49) |
| LMX<br>case BB48 | LMX-113                        | 5-1000     | DC-1000            | 6.5  | 7.0         | 7.0  | 8.0                 | 50   | 40   | 40       | 30       | 35   | 25                  | 45   | 35   | 35       | 30       | 30   | 20        | 14.95 | (6-24)  |
|                  | LMX-124                        | 0.5-500    | DC-500             | 5.5  | 6/5         | 6.0  | 7.0                 | 50   | 40   | 45       | 30       | 45   | 25                  | 45   | 40   | 40       | 30       | 30   | 20        | 22.95 | (6-24)  |
|                  | LMX-149                        | 10-1500    | DC-1500            | 6.0  | 7.0         | 6.0  | 10.0                | 55   | 45   | 45       | 35       | 30   | 20                  | 50   | 45   | 40       | 25       | 20   | 12        | 24.95 | (6-24)  |
| PAM<br>case AA46 | PAM-42                         | 2.0-4.2GHz | DC-1.3GHz          | —    | —           | 7.0  | 8.5                 | —    | —    | 25 (typ) | 17 (min) | —    | —                   | —    | —    | 18 (typ) | 10 (min) | —    | —         | 26.95 | (1-24)  |

L = low range ( $f_L$  to 10  $f_L$ )M = mid range (10  $f_L$  to  $f_U/2$ )U = upper range ( $f_U/2$  to  $f_U$ )m = mid band ( $2f_L$  to  $f_U/2$ )

\* Surface Mounting Available  
See case KK81, page 18

| SAM     |         |         | TSM        | TFM        | ASK        | LMX        | PAM        |
|---------|---------|---------|------------|------------|------------|------------|------------|
| -1      | -4      | -2      |            |            |            |            |            |
| -3      | -5      |         | all models | all models | all models | all models | all models |
| 8       | 8       | 8       | 8          | 4          | 1          | 8          | 3          |
| 1       | 3,4     | 1       | 1          | 1          | 4          | 5          | 1          |
| 3,4*    | 1       | 3,4*    | 3,4*       | 2          | 5          | 4          | 4          |
| 2,5,6,7 | 2,5,6,7 | 2,5,6,7 | 2,5,6,7    | 3          | 2,3,6      | 2,3,6,7    | 2          |
| 2       | 2,5,6,7 | 2,5,6,7 | 2          | 3          | —          | 2,3,6,7    | 2          |

## MIL-M-288837/1A, NSN GUIDE

| MCL NO.       | NSN              | MIL-M-288837/1A* |
|---------------|------------------|------------------|
| GRA-1         |                  | 07 N             |
| GRA-1 HI-REL  |                  | 07 S             |
| SAM-1         | 5895-01-117-2926 |                  |
| SAM-3         | 5895-01-062-9973 |                  |
| SAM-5         | 5895-01-036-9507 |                  |
| SBL-1         | 9058-00-256-6818 |                  |
| SRA-1         | 6625-00-008-8272 | 03 N             |
| SRA-1 HI-REL  |                  | 03 S             |
| SRA-1-1       | 5962-01-113-5431 |                  |
| SRA-1W        |                  | 09 N             |
| SRA-1W HI-REL |                  | 09 S             |
| SRA-3         | 5895-01-021-5914 |                  |
| SRA-6         | 5895-01-124-0117 |                  |
| SRA-8         | 5985-01-081-0977 | 12 N             |
| SRA-8 HI-REL  |                  | 12 S             |
| TAK-5R        |                  | 01 N             |
| TAK-5R HI-REL |                  | 01 S             |
| TAK-6R        |                  | 02 N             |
| TAK-6R HI-REL |                  | 02 S             |
| TFM-2-408     | 5821-01-076-2497 |                  |
| TFM-3         | 5840-01-112-0031 |                  |
| TSM-1         | 5895-01-121-7958 |                  |

\*units are not QPL-listed

In Stock... Immediate Delivery



widest-variety of connector types

# Frequency Mixers

LEVEL 7 (+7 dBm LO, up to +1 dBm RF)

performance data

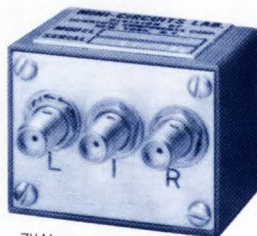
curves, tables, page 4 Model Index

case style selection

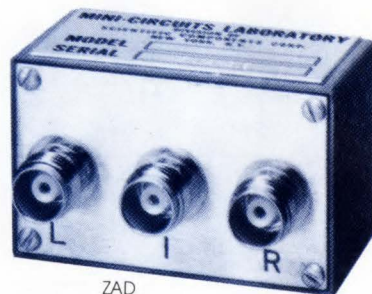
outline drawings see page 3



ZP



ZLW



ZAD  
ZMA

|                 | MODEL NO.   | FREQUENCY MHz                           |         | CONVERSION LOSS dB |      |                |      | LO-RF ISOLATION, dB |      |      |      |      |      | LO-IF ISOLATION, dB |      |      |      |      |      | PRICE, \$ |        |
|-----------------|-------------|-----------------------------------------|---------|--------------------|------|----------------|------|---------------------|------|------|------|------|------|---------------------|------|------|------|------|------|-----------|--------|
|                 |             | LO/RF<br>f <sub>L</sub> -f <sub>U</sub> | IF      | Mid-Band<br>m      |      | Total<br>Range |      | L                   |      | M    |      | U    |      | L                   |      | M    |      | U    |      | Ea.       | Qty.   |
|                 |             |                                         |         | Typ.               | Max. | Typ.           | Max. | Typ.                | Min. | Typ. | Min. | Typ. | Min. | Typ.                | Min. | Typ. | Min. | Typ. | Min. |           |        |
| ZP<br>case GG60 | ZP10514 NEW | .2-500                                  | DC-500  | 5.5                | 7.0  | 6.5            | 8.5  | 55                  | 45   | 50   | 35   | 35   | 30   | 50                  | 40   | 36   | 30   | 30   | 20   | 51.95     | (1-49) |
| ZLW<br>case M21 | ZLW-1       | .5-500                                  | DC-500  | 5.5                | 7.0  | 6.5            | 8.5  | 50                  | 45   | 45   | 30   | 35   | 25   | 45                  | 35   | 40   | 25   | 30   | 20   | 39.95     | (4-24) |
|                 | ZLW-1W      | 1-750                                   | DC-750  | 5.5                | 7.5  | 6.5            | 8.5  | 50                  | 45   | 45   | 30   | 35   | 25   | 45                  | 30   | 40   | 25   | 30   | 20   | 44.95     | (4-24) |
|                 | ZLW-1-1     | .1-500                                  | DC-500  | 5.5                | 7.5  | 6.5            | 8.5  | 50                  | 45   | 45   | 30   | 35   | 25   | 45                  | 30   | 40   | 25   | 30   | 20   | 41.95     | (4-24) |
|                 | ZLW-2       | 1-1000                                  | DC-1000 | 6.0                | 7.5  | 7.0            | 9.5  | 55                  | 45   | 40   | 25   | 35   | 20   | 50                  | 40   | 40   | 25   | 30   | 20   | 44.95     | (4-24) |
|                 | ZLW-3       | .025-200                                | DC-200  | 5.5                | 7.5  | 6.5            | 8.5  | 60                  | 50   | 45   | 35   | 35   | 25   | 45                  | 35   | 40   | 30   | 30   | 20   | 41.95     | (4-24) |
|                 | ZLW-5       | 5-1500                                  | 5-100   | 6.5                | 7.5  | 6.5            | 8.5  | 55                  | 40   | 35   | 25   | 30   | 20   | 50                  | 40   | 35   | 25   | 30   | 20   | 51.95     | (4-24) |
|                 | ZLW-6       | .003-100                                | DC-100  | 5.5                | 7.5  | 6.5            | 8.5  | 60                  | 50   | 45   | 30   | 35   | 25   | 60                  | 45   | 40   | 25   | 30   | 20   | 49.95     | (4-24) |
|                 | ZLW-8       | .0005-10                                | DC-10   | 6.5                | 7.5  | 7.0            | 8.5  | 60                  | 50   | 50   | 40   | 45   | 35   | 60                  | 50   | 50   | 40   | 45   | 35   | 54.95     | (4-24) |
|                 | ZLW-11      | 5-2000                                  | 10-600  | 7.0                | 8.5  | 7.5            | 9.0  | 50                  | 45   | 35   | 25   | 30   | 20   | 45                  | 40   | 30   | 20   | 25   | 15   | 61.95     | (4-24) |
|                 | ZLW-12      | 800-1250                                | 50-90   | —                  | —    | 6.0            | 7.5  | 35                  | 25   | 35   | 25   | 35   | 25   | 30                  | 20   | 30   | 20   | 30   | 20   | 61.95     | (4-24) |
| ZAD<br>case M22 | ZAD-1       | .5-500                                  | DC-500  | 5.5                | 7.0  | 6.5            | 8.5  | 50                  | 45   | 45   | 30   | 35   | 25   | 45                  | 35   | 40   | 25   | 30   | 20   | 29.95     | (4-24) |
|                 | ZAD-1W      | 1-750                                   | DC-750  | 5.5                | 7.5  | 6.5            | 8.5  | 50                  | 45   | 45   | 30   | 35   | 25   | 45                  | 30   | 40   | 25   | 30   | 20   | 34.95     | (4-24) |
|                 | ZAD-1-1     | .1-500                                  | DC-500  | 5.5                | 7.5  | 6.5            | 8.5  | 50                  | 45   | 45   | 30   | 35   | 25   | 45                  | 30   | 40   | 25   | 30   | 20   | 31.95     | (4-24) |
|                 | ZAD-2       | 1-1000                                  | .5-500  | 5.5                | 7.5  | 6.5            | 8.5  | 45                  | 30   | 35   | 20   | 30   | 20   | 45                  | 30   | 35   | 20   | 30   | 20   | 39.95     | (4-24) |
|                 | ZAD-3       | .025-200                                | DC-200  | 5.5                | 7.5  | 6.5            | 8.5  | 60                  | 50   | 45   | 35   | 35   | 25   | 45                  | 35   | 40   | 30   | 30   | 20   | 31.95     | (4-24) |
|                 | ZAD-4       | .5-1250                                 | .5-500  | 5.5                | 7.5  | 6.5            | 8.5  | 50                  | 40   | 40   | 20   | 30   | 20   | 50                  | 40   | 40   | 20   | 30   | 20   | 41.95     | (4-24) |
|                 | ZAD-6       | .003-100                                | DC-100  | 5.5                | 7.5  | 6.5            | 8.5  | 60                  | 50   | 45   | 30   | 35   | 25   | 60                  | 45   | 40   | 25   | 30   | 20   | 39.95     | (4-24) |
|                 | ZAD-8       | .0005-10                                | DC-10   | 6.5                | 7.5  | 7.0            | 8.5  | 60                  | 50   | 50   | 40   | 45   | 35   | 60                  | 50   | 50   | 40   | 45   | 35   | 44.95     | (4-24) |
|                 | ZAD-11      | 5-2000                                  | 10-600  | 7.0                | 8.5  | 7.5            | 9.0  | 50                  | 45   | 35   | 25   | 30   | 20   | 45                  | 40   | 30   | 20   | 25   | 15   | 51.95     | (4-24) |
|                 | ZAD-12      | 800-1250                                | 50-90   | 6.0                | 7.5  | 6.0            | 7.5  | 35                  | 25   | 35   | 25   | 35   | 25   | 30                  | 20   | 30   | 20   | 30   | 20   | 51.95     | (4-24) |

L = low range ( $f_L$  to 10  $f_L$ )

M = mid range (10 $f_L$  to  $f_U/2$ )

U = upper range ( $f_U/2$  to  $f_U$ )

m = mid band ( $2f_L$  to  $f_U/2$ )

single-balanced (1 to 3 GHz)

| MODEL NO.       | LO/RF<br>$f_L$ - $f_U$ | IF         | Mid-Band<br>m* |      | Total<br>Range |      | L*   |      | M*   |      | U*   |      | L*   |      | M*   |      | U* |    | Ea. | Qty.  |       |
|-----------------|------------------------|------------|----------------|------|----------------|------|------|------|------|------|------|------|------|------|------|------|----|----|-----|-------|-------|
|                 |                        |            | Typ.           | Max. | Typ.           | Max. | Typ. | Min. | Typ. | Min. | Typ. | Min. | Typ. | Min. | Typ. | Min. |    |    |     |       |       |
|                 |                        |            |                |      |                |      |      |      |      |      |      |      |      |      |      |      |    |    |     |       |       |
| ZMA<br>case M23 | ZMA-2*                 | 1-2.5GHz   | DC-150         | 7.0  | 8.5            | 8.0  | 9.0  | 25   | 20   | 22   | 17   | 20   | 15   | 50   | 35   | 40   | 30 | 35 | 25  | 63.95 | (1-9) |
|                 | ZMA-3*                 | 1.4-3.0GHz | DC-500         | 6.5  | 8.0            | 7.0  | 9.0  | 25   | 20   | 28   | 18   | 23   | 15   | 50   | 35   | 50   | 30 | 50 | 30  | 67.95 | (1-9) |

\*m = 500MHz

\*L =  $f_L$  to ( $f_L + 500$ )

\*M = ( $f_L + 500$ ) to ( $f_U - 500$ )

\*U =  $f_U$  to ( $f_U - 500$ )

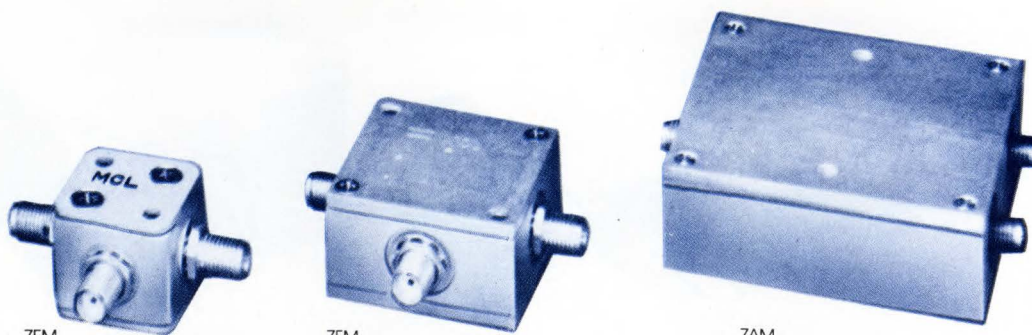
## NOTES:

1. For typical characteristics, compression level, phase detection and electronic attenuation, see "Mixer Technical Section."
2. For Quality Control procedures, see page 6.
3. For environmental specifications see page 7.
4. For High-Rel and TX description, see page 6.
5. Absolute Maximum Ratings; RF Power 50mW, peak IF current 40mA.
6. For connector types and case mounting options, see case style outline drawing.
7. Prices and specifications subject to change without notice.



500 Hz to 4.2 GHz

# Mini-Circuits



ZEM

ZFM

ZAM

|                 |           | FREQUENCY<br>MHZ |                                         | CONVERSION LOSS<br>dB |               |      |                | LO-RF ISOLATION, dB |      |      |      |      |      | LO-IF ISOLATION, dB |      |      |      |      |       | PRICE, \$ |        |      |
|-----------------|-----------|------------------|-----------------------------------------|-----------------------|---------------|------|----------------|---------------------|------|------|------|------|------|---------------------|------|------|------|------|-------|-----------|--------|------|
|                 |           | MODEL<br>NO.     | LO/RF<br>f <sub>L</sub> -f <sub>U</sub> | IF                    | Mid-Band<br>m |      | Total<br>Range |                     | L    |      | M    |      | U    |                     | L    |      | M    |      | U     |           | Ea.    | Qty. |
|                 |           |                  |                                         |                       | Typ.          | Max. | Typ.           | Max.                | Typ. | Min. | Typ. | Min. | Typ. | Min.                | Typ. | Min. | Typ. | Min. | Typ.  | Min.      |        |      |
| ZEM<br>case V37 | ZEM-2     | 10-1000          | DC-1000                                 | 6.0                   | 7.0           | 6.5  | 8.5            | 55                  | 50   | 30   | 25   | 25   | 20   | 55                  | 45   | 30   | 20   | 25   | 20    | 49.95     | (4-24) |      |
| ZFM<br>case K18 | ZFM-1W    | 10-750           | DC-750                                  | 6.0                   | 7.0           | 6.2  | 8.0            | 50                  | 45   | 45   | 30   | 35   | 25   | 45                  | 40   | 40   | 25   | 27   | 20    | 41.95     | (4-24) |      |
|                 | ZFM-2     | 1-1000           | DC-1000                                 | 6.0                   | 7.5           | 7.0  | 8.5            | 50                  | 45   | 40   | 25   | 30   | 25   | 45                  | 40   | 35   | 25   | 25   | 20    | 43.95     | (1-24) |      |
|                 | ZFM-3     | .04-400          | DC-400                                  | 5.3                   | 7.0           | 6.0  | 8.0            | 60                  | 50   | 50   | 35   | 35   | 25   | 55                  | 40   | 45   | 30   | 35   | 25    | 51.95     | (1-24) |      |
|                 | ZFM-4     | 5-1250           | DC-1250                                 | 6.0                   | 7.5           | 7.5  | 8.5            | 50                  | 45   | 40   | 30   | 30   | 25   | 45                  | 40   | 35   | 25   | 25   | 20    | 51.95     | (1-24) |      |
|                 | ZFM-11    | 1-2000           | 5-600                                   | 7.0                   | 8.5           | 7.5  | 9.0            | 50                  | 45   | 35   | 25   | 25   | 20   | 45                  | 40   | 27   | 20   | 25   | 20    | 81.95     | (1-24) |      |
|                 | ZFM-12    | 800-1250         | 50-90                                   | —                     | —             | 6.0  | 7.5            | 35                  | 25   | 35   | 25   | 35   | 25   | 30                  | 20   | 30   | 20   | 30   | 20    | 71.95     | (1-24) |      |
|                 | ZFM-2000  | 100-2000         | DC-600                                  | 6.0                   | 8.0           | 7.0  | 9.5            | —                   | —    | 37   | 20   | —    | —    | —                   | —    | —    | —    | 30   | 20    | 61.95     | (1-24) |      |
| ZFM-4212        | 2000-4200 | DC-1300          | —                                       | —                     | 7.0           | 8.5  | —              | —                   | 25   | 17   | —    | —    | —    | —                   | 18   | 10   | —    | —    | 39.95 | (1-9)     |        |      |
| ZAM<br>case F14 | ZAM-42    | 1500-4200        | DC-500                                  | —                     | —             | 7.0  | 8.5            | 25                  | 20   | 25   | 17   | 25   | 20   | 18                  | 10   | 18   | 10   | 18   | 10    | 39.95     | (1-24) |      |

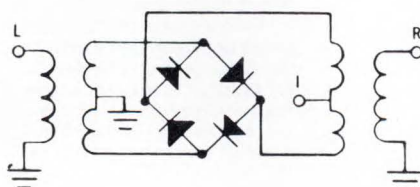
L = low range ( $f_L$  to  $10 f_L$ )

M = mid range ( $10 f_L$  to  $f_U/2$ )

U = upper range ( $f_U/2$  to  $f_U$ )

m = mid band ( $2 f_L$  to  $f_U/2$ )

## schematic



## MIL-M-28837/1A, NSN GUIDE

| MCL NO.  | NSN              |
|----------|------------------|
| ZAD-1B   | 5895-00-280-7750 |
| ZAD-4B   | 5895-01-127-0376 |
| ZAD-6B   | 5865-21-200-6364 |
| ZFM-12-1 | 5825-01-127-3377 |
| ZLW-1W   | 5840-00-607-7010 |
| ZLW-2B   | 6920-01-037-1974 |
| ZLW-5-1  | 4920-01-017-2753 |
| ZMA-3    | 5865-01-064-0212 |

## coaxial connections

see case style outline drawing

| Series | ZP         | ZLW        | ZAD (ex-2, -4) | ZAD -2, -4 | ZMA        | ZEM        | ZFM        | ZAM        |
|--------|------------|------------|----------------|------------|------------|------------|------------|------------|
| models | all models | all models | all models     | all models | all models | all models | all models | all models |
| L      | L          | 1          | 1              | 1          | 1          | 1          | 1          | 2          |
| R      | X          | 3          | 3              | 2          | 2          | 2          | 2          | 1          |
| I      | R          | 2          | 2              | 3          | 3          | 3          | 3          | 3          |

**In Stock... Immediate Delivery**



broadband, high dynamic range

# Frequency Mixers

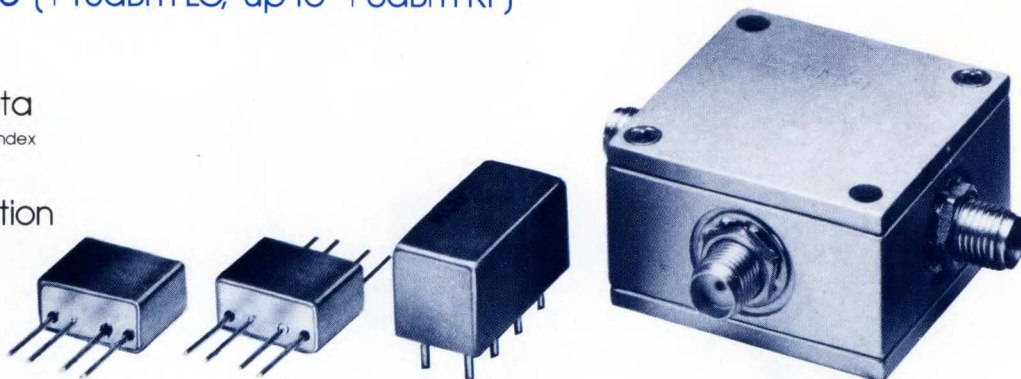
LEVEL 10 (+10dBm LO, up to +5dBm RF)

## performance data

curves, tables, page 4 Model Index

## case style selection

outline drawings see page 3



TFM

LMX

SRA

ZFM

|                  | MODEL NO.   | FREQUENCY MHz   |         | CONVERSION LOSS dB |      |             |      | LO-RF ISOLATION, dB |      |      |      |      |      | LO-IF ISOLATION, dB |      |      |      |      |      | PRICE, \$ |        |
|------------------|-------------|-----------------|---------|--------------------|------|-------------|------|---------------------|------|------|------|------|------|---------------------|------|------|------|------|------|-----------|--------|
|                  |             | LO/RF $f_L-f_U$ | IF      | Mid-Band m         |      | Total Range |      | L                   |      | M    |      | U    |      | L                   |      | M    |      | U    |      | Eq.       | Qty.   |
|                  |             |                 |         | Typ.               | Max. | Typ.        | Max. | Typ.                | Min. | Typ. | Min. | Typ. | Min. | Typ.                | Min. | Typ. | Min. | Typ. | Min. |           |        |
| TFM<br>case B13  | TFM-15      | 10-3000         | 10-800  | 6.3                | 8.0  | 6.5         | 8.5  | 35                  | 25   | 35   | 25   | 35   | 25   | 30                  | 20   | 30   | 20   | 30   | 20   | 49.95     | (1-9)  |
|                  | TFM-150*    | 10-2000         | DC-1000 | 6.0                | 8.0  | 6.5         | 8.0  | 32                  | 25   | 35   | 25   | 35   | 25   | 33                  | 20   | 30   | 20   | 30   | 20   | 39.95     | (1-9)  |
| LMX<br>case BB48 | LMX-123 NEW | 10-3000         | 10-3000 | 7.5                | 8.0  | 7.5         | 8.5  | 35                  | 25   | 35   | 20   | 30   | 15   | 35                  | 25   | 30   | 25   | 30   | 20   | 59.95     | (6-24) |
|                  | LMX-148     | 10-1500         | DC-1500 | 6.0                | 7.0  | 6.0         | 10   | 45                  | 40   | 35   | 30   | 25   | 20   | 40                  | 35   | 35   | 25   | 20   | 12   | 24.95     | (6-24) |
| SRA<br>case A01  | SRA-215     | .05-1500        | .05-500 | 6.0                | 7.5  | 7.0         | 9.0  | 25                  | 20   | 35   | 25   | 30   | 20   | 25                  | 20   | 35   | 25   | 25   | 15   | 23.95     | (5-24) |
|                  | SRA-220     | .05-2000        | .05-500 | 6.0                | 7.5  | 7.0         | 9.0  | 25                  | 20   | 40   | 30   | 30   | 20   | 25                  | 20   | 40   | 30   | 25   | 15   | 26.95     | (5-24) |
| ZFM<br>case K18  | ZFM-15      | 10-3000         | 10-800  | 6.3                | 7.5  | 6.5         | 8.5  | 35                  | 25   | 35   | 25   | 35   | 25   | 30                  | 20   | 30   | 20   | 30   | 20   | 79.95     | (1-9)  |
|                  | ZFM-150     | 10-2000         | DC-1000 | 6.0                | 7.0  | 6.5         | 8.0  | 32                  | 25   | 35   | 25   | 35   | 20   | 33                  | 28   | 30   | 20   | 25   | 20   | 59.95     | (1-9)  |

L=low range ( $f_L$  to  $10 f_L$ )

M=mid range ( $10 f_L$  to  $f_U/2$ )

U=upper range ( $f_U/2$  to  $f_U$ )

m=mid band ( $2 f_L$  to  $f_U/2$ )

## harmonic attenuation

|                    |    | MODEL TFM-15 |                   |    |    |    |    |    |    |    |    |    |  |
|--------------------|----|--------------|-------------------|----|----|----|----|----|----|----|----|----|--|
|                    |    | RF<br>CAL    |                   |    |    |    |    |    |    |    |    |    |  |
| Harmonics RF Order | 1  | 0            | 0                 | 31 | 17 | 42 | 32 | 48 | 47 | 52 | 65 | 59 |  |
|                    | 2  | 83           | 38                | 45 | 39 | 48 | 46 | 76 | 69 | 70 | 64 | 71 |  |
|                    | 3  | 87           | 39                | 49 | 37 | 52 | 42 | 57 | 63 | 65 | 65 | 65 |  |
|                    | 4  | 89           | 64                | 60 | 58 | 56 | 59 | 60 | 62 | 69 | 74 | 70 |  |
|                    | 5  | 90           | 74                | 69 | 59 | 72 | 55 | 74 | 58 | 71 | 67 | 72 |  |
|                    | 6  | 83           | 83                | 76 | 74 | 67 | 69 | 67 | 72 | 70 | 74 | 78 |  |
|                    | 7  | 83           | 76                | 83 | 81 | 79 | 69 | 71 | 66 | 70 | 69 | 77 |  |
|                    | 8  | 84           | 75                | 76 | 81 | 82 | 77 | 77 | 80 | 78 | 78 | 77 |  |
|                    | 9  | 84           | 77                | 76 | 75 | 82 | 80 | 81 | 82 | 80 | 79 | 80 |  |
|                    | 10 | 81           | 76                | 76 | 74 | 75 | 80 | 81 | 81 | 81 | 80 | 81 |  |
|                    |    |              | 1                 | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 |  |
|                    |    |              | Harmonic LO Order |    |    |    |    |    |    |    |    |    |  |

Model: TFM-15 S/N: sample band-width: 0-99999 MHz

999.100 MHz input P. - .06 dBm

969.010 MHz input P. + 9.96 dBm

IF = 30.090 MHz | LO = +10 dBm, 969.01 MHz

IF amplif. -7.14 dBm | RF = 0 dBm, 999.1 MHz

Final Spectrum Analyzer HP-8566A Parameters:

RES BW 1kHz VBW 3kHz

SWP 300 msec ATTEN 10 dB 5 dB/div SPAN 100 kHz

LO drive adjusted with 19.75db Weinschel S/N:G4047 RF,IF attenuator  
10.0dB Tektronix S/N:011-0085-00

## NOTES:

\* Below 10 MHz IF, conversion loss increases up to 6dB higher as frequency decreases to DC.

1. For typical characteristics, compression level, phase detection and electronic attenuation, see "Mixer Technical Section."

2. For Quality Control procedures, see page 6.

3. For environmental specifications see page 7.

4. For High-Rel and TX description, see page 6.

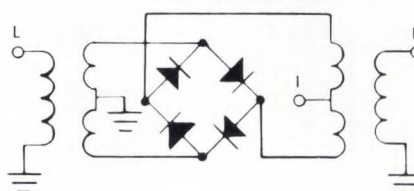
5. Absolute Maximum Ratings,

RF power 50 mW level 10, 200mW level 13, peak IF current 40 mA, see pg. 7.

6. For connector types and case mounting options, see case style outline drawings.

7. Prices and specifications subject to change without notice.

## schematic



**Mini-Circuits**

P.O. BOX 166, Brooklyn, New York 11235 (718) 934-4500

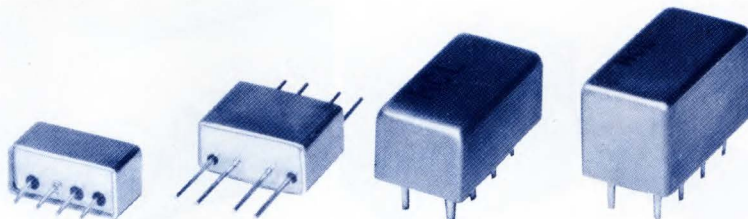


50 KHz to 3 GHz

LEVEL 13 (+13dBm LO, up to +9dBm RF)

# Mini-Circuits

NEW



TFM-MH

LMX-MH

SBL-MH

SRA-MH

|                     | MODEL NO.          | FREQUENCY MHz          |                  | CONVERSION LOSS dB |            |             |            | LO-RF ISOLATION, dB |          |          |          |          |          | LO-IF ISOLATION, dB |          |          |          |          |                | PRICE, \$        |                  |
|---------------------|--------------------|------------------------|------------------|--------------------|------------|-------------|------------|---------------------|----------|----------|----------|----------|----------|---------------------|----------|----------|----------|----------|----------------|------------------|------------------|
|                     |                    | LO/RF<br>$f_L$ - $f_U$ | IF               | Mid-Band m         |            | Total Range |            | L                   |          | M        |          | U        |          | L                   |          | M        |          | U        |                | Ea.              | Qty.             |
|                     |                    |                        |                  | Typ.               | Max.       | Typ.        | Max.       | Typ.                | Min.     | Typ.     | Min.     | Typ.     | Min.     | Typ.                | Min.     | Typ.     | Min.     |          |                |                  |                  |
|                     |                    |                        |                  |                    |            |             |            |                     |          |          |          |          |          |                     |          |          |          |          |                |                  |                  |
| TFM-MH<br>case B02  | TFM-1MH<br>TFM-3MH | 2-500<br>.1-250        | DC-500<br>DC-250 | 6.0<br>5.0         | 7.5<br>7.0 | 7.0<br>6.0  | 8.5<br>8.5 | 50<br>50            | 45<br>45 | 40<br>40 | 30<br>30 | 20<br>23 | 45<br>45 | 40<br>40            | 35<br>35 | 25<br>25 | 25<br>26 | 20<br>20 | 21.95<br>21.95 | (5-24)<br>(5-24) |                  |
| LMX-MH<br>case BB48 | LMX-125MH          | 0.5-500                | DC-500           | 6.0                | 7.0        | 7.0         | 9.0        | 45                  | 40       | 45       | 40       | 40       | 30       | 45                  | 40       | 40       | 35       | 35       | 25             | 54.95            | (6-24)           |
| SBL-MH<br>case A06  | SBL-1MH            | 1-500                  | DC-500           | 5.5                | 7.5        | 6.5         | 8.5        | 50                  | 35       | 45       | 30       | 35       | 25       | 45                  | 30       | 40       | 25       | 30       | 20             | 9.50             | (10-49)          |
| SRA-MH<br>case A01  | SRA-1MH<br>SRA-3MH | 5-500<br>.025-200      | DC-500<br>DC-200 | 5.5<br>5.5         | 7.0<br>7.5 | 6.5<br>6.5  | 8.5<br>8.5 | 50<br>60            | 45<br>50 | 45<br>45 | 30<br>35 | 35<br>25 | 25<br>25 | 45<br>45            | 35<br>35 | 40<br>40 | 25<br>30 | 30<br>20 | 20<br>20       | 13.95<br>15.95   | (5-24)<br>(5-24) |

L = low range ( $f_L$  to  $10 f_L$ )

M = mid range ( $10 f_L$  to  $f_U/2$ )

U = upper range ( $f_U/2$  to  $f_U$ )

m = mid band ( $2 f_L$  to  $f_U/2$ )

## pin and coaxial connections

see case style outline drawing

| Series   | TFM        | LMX        | SRA        | ZFM        | TFM-MH     | LMX-MH     | SBL-MH     | SRA-MH     |
|----------|------------|------------|------------|------------|------------|------------|------------|------------|
| Models   | all models | all models | all models | all models | all models | all models | all models | all models |
| LO       | 4          | 8          | 8          | 1          | 4          | 8          | 8          | 8          |
| RF       | 1          | 5          | 1          | 2          | 1          | 5          | 1          | 1          |
| IF       | 2          | 4          | 3          | 3          | 2          | 4          | 3,4*       | 3,4*       |
| GND      | 3          | 2,3,6,7    | 2,5,6,7    | —          | 3          | 2,3,6,7    | 2,5,6,7    | 2,5,6,7    |
| CASE GND | 3          | 2,3,6,7    | 2,5,6,7    | —          | 3          | 2,3,6,7    | —          | 2          |

\*pins must be connected together externally



In Stock... Immediate Delivery



very high dynamic range

# Frequency Mixers

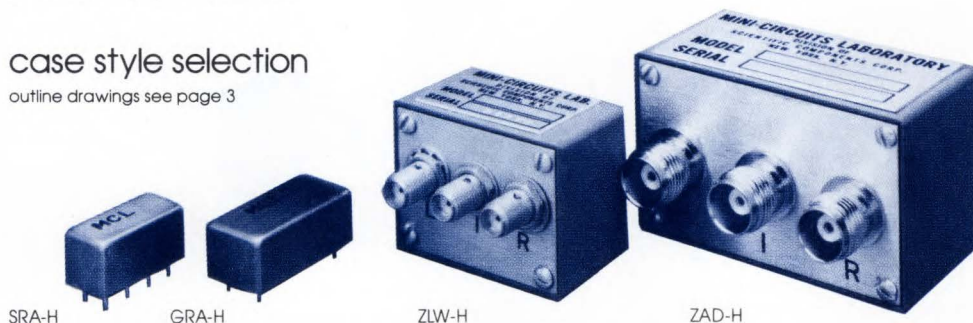
LEVEL 17 (+17 dBm LO, up to +10 dBm RF)

performance data

curves, tables, page 4 Model Index

case style selection

outline drawings see page 3



|                               | MODEL NO.  | FREQUENCY MHz          |         | CONVERSION LOSS dB |      |             |      | LO-RF ISOLATION, dB |      |      |      |      |      | LO-IF ISOLATION, dB |      |      |      |    |    | PRICE, \$ |        |
|-------------------------------|------------|------------------------|---------|--------------------|------|-------------|------|---------------------|------|------|------|------|------|---------------------|------|------|------|----|----|-----------|--------|
|                               |            | LO/RF<br>$f_L$ - $f_U$ | IF      | Mid-Band m         |      | Total Range |      | L                   |      | M    |      | U    |      | L                   |      | M    |      | U  |    | Ea.       | Qty.   |
|                               |            |                        |         | Typ.               | Max. | Typ.        | Max. | Typ.                | Min. | Typ. | Min. | Typ. | Min. | Typ.                | Min. | Typ. | Min. |    |    |           |        |
|                               |            |                        |         |                    |      |             |      |                     |      |      |      |      |      |                     |      |      |      |    |    |           |        |
| SRA-H<br>case A01             | ● SRA-1H   | .5-500                 | DC-500  | 5.5                | 7.5  | 6.5         | 8.5  | 55                  | 45   | 45   | 30   | 35   | 25   | 45                  | 35   | 40   | 30   | 30 | 20 | 17.95     | (5-24) |
|                               | ● SRA-1WH  | 1-750                  | DC-750  | 5.5                | 7.5  | 6.5         | 8.5  | 50                  | 40   | 45   | 25   | 35   | 25   | 45                  | 35   | 40   | 30   | 30 | 20 | 21.95     | (5-24) |
|                               | ● SRA-2H   | 2-1000                 | DC-1000 | 6.0                | 7.5  | 8.5         | 10   | 50                  | 40   | 35   | 25   | 35   | 25   | 45                  | 30   | 30   | 20   | 25 | 20 | 29.95     | (5-24) |
|                               | ● SRA-3H   | .05-200                | DC-200  | 5.5                | 7.0  | 5.5         | 7.5  | 50                  | 45   | 40   | 30   | 35   | 25   | 45                  | 35   | 40   | 30   | 30 | 20 | 19.95     | (5-24) |
|                               | ● SRA-11H  | 10-3000                | 10-1000 | 8.0                | 10   | 10          | 12   | 27                  | 20   | 25   | 18   | 23   | 16   | 27                  | 20   | 25   | 18   | 23 | 16 | 39.95     | (1-24) |
|                               | ● SRA-173H | 5-1200                 | DC-1200 | 6.0                | 7.0  | 7.0         | 9.0  | 25                  | 20   | 25   | 18   | 25   | 18   | 27                  | 20   | 25   | 18   | 25 | 18 | 29.95     | (1-5)  |
| GRA-H<br>case D08             | ● GRA-1H   | .5-500                 | DC-500  | 5.5                | 7.5  | 6.5         | 8.5  | 55                  | 45   | 45   | 30   | 35   | 25   | 45                  | 35   | 40   | 30   | 30 | 20 | 18.95     | (5-24) |
|                               | ● GRA-3H   | .05-200                | DC-200  | 5.5                | 7.0  | 5.5         | 7.5  | 55                  | 45   | 45   | 30   | 35   | 25   | 45                  | 35   | 40   | 30   | 30 | 20 | 20.95     | (5-24) |
|                               | ● GRA-6H   | .01-50                 | DC-50   | 5.5                | 6.0  | 5.5         | 7.0  | 50                  | 45   | 45   | 30   | 35   | 25   | 50                  | 40   | 47   | 35   | 32 | 25 | 26.95     | (5-24) |
| ZLW-H<br>case M21<br>SMA      | ● ZLW-1H   | .5-500                 | DC-500  | 5.5                | 7.5  | 6.5         | 8.5  | 55                  | 45   | 45   | 30   | 35   | 25   | 45                  | 35   | 40   | 30   | 30 | 20 | 45.95     | (4-24) |
|                               | ● ZLW-1WH  | 1-750                  | DC-750  | 5.5                | 7.5  | 6.5         | 8.5  | 50                  | 45   | 45   | 25   | 35   | 25   | 45                  | 35   | 40   | 25   | 30 | 20 | 49.95     | (4-24) |
|                               | ● ZLW-2H   | 2-1000                 | DC-1000 | 6.0                | 7.5  | 8.5         | 10   | 50                  | 40   | 35   | 25   | 35   | 25   | 45                  | 35   | 30   | 20   | 25 | 20 | 59.95     | (4-24) |
|                               | ● ZLW-3H   | .05-200                | DC-200  | 5.5                | 7.0  | 5.5         | 7.5  | 55                  | 45   | 45   | 30   | 35   | 25   | 45                  | 35   | 40   | 30   | 30 | 20 | 47.95     | (4-24) |
|                               | ● ZLW-11H  | 10-3000                | 10-1000 | 8.0                | 10   | 10          | 12   | 27                  | 20   | 25   | 18   | 23   | 16   | 27                  | 20   | 25   | 18   | 23 | 16 | 91.95     | (4-24) |
| ZAD-H<br>case M22<br>BNC, TNC | ● ZAD-1H   | .5-500                 | DC-500  | 5.5                | 7.5  | 6.5         | 8.5  | 50                  | 45   | 45   | 30   | 35   | 25   | 45                  | 35   | 40   | 30   | 30 | 20 | 35.95     | (4-24) |
|                               | ● ZAD-1WH  | 1-750                  | DC-750  | 5.5                | 7.5  | 6.5         | 8.5  | 50                  | 45   | 45   | 25   | 35   | 25   | 45                  | 35   | 40   | 25   | 30 | 20 | 39.95     | (4-24) |
|                               | ● ZAD-2H   | 2-1000                 | DC-1000 | 6.0                | 7.5  | 8.5         | 10   | 50                  | 40   | 35   | 25   | 35   | 25   | 45                  | 35   | 30   | 20   | 25 | 20 | 49.95     | (4-24) |
|                               | ● ZAD-3H   | .05-200                | DC-200  | 5.5                | 7.0  | 5.5         | 7.5  | 55                  | 45   | 45   | 30   | 35   | 25   | 45                  | 35   | 40   | 30   | 30 | 20 | 37.95     | (4-24) |
|                               | ● ZAD-11H  | 10-3000                | 10-1000 | 8.0                | 10   | 10          | 12   | 27                  | 20   | 25   | 18   | 23   | 16   | 27                  | 20   | 25   | 18   | 23 | 16 | 81.95     | (4-24) |

L = low range ( $f_L$  to 10  $f_L$ )

M = mid range (10  $f_L$  to  $f_U/2$ )

U = upper range ( $f_U/2$  to  $f_U$ )

## NOTES:

• HTRB tested

- For typical characteristics, compression level, phase detection and electronic attenuation, see "Mixer Technical Section."
- For Quality Control procedures, see page 6.
- For environmental specifications see page 7.
- For High-Rel and TX description, see page 6.
- Absolute Maximum Ratings, RF power 200 mW, peak IF current 40 mA, see pg. 7.
- For connector types and case mounting options, see case style outline drawings.
- Prices and specifications subject to change without notice.

## MIL-M-28837/1A, NSN GUIDE

| MCL NO.       | NSN              | MIL-M-28837/1A* |
|---------------|------------------|-----------------|
| GRA-1H        |                  | 06N             |
| GRA-1H Hi-Rel |                  | 06S             |
| GRA-1H        |                  | 10N             |
| GRA-1H        |                  | 10S             |
| GRA-3H        |                  | 05N             |
| GRA-3H Hi-Rel |                  | 05S             |
| SRA-1H        | 6625-00-594-0223 | 08N             |
| SRA-1 Hi-Rel  |                  | 08S             |
| SRA-1WH       | 5840-00-576-0716 |                 |
| SRA-2H        | 5895-01-063-1078 |                 |
| SRA-3H        | 5895-01-117-4537 |                 |
| ZAD-1WH       | 5895-01-045-4647 |                 |
| ZLW-1H        | 5985-01-080-7637 |                 |
| ZLW-1H-B      | 5962-045-7500    |                 |

\*units are not GPL listed

## pin and coaxial connections

see case style outline drawing

| Series   | SRA     |         |         |                 |         | GRA-H      | ZLW-H      | ZAD-H      |
|----------|---------|---------|---------|-----------------|---------|------------|------------|------------|
| Models   | -1H     | -1WH    | -11H    | -173H           |         | all models | all models | all models |
|          | -3H     | -2H     |         | Configuration 1 | 2       |            |            |            |
| LO       | 8       | 8       | 8       | 3,4*            | 8       | 1          | 1          | 1          |
| RF       | 1       | 1       | 1       | 1               | 1       | 6          | 3          | 3          |
| IF       | 3,4*    | 3,4*    | 3       | 8               | 3,4*    | 4          | 2          | 2          |
| GND      | 2,5,6,7 | 2,5,6,7 | 2,5,6,7 | 2,5,6,7         | 2,5,6,7 | 2,3,5      | —          | —          |
| CASE GND | 2       | 2,5,6,7 | 2,5,6,7 | 2,5,6,7         | 2,5,6,7 | —          | —          | —          |

\*pins must be connected together externally



10 KHz to 3 GHz

# Mini-Circuits



computer-automated performance data  
typical production unit / for data of other models consult factory

## SRA-1H

| RF<br>(MHz) | LO<br>(MHz) | CONVERSION LOSS<br>(dB) |                |                | ISOLATION (dB) |       |       |       |       |       |        |       | VSWR<br>(+17dBm LO) |      |      |
|-------------|-------------|-------------------------|----------------|----------------|----------------|-------|-------|-------|-------|-------|--------|-------|---------------------|------|------|
|             |             | LO + 10<br>dBm          | LO + 15<br>dBm | LO + 17<br>dBm | L-R            |       |       |       | L-I   |       |        |       | LO                  | RF   | IF   |
| 10.00       | 40.00       | 6.99                    | 6.36           | 6.15           | 54.08          | 56.43 | 54.97 | 54.54 | 52.32 | 51.54 | 50.87  | 50.53 | —                   | —    | —    |
| 35.70       | 65.70       | 7.32                    | 6.45           | 6.24           | 53.91          | 51.73 | 49.79 | 49.89 | 50.23 | 48.49 | 47.55  | 46.59 | 2.40                | 1.13 | 1.21 |
| 61.56       | 91.56       | 6.91                    | 6.19           | 6.06           | 52.44          | 50.08 | 48.37 | 47.04 | 48.30 | 46.56 | 44.44  | 44.06 | 2.68                | 1.13 | 1.20 |
| 87.34       | 57.34       | 6.87                    | 6.27           | 6.09           | 53.43          | 54.16 | 51.79 | 51.34 | 51.12 | 50.03 | 48.89  | 47.85 | 2.33                | 1.13 | 1.20 |
| 113.12      | 83.12       | 7.22                    | 6.46           | 6.28           | 52.65          | 50.32 | 48.99 | 47.43 | 48.68 | 47.19 | 45.07  | 44.75 | 2.63                | 1.16 | 1.24 |
| 138.90      | 108.90      | 5.83                    | 6.18           | 6.09           | 51.41          | 48.68 | 46.06 | 45.59 | 46.51 | 44.71 | 42.83  | 42.51 | 2.48                | 1.22 | 1.36 |
| 164.68      | 134.68      | 6.06                    | 6.38           | 6.24           | 48.62          | 46.56 | 43.46 | 43.17 | 44.84 | 42.84 | 40.96  | 40.59 | 2.30                | 1.31 | 1.47 |
| 190.46      | 160.46      | 5.91                    | 6.24           | 6.12           | 47.58          | 44.71 | 41.57 | 41.29 | 43.33 | 41.13 | 39.43  | 38.96 | 2.46                | 1.34 | 1.58 |
| 216.24      | 186.24      | 5.89                    | 6.27           | 6.14           | 46.31          | 43.35 | 40.90 | 40.77 | 41.89 | 40.25 | 38.44  | 37.95 | 2.15                | 1.32 | 1.57 |
| 242.02      | 212.02      | 6.97                    | 6.39           | 6.27           | 44.86          | 41.28 | 39.90 | 39.73 | 41.22 | 39.15 | 37.32  | 36.66 | 2.44                | 1.30 | 1.56 |
| 267.80      | 237.80      | 6.89                    | 6.27           | 6.14           | 43.39          | 40.11 | 38.57 | 38.38 | 40.38 | 37.88 | 36.03  | 35.60 | 2.13                | 1.29 | 1.60 |
| 293.58      | 263.58      | 7.12                    | 6.57           | 6.35           | 42.94          | 39.51 | 37.78 | 37.29 | 39.34 | 36.32 | 34.56  | 34.34 | 2.20                | 1.35 | 1.86 |
| 319.36      | 289.36      | 6.82                    | 6.36           | 6.25           | 42.95          | 39.40 | 38.51 | 37.90 | 38.29 | 35.30 | 33.21  | 32.87 | 2.00                | 1.40 | 2.26 |
| 345.14      | 315.14      | 7.16                    | 6.67           | 6.48           | 40.60          | 37.77 | 38.42 | 37.63 | 37.52 | 34.26 | 32.09  | 31.51 | 2.10                | 1.39 | 2.51 |
| 370.90      | 340.92      | 7.31                    | 6.73           | 6.46           | 38.07          | 36.51 | 38.02 | 36.99 | 36.70 | 33.98 | 31.44  | 30.59 | 1.88                | 1.32 | 2.38 |
| 396.70      | 366.70      | 7.80                    | 6.91           | 6.57           | 38.32          | 36.15 | 37.63 | 37.27 | 37.02 | 34.60 | 31.29  | 30.28 | 2.21                | 1.25 | 2.11 |
| 422.48      | 392.48      | 8.05                    | 6.97           | 6.57           | 38.36          | 36.13 | 36.72 | 37.13 | 35.55 | 33.82 | 31.33  | 30.13 | 1.82                | 1.22 | 2.02 |
| 448.26      | 418.26      | 7.89                    | 7.43           | 7.02           | 38.68          | 36.11 | 35.45 | 35.92 | 33.99 | 32.13 | 31.15  | 30.54 | 2.09                | 1.26 | 2.18 |
| 474.04      | 444.04      | 8.48                    | 7.74           | 7.34           | 38.75          | 36.37 | 35.46 | 35.47 | 32.62 | 30.50 | 29.83  | 29.60 | 1.88                | 1.30 | 2.46 |
| 500.00      | 470.00      | 8.84                    | 7.62           | 6.95           | 37.95          | 36.25 | 35.58 | 35.66 | 30.74 | 28.73 | 28.642 | 28.63 | 1.99                | 1.35 | 2.58 |

## harmonic intermodulation

(Relative to desired IF Output)

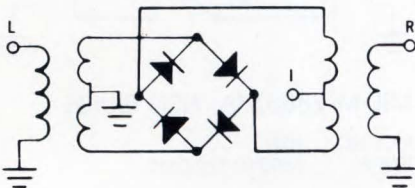
## SRA-1H

| Harmonics RF Order | RF<br>CAL | RF Input power 0dBm |    |    |    |    |    |    |    |    |    |
|--------------------|-----------|---------------------|----|----|----|----|----|----|----|----|----|
|                    |           | 0                   | 46 | 10 | 44 | 17 | 45 | 28 | 48 | 33 | 50 |
| 1                  | 0         | 0                   | 46 | 10 | 44 | 17 | 45 | 28 | 48 | 33 | 50 |
| 2                  | 75        | 75                  | 75 | 75 | 75 | 73 | 75 | 71 | 75 | 69 | 75 |
| 3                  | 73        | 64                  | 73 | 66 | 72 | 55 | 70 | 51 | 66 | 50 | 64 |
| 4                  | 105       | 74                  | 84 | 82 | 85 | 79 | 86 | 78 | 91 | 78 | 93 |
| 5                  | 106       | 74                  | 82 | 72 | 80 | 68 | 80 | 65 | 82 | 64 | 81 |
| 6                  | 105       | 83                  | 84 | 83 | 84 | 84 | 86 | 86 | 90 | 88 | 92 |
| 7                  | 104       | 84                  | 85 | 82 | 85 | 80 | 87 | 78 | 90 | 79 | 91 |
| 8                  | 104       | 86                  | 74 | 85 | 84 | 86 | 84 | 87 | 88 | 92 | 91 |
| 9                  | 102       | 83                  | 86 | 84 | 85 | 85 | 86 | 86 | 89 | 89 | 93 |
| 10                 | 105       | 84                  | 84 | 83 | 84 | 84 | 84 | 87 | 87 | 90 | 92 |
|                    |           | 1                   | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 |
|                    |           | Harmonic LO Order   |    |    |    |    |    |    |    |    |    |

| Harmonics RF Order | RF<br>CAL | RF Input power -10dBm |    |    |    |    |    |    |    |    |    |
|--------------------|-----------|-----------------------|----|----|----|----|----|----|----|----|----|
|                    |           | 0                     | 47 | 10 | 44 | 18 | 44 | 30 | 46 | 36 | 47 |
| 1                  | 0         | 0                     | 47 | 10 | 44 | 18 | 44 | 30 | 46 | 36 | 47 |
| 2                  | 84        | 78                    | 78 | 76 | 78 | 72 | 78 | 70 | 83 | 70 | 82 |
| 3                  | 91        | 73                    | 79 | 70 | 79 | 65 | 78 | 62 | 78 | 62 | 77 |
| 4                  | 95        | 64                    | 83 | 82 | 85 | 83 | 86 | 86 | 87 | 88 | 86 |
| 5                  | 95        | 84                    | 80 | 84 | 82 | 83 | 84 | 86 | 88 | 88 | 88 |
| 6                  | 95        | 82                    | 81 | 83 | 83 | 84 | 84 | 86 | 87 | 87 | 87 |
| 7                  | 95        | 81                    | 84 | 81 | 82 | 83 | 85 | 85 | 86 | 86 | 87 |
| 8                  | 96        | 82                    | 65 | 84 | 83 | 83 | 83 | 85 | 86 | 88 | 87 |
| 9                  | 95        | 81                    | 85 | 82 | 83 | 82 | 85 | 85 | 87 | 88 | 86 |
| 10                 | 95        | 83                    | 83 | 83 | 82 | 83 | 83 | 85 | 87 | 87 | 88 |
|                    |           | 1                     | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 |
|                    |           | Harmonic LO Order     |    |    |    |    |    |    |    |    |    |

test conditions RF = 10 MHz LO = 40 MHz at +17dBm  
for other test frequencies, contact factory

## schematic



In Stock... Immediate Delivery



very low distortion

# Frequency Mixers

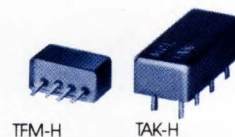
LEVEL 17S (+17dBm LO, up to +14dBm RF)

performance data

curves, tables, page 4 Model Index

case style selection

outline drawings see page 3



|                   |         | FREQUENCY<br>MHz |                                             | CONVERSION LOSS<br>dB |               |      |                | LO-RF ISOLATION, dB |      |      |      |      |      | LO-IF ISOLATION, dB |      |      |      |    |    | PRICE, \$ |        |        |
|-------------------|---------|------------------|---------------------------------------------|-----------------------|---------------|------|----------------|---------------------|------|------|------|------|------|---------------------|------|------|------|----|----|-----------|--------|--------|
|                   |         | MODEL<br>NO.     | LO/RF<br><br>f <sub>L</sub> -f <sub>U</sub> | IF                    | Mid-Band<br>m |      | Total<br>Range | L                   |      | M    |      | U    |      | L                   |      | M    |      | U  |    | Ea.       | Qty.   |        |
|                   |         |                  |                                             |                       | Typ.          | Max. |                | Typ.                | Min. | Typ. | Min. | Typ. | Min. | Typ.                | Min. | Typ. | Min. |    |    |           |        |        |
|                   |         |                  |                                             |                       |               |      |                |                     |      |      |      |      |      |                     |      |      |      |    |    |           |        |        |
| TFM-H<br>case B02 | TFM-1H  | 2-500            | DC-500                                      | 6.0                   | 7.5           | 7.0  | 8.5            | 50                  | 45   | 40   | 30   | 30   | 20   | 45                  | 40   | 35   | 25   | 25 | 20 | 23.95     | (5-24) |        |
|                   | TFM-2H  | 5-1000           | DC-1000                                     | 6.2                   | 7.0           | 7.0  | 10             | 50                  | 45   | 40   | 30   | 30   | 20   | 45                  | 40   | 35   | 25   | 25 | 17 | 31.95     | (5-24) |        |
|                   | TFM-3H  | .1-250           | DC-250                                      | 5.0                   | 7.0           | 6.0  | 8.5            | 50                  | 45   | 40   | 30   | 28   | 23   | 45                  | 40   | 35   | 25   | 26 | 20 | 23.95     | (5-24) |        |
| case B13          | TFM-4H  | NEW              | 5-1200                                      | DC-1200               | 6.5           | 8.0  | 7.0            | 9.0                 | 50   | 40   | 35   | 25   | 30   | 20                  | 50   | 40   | 35   | 20 | 30 | 20        | 33.95  | (5-24) |
| TAK-H<br>case A05 | TAK-1H  | 2-500            | DC-500                                      | 6.0                   | 7.5           | 7.0  | 8.5            | 50                  | 40   | 40   | 30   | 30   | 25   | 45                  | 35   | 35   | 25   | 25 | 20 | 19.95     | (5-24) |        |
|                   | TAK-1WH | 5-750            | DC-750                                      | 6.2                   | 7.5           | 7.0  | 9.0            | 50                  | 40   | 40   | 30   | 30   | 25   | 45                  | 35   | 35   | 25   | 30 | 20 | 23.95     | (5-24) |        |
|                   | TAK-3H  | .05-300          | DC-300                                      | 5.0                   | 7.0           | 6.0  | 8.5            | 55                  | 45   | 40   | 30   | 30   | 25   | 50                  | 40   | 35   | 25   | 25 | 20 | 21.95     | (5-24) |        |

L = low range ( $f_L$  to  $10 f_L$ )

M = mid range ( $10 f_L$  to  $f_U/2$ )

U = upper range ( $f_U/2$  to  $f_U$ )

m = mid band ( $2 f_L$  to  $f_U/2$ )

## NOTES:

1. For typical characteristics, compression level, phase detection and electronic attenuation, see "Mixer Technical Section."
2. For Quality Control procedures, see page 6.
3. For environmental specifications, see page 7.
4. For High-Rel and TX description, see page 6.
5. Absolute Maximum Ratings:  
RF power 200 mW, peak IF current 40 mA, see pg. 7.
6. For connector types and case mounting options, see case style outline drawings.
7. Prices and specifications subject to change without notice.

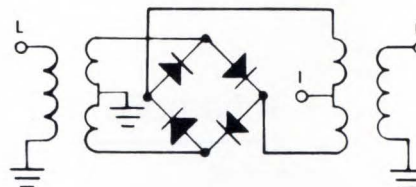
## pin and coaxial connections

see case style outline drawing

| Series   | TFM-H      | TAK-H      |         | ZFM-H      | ZLW-SH     | ZAD-SH     |
|----------|------------|------------|---------|------------|------------|------------|
| Models   | all models | -1H<br>-3H | -1WH    | all models | all models | all models |
| LO       | 4          | 8          | 8       | 1          | 1          | 1          |
| RF       | 1          | 1          | 1       | 2          | 3          | 3          |
| IF       | 2          | 3,4*       | 3,4*    | 3          | 2          | 2          |
| GND      | 3          | 2,5,6,7    | 2,5,6,7 | —          | —          | —          |
| CASE GND | 3          | 2          | 2,5,6,7 | —          | —          | —          |

\*pins must be connected externally

## schematic



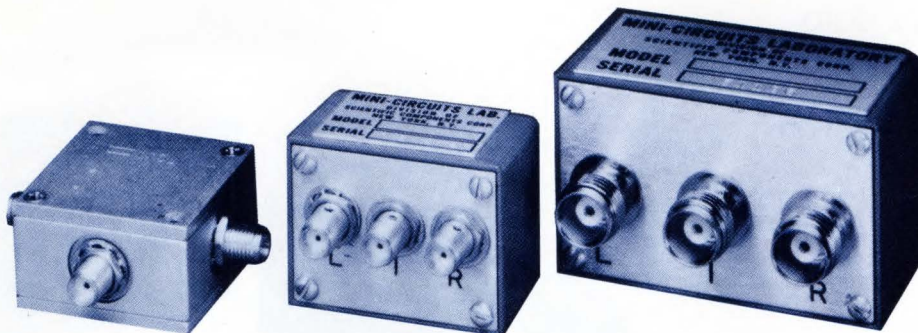
MIL-M-28837/1A, NSN GUIDE

MCL NO. NSN  
TFM-1H 5895-01-129-0110



10 KHz to 1.2 GHz

# Mini-Circuits



ZFM-H

ZLW-SH

ZAD-SH

|                    | MODEL NO. | FREQUENCY MHz                           |         | CONVERSION LOSS dB |      |             |      | LO-RF ISOLATION, dB |      |      |      |      |      | LO-IF ISOLATION, dB |      |      |      |    |    | PRICE, \$ |        |
|--------------------|-----------|-----------------------------------------|---------|--------------------|------|-------------|------|---------------------|------|------|------|------|------|---------------------|------|------|------|----|----|-----------|--------|
|                    |           | LO/RF<br>f <sub>L</sub> -f <sub>U</sub> | IF      | Mid-Band m         |      | Total Range |      | L                   |      | M    |      | U    |      | L                   |      | M    |      | U  |    | Ea.       | Qty.   |
|                    |           |                                         |         | Typ.               | Max. | Typ.        | Max. | Typ.                | Min. | Typ. | Min. | Typ. | Min. | Typ.                | Min. | Typ. | Min. |    |    |           |        |
|                    |           |                                         |         |                    |      |             |      |                     |      |      |      |      |      |                     |      |      |      |    |    |           |        |
| ZFM-H<br>case K18  | ZFM-1H    | 2-500                                   | DC-500  | 6.0                | 7.5  | 7.0         | 8.5  | 50                  | 45   | 40   | 30   | 30   | 25   | 45                  | 35   | 35   | 25   | 25 | 20 | 53.95     | (1-24) |
|                    | ZFM-2H    | 5-1000                                  | DC-1000 | 6.2                | 7.0  | 7.0         | 10   | 50                  | 40   | 40   | 30   | 30   | 20   | 45                  | 40   | 35   | 25   | 25 | 17 | 61.95     | (1-24) |
|                    | ZFM-3H    | .05-300                                 | DC-300  | 5.0                | 7.0  | 6.0         | 8.5  | 55                  | 45   | 40   | 30   | 30   | 25   | 50                  | 40   | 35   | 25   | 25 | 20 | 54.95     | (1-24) |
| ZLW-SH<br>case M21 | ZLW-1H    | 2-500                                   | DC-500  | 6.0                | 7.5  | 7.0         | 8.5  | 50                  | 40   | 40   | 30   | 30   | 25   | 45                  | 35   | 35   | 25   | 25 | 20 | 50.95     | (4-24) |
|                    | ZLW-1WSH  | 5-750                                   | DC-750  | 6.2                | 7.5  | 7.0         | 9.0  | 50                  | 45   | 40   | 30   | 30   | 20   | 45                  | 40   | 35   | 25   | 30 | 20 | 54.95     | (4-24) |
|                    | ZLW-3SH   | .05-300                                 | DC-300  | 5.0                | 7.0  | 6.0         | 8.5  | 55                  | 45   | 40   | 30   | 30   | 25   | 50                  | 40   | 35   | 25   | 25 | 20 | 52.95     | (4-24) |
| ZAD-SH<br>case M22 | ZAD-1SH   | 2-500                                   | DC-500  | 6.0                | 7.5  | 7.0         | 8.5  | 50                  | 40   | 40   | 30   | 30   | 25   | 45                  | 35   | 35   | 25   | 25 | 20 | 40.95     | (4-24) |
|                    | ZAD-1WSH  | 5-750                                   | DC-750  | 6.2                | 7.5  | 7.0         | 9.0  | 50                  | 45   | 40   | 30   | 30   | 20   | 45                  | 40   | 35   | 25   | 30 | 20 | 44.95     | (4-24) |
|                    | ZAD-3SH   | .05-300                                 | DC-300  | 5.0                | 7.0  | 6.0         | 8.5  | 55                  | 45   | 40   | 30   | 30   | 25   | 50                  | 40   | 35   | 25   | 25 | 20 | 42.95     | (4-24) |

L=low range ( $f_L$  to  $10 f_L$ )

M=mid range ( $10 f_L$  to  $f_U/2$ )

U=upper range ( $f_U/2$  to  $f_U$ )

m=mid band ( $2 f_L$  to  $f_U/2$ )



computer-automated performance data

typical production unit / for data of other models consult factory

## TFM-1H

| RF (MHz) | LO (MHz) | CONVERSION LOSS (dB) | ISOLATION (dB) |       | VSWR |      |      |
|----------|----------|----------------------|----------------|-------|------|------|------|
|          |          |                      | L-R            | L-R   | LO   | RF   | IF   |
| 10.00    | 40.00    | 5.89                 | 52.26          | 54.10 | 1.59 | 1.15 | 1.33 |
| 35.78    | 65.78    | 6.15                 | 47.79          | 50.70 | 1.67 | 1.10 | 1.34 |
| 61.56    | 91.56    | 6.24                 | 45.16          | 47.94 | 1.51 | 1.09 | 1.34 |
| 87.34    | 57.34    | 6.16                 | 48.87          | 51.91 | 1.53 | 1.08 | 1.35 |
| 113.12   | 83.12    | 6.03                 | 46.18          | 48.52 | 1.57 | 1.08 | 1.35 |
| 138.90   | 108.90   | 6.29                 | 43.89          | 45.76 | 1.57 | 1.08 | 1.36 |
| 164.68   | 134.68   | 6.13                 | 41.75          | 44.17 | 1.55 | 1.08 | 1.37 |
| 190.46   | 160.46   | 5.89                 | 40.42          | 42.16 | 1.50 | 1.07 | 1.38 |
| 216.24   | 186.24   | 6.13                 | 38.76          | 40.87 | 1.51 | 1.07 | 1.40 |
| 242.02   | 212.02   | 6.00                 | 37.29          | 38.89 | 1.47 | 1.07 | 1.41 |
| 267.00   | 237.80   | 5.86                 | 36.41          | 37.32 | 1.47 | 1.06 | 1.42 |
| 293.58   | 263.58   | 6.12                 | 35.27          | 36.40 | 1.48 | 1.06 | 1.44 |
| 319.36   | 289.36   | 6.03                 | 34.46          | 34.97 | 1.44 | 1.05 | 1.45 |
| 345.14   | 315.14   | 5.94                 | 33.99          | 34.19 | 1.48 | 1.05 | 1.48 |
| 370.92   | 340.92   | 6.01                 | 33.19          | 32.90 | 1.47 | 1.04 | 1.50 |
| 396.70   | 366.70   | 6.00                 | 32.52          | 32.93 | 1.45 | 1.04 | 1.52 |
| 422.48   | 392.48   | 6.19                 | 32.12          | 32.12 | 1.48 | 1.04 | 1.56 |
| 448.26   | 418.26   | 6.39                 | 31.50          | 31.13 | 1.47 | 1.05 | 1.57 |
| 474.04   | 444.04   | 6.22                 | 31.48          | 30.35 | 1.50 | 1.05 | 1.61 |
| 500.00   | 470.00   | 6.44                 | 31.93          | 29.87 | 1.47 | 1.06 | 1.64 |

In Stock... Immediate Delivery



ultra-low distortion

# Frequency Mixers

LEVEL 23 (+23dBm LO, up to +15dBm RF)

10 KHz to 1 GHz

performance data

curves, tables, page 4 Model Index

case style selection

outline drawings see page 3



| MODEL NO.       |            | FREQUENCY MHz                           |         | CONVERSION LOSS dB |      |                |      | LO-RF ISOLATION, dB |      |      |      |      |      | LO-IF ISOLATION, dB |      |      |      |      |      | PRICE, \$ |        |
|-----------------|------------|-----------------------------------------|---------|--------------------|------|----------------|------|---------------------|------|------|------|------|------|---------------------|------|------|------|------|------|-----------|--------|
|                 |            | LO/RF<br>f <sub>L</sub> -f <sub>U</sub> | IF      | Mid-Band<br>m      |      | Total<br>Range |      | L                   |      | M    |      | U    |      | L                   |      | M    |      | U    |      | Ea.       | Qty.   |
|                 |            |                                         |         | Typ.               | Max. | Typ.           | Max. | Typ.                | Min. | Typ. | Min. | Typ. | Min. | Typ.                | Min. | Typ. | Min. | Typ. | Min. |           |        |
| RAY<br>case A01 | ●RAY-1     | 5-500                                   | DC-500  | 6.0                | 7.5  | 7.5            | 8.5  | 55                  | 45   | 40   | 30   | 30   | 25   | 55                  | 45   | 40   | 30   | 30   | 20   | 34.95     | (4-9)  |
|                 | ●RAY-2     | 10-1000                                 | DC-1000 | 7.0                | 8.5  | 8.5            | 10   | 50                  | 35   | 40   | 30   | 35   | 25   | 50                  | 35   | 35   | 25   | 25   | 20   | 54.95     | (4-9)  |
|                 | ●RAY-3     | .07-300                                 | DC-200  | 6.0                | 7.5  | 6.5            | 8.0  | 55                  | 45   | 40   | 30   | 30   | 25   | 55                  | 45   | 40   | 30   | 30   | 20   | 34.95     | (4-9)  |
|                 | ●RAY-6 NEW | 0.01-50                                 | DC50    | 5.5                | 7.5  | 6.5            | 8.5  | 60                  | 50   | 45   | 30   | 35   | 25   | 60                  | 45   | 40   | 25   | 30   | 20   | 31.95     | (1-24) |
| ZMY<br>case M21 | ●ZMY-1     | 5-500                                   | DC-500  | 6.0                | 7.5  | 7.5            | 8.5  | 55                  | 45   | 40   | 30   | 30   | 25   | 55                  | 45   | 40   | 30   | 30   | 20   | 57.95     | (1-9)  |
|                 | ●ZMY-2     | 10-1000                                 | DC-1000 | 7.0                | 8.5  | 8.5            | 10   | 50                  | 35   | 40   | 30   | 35   | 25   | 50                  | 35   | 35   | 25   | 25   | 20   | 77.95     | (1-9)  |
|                 | ●ZMY-3     | .07-300                                 | DC-200  | 6.0                | 7.5  | 6.5            | 8.0  | 55                  | 45   | 40   | 30   | 30   | 25   | 55                  | 45   | 40   | 30   | 30   | 20   | 57.95     | (1-9)  |
| ZAY<br>case M22 | ●ZAY-1     | 5-500                                   | DC-500  | 6.0                | 7.5  | 7.5            | 8.5  | 55                  | 45   | 40   | 30   | 30   | 25   | 55                  | 45   | 40   | 30   | 30   | 20   | 47.95     | (1-9)  |
|                 | ●ZAY-2     | 10-1000                                 | DC-1000 | 7.0                | 8.5  | 8.5            | 10   | 50                  | 35   | 40   | 30   | 35   | 25   | 50                  | 35   | 35   | 25   | 25   | 20   | 67.95     | (1-9)  |
|                 | ●ZAY-3     | .07-300                                 | DC-200  | 6.0                | 7.5  | 6.5            | 8.0  | 55                  | 45   | 40   | 30   | 30   | 25   | 55                  | 45   | 40   | 30   | 30   | 20   | 47.95     | (1-9)  |

L = low range ( $f_L$  to 10  $f_L$ )

M = mid range (10  $f_L$  to  $f_U/2$ )

U = upper range ( $f_U/2$  to  $f_U$ )

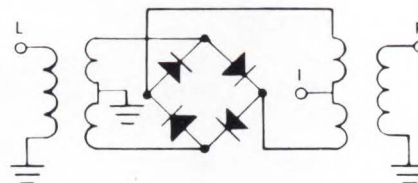
m = mid band ( $2f_L$  to  $f_U/2$ )

## NOTES:

- HTRB tested

- For typical characteristics, compression level, phase detection and electronic attenuation, see "Mixer Technical Section".
- For Quality Control procedures, see page 6.
- For environmental specifications see page 7.
- For High-Rel and TX description, see page 6.
- Absolute Maximum Ratings: RF power 350 mW for level 23, 23S and 700 mW for level 27. Peak IF current 40 mA.
- For connector types and case mounting options, see case style outline drawing.
- Prices and specifications subject to change without notice.

## schematic



## pin and coaxial connections

see case style outline drawing

| Series   | RAY     |         |         | ZMY        | ZAY        | SAY        | ZFY        | VAY        |
|----------|---------|---------|---------|------------|------------|------------|------------|------------|
| Models   | -1      | -2      | -6      | all models | all models | all models | all models | all models |
| LO       | 8       | 8       | 8       | 1          | 1          | 8          | 1          | 8          |
| RF       | 1       | 1       | 1       | 3          | 3          | 1          | 2          | 1          |
| IF       | 3,4*    | 3,4*    | 3,4*    | 2          | 2          | 3          | 3          | 3          |
| GND      | 2,5,6,7 | 2,5,6,7 | 2,5,6,7 | —          | —          | 2,5,6,7    | —          | 2,5,6,7    |
| CASE GND | 2       | 2,5,6,7 | —       | —          | —          | 2,5,6,7    | —          | 2,5,6,7    |

\*pins must be connected externally

## MIL-M-28837/1A, NSN GUIDE

| MCL NO.      | NSN              | MIL-M-28837/1A* |
|--------------|------------------|-----------------|
| RAY-1        | 5825-01-105-6188 | 04N             |
| RAY-1 Hi-Rel |                  | 04S             |
| RAY-2        | 5895-01-111-7368 |                 |
| RAY-3        | 5895-01-064-5082 |                 |
| ZMY-2        | 4935-01-080-7636 |                 |

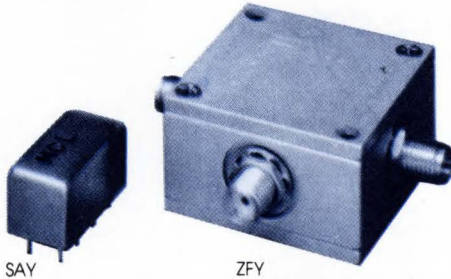
\*units are not GPL listed

**Mini-Circuits**

P.O. BOX 166, Brooklyn, New York 11235 (718) 934-4500



## LEVEL 23S (+23dBm LO, up to +20dBm RF) 100 KHz to 2.4 GHz



|              | FREQUENCY<br>MHz |         | CONVERSION LOSS<br>dB |      |                |      | LO-RF ISOLATION, dB |      |      |      |      |      | LO-IF ISOLATION, dB |      |      |      |      |      | PRICE, \$ |       |
|--------------|------------------|---------|-----------------------|------|----------------|------|---------------------|------|------|------|------|------|---------------------|------|------|------|------|------|-----------|-------|
| MODEL<br>NO. | LO/RF            | IF      | Mid-Band<br>m         |      | Total<br>Range |      | L                   |      | M    |      | U    |      | L                   |      | M    |      | U    |      | Ea.       | Qty.  |
|              | $f_L$ - $f_U$    |         | Typ.                  | Max. | Typ.           | Max. | Typ.                | Min. | Typ. | Min. | Typ. | Min. | Typ.                | Min. | Typ. | Min. | Typ. | Min. |           |       |
| SAY-1        | 0.1-500          | .01-500 | 5.3                   | 6.0  | 5.3            | 7.5  | 47                  | 40   | 46   | 35   | 40   | 30   | 47                  | 40   | 46   | 35   | 40   | 30   | 54.95     | (1-9) |
| SAY-2        | 0.1-1000         | .01-500 | 5.3                   | 7.5  | 7.5            | 9.5  | 47                  | 40   | 40   | 30   | 30   | 25   | 47                  | 40   | 40   | 25   | 25   | 20   | 59.95     | (1-9) |
| SAY-11       | 10-2400          | 5-1000  | 7.0                   | 8.5  | 8.0            | 10   | 28                  | 20   | 26   | 20   | 25   | 20   | 28                  | 20   | 26   | 20   | 25   | 20   | 64.95     | (1-9) |
| ZFY-1        | 0.1-500          | .01-500 | 5.3                   | 6.0  | 5.3            | 7.5  | 47                  | 40   | 46   | 35   | 40   | 30   | 47                  | 40   | 46   | 35   | 40   | 30   | 74.95     | (1-9) |
| ZFY-2        | 0.1-1000         | .01-500 | 5.3                   | 7.5  | 7.5            | 9.5  | 47                  | 40   | 40   | 30   | 30   | 25   | 47                  | 40   | 40   | 25   | 25   | 20   | 79.95     | (1-9) |
| ZFY-11       | 10-2400          | 5-1000  | 7.0                   | 8.5  | 8.0            | 10   | 28                  | 20   | 26   | 20   | 25   | 20   | 28                  | 20   | 26   | 20   | 25   | 20   | 84.95     | (1-9) |

L = low range ( $f_L$  to  $10 f_L$ )

M = mid range ( $10 f_L$  to  $f_U/2$ )

U = upper range ( $f_U/2$  to  $f_U$ )

m = mid band ( $2 f_L$  to  $f_U/2$ )

## LEVEL 27 (+27dBm LO, up to +24dBm RF) 50 KHz to 500 MHz



VAY-1

| MODEL NO.         | FREQUENCY MHz |         | CONVERSION LOSS dB |      |             |      | LO-RF ISOLATION, dB |      |      |      |      |      | LO-IF ISOLATION, dB |      |      |      |      |      | PRICE, \$ |       |
|-------------------|---------------|---------|--------------------|------|-------------|------|---------------------|------|------|------|------|------|---------------------|------|------|------|------|------|-----------|-------|
|                   | LO/RF         | IF      | Mid-Band m         |      | Total Range |      | L                   |      | M    |      | U    |      | L                   |      | M    |      | U    |      | Ea.       | Qty.  |
|                   | $f_L-f_U$     |         | Typ.               | Max. | Typ.        | Max. | Typ.                | Min. | Typ. | Min. | Typ. | Min. | Typ.                | Min. | Typ. | Min. | Typ. | Min. |           |       |
| VAY-1<br>case A01 | .05-500       | .02-500 | 6.0                | 7.5  | 7.5         | 8.5  | 47                  | 40   | 46   | 35   | 35   | 25   | 47                  | 40   | 46   | 35   | 35   | 25   | 74.95     | (1-9) |

L = low range ( $f_L$  to  $10 f_L$ )

M = mid range ( $10 f_L$  to  $f_U/2$ )

U = upper range ( $f_U/2$  to  $f_U$ )

m = mid band ( $2 f_L$  to  $f_U/2$ )



**In Stock... Immediate Delivery**



most widely-used

# Frequency Mixers

LEVEL 7 (+7 dBm LO, up to +1 dBm RF)

## Models

GRA-1  
SRA-1  
SRA-1 TX  
ZLW-1  
ZAD-1



computer-automated performance data  
typical production unit / for data of other models consult factory

## mixer conversion loss and isolation

| RF<br>MHz | LO<br>MHz | Conversion Loss<br>(dB) |             |              | Isolation L-R<br>(dB) |             |              | Isolation L-I<br>(dB) |             |              |
|-----------|-----------|-------------------------|-------------|--------------|-----------------------|-------------|--------------|-----------------------|-------------|--------------|
|           |           | LO<br>+4dBm             | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm           | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm           | LO<br>+7dBm | LO<br>+10dBm |
| .500      | 30.50     | 7.78                    | 7.29        | 7.01         | > 64.00               | > 67.00     | 64.94        | > 64.00               | > 67.00     | 56.93        |
| 1.000     | 31.00     | 7.34                    | 6.89        | 6.61         | > 64.00               | > 67.00     | 63.22        | > 64.00               | 62.73       | 56.27        |
| 2.000     | 32.00     | 6.97                    | 6.49        | 6.20         | > 64.00               | > 67.00     | 61.14        | > 64.00               | 61.28       | 55.71        |
| 5.000     | 35.00     | 6.39                    | 6.01        | 5.80         | > 64.00               | > 67.00     | 60.28        | > 64.00               | 60.55       | 55.46        |
| 10.000    | 40.00     | 6.40                    | 5.99        | 5.75         | > 64.00               | > 67.00     | 59.63        | > 64.00               | 59.37       | 55.25        |
|           |           |                         |             |              |                       |             |              |                       |             |              |
| 20.000    | 50.00     | 6.46                    | 6.02        | 5.75         | > 64.00               | > 67.00     | 58.89        | > 64.00               | 59.08       | 55.09        |
| 32.726    | 62.73     | 6.37                    | 5.96        | 5.74         | > 64.00               | 59.27       | 56.91        | > 64.00               | 57.92       | 54.20        |
| 50.000    | 80.00     | 6.28                    | 5.91        | 5.71         | 58.05                 | 56.01       | 54.48        | > 64.00               | 56.08       | 53.11        |
| 64.952    | 94.95     | 6.22                    | 5.87        | 5.64         | 54.46                 | 53.83       | 52.86        | 57.32                 | 54.11       | 51.72        |
| 100.000   | 70.00     | 6.13                    | 5.81        | 5.66         | 50.35                 | 49.90       | 48.91        | 51.33                 | 49.45       | 47.96        |
|           |           |                         |             |              |                       |             |              |                       |             |              |
| 161.630   | 131.63    | 6.13                    | 5.84        | 5.70         | 45.29                 | 44.60       | 44.03        | 44.16                 | 43.60       | 43.25        |
| 200.000   | 170.00    | 6.27                    | 5.99        | 5.82         | 42.19                 | 41.47       | 41.29        | 41.32                 | 40.82       | 40.93        |
| 226.080   | 196.08    | 6.26                    | 5.95        | 5.75         | 41.04                 | 40.62       | 40.68        | 39.98                 | 39.96       | 40.20        |
| 258.310   | 228.31    | 6.19                    | 5.89        | 5.72         | 39.93                 | 39.44       | 39.63        | 38.30                 | 37.84       | 38.74        |
| 306.650   | 276.65    | 6.26                    | 5.99        | 5.84         | 36.83                 | 37.26       | 37.70        | 35.84                 | 36.42       | 36.87        |
|           |           |                         |             |              |                       |             |              |                       |             |              |
| 354.990   | 324.99    | 6.57                    | 6.23        | 6.05         | 34.24                 | 34.94       | 35.71        | 33.81                 | 34.34       | 35.10        |
| 403.330   | 373.33    | 6.74                    | 6.32        | 6.07         | 33.60                 | 33.70       | 34.26        | 33.74                 | 33.77       | 34.23        |
| 451.660   | 421.66    | 7.29                    | 6.68        | 6.25         | 33.90                 | 33.66       | 34.10        | 34.38                 | 33.23       | 33.15        |
| 483.890   | 453.89    | 7.77                    | 7.17        | 6.69         | 33.99                 | 34.17       | 34.71        | 34.99                 | 34.46       | 34.37        |
| 500.000   | 470.00    | 7.86                    | 7.25        | 6.77         | 34.23                 | 34.51       | 35.08        | 34.62                 | 34.41       | 34.36        |

## mixer VSWR

## $\phi$ detection

| freq.<br>MHz | VSWR, RF port |             |              | VSWR, LO port |             |              | VSWR, IF port |             |              | max. output/DC offset vs. freq. |                      |                 |
|--------------|---------------|-------------|--------------|---------------|-------------|--------------|---------------|-------------|--------------|---------------------------------|----------------------|-----------------|
|              | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | Freq.<br>(MHz)                  | max. DC<br>output mV | DC offset<br>mV |
| 5.001        | 1.22          | 1.21        | 1.25         | 1.36          | 1.98        | 2.99         | 1.47          | 1.28        | 1.16         | 10.000                          | -270.82              | -.24            |
| 17.692       | 1.12          | 1.03        | 1.09         | 1.29          | 1.93        | 2.84         | 1.48          | 1.29        | 1.17         | 20.000                          | -267.82              | -.23            |
| 30.384       | 1.10          | 1.02        | 1.09         | 1.30          | 1.96        | 2.82         | 1.48          | 1.30        | 1.18         | 24.000                          | -264.99              | -.21            |
| 55.768       | 1.11          | 1.06        | 1.12         | 1.27          | 1.86        | 2.69         | 1.50          | 1.32        | 1.21         | 50.000                          | -261.17              | -.19            |
| 81.152       | 1.12          | 1.10        | 1.14         | 1.25          | 1.83        | 2.61         | 1.53          | 1.35        | 1.25         | 80.000                          | -263.77              | -.16            |
|              |               |             |              |               |             |              |               |             |              |                                 |                      |                 |
| 106.540      | 1.14          | 1.13        | 1.17         | 1.28          | 1.87        | 2.68         | 1.58          | 1.40        | 1.30         | 100.000                         | -264.35              | -.15            |
| 119.230      | 1.16          | 1.15        | 1.19         | 1.29          | 1.88        | 2.67         | 1.60          | 1.43        | 1.33         | 122.000                         | -267.69              | -.12            |
| 144.610      | 1.19          | 1.19        | 1.23         | 1.31          | 1.91        | 2.63         | 1.69          | 1.52        | 1.42         | 150.000                         | -263.45              | -.11            |
| 170.000      | 1.22          | 1.23        | 1.26         | 1.32          | 1.91        | 2.59         | 1.73          | 1.54        | 1.43         | 178.000                         | -262.10              | -.07            |
| 208.070      | 1.28          | 1.29        | 1.33         | 1.35          | 1.92        | 2.62         | 1.86          | 1.66        | 1.54         | 200.000                         | -261.22              | -.13            |
|              |               |             |              |               |             |              |               |             |              |                                 |                      |                 |
| 233.460      | 1.33          | 1.35        | 1.38         | 1.39          | 1.91        | 2.59         | 1.96          | 1.74        | 1.62         | 248.000                         | -265.76              | -.10            |
| 271.530      | 1.41          | 1.42        | 1.46         | 1.43          | 1.99        | 2.65         | 2.10          | 1.88        | 1.73         | 276.000                         | -270.40              | -.18            |
| 296.920      | 1.47          | 1.49        | 1.52         | 1.48          | 1.99        | 2.63         | 2.18          | 1.97        | 1.80         | 304.000                         | -266.94              | -.26            |
| 322.300      | 1.53          | 1.56        | 1.58         | 1.52          | 1.99        | 2.66         | 2.29          | 2.07        | 1.90         | 332.000                         | -249.96              | -.23            |
| 360.380      | 1.62          | 1.65        | 1.68         | 1.62          | 2.03        | 2.64         | 2.45          | 2.19        | 2.03         | 360.000                         | -231.15              | -.47            |
|              |               |             |              |               |             |              |               |             |              |                                 |                      |                 |
| 398.450      | 1.73          | 1.74        | 1.77         | 1.73          | 2.16        | 2.72         | 2.59          | 2.33        | 2.13         | 388.000                         | -211.89              | -.18            |
| 423.840      | 1.80          | 1.81        | 1.83         | 1.77          | 2.20        | 2.83         | 2.65          | 2.40        | 2.20         | 430.000                         | -189.53              | -.45            |
| 461.910      | 1.92          | 1.93        | 1.94         | 1.80          | 2.27        | 2.90         | 2.76          | 2.49        | 2.29         | 458.000                         | -184.41              | -.03            |
| 487.300      | 1.99          | 2.00        | 2.00         | 1.82          | 2.25        | 2.87         | 2.81          | 2.53        | 2.32         | 486.000                         | -184.46              | -.13            |
| 500.000      | 2.03          | 2.03        | 2.02         | 1.83          | 2.26        | 2.86         | 2.79          | 2.55        | 2.33         | 500.000                         | -181.27              | -.33            |

Measurements at RF & LO Power +7 dBm

**Mini-Circuits**

P.O. BOX 166, Brooklyn, New York 11235 (718) 934-4500



## mixer harmonic intermodulation

(relative to desired IF output)

| RF ORDER HARMONIC | RF CAL |      |      |      |      |      |      |      |      |      |      |      |      |
|-------------------|--------|------|------|------|------|------|------|------|------|------|------|------|------|
|                   | 0      | > 94 | -    | 36   | 51   | 42   | 61   | 42   | 60   | 58   | 62   | 54   | 72   |
|                   | 1      | > 94 | 23   | -    | 39   | 12   | 46   | 22   | 51   | 35   | 56   | 48   | 72   |
|                   | 2      | 74   | 68   | 54   | 71   | 55   | 73   | 55   | 74   | 55   | 64   | 50   | 77   |
|                   | 3      | 81   | 47   | 41   | 49   | 40   | 53   | 42   | 55   | 42   | 56   | 44   | 64   |
|                   | 4      | > 94 | 73   | 75   | 76   | 71   | 77   | 67   | 76   | 66   | 76   | 62   | 75   |
|                   | 5      | > 94 | 70   | 66   | 67   | 52   | 71   | 49   | 66   | 49   | 71   | 52   | 65   |
|                   | 6      | > 94 | 84   | 77   | > 86 | > 86 | > 86 | 81   | > 86 | 82   | 84   | 82   | 83   |
|                   | 7      | > 94 | 83   | 65   | 79   | 65   | 78   | 75   | 76   | 60   | 77   | 55   | 73   |
|                   | 8      | > 94 | 86   | 85   | > 88 | 81   | > 86 | > 86 | > 86 | > 86 | > 86 | 84   | > 86 |
|                   | 9      | 93   | 87   | 84   | 86   | 80   | 82   | 73   | 85   | 75   | 86   | 84   | 78   |
|                   | 10     | > 93 | > 87 | > 87 | 86   | > 87 | > 88 | > 88 | > 86 | > 86 | > 86 | > 86 | > 86 |
|                   |        | 0    | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   |      |
| Harmonic LO Order |        |      |      |      |      |      |      |      |      |      |      |      |      |

Harmonic LO Order

test conditions: RF=185.100 MHz INPUT P.=+0.00DBM  
LO=155.010 MHz INPUT P.=+6.92DBM  
IF=30.090 MHz IF AMPLIT.=-6.18 DBM

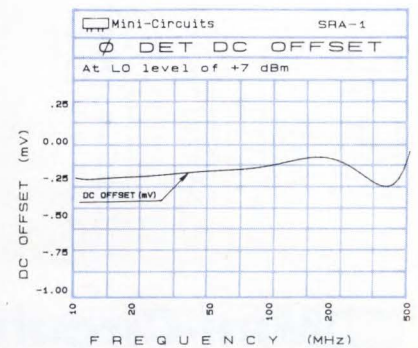
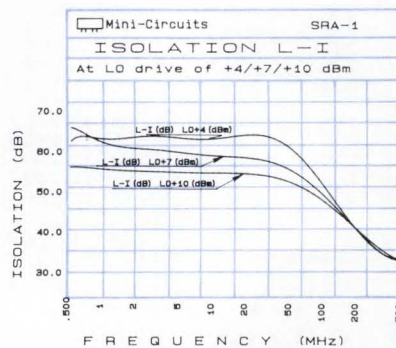
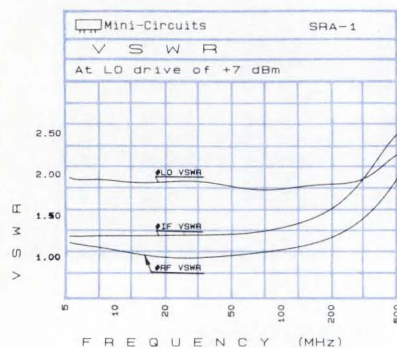
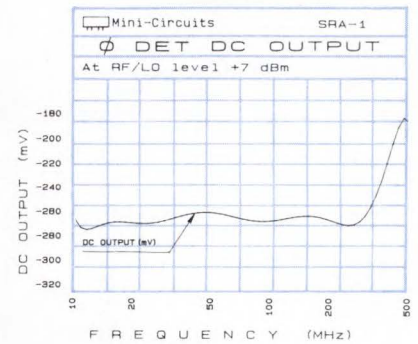
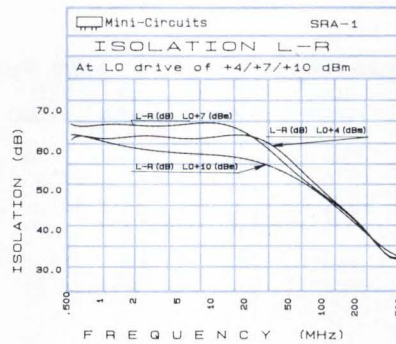
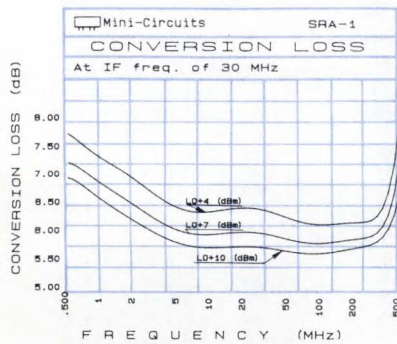
| RF ORDER HARMONIC | RF CAL |      |      |      |      |      |      |      |      |      |      |      |      |
|-------------------|--------|------|------|------|------|------|------|------|------|------|------|------|------|
|                   | 0      | > 84 | -    | 28   | 42   | 28   | 52   | 27   | 43   | 30   | 48   | 35   | 48   |
|                   | 1      | > 84 | 22   | -    | 36   | 13   | 40   | 21   | 47   | 30   | 44   | 36   | 49   |
|                   | 2      | 82   | 75   | 60   | 76   | 60   | 73   | 59   | 73   | 58   | 69   | 49   | 69   |
|                   | 3      | > 84 | 65   | 62   | 67   | 66   | 69   | 56   | 73   | 55   | 69   | 53   | 68   |
|                   | 4      | > 84 | > 76 | > 76 | > 76 | > 76 | > 76 | > 76 | > 76 | > 76 | > 76 | > 76 | > 76 |
|                   | 5      | > 84 | > 76 | > 76 | > 76 | > 76 | > 76 | > 76 | > 76 | > 76 | > 76 | > 76 | > 76 |
|                   | 6      | > 84 | > 78 | > 76 | > 76 | > 76 | > 76 | > 76 | > 76 | > 76 | > 76 | > 76 | > 76 |
|                   | 7      | 84   | > 78 | > 78 | > 76 | > 76 | > 76 | > 76 | > 76 | > 76 | > 76 | > 76 | > 76 |
|                   | 8      | > 84 | > 78 | > 78 | 78   | > 78 | > 76 | > 76 | > 76 | > 76 | > 76 | > 76 | > 76 |
|                   | 9      | 82   | 77   | > 78 | > 78 | > 78 | > 78 | > 76 | > 76 | > 76 | > 76 | > 76 | > 76 |
| 10                | > 82   | > 76 | 78   | 78   | > 78 | 78   | > 78 | > 76 | > 76 | > 76 | > 76 | > 76 |      |
|                   |        | 0    | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   |      |
| Harmonic LO Order |        |      |      |      |      |      |      |      |      |      |      |      |      |

Harmonic LO Order

test conditions: RF=185.100 MHz INPUT P.=+9.96DBM  
LO=155.010 MHz INPUT P.=+6.92DBM  
IF=30.090 MHz IF AMPLIT.=-15.97 DBM

## typical performance curves

(production unit)





most widely-used

# Frequency Mixers

LEVEL 7 (+7 dBm LO, up to +1 dBm RF)

## Models

GRA-3  
SRA-3  
ZLW-3  
ZAD-3



computer-automated performance data  
typical production unit / for data of other models consult factory

## mixer conversion loss and isolation

| RF<br>MHz | LO<br>MHz | Conversion Loss<br>(dB) |             |              | Isolation L-R<br>(dB) |             |              | Isolation L-I<br>(dB) |             |              |
|-----------|-----------|-------------------------|-------------|--------------|-----------------------|-------------|--------------|-----------------------|-------------|--------------|
|           |           | LO<br>+4dBm             | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm           | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm           | LO<br>+7dBm | LO<br>+10dBm |
| .025      | 30.03     | 6.51                    | 6.32        | 6.11         | > 64.00               | 61.81       | 62.76        | > 64.00               | > 67.00     | > 70.00      |
| .050      | 30.05     | 5.30                    | 5.12        | 5.04         | > 64.00               | 61.72       | 62.74        | > 64.00               | > 67.00     | > 70.00      |
| .070      | 30.07     | 5.14                    | 4.92        | 4.79         | > 64.00               | 61.54       | 62.53        | > 64.00               | > 67.00     | > 70.00      |
| .100      | 30.10     | 5.03                    | 4.82        | 4.74         | > 64.00               | 61.91       | 62.09        | > 64.00               | > 67.00     | > 70.00      |
| .500      | 30.50     | 4.93                    | 4.77        | 4.65         | > 64.00               | 62.49       | 62.14        | > 64.00               | > 67.00     | > 70.00      |
| 1.000     | 31.00     | 4.80                    | 4.62        | 4.57         | > 64.00               | 62.67       | 62.27        | > 64.00               | > 67.00     | > 70.00      |
| 2.000     | 32.00     | 4.81                    | 4.62        | 4.54         | > 64.00               | 63.24       | 62.43        | > 64.00               | > 67.00     | > 70.00      |
| 5.000     | 35.00     | 4.82                    | 4.62        | 4.55         | > 64.00               | 63.76       | 62.53        | > 64.00               | > 67.00     | > 70.00      |
| 10.000    | 40.00     | 4.84                    | 4.63        | 4.54         | > 64.00               | 63.89       | 62.58        | > 64.00               | > 67.00     | > 70.00      |
| 20.000    | 50.00     | 4.94                    | 4.73        | 4.60         | > 64.00               | 61.30       | 60.40        | > 64.00               | > 67.00     | > 70.00      |
| 33.750    | 63.75     | 4.83                    | 4.68        | 4.53         | 57.85                 | 55.93       | 54.70        | > 64.00               | > 67.00     | > 70.00      |
| 50.000    | 80.00     | 4.79                    | 4.64        | 4.52         | 51.71                 | 51.22       | 50.98        | > 64.00               | > 67.00     | > 70.00      |
| 65.417    | 95.42     | 4.78                    | 4.67        | 4.54         | 47.21                 | 47.30       | 47.63        | > 64.00               | > 67.00     | 65.96        |
| 89.167    | 59.17     | 4.70                    | 4.57        | 4.53         | 43.02                 | 43.43       | 43.96        | > 64.00               | 60.81       | 60.62        |
| 100.000   | 70.00     | 4.67                    | 4.60        | 4.57         | 41.66                 | 40.49       | 41.59        | 58.46                 | 60.50       | 60.24        |
| 120.830   | 90.83     | 4.77                    | 4.66        | 4.63         | 39.80                 | 40.83       | 41.71        | 57.31                 | 56.75       | 57.72        |
| 152.500   | 122.50    | 4.98                    | 4.87        | 4.81         | 35.98                 | 36.91       | 38.08        | 53.63                 | 54.57       | 56.35        |
| 184.170   | 154.17    | 5.24                    | 5.09        | 4.98         | 34.97                 | 36.81       | 38.19        | 50.67                 | 52.08       | 53.43        |
| 192.080   | 162.08    | 5.27                    | 5.15        | 5.09         | 34.86                 | 36.76       | 37.90        | 49.85                 | 51.00       | 53.26        |
| 200.000   | 170.00    | 5.31                    | 5.22        | 5.13         | 35.10                 | 37.30       | 38.17        | 49.26                 | 51.05       | 52.79        |

## mixer VSWR

## φ detection

| freq.<br>MHz | VSWR, RF port |             |              | VSWR, LO port |             |              | VSWR, IF port |             |              | max. output/DC offset vs. freq. |                      |                 |
|--------------|---------------|-------------|--------------|---------------|-------------|--------------|---------------|-------------|--------------|---------------------------------|----------------------|-----------------|
|              | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | Freq.<br>(MHz)                  | max. DC<br>output mV | DC offset<br>mV |
| 5.000        | 1.21          | 1.13        | 1.07         | 1.76          | 2.82        | 4.16         | 1.56          | 1.46        | 1.38         | .025                            | -231.13              | + .26           |
| 10.000       | 1.22          | 1.13        | 1.07         | 1.68          | 2.65        | 3.93         | 1.57          | 1.47        | 1.38         | .040                            | -237.32              | + .23           |
| 16.818       | 1.22          | 1.13        | 1.07         | 1.71          | 2.69        | 3.93         | 1.57          | 1.48        | 1.39         | .100                            | -241.68              | + .20           |
| 20.000       | 1.22          | 1.13        | 1.06         | 1.73          | 2.72        | 4.05         | 1.58          | 1.48        | 1.39         | .200                            | -241.66              | + .20           |
| 28.636       | 1.21          | 1.12        | 1.06         | 1.75          | 2.72        | 3.90         | 1.59          | 1.49        | 1.40         | 1.000                           | -245.59              | + .20           |
| 40.455       | 1.20          | 1.11        | 1.05         | 1.70          | 2.65        | 3.86         | 1.61          | 1.51        | 1.43         | 5.000                           | -237.45              | + .19           |
| 50.000       | 1.19          | 1.10        | 1.05         | 1.68          | 2.63        | 3.79         | 1.63          | 1.53        | 1.45         | 13.864                          | -235.23              | + .19           |
| 58.182       | 1.18          | 1.09        | 1.04         | 1.65          | 2.56        | 3.68         | 1.66          | 1.56        | 1.48         | 22.727                          | -235.03              | + .18           |
| 70.000       | 1.17          | 1.08        | 1.04         | 1.64          | 2.50        | 3.50         | 1.70          | 1.60        | 1.52         | 40.454                          | -235.11              | + .19           |
| 81.818       | 1.16          | 1.07        | 1.04         | 1.62          | 2.44        | 3.41         | 1.74          | 1.65        | 1.57         | 50.000                          | -235.70              | + .21           |
| 93.637       | 1.14          | 1.07        | 1.05         | 1.65          | 2.47        | 3.48         | 1.80          | 1.71        | 1.63         | 67.045                          | -236.33              | + .24           |
| 100.000      | 1.14          | 1.06        | 1.05         | 1.65          | 2.50        | 3.49         | 1.83          | 1.72        | 1.65         | 84.772                          | -234.74              | + .20           |
| 117.270      | 1.12          | 1.07        | 1.07         | 1.71          | 2.52        | 3.43         | 1.93          | 1.79        | 1.71         | 100.000                         | -231.73              | + .30           |
| 129.090      | 1.11          | 1.07        | 1.09         | 1.71          | 2.44        | 3.33         | 1.97          | 1.82        | 1.75         | 111.360                         | -229.31              | + .13           |
| 140.910      | 1.11          | 1.09        | 1.11         | 1.73          | 2.46        | 3.24         | 2.07          | 1.91        | 1.83         | 120.230                         | -228.00              | + .04           |
| 152.730      | 1.12          | 1.11        | 1.14         | 1.76          | 2.45        | 3.27         | 2.15          | 2.00        | 1.90         | 137.950                         | -231.37              | + .03           |
| 164.550      | 1.13          | 1.14        | 1.17         | 1.77          | 2.50        | 3.32         | 2.23          | 2.06        | 1.97         | 150.000                         | -232.21              | - .09           |
| 176.360      | 1.15          | 1.17        | 1.20         | 1.75          | 2.46        | 3.22         | 2.32          | 2.14        | 2.03         | 164.540                         | -230.38              | +0.00           |
| 188.180      | 1.18          | 1.20        | 1.24         | 1.73          | 2.38        | 3.13         | 2.41          | 2.22        | 2.12         | 182.270                         | -225.80              | - .06           |
| 200.000      | 1.21          | 1.23        | 1.27         | 1.74          | 2.40        | 3.06         | 2.48          | 2.30        | 2.21         | 200.000                         | -223.25              | +0.00           |

Measurements at RF & LO Power +7 dBm



P.O. BOX 166, Brooklyn, New York 11235 (718) 934-4500

## mixer harmonic intermodulation

(relative to desired IF output)

| RF ORDER HARMONIC | RF CAL |     |     |    |     |     |     |     |     |     |     |     |     |
|-------------------|--------|-----|-----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|                   | 0      | -   | -   | 38 | >87 | 44  | 61  | 46  | 61  | 52  | 60  | 66  | 62  |
|                   | 1      | -   | 31  | -  | 37  | 11  | 42  | 18  | 55  | 24  | 55  | 31  | 48  |
|                   | 2      | 88  | >84 | 73 | >85 | 71  | >86 | 67  | 79  | 64  | >83 | 61  | 81  |
|                   | 3      | 87  | 52  | 52 | 51  | 51  | 50  | 46  | 51  | 45  | 50  | 45  | 52  |
|                   | 4      | >96 | >87 | 75 | >87 | 76  | 87  | 74  | >87 | 75  | >88 | 82  | >85 |
|                   | 5      | >96 | 73  | 69 | 73  | 63  | 72  | 61  | 69  | 58  | 64  | 60  | 62  |
|                   | 6      | >96 | >86 | 81 | >85 | 81  | >88 | 82  | >86 | 81  | >87 | 81  | >87 |
|                   | 7      | >95 | 87  | 69 | 85  | 69  | 83  | 68  | 76  | 67  | 75  | 64  | 74  |
|                   | 8      | >96 | >86 | 85 | >86 | 84  | >86 | 84  | >86 | 85  | >86 | >86 | >87 |
|                   | 9      | >95 | 81  | 74 | 81  | 75  | 81  | 73  | 80  | 72  | 78  | 71  | 78  |
| 10                | >95    | 86  | >87 | 88 | >88 | >86 | >87 | >86 | >86 | >86 | >86 | 88  |     |
| <hr/>             |        |     |     |    |     |     |     |     |     |     |     |     |     |
|                   | 0      | 1   | 2   | 3  | 4   | 5   | 6   | 7   | 8   | 9   | 10  |     |     |

Harmonic LO Order

test conditions: RF, =IN: FREQ. 10.1 MHZ DRIVE -4.01 DBM TESTED ON :16,10,84  
 LO, =IN: FREQ. 40.01 MHZ DRIVE +7.03 DBM TESTED BY :D.E.  
 IF =MEASURED: FREQ. 29.91 AMP. -9.13 DBM

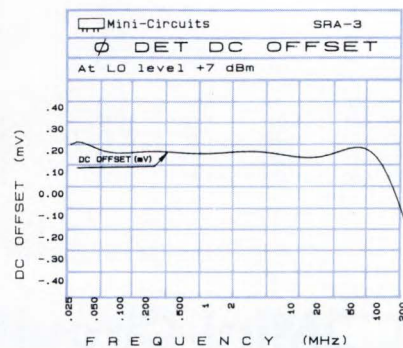
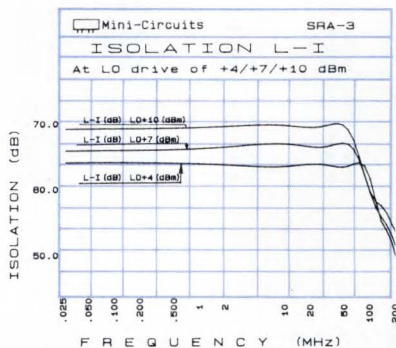
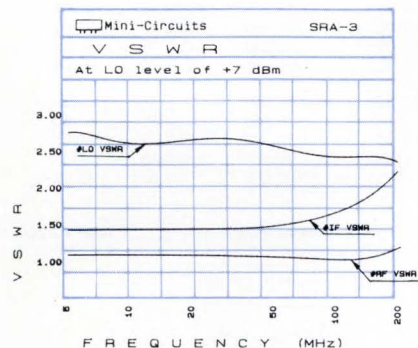
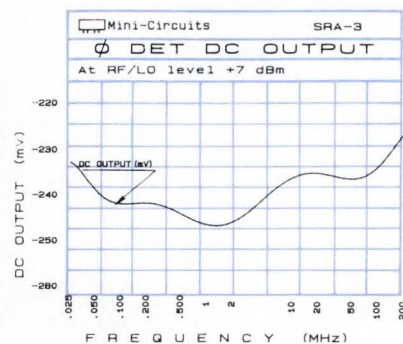
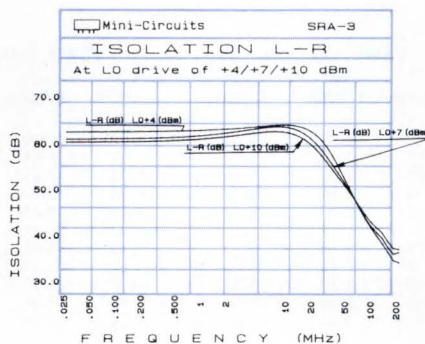
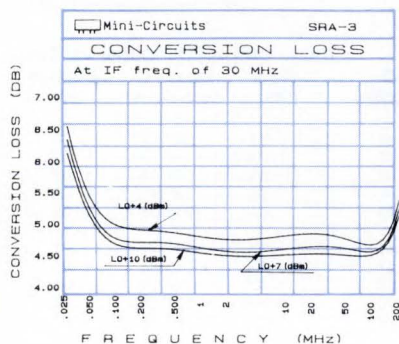
| RF ORDER HARMONIC | RF CAL |      |      |      |      |      |      |      |      |      |      |      |      |
|-------------------|--------|------|------|------|------|------|------|------|------|------|------|------|------|
|                   | 0      | -    | -    | 28   | 65   | 34   | 51   | 35   | 51   | 38   | 51   | 43   | 56   |
|                   | 1      | -    | 29   | -    | 34   | 11   | 36   | 17   | 41   | 23   | 43   | 28   | 59   |
|                   | 2      | > 95 | > 76 | 65   | 75   | 65   | > 76 | 64   | > 77 | 65   | > 77 | 72   | > 76 |
|                   | 3      | > 96 | 71   | 63   | 71   | 60   | 69   | 62   | 67   | 61   | 63   | 60   | 65   |
|                   | 4      | > 96 | > 77 | > 76 | > 77 | > 75 | > 76 | 76   | > 77 | > 75 | > 75 | > 76 | > 77 |
|                   | 5      | > 95 | > 76 | > 76 | > 76 | 77   | > 77 | > 75 | > 77 | 75   | > 77 | 74   | > 78 |
|                   | 6      | > 95 | > 76 | > 76 | > 76 | > 76 | > 77 | > 77 | > 76 | > 75 | > 77 | > 76 | > 76 |
|                   | 7      | > 95 | > 77 | > 77 | > 76 | > 77 | > 76 | > 76 | > 77 | 77   | > 77 | > 77 | > 75 |
|                   | 8      | > 95 | > 76 | > 76 | > 75 | > 76 | > 76 | > 76 | > 75 | > 75 | > 76 | > 76 | 76   |
|                   | 9      | > 96 | > 76 | > 76 | > 76 | > 76 | > 75 | > 76 | > 77 | > 76 | > 76 | > 77 | > 75 |
|                   | 10     | > 96 | > 77 | > 76 | > 77 | > 76 | > 76 | > 77 | > 77 | > 77 | > 77 | > 77 | > 78 |
| <hr/>             |        |      |      |      |      |      |      |      |      |      |      |      |      |
|                   | 0      | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   |      |      |

Harmonic LO Order

test conditions: RF, =IN: FREQ. 10.1 MHZ DRIVE -14.03 DBM TESTED ON :16,10,84  
 LO, =IN: FREQ. 40.01 MHZ DRIVE +7.08 DBM TESTED BY :D.E.  
 IF =MEASURED: FREQ. 29.91 AMP. -19.1 DBM

## typical performance curves

(production unit)





most widely-used

# Frequency Mixers

LEVEL 7 (+7 dBm LO, up to +1 dBm RF)

## Models

GRA-6  
SRA-6  
ZLW-6  
ZAD-6



computer-automated performance data  
typical production unit / for data of other models consult factory

## mixer conversion loss and isolation

| RF<br>MHz | LO<br>MHz | Conversion Loss<br>(dB) |             |              | Isolation L-R<br>(dB) |             |              | Isolation L-I<br>(dB) |             |              |
|-----------|-----------|-------------------------|-------------|--------------|-----------------------|-------------|--------------|-----------------------|-------------|--------------|
|           |           | LO<br>+4dBm             | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm           | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm           | LO<br>+7dBm | LO<br>+10dBm |
| .003      | 30.00     | 6.43                    | 6.08        | 5.85         | > 64.00               | 61.88       | 59.98        | > 64.00               | 63.93       | 62.81        |
| .100      | 30.10     | 6.22                    | 5.90        | 5.63         | > 64.00               | 62.42       | 60.32        | > 64.00               | 63.98       | 63.03        |
| .200      | 30.20     | 6.22                    | 5.92        | 5.52         | > 64.00               | 62.44       | 60.51        | > 64.00               | 64.17       | 63.17        |
| .500      | 30.50     | 6.22                    | 5.87        | 5.59         | > 64.00               | 62.74       | 60.50        | > 64.00               | 64.06       | 63.48        |
| .800      | 30.80     | 6.19                    | 5.87        | 5.54         | > 64.00               | 62.70       | 60.52        | > 64.00               | 64.22       | 63.19        |
| 1.000     | 31.00     | 6.12                    | 5.82        | 5.46         | > 64.00               | 62.48       | 60.50        | > 64.00               | 64.07       | 63.36        |
| 2.000     | 32.00     | 6.20                    | 5.85        | 5.42         | > 64.00               | 62.34       | 60.33        | > 64.00               | 63.72       | 63.16        |
| 5.000     | 35.00     | 6.23                    | 5.93        | 5.58         | > 64.00               | 61.61       | 59.62        | > 64.00               | 63.44       | 61.59        |
| 10.000    | 40.00     | 6.28                    | 5.96        | 5.62         | 58.73                 | 56.55       | 55.24        | 59.27                 | 56.72       | 55.57        |
| 20.000    | 50.00     | 6.43                    | 6.13        | 5.67         | 50.42                 | 49.50       | 49.52        | 50.36                 | 49.60       | 49.77        |
| 22.225    | 52.23     | 6.43                    | 6.08        | 5.56         | 48.95                 | 48.53       | 48.63        | 48.74                 | 48.53       | 48.79        |
| 29.632    | 59.63     | 6.45                    | 6.15        | 5.62         | 44.51                 | 44.72       | 45.32        | 43.64                 | 43.96       | 44.58        |
| 37.039    | 7.04      | 6.43                    | 6.11        | 6.04         | 41.84                 | 42.63       | 43.62        | 42.26                 | 43.10       | 44.11        |
| 44.446    | 14.45     | 6.52                    | 6.17        | 6.09         | 40.48                 | 41.27       | 42.13        | 40.30                 | 41.40       | 42.53        |
| 50.000    | 20.00     | 6.55                    | 6.25        | 6.26         | 38.93                 | 39.99       | 41.13        | 39.16                 | 40.43       | 41.73        |
| 62.964    | 32.96     | 6.77                    | 6.42        | 6.46         | 34.58                 | 35.83       | 37.01        | 36.69                 | 37.97       | 39.05        |
| 70.371    | 40.37     | 6.81                    | 6.51        | 6.18         | 33.01                 | 34.72       | 36.60        | 34.40                 | 35.50       | 36.14        |
| 77.779    | 47.78     | 7.13                    | 6.81        | 6.43         | 32.20                 | 34.07       | 35.62        | 32.19                 | 32.41       | 32.56        |
| 85.186    | 55.19     | 7.43                    | 7.08        | 6.83         | 32.50                 | 33.63       | 34.68        | 31.56                 | 31.31       | 30.96        |
| 92.593    | 62.59     | 7.43                    | 7.13        | 6.78         | 34.01                 | 34.08       | 34.08        | 32.70                 | 31.97       | 30.63        |
| 100.000   | 70.00     | 7.56                    | 7.24        | 6.87         | 36.49                 | 36.43       | 34.99        | 33.82                 | 32.88       | 30.92        |

## mixer VSWR

## φ detection

| freq.<br>MHz | VSWR, RF port |             |              | VSWR, LO port |             |              | VSWR, IF port |             |              | max. output/DC offset vs. freq. |                      |                 |
|--------------|---------------|-------------|--------------|---------------|-------------|--------------|---------------|-------------|--------------|---------------------------------|----------------------|-----------------|
|              | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | Freq.<br>(MHz)                  | max. DC<br>output mV | DC offset<br>mV |
| 5.001        | 1.35          | 1.25        | 1.15         | 1.85          | 2.77        | 4.14         | 1.73          | 1.60        | 1.44         | .003                            | -241.92              | +0.00           |
| 7.795        | 1.36          | 1.25        | 1.15         | 1.80          | 2.73        | 3.93         | 1.74          | 1.61        | 1.45         | .007                            | -236.39              | + .02           |
| 10.000       | 1.35          | 1.25        | 1.15         | 1.79          | 2.68        | 3.84         | 1.75          | 1.61        | 1.46         | .010                            | -235.94              | + .02           |
| 13.382       | 1.35          | 1.25        | 1.15         | 1.74          | 2.59        | 3.67         | 1.76          | 1.63        | 1.48         | .040                            | -235.42              | + .02           |
| 18.971       | 1.33          | 1.24        | 1.15         | 1.82          | 2.60        | 3.72         | 1.79          | 1.66        | 1.51         | .070                            | -235.38              | + .02           |
| 20.000       | 1.33          | 1.23        | 1.14         | 1.81          | 2.58        | 3.75         | 1.79          | 1.67        | 1.51         | .100                            | -231.29              | + .01           |
| 27.353       | 1.30          | 1.21        | 1.12         | 1.78          | 2.63        | 3.66         | 1.85          | 1.72        | 1.57         | .300                            | -226.88              | + .01           |
| 32.941       | 1.27          | 1.18        | 1.10         | 1.79          | 2.61        | 3.53         | 1.92          | 1.77        | 1.63         | .700                            | -227.59              | + .01           |
| 38.529       | 1.23          | 1.15        | 1.08         | 1.81          | 2.55        | 3.51         | 1.99          | 1.84        | 1.70         | 1.000                           | -227.36              | + .01           |
| 41.323       | 1.21          | 1.13        | 1.07         | 1.81          | 2.55        | 3.48         | 2.02          | 1.88        | 1.74         | 5.000                           | -226.73              | + .01           |
| 46.912       | 1.17          | 1.10        | 1.06         | 1.79          | 2.56        | 3.47         | 2.10          | 1.97        | 1.81         | 14.329                          | -227.40              | + .03           |
| 50.000       | 1.15          | 1.08        | 1.06         | 1.80          | 2.56        | 3.45         | 2.17          | 2.02        | 1.86         | 23.848                          | -228.70              | + .07           |
| 52.500       | 1.13          | 1.07        | 1.07         | 1.81          | 2.56        | 3.44         | 2.20          | 2.07        | 1.90         | 33.367                          | -225.12              | + .09           |
| 60.882       | 1.08          | 1.06        | 1.11         | 1.83          | 2.56        | 3.42         | 2.32          | 2.18        | 2.03         | 42.886                          | -220.78              | + .12           |
| 66.470       | 1.06          | 1.08        | 1.14         | 1.84          | 2.55        | 3.36         | 2.40          | 2.28        | 2.13         | 50.000                          | -219.72              | + .08           |
| 72.058       | 1.05          | 1.10        | 1.17         | 1.86          | 2.53        | 3.30         | 2.47          | 2.35        | 2.22         | 61.924                          | -212.18              | + .46           |
| 80.441       | 1.06          | 1.13        | 1.19         | 1.93          | 2.57        | 3.33         | 2.52          | 2.42        | 2.30         | 70.000                          | -209.35              | + .60           |
| 88.823       | 1.08          | 1.15        | 1.21         | 2.05          | 2.71        | 3.45         | 2.52          | 2.43        | 2.33         | 80.962                          | -204.70              | + 1.05          |
| 94.411       | 1.08          | 1.15        | 1.20         | 2.09          | 2.79        | 3.60         | 2.51          | 2.40        | 2.32         | 90.481                          | -188.36              | + 1.33          |
| 100.000      | 1.07          | 1.14        | 1.18         | 2.16          | 2.86        | 3.68         | 2.49          | 2.39        | 2.30         | 100.000                         | -170.55              | + 2.08          |

Measurements at RF & LO Power +7 dBm

**Mini-Circuits**

P.O. BOX 166, Brooklyn, New York 11235 (718) 934-4500

## mixer harmonic intermodulation

(relative to desired IF output)

| RF ORDER HARMONIC | RF CAL |      |    |    |    |    |      |    |      |      |    |    |    |
|-------------------|--------|------|----|----|----|----|------|----|------|------|----|----|----|
|                   | 0      | > 88 | -  | 31 | 51 | 33 | 41   | 27 | 48   | 35   | 60 | 44 | 62 |
|                   | 1      | > 88 | 22 | -  | 29 | 12 | 34   | 21 | 42   | 37   | 55 | 44 | 60 |
|                   | 2      | 80   | 55 | 51 | 56 | 51 | 57   | 50 | 60   | 53   | 73 | 57 | 73 |
|                   | 3      | 81   | 46 | 39 | 45 | 39 | 45   | 36 | 47   | 50   | 64 | 59 | 71 |
|                   | 4      | 85   | 68 | 63 | 71 | 67 | 69   | 71 | 75   | 66   | 79 | 68 | 81 |
|                   | 5      | 85   | 60 | 55 | 64 | 55 | 60   | 53 | 69   | 62   | 74 | 64 | 74 |
|                   | 6      | 85   | 72 | 70 | 73 | 71 | 70   | 68 | 75   | 78   | 80 | 81 | 81 |
|                   | 7      | 87   | 71 | 64 | 68 | 68 | 65   | 61 | 68   | 65   | 73 | 71 | 77 |
|                   | 8      | 86   | 82 | 83 | 80 | 75 | 78   | 78 | 81   | 81   | 80 | 80 | 80 |
|                   | 9      | 86   | 81 | 74 | 83 | 79 | > 84 | 83 | 76   | 80   | 81 | 79 | 81 |
|                   | 10     | 85   | 82 | 83 | 83 | 82 | > 84 | 81 | > 84 | > 84 | 80 | 81 | 80 |
|                   |        | 0    | 1  | 2  | 3  | 4  | 5    | 6  | 7    | 8    | 9  | 10 |    |
| Harmonic LO Order |        |      |    |    |    |    |      |    |      |      |    |    |    |

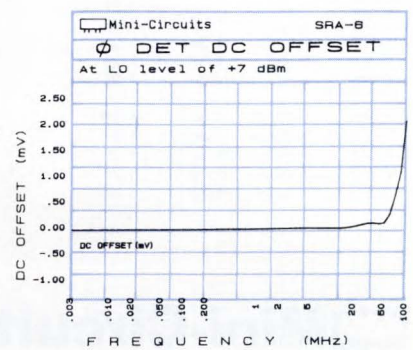
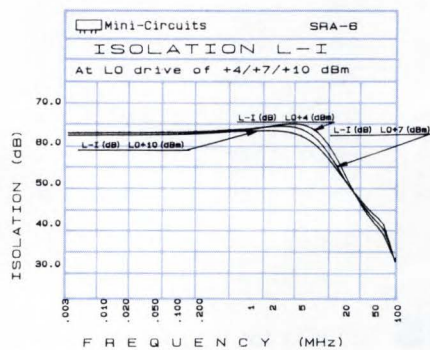
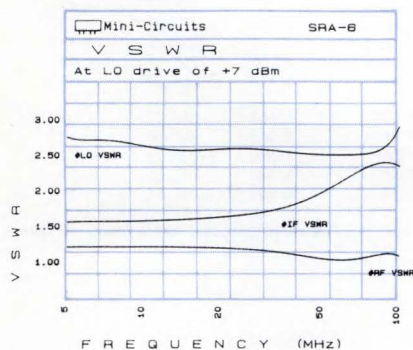
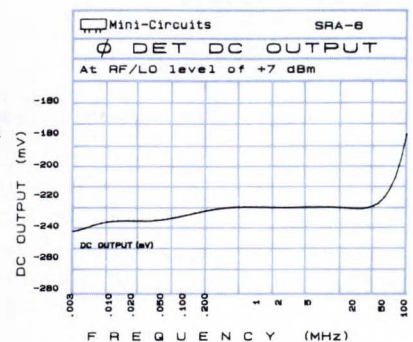
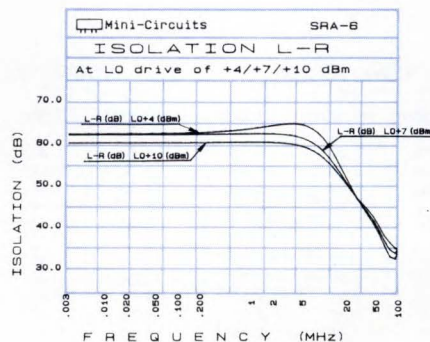
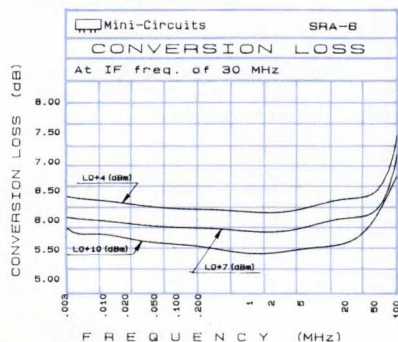
test conditions: RF=10.100 MHz INPUT P<sub>i</sub> = -3.94DBM  
 LO=40.010 MHz INPUT P<sub>i</sub> = +6.82DBM  
 IF=29.990 MHz IF=AMPLIT. = -9.26 DBM

| RF ORDER HARMONIC | RF CAL  |      |      |      |      |      |      |      |      |      |    |    |    |
|-------------------|---------|------|------|------|------|------|------|------|------|------|----|----|----|
|                   | 0 > 79  | -    | 22   | 35   | 22   | 29   | 16   | 36   | 23   | 48   | 31 | 49 |    |
|                   | 1 > 79  | 20   | -    | 28   | 12   | 38   | 19   | 36   | 36   | 51   | 47 | 52 |    |
|                   | 2 > 79  | 68   | 63   | 67   | 61   | 65   | 56   | 70   | 58   | 71   | 61 | 71 |    |
|                   | 3 > 79  | 65   | 59   | 62   | 59   | 61   | 66   | 66   | 64   | 70   | 63 | 70 |    |
|                   | 4 > 79  | > 73 | > 73 | > 73 | > 73 | > 73 | 72   | 71   | 71   | 71   | 71 | 70 |    |
|                   | 5 > 79  | > 73 | > 73 | > 73 | > 73 | 71   | > 73 | > 73 | > 73 | 71   | 70 | 71 | 70 |
|                   | 6 > 79  | > 73 | > 73 | > 73 | > 73 | > 73 | > 73 | > 73 | > 73 | 70   | 70 | 69 | 71 |
|                   | 7 > 79  | 71   | > 73 | > 73 | > 73 | > 73 | 72   | > 73 | > 73 | 69   | 70 | 70 | 71 |
|                   | 8 > 79  | > 73 | > 73 | > 73 | > 73 | > 73 | > 73 | > 73 | 72   | > 73 | 70 | 71 | 71 |
|                   | 9 > 79  | 72   | > 73 | > 73 | > 73 | > 73 | 71   | > 73 | > 73 | > 73 | 71 | 69 | 70 |
|                   | 10 > 79 | > 73 | > 73 | > 73 | > 73 | > 73 | > 73 | > 73 | > 73 | > 73 | 70 | 70 | 71 |
|                   |         | 0    | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9  | 10 |    |
| Harmonic LO Order |         |      |      |      |      |      |      |      |      |      |    |    |    |

test conditions: RF=0.100 MHz INPUT P<sub>i</sub> = -13.96DBM  
 LO=40.010 MHz INPUT P<sub>i</sub> = +6.82DBM  
 IF=29.990 MHz IF AMPLIT. = -19.35 DBM ALL HARMONICS ARE

## typical performance curves

(production unit)





most widely-used

# Frequency Mixers

LEVEL 7 (+7 dBm LO, up to +1 dBm RF)

## Models

GRA-8  
SRA-8  
ZLW-8  
ZAD-8



computer-automated performance data  
typical production unit / for data of other models consult factory

## mixer conversion loss and isolation

| RF<br>MHz | LO<br>MHz | Conversion Loss<br>(dB) |             |              | Isolation L-R<br>(dB) |             |              | Isolation L-I<br>(dB) |             |              |
|-----------|-----------|-------------------------|-------------|--------------|-----------------------|-------------|--------------|-----------------------|-------------|--------------|
|           |           | LO<br>+4dBm             | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm           | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm           | LO<br>+7dBm | LO<br>+10dBm |
| .001      | 3.00      | 5.43                    | 5.26        | 4.97         | 63.49                 | 67.32       | 68.05        | > 64.00               | > 67.00     | > 70.00      |
| .002      | 3.00      | 5.18                    | 4.96        | 4.76         | 63.34                 | 67.15       | 67.96        | > 64.00               | > 67.00     | > 70.00      |
| .005      | 3.01      | 4.98                    | 4.92        | 4.61         | 63.46                 | 67.23       | 67.72        | > 64.00               | > 67.00     | > 70.00      |
| .010      | 3.01      | 4.96                    | 4.88        | 4.59         | 63.99                 | 67.03       | 67.90        | > 64.00               | > 67.00     | > 70.00      |
| .020      | 3.02      | 5.04                    | 4.84        | 4.64         | > 64.00               | 66.98       | 68.02        | > 64.00               | > 67.00     | > 70.00      |
| .050      | 3.05      | 5.04                    | 4.84        | 4.61         | > 64.00               | 66.86       | 68.43        | > 64.00               | > 67.00     | > 70.00      |
| .100      | 3.10      | 5.00                    | 4.79        | 4.59         | > 64.00               | > 67.00     | 68.45        | > 64.00               | > 67.00     | > 70.00      |
| .200      | 3.20      | 5.06                    | 4.88        | 4.63         | > 64.00               | > 67.00     | 68.61        | > 64.00               | > 67.00     | > 70.00      |
| .500      | 3.50      | 5.07                    | 4.86        | 4.64         | > 64.00               | 66.98       | 68.77        | > 64.00               | > 67.00     | > 70.00      |
| .700      | 3.70      | 5.11                    | 4.83        | 4.66         | > 64.00               | > 67.00     | 68.83        | > 64.00               | > 67.00     | > 70.00      |
| 1.000     | 4.00      | 5.13                    | 4.88        | 4.66         | > 64.00               | 66.64       | 67.78        | > 64.00               | > 67.00     | > 70.00      |
| 1.430     | 4.43      | 5.12                    | 4.91        | 4.71         | > 64.00               | 65.85       | 65.86        | > 64.00               | > 67.00     | > 70.00      |
| 2.000     | 5.00      | 5.16                    | 4.91        | 4.72         | 63.68                 | 64.48       | 63.99        | > 64.00               | > 67.00     | > 70.00      |
| 2.858     | 5.86      | 5.15                    | 4.97        | 4.78         | 59.08                 | 57.58       | 56.32        | > 64.00               | > 67.00     | > 70.00      |
| 4.287     | 7.29      | 5.22                    | 5.16        | 4.88         | 54.41                 | 53.00       | 52.31        | > 64.00               | > 67.00     | > 70.00      |
| 5.001     | 8.00      | 5.24                    | 5.17        | 4.89         | 51.08                 | 50.13       | 50.21        | > 64.00               | > 67.00     | > 70.00      |
| 6.429     | 9.43      | 5.36                    | 5.18        | 4.97         | 48.83                 | 48.56       | 48.77        | > 64.00               | > 67.00     | > 70.00      |
| 7.143     | 4.14      | 5.24                    | 5.21        | 4.95         | 45.65                 | 45.59       | 45.96        | > 64.00               | > 67.00     | > 70.00      |
| 8.572     | 5.57      | 5.34                    | 5.23        | 5.11         | 43.01                 | 43.14       | 43.64        | > 64.00               | > 67.00     | > 70.00      |
| 10.000    | 7.00      | 5.54                    | 5.22        | 5.22         |                       |             |              | > 64.00               | > 67.00     | > 70.00      |

## mixer VSWR

## φ detection

| freq.<br>MHz | VSWR, RF port |             |              | VSWR, LO port |             |              | VSWR, IF port |             |              | max. output/DC offset vs. freq. |                      |                 |
|--------------|---------------|-------------|--------------|---------------|-------------|--------------|---------------|-------------|--------------|---------------------------------|----------------------|-----------------|
|              | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | Freq.<br>(MHz)                  | max. DC<br>output mV | DC offset<br>mV |
| .101         | 1.58          | 1.41        | 1.30         | 1.78          | 3.30        | 7.11         | 1.62          | 1.47        | 1.38         | .001                            | -275.22              | -.11            |
| .201         | 1.54          | 1.37        | 1.27         | 1.64          | 2.70        | 4.36         | 1.58          | 1.44        | 1.35         | .005                            | -271.22              | -.13            |
| .420         | 1.54          | 1.38        | 1.28         | 1.57          | 2.54        | 3.76         | 1.58          | 1.43        | 1.35         | .010                            | -264.26              | -.13            |
| .740         | 1.53          | 1.37        | 1.28         | 1.55          | 2.46        | 3.67         | 1.59          | 1.44        | 1.36         | .020                            | -261.87              | -.13            |
| 1.001        | 1.54          | 1.37        | 1.28         | 1.56          | 2.41        | 3.56         | 1.58          | 1.44        | 1.36         | .050                            | -262.01              | -.12            |
| 1.698        | 1.54          | 1.38        | 1.29         | 1.51          | 2.32        | 3.35         | 1.59          | 1.44        | 1.37         | .100                            | -259.74              | -.12            |
| 2.001        | 1.53          | 1.38        | 1.28         | 1.50          | 2.29        | 3.30         | 1.59          | 1.44        | 1.36         | .200                            | -260.96              | -.12            |
| 2.656        | 1.54          | 1.38        | 1.29         | 1.46          | 2.21        | 3.16         | 1.60          | 1.45        | 1.37         | .500                            | -262.44              | -.13            |
| 3.294        | 1.54          | 1.37        | 1.28         | 1.39          | 2.10        | 2.93         | 1.60          | 1.45        | 1.37         | .700                            | -264.77              | -.13            |
| 4.253        | 1.53          | 1.37        | 1.28         | 1.31          | 1.98        | 2.76         | 1.62          | 1.47        | 1.39         | 1.000                           | -265.78              | -.13            |
| 5.001        | 1.53          | 1.37        | 1.29         | 1.29          | 1.95        | 2.67         | 1.64          | 1.50        | 1.42         | 2.000                           | -266.07              | -.13            |
| 5.530        | 1.52          | 1.37        | 1.28         | 1.29          | 1.94        | 2.63         | 1.64          | 1.50        | 1.42         | 3.334                           | -259.84              | -.13            |
| 6.169        | 1.52          | 1.36        | 1.28         | 1.31          | 1.96        | 2.64         | 1.65          | 1.52        | 1.43         | 4.167                           | -258.11              | -.12            |
| 7.001        | 1.50          | 1.37        | 1.28         | 1.35          | 2.01        | 2.74         | 1.68          | 1.55        | 1.46         | 5.000                           | -255.49              | -.12            |
| 7.446        | 1.50          | 1.36        | 1.28         | 1.38          | 2.03        | 2.75         | 1.69          | 1.56        | 1.47         | 5.834                           | -250.59              | -.12            |
| 8.085        | 1.49          | 1.36        | 1.28         | 1.39          | 2.02        | 2.71         | 1.71          | 1.58        | 1.49         | 6.667                           | -246.55              | -.09            |
| 8.404        | 1.49          | 1.36        | 1.27         | 1.39          | 1.98        | 2.67         | 1.72          | 1.58        | 1.51         | 7.000                           | -247.09              | -.10            |
| 9.043        | 1.48          | 1.36        | 1.28         | 1.35          | 1.94        | 2.58         | 1.74          | 1.62        | 1.54         | 7.500                           | -246.77              | -.13            |
| 9.362        | 1.48          | 1.36        | 1.28         | 1.34          | 1.92        | 2.55         | 1.75          | 1.61        | 1.54         | 8.333                           | -247.65              | -.09            |
| 10.000       | 1.48          | 1.35        | 1.27         | 1.34          | 1.90        | 2.51         | 1.78          | 1.65        | 1.57         | 10.000                          | -247.81              | -.11            |

Measurements at RF & LO Power +7 dBm

**Mini-Circuits**

P.O. BOX 166, Brooklyn, New York 11235 (718) 934-4500

## mixer harmonic intermodulation

(relative to desired IF output)

| RF ORDER HARMONIC | RF CAL |     |     |     |     |     |    |     |     |     |     |     |    |
|-------------------|--------|-----|-----|-----|-----|-----|----|-----|-----|-----|-----|-----|----|
|                   | 0      | -   | -   | 30  | 39  | 35  | 44 | 33  | 51  | 41  | 60  | 50  | 69 |
|                   | 1      | -   | 16  | -   | 26  | 12  | 37 | 20  | 40  | 28  | 43  | 42  | 53 |
|                   | 2      | 84  | 69  | 66  | 70  | 65  | 63 | 58  | 57  | 49  | 65  | 54  | 75 |
|                   | 3      | 80  | 45  | 56  | 47  | 45  | 45 | 46  | 45  | 45  | 47  | 47  | 55 |
|                   | 4      | >95 | 71  | 70  | 75  | 70  | 77 | 71  | 76  | >85 | 73  | 66  | 79 |
|                   | 5      | >96 | 60  | 56  | 65  | 56  | 64 | 55  | 69  | 54  | 68  | 53  | 62 |
|                   | 6      | >94 | 83  | >87 | 81  | 81  | 82 | 78  | 81  | 79  | 86  | 78  | 88 |
|                   | 7      | 96  | 69  | 80  | 68  | 76  | 69 | 78  | 72  | 71  | 77  | 67  | 79 |
|                   | 8      | >95 | >87 | >85 | >86 | >85 | 86 | >87 | >85 | >87 | 86  | >86 | 84 |
| 9                 | >96    | 84  | 77  | 80  | 74  | 76  | 79 | 80  | 78  | 83  | 81  | 79  |    |
| 10                | >94    | >86 | 87  | >87 | >85 | >88 | 88 | >86 | >86 | >86 | >87 | >85 |    |
| <hr/>             |        |     |     |     |     |     |    |     |     |     |     |     |    |
|                   | 0      | 1   | 2   | 3   | 4   | 5   | 6  | 7   | 8   | 9   | 10  |     |    |
| Harmonic LO Order |        |     |     |     |     |     |    |     |     |     |     |     |    |

Harmonic LO Order

test conditions: RF, =IN: FREQ. 7.1002 MHz DRIVE -4.04 DBM  
 TESTED ON: 16.10.84  
 LO, =IN: FREQ. 10.01 MHz DRIVE +7.07 DBM TESTED BY: D.E.  
 IF=MEASURED: FREQ. 2.9102 AMP. -9.12 DBM

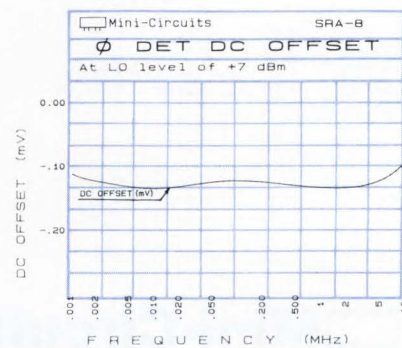
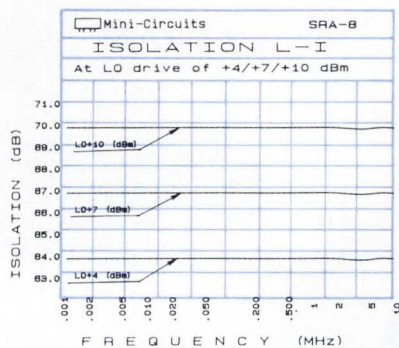
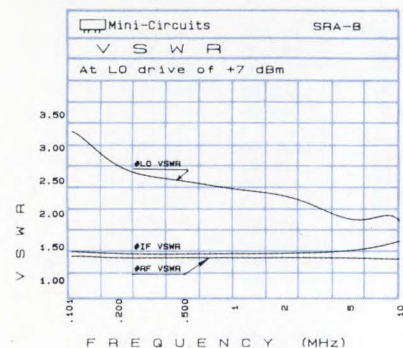
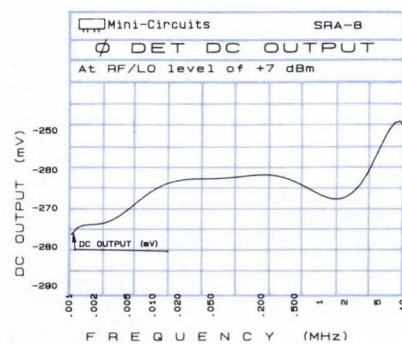
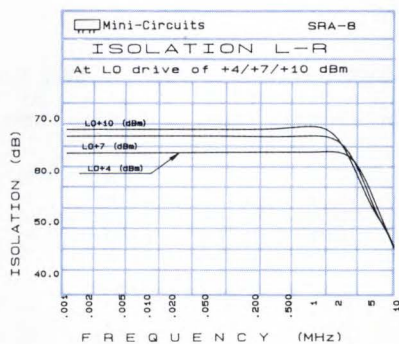
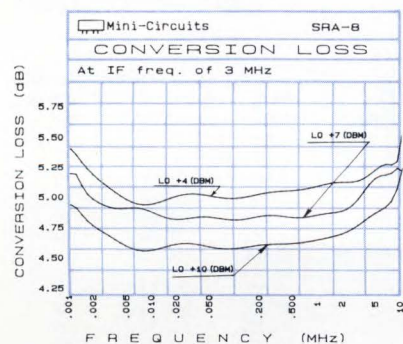
| RF ORDER HARMONIC | RF CAL |     |     |     |     |     |     |     |     |     |     |     |     |
|-------------------|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|                   | 0      | -   | -   | 20  | 29  | 25  | 33  | 21  | 38  | 27  | 54  | 35  | 64  |
|                   | 1      | -   | 16  | -   | 25  | 12  | 31  | 19  | 34  | 26  | 38  | 35  | 46  |
|                   | 2      | >96 | 73  | 65  | 70  | 66  | 69  | 71  | 65  | 60  | 67  | 61  | >76 |
|                   | 3      | >94 | 59  | 61  | 63  | 63  | 65  | 60  | 61  | 56  | 60  | 55  | 68  |
|                   | 4      | >96 | >77 | >76 | >76 | >77 | >76 | >76 | >76 | >78 | >76 | >76 | >77 |
|                   | 5      | >96 | >76 | >75 | 77  | >75 | >75 | >76 | 76  | 76  | >77 | 74  | >77 |
|                   | 6      | >96 | 75  | >76 | >77 | 76  | >77 | >77 | 76  | >76 | >76 | >76 | 75  |
|                   | 7      | >95 | >76 | >76 | >76 | >76 | >77 | >75 | >77 | >77 | >76 | >77 | >77 |
|                   | 8      | >96 | >76 | >77 | >77 | >76 | >76 | >76 | >76 | >77 | >76 | >77 | >76 |
|                   | 9      | >95 | >77 | >76 | >76 | >78 | 76  | >77 | >77 | >77 | >75 | >77 | >75 |
|                   | 10     | >94 | 77  | >76 | >76 | >77 | >76 | >76 | >77 | >76 | >77 | >75 | >77 |
| <hr/>             |        |     |     |     |     |     |     |     |     |     |     |     |     |
|                   | 0      | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  |     |     |
| Harmonic LO Order |        |     |     |     |     |     |     |     |     |     |     |     |     |

Harmonic LO Order

test conditions: RF, =IN: FREQ. 7.1002 MHz DRIVE -13.94 DBM  
 TESTED ON: 16.10.84  
 LO, =IN: FREQ. 10.01 MHz DRIVE +7.07 DBM TESTED BY: D.E.  
 IF=MEASURED: FREQ. 2.9102 AMP. -18.95 DBM

## typical performance curves

(production unit)





most widely-used

# Frequency Mixers

LEVEL 7 (+7 dBm LO, up to +1 dBm RF)

## Models

SRA-1-1

ZLW-1-1

ZAD-1-1



computer-automated performance data

typical production unit / for data of other models consult factory

## mixer conversion loss and isolation

| RF<br>MHz | LO<br>MHz | Conversion Loss<br>(dB) |             |              | Isolation L-R<br>(dB) |             |              | Isolation L-I<br>(dB) |             |              |
|-----------|-----------|-------------------------|-------------|--------------|-----------------------|-------------|--------------|-----------------------|-------------|--------------|
|           |           | LO<br>+4dBm             | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm           | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm           | LO<br>+7dBm | LO<br>+10dBm |
| .100      | 30.10     | 6.29                    | 5.97        | 5.79         | > 64.00               | > 67.00     | > 70.00      | > 64.00               | > 67.00     | > 70.00      |
| .500      | 30.50     | 5.39                    | 5.10        | 4.97         | > 64.00               | > 67.00     | > 70.00      | > 64.00               | > 67.00     | > 70.00      |
| 1.000     | 31.00     | 5.26                    | 5.03        | 4.88         | > 64.00               | > 67.00     | > 70.00      | > 64.00               | 60.45       | 58.45        |
| 2.000     | 32.00     | 5.17                    | 4.95        | 4.83         | > 64.00               | > 67.00     | > 70.00      | > 64.00               | 60.33       | 58.40        |
| 5.000     | 35.00     | 5.09                    | 4.94        | 4.79         | > 64.00               | > 67.00     | > 70.00      | > 64.00               | 60.77       | 58.85        |
| 10.000    | 40.00     | 5.11                    | 4.92        | 4.82         | > 64.00               | > 67.00     | > 70.00      | > 64.00               | 61.39       | 59.31        |
| 20.000    | 50.00     | 5.23                    | 5.01        | 4.91         | > 64.00               | > 67.00     | > 70.00      | > 64.00               | 61.65       | 59.31        |
| 50.000    | 80.00     | 5.11                    | 4.95        | 4.85         | > 64.00               | > 67.00     | 60.40        | > 64.00               | 61.63       | 57.18        |
| 69.828    | 99.83     | 5.07                    | 4.92        | 4.82         | > 64.00               | 57.89       | 55.46        | > 64.00               | 55.93       | 53.10        |
| 100.000   | 70.00     | 4.98                    | 4.82        | 4.77         | 53.52                 | 51.38       | 50.35        | 51.19                 | 49.30       | 48.15        |
| 173.070   | 143.07    | 5.09                    | 4.99        | 4.92         | 42.69                 | 42.54       | 43.78        | 40.65                 | 40.81       | 42.06        |
| 200.000   | 170.00    | 5.19                    | 5.08        | 4.99         | 43.25                 | 43.50       | 43.78        | 40.60                 | 41.01       | 41.28        |
| 224.690   | 194.69    | 5.33                    | 5.23        | 5.09         | 40.97                 | 41.57       | 42.12        | 38.49                 | 39.41       | 40.10        |
| 259.110   | 229.11    | 5.35                    | 5.21        | 5.12         | 38.29                 | 38.74       | 39.32        | 36.72                 | 36.85       | 37.59        |
| 293.520   | 263.52    | 5.41                    | 5.32        | 5.28         | 36.69                 | 37.88       | 39.26        | 35.47                 | 36.40       | 37.52        |
| 345.140   | 315.14    | 5.80                    | 5.71        | 5.62         | 35.04                 | 36.54       | 37.94        | 32.97                 | 33.55       | 34.49        |
| 396.760   | 366.76    | 6.04                    | 5.68        | 5.37         | 36.38                 | 37.59       | 38.39        | 34.55                 | 34.68       | 33.66        |
| 431.180   | 401.18    | 6.70                    | 5.98        | 5.36         | 37.85                 | 37.76       | 38.44        | 36.93                 | 36.68       | 35.35        |
| 465.590   | 435.59    | 7.52                    | 7.01        | 6.30         | 37.33                 | 37.18       | 37.12        | 35.95                 | 36.08       | 35.13        |
| 500.000   | 470.00    | 8.25                    | 7.80        | 7.14         | 37.02                 | 38.33       | 40.41        | 33.62                 | 34.17       | 32.40        |

## mixer VSWR

## φ detection

| freq.<br>MHz | VSWR, RF port |             |              | VSWR, LO port |             |              | VSWR, IF port |             |              | max. output/DC offset vs. freq.      |                      |                 |
|--------------|---------------|-------------|--------------|---------------|-------------|--------------|---------------|-------------|--------------|--------------------------------------|----------------------|-----------------|
|              | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | Freq.<br>(MHz)                       | max. DC<br>output mV | DC offset<br>mV |
| 5.001        | 1.38          | 1.27        | 1.20         | 1.50          | 2.30        | 3.45         | 2.13          | 1.92        | 1.78         | .100                                 | -252.07              | + .02           |
| 10.000       | 1.38          | 1.27        | 1.20         | 1.42          | 2.24        | 3.20         | 2.12          | 1.91        | 1.77         | .200                                 | -255.06              | + .03           |
| 20.000       | 1.37          | 1.27        | 1.20         | 1.51          | 2.26        | 3.25         | 2.12          | 1.90        | 1.76         | .500                                 | -256.56              | + .02           |
| 34.118       | 1.35          | 1.25        | 1.18         | 1.47          | 2.20        | 3.09         | 2.13          | 1.91        | 1.77         | 1.000                                | -257.44              | + .02           |
| 50.000       | 1.33          | 1.23        | 1.16         | 1.43          | 2.16        | 3.02         | 2.15          | 1.92        | 1.78         | 2.000                                | -256.78              | + .02           |
| 77.795       | 1.28          | 1.18        | 1.12         | 1.41          | 2.11        | 2.89         | 2.16          | 1.93        | 1.80         | 5.000                                | -258.91              | + .02           |
| 100.000      | 1.25          | 1.15        | 1.09         | 1.40          | 2.08        | 2.88         | 2.21          | 1.96        | 1.85         | 10.000                               | -257.73              | + .02           |
| 121.470      | 1.21          | 1.12        | 1.07         | 1.47          | 2.09        | 2.94         | 2.24          | 2.00        | 1.87         | 20.000                               | -259.14              | + .03           |
| 150.590      | 1.16          | 1.09        | 1.07         | 1.50          | 2.12        | 2.86         | 2.34          | 2.05        | 1.93         | 50.000                               | -256.04              | + .02           |
| 179.710      | 1.13          | 1.10        | 1.10         | 1.51          | 2.18        | 2.87         | 2.42          | 2.13        | 1.99         | 73.912                               | -260.65              | + .03           |
| 200.000      | 1.12          | 1.11        | 1.14         | 1.53          | 2.22        | 2.96         | 2.44          | 2.19        | 2.04         | 100.000                              | -261.64              | + .05           |
| 223.390      | 1.12          | 1.15        | 1.19         | 1.58          | 2.23        | 2.93         | 2.51          | 2.24        | 2.08         | 159.130                              | -256.39              | + .09           |
| 267.060      | 1.16          | 1.22        | 1.27         | 1.69          | 2.38        | 3.05         | 2.60          | 2.32        | 2.17         | 200.000                              | -257.48              | + .15           |
| 296.180      | 1.20          | 1.27        | 1.33         | 1.71          | 2.43        | 3.15         | 2.66          | 2.37        | 2.24         | 223.040                              | -261.16              | + .20           |
| 325.300      | 1.24          | 1.31        | 1.38         | 1.80          | 2.44        | 3.20         | 2.68          | 2.41        | 2.25         | 265.650                              | -248.60              | + .26           |
| 354.420      | 1.27          | 1.34        | 1.41         | 1.93          | 2.56        | 3.26         | 2.66          | 2.37        | 2.25         | 300.000                              | -236.58              | + .14           |
| 383.530      | 1.29          | 1.36        | 1.41         | 2.09          | 2.75        | 3.42         | 2.65          | 2.37        | 2.23         | 372.170                              | -208.88              | - .07           |
| 412.650      | 1.29          | 1.35        | 1.40         | 2.17          | 2.85        | 3.56         | 2.69          | 2.37        | 2.24         | 400.000                              | -197.61              | - .18           |
| 441.770      | 1.26          | 1.31        | 1.36         | 2.22          | 2.95        | 3.69         | 2.65          | 2.34        | 2.19         | 457.380                              | -180.61              | - .37           |
| 470.890      | 1.19          | 1.23        | 1.28         | 2.29          | 3.00        | 3.82         | 2.63          | 2.31        | 2.16         | 500.000                              | -182.97              | + .07           |
| 500.000      | 1.13          | 1.16        | 1.21         | 2.32          | 3.10        | 3.77         | 2.70          | 2.32        | 2.18         | Measurements at RF & LO Power +7 dBm |                      |                 |

**Mini-Circuits**

P.O. BOX 166, Brooklyn, New York 11235

(718) 934-4500

## mixer harmonic intermodulation

(relative to desired IF output)

| RF ORDER HARMONIC | RF CAL | 0   | 1  | 2  | 3  | 4   | 5   | 6   | 7   | 8   | 9   | 10  |
|-------------------|--------|-----|----|----|----|-----|-----|-----|-----|-----|-----|-----|
| 0                 | >89    | -   | 41 | 48 | 40 | 59  | 33  | 49  | 33  | 52  | 41  | 72  |
| 1                 | >89    | 20  | -  | 31 | 11 | 39  | 18  | 39  | 27  | 43  | 43  | 52  |
| 2                 | 76     | 56  | 69 | 61 | 64 | 63  | 65  | 64  | 52  | 56  | 48  | 64  |
| 3                 | 85     | 51  | 44 | 50 | 45 | 58  | 45  | 52  | 41  | 55  | 45  | 53  |
| 4                 | 85     | 73  | 64 | 74 | 66 | 72  | 66  | 76  | 67  | 72  | 66  | 67  |
| 5                 | 85     | >83 | 59 | 67 | 63 | 69  | 57  | 66  | 54  | 66  | 53  | 73  |
| 6                 | 85     | 80  | 82 | 79 | 77 | >83 | 74  | >84 | 75  | >84 | 74  | >83 |
| 7                 | 84     | 80  | 76 | 82 | 69 | 79  | 72  | 77  | 74  | 76  | 70  | 74  |
| 8                 | 86     | 80  | 79 | 80 | 80 | >83 | >83 | >83 | 83  | >84 | >84 | >84 |
| 9                 | 86     | 79  | 80 | 80 | 80 | 80  | 81  | >83 | 77  | 82  | >83 | 81  |
| 10                | 85     | 80  | 80 | 80 | 80 | 80  | 81  | >83 | >83 | >83 | >83 | >83 |

Harmonic LO Order

test conditions: RF = 185.100 MHz INPUT P. -3.91 dBm  
 LO = 155.010 MHz INPUT P. +6.83 dBm  
 IF = 30.090 MHz IF = AMPLIT. -9.36 dBm

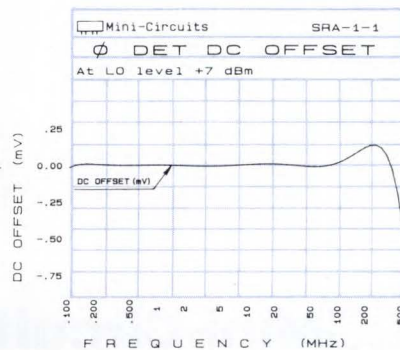
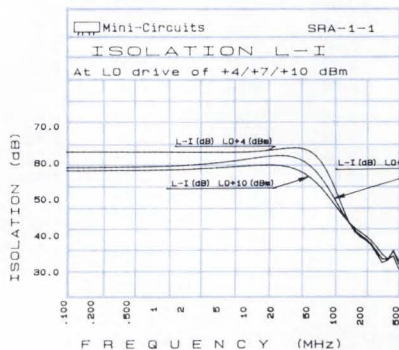
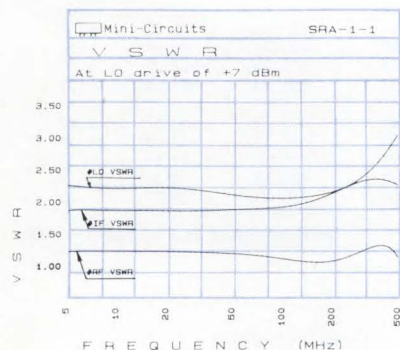
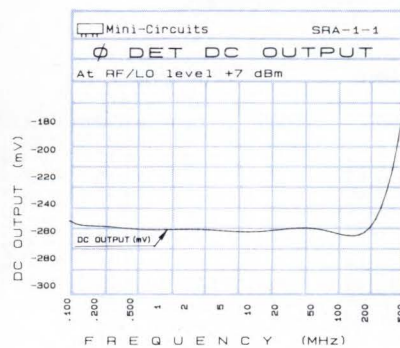
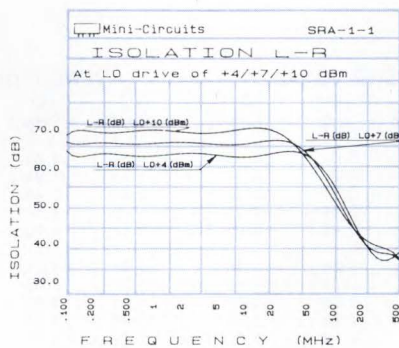
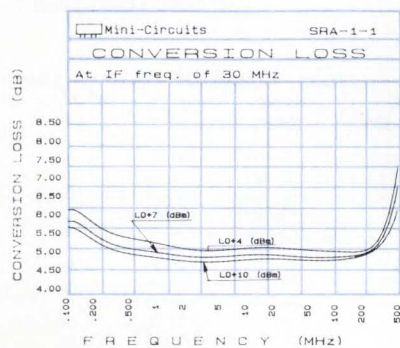
| RF ORDER HARMONIC | RF CAL | 0   | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  |
|-------------------|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0                 | >80    | -   | 34  | 37  | 29  | 47  | 21  | 34  | 20  | 43  | 26  | 60  |
| 1                 | >80    | 20  | -   | 32  | 12  | 36  | 17  | 40  | 26  | 40  | 42  | 48  |
| 2                 | >80    | 62  | 61  | 64  | 59  | 67  | 60  | 63  | 54  | 58  | 52  | 68  |
| 3                 | >80    | 72  | 59  | 67  | 63  | 67  | 57  | >73 | 57  | 66  | 58  | >73 |
| 4                 | >80    | >73 | >73 | >73 | >73 | >74 | >74 | >74 | >73 | >73 | >73 | >73 |
| 5                 | >80    | >73 | >73 | >73 | >73 | >73 | >74 | >74 | >74 | >73 | >73 | >73 |
| 6                 | >80    | 69  | >73 | >73 | >73 | >73 | >73 | >74 | >74 | >74 | >73 | >73 |
| 7                 | >80    | 70  | 70  | >73 | >73 | >73 | >73 | >73 | >74 | >74 | >74 | >73 |
| 8                 | >80    | 69  | 70  | 69  | 68  | >73 | >73 | >73 | >73 | >74 | >74 | >74 |
| 9                 | >80    | 69  | 69  | 70  | 71  | 70  | >73 | >73 | >73 | >73 | >73 | >74 |
| 10                | >79    | 70  | 70  | 70  | 70  | 70  | 70  | >73 | >73 | >73 | >73 | >73 |

HARMONIC LO ORDER

test conditions: RF 185.100 MHz INPUT P. -13.96 dBm  
 LO 155.010 MHz INPUT P. +6.83 dBm  
 IF = 30.090 MHz IF = AMPLIT. -19.44 dBm

## typical performance curves

(production unit)





most widely-used

# Frequency Mixers

LEVEL 7 (+7 dBm LO, up to +1 dBm RF)

## Models

SRA-1W

ZLW-1W

ZAD-1W



computer-automated performance data

typical production unit / for data of other models consult factory

## mixer conversion loss and isolation

| RF<br>MHz | LO<br>MHz | Conversion Loss<br>(dB) |             |              | Isolation L-R<br>(dB) |             |              | Isolation L-I<br>(dB) |             |              |
|-----------|-----------|-------------------------|-------------|--------------|-----------------------|-------------|--------------|-----------------------|-------------|--------------|
|           |           | LO<br>+4dBm             | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm           | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm           | LO<br>+7dBm | LO<br>+10dBm |
| 1.000     | 31.00     | 6.40                    | 6.42        | 6.47         | > 64.00               | > 67.00     | > 70.00      | > 64.00               | > 67.00     | 64.91        |
| 2.000     | 32.00     | 6.15                    | 5.97        | 6.07         | > 64.00               | > 67.00     | > 70.00      | > 64.00               | > 67.00     | 64.71        |
| 5.000     | 35.00     | 5.80                    | 5.50        | 5.73         | > 64.00               | > 67.00     | > 70.00      | > 64.00               | > 67.00     | 64.82        |
| 10.000    | 40.00     | 5.92                    | 5.66        | 5.47         | > 64.00               | > 67.00     | > 70.00      | > 64.00               | > 67.00     | 65.02        |
| 20.000    | 50.00     | 5.93                    | 5.60        | 5.41         | > 64.00               | > 67.00     | > 70.00      | > 64.00               | > 67.00     | 64.65        |
| 50.000    | 80.00     | 5.85                    | 5.60        | 5.50         | > 64.00               | > 67.00     | > 70.00      | > 64.00               | 62.28       | 61.08        |
| 100.000   | 70.00     | 5.75                    | 5.47        | 5.47         | > 64.00               | > 67.00     | 59.87        | 54.37                 | 55.09       | 54.33        |
| 130.140   | 100.14    | 5.74                    | 5.52        | 5.42         | > 64.00               | 57.96       | 55.48        | 51.69                 | 51.55       | 51.11        |
| 200.000   | 170.00    | 5.81                    | 5.62        | 5.55         | 51.92                 | 50.48       | 49.20        | 46.26                 | 45.84       | 44.92        |
| 285.110   | 255.11    | 5.64                    | 5.47        | 5.44         | 46.41                 | 45.61       | 44.78        | 41.42                 | 40.64       | 40.18        |
| 362.590   | 332.59    | 5.90                    | 5.71        | 5.53         | 43.45                 | 42.62       | 42.43        | 38.16                 | 37.34       | 37.26        |
| 414.250   | 384.25    | 6.10                    | 5.97        | 5.63         | 40.29                 | 40.09       | 40.38        | 35.59                 | 36.21       | 36.95        |
| 500.000   | 470.00    | 6.39                    | 6.14        | 5.93         | 40.14                 | 39.49       | 39.46        | 33.46                 | 33.17       | 33.44        |
| 543.390   | 513.39    | 6.45                    | 6.24        | 5.97         | 38.53                 | 37.59       | 37.08        | 32.09                 | 31.35       | 31.13        |
| 595.040   | 565.04    | 6.61                    | 6.21        | 6.28         | 37.16                 | 37.44       | 37.78        | 32.18                 | 31.39       | 31.01        |
| 646.700   | 616.70    | 6.61                    | 6.16        | 5.91         | 35.85                 | 36.31       | 37.13        | 33.13                 | 33.58       | 33.33        |
| 672.530   | 642.53    | 6.88                    | 6.27        | 5.93         | 36.55                 | 36.63       | 37.42        | 30.97                 | 31.60       | 31.99        |
| 698.360   | 668.36    | 7.13                    | 6.43        | 5.95         | 36.25                 | 36.64       | 37.41        | 29.19                 | 29.86       | 30.40        |
| 724.180   | 694.18    | 7.46                    | 6.68        | 6.13         | 36.48                 | 36.68       | 37.16        | 28.44                 | 28.78       | 29.14        |
| 750.000   | 720.00    | 7.84                    | 6.98        | 6.25         | 35.61                 | 35.77       | 36.24        | 27.28                 | 27.45       | 27.86        |

## mixer VSWR

## φ detection

| freq.<br>MHz | VSWR, RF port |             |              | VSWR, LO port |             |              | VSWR, IF port |             |              | max. output/DC offset vs. freq. |                      |                 |
|--------------|---------------|-------------|--------------|---------------|-------------|--------------|---------------|-------------|--------------|---------------------------------|----------------------|-----------------|
|              | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | Freq.<br>(MHz)                  | max. DC<br>output mV | DC offset<br>mV |
| 5.001        | 1.15          | 1.20        | 1.23         | 2.15          | 3.31        | 4.93         | 1.64          | 1.46        | 1.35         | 1.000                           | -225.12              | -06             |
| 10.000       | 1.07          | 1.12        | 1.16         | 2.07          | 3.09        | 4.57         | 1.64          | 1.46        | 1.35         | 2.000                           | -228.82              | -06             |
| 20.000       | 1.05          | 1.10        | 1.15         | 2.12          | 3.15        | 4.56         | 1.64          | 1.46        | 1.36         | 5.000                           | -229.29              | -06             |
| 50.000       | 1.08          | 1.12        | 1.17         | 2.04          | 2.99        | 4.21         | 1.65          | 1.47        | 1.37         | 10.000                          | -231.45              | -05             |
| 78.484       | 1.10          | 1.14        | 1.19         | 2.00          | 2.99        | 4.06         | 1.67          | 1.50        | 1.40         | 20.000                          | -226.19              | -04             |
| 100.000      | 1.11          | 1.16        | 1.21         | 2.00          | 2.84        | 3.86         | 1.68          | 1.51        | 1.42         | 49.322                          | -222.81              | -04             |
| 155.970      | 1.15          | 1.20        | 1.25         | 1.99          | 2.88        | 3.83         | 1.77          | 1.60        | 1.51         | 73.483                          | -223.49              | -05             |
| 200.000      | 1.18          | 1.23        | 1.28         | 1.96          | 2.75        | 3.59         | 1.86          | 1.68        | 1.59         | 100.000                         | -228.62              | -05             |
| 259.280      | 1.24          | 1.30        | 1.35         | 1.96          | 2.74        | 3.56         | 1.99          | 1.81        | 1.71         | 145.970                         | -229.46              | -04             |
| 310.940      | 1.29          | 1.35        | 1.41         | 2.00          | 2.74        | 3.58         | 2.12          | 1.93        | 1.81         | 200.000                         | -226.10              | +0.00           |
| 362.590      | 1.34          | 1.40        | 1.46         | 2.08          | 2.78        | 3.61         | 2.26          | 2.05        | 1.94         | 266.770                         | -229.57              | +0.00           |
| 414.250      | 1.39          | 1.45        | 1.50         | 2.07          | 2.78        | 3.56         | 2.35          | 2.13        | 2.01         | 387.580                         | -193.60              | +08             |
| 465.900      | 1.43          | 1.48        | 1.53         | 2.10          | 2.80        | 3.48         | 2.43          | 2.22        | 2.09         | 460.060                         | -199.61              | -23             |
| 517.560      | 1.45          | 1.50        | 1.54         | 2.15          | 2.82        | 3.52         | 2.45          | 2.24        | 2.11         | 500.000                         | -207.29              | -12             |
| 569.220      | 1.47          | 1.49        | 1.53         | 2.18          | 2.85        | 3.52         | 2.45          | 2.23        | 2.11         | 556.700                         | -187.14              | +32             |
| 620.870      | 1.49          | 1.51        | 1.54         | 2.30          | 2.93        | 3.47         | 2.38          | 2.20        | 2.09         | 605.030                         | -160.57              | +22             |
| 672.530      | 1.55          | 1.58        | 1.60         | 2.39          | 2.94        | 3.57         | 2.27          | 2.10        | 2.00         | 677.510                         | -144.43              | +16             |
| 698.360      | 1.62          | 1.64        | 1.68         | 2.41          | 3.03        | 3.52         | 2.24          | 2.05        | 1.97         | 701.670                         | -137.65              | -18             |
| 724.180      | 1.69          | 1.72        | 1.75         | 2.43          | 3.01        | 3.55         | 2.16          | 1.99        | 1.91         | 725.830                         | -124.38              | -31             |
| 750.000      | 1.80          | 1.83        | 1.86         | 2.45          | 3.01        | 3.56         | 2.11          | 1.93        | 1.84         | 750.000                         | -115.97              | -53             |

Measurements at RF & LO Power +7 dBm

**Mini-Circuits**

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(718) 934-4500

## mixer harmonic intermodulation

(relative to desired IF output)

| RF ORDER HARMONIC | RF CAL |     |     |     |     |     |     |     |     |     |
|-------------------|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|                   | 0      | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   |
| 0                 | >80    | -   | 14  | 23  | 11  | 32  | 11  | 25  | 26  | 46  |
| 1                 | >80    | 18  | -   | 36  | 10  | 34  | 34  | 35  | 47  | 51  |
| 2                 | >80    | >74 | 53  | >72 | 55  | 66  | 51  | 71  | 49  | 59  |
| 3                 | >80    | 70  | 58  | 68  | 57  | 67  | 53  | 70  | >73 | 67  |
| 4                 | >80    | 68  | >74 | >74 | >72 | >72 | >72 | >72 | >73 | 67  |
| 5                 | >80    | 68  | 68  | >74 | >74 | >72 | >72 | >72 | >72 | 73  |
| 6                 | >80    | 69  | 68  | 69  | >74 | >74 | >72 | >72 | >72 | >74 |
| 7                 | >80    | 69  | 68  | 68  | 68  | >74 | >74 | >72 | >72 | >72 |
| 8                 | >80    | 69  | 69  | 68  | 68  | 67  | >74 | >74 | >72 | >72 |
| 9                 | >80    | 69  | 70  | 69  | 69  | 68  | 68  | >74 | >74 | >72 |
| 10                | >80    | 69  | 68  | 69  | 69  | 67  | 68  | 68  | >74 | >72 |
|                   | 0      | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   |
| Harmonic LO Order |        |     |     |     |     |     |     |     |     |     |

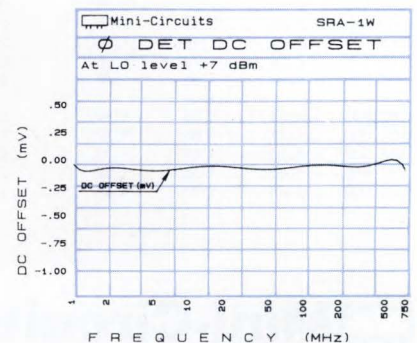
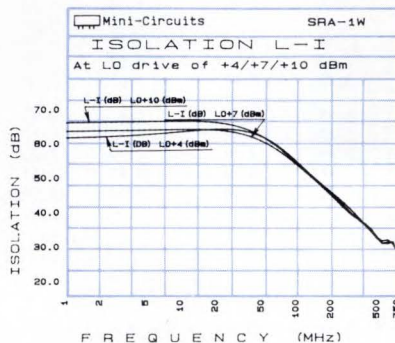
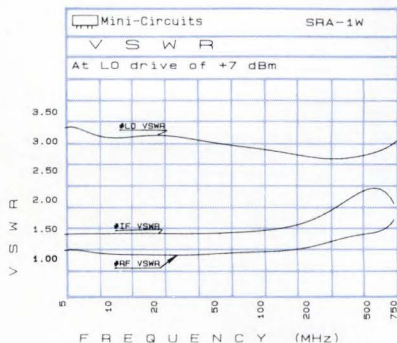
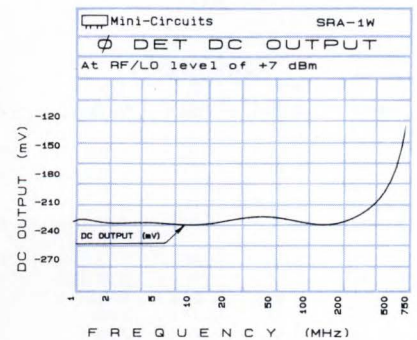
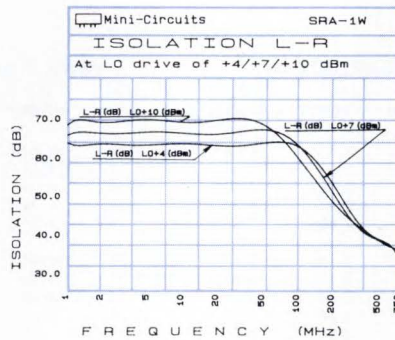
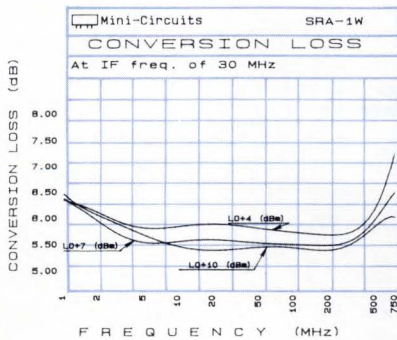
test conditions: RF=500.100 MHz INPUT P.<sub>1</sub>= -14.06DBM  
 LO=470.010 MHz INPUT P.<sub>2</sub>= +7.15DBM  
 IF= 30.090MHz IF AMPLIT. = -20.66 DBM

| RF ORDER HARMONIC | RF CAL |    |    |    |     |     |     |     |     |     |
|-------------------|--------|----|----|----|-----|-----|-----|-----|-----|-----|
|                   | 0      | 1  | 2  | 3  | 4   | 5   | 6   | 7   | 8   | 9   |
| 0                 | >90    | -  | 22 | 34 | 23  | 48  | 22  | 37  | 38  | 59  |
| 1                 | >90    | 18 | -  | 37 | 11  | 36  | 38  | 40  | 59  | 54  |
| 2                 | 76     | 64 | 44 | 65 | 47  | 58  | 42  | 77  | 42  | 50  |
| 3                 | 85     | 54 | 46 | 54 | 41  | 57  | 37  | 59  | 64  | 54  |
| 4                 | 84     | 78 | 76 | 69 | 61  | 75  | 59  | 69  | 61  | 76  |
| 5                 | 83     | 77 | 71 | 83 | 58  | 64  | 54  | 66  | 51  | 64  |
| 6                 | 84     | 77 | 79 | 76 | >84 | 83  | 73  | 79  | 69  | 77  |
| 7                 | 85     | 79 | 76 | 77 | 78  | >84 | 79  | >82 | 73  | 80  |
| 8                 | 86     | 79 | 79 | 79 | 78  | 78  | >84 | >84 | >82 | >81 |
| 9                 | 85     | 77 | 79 | 78 | 79  | 79  | 78  | 84  | >84 | >82 |
| 10                | 85     | 79 | 79 | 79 | 80  | 78  | 78  | 77  | >84 | 84  |
|                   | 0      | 1  | 2  | 3  | 4   | 5   | 6   | 7   | 8   | 9   |
| Harmonic LO Order |        |    |    |    |     |     |     |     |     |     |

test conditions: RF=500.100 MHz INPUT P.<sub>1</sub>= -3.98DBM  
 LO=470.010 MHz INPUT P.<sub>2</sub>= +7.15DBM  
 IF=30.090MHz IF AMPLIT. = -10.65 DBM

## typical performance curves

(production unit)





most widely-used

# Frequency Mixers

LEVEL 7 (+7 dBm LO, up to +1 dBm RF)

## Models

SRA-2

ZAD-2



computer-automated performance data

typical production unit / for data of other models consult factory

## mixer conversion loss and isolation

| RF<br>MHz | LO<br>MHz | Conversion Loss<br>(dB) |             |              | Isolation L-R<br>(dB) |             |              | Isolation L-I<br>(dB) |             |              |
|-----------|-----------|-------------------------|-------------|--------------|-----------------------|-------------|--------------|-----------------------|-------------|--------------|
|           |           | LO<br>+4dBm             | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm           | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm           | LO<br>+7dBm | LO<br>+10dBm |
| 1.000     | 31.00     | 6.07                    | 5.81        | 5.46         | 62.60                 | 62.40       | > 66.00      | > 64.00               | 66.60       | > 70.00      |
| 10.000    | 40.00     | 6.08                    | 5.74        | 5.59         | > 64.00               | > 67.00     | > 70.00      | > 64.00               | > 67.00     | > 70.00      |
| 20.000    | 50.00     | 6.30                    | 5.87        | 5.69         | > 64.00               | 63.37       | 61.98        | > 64.00               | > 67.00     | 65.75        |
| 50.000    | 80.00     | 6.12                    | 5.77        | 5.63         | 55.60                 | 55.36       | 54.47        | 59.32                 | 58.05       | 57.23        |
| 100.000   | 70.00     | 6.19                    | 5.79        | 5.61         | 49.88                 | 49.04       | 48.78        | 53.06                 | 52.36       | 51.54        |
| 160.320   | 130.32    | 6.26                    | 5.85        | 5.67         | 45.01                 | 45.18       | 45.58        | 49.33                 | 48.76       | 47.95        |
| 200.000   | 170.00    | 6.37                    | 5.92        | 5.76         | 42.87                 | 43.67       | 44.12        | 47.83                 | 47.23       | 46.11        |
| 284.570   | 254.57    | 6.33                    | 5.95        | 5.78         | 39.78                 | 41.08       | 41.57        | 45.98                 | 44.56       | 43.24        |
| 346.690   | 316.69    | 6.46                    | 6.00        | 5.80         | 37.76                 | 39.04       | 39.72        | 46.26                 | 43.59       | 42.36        |
| 408.820   | 378.82    | 6.63                    | 6.15        | 6.03         | 36.41                 | 36.94       | 37.09        | 45.83                 | 43.85       | 42.15        |
| 500.000   | 470.00    | 6.65                    | 6.25        | 6.02         | 34.76                 | 35.65       | 36.13        | 42.46                 | 41.57       | 41.15        |
| 533.070   | 503.07    | 6.60                    | 6.19        | 5.99         | 33.76                 | 34.41       | 34.81        | 41.86                 | 42.87       | 40.89        |
| 595.200   | 565.20    | 6.36                    | 5.96        | 5.83         | 31.57                 | 33.15       | 32.76        | 38.80                 | 37.76       | 37.80        |
| 688.390   | 658.39    | 5.98                    | 5.57        | 5.36         | 30.43                 | 31.77       | 33.15        | 38.78                 | 38.59       | 39.85        |
| 750.510   | 720.51    | 6.09                    | 5.59        | 5.38         | 29.69                 | 30.90       | 32.19        | 40.24                 | 40.39       | 41.51        |
| 800.000   | 770.00    | 6.10                    | 5.60        | 5.40         | 29.15                 | 30.50       | 31.72        | 41.59                 | 41.73       | 42.48        |
| 843.700   | 813.70    | 6.02                    | 5.64        | 5.42         | 28.90                 | 30.24       | 31.53        | 41.01                 | 41.84       | 41.85        |
| 905.830   | 875.83    | 5.98                    | 5.62        | 5.46         | 28.01                 | 28.94       | 30.05        | 37.68                 | 47.26       | 38.04        |
| 967.950   | 937.95    | 6.15                    | 5.81        | 5.66         | 27.16                 | 28.12       | 28.44        | 36.14                 | 35.84       | 35.75        |
| 1000.000  | 970.00    | 6.36                    | 6.10        | 5.89         | 26.28                 | 27.73       | 27.35        | 33.59                 | 32.72       | 33.16        |

## mixer VSWR

| freq.<br>MHz | VSWR, RF port |             |              | VSWR, LO port |             |              | VSWR, IF port |             |              |
|--------------|---------------|-------------|--------------|---------------|-------------|--------------|---------------|-------------|--------------|
|              | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm |
| 5.001        | 1.94          | 1.73        | 1.58         | 2.14          | 3.13        | 4.78         | 1.32          | 1.39        | 1.45         |
| 10.000       | 1.94          | 1.73        | 1.59         | 2.01          | 2.99        | 4.46         | 1.23          | 1.31        | 1.37         |
| 20.000       | 1.93          | 1.73        | 1.59         | 2.14          | 3.08        | 4.50         | 1.19          | 1.28        | 1.35         |
| 50.000       | 1.95          | 1.74        | 1.61         | 2.02          | 2.94        | 4.34         | 1.19          | 1.29        | 1.35         |
| 100.000      | 1.99          | 1.80        | 1.67         | 1.98          | 2.86        | 3.95         | 1.23          | 1.31        | 1.38         |
| 137.670      | 2.05          | 1.86        | 1.73         | 1.96          | 2.78        | 3.79         | 1.26          | 1.34        | 1.40         |
| 200.000      | 2.17          | 1.97        | 1.88         | 1.93          | 2.72        | 3.68         | 1.31          | 1.38        | 1.44         |
| 237.170      | 2.25          | 2.06        | 1.95         | 1.91          | 2.74        | 3.68         | 1.33          | 1.40        | 1.46         |
| 303.500      | 2.35          | 2.17        | 2.05         | 1.94          | 2.74        | 3.60         | 1.34          | 1.41        | 1.47         |
| 369.840      | 2.42          | 2.23        | 2.12         | 2.04          | 2.85        | 3.76         | 1.31          | 1.37        | 1.43         |
| 436.170      | 2.40          | 2.21        | 2.11         | 2.10          | 2.86        | 3.68         | 1.24          | 1.30        | 1.35         |
| 500.000      | 2.31          | 2.11        | 2.01         | 2.14          | 2.92        | 3.68         | 1.15          | 1.20        | 1.24         |
| 568.840      | 2.17          | 1.98        | 1.86         | 2.25          | 2.94        | 3.76         | 1.12          | 1.17        | 1.21         |
| 635.170      | 2.01          | 1.78        | 1.66         | 2.34          | 3.02        | 3.79         | 1.32          | 1.35        | 1.39         |
| 701.510      | 1.90          | 1.66        | 1.49         | 2.47          | 3.13        | 3.97         | 1.65          | 1.68        | 1.73         |
| 767.840      | 1.81          | 1.56        | 1.39         | 2.61          | 3.33        | 4.10         | 2.10          | 2.12        | 2.17         |
| 800.000      | 1.77          | 1.55        | 1.37         | 2.68          | 3.40        | 4.14         | 2.37          | 2.37        | 2.44         |
| 867.340      | 1.76          | 1.57        | 1.46         | 2.74          | 3.45        | 4.19         | 2.99          | 3.00        | 3.00         |
| 933.680      | 1.66          | 1.56        | 1.52         | 2.75          | 3.47        | 4.14         | 3.62          | 3.57        | 3.55         |
| 1000.000     | 1.43          | 1.41        | 1.41         | 2.72          | 3.30        | 4.04         | 4.13          | 4.05        | 3.96         |

Mini-Circuits

P.O. BOX 166, Brooklyn, New York 11235 (718) 934-4500

## mixer harmonic intermodulation

(relative to desired IF output)

| RF ORDER HARMONIC | RF CAL | 0  | 1  | 2  | 3  | 4  | 5   | 6   | 7   | 8  | 9   | 10  |
|-------------------|--------|----|----|----|----|----|-----|-----|-----|----|-----|-----|
| 0                 | >90    | -  | 36 | 27 | 43 | 47 | 37  | 49  | 32  | 60 | 48  | 64  |
| 1                 | >90    | 17 | -  | 37 | 16 | 37 | 33  | 42  | 35  | 50 | 57  | 59  |
| 2                 | 77     | 52 | 60 | 51 | 58 | 54 | 69  | 75  | 56  | 54 | 43  | 75  |
| 3                 | >90    | 46 | 39 | 51 | 38 | 47 | 39  | 46  | 48  | 51 | 47  | 54  |
| 4                 | >90    | 78 | 78 | 62 | 69 | 58 | 77  | 60  | 71  | 76 | 70  | 67  |
| 5                 | >90    | 77 | 77 | 68 | 52 | 60 | 47  | 59  | 46  | 61 | 68  | 63  |
| 6                 | >90    | 78 | 78 | 77 | 82 | 75 | 77  | 73  | >82 | 73 | 77  | 79  |
| 7                 | >90    | 78 | 79 | 77 | 77 | 75 | 71  | 69  | 65  | 65 | 60  | 66  |
| 8                 | >90    | 80 | 80 | 79 | 78 | 79 | >83 | 81  | >82 | 79 | >82 | 73  |
| 9                 | >90    | 79 | 78 | 78 | 78 | 79 | 79  | >83 | 77  | 74 | 67  | 72  |
| 10                | >90    | 79 | 79 | 80 | 79 | 79 | 79  | 78  | >83 | 84 | >82 | >82 |
|                   |        | 0  | 1  | 2  | 3  | 4  | 5   | 6   | 7   | 8  | 9   | 10  |

Harmonic LO Order

test conditions: RF=500.100 MHz INPUT P.<sub>1</sub> = -3.95DBM  
 LO=470.010 MHz INPUT P.<sub>2</sub> = +6.86DBM  
 IF=30.090MHz IF AMPLIT. = -10.56 DBM

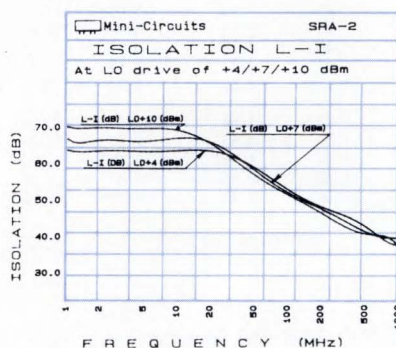
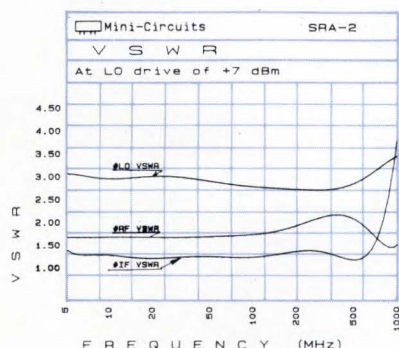
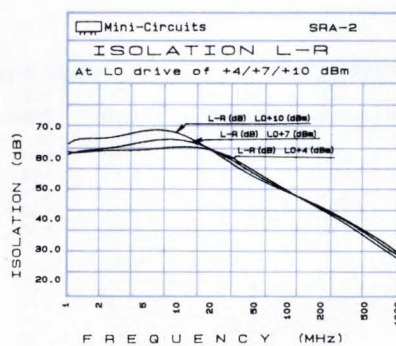
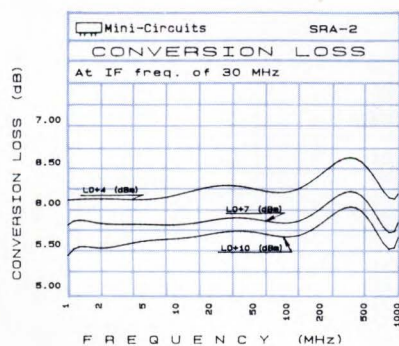
| RF ORDER HARMONIC | RF CAL | 0  | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  |
|-------------------|--------|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0                 | >80    | -  | 27  | 17  | 35  | 35  | 24  | 33  | 18  | 45  | 31  | 51  |
| 1                 | >80    | 18 | -   | 34  | 18  | 31  | 29  | 34  | 28  | 42  | 44  | 43  |
| 2                 | >80    | 57 | 61  | 52  | 61  | 53  | 66  | 68  | 64  | 56  | 45  | 67  |
| 3                 | >80    | 67 | 55  | 65  | 52  | 65  | 52  | 67  | 68  | 64  | 57  | 69  |
| 4                 | >80    | 68 | >74 | 73  | >72 | >72 | >72 | >72 | >74 | >73 | 68  | 68  |
| 5                 | >80    | 69 | 69  | >74 | >74 | >72 | >72 | >72 | >72 | >74 | >74 | 68  |
| 6                 | >80    | 68 | 69  | 68  | >74 | >74 | >72 | >72 | >72 | >72 | >74 | 73  |
| 7                 | >80    | 69 | 68  | 68  | 69  | 73  | >74 | >72 | >72 | >72 | >72 | >74 |
| 8                 | >80    | 68 | 69  | 69  | 69  | 68  | >74 | >74 | >72 | >72 | >72 | >72 |
| 9                 | >80    | 69 | 68  | 69  | 68  | 69  | 67  | >74 | >74 | >72 | >72 | >72 |
| 10                | >80    | 69 | 68  | 70  | 69  | 68  | 69  | 68  | >74 | >74 | >72 | >72 |
|                   |        | 0  | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  |

Harmonic LO Order

test conditions: RF=500.100 MHz INPUT P.<sub>1</sub> = -13.94DBM  
 LO=470.010 MHz INPUT P.<sub>2</sub> = +6.86DBM  
 IF=30.090 MHz IF AMPLIT. = -20.53 DBM

## typical performance curves

(production unit)





most widely-used

# Frequency Mixers **Models**

LEVEL 7 (+7 dBm LO, up to +1 dBm RF)

**SRA-11**  
**ZLW-11**  
**ZAD-11**



**computer-automated performance data**

typical production unit / for data of other models consult factory

## mixer conversion loss and isolation

| RF<br>MHz | LO<br>MHz | Conversion Loss<br>(dB) |             |              | Isolation L-R<br>(dB) |             |              | Isolation L-I<br>(dB) |             |              |
|-----------|-----------|-------------------------|-------------|--------------|-----------------------|-------------|--------------|-----------------------|-------------|--------------|
|           |           | LO<br>+4dBm             | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm           | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm           | LO<br>+7dBm | LO<br>+10dBm |
| 5.000     | 35.00     | 5.92                    | 5.85        | 5.80         | 46.33                 | 46.19       | 48.51        | > 64.00               | > 67.00     | > 70.00      |
| 10.000    | 40.00     | 6.02                    | 5.88        | 5.81         | 46.80                 | 46.23       | 48.89        | > 64.00               | > 67.00     | > 70.00      |
| 20.000    | 50.00     | 6.35                    | 6.11        | 5.99         | 46.84                 | 46.26       | 48.68        | > 64.00               | > 67.00     | > 70.00      |
| 50.000    | 80.00     | 6.61                    | 6.37        | 6.24         | 46.25                 | 45.89       | 47.69        | > 64.00               | > 67.00     | 69.02        |
| 100.000   | 70.00     | 6.49                    | 6.25        | 6.14         | 44.81                 | 44.70       | 45.68        | > 64.00               | 64.66       | 64.72        |
| 200.000   | 170.00    | 6.94                    | 6.62        | 6.39         | 41.62                 | 41.17       | 41.39        | 57.90                 | 55.90       | 54.53        |
| 311.920   | 281.92    | 7.16                    | 6.71        | 6.44         | 39.17                 | 38.72       | 38.07        | 50.53                 | 50.11       | 51.19        |
| 465.390   | 435.39    | 7.66                    | 7.06        | 6.64         | 36.28                 | 37.94       | 35.08        | 44.95                 | 46.15       | 47.44        |
| 618.850   | 588.85    | 7.95                    | 7.40        | 7.00         | 33.62                 | 38.38       | 32.75        | 43.83                 | 45.38       | 47.50        |
| 772.310   | 742.31    | 7.79                    | 7.53        | 7.35         | 33.55                 | 38.07       | 32.37        | 44.19                 | 45.67       | 46.26        |
| 849.040   | 819.04    | 7.49                    | 7.22        | 7.09         | 32.38                 | 37.13       | 31.82        | 42.69                 | 43.78       | 44.40        |
| 1000.000  | 970.00    | 7.28                    | 7.05        | 6.96         | 30.89                 | 36.28       | 29.71        | 37.21                 | 38.27       | 39.01        |
| 1156.000  | 1126.00   | 7.04                    | 6.76        | 6.66         | 31.61                 | 35.18       | 29.94        | 44.42                 | 43.23       | 41.99        |
| 1386.200  | 1356.20   | 8.05                    | 7.53        | 7.24         | 38.48                 | 41.65       | 36.24        | 41.70                 | 38.52       | 36.21        |
| 1462.900  | 1432.90   | 8.10                    | 7.62        | 7.34         | 41.17                 | 41.43       | 33.31        | 43.90                 | 41.57       | 39.61        |
| 1500.000  | 1470.00   | 7.94                    | 7.48        | 7.24         | 39.84                 | 41.94       | 35.06        | 44.76                 | 42.71       | 40.60        |
| 1616.400  | 1586.40   | 7.34                    | 6.96        | 6.78         | 38.73                 | 43.41       | 40.48        | 46.03                 | 43.97       | 43.05        |
| 1800.000  | 1770.00   | 7.07                    | 6.79        | 6.60         | 40.00                 | 41.03       | 41.30        | 40.95                 | 38.23       | 35.95        |
| 1923.300  | 1893.30   | 6.90                    | 6.64        | 6.51         | 39.95                 | 38.49       | 40.75        | 32.70                 | 30.27       | 28.57        |
| 2000.000  | 1970.00   | 6.99                    | 6.69        | 6.52         | 39.23                 | 39.35       | 39.94        | 29.79                 | 27.98       | 26.39        |

## mixer VSWR

| freq.<br>MHz | VSWR, RF port |             |              | VSWR, LO port |             |              | VSWR, IF port |             |              |
|--------------|---------------|-------------|--------------|---------------|-------------|--------------|---------------|-------------|--------------|
|              | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm |
| 5.001        | 3.06          | 3.19        | 3.19         | 2.29          | 3.03        | 4.59         | 3.11          | 3.21        | 3.24         |
| 10.000       | 2.54          | 2.54        | 2.51         | 1.90          | 2.69        | 4.03         | 1.90          | 2.08        | 2.20         |
| 50.000       | 2.48          | 2.45        | 2.43         | 1.81          | 2.70        | 4.02         | 1.55          | 1.79        | 1.93         |
| 100.000      | 2.64          | 2.62        | 2.58         | 1.81          | 2.61        | 3.85         | 1.48          | 1.68        | 1.81         |
| 200.000      | 3.00          | 2.96        | 2.92         | 1.83          | 2.46        | 3.45         | 1.38          | 1.55        | 1.67         |
| 300.560      | 3.25          | 3.21        | 3.17         | 1.83          | 2.31        | 3.19         | 1.34          | 1.49        | 1.59         |
| 374.450      | 3.42          | 3.31        | 3.28         | 1.86          | 2.27        | 3.05         | 1.38          | 1.52        | 1.62         |
| 500.000      | 3.40          | 3.42        | 3.37         | 1.76          | 2.13        | 2.75         | 1.53          | 1.67        | 1.76         |
| 670.000      | 3.25          | 3.19        | 3.18         | 1.70          | 2.08        | 2.48         | 1.90          | 2.08        | 2.17         |
| 817.780      | 3.00          | 2.96        | 2.93         | 1.81          | 1.93        | 2.27         | 2.30          | 2.56        | 2.66         |
| 1000.000     | 2.50          | 2.41        | 2.35         | 1.83          | 1.73        | 1.98         | 3.00          | 3.20        | 3.35         |
| 1100.000     | 2.24          | 2.10        | 2.01         | 1.79          | 1.58        | 1.78         | 3.90          | 4.07        | 4.20         |
| 1200.000     | 2.05          | 1.86        | 1.73         | 1.63          | 1.45        | 1.64         | 4.72          | 4.75        | 4.91         |
| 1408.900     | 2.28          | 2.12        | 2.02         | 1.41          | 1.17        | 1.47         | 4.12          | 4.12        | 4.14         |
| 1500.000     | 2.44          | 2.27        | 2.12         | 1.25          | 1.17        | 1.52         | 9.74          | 9.63        | 9.79         |
| 1630.600     | 2.32          | 2.19        | 2.06         | 1.15          | 1.32        | 1.68         | 13.39         | 13.09       | 13.29        |
| 1704.400     | 2.22          | 2.08        | 2.00         | 1.11          | 1.39        | 1.83         | 12.71         | 12.26       | 12.44        |
| 1852.200     | 1.97          | 1.87        | 1.81         | 1.18          | 1.59        | 1.99         | 10.96         | 11.10       | 10.89        |
| 1926.100     | 1.85          | 1.79        | 1.72         | 1.26          | 1.70        | 2.16         | 10.31         | 9.90        | 9.79         |
| 2000.000     | 1.77          | 1.67        | 1.62         | 1.33          | 1.74        | 2.14         | 9.23          | 8.72        | 8.72         |

**Mini-Circuits**

P.O. BOX 166, Brooklyn, New York 11235 (718) 934-4500

## mixer harmonic intermodulation

(relative to desired IF output)

| RF ORDER HARMONIC | RF CAL |     |     |     |     |     |     |     |     |     |     |
|-------------------|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|                   | 0      | -   | -   | 14  | 34  | 23  | 48  | 33  | 57  | 44  | 60  |
| 0                 | -      | -   | -   | 14  | 34  | 23  | 48  | 33  | 57  | 44  | 60  |
| 1                 | -      | 16  | -   | 29  | 23  | 36  | 36  | 37  | 52  | 58  | 49  |
| 2                 | 94     | 61  | 54  | 61  | 44  | 66  | 49  | 69  | 48  | 63  | 55  |
| 3                 | >94    | 68  | 44  | 66  | 38  | 53  | 51  | 66  | 53  | 51  | 62  |
| 4                 | 93     | >84 | 72  | 75  | 65  | 82  | 57  | 75  | 60  | 80  | 61  |
| 5                 | >95    | 82  | 80  | 82  | 65  | >84 | 56  | 70  | 70  | 75  | 65  |
| 6                 | >90    | >77 | >83 | >84 | 77  | >83 | 74  | >84 | 66  | >83 | 68  |
| 7                 | 89     | >77 | >77 | >84 | >84 | >84 | 80  | >84 | 69  | 79  | >85 |
| 8                 | >89    | >78 | >78 | >77 | >85 | >86 | >83 | >84 | >84 | >84 | 75  |
| 9                 | >89    | 78  | >79 | >78 | >77 | >84 | >83 | >84 | >84 | >84 | 81  |
| 10                | 89     | >79 | >78 | >76 | >79 | >77 | >83 | >83 | >83 | >82 | >84 |
|                   | 0      | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  |

Harmonic LO Order

test conditions: RF.=IN: FREQ. 1000.1 MHZ DRIVE -4 DBM TESTED ON :16.10.84  
 LO.=IN: FREQ. 970.01 MHZ DRIVE +6.97 DBM TESTED BY :D.E.  
 IF=MEASURED: FREQ. 30.09 AMP. -11.21 DBM

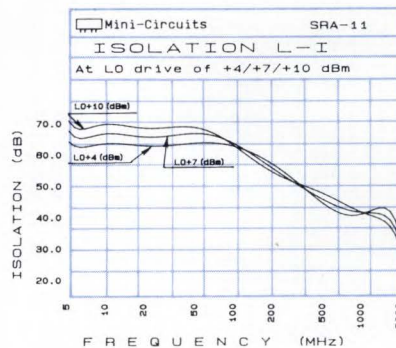
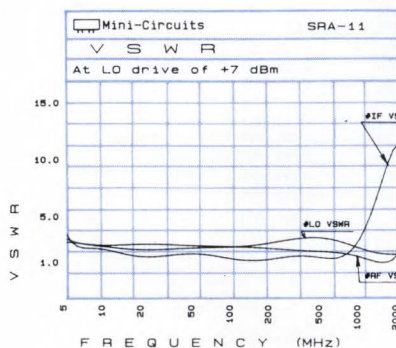
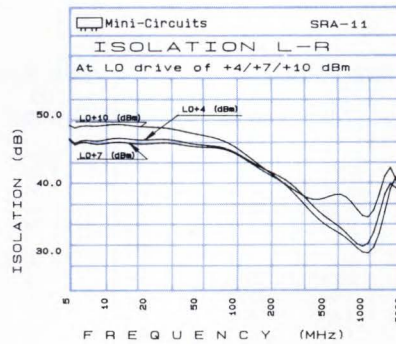
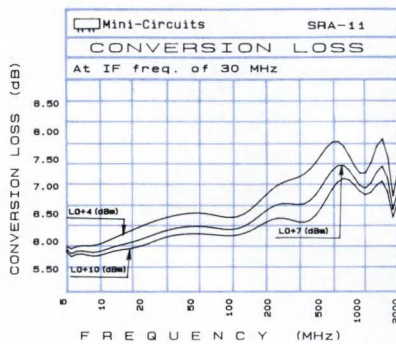
| RF ORDER HARMONIC | RF CAL |     |     |     |     |     |     |     |     |     |     |
|-------------------|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|                   | 0      | -   | -   | 4   | 24  | 13  | 37  | 21  | 38  | 33  | 40  |
| 0                 | -      | -   | -   | 4   | 24  | 13  | 37  | 21  | 38  | 33  | 40  |
| 1                 | -      | 16  | -   | 29  | 23  | 36  | 34  | 33  | 48  | 52  | 40  |
| 2                 | >94    | 66  | 66  | 68  | 52  | 70  | 53  | >73 | 53  | 65  | 58  |
| 3                 | >94    | >73 | 64  | >73 | 57  | 71  | 69  | >73 | 67  | 67  | 74  |
| 4                 | >95    | >74 | >73 | >73 | 74  | >75 | >74 | >73 | >73 | >75 | >74 |
| 5                 | >95    | >74 | >73 | >74 | >73 | >74 | >74 | >74 | >73 | >73 | >75 |
| 6                 | >89    | >69 | >75 | >74 | >74 | >73 | >74 | >75 | >74 | >74 | >74 |
| 7                 | >89    | >66 | >67 | >74 | >75 | >75 | >74 | >75 | >74 | >74 | >73 |
| 8                 | >90    | >67 | >67 | >68 | >74 | >74 | >72 | >73 | >74 | >74 | >73 |
| 9                 | >89    | >67 | >70 | 67  | >68 | >74 | >74 | >73 | >73 | >74 | >74 |
| 10                | >88    | >68 | 68  | >68 | >67 | >68 | >73 | >74 | >74 | >73 | >74 |
|                   | 0      | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  |

Harmonic LO Order

test conditions: RF.=IN: FREQ. 1000.1 MHZ DRIVE -14.01 DBM  
 TESTED ON :15.10.84  
 LO.=IN: FREQ. 970.01 MHZ DRIVE +6.94 DBM TESTED BY :D.E.  
 IF=MEASURED: FREQ. 30.09 AMP. -21.27 DBM

## typical performance curves

(production unit)





most widely-used

# Frequency Mixers

LEVEL 7 (+7 dBm LO, up to +1 dBm RF)

## Models

SRA-2000  
ZFM-2000



computer-automated performance data  
typical production unit / for data of other models consult factory

## mixer conversion loss and isolation

| RF<br>MHz | LO<br>MHz | Conversion Loss<br>(dB) |             |              | Isolation L-R<br>(dB) |             |              | Isolation L-I<br>(dB) |             |              |
|-----------|-----------|-------------------------|-------------|--------------|-----------------------|-------------|--------------|-----------------------|-------------|--------------|
|           |           | LO<br>+4dBm             | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm           | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm           | LO<br>+7dBm | LO<br>+10dBm |
| 100.000   | 70.00     | 9.75                    | 9.45        | 9.21         | 55.86                 | 56.94       | 57.94        | 52.95                 | 55.05       | 55.35        |
| 163.330   | 133.33    | 8.22                    | 7.92        | 7.75         | 50.50                 | 51.21       | 52.34        | 49.70                 | 49.66       | 50.37        |
| 200.000   | 170.00    | 8.09                    | 7.75        | 7.56         | 49.54                 | 50.54       | 51.46        | 48.64                 | 48.68       | 49.39        |
| 290.000   | 260.00    | 8.16                    | 7.71        | 7.42         | 44.50                 | 44.91       | 45.60        | 40.82                 | 39.11       | 37.96        |
| 416.670   | 386.67    | 9.02                    | 8.09        | 7.69         | 43.16                 | 42.91       | 43.02        | 36.51                 | 35.05       | 34.05        |
|           |           |                         |             |              |                       |             |              |                       |             |              |
| 500.000   | 470.00    | 8.58                    | 7.87        | 7.53         | 39.99                 | 39.28       | 39.16        | 31.52                 | 30.43       | 29.68        |
| 606.660   | 576.66    | 8.64                    | 7.96        | 7.64         | 38.76                 | 37.70       | 37.00        | 31.01                 | 29.62       | 28.64        |
| 733.330   | 703.33    | 8.53                    | 8.16        | 8.00         | 35.70                 | 35.16       | 34.63        | 29.03                 | 27.84       | 26.89        |
| 800.000   | 770.00    | 8.27                    | 7.98        | 7.88         | 33.74                 | 33.65       | 33.57        | 27.31                 | 26.31       | 25.52        |
| 923.330   | 893.33    | 8.11                    | 7.81        | 7.70         | 33.23                 | 33.12       | 32.93        | 28.72                 | 27.64       | 26.75        |
|           |           |                         |             |              |                       |             |              |                       |             |              |
| 1050.000  | 1020.00   | 8.10                    | 7.72        | 7.59         | 34.07                 | 33.89       | 33.73        | 35.03                 | 34.13       | 33.42        |
| 1113.300  | 1083.30   | 8.28                    | 7.82        | 7.67         | 34.19                 | 34.02       | 33.88        | 36.03                 | 35.20       | 34.51        |
| 1200.000  | 1170.00   | 8.87                    | 8.21        | 7.97         | 33.84                 | 33.77       | 33.74        | 37.65                 | 37.17       | 36.68        |
| 1303.300  | 1273.30   | 9.07                    | 8.26        | 7.95         | 34.83                 | 34.66       | 34.47        | 41.58                 | 41.70       | 41.66        |
| 1430.000  | 1400.00   | 8.90                    | 8.17        | 7.93         | 35.26                 | 35.08       | 34.26        | 41.21                 | 41.84       | 41.80        |
|           |           |                         |             |              |                       |             |              |                       |             |              |
| 1556.700  | 1526.70   | 8.94                    | 8.39        | 8.14         | 36.16                 | 36.24       | 36.09        | 36.84                 | 36.92       | 36.75        |
| 1683.300  | 1653.30   | 8.68                    | 8.22        | 8.00         | 37.49                 | 37.59       | 37.79        | 35.41                 | 35.44       | 35.38        |
| 1800.000  | 1770.00   | 8.43                    | 7.97        | 7.81         | 41.38                 | 41.52       | 41.54        | 34.18                 | 34.28       | 34.31        |
| 1873.300  | 1843.30   | 8.30                    | 7.81        | 7.67         | 41.19                 | 42.79       | 43.94        | 30.58                 | 31.15       | 31.65        |
| 2000.000  | 1970.00   | 8.04                    | 7.67        | 7.55         | 40.54                 | 41.62       | 42.18        | 27.49                 | 27.96       | 28.40        |

## mixer VSWR

## $\phi$ detection

| freq.<br>MHz | VSWR, RF port |             |              | VSWR, LO port |             |              | VSWR, IF port |             |              | max. output/DC offset vs. freq. |                      |                 |       |
|--------------|---------------|-------------|--------------|---------------|-------------|--------------|---------------|-------------|--------------|---------------------------------|----------------------|-----------------|-------|
|              | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | Freq.<br>(MHz)                  | max. DC<br>output mV | DC offset<br>mV |       |
| 100.000      | 4.07          | 4.28        | 4.69         | 1.69          | 2.39        | 3.52         | 1.39          | 1.66        | 1.80         | 100.000                         | +147.31              | + .16           |       |
| 161.290      | 4.07          | 4.10        | 4.48         | 1.76          | 2.47        | 3.31         | 1.34          | 1.55        | 1.69         | 132.110                         | +171.16              | + .15           |       |
| 200.000      | 4.42          | 4.26        | 4.62         | 1.76          | 2.41        | 3.30         | 1.34          | 1.54        | 1.70         | 164.210                         | +185.12              | + .16           |       |
| 283.870      | 4.45          | 4.09        | 4.37         | 1.73          | 2.31        | 3.07         | 1.34          | 1.55        | 1.67         | 200.000                         | +198.64              | + .15           |       |
| 345.160      | 4.72          | 4.36        | 4.45         | 1.76          | 2.28        | 2.98         | 1.38          | 1.58        | 1.72         | 260.540                         | +207.88              | + .07           |       |
|              |               |             |              |               |             |              |               |             |              |                                 |                      |                 |       |
| 406.450      | 4.43          | 4.06        | 4.14         | 1.77          | 2.27        | 2.88         | 1.46          | 1.65        | 1.77         | 324.750                         | +206.93              | — .01           |       |
| 500.000      | 4.30          | 3.75        | 3.82         | 1.74          | 2.04        | 2.81         | 1.65          | 1.84        | 2.02         | 388.960                         | +204.56              | — .07           |       |
| 590.320      | 3.71          | 3.40        | 3.52         | 1.73          | 1.99        | 2.53         | 1.94          | 2.15        | 2.34         | 421.070                         | +208.08              | — .41           |       |
| 712.900      | 3.32          | 2.84        | 3.00         | 1.80          | 1.91        | 2.35         | 2.48          | 2.77        | 3.03         | 500.000                         | +218.54              | — .21           |       |
| 835.480      | 3.07          | 2.60        | 2.66         | 1.93          | 1.83        | 2.19         | 3.39          | 3.70        | 4.14         | 613.710                         | +205.71              | — .14           |       |
|              |               |             |              |               |             |              |               |             |              |                                 |                      |                 |       |
| 958.060      | 2.92          | 2.44        | 2.45         | 1.92          | 1.70        | 2.00         | 4.70          | 5.30        | 5.75         | 710.030                         | +218.39              | + .06           |       |
| 1019.400     | 2.89          | 2.39        | 2.39         | 1.94          | 1.65        | 1.89         | 5.27          | 5.93        | 6.35         | 838.460                         | +225.82              | + .08           |       |
| 1100.000     | 2.89          | 2.55        | 2.44         | 1.98          | 1.55        | 1.71         | 6.09          | 5.97        | 6.51         | 934.780                         | +233.68              | — .28           |       |
| 1203.200     | 3.09          | 2.65        | 2.51         | 1.85          | 1.40        | 1.49         | 7.11          | 7.05        | 7.83         | 1000.000                        | +238.90              | — .16           |       |
| 1325.800     | 3.37          | 2.86        | 2.79         | 1.63          | 1.27        | 1.44         | 15.13         | 14.74       | 17.39        | 1100.000                        | +233.02              | + .25           |       |
|              |               |             |              |               |             |              |               |             |              |                                 |                      |                 |       |
| 1500.000     | 3.65          | 3.06        | 3.00         | 1.42          | 1.06        | 1.45         | 17.39         | 17.39       | 17.39        | 1200.000                        | +224.34              | + .10           |       |
| 1632.300     | 3.49          | 2.98        | 2.94         | 1.26          | 1.15        | 1.57         | 17.39         | 16.72       | 17.39        | 1300.000                        | +221.16              | +5.03           |       |
| 1754.800     | 3.34          | 2.92        | 2.84         | 1.11          | 1.26        | 1.67         | 13.92         | 11.61       | 15.00        | 1400.000                        | +214.63              | +3.73           |       |
| 1877.400     | 3.15          | 2.75        | 2.77         | 1.03          | 1.37        | 1.77         | 8.05          | 7.47        | 7.97         | 1500.000                        | +216.50              | +1.92           |       |
| 2000.000     | 3.02          | 2.69        | 2.72         | 1.11          | 1.40        | 1.80         | 4.74          | 4.38        | 4.41         | 1800.000                        | +215.48              | +1.60           |       |
|              |               |             |              |               |             |              |               |             |              |                                 | 2000.000             | +201.13         | +1.94 |

Measurements at RF & LO Power +7 dBm

**Mini-Circuits**

P.O. BOX 166, Brooklyn, New York 11235 (718) 934-4500

## mixer harmonic intermodulation

(relative to desired IF output)

| RF ORDER HARMONIC | RF CAL |     |     |     |     |     |     |     |     |     |     |
|-------------------|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|                   | 0      | -   | -   | 11  | 34  | 26  | 53  | 47  | 66  | 62  | 69  |
| 0                 | -      | -   | -   | 11  | 34  | 26  | 53  | 47  | 66  | 62  | 69  |
| 1                 | -      | 12  | -   | 29  | 17  | 38  | 43  | 35  | 54  | 56  | 59  |
| 2                 | 94     | 65  | 52  | 62  | 58  | 64  | 52  | 69  | 63  | 82  | 69  |
| 3                 | >94    | 53  | 43  | 52  | 43  | 52  | 50  | 65  | 67  | 48  | 62  |
| 4                 | 92     | 83  | 79  | >82 | 78  | 82  | 83  | 82  | 70  | >85 | 81  |
| 5                 | >95    | 77  | >84 | 74  | 65  | 74  | 60  | 67  | 64  | 70  | >83 |
| 6                 | >89    | >77 | >84 | >85 | >84 | >82 | >84 | >84 | >84 | >84 | >82 |
| 7                 | >88    | >77 | >78 | >83 | >84 | >83 | 78  | >84 | 72  | 78  | 78  |
| 8                 | >90    | >77 | >77 | >77 | >85 | >85 | >84 | >82 | >83 | >85 | >85 |
| 9                 | >88    | >77 | >79 | >77 | >76 | >85 | >82 | >83 | >82 | >83 | >84 |
| 10                | >88    | >77 | >77 | 81  | >78 | >78 | >84 | >83 | >84 | >81 | >84 |
|                   | 0      | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  |

Harmonics LO Order

test conditions: RF.=IN: FREQ. 1000.1 MHz DRIVE -3.99 DBM TESTED ON :15.10.84  
 LO.=IN: FREQ. 970.01 MHz DRIVE +7.03 DBM TESTED BY :D.E.  
 IF=MEASURED: FREQ. 30.09 AMP. = -11.78 DBM

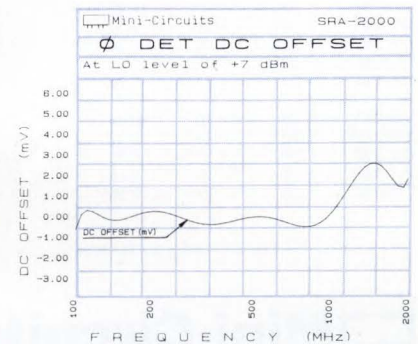
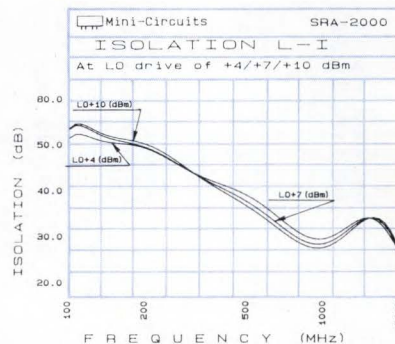
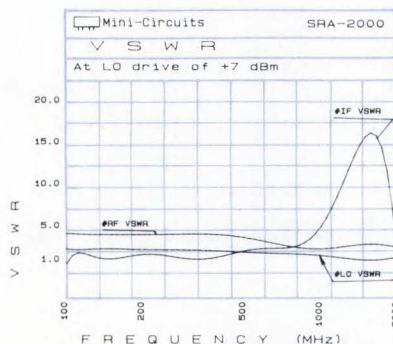
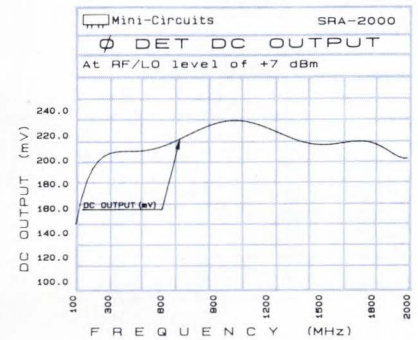
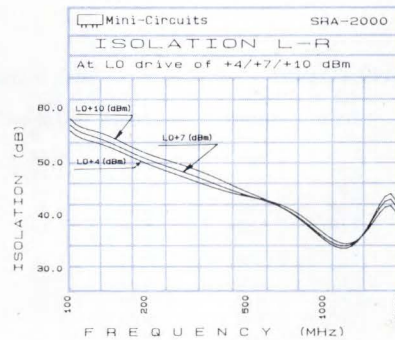
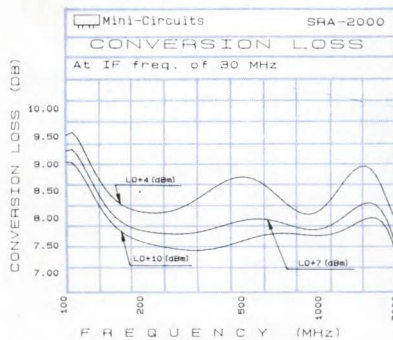
| RF ORDER HARMONIC | RF CAL |     |     |     |     |     |     |     |     |     |     |
|-------------------|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|                   | 0      | -   | -   | 1   | 24  | 16  | 41  | 34  | 53  | 45  | 58  |
| 0                 | -      | -   | -   | 1   | 24  | 16  | 41  | 34  | 53  | 45  | 58  |
| 1                 | -      | 12  | -   | 28  | 17  | 37  | 42  | 30  | 50  | 49  | 48  |
| 2                 | >94    | 70  | 62  | 69  | 67  | 70  | 58  | 73  | 69  | >73 | >66 |
| 3                 | >94    | 70  | 60  | 68  | 60  | 70  | 65  | >73 | >74 | 63  | >72 |
| 4                 | >95    | >73 | >73 | >72 | >74 | >73 | >74 | >72 | >73 | >73 | >73 |
| 5                 | >95    | >74 | >73 | >73 | >72 | >74 | >75 | >74 | >74 | >72 | >73 |
| 6                 | >89    | 66  | >74 | >74 | >74 | >73 | >74 | >74 | 74  | >72 | >74 |
| 7                 | >89    | >66 | >67 | >73 | 75  | >74 | >73 | >72 | >73 | >74 | >74 |
| 8                 | >90    | >67 | >68 | >67 | >73 | >73 | >73 | >73 | >73 | >74 | >74 |
| 9                 | >89    | >68 | >67 | >68 | >67 | >73 | >74 | >73 | >73 | >73 | >73 |
| 10                | >88    | >68 | >67 | >68 | >69 | 67  | >72 | >72 | >73 | >74 | >73 |
|                   | 0      | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  |

Harmonics LO Order

test conditions: RF.=IN: FREQ. 1000.1 MHz DRIVE -14.01 DBM  
 TESTED ON :15.10.84  
 LO.=IN: FREQ. 970.01 MHz DRIVE +6.94 DBM  
 TESTED BY :D.E.  
 IF=MEASURED: FREQ. 30.09 AMP. = -21.81 DBM

## typical performance curves

(production unit)





most widely-used

# Frequency Mixers

**Models**

**SBL-1**

LEVEL 7 (+7 dBm LO, up to +1 dBm RF)



**computer-automated performance data**

typical production unit / for data of other models consult factory

## mixer conversion loss and isolation

| RF<br>MHz | LO<br>MHz | Conversion Loss<br>(dB) |             |              | Isolation L-R<br>(dB) |             |              | Isolation L-I<br>(dB) |             |              |
|-----------|-----------|-------------------------|-------------|--------------|-----------------------|-------------|--------------|-----------------------|-------------|--------------|
|           |           | LO<br>+4dBm             | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm           | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm           | LO<br>+7dBm | LO<br>+10dBm |
| 1.000     | 31.00     | 6.99                    | 6.67        | 6.45         | 62.73                 | > 67.00     | 68.01        | 61.88                 | 65.61       | > 70.00      |
| 2.000     | 32.00     | 6.50                    | 6.24        | 6.05         | 61.86                 | > 67.00     | 67.46        | 61.93                 | > 67.00     | > 70.00      |
| 5.000     | 35.00     | 5.96                    | 5.74        | 5.60         | 61.73                 | 64.84       | 66.12        | 62.43                 | > 67.00     | > 70.00      |
| 10.000    | 40.00     | 5.85                    | 5.58        | 5.46         | 61.35                 | 64.19       | 65.15        | 61.72                 | 64.81       | 66.04        |
| 20.000    | 50.00     | 5.96                    | 5.67        | 5.51         | 60.14                 | 62.22       | 62.01        | 60.33                 | 61.69       | 61.30        |
| 32.188    | 62.19     | 5.86                    | 5.60        | 5.51         | 58.85                 | 59.04       | 58.99        | 58.27                 | 57.74       | 57.09        |
| 50.000    | 80.00     | 5.84                    | 5.60        | 5.49         | 56.98                 | 56.71       | 55.75        | 54.84                 | 54.39       | 53.61        |
| 78.970    | 48.97     | 5.83                    | 5.56        | 5.44         | 54.05                 | 52.21       | 50.75        | 51.16                 | 49.67       | 48.53        |
| 100.000   | 70.00     | 5.74                    | 5.52        | 5.43         | 51.39                 | 49.41       | 48.33        | 48.54                 | 46.90       | 46.10        |
| 156.940   | 126.94    | 5.69                    | 5.53        | 5.47         | 45.18                 | 44.20       | 43.99        | 42.22                 | 41.66       | 41.56        |
| 200.000   | 170.00    | 5.85                    | 5.68        | 5.60         | 41.88                 | 41.56       | 41.75        | 39.00                 | 38.98       | 39.65        |
| 203.720   | 173.72    | 5.83                    | 5.67        | 5.56         | 41.46                 | 41.05       | 41.34        | 38.60                 | 38.52       | 39.23        |
| 250.500   | 220.50    | 5.80                    | 5.63        | 5.47         | 40.14                 | 40.04       | 40.21        | 37.21                 | 37.29       | 37.77        |
| 297.290   | 267.29    | 5.77                    | 5.61        | 5.48         | 36.89                 | 36.90       | 37.90        | 33.86                 | 33.97       | 34.98        |
| 344.070   | 314.07    | 5.93                    | 5.81        | 5.72         | 36.80                 | 37.11       | 37.44        | 33.43                 | 33.88       | 34.36        |
| 375.260   | 345.26    | 6.28                    | 6.13        | 5.97         | 34.83                 | 36.02       | 37.25        | 31.69                 | 32.79       | 34.20        |
| 406.440   | 376.44    | 6.27                    | 6.15        | 6.07         | 33.09                 | 34.80       | 36.66        | 29.68                 | 31.05       | 32.79        |
| 437.630   | 407.63    | 6.38                    | 6.08        | 5.88         | 32.48                 | 33.79       | 35.38        | 29.38                 | 30.39       | 31.81        |
| 468.820   | 438.82    | 6.48                    | 6.00        | 5.73         | 32.24                 | 32.80       | 34.05        | 29.76                 | 30.12       | 30.96        |
| 500.000   | 470.00    | 6.90                    | 6.31        | 5.99         | 32.48                 | 32.36       | 33.04        | 30.19                 | 30.37       | 30.65        |

## mixer VSWR

φ detection

| freq.<br>MHz | VSWR, RF port |             |              | VSWR, LO port |             |              | VSWR, IF port |             |              | max. output/DC offset vs. freq. |                      |                 |
|--------------|---------------|-------------|--------------|---------------|-------------|--------------|---------------|-------------|--------------|---------------------------------|----------------------|-----------------|
|              | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | Freq.<br>(MHz)                  | max. DC<br>output mV | DC offset<br>mV |
| 1.004        | 1.83          | 1.80        | 1.86         | 2.45          | 3.75        | 5.47         | 1.67          | 1.44        | 1.30         | 10.000                          | -233.19              | +0.00           |
| 16.121       | 1.07          | 1.14        | 1.20         | 1.92          | 2.81        | 3.95         | 1.68          | 1.45        | 1.31         | 20.000                          | -230.80              | -.01            |
| 20.000       | 1.06          | 1.14        | 1.20         | 1.94          | 2.89        | 3.95         | 1.68          | 1.44        | 1.31         | 38.000                          | -225.55              | +0.00           |
| 31.242       | 1.06          | 1.14        | 1.20         | 1.93          | 2.83        | 3.88         | 1.68          | 1.44        | 1.32         | 50.000                          | -225.92              | +0.00           |
| 50.000       | 1.07          | 1.15        | 1.20         | 1.83          | 2.69        | 3.54         | 1.69          | 1.46        | 1.33         | 66.000                          | -226.43              | +0.00           |
| 76.605       | 1.08          | 1.16        | 1.21         | 1.84          | 2.72        | 3.70         | 1.71          | 1.48        | 1.36         | 80.000                          | -230.22              | + .01           |
| 100.000      | 1.09          | 1.17        | 1.22         | 1.82          | 2.62        | 3.38         | 1.74          | 1.52        | 1.39         | 100.000                         | -231.28              | + .03           |
| 121.970      | 1.11          | 1.18        | 1.24         | 1.82          | 2.62        | 3.53         | 1.79          | 1.55        | 1.42         | 136.000                         | -229.89              | + .08           |
| 152.210      | 1.13          | 1.20        | 1.25         | 1.88          | 2.66        | 3.42         | 1.85          | 1.62        | 1.50         | 178.000                         | -223.93              | + .17           |
| 182.450      | 1.15          | 1.22        | 1.27         | 1.83          | 2.62        | 3.21         | 1.93          | 1.69        | 1.57         | 200.000                         | -223.43              | + .15           |
| 200.000      | 1.12          | 1.26        | 1.27         | 1.87          | 2.58        | 3.22         | 1.98          | 1.77        | 1.62         | 234.000                         | -223.86              | + .23           |
| 242.940      | 1.19          | 1.26        | 1.32         | 1.89          | 2.56        | 3.19         | 2.11          | 1.88        | 1.74         | 262.000                         | -229.61              | + .25           |
| 273.180      | 1.21          | 1.28        | 1.34         | 1.90          | 2.59        | 3.17         | 2.21          | 1.99        | 1.86         | 304.000                         | -218.66              | + .32           |
| 318.540      | 1.23          | 1.30        | 1.35         | 1.99          | 2.64        | 3.25         | 2.35          | 2.11        | 1.95         | 360.000                         | -194.91              | + .72           |
| 348.780      | 1.24          | 1.31        | 1.36         | 2.01          | 2.59        | 3.18         | 2.38          | 2.15        | 2.03         | 402.000                         | -179.58              | + .97           |
| 379.030      | 1.24          | 1.30        | 1.34         | 2.03          | 2.60        | 3.15         | 2.45          | 2.24        | 2.09         | 444.000                         | -163.75              | + .88           |
| 409.270      | 1.23          | 1.28        | 1.32         | 2.12          | 2.72        | 3.19         | 2.46          | 2.24        | 2.11         | 458.000                         | -160.12              | + .78           |
| 424.390      | 1.21          | 1.27        | 1.31         | 2.20          | 2.77        | 3.27         | 2.50          | 2.30        | 2.16         | 472.000                         | -155.46              | + .60           |
| 454.630      | 1.19          | 1.24        | 1.28         | 2.30          | 2.82        | 3.34         | 2.46          | 2.32        | 2.14         | 486.000                         | -150.45              | + .39           |
| 500.000      | 1.16          | 1.21        | 1.25         | 2.40          | 3.01        | 3.54         | 2.43          | 2.23        | 2.12         | 500.000                         | -142.53              | + .23           |

Measurements at RF & LO Power +7 dBm

**Mini-Circuits**

P.O. BOX 166, Brooklyn, New York 11235 (718) 934-4500

## mixer harmonic intermodulation

(relative to desired IF output)

| RF ORDER HARMONIC | RF CAL | 0   | 1  | 2   | 3  | 4   | 5  | 6   | 7   | 8   | 9  | 10  |
|-------------------|--------|-----|----|-----|----|-----|----|-----|-----|-----|----|-----|
| 0                 | >93    | -   | 45 | 50  | 36 | 56  | 49 | 65  | 47  | 66  | 52 | 68  |
| 1                 | >93    | 25  | -  | 39  | 12 | 47  | 22 | 46  | 29  | 49  | 55 | 62  |
| 2                 | 74     | 62  | 55 | 71  | 60 | 69  | 53 | 72  | 61  | 71  | 54 | 75  |
| 3                 | 81     | 44  | 33 | 49  | 35 | 59  | 36 | 60  | 36  | 64  | 37 | 51  |
| 4                 | >93    | 80  | 70 | 66  | 58 | 75  | 62 | 79  | 59  | 78  | 69 | 76  |
| 5                 | >93    | 61  | 46 | 62  | 50 | 59  | 60 | 63  | 67  | 66  | 53 | 65  |
| 6                 | >93    | 88  | 78 | 78  | 74 | 75  | 69 | 75  | 70  | 78  | 66 | 76  |
| 7                 | >93    | 81  | 64 | 67  | 63 | 73  | 56 | 71  | 55  | 78  | 55 | 69  |
| 8                 | >93    | >88 | 84 | 88  | 84 | >86 | 83 | >86 | 76  | 81  | 78 | 81  |
| 9                 | 93     | 82  | 83 | 83  | 75 | 79  | 67 | 75  | 64  | 84  | 60 | 77  |
| 10                | 93     | >87 | 87 | >87 | 86 | >88 | 86 | >86 | >86 | >86 | 81 | >86 |
|                   |        | 0   | 1  | 2   | 3  | 4   | 5  | 6   | 7   | 8   | 9  | 10  |
| Harmonic LO Order |        |     |    |     |    |     |    |     |     |     |    |     |

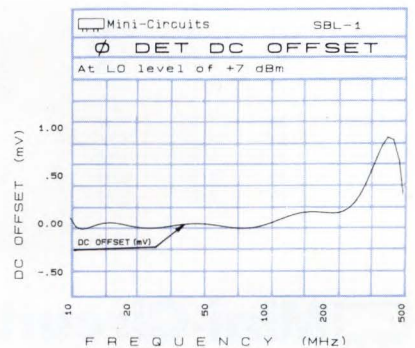
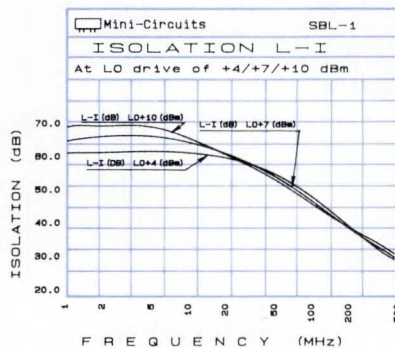
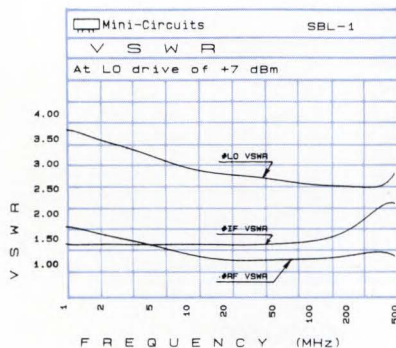
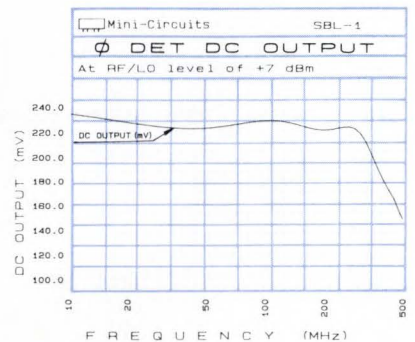
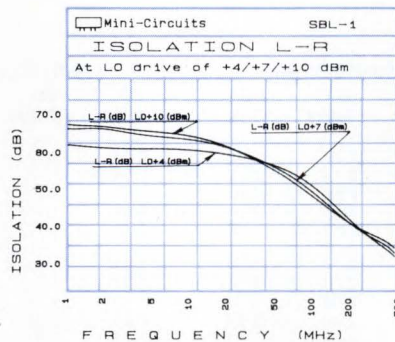
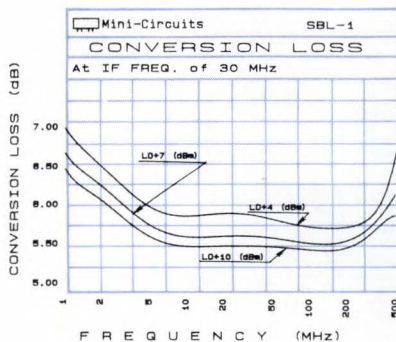
test conditions: RF=185.100 MHz INPUT P.=+0.00DBM  
LO=155.010 MHz INPUT P.=+6.92DBM  
IF=30.090 MHz IF AMPLIT.=-6.11 DBM

| RF ORDER HARMONIC | RF CAL | 0   | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  |
|-------------------|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0                 | >84    | -   | 36  | 38  | 24  | 41  | 35  | 45  | 30  | 52  | 31  | 52  |
| 1                 | >84    | 25  | -   | 38  | 12  | 50  | 19  | 41  | 21  | 37  | 40  | 47  |
| 2                 | 82     | 63  | 55  | 68  | 54  | 66  | 52  | 64  | 52  | 66  | 54  | 74  |
| 3                 | >84    | 66  | 53  | 66  | 58  | 71  | 55  | 75  | 52  | 65  | 54  | 73  |
| 4                 | >84    | >76 | 75  | >76 | 75  | >77 | 76  | >77 | 75  | >76 | 74  | >76 |
| 5                 | >84    | >76 | >76 | >76 | >76 | >76 | >77 | >77 | 73  | >76 | 71  | >76 |
| 6                 | >84    | >78 | >76 | >76 | >76 | >76 | >76 | >77 | >77 | >77 | >76 | >76 |
| 7                 | >84    | >78 | >78 | >76 | >76 | >76 | >76 | >76 | >77 | >77 | >77 | >76 |
| 8                 | >84    | >78 | >78 | >78 | >78 | >76 | >76 | >76 | >76 | >77 | >77 | >77 |
| 9                 | >84    | >78 | >78 | >78 | >78 | >78 | >76 | >76 | >76 | >76 | >76 | >77 |
| 10                | >83    | >77 | 78  | >78 | >78 | >78 | >78 | >76 | >76 | >76 | >76 | >76 |
|                   |        | 0   | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  |
| Harmonic LO Order |        |     |     |     |     |     |     |     |     |     |     |     |

test conditions: RF=185.100 MHz INPUT P.= -10.03DBM  
LO=155.010 MHz INPUT P.=+6.92DBM  
IF=30.090 MHz IF AMPLIT.=-15.84 DBM

## typical performance curves

(production unit)





most widely-used

# Frequency Mixers

**Models**

LEVEL 7 (+7 dBm LO, up to +1 dBm RF)

**SBL-1X**



**computer-automated performance data**

typical production unit / for data of other models consult factory

## mixer conversion loss and isolation

| RF<br>MHz | LO<br>MHz | Conversion Loss<br>(dB) |             |              | Isolation L-R<br>(dB) |             |              | Isolation L-I<br>(dB) |             |              |
|-----------|-----------|-------------------------|-------------|--------------|-----------------------|-------------|--------------|-----------------------|-------------|--------------|
|           |           | LO<br>+4dBm             | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm           | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm           | LO<br>+7dBm | LO<br>+10dBm |
| 10.000    | 40.00     | 6.29                    | 5.91        | 5.70         | 50.68                 | 52.58       | 54.27        | 55.71                 | 57.65       | 58.94        |
| 20.000    | 50.00     | 6.55                    | 6.07        | 5.85         | 50.33                 | 51.57       | 52.78        | 55.05                 | 56.10       | 56.31        |
| 50.000    | 80.00     | 6.34                    | 5.97        | 5.76         | 48.45                 | 48.88       | 48.88        | 51.91                 | 51.40       | 50.84        |
| 100.000   | 70.00     | 6.32                    | 6.02        | 5.79         | 45.57                 | 44.82       | 44.29        | 47.39                 | 46.42       | 45.36        |
| 160.320   | 130.32    | 6.46                    | 6.05        | 5.84         | 42.61                 | 42.05       | 41.40        | 43.63                 | 42.49       | 41.59        |
| 200.000   | 170.00    | 6.59                    | 6.14        | 5.89         | 41.43                 | 40.99       | 39.98        | 41.84                 | 40.75       | 39.77        |
| 253.500   | 223.50    | 6.71                    | 6.19        | 5.95         | 40.54                 | 40.18       | 38.99        | 40.75                 | 39.56       | 38.54        |
| 315.630   | 285.63    | 6.66                    | 6.25        | 6.01         | 39.31                 | 38.29       | 37.09        | 39.48                 | 37.94       | 37.02        |
| 377.760   | 347.76    | 6.83                    | 6.34        | 6.11         | 36.67                 | 35.80       | 35.11        | 38.56                 | 36.81       | 35.91        |
| 439.880   | 409.88    | 6.97                    | 6.56        | 6.34         | 34.91                 | 33.93       | 33.09        | 37.98                 | 35.80       | 34.50        |
| 500.000   | 470.00    | 6.99                    | 6.55        | 6.31         | 32.30                 | 31.47       | 30.75        | 37.04                 | 35.23       | 34.36        |
| 564.130   | 534.13    | 6.57                    | 6.24        | 6.01         | 30.82                 | 30.58       | 30.10        | 34.75                 | 33.53       | 33.09        |
| 626.260   | 596.26    | 6.26                    | 5.86        | 5.67         | 29.12                 | 29.34       | 29.13        | 35.60                 | 34.86       | 33.59        |
| 657.320   | 627.32    | 6.35                    | 5.95        | 5.71         | 29.01                 | 29.13       | 29.15        | 36.32                 | 35.78       | 34.99        |
| 719.450   | 689.45    | 6.31                    | 5.84        | 5.60         | 28.83                 | 28.51       | 28.62        | 35.42                 | 35.11       | 35.80        |
| 781.580   | 751.58    | 6.26                    | 5.77        | 5.51         | 28.12                 | 28.01       | 27.67        | 35.25                 | 34.75       | 34.77        |
| 812.640   | 782.64    | 6.43                    | 5.92        | 5.59         | 27.51                 | 27.68       | 27.45        | 34.28                 | 33.85       | 33.92        |
| 874.760   | 844.76    | 6.30                    | 5.87        | 5.58         | 26.96                 | 27.52       | 27.88        | 32.62                 | 32.09       | 32.28        |
| 936.890   | 906.89    | 6.25                    | 5.87        | 5.63         | 26.56                 | 27.40       | 28.21        | 30.70                 | 30.31       | 30.84        |
| 1000.000  | 970.00    | 6.33                    | 6.04        | 5.90         | 26.20                 | 27.28       | 28.39        | 30.15                 | 30.12       | 30.53        |

## mixer VSWR

| freq.<br>MHz | VSWR, RF port |             |              | VSWR, LO port |             |              | VSWR, IF port |             |              |
|--------------|---------------|-------------|--------------|---------------|-------------|--------------|---------------|-------------|--------------|
|              | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm |
| 10.000       | 1.11          | 1.11        | 1.16         | 1.68          | 2.50        | 3.70         | 2.06          | 1.70        | 1.49         |
| 20.000       | 1.06          | 1.07        | 1.14         | 1.76          | 2.58        | 3.78         | 2.04          | 1.68        | 1.48         |
| 38.167       | 1.03          | 1.07        | 1.15         | 1.64          | 2.46        | 3.62         | 2.03          | 1.73        | 1.49         |
| 50.000       | 1.03          | 1.08        | 1.16         | 1.64          | 2.54        | 3.63         | 2.06          | 1.74        | 1.50         |
| 100.000      | 1.02          | 1.10        | 1.18         | 1.64          | 2.40        | 3.40         | 2.11          | 1.77        | 1.54         |
| 137.670      | 1.02          | 1.12        | 1.20         | 1.61          | 2.34        | 3.24         | 2.12          | 1.82        | 1.60         |
| 200.000      | 1.06          | 1.16        | 1.25         | 1.57          | 2.31        | 3.11         | 2.24          | 1.96        | 1.73         |
| 270.340      | 1.11          | 1.23        | 1.31         | 1.65          | 2.35        | 3.18         | 2.44          | 2.14        | 1.92         |
| 336.670      | 1.17          | 1.29        | 1.37         | 1.73          | 2.38        | 3.22         | 2.55          | 2.31        | 2.09         |
| 403.000      | 1.22          | 1.34        | 1.42         | 1.78          | 2.48        | 3.24         | 2.71          | 2.41        | 2.20         |
| 469.340      | 1.26          | 1.37        | 1.44         | 1.88          | 2.51        | 3.16         | 2.77          | 2.49        | 2.29         |
| 500.000      | 1.26          | 1.36        | 1.44         | 1.97          | 2.60        | 3.24         | 2.80          | 2.52        | 2.31         |
| 568.840      | 1.25          | 1.33        | 1.39         | 2.01          | 2.65        | 3.29         | 2.78          | 2.48        | 2.25         |
| 635.170      | 1.21          | 1.27        | 1.35         | 2.08          | 2.64        | 3.23         | 2.68          | 2.37        | 2.18         |
| 701.510      | 1.23          | 1.27        | 1.36         | 2.25          | 2.84        | 3.35         | 2.57          | 2.31        | 2.08         |
| 767.840      | 1.38          | 1.40        | 1.47         | 2.39          | 3.02        | 3.53         | 2.52          | 2.22        | 1.98         |
| 800.000      | 1.51          | 1.51        | 1.56         | 2.51          | 3.03        | 3.56         | 2.46          | 2.17        | 1.94         |
| 867.340      | 1.91          | 1.88        | 1.90         | 2.57          | 3.15        | 3.62         | 2.42          | 2.09        | 1.84         |
| 900.510      | 2.14          | 2.10        | 2.11         | 2.61          | 3.11        | 3.60         | 2.36          | 2.02        | 1.77         |
| 1000.000     | 2.99          | 2.89        | 2.87         | 2.68          | 3.07        | 3.50         | 2.24          | 1.95        | 1.71         |

**Mini-Circuits**

P.O. BOX 166, Brooklyn, New York 11235 (718) 934-4500

## mixer harmonic intermodulation

(relative to desired IF output)

| RF ORDER HARMONIC | RF CAL | 0  | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 |
|-------------------|--------|----|----|----|----|----|----|----|----|----|----|----|
| 0                 | 90     | -  | 31 | 23 | 43 | 46 | 41 | 42 | 32 | 53 | 67 | 61 |
| 1                 | 90     | 18 | -  | 34 | 18 | 32 | 34 | 36 | 35 | 43 | 61 | 58 |
| 2                 | 77     | 47 | 56 | 46 | 58 | 45 | 55 | 64 | 57 | 56 | 40 | 58 |
| 3                 | 90     | 46 | 37 | 47 | 38 | 52 | 35 | 47 | 48 | 51 | 56 | 54 |
| 4                 | 90     | 77 | 79 | 59 | 69 | 54 | 67 | 53 | 70 | 82 | 73 | 62 |
| 5                 | 90     | 75 | 77 | 70 | 52 | 61 | 49 | 58 | 48 | 71 | 82 | 63 |
| 6                 | 90     | 76 | 78 | 77 | 81 | 68 | 70 | 67 | 70 | 62 | 76 | 75 |
| 7                 | 90     | 78 | 75 | 78 | 77 | 75 | 71 | 64 | 65 | 66 | 59 | 78 |
| 8                 | 90     | 79 | 80 | 79 | 78 | 78 | 83 | 83 | 75 | 73 | 75 | 68 |
| 9                 | 90     | 79 | 79 | 78 | 78 | 78 | 77 | 83 | 78 | 74 | 71 | 71 |
| 10                | 90     | 78 | 79 | 78 | 79 | 78 | 78 | 77 | 83 | 83 | 80 | 77 |
|                   |        | 0  | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 |

Harmonic LO Order

test conditions: RF=500.100 MHz INPUT P. = -3.91DBM  
 LO=470.010 MHz INPUT P. = +7.13DBM  
 IF=30.090MHz IF AMPLIT. = -10.78 DBM

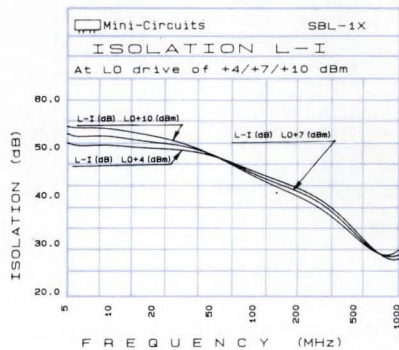
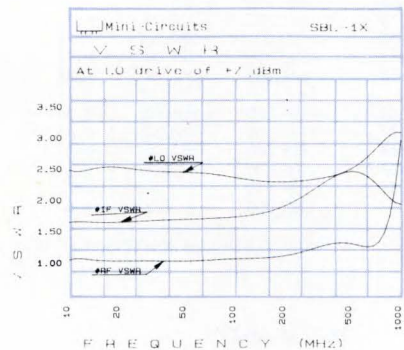
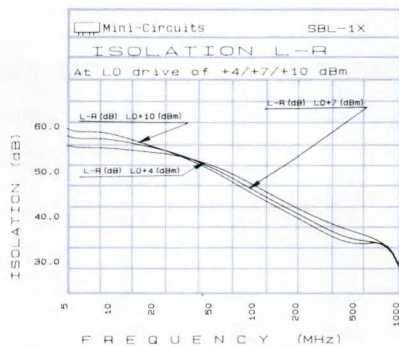
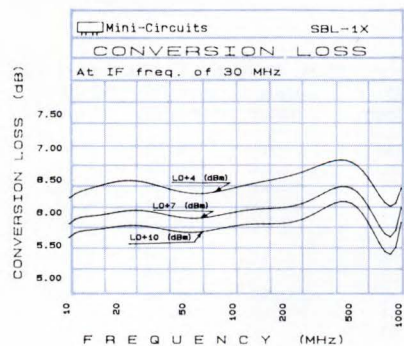
| RF ORDER HARMONIC | RF CAL | 0  | 1   | 2  | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  |
|-------------------|--------|----|-----|----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0                 | >80    | -  | 22  | 15 | 33  | 33  | 30  | 30  | 16  | 36  | 31  | 42  |
| 1                 | >80    | 19 | -   | 31 | 19  | 29  | 30  | 31  | 31  | 35  | 48  | 41  |
| 2                 | >80    | 50 | 61  | 48 | 65  | 47  | 60  | 66  | 67  | 51  | 43  | 66  |
| 3                 | >80    | 69 | 56  | 64 | 54  | 66  | 52  | 70  | 72  | 66  | 65  | 68  |
| 4                 | >80    | 68 | >73 | 72 | >72 | >72 | >72 | >71 | >73 | >72 | 67  | 68  |
| 5                 | >80    | 68 | 69  | 72 | >73 | >72 | >72 | >72 | >71 | >73 | >73 | 67  |
| 6                 | >80    | 68 | 68  | 68 | >73 | >73 | >72 | >72 | >72 | >71 | >73 | >73 |
| 7                 | >80    | 68 | 67  | 68 | 67  | >73 | >73 | >72 | >72 | >72 | >72 | >73 |
| 8                 | >80    | 69 | 69  | 69 | 68  | 67  | >73 | >73 | >72 | >72 | >72 | >72 |
| 9                 | >80    | 68 | 68  | 69 | 68  | 68  | 68  | >73 | >73 | >72 | >72 | >72 |
| 10                | >81    | 68 | 68  | 68 | 69  | 68  | 68  | 68  | >73 | >73 | >71 | >72 |
|                   |        | 0  | 1   | 2  | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  |

Harmonic LO Order

test conditions: RF=500.100 MHz INPUT P. = -13.99DBM  
 LO=470.010 MHz INPUT P. = +7.13DBM  
 IF=30.090 MHz IF AMPLIT. = -20.88 DBM

## typical performance curves

(production unit)





most widely-used

# Frequency Mixers

LEVEL 7 (+7 dBm LO, up to +1 dBm RF)

## Models

TFM-2  
ZLW-2  
ZEM-2  
ZFM-2



computer-automated performance data  
typical production unit / for data of other models consult factory

## mixer conversion loss and isolation

| RF<br>MHz | LO<br>MHz | Conversion Loss<br>(dB) |             |              | Isolation L-R<br>(dB) |             |              | Isolation L-I<br>(dB) |             |              |
|-----------|-----------|-------------------------|-------------|--------------|-----------------------|-------------|--------------|-----------------------|-------------|--------------|
|           |           | LO<br>+4dBm             | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm           | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm           | LO<br>+7dBm | LO<br>+10dBm |
| 1.000     | 31.00     | 7.65                    | 7.23        | 7.05         | > 64.00               | > 67.00     | > 70.00      | > 64.00               | > 67.00     | > 70.00      |
| 2.000     | 32.00     | 6.99                    | 6.50        | 6.38         | > 64.00               | > 67.00     | > 70.00      | > 64.00               | > 67.00     | > 70.00      |
| 5.000     | 35.00     | 6.14                    | 5.80        | 5.68         | > 64.00               | > 67.00     | > 70.00      | > 64.00               | > 67.00     | > 70.00      |
| 10.000    | 40.00     | 6.01                    | 5.62        | 5.47         | > 64.00               | > 67.00     | > 70.00      | > 64.00               | > 67.00     | > 70.00      |
| 20.000    | 50.00     | 6.10                    | 5.68        | 5.51         | > 64.00               | > 67.00     | > 70.00      | > 64.00               | > 67.00     | > 70.00      |
| 50.000    | 80.00     | 5.94                    | 5.58        | 5.44         | > 64.00               | 61.94       | 60.30        | > 64.00               | 63.74       | 61.51        |
| 100.000   | 70.00     | 5.88                    | 5.53        | 5.39         | 56.03                 | 54.33       | 53.23        | 55.98                 | 54.76       | 53.55        |
| 167.340   | 137.34    | 5.89                    | 5.57        | 5.44         | 50.05                 | 48.65       | 48.08        | 48.75                 | 47.61       | 47.01        |
| 233.870   | 203.87    | 6.02                    | 5.72        | 5.54         | 46.08                 | 45.10       | 44.88        | 43.82                 | 43.03       | 43.10        |
| 300.400   | 270.40    | 5.74                    | 5.45        | 5.37         | 43.14                 | 42.56       | 42.56        | 40.29                 | 40.00       | 40.23        |
| 366.940   | 336.94    | 6.01                    | 5.73        | 5.58         | 40.77                 | 40.45       | 40.57        | 37.73                 | 37.57       | 38.18        |
| 466.740   | 436.74    | 6.15                    | 5.82        | 5.66         | 38.41                 | 38.33       | 38.72        | 33.78                 | 34.32       | 35.36        |
| 500.000   | 470.00    | 6.05                    | 5.72        | 5.56         | 38.98                 | 38.80       | 39.09        | 33.83                 | 34.10       | 34.86        |
| 599.810   | 569.81    | 6.34                    | 6.02        | 5.78         | 38.50                 | 37.43       | 36.87        | 32.71                 | 32.81       | 32.88        |
| 666.340   | 636.34    | 6.54                    | 6.11        | 5.88         | 38.54                 | 37.94       | 37.43        | 31.60                 | 31.57       | 31.51        |
| 799.410   | 769.41    | 7.07                    | 6.27        | 5.92         | 35.96                 | 36.06       | 36.24        | 29.94                 | 29.67       | 29.67        |
| 832.680   | 802.68    | 7.29                    | 6.46        | 6.03         | 35.29                 | 35.22       | 35.39        | 28.80                 | 28.79       | 28.42        |
| 899.210   | 869.21    | 7.77                    | 7.00        | 6.39         | 34.14                 | 33.77       | 33.77        | 26.59                 | 26.14       | 25.92        |
| 932.480   | 902.48    | 8.11                    | 7.37        | 6.84         | 33.72                 | 33.17       | 33.14        | 25.85                 | 25.03       | 24.52        |
| 1000.000  | 969.00    | 8.20                    | 7.63        | 7.18         | 33.25                 | 32.49       | 32.14        | 24.75                 | 23.59       | 22.58        |

## mixer VSWR

## φ detection

| freq.<br>MHz | VSWR, RF port |             |              | VSWR, LO port |             |              | VSWR, IF port |             |              | max. output/DC offset vs. freq. |                      |                 |
|--------------|---------------|-------------|--------------|---------------|-------------|--------------|---------------|-------------|--------------|---------------------------------|----------------------|-----------------|
|              | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | Freq.<br>(MHz)                  | max. DC<br>output mV | DC offset<br>mV |
| 5.001        | 1.26          | 1.30        | 1.34         | 1.77          | 2.70        | 4.33         | 1.43          | 1.24        | 1.09         | 1.000                           | -230.07              | + .09           |
| 10.000       | 1.12          | 1.15        | 1.20         | 1.71          | 2.63        | 3.91         | 1.44          | 1.25        | 1.10         | 2.000                           | -234.86              | + .09           |
| 20.000       | 1.04          | 1.07        | 1.15         | 1.76          | 2.77        | 3.95         | 1.43          | 1.25        | 1.10         | 5.000                           | -240.18              | + .08           |
| 50.000       | 1.02          | 1.06        | 1.15         | 1.69          | 2.55        | 3.74         | 1.44          | 1.25        | 1.11         | 20.000                          | -240.24              | + .09           |
| 100.000      | 1.06          | 1.07        | 1.14         | 1.63          | 2.41        | 3.37         | 1.45          | 1.27        | 1.13         | 50.000                          | -236.50              | + .09           |
| 155.760      | 1.09          | 1.09        | 1.14         | 1.61          | 2.37        | 3.24         | 1.49          | 1.31        | 1.18         | 100.000                         | -238.59              | + .08           |
| 200.000      | 1.12          | 1.11        | 1.14         | 1.54          | 2.29        | 3.18         | 1.54          | 1.36        | 1.23         | 161.970                         | -242.90              | + .06           |
| 306.520      | 1.18          | 1.16        | 1.16         | 1.53          | 2.20        | 2.95         | 1.66          | 1.48        | 1.35         | 200.000                         | -243.36              | + .02           |
| 366.820      | 1.21          | 1.18        | 1.17         | 1.52          | 2.16        | 2.89         | 1.75          | 1.57        | 1.44         | 290.750                         | -246.83              | + .11           |
| 427.130      | 1.23          | 1.20        | 1.18         | 1.52          | 2.13        | 2.83         | 1.84          | 1.66        | 1.53         | 322.940                         | -237.61              | + .11           |
| 500.000      | 1.26          | 1.22        | 1.21         | 1.55          | 2.06        | 2.74         | 1.97          | 1.77        | 1.66         | 387.330                         | -224.03              | + .01           |
| 547.740      | 1.28          | 1.23        | 1.22         | 1.53          | 2.13        | 2.70         | 2.04          | 1.88        | 1.78         | 451.720                         | -223.29              | + .22           |
| 608.040      | 1.30          | 1.26        | 1.24         | 1.50          | 2.09        | 2.65         | 2.02          | 1.87        | 1.77         | 500.000                         | -229.56              | + .23           |
| 668.340      | 1.34          | 1.29        | 1.27         | 1.51          | 2.09        | 2.65         | 2.07          | 1.90        | 1.81         | 580.490                         | -229.04              | + .37           |
| 728.650      | 1.38          | 1.34        | 1.32         | 1.56          | 2.04        | 2.69         | 2.08          | 1.91        | 1.83         | 644.880                         | -207.44              | + .48           |
| 788.950      | 1.44          | 1.40        | 1.38         | 1.61          | 2.13        | 2.69         | 2.07          | 1.91        | 1.82         | 709.270                         | -196.52              | +1.06           |
| 849.260      | 1.51          | 1.47        | 1.46         | 1.63          | 2.19        | 2.70         | 2.02          | 1.86        | 1.77         | 773.660                         | -188.54              | + .83           |
| 909.560      | 1.58          | 1.55        | 1.54         | 1.67          | 2.24        | 2.78         | 1.93          | 1.77        | 1.68         | 838.040                         | -187.28              | + .49           |
| 969.860      | 1.68          | 1.66        | 1.66         | 1.74          | 2.28        | 2.85         | 1.81          | 1.66        | 1.57         | 902.430                         | -173.88              | + .72           |
| 1000.000     | 1.75          | 1.72        | 1.72         | 1.77          | 2.30        | 2.89         | 1.74          | 1.60        | 1.51         | 934.630                         | -171.49              | + .76           |
|              |               |             |              |               |             |              |               |             |              | 1000.000                        | -178.52              | + .64           |

Measurements at RF & LO Power +7 dBm

**Mini-Circuits**

P.O. BOX 166, Brooklyn, New York 11235

(718) 934-4500

## mixer harmonic intermodulation

(relative to desired IF output)

| RF ORDER HARMONIC | RF CAL | 0  | 1  | 2  | 3  | 4  | 5   | 6   | 7   | 8   | 9   | 10  |
|-------------------|--------|----|----|----|----|----|-----|-----|-----|-----|-----|-----|
| 0                 | >90    | -  | 14 | 29 | 23 | 42 | 25  | 43  | 53  | 57  | 65  | 72  |
| 1                 | >90    | 20 | -  | 29 | 12 | 34 | 25  | 47  | 35  | 42  | 57  | 57  |
| 2                 | 76     | 52 | 40 | 58 | 40 | 58 | 41  | 50  | 48  | 66  | 53  | 68  |
| 3                 | 86     | 46 | 49 | 50 | 49 | 53 | 49  | 52  | 48  | 58  | 57  | 51  |
| 4                 | 84     | 73 | 73 | 65 | 62 | 66 | 59  | 66  | 55  | 65  | 65  | 70  |
| 5                 | 85     | 77 | 76 | 84 | 63 | 64 | 60  | 59  | 60  | 59  | 68  | 71  |
| 6                 | 85     | 78 | 79 | 78 | 82 | 79 | 79  | 76  | 75  | 75  | 74  | 79  |
| 7                 | 85     | 79 | 78 | 77 | 79 | 82 | 80  | 81  | 80  | 80  | 79  | 78  |
| 8                 | 86     | 79 | 80 | 79 | 78 | 78 | >84 | >84 | >82 | >82 | 81  | >82 |
| 9                 | 85     | 79 | 79 | 80 | 79 | 78 | 79  | >84 | >84 | >82 | >83 | >82 |
| 10                | 86     | 79 | 79 | 79 | 79 | 80 | 79  | >84 | >84 | >82 | >83 | >83 |
|                   |        | 0  | 1  | 2  | 3  | 4  | 5   | 6   | 7   | 8   | 9   | 10  |
| Harmonic LO Order |        |    |    |    |    |    |     |     |     |     |     |     |

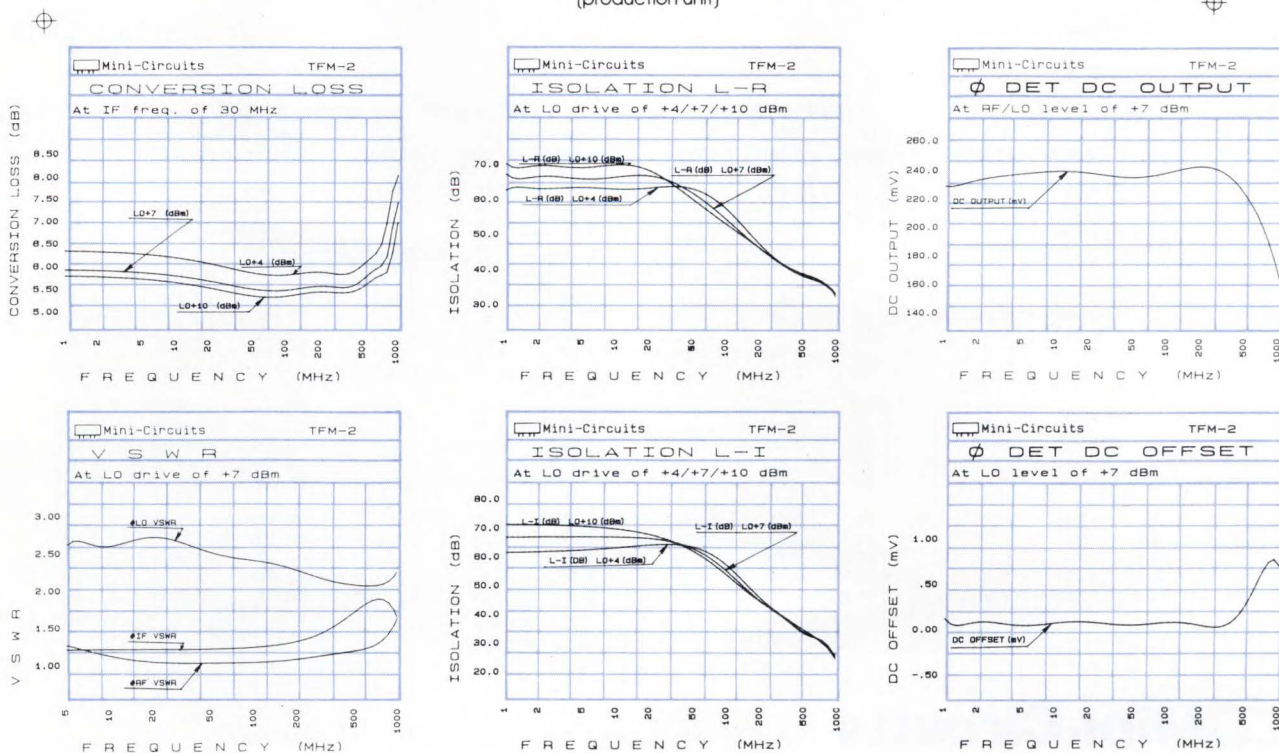
test conditions: RF=500.100 MHz INPUT P.<sub>1</sub>= -3.98DBM  
 LO=470.010 MHz INPUT P.<sub>2</sub>= +6.86DBM  
 IF=30.090 MHz IF AMPLIT.<sub>1</sub>= -10.31 DBM

| RF ORDER HARMONIC | RF CAL | 0  | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  |
|-------------------|--------|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0                 | >81    | -  | 5   | 19  | 11  | 28  | 14  | 31  | 32  | 47  | 61  | 58  |
| 1                 | >81    | 19 | -   | 32  | 12  | 30  | 24  | 44  | 35  | 36  | 59  | 49  |
| 2                 | >81    | 65 | 48  | >72 | 48  | 64  | 47  | 58  | 54  | 63  | 60  | 65  |
| 3                 | >81    | 66 | 70  | 65  | >72 | 64  | 68  | 64  | 72  | 68  | 68  | 66  |
| 4                 | >81    | 69 | >74 | >74 | >72 | >72 | >72 | >72 | >74 | >73 | 68  | 69  |
| 5                 | >81    | 68 | 68  | >74 | 74  | >72 | >72 | >72 | >72 | >74 | >74 | 67  |
| 6                 | >81    | 69 | 69  | 68  | >74 | >74 | >72 | >72 | >72 | >72 | >74 | >74 |
| 7                 | >81    | 69 | 68  | 67  | 69  | 73  | 74  | >72 | >72 | >72 | >72 | >74 |
| 8                 | >81    | 69 | 70  | 69  | 68  | 68  | >74 | >74 | >72 | >72 | >72 | >72 |
| 9                 | >81    | 69 | 69  | 69  | 69  | 69  | 68  | >74 | >74 | >72 | >72 | >72 |
| 10                | >80    | 69 | 69  | 70  | 70  | 69  | 69  | 68  | >74 | >74 | >72 | >72 |
|                   |        | 0  | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  |
| Harmonic LO Order |        |    |     |     |     |     |     |     |     |     |     |     |

test conditions: RF=500.100 MHz INPUT P.<sub>1</sub>= -13.94DBM  
 LO=470.010 MHz INPUT P.<sub>2</sub>= +6.86DBM  
 IF=30.090MHz IF AMPLIT.<sub>1</sub>= -20.22 DBM

## typical performance curves

(production unit)





most widely-used

# Frequency Mixers

**Models**

LEVEL 7 (+7 dBm LO, up to +1 dBm RF)

TFM-3  
ZFM-3



**computer-automated performance data**

typical production unit / for data of other models consult factory

## mixer conversion loss and isolation

| RF<br>MHz | LO<br>MHz | Conversion Loss<br>(dB) |             |              | Isolation L-R<br>(dB) |             |              | Isolation L-I<br>(dB) |             |              |
|-----------|-----------|-------------------------|-------------|--------------|-----------------------|-------------|--------------|-----------------------|-------------|--------------|
|           |           | LO<br>+4dBm             | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm           | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm           | LO<br>+7dBm | LO<br>+10dBm |
| .040      | 30.04     | 6.45                    | 6.15        | 6.01         | > 64.00               | > 67.00     | > 70.00      | > 64.00               | > 67.00     | > 70.00      |
| .050      | 30.05     | 5.82                    | 5.52        | 5.36         | > 64.00               | > 67.00     | > 70.00      | > 64.00               | > 67.00     | > 70.00      |
| .070      | 30.07     | 5.44                    | 5.12        | 4.99         | > 64.00               | > 67.00     | > 70.00      | > 64.00               | > 67.00     | > 70.00      |
| .100      | 30.10     | 5.30                    | 4.92        | 4.76         | > 64.00               | > 67.00     | > 70.00      | > 64.00               | > 67.00     | > 70.00      |
| .500      | 30.50     | 5.10                    | 4.77        | 4.60         | > 64.00               | > 67.00     | > 70.00      | > 64.00               | > 67.00     | > 70.00      |
| 1.000     | 31.00     | 5.07                    | 4.76        | 4.59         | > 64.00               | > 67.00     | > 70.00      | 62.64                 | 63.53       | > 70.00      |
| 5.000     | 35.00     | 4.91                    | 4.75        | 4.56         | > 64.00               | > 67.00     | > 70.00      | 59.16                 | 60.91       | 64.41        |
| 10.000    | 40.00     | 4.87                    | 4.75        | 4.56         | > 64.00               | > 67.00     | > 70.00      | 58.46                 | 60.97       | 63.86        |
| 20.000    | 50.00     | 4.98                    | 4.74        | 4.60         | > 64.00               | > 67.00     | 63.79        | 57.26                 | 58.52       | 60.41        |
| 60.871    | 90.87     | 4.87                    | 4.73        | 4.60         | 51.05                 | 50.40       | 50.16        | 49.67                 | 49.37       | 49.56        |
| 100.000   | 70.00     | 4.76                    | 4.63        | 4.51         | 44.79                 | 44.80       | 44.88        | 43.57                 | 44.05       | 44.87        |
| 162.610   | 132.61    | 4.94                    | 4.79        | 4.70         | 38.73                 | 39.22       | 39.57        | 38.80                 | 39.87       | 40.79        |
| 200.000   | 170.00    | 5.13                    | 4.95        | 4.84         | 36.77                 | 37.18       | 37.12        | 36.43                 | 37.86       | 38.79        |
| 230.440   | 200.44    | 5.11                    | 4.89        | 4.78         | 35.18                 | 35.78       | 35.97        | 36.79                 | 37.67       | 38.36        |
| 281.310   | 251.31    | 5.16                    | 5.05        | 4.93         | 33.40                 | 33.68       | 33.93        | 34.86                 | 35.71       | 35.77        |
| 315.230   | 285.23    | 5.38                    | 5.25        | 5.22         | 34.35                 | 34.22       | 34.07        | 33.94                 | 33.98       | 33.69        |
| 349.140   | 319.14    | 5.60                    | 5.32        | 5.18         | 36.71                 | 35.64       | 34.41        | 36.04                 | 34.07       | 32.17        |
| 366.100   | 336.10    | 5.72                    | 5.37        | 5.15         | 36.71                 | 35.56       | 34.41        | 37.45                 | 34.58       | 31.91        |
| 383.050   | 353.05    | 5.85                    | 5.44        | 5.19         | 36.26                 | 35.25       | 34.16        | 36.77                 | 34.26       | 31.46        |
| 400.000   | 370.00    | 6.20                    | 5.56        | 5.18         | 35.85                 | 34.72       | 33.54        | 34.74                 | 32.46       | 29.98        |

## mixer VSWR

## φ detection

| freq.<br>MHz | VSWR, RF port |             |              | VSWR, LO port |             |              | VSWR, IF port |             |              | max. output/DC offset vs. freq. |                      |                 |
|--------------|---------------|-------------|--------------|---------------|-------------|--------------|---------------|-------------|--------------|---------------------------------|----------------------|-----------------|
|              | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | Freq.<br>(MHz)                  | max. DC<br>output mV | DC offset<br>mV |
| 5.001        | 1.36          | 1.24        | 1.18         | 1.71          | 2.69        | 4.09         | 1.73          | 1.59        | 1.46         | .040                            | +239.68              | + .03           |
| 10.000       | 1.36          | 1.25        | 1.18         | 1.64          | 2.55        | 3.82         | 1.74          | 1.59        | 1.47         | .050                            | +241.65              | + .02           |
| 20.000       | 1.36          | 1.25        | 1.18         | 1.70          | 2.67        | 3.89         | 1.73          | 1.59        | 1.47         | .100                            | +246.04              | + .02           |
| 29.688       | 1.35          | 1.24        | 1.17         | 1.70          | 2.63        | 3.95         | 1.72          | 1.59        | 1.47         | .500                            | +247.27              | + .01           |
| 50.000       | 1.33          | 1.23        | 1.16         | 1.64          | 2.55        | 3.75         | 1.73          | 1.60        | 1.48         | 1.000                           | +249.11              | + .01           |
| 66.720       | 1.33          | 1.23        | 1.16         | 1.59          | 2.45        | 3.58         | 1.74          | 1.62        | 1.49         | 5.000                           | +239.67              | +0.00           |
| 100.000      | 1.31          | 1.21        | 1.14         | 1.63          | 2.48        | 3.51         | 1.77          | 1.67        | 1.53         | 10.000                          | +239.13              | +0.00           |
| 116.100      | 1.30          | 1.21        | 1.14         | 1.64          | 2.42        | 3.47         | 1.80          | 1.69        | 1.56         | 20.000                          | +238.04              | +0.00           |
| 153.130      | 1.28          | 1.19        | 1.12         | 1.66          | 2.42        | 3.35         | 1.87          | 1.76        | 1.64         | 50.000                          | +236.98              | + .02           |
| 177.820      | 1.26          | 1.18        | 1.11         | 1.68          | 2.36        | 3.34         | 1.93          | 1.82        | 1.69         | 76.820                          | +238.73              | + .07           |
| 200.000      | 1.24          | 1.16        | 1.10         | 1.69          | 2.38        | 3.21         | 1.97          | 1.87        | 1.74         | 100.000                         | +239.43              | + .13           |
| 227.190      | 1.22          | 1.15        | 1.09         | 1.73          | 2.46        | 3.35         | 2.03          | 1.94        | 1.80         | 150.000                         | +235.41              | + .21           |
| 251.880      | 1.20          | 1.13        | 1.09         | 1.74          | 2.40        | 3.29         | 2.06          | 1.97        | 1.83         | 200.000                         | +239.94              | + .20           |
| 264.220      | 1.19          | 1.13        | 1.09         | 1.75          | 2.42        | 3.39         | 2.12          | 2.03        | 1.90         | 256.370                         | +229.27              | + .12           |
| 288.910      | 1.18          | 1.13        | 1.10         | 1.76          | 2.41        | 3.33         | 2.17          | 2.10        | 1.97         | 300.000                         | +224.42              | + .63           |
| 325.940      | 1.17          | 1.14        | 1.13         | 1.89          | 2.56        | 3.43         | 2.26          | 2.19        | 2.06         | 328.190                         | +216.15              | + .53           |
| 350.630      | 1.16          | 1.14        | 1.14         | 1.97          | 2.63        | 3.54         | 2.29          | 2.23        | 2.11         | 346.150                         | +208.91              | + .60           |
| 375.320      | 1.16          | 1.14        | 1.15         | 2.00          | 2.68        | 3.74         | 2.32          | 2.26        | 2.15         | 364.100                         | +198.11              | + .88           |
| 387.660      | 1.16          | 1.15        | 1.16         | 2.00          | 2.69        | 3.75         | 2.33          | 2.28        | 2.17         | 382.060                         | +190.39              | + .64           |
| 400.000      | 1.15          | 1.15        | 1.16         | 1.99          | 2.76        | 3.83         | 2.33          | 2.29        | 2.17         | 400.000                         | +182.44              | - .09           |

Measurements at RF & LO Power +7 dBm

**Mini-Circuits**

P.O. BOX 166, Brooklyn, New York 11235 (718) 934-4500

## mixer harmonic intermodulation

(relative to desired IF output)

| RF CAL            |      |      |      |      |      |      |      |      |      |      |      |      |  |
|-------------------|------|------|------|------|------|------|------|------|------|------|------|------|--|
| 0                 | -    | -    | 42   | 50   | 47   | 62   | 49   | 80   | 50   | 69   | 57   | 69   |  |
| 1                 | -    | 35   | -    | 42   | 11   | 45   | 18   | 57   | 24   | 60   | 32   | 55   |  |
| 2                 | 88   | 79   | 70   | 82   | 68   | 81   | 65   | 80   | 61   | 78   | 59   | 76   |  |
| 3                 | 87   | 56   | 53   | 55   | 48   | 55   | 45   | 56   | 49   | 53   | 47   | 54   |  |
| 4                 | > 96 | > 87 | 84   | > 87 | > 87 | > 85 | > 86 | > 86 | 80   | > 86 | 74   | 83   |  |
| 5                 | > 96 | 69   | 70   | 70   | 62   | 71   | 59   | 71   | 57   | 68   | 57   | 66   |  |
| 6                 | > 96 | > 85 | > 86 | > 87 | > 86 | > 87 | > 86 | > 87 | 84   | > 86 | > 86 | > 86 |  |
| 7                 | > 95 | 84   | > 85 | 84   | > 85 | 85   | 82   | > 86 | 75   | > 85 | 71   | 83   |  |
| 8                 | > 96 | > 87 | > 87 | 87   | > 86 | > 86 | > 86 | > 86 | > 87 | > 86 | > 87 | > 86 |  |
| 9                 | > 95 | > 88 | 81   | > 87 | 81   | > 86 | 79   | > 86 | 80   | > 87 | 81   | > 86 |  |
| 10                | > 95 | > 85 | > 86 | > 85 | > 87 | > 87 | > 86 | > 85 | > 86 | > 86 | > 87 | > 86 |  |
|                   |      | 0    | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   |  |
| Harmonic LO Order |      |      |      |      |      |      |      |      |      |      |      |      |  |

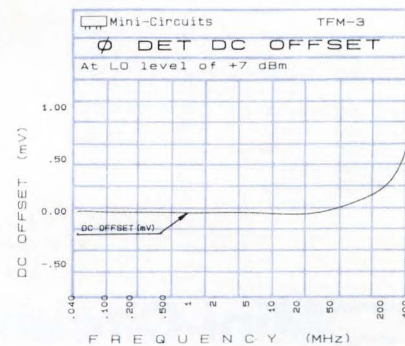
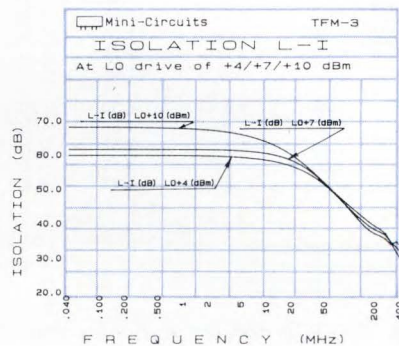
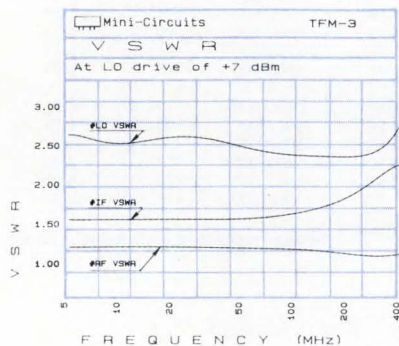
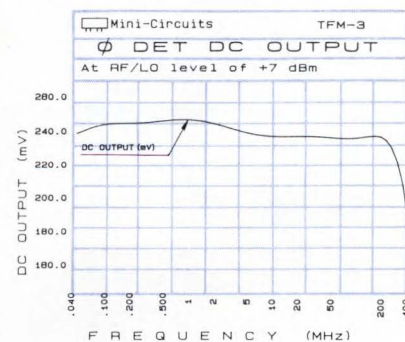
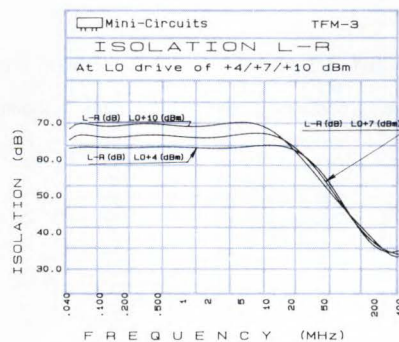
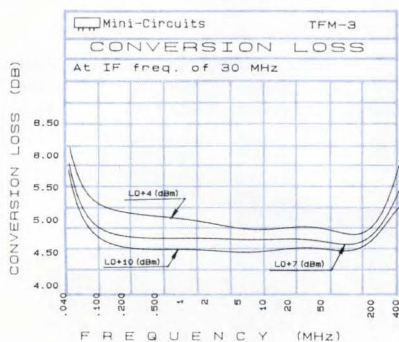
test conditions: RF.=IN: FREQ. 10.1 MHZ DRIVE -4.01 DBM  
 TESTED ON: 16.10.84  
 LO.=IN: FREQ. 40.01 MHZ DRIVE +7.03 DBM TESTED BY: D.E.  
 IF=MEASURED: FREQ. 29.91 AMP. -9.18 DBM

| RF<br>CAL | 0  | -    | 31   | 40   | 35   | 52   | 36   | 55   | 35   | 52   | 38   | 55   |      |
|-----------|----|------|------|------|------|------|------|------|------|------|------|------|------|
| 1         | 1  | -    | 33   | -    | 37   | 11   | 38   | 17   | 43   | 23   | 42   | 31   | 41   |
| 2         | 2  | > 95 | > 76 | > 75 | > 77 | > 76 | > 76 | 74   | > 76 | 69   | > 77 | 65   | > 76 |
| 3         | 3  | > 96 | 69   | 69   | 69   | 64   | 70   | 67   | 72   | 62   | 68   | 60   | 66   |
| 4         | 4  | > 96 | > 75 | > 76 | > 77 | > 77 | > 77 | > 76 | > 75 | > 77 | > 77 | > 77 | > 77 |
| 5         | 5  | > 95 | > 75 | > 76 | > 76 | > 76 | > 77 | > 77 | 76   | > 77 | > 77 | 75   | > 75 |
| 6         | 6  | > 95 | > 76 | > 75 | > 77 | > 76 | > 76 | > 76 | > 77 | > 76 | > 76 | > 75 | > 76 |
| 7         | 7  | > 95 | > 76 | > 76 | > 75 | > 76 | > 77 | > 77 | > 77 | > 77 | > 75 | > 77 | > 77 |
| 8         | 8  | > 95 | > 76 | > 77 | > 76 | > 76 | > 76 | > 76 | > 76 | > 77 | > 76 | > 75 | > 76 |
| 9         | 9  | > 96 | > 75 | > 77 | > 76 | > 76 | > 76 | > 76 | > 76 | > 77 | > 76 | > 77 | > 77 |
| 10        | 10 | > 96 | > 77 | > 77 | > 77 | > 76 | > 75 | > 76 | > 78 | > 76 | > 77 | > 76 | > 76 |
|           |    | 0    | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   |      |

test conditions: RF.=IN: FREQ. 10.1 MHZ DRIVE -14.03 DBM  
 TESTED ON: 16.10.84  
 LO.=IN: FREQ. 40.01 MHZ DRIVE +7.08 DBM TESTED BY: D.E.  
 IF=MEASURED: FREQ. 29.91 AMP. -19.19 DBM

## typical performance curves

(production unit)





broadband, high dynamic range

# Frequency Mixers

LEVEL 10 (+10dBm LO, up to +5dBm RF)

## Models

TFM-15  
ZFM-15



computer-automated performance data  
typical production unit / for data of other models consult factory

## mixer conversion loss and isolation

| RF<br>MHz | LO<br>MHz | Conversion Loss<br>(dB) |              |              | Isolation L-R<br>(dB) |              |              | Isolation L-I<br>(dB) |              |              |
|-----------|-----------|-------------------------|--------------|--------------|-----------------------|--------------|--------------|-----------------------|--------------|--------------|
|           |           | LO<br>+7dBm             | LO<br>+10dBm | LO<br>+13dBm | LO<br>+7dBm           | LO<br>+10dBm | LO<br>+13dBm | LO<br>+7dBm           | LO<br>+10dBm | LO<br>+13dBm |
| 10.000    | 40.00     | 7.09                    | 6.53         | 6.23         | 23.88                 | 26.10        | 27.81        | 23.04                 | 25.08        | 27.01        |
| 20.000    | 50.00     | 7.15                    | 6.60         | 6.36         | 28.07                 | 30.38        | 32.40        | 27.25                 | 29.74        | 31.89        |
| 100.000   | 70.00     | 7.10                    | 6.55         | 6.27         | 33.54                 | 35.82        | 38.01        | 32.56                 | 35.93        | 38.89        |
| 200.000   | 170.00    | 7.14                    | 6.60         | 6.32         | 35.25                 | 37.35        | 39.48        | 34.67                 | 38.21        | 41.31        |
| 400.000   | 370.00    | 7.36                    | 6.74         | 6.38         | 35.50                 | 36.49        | 37.50        | 37.43                 | 39.50        | 39.44        |
| 500.000   | 470.00    | 7.13                    | 6.52         | 6.23         | 34.59                 | 35.42        | 36.65        | 37.49                 | 38.00        | 37.53        |
| 790.000   | 760.00    | 7.40                    | 6.70         | 6.39         | 31.76                 | 32.94        | 34.27        | 35.00                 | 33.60        | 34.14        |
| 920.000   | 890.00    | 7.71                    | 6.76         | 6.35         | 30.94                 | 32.80        | 34.84        | 33.13                 | 33.97        | 33.68        |
| 1180.000  | 1150.00   | 8.13                    | 7.30         | 6.99         | 30.06                 | 31.62        | 33.62        | 31.75                 | 32.89        | 33.47        |
| 1310.000  | 1280.00   | 8.32                    | 7.30         | 6.91         | 29.59                 | 31.27        | 33.27        | 32.10                 | 34.31        | 35.08        |
| 1500.000  | 1470.00   | 7.32                    | 6.54         | 6.25         | 28.50                 | 29.76        | 30.77        | 30.68                 | 32.85        | 34.76        |
| 1700.000  | 1670.00   | 7.69                    | 6.91         | 6.53         | 28.13                 | 28.49        | 28.63        | 31.86                 | 30.87        | 31.34        |
| 1830.000  | 1800.00   | 7.60                    | 6.97         | 6.65         | 28.52                 | 29.46        | 29.52        | 29.41                 | 28.22        | 28.72        |
| 2000.000  | 1970.00   | 7.61                    | 7.07         | 6.84         | 27.07                 | 28.32        | 29.26        | 28.50                 | 27.77        | 27.62        |
| 2200.000  | 2170.00   | 7.47                    | 6.97         | 6.80         | 27.16                 | 27.89        | 28.41        | 29.65                 | 27.68        | 25.61        |
| 2480.000  | 2450.00   | 7.51                    | 6.93         | 6.70         | 28.24                 | 28.37        | 28.05        | 25.87                 | 24.64        | 20.89        |
| 2610.000  | 2580.00   | 7.71                    | 7.08         | 6.90         | 27.17                 | 27.10        | 27.02        | 24.02                 | 23.13        | 20.35        |
| 2740.000  | 2710.00   | 8.11                    | 7.45         | 7.20         | 27.49                 | 26.79        | 26.50        | 22.65                 | 21.95        | 20.52        |
| 2870.000  | 2840.00   | 8.18                    | 7.56         | 7.37         | 26.75                 | 26.23        | 24.58        | 21.48                 | 21.25        | 20.52        |
| 3000.000  | 2970.00   | 8.63                    | 8.31         | 8.20         | 27.78                 | 29.30        | 29.14        | 20.68                 | 20.32        | 19.50        |

## mixer VSWR

## φ detection

| freq.<br>MHz | VSWR, RF port |              |              | VSWR, LO port |              |              | VSWR, IF port |              |              | max. output/DC offset vs. freq. |                      |                 |
|--------------|---------------|--------------|--------------|---------------|--------------|--------------|---------------|--------------|--------------|---------------------------------|----------------------|-----------------|
|              | LO<br>+7dBm   | LO<br>+10dBm | LO<br>+13dBm | LO<br>+7dBm   | LO<br>+10dBm | LO<br>+13dBm | LO<br>+7dBm   | LO<br>+10dBm | LO<br>+13dBm | Freq.<br>(MHz)                  | max. DC<br>output mV | DC offset<br>mV |
| 10.000       | 2.11          | 1.84         | 1.62         | 1.62          | 1.71         | 2.26         | 1.56          | 1.45         | 1.39         | 10.000                          | +216.05              | -2.26           |
| 20.000       | 1.77          | 1.54         | 1.35         | 1.26          | 1.51         | 2.32         | 1.48          | 1.29         | 1.22         | 20.000                          | +216.68              | -1.18           |
| 50.000       | 1.75          | 1.50         | 1.30         | 1.08          | 1.37         | 2.18         | 1.50          | 1.25         | 1.17         | 50.000                          | +217.07              | +1.25           |
| 100.000      | 1.81          | 1.55         | 1.33         | 1.07          | 1.44         | 2.07         | 1.53          | 1.26         | 1.17         | 100.000                         | +214.73              | +1.40           |
| 200.000      | 2.02          | 1.72         | 1.48         | 1.23          | 1.40         | 1.96         | 1.56          | 1.27         | 1.19         | 200.000                         | +218.98              | +1.57           |
| 316.150      | 2.26          | 1.99         | 1.72         | 1.43          | 1.34         | 1.78         | 1.56          | 1.26         | 1.20         | 324.690                         | +232.84              | +1.80           |
| 500.000      | 2.79          | 2.45         | 2.22         | 1.75          | 1.33         | 1.57         | 1.55          | 1.23         | 1.19         | 414.600                         | +206.43              | +1.02           |
| 622.300      | 3.09          | 2.70         | 2.51         | 1.96          | 1.36         | 1.40         | 1.52          | 1.20         | 1.16         | 500.000                         | +192.47              | +1.93           |
| 851.920      | 3.28          | 2.85         | 2.67         | 2.19          | 1.36         | 1.11         | 1.43          | 1.16         | 1.07         | 639.370                         | +223.80              | +1.05           |
| 1000.000     | 3.18          | 2.75         | 2.04         | 2.35          | 1.38         | 1.12         | 1.40          | 1.20         | 1.24         | 729.280                         | +205.59              | +1.39           |
| 1200.000     | 2.64          | 2.28         | 1.96         | 1.98          | 1.30         | 1.33         | 1.48          | 1.37         | 1.14         | 800.000                         | +179.59              | +1.40           |
| 1311.100     | 2.23          | 1.94         | 1.83         | 1.74          | 1.27         | 1.51         | 1.58          | 1.48         | 1.04         | 909.100                         | +183.16              | +1.28           |
| 1500.000     | 1.63          | 1.44         | 1.52         | 1.27          | 1.29         | 1.75         | 1.74          | 1.56         | 1.19         | 1000.000                        | +190.29              | +1.27           |
| 1617.300     | 1.38          | 1.25         | 1.27         | 1.12          | 1.34         | 1.92         | 1.76          | 1.52         | 1.37         | 1200.000                        | +196.42              | +1.71           |
| 1770.400     | 1.49          | 1.42         | 1.24         | 1.08          | 1.34         | 1.98         | 1.59          | 1.31         | 1.62         | 1500.000                        | +178.74              | +3.01           |
| 2000.000     | 2.09          | 1.97         | 1.83         | 1.50          | 1.44         | 1.89         | 1.34          | 1.14         | 1.87         | 1800.000                        | +175.84              | +2.71           |
| 2200.000     | 2.17          | 2.18         | 2.12         | 1.71          | 1.52         | 1.60         | 1.37          | 1.30         | 1.80         | 2000.000                        | +195.03              | +1.08           |
| 2500.000     | 2.63          | 2.37         | 2.45         | 2.94          | 1.93         | 1.31         | 2.37          | 2.66         | 1.72         | 2200.000                        | +171.75              | -1.67           |
| 2800.000     | 2.10          | 2.09         | 1.95         | 2.96          | 2.25         | 2.04         | 3.68          | 3.79         | 3.80         | 2500.000                        | +177.30              | -2.90           |
| 3000.000     | 2.21          | 2.18         | 2.28         | 3.00          | 2.63         | 1.80         | 3.82          | 4.88         | 3.98         | 2800.000                        | +163.24              | -5.28           |
|              |               |              |              |               |              |              |               |              |              | 3000.000                        | +180.13              | -6.79           |

Measurements at RF & LO Power +10 dBm

**Mini-Circuits**

P.O. BOX 166, Brooklyn, New York 11235 (718) 934-4500

## mixer harmonic intermodulation

(relative to desired IF output)

|                   | RF<br>CAL |      |      |      |      |      |      |      |      |      |      |      |      |
|-------------------|-----------|------|------|------|------|------|------|------|------|------|------|------|------|
| RF ORDER HARMONIC | 0         | -    | -    | 22   | 24   | 16   | 31   | 30   | 32   | 36   | 45   | 48   | 65   |
|                   | 1         | -    | 33   | -    | 35   | 18   | 44   | 27   | 45   | 38   | 51   | 41   | 59   |
|                   | 2         | 94   | 69   | 57   | 52   | 56   | 61   | 52   | 48   | 63   | 47   | 52   | 50   |
|                   | 3         | > 94 | 59   | 47   | 56   | 45   | 56   | 46   | 74   | 51   | 67   | 55   | 75   |
|                   | 4         | 93   | 77   | 82   | > 83 | 75   | 80   | 72   | 77   | 70   | 80   | 80   | 65   |
|                   | 5         | > 95 | > 83 | > 84 | > 84 | 73   | 83   | 72   | 78   | 73   | 80   | 80   | 84   |
|                   | 6         | > 90 | > 77 | > 83 | > 83 | > 85 | > 84 | > 84 | > 84 | > 84 | > 84 | > 82 | > 84 |
|                   | 7         | 89   | > 77 | > 77 | > 84 | > 84 | > 84 | > 83 | > 83 | > 85 | > 86 | > 84 | > 83 |
|                   | 8         | > 89 | > 78 | > 78 | > 77 | > 84 | > 84 | > 85 | > 82 | > 84 | > 84 | > 84 | > 83 |
|                   | 9         | > 89 | > 78 | > 79 | > 77 | > 78 | > 83 | > 84 | > 83 | > 83 | > 83 | > 84 | > 83 |
|                   | 10        | 89   | > 79 | 78   | > 78 | > 78 | > 76 | > 84 | > 84 | > 84 | > 83 | > 84 | > 83 |
|                   | 0         | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   |      |      |
| Harmonic LO Order |           |      |      |      |      |      |      |      |      |      |      |      |      |

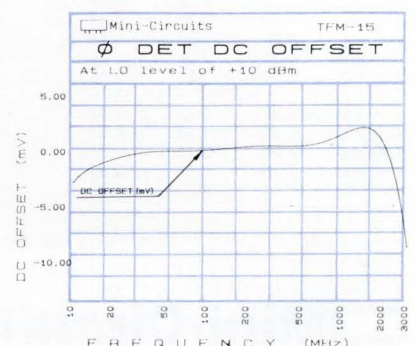
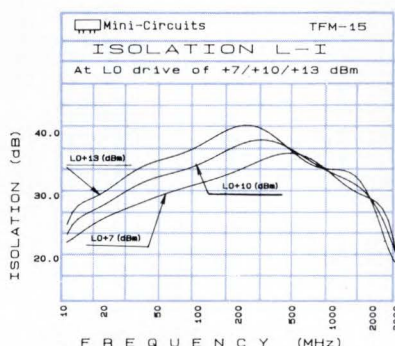
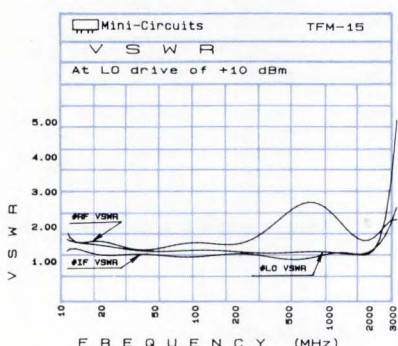
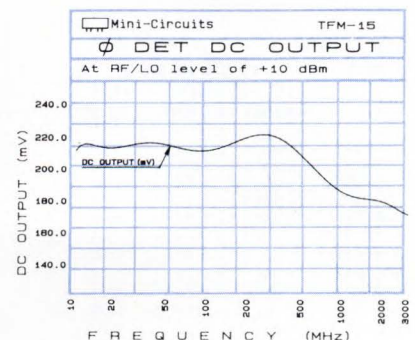
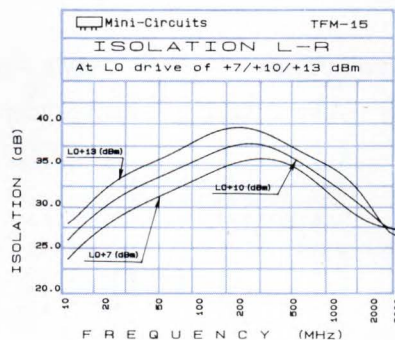
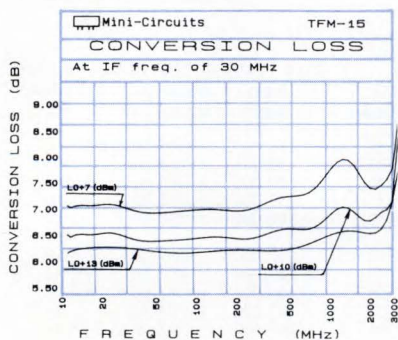
test conditions: RF = IN: FREQ. 1000.1 MHz DRIVE -4 DBM TESTED ON :16.10.84  
 LO = IN: FREQ. 970.01 MHz DRIVE +9.98 DBM TESTED BY :D.E.  
 IF = MEASURED: FREQ. 30.09 AMP. = -11.23 DBM

| RF CAL            |     |                   |     |     |     |     |     |     |     |     |     |     |  |
|-------------------|-----|-------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|
| 0                 | -   | -                 | 12  | 15  | 6   | 19  | 20  | 18  | 24  | 28  | 36  | 41  |  |
| 1                 | -   | 32                | -   | 36  | 17  | 45  | 25  | 46  | 38  | 48  | 40  | 60  |  |
| 2                 | >94 | 73                | 66  | 62  | 68  | 71  | 61  | 58  | 67  | 55  | 59  | 57  |  |
| 3                 | >94 | >73               | 68  | >73 | 66  | >73 | 67  | 73  | 70  | >72 | >74 | >66 |  |
| 4                 | >96 | >73               | >72 | >73 | >74 | >74 | >73 | >74 | >77 | >74 | >74 | >74 |  |
| 5                 | >96 | >74               | >74 | >73 | >74 | >74 | >74 | >72 | >74 | >73 | >74 | >73 |  |
| 6                 | >89 | >69               | >75 | >75 | >73 | >73 | >74 | >75 | >74 | >72 | >73 | >74 |  |
| 7                 | 89  | >67               | >67 | >73 | >74 | >74 | 73  | >73 | >74 | >72 | >73 | 74  |  |
| 8                 | 90  | >68               | >66 | >68 | >74 | >75 | >74 | >73 | >74 | 74  | >73 | 73  |  |
| 9                 | >89 | >68               | >68 | >67 | >68 | >74 | >75 | >74 | >73 | >74 | >75 | >73 |  |
| 10                | >89 | >69               | >68 | >68 | >69 | >68 | >74 | >73 | >73 | >74 | >72 | >75 |  |
|                   |     | 0                 | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  |  |
| RF ORDER HARMONIC |     | Harmonic LO Order |     |     |     |     |     |     |     |     |     |     |  |

test conditions: RF = IN: FREQ. 1000.1 MHz DRIVE -14.07 DBM  
 TESTED ON :16.10.84  
 LO = IN: FREQ. 970.01 MHz DRIVE +9.98 DBM TESTED BY :D.E.  
 IF = MEASURED: FREQ. 30.09 AMP. = -21.46 DBM

## typical performance curves

(production unit)





very high dynamic range

# Frequency Mixers

LEVEL 17 (+17 dBm LO, up to +10 dBm RF)

**Models**

**SRA-173H**



**computer-automated performance data**

typical production unit / for data of other models consult factory

## mixer conversion loss and isolation

| RF<br>MHz | LO<br>MHz | Conversion Loss<br>(dB) |              |              | Isolation L-R<br>(dB) |              |              | Isolation L-I<br>(dB) |              |              |
|-----------|-----------|-------------------------|--------------|--------------|-----------------------|--------------|--------------|-----------------------|--------------|--------------|
|           |           | LO<br>+14dBm            | LO<br>+17dBm | LO<br>+20dBm | LO<br>+14dBm          | LO<br>+17dBm | LO<br>+20dBm | LO<br>+14dBm          | LO<br>+17dBm | LO<br>+20dBm |
| 5.000     | 35.00     | 5.61                    | 5.36         | 5.21         | 38.90                 | 40.90        | 43.43        | 37.50                 | 39.89        | 41.78        |
| 10.000    | 40.00     | 5.47                    | 5.22         | 5.15         | 39.23                 | 41.90        | 44.17        | 40.65                 | 43.43        | 45.51        |
| 20.000    | 50.00     | 5.63                    | 5.36         | 5.25         | 40.04                 | 42.71        | 45.06        | 41.68                 | 44.48        | 46.35        |
| 50.000    | 80.00     | 5.57                    | 5.33         | 5.26         | 39.43                 | 41.81        | 43.72        | 40.61                 | 42.82        | 43.93        |
| 100.000   | 70.00     | 5.55                    | 5.34         | 5.26         | 38.64                 | 40.38        | 41.69        | 39.38                 | 40.38        | 40.76        |
| 128.620   | 98.62     | 5.59                    | 5.36         | 5.33         | 38.20                 | 39.66        | 40.47        | 38.61                 | 39.17        | 39.09        |
| 200.000   | 170.00    | 5.70                    | 5.47         | 5.38         | 37.19                 | 38.20        | 38.80        | 36.75                 | 36.56        | 36.05        |
| 252.240   | 222.24    | 5.83                    | 5.54         | 5.42         | 36.66                 | 37.74        | 37.96        | 35.55                 | 35.15        | 34.45        |
| 334.660   | 304.66    | 5.69                    | 5.46         | 5.40         | 36.35                 | 37.00        | 36.84        | 33.82                 | 33.06        | 32.19        |
| 417.070   | 387.07    | 5.75                    | 5.47         | 5.39         | 35.71                 | 36.23        | 36.50        | 32.59                 | 31.39        | 30.37        |
| 500.000   | 470.00    | 5.95                    | 5.65         | 5.57         | 36.91                 | 37.19        | 36.50        | 32.04                 | 30.16        | 28.71        |
| 581.900   | 551.90    | 5.78                    | 5.49         | 5.40         | 37.93                 | 37.86        | 37.28        | 32.32                 | 29.87        | 28.35        |
| 623.110   | 593.11    | 5.97                    | 5.61         | 5.52         | 34.30                 | 34.99        | 35.07        | 32.27                 | 29.66        | 27.90        |
| 705.520   | 675.52    | 6.10                    | 5.76         | 5.59         | 35.89                 | 35.63        | 34.99        | 32.51                 | 29.66        | 27.57        |
| 800.000   | 770.00    | 6.75                    | 6.43         | 6.38         | 37.22                 | 36.96        | 36.12        | 32.61                 | 29.67        | 27.61        |
| 911.550   | 881.55    | 7.21                    | 6.71         | 6.39         | 35.14                 | 35.83        | 35.11        | 32.87                 | 30.27        | 28.30        |
| 1000.000  | 970.00    | 7.15                    | 6.65         | 6.34         | 35.08                 | 33.44        | 31.61        | 33.03                 | 32.10        | 30.71        |
| 1076.400  | 1046.40   | 7.01                    | 6.45         | 6.20         | 36.33                 | 35.45        | 33.54        | 30.48                 | 31.19        | 31.23        |
| 1158.800  | 1128.80   | 7.04                    | 6.29         | 6.04         | 34.81                 | 35.75        | 35.82        | 33.57                 | 36.16        | 37.63        |
| 1200.000  | 1170.00   | 6.80                    | 6.08         | 6.01         | 34.39                 | 34.68        | 34.53        | 34.21                 | 37.45        | 39.04        |

## mixer VSWR

## φ detection

| freq.<br>MHz | VSWR, RF port |             |              | VSWR, LO port |             |              | VSWR, IF port |             |              | max. output/DC offset vs. freq. |                      |                 |
|--------------|---------------|-------------|--------------|---------------|-------------|--------------|---------------|-------------|--------------|---------------------------------|----------------------|-----------------|
|              | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | Freq.<br>(MHz)                  | max. DC<br>output mV | DC offset<br>mV |
| 5.001        | 1.25          | 1.18        | 1.09         | 1.68          | 2.53        | 3.86         | 1.10          | 1.06        | 1.12         | 5.000                           | +397.20              | -1.85           |
| 10.000       | 1.24          | 1.18        | 1.08         | 1.69          | 2.52        | 3.46         | 1.09          | 1.03        | 1.10         | 10.000                          | +397.00              | -1.96           |
| 20.000       | 1.25          | 1.18        | 1.07         | 1.70          | 2.54        | 3.85         | 1.08          | 1.00        | 1.10         | 20.000                          | +392.50              | -2.11           |
| 50.000       | 1.24          | 1.17        | 1.06         | 1.62          | 2.44        | 3.65         | 1.08          | 1.01        | 1.11         | 50.000                          | +385.40              | -2.50           |
| 100.000      | 1.26          | 1.18        | 1.08         | 1.65          | 2.36        | 3.41         | 1.09          | 1.01        | 1.10         | 100.000                         | +390.90              | -2.89           |
| 124.500      | 1.27          | 1.20        | 1.09         | 1.69          | 2.40        | 3.40         | 1.10          | 1.02        | 1.10         | 200.000                         | +397.50              | -1.99           |
| 200.000      | 1.34          | 1.26        | 1.14         | 1.57          | 2.16        | 2.92         | 1.14          | 1.05        | 1.07         | 289.000                         | +407.20              | -1.11           |
| 283.830      | 1.42          | 1.34        | 1.21         | 1.48          | 1.99        | 2.77         | 1.20          | 1.10        | 1.04         | 360.000                         | +387.50              | +0.00           |
| 363.500      | 1.52          | 1.44        | 1.29         | 1.43          | 1.93        | 2.59         | 1.25          | 1.14        | 1.03         | 431.000                         | +334.40              | -.48            |
| 443.160      | 1.67          | 1.56        | 1.40         | 1.32          | 1.75        | 2.37         | 1.31          | 1.20        | 1.06         | 537.500                         | +352.60              | -1.94           |
| 500.000      | 1.76          | 1.66        | 1.47         | 1.28          | 1.67        | 2.21         | 1.36          | 1.25        | 1.10         | 608.500                         | +357.50              | -4.39           |
| 602.500      | 1.95          | 1.85        | 1.61         | 1.26          | 1.55        | 2.01         | 1.42          | 1.32        | 1.18         | 679.500                         | +311.20              | -3.23           |
| 682.160      | 2.12          | 2.01        | 1.76         | 1.24          | 1.40        | 1.87         | 1.46          | 1.38        | 1.27         | 750.500                         | +293.80              | -2.37           |
| 761.830      | 2.37          | 2.24        | 1.98         | 1.20          | 1.29        | 1.70         | 1.55          | 1.48        | 1.39         | 800.000                         | +297.03              | -1.95           |
| 841.490      | 2.59          | 2.43        | 2.15         | 1.23          | 1.21        | 1.60         | 1.64          | 1.59        | 1.52         | 857.000                         | +309.00              | -1.18           |
| 921.160      | 2.82          | 2.66        | 2.31         | 1.20          | 1.17        | 1.52         | 1.74          | 1.71        | 1.66         | 928.000                         | +319.80              | -.76            |
| 1000.000     | 2.92          | 2.61        | 2.37         | 1.24          | 1.20        | 1.52         | 1.81          | 1.79        | 1.75         | 1000.000                        | +346.00              | -.84            |
| 1080.500     | 2.99          | 2.78        | 2.46         | 1.31          | 1.32        | 1.54         | 1.91          | 1.88        | 1.83         | 1100.000                        | +353.40              | -.53            |
| 1160.200     | 2.78          | 2.59        | 2.33         | 1.39          | 1.48        | 1.64         | 1.85          | 1.83        | 1.78         | 1150.000                        | +361.10              | -.93            |
| 1200.000     | 2.68          | 2.53        | 2.26         | 1.49          | 1.59        | 1.73         | 1.87          | 1.84        | 1.81         | 1200.000                        | +351.60              | -1.13           |

Measurements at RF & LO Power +17 dBm

**Mini-Circuits**

P.O. BOX 166, Brooklyn, New York 11235 (718) 934-4500

## mixer harmonic intermodulation

(relative to desired IF output)

| RF ORDER HARMONIC | RF CAL | 0   | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  |
|-------------------|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0                 | -      | -   | 14  | 29  | 36  | 38  | 29  | 28  | 47  | 42  | 40  | 61  |
| 1                 | -      | 23  | -   | 34  | 18  | 44  | 30  | 50  | 35  | 57  | 54  | 43  |
| 2                 | 77     | 49  | 42  | 43  | 53  | 48  | 68  | 59  | 53  | 48  | 53  | 54  |
| 3                 | >94    | 69  | 45  | 62  | 41  | 60  | 48  | 62  | 57  | 58  | 61  | 63  |
| 4                 | >96    | 71  | 76  | 68  | 66  | 64  | 68  | 65  | 71  | 81  | 75  | 67  |
| 5                 | >96    | 82  | 76  | 81  | 70  | 78  | 64  | 75  | 67  | 77  | 84  | 74  |
| 6                 | >90    | 79  | >93 | >86 | >89 | 79  | 81  | 77  | >84 | 78  | >86 | >87 |
| 7                 | >88    | >86 | >85 | >93 | >94 | >93 | >90 | >93 | >86 | >83 | >89 | >88 |
| 8                 | >89    | >87 | >87 | >87 | >93 | >92 | >92 | >90 | >94 | >86 | >93 | >89 |
| 9                 | >90    | >87 | >89 | >88 | >88 | >92 | >92 | >93 | >93 | >92 | >93 | >92 |
| 10                | >90    | >88 | >87 | >87 | >88 | >87 | >94 | >93 | >93 | >93 | >93 | >92 |

Harmonic LO Order

test conditions: RF = IN: FREQ. 10.1 MHZ DRIVE -14.03 DBM TESTED ON :16.10.84  
 LO = IN: FREQ. 40.01 MHZ DRIVE +7.08 DBM TESTED BY :D.E.  
 IF = MEASURED: FREQ. 29.91 AMP. -19.1 DBM

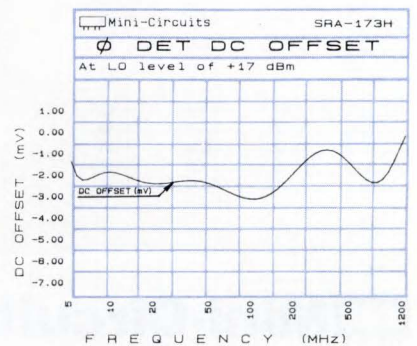
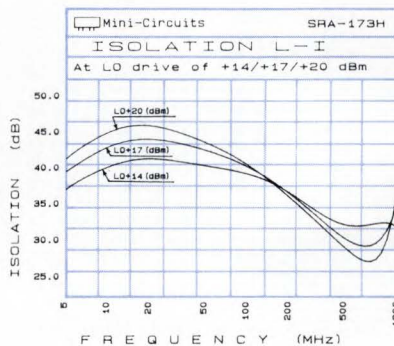
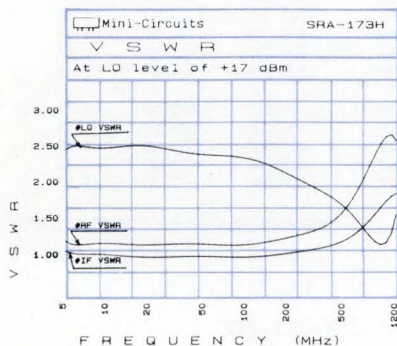
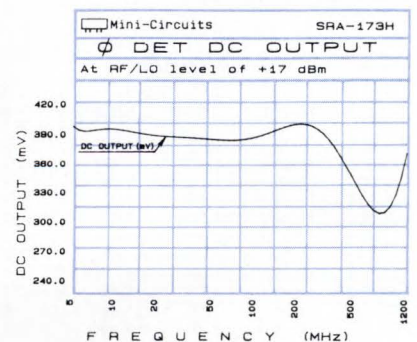
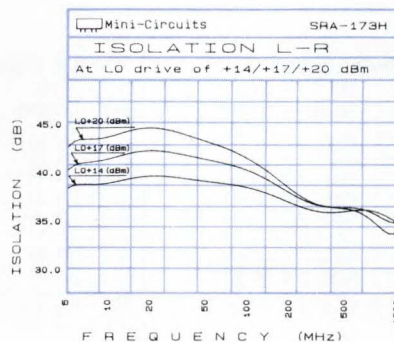
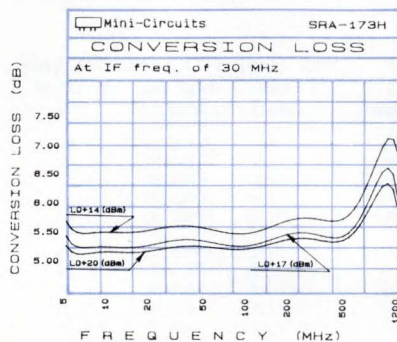
| RF ORDER HARMONIC | RF CAL | 0   | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  |
|-------------------|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0                 | -      | -   | 4   | 18  | 25  | 27  | 19  | 17  | 32  | 31  | 29  | 48  |
| 1                 | -      | 23  | -   | 33  | 18  | 43  | 31  | 47  | 36  | 55  | 43  | 39  |
| 2                 | >95    | 56  | 52  | 51  | 60  | 56  | 72  | 70  | 61  | 59  | 61  | 59  |
| 3                 | >94    | >83 | 64  | 81  | 61  | 74  | 68  | 77  | 74  | 73  | 73  | 75  |
| 4                 | >95    | >85 | >81 | >81 | >83 | >83 | >83 | >82 | >83 | >83 | 83  | >83 |
| 5                 | >95    | >86 | >83 | >83 | >83 | 83  | >82 | >84 | >82 | >84 | >85 | >83 |
| 6                 | >89    | >78 | >83 | >83 | >83 | >82 | >83 | >82 | >84 | >81 | >82 | >85 |
| 7                 | >89    | >76 | >77 | >82 | >83 | >83 | >82 | >84 | >83 | >84 | >82 | >82 |
| 8                 | >89    | >78 | >77 | >77 | >84 | >84 | >84 | >81 | >83 | >83 | >83 | >84 |
| 9                 | >88    | >77 | >77 | >76 | >77 | >84 | >83 | >84 | >82 | >83 | >83 | >85 |
| 10                | >89    | >76 | >77 | >78 | >78 | >76 | >84 | >83 | >83 | >82 | >83 | >83 |

Harmonic LO Order

test conditions: RF = IN: FREQ. 1000.1 MHZ DRIVE -5.06 DBM  
 TESTED ON :16.10.84  
 LO = IN: FREQ. 970.01 MHZ DRIVE +16.97 DBM TESTED BY :D.E.  
 IF = MEASURED: FREQ. 30.09 AMP. -11.97 DBM

## typical performance curves

(production unit)





very low distortion

# Frequency Mixers

LEVEL 17S (+17dBm LO, up to +14dBm RF)

## Models

TFM-1H  
TAK-1H  
ZFM-1H  
ZLW-1SH  
ZAD-1SH



computer-automated performance data  
typical production unit / for data of other models consult factory

## mixer conversion loss and isolation

| RF<br>MHz | LO<br>MHz | Conversion Loss<br>(dB) |              |              | Isolation L-R<br>(dB) |              |              | Isolation L-I<br>(dB) |              |              |
|-----------|-----------|-------------------------|--------------|--------------|-----------------------|--------------|--------------|-----------------------|--------------|--------------|
|           |           | LO<br>+14dBm            | LO<br>+17dBm | LO<br>+20dBm | LO<br>+14dBm          | LO<br>+17dBm | LO<br>+20dBm | LO<br>+14dBm          | LO<br>+17dBm | LO<br>+20dBm |
| 2.000     | 32.00     | 6.99                    | 6.30         | 5.96         | 59.73                 | 62.98        | 64.42        | 49.91                 | 52.28        | 53.48        |
| 5.000     | 35.00     | 6.55                    | 5.95         | 5.64         | 58.95                 | 62.06        | 63.57        | 50.65                 | 52.79        | 53.94        |
| 10.000    | 40.00     | 6.49                    | 5.92         | 5.61         | 58.36                 | 60.47        | 61.17        | 50.51                 | 52.35        | 53.27        |
| 20.000    | 50.00     | 6.50                    | 5.91         | 5.56         | 56.65                 | 57.14        | 56.42        | 49.94                 | 51.13        | 51.39        |
| 34.130    | 64.13     | 6.36                    | 5.81         | 5.52         | 54.15                 | 53.27        | 52.36        | 49.01                 | 49.30        | 48.99        |
| 50.000    | 80.00     | 6.25                    | 5.72         | 5.45         | 51.52                 | 50.24        | 49.08        | 47.71                 | 47.27        | 46.43        |
| 66.260    | 96.26     | 6.18                    | 5.66         | 5.41         | 49.53                 | 48.03        | 46.97        | 46.55                 | 45.61        | 44.80        |
| 82.325    | 112.33    | 6.26                    | 5.71         | 5.44         | 47.86                 | 46.33        | 45.28        | 45.48                 | 44.27        | 43.40        |
| 100.000   | 130.00    | 6.11                    | 5.63         | 5.41         | 46.57                 | 44.99        | 43.58        | 44.56                 | 43.26        | 41.99        |
| 130.520   | 160.52    | 6.17                    | 5.61         | 5.39         | 45.09                 | 43.18        | 41.88        | 43.49                 | 41.91        | 40.57        |
| 162.650   | 192.65    | 6.18                    | 5.61         | 5.47         | 43.61                 | 41.46        | 40.35        | 42.55                 | 40.45        | 39.27        |
| 200.000   | 230.00    | 5.98                    | 5.60         | 5.49         | 42.31                 | 40.12        | 38.78        | 41.40                 | 39.22        | 37.84        |
| 259.040   | 289.04    | 5.65                    | 5.42         | 5.35         | 39.68                 | 38.10        | 36.88        | 38.80                 | 37.51        | 36.43        |
| 307.240   | 337.24    | 5.78                    | 5.62         | 5.51         | 39.02                 | 37.54        | 36.24        | 37.22                 | 36.13        | 34.78        |
| 355.430   | 385.43    | 6.08                    | 5.86         | 5.65         | 38.51                 | 37.41        | 36.33        | 37.11                 | 36.94        | 36.74        |
| 387.560   | 417.56    | 6.14                    | 5.92         | 5.76         | 37.04                 | 36.35        | 35.45        | 36.53                 | 35.99        | 35.89        |
| 435.760   | 465.76    | 6.05                    | 5.81         | 5.70         | 36.29                 | 35.35        | 33.81        | 34.02                 | 33.91        | 32.80        |
| 467.890   | 497.89    | 6.02                    | 5.90         | 5.85         | 36.52                 | 36.34        | 34.94        | 33.70                 | 33.81        | 33.32        |
| 483.950   | 513.95    | 6.15                    | 6.08         | 6.03         | 36.00                 | 36.44        | 35.92        | 33.21                 | 33.54        | 33.58        |
| 500.000   | 530.00    | 6.33                    | 6.27         | 6.18         | 35.43                 | 36.27        | 36.07        | 32.39                 | 33.21        | 33.60        |

## mixer VSWR

## $\phi$ detection

| freq.<br>MHz | VSWR, RF port |             |              | VSWR, LO port |             |              | VSWR, IF port |             |              | max. output/DC offset vs. freq. |                      |                 |
|--------------|---------------|-------------|--------------|---------------|-------------|--------------|---------------|-------------|--------------|---------------------------------|----------------------|-----------------|
|              | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | LO<br>+4dBm   | LO<br>+7dBm | LO<br>+10dBm | Freq.<br>(MHz)                  | max. DC<br>output mV | DC offset<br>mV |
| 5.002        | 1.28          | 1.22        | 1.25         | 1.27          | 1.67        | 2.71         | 1.51          | 1.33        | 1.25         | 2.000                           | -896.40              | + .84           |
| 10.000       | 1.20          | 1.10        | 1.14         | 1.20          | 1.60        | 2.58         | 1.51          | 1.34        | 1.25         | 5.000                           | -910.70              | + .82           |
| 20.000       | 1.16          | 1.03        | 1.09         | 1.07          | 1.63        | 2.60         | 1.51          | 1.33        | 1.25         | 10.000                          | -925.30              | + .82           |
| 35.938       | 1.14          | 1.02        | 1.10         | 1.08          | 1.61        | 2.56         | 1.50          | 1.33        | 1.25         | 20.000                          | -928.20              | + .82           |
| 50.000       | 1.14          | 1.04        | 1.12         | 1.13          | 1.58        | 2.55         | 1.51          | 1.34        | 1.26         | 50.000                          | -907.30              | + .86           |
| 82.345       | 1.14          | 1.06        | 1.13         | 1.12          | 1.57        | 2.33         | 1.52          | 1.36        | 1.27         | 70.688                          | -918.40              | + .93           |
| 100.000      | 1.15          | 1.07        | 1.14         | 1.11          | 1.55        | 2.46         | 1.55          | 1.38        | 1.29         | 100.000                         | -923.40              | + .89           |
| 128.750      | 1.15          | 1.08        | 1.15         | 1.12          | 1.54        | 2.30         | 1.58          | 1.41        | 1.32         | 122.200                         | -943.50              | + .97           |
| 175.160      | 1.18          | 1.09        | 1.16         | 1.10          | 1.57        | 2.33         | 1.68          | 1.49        | 1.41         | 156.550                         | -957.90              | + 1.21          |
| 200.000      | 1.18          | 1.10        | 1.16         | 1.08          | 1.55        | 2.24         | 1.73          | 1.54        | 1.45         | 173.720                         | -976.00              | + 1.21          |
| 252.500      | 1.20          | 1.10        | 1.16         | 1.06          | 1.55        | 2.23         | 1.89          | 1.70        | 1.60         | 200.000                         | -989.10              | + 1.53          |
| 298.910      | 1.21          | 1.08        | 1.15         | 1.08          | 1.60        | 2.29         | 2.12          | 1.85        | 1.72         | 242.410                         | -1025.60             | + 1.08          |
| 329.850      | 1.21          | 1.07        | 1.14         | 1.11          | 1.67        | 2.37         | 2.30          | 1.96        | 1.83         | 276.750                         | -1017.80             | + 1.54          |
| 360.790      | 1.20          | 1.06        | 1.13         | 1.16          | 1.70        | 2.33         | 2.43          | 2.10        | 1.91         | 300.000                         | -987.00              | + 1.77          |
| 391.730      | 1.19          | 1.05        | 1.12         | 1.20          | 1.76        | 2.38         | 2.63          | 2.24        | 2.05         | 328.270                         | -939.20              | + 2.14          |
| 422.660      | 1.17          | 1.04        | 1.12         | 1.21          | 1.82        | 2.41         | 2.86          | 2.38        | 2.19         | 362.610                         | -883.40              | + 1.02          |
| 453.600      | 1.14          | 1.05        | 1.13         | 1.28          | 1.84        | 2.51         | 3.02          | 2.52        | 2.28         | 400.000                         | -847.50              | + .71           |
| 469.070      | 1.12          | 1.06        | 1.14         | 1.31          | 1.85        | 2.49         | 3.14          | 2.61        | 2.35         | 431.300                         | -861.90              | + 1.38          |
| 484.540      | 1.10          | 1.08        | 1.16         | 1.38          | 1.87        | 2.48         | 3.22          | 2.69        | 2.43         | 465.640                         | -903.30              | + 1.34          |
| 500.000      | 1.08          | 1.09        | 1.17         | 1.42          | 1.90        | 2.52         | 3.27          | 2.73        | 2.44         | 500.000                         | -877.00              | + 1.67          |

Measurements at RF & LO Power +17 dBm

**Mini-Circuits**

P.O. BOX 166, Brooklyn, New York 11235 (718) 934-4500

## mixer harmonic intermodulation

(relative to desired IF output)

| RF ORDER HARMONIC | RF CAL |     |     |     |     |     |     |     |     |     |     |     |     |
|-------------------|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|                   | 0      | -   | -   | 29  | 52  | 28  | 50  | 35  | 50  | 44  | 54  | 49  | 66  |
|                   | 1      | -   | -   | 25  | 38  | 14  | 45  | 34  | 38  | 33  | 43  | 32  | 47  |
|                   | 2      | 64  | >65 | 56  | >72 | 54  | >73 | 52  | >72 | 55  | >78 | 57  | >65 |
|                   | 3      | 68  | 60  | 55  | >64 | 62  | >67 | 51  | >73 | 45  | 60  | 43  | 58  |
|                   | 4      | >95 | >89 | 77  | 84  | 71  | 81  | 73  | 81  | >95 | 79  | 72  | 83  |
|                   | 5      | >95 | 82  | 67  | 73  | 65  | 74  | 56  | 73  | 55  | 75  | 55  | 84  |
|                   | 6      | >96 | 86  | 78  | >91 | 77  | 89  | 76  | 86  | 78  | 86  | 84  | >91 |
|                   | 7      | >95 | 86  | 76  | >94 | 81  | 85  | 71  | 82  | 66  | 82  | 65  | 84  |
|                   | 8      | >94 | >94 | 82  | >91 | 85  | >94 | 84  | >92 | 86  | >95 | >90 | >95 |
|                   | 9      | 94  | >94 | >94 | >95 | 83  | >90 | 82  | >90 | 80  | >94 | 77  | >94 |
|                   | 10     | >95 | >93 | >94 | >94 | >91 | >95 | >93 | >95 | >92 | >95 | >94 | >94 |
|                   |        | 0   | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  |     |

Harmonic LO Order

test conditions: RF.=IN: FREQ.185.1 MHZ DRIVE +4.97 DBM TESTED ON :17.10.84  
 LO.=IN: FREQ.155.01 MHZ DRIVE +16.91 DBM TESTED BY :D.E.  
 IF=MEASURED: FREQ.30.09 AMP. =-.93 DBM

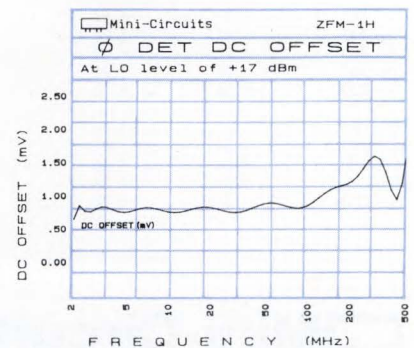
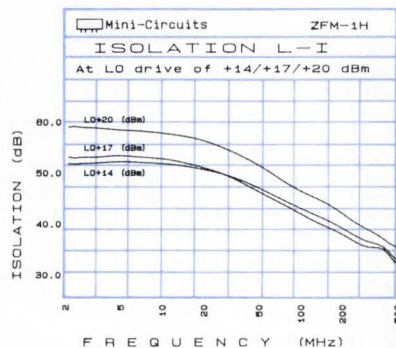
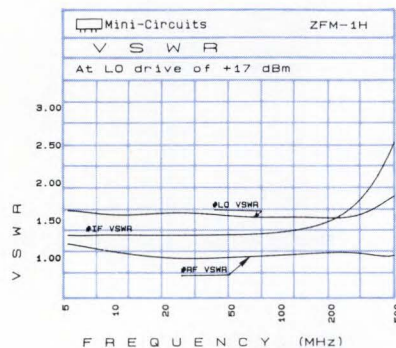
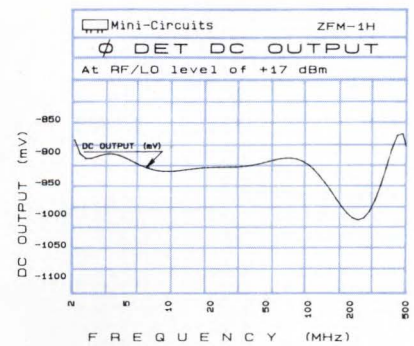
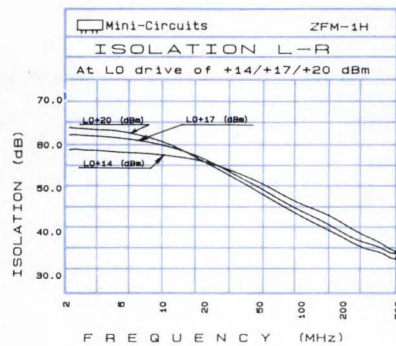
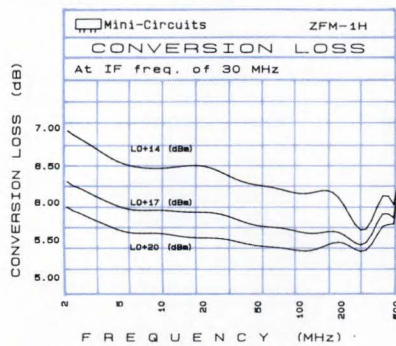
| RF ORDER HARMONIC | RF CAL |     |     |     |     |     |     |     |     |     |     |     |     |
|-------------------|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|                   | 0      | -   | -   | 20  | 42  | 17  | 41  | 23  | 39  | 32  | 39  | 32  | 50  |
|                   | 1      | -   | 25  | -   | 39  | 15  | 44  | 54  | 35  | 29  | 38  | 24  | 41  |
|                   | 2      | 83  | >77 | 58  | 71  | 58  | 69  | 60  | 69  | 64  | >77 | 65  | >82 |
|                   | 3      | 95  | 71  | 62  | 74  | 59  | 72  | 54  | 78  | 53  | 74  | 54  | 72  |
|                   | 4      | >95 | >85 | 80  | >86 | 79  | >84 | 83  | >84 | >84 | >86 | 82  | >86 |
|                   | 5      | >96 | >85 | >85 | >85 | 84  | >84 | 80  | 85  | 79  | 86  | 82  | >86 |
|                   | 6      | >94 | >84 | >84 | >85 | >84 | >84 | 84  | 87  | >85 | >85 | 85  | >84 |
|                   | 7      | >94 | >85 | >85 | >84 | >83 | >85 | >84 | >85 | >84 | >84 | >85 | >83 |
|                   | 8      | >95 | >84 | 84  | >84 | >85 | >85 | >85 | >84 | >85 | >84 | >85 | >84 |
|                   | 9      | >95 | >84 | >84 | 85  | >85 | >84 | >85 | >85 | >85 | 85  | >84 | >84 |
|                   | 10     | >94 | >84 | >84 | >83 | >84 | >84 | >83 | >84 | >85 | >84 | >85 | >84 |
|                   | <hr/>  |     |     |     |     |     |     |     |     |     |     |     |     |
|                   | 0      | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  |     |     |

Harmonic LO Order

test conditions: RF.=IN: FREQ.185.1 MHZ DRIVE -4.95 DBM TESTED ON :17.10.84  
 LO.=IN: FREQ.155.01 MHZ DRIVE +16.91 DBM TESTED BY :D.E.  
 IF=MEASURED: FREQ.30.09 AMP. =-10.85 DBM

## typical performance curves

(production unit)





ultra-low distortion

# Frequency Mixers

LEVEL 23 (+23dBm LO, up to +15dBm RF)

## Models

RAY-1

ZMY-1

ZAY-1



computer-automated performance data

typical production unit / for data of other models consult factory

## mixer conversion loss and isolation

| RF<br>MHz | LO<br>MHz | Conversion Loss<br>(dB) |              |              | Isolation L-R<br>(dB) |              |              | Isolation L-I<br>(dB) |              |              |
|-----------|-----------|-------------------------|--------------|--------------|-----------------------|--------------|--------------|-----------------------|--------------|--------------|
|           |           | LO<br>+20dBm            | LO<br>+23dBm | LO<br>+26dBm | LO<br>+20dBm          | LO<br>+23dBm | LO<br>+26dBm | LO<br>+20dBm          | LO<br>+23dBm | LO<br>+26dBm |
| 5.000     | 35.00     | 6.50                    | 6.52         | 6.53         | 61.85                 | 57.02        | 53.70        | 79.05                 | 82.02        | >86.00       |
| 10.000    | 40.00     | 6.43                    | 6.40         | 6.48         | 60.36                 | 56.72        | 53.82        | 79.25                 | 82.32        | >86.00       |
| 20.000    | 50.00     | 6.40                    | 6.40         | 6.49         | 56.74                 | 54.48        | 52.00        | 79.36                 | 81.28        | 81.01        |
| 35.938    | 65.94     | 6.43                    | 6.43         | 6.53         | 52.88                 | 51.51        | 49.99        | 76.65                 | 75.99        | 75.33        |
| 50.000    | 80.00     | 6.38                    | 6.40         | 6.51         | 50.10                 | 48.82        | 47.85        | 72.70                 | 72.57        | 68.82        |
|           |           |                         |              |              |                       |              |              |                       |              |              |
| 82.345    | 52.35     | 6.37                    | 6.39         | 6.59         | 45.91                 | 45.62        | 45.16        | 66.35                 | 62.91        | 60.22        |
| 100.000   | 70.00     | 6.33                    | 6.36         | 6.56         | 44.28                 | 44.05        | 43.27        | 61.72                 | 58.66        | 56.52        |
| 144.220   | 114.22    | 6.45                    | 6.53         | 6.64         | 41.58                 | 41.60        | 41.21        | 54.43                 | 53.71        | 54.55        |
| 175.160   | 145.16    | 6.63                    | 6.68         | 6.77         | 39.88                 | 40.04        | 39.24        | 51.26                 | 51.38        | 50.90        |
| 200.000   | 170.00    | 6.68                    | 6.69         | 6.76         | 39.60                 | 39.45        | 38.48        | 50.04                 | 50.73        | 50.65        |
|           |           |                         |              |              |                       |              |              |                       |              |              |
| 221.570   | 191.57    | 6.49                    | 6.52         | 6.62         | 36.79                 | 36.41        | 37.51        | 45.90                 | 46.45        | 49.56        |
| 252.500   | 222.50    | 6.51                    | 6.52         | 6.61         | 36.84                 | 36.33        | 36.92        | 47.05                 | 47.23        | 49.54        |
| 283.440   | 253.44    | 6.62                    | 6.64         | 6.77         | 37.32                 | 36.36        | 36.25        | 47.30                 | 47.98        | 49.23        |
| 314.380   | 284.38    | 6.70                    | 6.74         | 6.84         | 37.11                 | 36.35        | 36.04        | 46.09                 | 46.73        | 48.01        |
| 345.320   | 315.32    | 6.67                    | 6.62         | 6.75         | 34.44                 | 33.85        | 34.16        | 42.98                 | 44.99        | 48.25        |
|           |           |                         |              |              |                       |              |              |                       |              |              |
| 376.260   | 346.26    | 6.57                    | 6.50         | 6.57         | 30.62                 | 30.50        | 31.71        | 40.13                 | 41.75        | 42.64        |
| 407.190   | 377.19    | 6.63                    | 6.43         | 6.39         | 32.30                 | 32.89        | 32.68        | 41.52                 | 42.28        | 41.96        |
| 438.130   | 408.13    | 6.83                    | 6.50         | 6.32         | 34.18                 | 33.81        | 34.16        | 42.37                 | 42.66        | 43.08        |
| 469.070   | 439.07    | 7.31                    | 6.81         | 6.64         | 34.59                 | 33.63        | 34.33        | 42.39                 | 41.41        | 40.68        |
| 500.000   | 470.00    | 7.15                    | 6.62         | 6.62         | 34.79                 | 34.24        | 34.04        | 40.74                 | 40.42        | 39.86        |

## mixer VSWR

## φ detection

| freq.<br>MHz | VSWR, RF port |              | VSWR, LO port |              | VSWR, IF port |              | max. output/DC offset vs. freq. |                      |                 |
|--------------|---------------|--------------|---------------|--------------|---------------|--------------|---------------------------------|----------------------|-----------------|
|              | LO<br>+20dBm  | LO<br>+23dBm | LO<br>+20dBm  | LO<br>+23dBm | LO<br>+20dBm  | LO<br>+23dBm | Freq.<br>(MHz)                  | max. DC<br>output mV | DC offset<br>mV |
| 5.001        | 1.26          | 1.29         | 1.88          | 2.50         | 1.47          | 1.33         | 5.000                           | -1385.80             | -1.23           |
| 10.000       | 1.12          | 1.14         | 1.80          | 2.37         | 1.47          | 1.33         | 10.000                          | -1409.30             | -1.23           |
| 20.000       | 1.03          | 1.06         | 1.85          | 2.33         | 1.48          | 1.33         | 20.000                          | -1383.10             | -1.25           |
| 35.938       | 1.01          | 1.05         | 1.82          | 2.31         | 1.48          | 1.33         | 36.344                          | -1343.30             | -1.31           |
| 50.000       | 1.03          | 1.07         | 1.85          | 2.37         | 1.47          | 1.34         | 50.000                          | -1331.10             | -1.34           |
|              |               |              |               |              |               |              |                                 |                      |                 |
| 82.345       | 1.06          | 1.08         | 1.76          | 2.20         | 1.51          | 1.36         | 70.688                          | -1336.80             | -1.35           |
| 100.000      | 1.07          | 1.10         | 1.77          | 2.25         | 1.53          | 1.39         | 87.860                          | -1376.40             | -1.51           |
| 144.220      | 1.11          | 1.12         | 1.72          | 2.11         | 1.62          | 1.45         | 100.000                         | -1386.40             | -1.35           |
| 175.160      | 1.13          | 1.14         | 1.80          | 2.25         | 1.66          | 1.51         | 139.380                         | -1311.20             | -1.32           |
| 200.000      | 1.15          | 1.16         | 1.68          | 2.06         | 1.74          | 1.56         | 173.720                         | -1328.90             | -1.90           |
|              |               |              |               |              |               |              |                                 |                      |                 |
| 221.570      | 1.17          | 1.18         | 1.76          | 2.17         | 1.78          | 1.61         | 200.000                         | -1376.10             | -1.77           |
| 252.500      | 1.19          | 1.20         | 1.67          | 2.04         | 1.87          | 1.67         | 242.410                         | -1327.70             | -1.60           |
| 283.440      | 1.21          | 1.22         | 1.74          | 2.10         | 1.82          | 1.66         | 276.750                         | -1361.20             | -2.85           |
| 314.380      | 1.24          | 1.24         | 1.68          | 1.96         | 1.98          | 1.79         | 300.000                         | -1342.10             | -2.44           |
| 345.320      | 1.26          | 1.26         | 1.75          | 2.04         | 2.06          | 1.87         | 345.440                         | -1273.10             | -3.00           |
|              |               |              |               |              |               |              |                                 |                      |                 |
| 376.260      | 1.29          | 1.29         | 1.70          | 1.96         | 2.13          | 1.91         | 379.780                         | -1214.40             | -.53            |
| 407.190      | 1.31          | 1.31         | 1.69          | 1.95         | 2.18          | 1.96         | 400.000                         | -1216.90             | -1.82           |
| 438.130      | 1.34          | 1.35         | 1.67          | 1.90         | 2.23          | 2.01         | 431.300                         | -1282.30             | +.07            |
| 469.070      | 1.37          | 1.38         | 1.63          | 1.87         | 2.25          | 2.04         | 465.640                         | -1220.50             | +.70            |
| 500.000      | 1.43          | 1.44         | 1.60          | 1.83         | 2.26          | 2.05         | 500.000                         | -1228.50             | -2.86           |

Measurements at RF & LO Power +23 dBm

**Mini-Circuits**

P.O. BOX 166, Brooklyn, New York 11235 (718) 934-4500

## mixer harmonic intermodulation

(relative to desired IF output)

| RF CAL |     |     |     |     |     |     |     |     |     |     |     |     |  |
|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|
| 0      | -   | -   | 19  | 37  | 32  | 44  | 30  | 50  | 34  | 58  | 46  | 61  |  |
| 1      | -   | 21  | -   | 33  | 11  | 39  | 18  | 49  | 24  | 43  | 36  | 49  |  |
| 2      | 63  | 56  | 42  | >66 | 47  | >65 | 49  | >64 | 47  | >67 | 46  | >61 |  |
| 3      | 73  | 53  | 42  | 52  | 56  | 57  | 49  | 57  | 42  | 57  | 42  | 64  |  |
| 4      | >85 | 71  | 61  | 77  | 60  | 77  | 59  | 70  | 63  | 69  | 58  | 69  |  |
| 5      | >86 | 64  | 56  | 64  | 59  | 70  | 53  | 67  | 53  | 70  | 53  | 76  |  |
| 6      | >86 | 75  | 62  | >82 | 70  | >80 | 70  | 78  | 66  | >84 | 72  | >82 |  |
| 7      | >86 | 69  | 65  | >80 | 62  | 74  | 64  | 75  | 69  | 77  | 67  | >80 |  |
| 8      | >86 | >83 | 78  | >89 | 75  | >87 | >81 | >85 | >79 | >88 | >79 | >87 |  |
| 9      | >85 | >86 | 74  | >83 | >81 | >88 | >84 | >81 | 76  | >85 | 73  | >88 |  |
| 10     | >85 | >88 | >80 | >88 | >88 | >88 | >85 | >89 | >88 | >88 | >79 | >89 |  |
|        |     | 0   | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  |  |

Harmonic LO Order

test conditions: RF = IN: FREQ. 185.1 MHZ DRIVE +9.98 DBM  
 TESTED ON: 17.10.84  
 LO = IN: FREQ. 155.01 MHZ DRIVE +22.98 DBM TESTED BY: D.E.  
 IF = MEASURED: FREQ. 30.09 AMP. +3.07 DBM

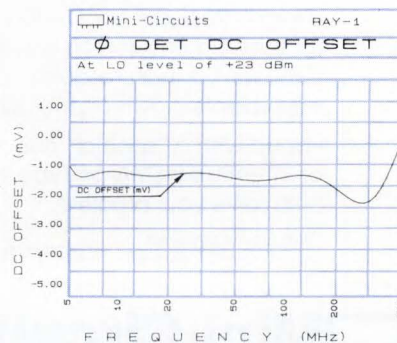
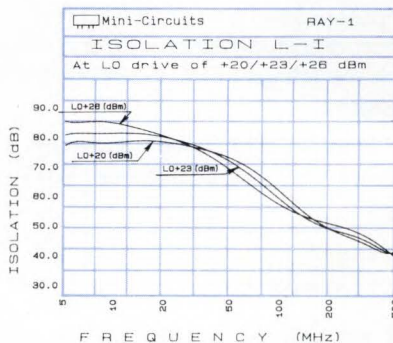
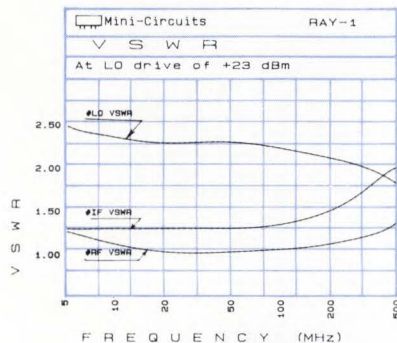
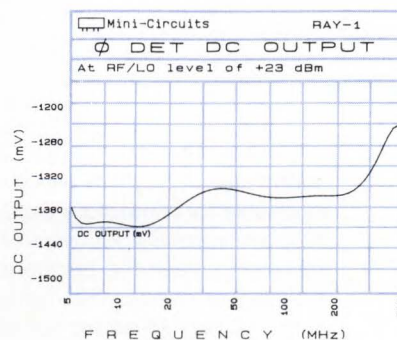
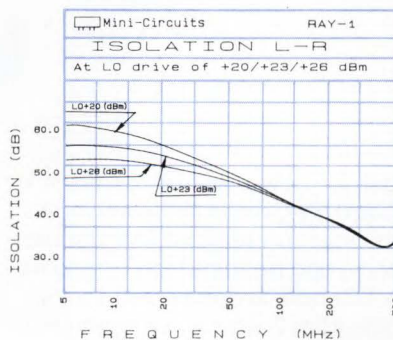
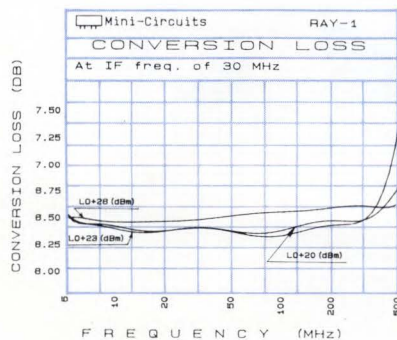
| RF ORDER HARMONIC | RF CAL |     |     |     |     |     |     |     |     |     |     |     |     |
|-------------------|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|                   | 0      | -   | -   | 13  | 20  | 24  | 27  | 21  | 35  | 19  | 40  | 26  | 51  |
|                   | 1      | -   | 19  | -   | 36  | 11  | 40  | 17  | 46  | 21  | 42  | 31  | 40  |
|                   | 2      | 83  | 60  | 50  | 62  | 51  | 60  | 52  | 59  | 53  | 59  | 52  | 67  |
|                   | 3      | >85 | 72  | 62  | 68  | 60  | 69  | 58  | 71  | 55  | 72  | 54  | 76  |
|                   | 4      | >85 | >78 | 73  | >78 | 76  | >78 | >78 | >77 | >78 | >79 | >78 | >78 |
|                   | 5      | >85 | >78 | >79 | >79 | >79 | >78 | >78 | >78 | 77  | >78 | 75  | >79 |
|                   | 6      | >85 | >77 | >79 | >78 | >79 | >79 | >78 | >78 | >78 | >79 | >79 | >80 |
|                   | 7      | >84 | >78 | >77 | >79 | >78 | >78 | >78 | >79 | >78 | >78 | >79 | >79 |
|                   | 8      | >86 | >78 | >79 | >78 | >78 | 79  | >78 | >79 | >79 | >79 | >78 | >78 |
|                   | 9      | >86 | >78 | >77 | >78 | >78 | >78 | >79 | >78 | >80 | >80 | >78 | >79 |
|                   | 10     | >85 | >79 | >78 | >77 | >77 | >78 | >77 | >79 | >78 | >79 | >78 | >79 |
|                   |        | 0   | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  |     |

Harmonic LO Order

test conditions: RF = IN: FREQ. 185.1 MHZ DRIVE 0 DBM  
 TESTED ON: 17.10.84  
 LO = IN: FREQ. 155.01 MHZ DRIVE +22.97 DBM TESTED BY: D.E.  
 IF = MEASURED: FREQ. 30.09 AMP. -6.82 DBM

## typical performance curves

(production unit)

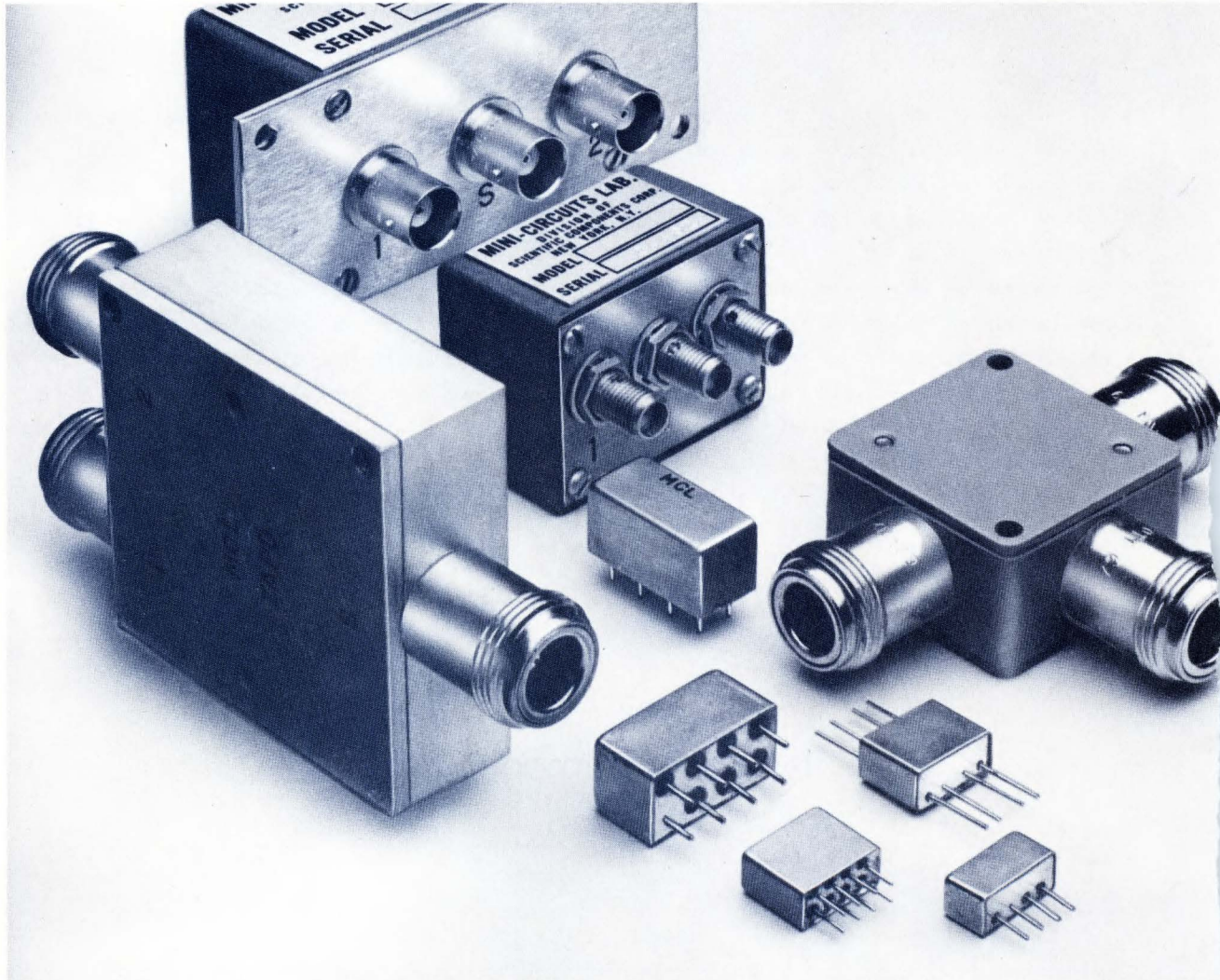




high isolation, wide bandwidth

# Power Splitter/Combiners

2 to 48 Way . . . 0°, 90°, 180°  
2KHz to 4.2GHz



With over 200 off-the-shelf models of power splitter/combiners available for immediate delivery from Mini-Circuits, there is no need to compromise your requirements. You can select a Mini-Circuits device to meet the frequency range and performance criteria of your system design. Pin models for PC- boards and connector versions (50 and 75 ohms) are available from 2-way 0°, 90° and 180° to 48-way covering 2KHz to 4.2GHz. Need detailed data for your design? Request our CAPD (computer-aided performance data) for specifics on insertion loss, isolation, amplitude unbalance and return loss. For high reliability, check the listings of MIL-P-23971/15\* equivalents shown on the data pages.

Faced with a "special" need . . . higher isolation, wide bandwidth, or intermixed SMA or Type N connectors? Just contact us. We'll help solve your problem.

\*Units are not GPL listed.

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## getting tighter specs at lower costs

Basically, a 0° splitter is a passive device which accepts an input signal and delivers multiple output signals with specific phase and amplitude characteristics, see Fig. 1. The output signals theoretically possesses the following characteristics:

- equal amplitude
- 0° phase relationship between any two output ports
- insertion loss as follows:

| No. of Output Ports | Theoretical Insertion Loss (dB) |
|---------------------|---------------------------------|
| 2                   | 3.0                             |
| 3                   | 4.8                             |
| 4                   | 6.0                             |
| 6                   | 7.8                             |
| 8                   | 9.0                             |
| 16                  | 12.0                            |
| 24                  | 13.8                            |

A 0° power splitter can be used as a power combiner by applying the signals to be combined into the ports A and B and then delivering the vector sum to port S. Now the device provides a single output equal to the vector sum of the inputs reduced in power by the theoretical insertion loss. An important characteristic of a power combiner is the high isolation between inputs.

The following signal processing functions can be accomplished by power splitter/combiners:

1. Add or subtract signal vectorially.
2. Obtain multi in-phase output signals proportional to the level of a common input signal.
3. Split an input signal into multi-outputs.
4. Combine signals from different sources to obtain a single port output.
5. Provide a capability to obtain RF logic arrangements.

## match the specs to the application

Generally, engineering designs exist in a world of tradeoffs. Mixers, for example, can be designed so that isolation can be improved at the expense of conversion loss; similarly, a mixer's noise figure can be improved if a reduction in dynamic range can be accepted in exchange.

Not so, fortunately with power splitters. The key parameters are influenced in the same direction during the design stage. A well-designed power splitter will offer high isolation low insertion loss and good VSWR. You just don't encounter a power splitter with high isolation and poor VSWR, nor high isolation with a poor insertion loss spec. Why? Because poor insertion loss specs generally result from an improper matching transformer (winding not exactly symmetrical) or slight variations in stray capacitances at each end of the transformer; these effects, however, adversely affect isolation loss as well as isolation.



### 1. When used as a 0° power splitter

the input is applied to port S and equal outputs appear at ports A and B. When used as a power combiner, both inputs are applied to ports A and B and the sum taken from port S.

(END minipg69)

This raises a significant point. There is no need to specify a number of tight spec parameters when you need a power splitter for a particularly stringent requirement. Simply specify a tight improved spec on the key parameter most critical to the task and you'll find the remaining specs will also be upgraded. If you insist on writing tight specs on a number of parameters, you may be paying extra money for a device you would have received anyway. Of course, you can specify one tight parameter, as suggested, and request support data on the other parameters to monitor their characteristics.

In some applications, it is possible for several parameters to be important. In other applications, only one parameter may be considerably significant while others are not. For example, in a power combiner used to add the outputs of two amplifiers, insertion loss is a critical factor while isolation may not be deemed critical.

On the other hand, consider a test setup for two-tone, third-order IM measurement. Here it is common to operate two RF generators that are close to each other in frequency, resulting in one generator "talking to the other" or "pulling". To avoid this measurement pitfall, a power splitter is placed between both RF generators; here the isolation spec is very significant while other parameters, such as phase of amplitude unbalance, have no importance at all.

Again, you can lower your demands, and your cost, by analyzing what parameters must be met while understanding others that can be ignored.



## Don't guess, use CAPD data

Don't gamble with your systems design. Refer to the computer-automated performance data (CAPD) within the Mini-Circuits pages of this directory. Need CAPD data at the specific frequencies your application involves? Just phone or write us.



# Power Splitter/Combiners

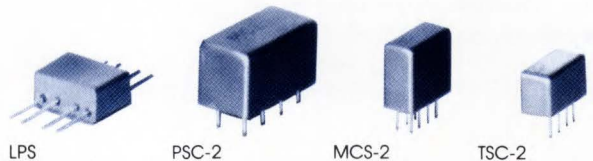
2 WAY-O°  
2 KHz to 4.2 GHz

## performance data

curves, tables, page 4 Model Index

## case style selection

outline drawings see page 3



|                   | MODEL NO.    | FREQ. RANGE<br>MHz<br>$f_L$ - $f_U$ | ISOLATION<br>dB |      |      |      |      |      | INSERTION LOSS, dB<br>Above 3dB |      |      |      |      |      | PHASE<br>UNBALANCE<br>Degrees |      |      | AMPLITUDE<br>UNBALANCE<br>dB |      |      | PRICE, \$ |       |        |
|-------------------|--------------|-------------------------------------|-----------------|------|------|------|------|------|---------------------------------|------|------|------|------|------|-------------------------------|------|------|------------------------------|------|------|-----------|-------|--------|
|                   |              |                                     | L               |      | M    |      | U    |      | L                               |      | M    |      | U    |      | L                             | M    | U    | L                            | M    | U    | Ea.       | Qty.  |        |
|                   |              |                                     | Typ.            | Min. | Typ. | Min. | Typ. | Min. | Typ.                            | Max. | Typ. | Max. | Typ. | Max. | Max.                          | Max. | Max. | Max.                         | Max. | Max. |           |       |        |
| LPS<br>case BB48  | LPS-109      | NEW                                 | 10-500          | 35   | 25   | 30   | 25   | 30   | 25                              | 0.3  | 0.5  | 0.4  | 0.6  | 0.5  | 0.8                           | 2.0  | 3.0  | 2.0                          | 0.15 | 0.2  | 0.3       | 15.95 | (5-24) |
| PSC-2<br>case A01 | PSC-2-1      |                                     | 0.1-400         | 20   | 15   | 25   | 20   | 25   | 20                              | 0.2  | 0.6  | 0.4  | 0.75 | 0.6  | 1.0                           | 2.0  | 3.0  | 4.0                          | 0.15 | 0.2  | 0.3       | 9.95  | (6-49) |
|                   | PSC-2-1W     |                                     | 1-650           | 25   | 20   | 35   | 25   | 25   | 20                              | 0.3  | 0.6  | 0.5  | 0.9  | 0.7  | 1.0                           | 2.0  | 3.0  | 4.0                          | 0.15 | 0.2  | 0.3       | 14.95 | (6-49) |
|                   | PSC-2-2      |                                     | 0.002-60        | 27   | 20   | 30   | 20   | 27   | 20                              | 0.3  | 0.6  | 0.3  | 0.6  | 0.6  | 1.0                           | 2.0  | 3.0  | 4.0                          | 0.15 | .25  | 0.3       | 19.95 | (6-49) |
|                   | PSC-2-4      |                                     | 10-1000         | 30   | 25   | 25   | 20   | 25   | 20                              | 0.6  | 1.0  | 0.6  | 1.2  | 0.7  | 1.2                           | 2.0  | 8.0  | 20                           | 0.15 | 0.2  | 0.4       | 19.95 | (6-49) |
|                   | ■ PSC-2375   |                                     | 55-85           | —    | —    | 35   | 25   | —    | —                               | —    | —    | 0.3  | 0.5  | —    | —                             | —    | 1.0  | —                            | —    | 0.1  | —         | 19.95 | (6-24) |
|                   | ■ PSC-2-1-75 |                                     | 0.25-300        | 20   | 15   | 30   | 20   | 20   | 15                              | 0.4  | 0.75 | 0.4  | 0.75 | 0.4  | 1.0                           | 2.0  | 3.0  | 5.0                          | 0.15 | 0.2  | 0.3       | 11.95 | (6-49) |
| MSC-2<br>case A03 | MSC-2-1      |                                     | 0.1-450         | 20   | 15   | 30   | 20   | 30   | 20                              | 0.3  | 0.5  | 0.4  | 0.75 | 0.6  | 1.0                           | 2.0  | 3.0  | 4.0                          | 0.15 | 0.2  | 0.3       | 16.95 | (5-24) |
|                   | MSC-2-1W     |                                     | 2-650           | 22   | 18   | 30   | 25   | 22   | 18                              | 0.3  | 0.5  | 0.5  | 0.8  | 0.8  | 1.2                           | 1.0  | 2.0  | 4.0                          | 0.15 | 0.2  | 0.3       | 17.95 | (5-24) |
| TSC-2<br>case B02 | TSC-2-1      | NEW                                 | 1-400           | 30   | 25   | 30   | 25   | 30   | 20                              | 0.25 | 0.5  | 0.4  | 0.75 | 0.8  | 1.0                           | 2.0  | 3.0  | 4.0                          | 0.15 | 0.2  | 0.6       | 13.95 | (5-24) |

L = low range ( $f_L$  to  $10 f_L$ )

M = mid range ( $10 f_L$  to  $f_U/2$ )

U = upper range ( $f_U/2$  to  $f_U$ )



## computer-automated performance data

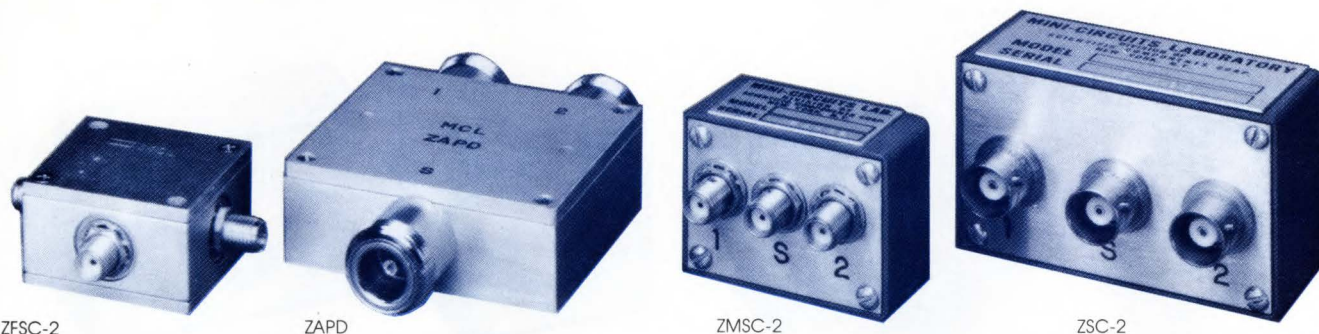
typical production unit / for data of other models consult factory

### PSC-2-1

| FREQUENCY MHz | INSERTION LOSS (dB) |      | UNBALANCE (dB) | ISOLATION (dB) | VSWR |      |      |
|---------------|---------------------|------|----------------|----------------|------|------|------|
|               | S-1                 | S-2  |                |                | SUM  | 1    | 2    |
| 10            | 3.33                | 3.33 | .02            | 21.96          | 1.40 | 1.14 | 1.14 |
| 21.147        | 3.19                | 3.19 | 0.00           | 33.40          | 1.12 | 1.11 | 1.12 |
| 42.194        | 3.19                | 3.19 | 0.00           | 34.63          | 1.13 | 1.11 | 1.11 |
| 63.241        | 3.27                | 3.25 | -.02           | 33.73          | 1.13 | 1.11 | 1.11 |
| 84.288        | 3.24                | 3.25 | .01            | 32.70          | 1.13 | 1.11 | 1.11 |
| 105.335       | 3.27                | 3.27 | .00            | 31.70          | 1.13 | 1.11 | 1.10 |
| 126.382       | 3.27                | 3.27 | 0.00           | 31.06          | 1.13 | 1.11 | 1.11 |
| 147.429       | 3.29                | 3.29 | 0.00           | 30.47          | 1.13 | 1.11 | 1.11 |
| 168.476       | 3.29                | 3.29 | 0.00           | 30.05          | 1.14 | 1.11 | 1.11 |
| 189.523       | 3.32                | 3.32 | 0.00           | 29.71          | 1.15 | 1.12 | 1.12 |
| 210.570       | 3.34                | 3.34 | 0.00           | 29.42          | 1.16 | 1.14 | 1.14 |
| 231.617       | 3.36                | 3.37 | .01            | 29.18          | 1.18 | 1.15 | 1.15 |
| 252.664       | 3.37                | 3.41 | .04            | 28.85          | 1.21 | 1.17 | 1.17 |
| 273.711       | 3.43                | 3.47 | .04            | 28.53          | 1.25 | 1.20 | 1.20 |
| 294.758       | 3.45                | 3.45 | 0.00           | 27.90          | 1.30 | 1.23 | 1.23 |
| 315.805       | 3.47                | 3.49 | .02            | 27.03          | 1.34 | 1.26 | 1.26 |
| 336.852       | 3.48                | 3.50 | .03            | 25.92          | 1.40 | 1.29 | 1.29 |
| 357.899       | 3.50                | 3.56 | .06            | 24.51          | 1.46 | 1.32 | 1.33 |
| 378.946       | 3.58                | 3.62 | .06            | 22.93          | 1.54 | 1.36 | 1.37 |
| 400.000       | 3.70                | 3.74 | .04            | 21.19          | 1.63 | 1.40 | 1.41 |

 **Mini-Circuits**

P.O. BOX 166, Brooklyn, New York 11235 (718) 934-4500



| MODEL NO.          |             | FREQ. RANGE<br>MHz<br>$f_L$ - $f_U$ | ISOLATION<br>dB  |    |                  |    |                  |    | INSERTION LOSS, dB<br>Above 3dB |      |                  |      |                  |     | PHASE UNBALANCE<br>Degrees |             |             | AMPLITUDE UNBALANCE<br>dB |             |             | PRICE, \$ |        |
|--------------------|-------------|-------------------------------------|------------------|----|------------------|----|------------------|----|---------------------------------|------|------------------|------|------------------|-----|----------------------------|-------------|-------------|---------------------------|-------------|-------------|-----------|--------|
|                    |             |                                     | $L$<br>Typ. Min. |    | $M$<br>Typ. Min. |    | $U$<br>Typ. Min. |    | $L$<br>Typ. Max.                |      | $M$<br>Typ. Max. |      | $U$<br>Typ. Max. |     | $L$<br>Max.                | $M$<br>Max. | $U$<br>Max. | $L$<br>Max.               | $M$<br>Max. | $U$<br>Max. | Ea.       | Qty.   |
| ZFSC-2<br>case K18 | ZFSC-2-1    | 5-500                               | 30               | 25 | 28               | 20 | 25               | 20 | 0.2                             | 0.5  | 0.3              | 0.6  | 0.6              | 0.8 | 2.0                        | 4.0         | 4.0         | .15                       | .15         | 0.3         | 31.95     | (4-24) |
|                    | ZFSC-2-1-75 | 0.25-300                            | 20               | 15 | 30               | 20 | 20               | 15 | 0.4                             | 0.75 | 0.4              | 0.75 | 0.4              | 1.0 | 2.0                        | 3.0         | 5.0         | .15                       | 0.2         | 0.3         | 32.95     | (4-24) |
|                    | ZFSC-2-1W   | 1-750                               | 30               | 20 | 28               | 20 | 25               | 20 | 0.2                             | 0.5  | 0.4              | 0.8  | 0.8              | 1.0 | 2.0                        | 4.0         | 4.0         | .15                       | .15         | 0.3         | 35.95     | (4-24) |
|                    | ZFSC-2-2    | 10-1000                             | 30               | 20 | 25               | 20 | 23               | 18 | 0.2                             | 0.5  | 0.5              | 1.0  | 0.9              | 1.2 | 2.0                        | 4.0         | 4.0         | .15                       | .15         | 0.3         | 39.95     | (4-24) |
|                    | ZFSC-2-4    | 0.2-1000                            | 20               | 15 | 25               | 20 | 23               | 18 | 0.2                             | 0.5  | 0.5              | 1.0  | 0.9              | 1.2 | 2.0                        | 4.0         | 4.0         | .15                       | .15         | 0.3         | 44.95     | (4-24) |
|                    | ZFSC-2-5    | 10-1500                             | 25               | 15 | 30               | 20 | 25               | 18 | 0.25                            | 0.6  | 0.5              | 1.0  | 0.8              | 1.5 | 5.0                        | 8.0         | 10.0        | .15                       | 0.2         | 0.5         | 49.95     | (4-24) |
| ZFSC-2-6           |             | 0.002-60                            | 27               | 20 | 30               | 20 | 27               | 20 | 0.3                             | 0.6  | 0.3              | 0.6  | 0.6              | 1.0 | 2.0                        | 3.0         | 4.0         | .15                       | 0.2         | 0.3         | 36.95     | (4-24) |
|                    | ZFSC-2-6-75 | 0.004-60                            | 30               | 20 | 35               | 20 | 25               | 20 | 0.5                             | 0.8  | 0.4              | 0.8  | 0.7              | 1.0 | 1.0                        | 2.0         | 3.0         | .15                       | 0.2         | 0.3         | 38.95     | (4-24) |
| ZAPD<br>case F14   | ZAPD-1      | 0.5-1.0                             | 25               | 19 | 25               | 19 | 25               | 19 | 0.25                            | 0.6  | 0.25             | 0.6  | 0.25             | 0.6 | —                          | 1           | —           | —                         | 0.2         | —           | 39.95     | (1-9)  |
|                    | ZAPD-2      | 1.0-2.0                             | 25               | 19 | 25               | 19 | 25               | 19 | 0.25                            | 0.6  | 0.25             | 0.6  | 0.25             | 0.6 | —                          | 2           | —           | —                         | 0.2         | —           | 39.95     | (1-9)  |
|                    | ZAPD-4      | 2.0-4.2                             | 25               | 19 | 25               | 19 | 25               | 19 | 0.4                             | 0.8  | 0.4              | 0.8  | 0.4              | 0.8 | —                          | 6           | —           | —                         | 0.4         | —           | 39.95     | (1-9)  |
|                    | ZAPD-21     | 0.5-2.0                             | 25               | 19 | 25               | 19 | 25               | 19 | 0.25                            | 0.8  | 0.25             | 0.8  | 0.25             | 0.8 | —                          | 2           | —           | —                         | 0.2         | —           | 49.95     | (1-9)  |
| ZMSC-2<br>case M21 | ZMSC-2-1    | 0.1-400                             | 20               | 15 | 25               | 20 | 25               | 20 | 0.2                             | 0.5  | 0.4              | 0.75 | 0.6              | 1.0 | 2.0                        | 3.0         | 4.0         | .15                       | 0.2         | 0.3         | 37.95     | (4-24) |
|                    | ZMSC-2-1W   | 1-650                               | 25               | 20 | 35               | 25 | 25               | 20 | 0.3                             | 0.5  | 0.5              | 0.8  | 0.7              | 1.0 | 2.0                        | 3.0         | 4.0         | .15                       | 0.2         | 0.3         | 42.95     | (4-24) |
|                    | ZMSC-2-2    | 0.002-60                            | 27               | 20 | 30               | 20 | 27               | 20 | 0.3                             | 0.6  | 0.3              | 0.6  | 0.6              | 1.0 | 2.0                        | 3.0         | 4.0         | .15                       | .25         | 0.3         | 47.95     | (4-24) |
| ZSC-2<br>case M22  | ZSC-2-1     | 0.1-400                             | 20               | 15 | 25               | 20 | 25               | 20 | 0.2                             | 0.5  | 0.4              | 0.75 | 0.6              | 1.0 | 2.0                        | 3.0         | 4.0         | .15                       | 0.2         | 0.3         | 27.95     | (4-24) |
|                    | ZSC-2-1W    | 1-650                               | 25               | 20 | 35               | 25 | 25               | 20 | 0.3                             | 0.5  | 0.5              | 0.8  | 0.7              | 1.0 | 2.0                        | 3.0         | 4.0         | .15                       | 0.2         | 0.3         | 32.95     | (4-24) |
|                    | ZSC-2-2     | 0.002-60                            | 25               | 20 | 30               | 20 | 27               | 20 | 0.3                             | 0.6  | 0.3              | 0.6  | 0.6              | 1.0 | 2.0                        | 3.0         | 4.0         | .15                       | .25         | 0.3         | 37.95     | (4-24) |
|                    | ZSC-2-4     | 10-1000                             | 25               | 20 | 35               | 20 | 25               | 20 | 0.2                             | 0.5  | 0.5              | 0.8  | 0.7              | 1.3 | 2.0                        | 4.0         | 6.0         | .15                       | 0.2         | 0.3         | 37.95     | (4-24) |
|                    | ZSC-2375    | 55-85                               | 35               | 25 | 35               | 25 | 35               | 25 | 0.3                             | 0.5  | 0.3              | 0.5  | 0.3              | 0.5 | —                          | 1.0         | —           | —                         | 0.1         | —           | 37.95     | (4-24) |
|                    | ZSC-2-1-75  | 0.25-300                            | 20               | 15 | 30               | 20 | 20               | 15 | 0.4                             | 0.75 | 0.4              | 0.75 | 0.4              | 1.0 | 2.0                        | 3.0         | 5.0         | .15                       | 0.2         | 0.3         | 29.95     | (4-24) |

L = low range ( $f_L$  to  $10 f_L$ )M = mid range ( $10 f_L$  to  $f_U/2$ )U = upper range ( $f_U/2$  to  $f_U$ )**NOTES:**

■ Denotes 75 ohm models, 75 ohm BNC connectors are standard.

1. For Quality Control procedures, see page 6.
2. For environmental specifications, see page 7.
3. Absolute Maximum Ratings, Matched power rating ZAPD 10W  
all other models 1W, Internal load dissipation 0.125W, see page 6.
4. For connector types and case mounting options, see case style outline drawing.
5. Prices and specifications subject to change without notice.

**pin and coaxial connections**

see case style outline drawing

| Series | Sum Port | Port 1 | Port 2 | Ground    |
|--------|----------|--------|--------|-----------|
| LPS    | 1        | 4      | 5      | 2,3,6,7,8 |
| PSC-2  | 1        | 5      | 6      | 2,3,4,7,8 |
| MSC-2  | 1        | 5      | 6      | 2,3,4,7,8 |
| TSC-2  | 1        | 2      | 4      | 3         |
| ZFS-2  | 3        | 1      | 2      | —         |
| ZAPD-2 | 3        | 1      | 2      | —         |
| ZMSC-2 | 2        | 1      | 3      | —         |
| ZSC-2  | 2        | 1      | 3      | —         |

**MIL-P-23971/15, NSN GUIDE**

| MCL NO.      | NSN              | MIL-P-23971/15* |
|--------------|------------------|-----------------|
| MSC-2-1      | 6625-01-124-8595 | 02              |
| PSC-2-1      | 5820-00-548-0739 | 01              |
| PSC-2-2      | 5825-01-044-8944 |                 |
| ZFSC-2-2A    | 6625-01-079-7021 |                 |
| ZMSC-2-1W    | 5895-01-127-0232 |                 |
| ZSC-2-1BNC   | 5895-01-036-6254 |                 |
| ZSC-2-1B     | 5820-00-270-3055 |                 |
| ZSC-2-1B-TNC | 5820-01-109-3706 |                 |
| ZSC-2-2-75B  | 5915-01-012-8162 |                 |

\*units are not QPL listed

**In Stock... Immediate Delivery**



# Power Splitter/Combiners

## 2 WAY-90°

1.4 MHz to 4.2 GHz  
performance data

curves, tables, page 4 Model Index

### case style selection

outline drawings see page 3



| MODEL NO.           | FREQ RANGE MHz  | ISOLATION dB |      | INSERTION LOSS dB<br>Avg. of Coupled Outputs less 3 dB |      | PHASE UNBALANCE Degrees<br>Max. | AMPLITUDE UNBALANCE dB<br>Max. | PRICE \$ |              |
|---------------------|-----------------|--------------|------|--------------------------------------------------------|------|---------------------------------|--------------------------------|----------|--------------|
|                     |                 | Typ.         | Min. | Typ.                                                   | Max. |                                 |                                | Ea.      | Qty.         |
| PSCQ-2<br>case A01  | PSCQ-2-1.5      | 1.4-1.7      | 29   | 25                                                     | 0.4  | 0.7                             | 3.0                            | 1.2      | 12.95 (5-49) |
|                     | PSCQ-2-3.4      | 3.0-3.8      | 30   | 25                                                     | 0.4  | 0.7                             | 3.8                            | 1.2      | 16.95 (5-49) |
|                     | PSCQ-2-6.4      | 5.8-7.0      | 30   | 25                                                     | 0.4  | 0.7                             | 3.0                            | 1.2      | 12.95 (5-49) |
|                     | PSCQ-2-7.5      | 7.0-8.0      | 35   | 25                                                     | 0.4  | 0.7                             | 3.0                            | 1.2      | 12.95 (5-49) |
|                     | PSCQ-2-10.5     | 9.0-11.0     | 25   | 20                                                     | 0.4  | 0.7                             | 3.0                            | 1.2      | 12.95 (5-49) |
|                     | PSCQ-2-13       | 12-14        | 29   | 25                                                     | 0.4  | 0.7                             | 3.0                            | 1.2      | 12.95 (5-49) |
|                     | PSCQ-2-14       | 12-16        | 30   | 25                                                     | 0.3  | 0.6                             | 3.0                            | 1.8      | 16.95 (5-49) |
|                     | PSCQ-2-21.4 NEW | 20-23        | 30   | 25                                                     | 0.4  | 0.7                             | 3.0                            | 1.2      | 12.95 (5-49) |
|                     | PSCQ-2-50       | 25-50        | 30   | 20                                                     | 0.3  | 0.7                             | 3.0                            | 1.5      | 19.95 (5-49) |
|                     | PSCQ-2-70 NEW   | 40-70        | 30   | 20                                                     | 0.3  | 0.7                             | 3.0                            | 1.5      | 19.95 (5-49) |
|                     | PSCQ-2-90       | 55-90        | 30   | 20                                                     | 0.3  | 0.7                             | 3.0                            | 1.2      | 19.95 (5-49) |
|                     | PSCQ-2-120 NEW  | 80-120       | 25   | 18                                                     | 0.3  | 0.7                             | 3.0                            | 1.5      | 19.95 (5-49) |
|                     | PSCQ-2-180      | 120-180      | 23   | 15                                                     | 0.3  | 0.7                             | 4.0                            | 1.2      | 19.95 (5-49) |
|                     | PSCQ-2-250 NEW  | 150-250      | 25   | 18                                                     | 0.4  | 0.8                             | 4.0                            | 1.5      | 19.95 (5-49) |
| ZAPDQ<br>case F14   | ZAPDQ-2         | 1000-2000    | 22   | 16                                                     | 0.4  | 0.9                             | 5.0                            | 1.0      | 59.95 (1-9)  |
|                     | ZAPDQ-4         | 2000-4200    | 22   | 16                                                     | 0.4  | 0.9                             | 5.0                            | 1.0      | 59.95 (1-9)  |
| ZMSCQ-2<br>case M21 | ZMSCQ-2-50      | 25-50        | 30   | 20                                                     | 0.3  | 0.7                             | 3.0                            | 1.5      | 49.95 (4-24) |
|                     | ZMSCQ-2-90      | 55-90        | 30   | 20                                                     | 0.3  | 0.7                             | 3.0                            | 1.2      | 49.95 (4-24) |
|                     | ZMSCQ-2-180     | 120-180      | 23   | 15                                                     | 0.3  | 0.7                             | 4.0                            | 1.2      | 49.95 (4-24) |
| ZSCQ-2<br>case M22  | ZSCQ-2-50       | 25-50        | 30   | 20                                                     | 0.3  | 0.7                             | 3.0                            | 1.5      | 39.95 (4-24) |
|                     | ZSCQ-2-90       | 55-90        | 30   | 20                                                     | 0.3  | 0.7                             | 3.0                            | 1.2      | 39.95 (4-24) |
|                     | ZSCQ-2-180      | 120-180      | 23   | 15                                                     | 0.3  | 0.7                             | 4.0                            | 1.2      | 39.95 (4-24) |

### NOTES:

1. For Quality Control procedures, see page 6.
2. For environmental specifications see page 7.
3. Absolute Maximum Ratings.  
Matched power rating ZAPDQ(10W),  
all other models (1W).  
Internal load dissipation (0.125W), see page 7.
4. For connector types and case mounting options,  
see case style outline drawings.
5. Prices and specifications  
subject to change without notice.

### pin and coaxial connections

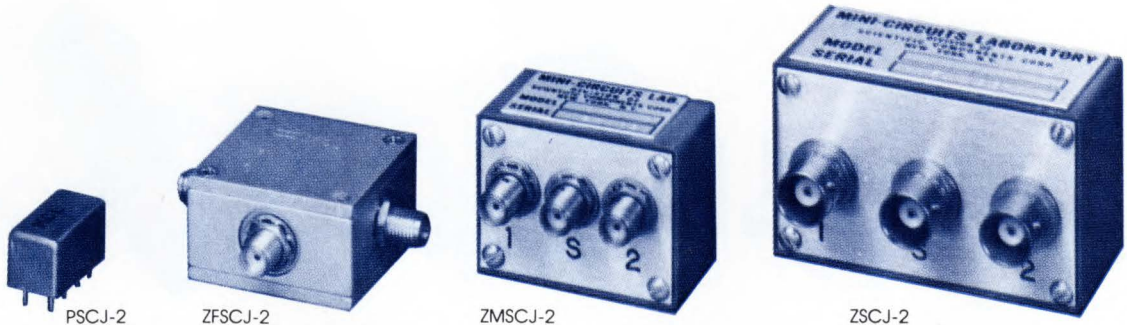
see case style outline drawing

| Series  | Sum Port | Port 1 | Port 2 | Ground    | Terminate 50 ohms |
|---------|----------|--------|--------|-----------|-------------------|
| PSCQ-2  | 1        | 2      | 5      | 3,4,7,8   | 6                 |
| PSCJ-2  | 1        | 5      | 6      | 2,3,4,7,8 | —                 |
| ZAPDQ   | 3        | 1      | 2      | —         | —                 |
| ZMSCQ-2 | 2        | 1      | 3      | —         | —                 |
| ZSCQ-2  | 2        | 1      | 3      | —         | —                 |
| ZFSCJ-2 | 3        | 1      | 2      | —         | —                 |
| ZMSCJ-2 | 2        | 1      | 3      | —         | —                 |
| ZSCJ-2  | 2        | 1      | 3      | —         | —                 |

50 ohms

# Mini-Circuits

**2 WAY-180°**  
10 KHz to 500 MHz



|                     | MODEL NO. | FREQ. RANGE<br>MHz<br>f <sub>L</sub> -f <sub>U</sub> | ISOLATION<br>dB |    |        |    |        |    | INSERTION LOSS, dB<br>Above 3dB |     |        |     |        |     | PHASE<br>UNBALANCE<br>Degrees |      |      | AMPLITUDE<br>UNBALANCE<br>dB |      |      | PRICE, \$ |        |
|---------------------|-----------|------------------------------------------------------|-----------------|----|--------|----|--------|----|---------------------------------|-----|--------|-----|--------|-----|-------------------------------|------|------|------------------------------|------|------|-----------|--------|
|                     |           |                                                      | L Min.          |    | M Min. |    | U Min. |    | L Max.                          |     | M Max. |     | U Max. |     | L                             | M    | U    | L                            | M    | U    | Ea.       | Qty.   |
|                     |           |                                                      | Typ.            |    | Typ.   |    | Typ.   |    | Typ.                            |     | Typ.   |     | Typ.   |     | Max.                          | Max. | Max. | Max.                         | Max. | Max. |           |        |
| PSCJ-2<br>case A01  | PSCJ-2-1  | 1-200                                                | 35              | 30 | 35     | 25 | 30     | 23 | .75                             | 1.0 | 0.5    | 0.8 | .75    | 1.2 | 2.0                           | 2.5  | 4.0  | .15                          | .15  | 0.3  | 19.95     | (5-49) |
|                     | PSCJ-2-2  | 0.01-20                                              | 35              | 25 | 30     | 25 | 25     | 18 | 0.3                             | 0.8 | 0.2    | 0.5 | 0.3    | 0.6 | 1.0                           | 2.0  | 2.5  | 0.1                          | 0.1  | 0.2  | 29.95     | (5-49) |
| ZFSCJ-2<br>case K18 | ZFSCJ-2-1 | 1-500                                                | 30              | 20 | 33     | 25 | 30     | 18 | 1.0                             | 1.5 | 1.0    | 1.5 | 1.0    | 1.5 | 2.0                           | 4.0  | 6.0  | .15                          | 0.2  | 0.5  | 49.95     | (4-24) |
|                     | ZFSCJ-2-3 | 5-300                                                | 30              | 20 | 33     | 25 | 30     | 18 | 1.0                             | 1.5 | 1.0    | 1.5 | 1.0    | 1.5 | 2.0                           | 4.0  | 6.0  | .15                          | 0.2  | 0.5  | 39.95     | (4-24) |
| ZMSCJ-2<br>case M21 | ZMSCJ-2-1 | 1-200                                                | 35              | 30 | 35     | 25 | 30     | 23 | .75                             | 1.0 | 0.6    | 0.8 | .75    | 1.2 | 2.0                           | 2.5  | 4.0  | .15                          | .15  | 0.3  | 47.95     | (4-24) |
|                     | ZMSCJ-2-2 | 0.01-20                                              | 35              | 25 | 30     | 25 | 25     | 18 | 0.3                             | 0.8 | 0.2    | 0.5 | 0.3    | 0.6 | 1.0                           | 2.0  | 2.5  | 0.1                          | 0.1  | 0.2  | 57.95     | (4-24) |
| ZSCJ-2<br>case M22  | ZSCJ-2-1  | 1-200                                                | 35              | 30 | 35     | 25 | 30     | 23 | .75                             | 1.0 | 0.6    | 0.8 | .75    | 1.2 | 2.0                           | 2.5  | 4.0  | .15                          | .15  | 0.3  | 37.95     | (4-24) |
|                     | ZSCJ-2-2  | 0.01-20                                              | 35              | 25 | 30     | 25 | 25     | 18 | 0.3                             | 0.8 | 0.2    | 0.5 | 0.3    | 0.6 | 1.0                           | 2.0  | 2.5  | 0.1                          | 0.1  | 0.2  | 47.95     | (4-24) |

L = low range ( $f_L$  to 10  $f_L$ )      M = mid range (10  $f_L$  to  $f_U/2$ )      U = upper range ( $f_U/2$  to  $f_U$ )



**computer-automated performance data**  
typical production unit / for data of other models consult factory

| PSCJ-2-1 | FREQUENCY<br>MHz | INSERTION LOSS<br>(dB) |      | UNBAL. (dB) | ISOLATION<br>(dB) | VSWR |      |      |
|----------|------------------|------------------------|------|-------------|-------------------|------|------|------|
|          |                  | S-1                    | S-2  |             |                   | Sum  | 1    | 2    |
|          | 1.20             | 3.79                   | 3.64 | .15         | 30.98             | 1.06 | 1.15 | 1.15 |
|          | 11.473           | 3.60                   | 3.44 | .16         | 32.77             | 1.04 | 1.19 | 1.19 |
|          | 21.946           | 3.56                   | 3.47 | .09         | 33.61             | 1.06 | 1.20 | 1.20 |
|          | 32.419           | 3.60                   | 3.51 | .09         | 34.38             | 1.08 | 1.21 | 1.22 |
|          | 42.892           | 3.61                   | 3.52 | .09         | 35.06             | 1.10 | 1.22 | 1.24 |
|          | 53.365           | 3.72                   | 3.53 | .19         | 35.92             | 1.11 | 1.24 | 1.25 |
|          | 63.838           | 3.64                   | 3.53 | .11         | 36.93             | 1.13 | 1.25 | 1.27 |
|          | 74.311           | 3.79                   | 3.58 | .21         | 38.25             | 1.15 | 1.26 | 1.29 |
|          | 84.784           | 3.77                   | 3.57 | .20         | 39.86             | 1.17 | 1.28 | 1.31 |
|          | 95.257           | 3.82                   | 3.62 | .20         | 41.94             | 1.19 | 1.29 | 1.33 |
|          | 105.73           | 3.88                   | 3.65 | .23         | 45.24             | 1.22 | 1.31 | 1.36 |
|          | 116.203          | 3.83                   | 3.66 | .17         | 48.23             | 1.24 | 1.33 | 1.38 |
|          | 126.676          | 3.92                   | 3.66 | .26         | 48.12             | 1.27 | 1.34 | 1.41 |
|          | 137.149          | 3.92                   | 3.65 | .27         | 44.90             | 1.29 | 1.36 | 1.43 |
|          | 147.622          | 3.96                   | 3.65 | .31         | 40.93             | 1.31 | 1.38 | 1.46 |
|          | 158.395          | 4.02                   | 3.69 | .33         | 39.29             | 1.34 | 1.40 | 1.50 |
|          | 168.568          | 3.97                   | 3.68 | .29         | 35.97             | 1.36 | 1.42 | 1.53 |
|          | 179.041          | 4.08                   | 3.66 | .42         | 34.09             | 1.39 | 1.45 | 1.56 |
|          | 189.514          | 4.09                   | 3.68 | .41         | 32.50             | 1.42 | 1.47 | 1.60 |
|          | 200.00           | 4.03                   | 3.65 | .38         | 30.89             | 1.44 | 1.49 | 1.64 |

**In Stock... Immediate Delivery**



# Power Splitter/Combiners

## 3 WAY-O°

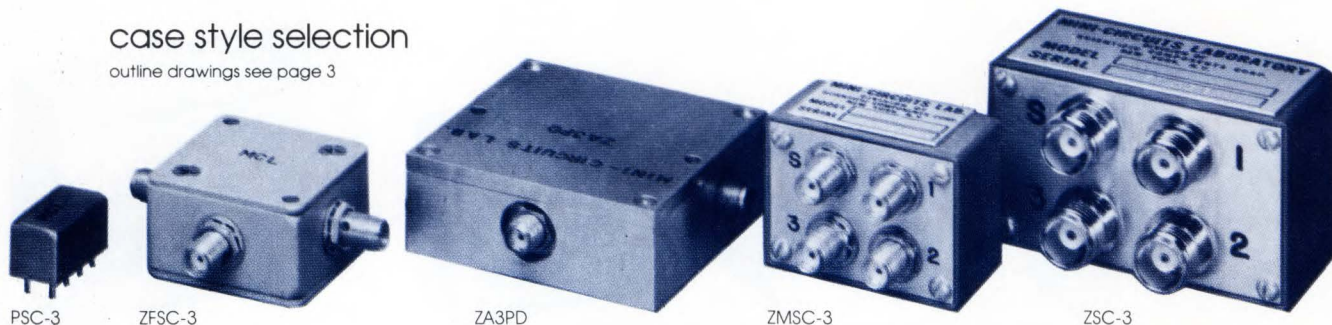
10 KHz to 4.2 GHz

performance data

curves, tables, page 4 Model Index

case style selection

outline drawings see page 3



PSC-3

ZFSC-3

ZA3PD

ZMSC-3

ZSC-3

| MODEL NO.          | FREQ. RANGE MHz<br>$f_L$ - $f_U$                                                                                                                                       | ISOLATION dB                                          |                                  |                                  |                                  |                                  |                                  | INSERTION LOSS, dB<br>Above 4.8dB      |                                        |                                        |                                        |                                        |                                        | PHASE UNBALANCE Degrees                |                                        |                                        | AMPLITUDE UNBALANCE dB                 |                                        |                                        | PRICE, \$                                          |                                                          |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|----------------------------------------------------|----------------------------------------------------------|
|                    |                                                                                                                                                                        | L                                                     |                                  | M                                |                                  | U                                |                                  | L                                      |                                        | M                                      |                                        | U                                      |                                        | L                                      |                                        | M                                      |                                        | U                                      |                                        | Ea.                                                | Qty.                                                     |
|                    |                                                                                                                                                                        | Typ.                                                  | Min.                             | Typ.                             | Min.                             | Typ.                             | Min.                             | Typ.                                   | Max.                                   | Typ.                                   | Max.                                   | Typ.                                   | Max.                                   | Max.                                   | Max.                                   | Max.                                   | Max.                                   | Max.                                   | Max.                                   |                                                    |                                                          |
| PSC-3<br>case A01  | <ul style="list-style-type: none"> <li>• PSC-3-1</li> <li>• PSC-3-1W</li> <li>• PSC-3-2</li> <li>• PSC-3-1-75</li> <li>NEW PSC-3-1-75-2</li> <li>• PSC-3-13</li> </ul> | 1-200<br>5-500<br>0.01-30<br>1-200<br>10-300<br>1-200 | 45<br>25<br>35<br>35<br>28<br>45 | 30<br>20<br>30<br>30<br>20<br>35 | 40<br>31<br>40<br>35<br>25<br>45 | 25<br>15<br>30<br>25<br>20<br>30 | 25<br>15<br>25<br>25<br>20<br>30 | 0.6<br>0.4<br>.25<br>0.6<br>0.2<br>.25 | 1.0<br>0.8<br>.45<br>1.0<br>0.4<br>0.5 | 0.4<br>0.4<br>.15<br>0.3<br>0.3<br>.35 | 0.7<br>1.4<br>0.3<br>0.7<br>0.5<br>0.6 | 0.6<br>0.8<br>.45<br>0.6<br>0.4<br>0.6 | 1.0<br>1.4<br>.75<br>1.0<br>0.7<br>0.6 | 1.0<br>6.0<br>1.0<br>2.0<br>2.0<br>1.0 | 2.0<br>14.<br>2.0<br>3.0<br>3.0<br>3.0 | 4.0<br>20.<br>4.0<br>4.0<br>4.0<br>4.0 | .15<br>0.1<br>0.2<br>.15<br>.15<br>0.1 | 0.2<br>0.3<br>0.3<br>0.2<br>0.2<br>0.2 | 0.3<br>0.6<br>0.4<br>0.3<br>0.3<br>0.2 | 19.95<br>29.95<br>29.95<br>20.95<br>22.95<br>24.95 | (5-49)<br>(5-49)<br>(5-49)<br>(5-49)<br>(5-49)<br>(5-49) |
| ZFSC-3<br>case J17 | <ul style="list-style-type: none"> <li>• ZFSC-3-1</li> <li>• ZFSC-3-1W</li> <li>• ZFSC-3-13</li> </ul>                                                                 | 1-500<br>2-750<br>1-200                               | 30<br>30<br>45                   | 20<br>20<br>30                   | 30<br>20<br>48                   | 20<br>20<br>35                   | 18<br>18<br>30                   | 0.4<br>0.4<br>.25                      | .75<br>.75<br>0.5                      | 0.5<br>1.0<br>.35                      | 0.9<br>1.0<br>0.6                      | 0.8<br>1.0<br>.35                      | 1.2<br>1.6<br>0.6                      | 2.0<br>3.0<br>1.0                      | 3.0<br>5.0<br>3.0                      | 4.0<br>7.0<br>5.0                      | 0.2<br>0.2<br>0.1                      | 0.3<br>0.3<br>0.2                      | 0.4<br>0.5<br>0.2                      | 39.95<br>41.95<br>39.95                            | (4-24)<br>(4-24)<br>(4-24)                               |
| ZA3PD<br>case CC51 | <ul style="list-style-type: none"> <li>• ZA3PD-1 NEW</li> <li>• ZA3PD-1.5 NEW</li> <li>• ZA3PD-2 NEW</li> <li>• ZA3PD-4 NEW</li> </ul>                                 | 0.5-1.0<br>0.75-1.5<br>1-2<br>2-4.2                   | 20<br>20<br>20<br>18             | 15<br>16<br>18<br>14             | 20<br>20<br>20<br>18             | 15<br>16<br>18<br>14             | 18<br>16<br>18<br>14             | 0.3<br>0.3<br>0.3<br>0.7               | 0.6<br>0.7<br>0.6<br>1.0               | 0.3<br>0.3<br>0.3<br>0.7               | 0.6<br>0.7<br>0.6<br>1.0               | 0.3<br>0.3<br>0.3<br>0.7               | 0.6<br>0.7<br>0.6<br>1.0               | —<br>—<br>—<br>—                       | —<br>—<br>—<br>—                       | —<br>—<br>—<br>—                       | 0.4<br>0.3<br>0.3<br>0.8               | 0.4<br>0.3<br>0.3<br>0.8               | 0.4<br>0.3<br>0.3<br>0.8               | 79.95<br>79.95<br>79.95<br>79.95                   | (1-9)<br>(1-9)<br>(1-9)<br>(1-9)                         |
| ZMSC-3<br>case P26 | <ul style="list-style-type: none"> <li>• ZMSC-3-1</li> <li>• ZMSC-3-2</li> </ul>                                                                                       | 1-200<br>0.01-30                                      | 45<br>35                         | 35<br>30                         | 40<br>40                         | 30<br>35                         | 25<br>25                         | 0.6<br>.25                             | 1.0<br>.45                             | 0.4<br>.15                             | 0.7<br>0.3                             | 0.6<br>.45                             | 1.0<br>.75                             | 1.0<br>1.0                             | 2.0<br>2.0                             | 4.0<br>4.0                             | .15<br>0.2                             | 0.2<br>0.3                             | 0.3<br>0.4                             | 47.95<br>57.95                                     | (4-24)<br>(4-24)                                         |
| ZSC-3<br>case P25  | <ul style="list-style-type: none"> <li>• ZSC-3-1</li> <li>• ZSC-3-2</li> <li>• ZSC-3-1-75</li> <li>• ZSC-3-2-75</li> </ul>                                             | 1-200<br>0.01-30<br>1-200<br>0.02-20                  | 45<br>35<br>35<br>35             | 30<br>30<br>30<br>30             | 40<br>40<br>35<br>35             | 30<br>35<br>25<br>25             | 25<br>25<br>35<br>20             | 0.6<br>.25<br>0.6<br>0.2               | 1.0<br>.45<br>1.0<br>0.5               | 0.4<br>.15<br>0.4<br>.25               | 0.7<br>0.3<br>0.7<br>0.6               | 0.6<br>.45<br>0.6<br>.45               | 1.0<br>.75<br>1.0<br>.75               | 1.0<br>1.0<br>2.0<br>2.0               | 2.0<br>2.0<br>3.0<br>3.0               | 4.0<br>4.0<br>4.0<br>4.0               | .15<br>0.2<br>.15<br>0.2               | 0.2<br>0.3<br>.15<br>0.2               | 0.3<br>0.4<br>0.3<br>0.4               | 37.95<br>47.95<br>38.95<br>48.95                   | (4-24)<br>(4-24)<br>(4-24)<br>(4-24)                     |

L = low range ( $f_L$  to 10  $f_L$ )

M = mid range (10  $f_L$  to  $f_U/2$ )

U = upper range ( $f_U/2$  to  $f_U$ )

### MIL-P-23971/15, NSN GUIDE

| MCL NO.  | NSN              |
|----------|------------------|
| PSC-3-1  | 5820-01-015-6027 |
| ZSC-3-1B | 5820-01-008-9566 |
| ZSC-3-2B | 5825-01-120-9320 |
| PSC-4-1  | 5821-01-065-0106 |
| PSC-4-2  | 5825-01-044-8945 |
| PSC-4-3  | 5825-01-105-6189 |
| ZSC-4-1B | 5820-00-270-3056 |
| ZSC-4-2B | 5820-01-120-5238 |
| ZSC-4-3B | 6920-01-038-8553 |

### pin connections

see case style outline drawing

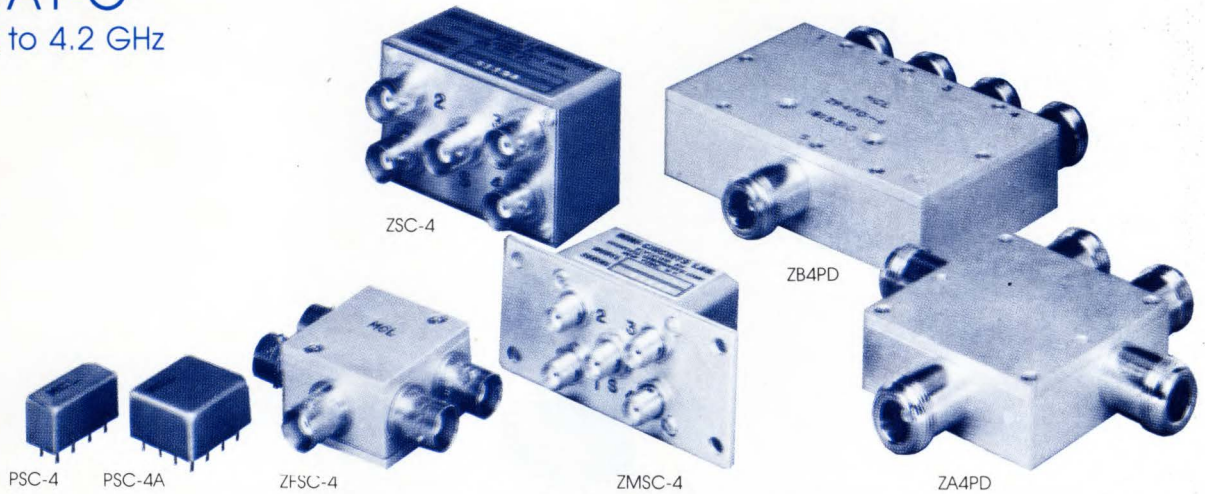
| Series                                 | Sum Port | Port 1 | Port 2 | Port 3 | Port 4 | Ground                         |
|----------------------------------------|----------|--------|--------|--------|--------|--------------------------------|
| PSC-3<br>except PSC-3-1W, PSC-3-1-75-2 | 6        | 1      | 2      | 5      | —      | 3,4,7,8                        |
| PSC-3-1W<br>PSC-3-1-75-2               | 1        | 5      | 7      | 8      | —      | 2,3,4,6                        |
| PSC-4                                  | 4        | 7      | 8      | 1      | 2      | 3,5,6                          |
| PSC-4A                                 | 2        | 8      | 12     | 5      | 9      | 1,3,4,6,7,10<br>11,13,14,15,16 |

50 ohms and 75 ohms

# Mini-Circuits

## 4 WAY-O°

2 KHz to 4.2 GHz



| MODEL NO.       | FREQ. RANGE MHz<br>$f_L$ - $f_U$ | ISOLATION dB |      |      |      |      |      | INSERTION LOSS, dB<br>Above 6dB |      |      |      |      |      | PHASE UNBALANCE Degrees |      |      | AMPLITUDE UNBALANCE dB |      |      | PRICE, \$ |              |
|-----------------|----------------------------------|--------------|------|------|------|------|------|---------------------------------|------|------|------|------|------|-------------------------|------|------|------------------------|------|------|-----------|--------------|
|                 |                                  | L            |      | M    |      | U    |      | L                               |      | M    |      | U    |      | L                       |      | M    |                        | U    |      | Ea.       | Qty.         |
|                 |                                  | Typ.         | Min. | Typ. | Min. | Typ. | Min. | Typ.                            | Max. | Typ. | Max. | Typ. | Max. | Max.                    | Max. | Max. | Max.                   | Max. | Max. |           |              |
| PSC-4 case A01  | PSC-4-1                          | 0.1-200      | 33   | 20   | 30   | 20   | 27   | 20                              | 0.4  | 0.6  | 0.5  | .75  | 0.7  | 1.0                     | 4.0  | 6.0  | 8.0                    | .15  | .20  | .25       | 28.95 (6-49) |
|                 | PSC-4-1-75                       | 1-200        | 30   | 20   | 25   | 20   | 25   | 20                              | 0.4  | 0.7  | 0.5  | 0.9  | 0.7  | 1.2                     | 4.0  | 6.0  | 10.0                   | .15  | .20  | 0.3       | 24.95 (6-49) |
|                 | PSC-4-3                          | 0.25-250     | 33   | 20   | 30   | 20   | 27   | 20                              | 0.4  | 0.7  | 0.5  | .75  | 0.7  | 1.2                     | 4.0  | 6.0  | 8.0                    | .15  | .20  | .25       | 23.95 (6-49) |
|                 | PSC-4-6                          | 0.01-40      | 35   | 29   | 32   | 25   | 25   | 18                              | 0.4  | 0.8  | 0.3  | 0.5  | 0.5  | 1.0                     | 4.0  | 6.0  | 8.0                    | .10  | .15  | .20       | 29.95 (6-49) |
| PSC-4A case C07 | PSC-4A-4                         | 10-1000      | 25   | 20   | 21   | 15   | 18   | 15                              | 0.5  | 0.8  | 0.8  | 1.1  | 1.5  | 2.5                     | 4.0  | 16.0 | 20.0                   | .20  | .30  | .20       | 49.95 (6-49) |
| ZFSC-4 case G15 | ZFSC-4-1                         | 1-1000       | 25   | 20   | 23   | 18   | 20   | 15                              | 0.4  | 0.8  | 0.6  | 1.5  | 1.6  | 2.5                     | 4.0  | 8.0  | 8.0                    | 0.2  | 0.4  | 0.7       | 89.95 (1-4)  |
|                 | ZFSC-4-1W                        | 10-500       | 23   | 20   | 23   | 20   | 23   | 20                              | 0.6  | 1.5  | 0.6  | 1.5  | 0.6  | 1.5                     | 4.0  | 8.0  | 8.0                    | 0.2  | 0.3  | 0.4       | 74.95 (1-4)  |
|                 | ZFSC-4-3                         | 10-300       | 32   | 28   | 38   | 30   | 38   | 30                              | 0.5  | 0.8  | 0.6  | 0.9  | 0.9  | 1.2                     | 4.0  | 6.0  | 8.0                    | 0.1  | 0.1  | 0.2       | 69.95 (1-4)  |
|                 | ZFSC-4375                        | 50-90        | 34   | 30   | 34   | 30   | 34   | 30                              | 0.3  | 0.8  | 0.3  | 0.8  | 0.3  | 0.8                     | 4.0  | 6.0  | 8.0                    | 0.15 | 0.15 | 0.15      | 89.95 (1-4)  |
|                 | ZFSC-4-2-75-1                    | 200-800      | 25   | 20   | 25   | 20   | 25   | 20                              | 0.8  | 1.0  | 0.8  | 1.0  | 0.8  | 1.0                     | 4.0  | 16.0 | 20.0                   | 0.4  | 0.4  | 0.4       | 74.95 (1-4)  |
| ZMSC-4 case N24 | ZMSC-4-1                         | 0.1-200      | 33   | 20   | 30   | 20   | 27   | 20                              | 0.4  | 0.6  | 0.5  | .75  | 0.7  | 1.0                     | 4.0  | 6.0  | 1.0                    | .15  | .20  | .25       | 56.95 (4-24) |
|                 | ZMSC-4-2                         | 0.002-20     | 30   | 20   | 33   | 25   | 33   | 25                              | .45  | .75  | 0.3  | 0.5  | 0.7  | 1.0                     | 4.0  | 6.0  | 8.0                    | .15  | .20  | .25       | 69.95 (4-24) |
|                 | ZMSC-4-3                         | 0.25-250     | 33   | 20   | 30   | 20   | 27   | 20                              | 0.4  | 0.7  | 0.5  | .75  | 0.7  | 1.2                     | 4.0  | 6.0  | 10.0                   | .15  | .20  | .25       | 53.95 (4-24) |
| ZSC-4 case N27  | ZSC-4-1                          | 0.1-200      | 33   | 20   | 30   | 20   | 27   | 20                              | 0.4  | 0.6  | 0.5  | .75  | 0.7  | 1.0                     | 4.0  | 6.0  | 8.0                    | .15  | .20  | .25       | 46.95 (4-24) |
|                 | ZSC-4-1-75                       | 1-200        | 30   | 20   | 25   | 20   | 25   | 20                              | 0.4  | 0.7  | 0.5  | 0.8  | 0.7  | 1.2                     | 4.0  | 6.0  | 10.0                   | .15  | .20  | 0.3       | 46.95 (4-24) |
|                 | ZSC-4-2                          | 0.002-20     | 30   | 20   | 33   | 25   | 33   | 25                              | .45  | .75  | 0.3  | 0.5  | 0.7  | 1.0                     | 4.0  | 6.0  | 8.0                    | .15  | .20  | .25       | 69.95 (4-24) |
|                 | ZSC-4-3                          | 0.25-250     | 33   | 20   | 30   | 20   | 27   | 20                              | 0.4  | 0.7  | 0.5  | .75  | 0.7  | 1.2                     | 4.0  | 6.0  | 10.0                   | .15  | .20  | .25       | 43.95 (4-24) |
| ZA4PD case DD52 | ZA4PD-2                          | 1-2          | 25   | 18   | 25   | 18   | 25   | 18                              | 0.3  | 0.8  | 0.3  | 0.8  | 0.3  | 0.8                     | —    | 6.0  | —                      | 0.7  | 0.7  | 0.7       | 79.95 (1-9)  |
|                 | ZA4PD-4                          | 2-4.2        | 25   | 18   | 25   | 18   | 25   | 18                              | 0.5  | 0.8  | 0.3  | 0.8  | 0.3  | 0.8                     | —    | 16.0 | —                      | 0.8  | 0.8  | 0.8       | 79.95 (1-9)  |
| ZB4PD case EE54 | ZB4PD-42                         | 1.7-4.2      | 23   | 16   | 23   | 16   | 23   | 16                              | 0.5  | 1.1  | 0.5  | 1.1  | 0.5  | 1.1                     | —    | 8.0  | —                      | 0.8  | 0.8  | 0.8       | 99.95 (1-9)  |
|                 | ZB4PD-4                          | 3.7-4.2      | 24   | 16   | 24   | 16   | 24   | 16                              | 0.6  | 1.1  | 0.6  | 1.1  | 0.6  | 1.1                     | —    | 16.0 | —                      | 0.8  | 0.8  | 0.8       | 89.95 (1-9)  |

L = low range ( $f_L$  to 10  $f_L$ )

M = mid range (10  $f_L$  to  $f_U/2$ )

U = upper range ( $f_U/2$  to  $f_U$ )

### NOTES:

- Denotes 75 ohm models, 75 ohm BNC connectors are standard.
- Model PSC-3-1 manufactured under license protected by patent 3,428,920.
- ▲ On Model ZFSC-4-2-75-1, up to 15V and 15mA DC may be passed from input to all outputs.
- 1. For quality control procedures, see page 6.
- 2. For environmental specifications see page 7.
- 3. Absolute Maximum Ratings:  
Matched power rating ZA3PD, ZA4PD, ZB4PD(10W)  
all other models (1W)  
Internal load dissipation  
all 3-way models (0.375W) all 4-way models (0.25W), see page 7.
- 3. For connector types and case mounting options, see case style outline drawing.
- 4. Prices and specifications subject to change without notice.
- 5. All 3-way power dividers with exception of ZA3PD are licensed under U.S. Patent 3,428,920; reissued as RE 27,299.



## In Stock... Immediate Delivery



# Power Splitter/Combiners

## 5 WAY-O°

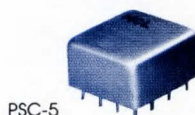
1 MHz to 300 MHz

performance data

curves, tables, page 4 Model Index

case style selection

outline drawings see page 3



PSC-5

| MODEL NO.                 | FREQ. RANGE MHz<br>$f_L$ - $f_U$ | ISOLATION dB |        |      |        |      |        | INSERTION LOSS, dB<br>Above 7.0dB |        |      |        |      |        | PHASE UNBALANCE Degrees |        |        | AMPLITUDE UNBALANCE dB |        |        | PRICE, \$ |       |
|---------------------------|----------------------------------|--------------|--------|------|--------|------|--------|-----------------------------------|--------|------|--------|------|--------|-------------------------|--------|--------|------------------------|--------|--------|-----------|-------|
|                           |                                  | Typ.         | L Min. | Typ. | M Min. | Typ. | U Min. | Typ.                              | L Max. | Typ. | M Max. | Typ. | U Max. | L Max.                  | M Max. | U Max. | L Max.                 | M Max. | U Max. | Ea.       | Qty.  |
| PSC-5-1 NEW               | 1-300                            | 25           | 20     | 23   | 18     | 20   | 17     | 0.2                               | 0.5    | 0.6  | 1.0    | 1.5  | 2.0    | 2.0                     | 4.0    | 8.0    | 0.2                    | 0.3    | 0.6    | 59.95     | (1-5) |
| case C07 ■ PSC-5-1-75 NEW | 1-300                            | 35           | 25     | 30   | 23     | 25   | 18     | 0.4                               | 0.6    | 0.6  | 0.9    | 0.9  | 1.3    | 2.0                     | 4.0    | 8.0    | 0.2                    | 0.3    | 0.6    | 59.95     | (1-5) |

L = low range ( $f_L$  to  $10 f_L$ )

M = mid range ( $10 f_L$  to  $f_U/2$ )

U = upper range ( $f_U/2$  to  $f_U$ )

### NOTES:

■ Denotes 75 ohm models, 75 ohm BNC connectors are standard.

1. Matched power rating, 1 watt

Internal load dissipation, 0.5 watt.

2. Refer to table of contents for quality control procedures, environmental specifications, and absolute maximum ratings.

3. For connector types, see case style outline drawing.

4. Prices and specifications subject to change without notice.

### pin connections

see case style outline drawing

| Series | Sum Port | Port 1 | Port 2 | Port 3 | Port 4 | Port 5 | Port 6 | Ground         | Not Used |
|--------|----------|--------|--------|--------|--------|--------|--------|----------------|----------|
| PSC-5  | 1        | 4      | 8      | 12     | 16     | 15     | —      | 2,5,7,11,13,14 | 3,6,9,10 |
| PSC-6  | 1        | 3      | 4      | 8      | 12     | 16     | 15     | 2,5,7,11,13,14 | 6,9,10   |

50 ohms and 75 ohms

# Mini-Circuits

## 6 WAY-O°

1 MHz to 300 MHz



PSC-6

ZFSC-6

| MODEL NO.          |             | FREQ. RANGE<br>MHz<br>$f_L$ - $f_U$ | ISOLATION<br>dB |      |      |      |      |      | INSERTION LOSS, dB<br>Above 7.8dB |      |      |      |      |      | PHASE UNBALANCE<br>Degrees |      |      | AMPLITUDE UNBALANCE<br>dB |      |      | PRICE, \$ |       |
|--------------------|-------------|-------------------------------------|-----------------|------|------|------|------|------|-----------------------------------|------|------|------|------|------|----------------------------|------|------|---------------------------|------|------|-----------|-------|
|                    |             |                                     | L               |      | M    |      | U    |      | L                                 |      | M    |      | U    |      | L                          | M    | U    | L                         | M    | U    | Ea.       | Qty.  |
|                    |             |                                     | Typ.            | Min. | Typ. | Min. | Typ. | Min. | Typ.                              | Max. | Typ. | Max. | Typ. | Max. | Max.                       | Max. | Max. | Max.                      | Max. | Max. |           |       |
| PSC-6<br>case C07  | PSC-6-1     | 1-175                               | 30              | 24   | 26   | 18   | 26   | 18   | 0.5                               | 0.8  | 0.7  | 1.0  | 1.0  | 1.5  | 4.0                        | 6.0  | 12.0 | 0.2                       | 0.4  | 0.8  | 68.95     | (1-5) |
|                    | PSC-6-1-75  | 1-300                               | 35              | 25   | 30   | 23   | 25   | 18   | 0.4                               | 0.6  | 0.6  | 0.9  | 0.6  | 1.1  | 2.0                        | 6.0  | 12.0 | 0.2                       | 0.3  | 0.6  | 78.95     | (1-5) |
| ZFSC-6<br>case Q28 | ZFSC-6-1    | 1-175                               | 27              | 22   | 26   | 20   | 26   | 20   | 0.75                              | 1.0  | 0.75 | 1.2  | 0.8  | 1.2  | 2.0                        | 6.0  | 12.0 | 0.2                       | 0.4  | 0.6  | 89.95     | (1-4) |
|                    | ZFSC-6-1-75 | 1-200                               | 30              | 25   | 30   | 22   | 20   | 18   | 0.75                              | 1.0  | 0.75 | 1.0  | 0.9  | 1.2  | 2.0                        | 6.0  | 12.0 | 0.2                       | 0.4  | 0.6  | 89.95     | (1-4) |

L= low range ( $f_L$  to 10  $f_L$ )

M= mid range (10  $f_L$  to  $f_U/2$ )

U= upper range ( $f_U/2$  to  $f_U$ )

PSC-6-1



computer-automated performance data  
typical production unit / for data of other models consult factory

| INSERTION LOSS | MHz     | S-1 (dB) | S-2 (dB) | S-3 (dB) | S-4 (dB) | S-5 (dB) | S-6 (dB) | UNBAL    |
|----------------|---------|----------|----------|----------|----------|----------|----------|----------|
|                | 1.00    | 8.39     | 8.40     | 8.42     | 8.43     | 8.45     | 8.43     | 0.06     |
|                | 10.157  | 8.16     | 8.17     | 8.14     | 8.19     | 8.19     | 8.20     | 0.05     |
|                | 28.471  | 8.24     | 8.24     | 8.23     | 8.27     | 8.27     | 8.29     | 0.04     |
|                | 55.942  | 8.32     | 8.36     | 8.30     | 8.35     | 8.35     | 8.36     | 0.06     |
|                | 83.413  | 8.39     | 8.43     | 8.38     | 8.42     | 8.46     | 8.43     | 0.08     |
|                | 101.727 | 8.48     | 8.52     | 8.49     | 8.48     | 8.52     | 8.52     | 0.04     |
|                | 120.041 | 8.62     | 8.62     | 8.55     | 8.58     | 8.62     | 8.63     | 0.07     |
|                | 138.355 | 8.62     | 8.65     | 8.56     | 8.58     | 8.68     | 8.67     | 0.12     |
|                | 156.669 | 8.68     | 8.72     | 8.60     | 8.65     | 8.75     | 8.72     | 0.15     |
|                | 175.00  | 8.76     | 8.80     | 8.65     | 8.70     | 8.84     | 8.77     | 0.19     |
|                |         |          |          |          |          |          |          |          |
| ISOLATION      | MHz     | 1-2 (dB) | 1-3 (dB) | 1-5 (dB) | 2-3 (dB) | 4-5 (dB) | 4-6 (dB) | 5-6 (dB) |
|                | 1.00    | 30.19    | 31.52    | 40.69    | 28.79    | 29.26    | 31.97    | 27.69    |
|                | 10.157  | 28.66    | 29.66    | 41.38    | 27.98    | 27.74    | 30.15    | 26.56    |
|                | 28.471  | 28.10    | 29.10    | 40.68    | 27.35    | 26.92    | 29.51    | 26.09    |
|                | 55.942  | 27.03    | 28.32    | 38.27    | 25.95    | 25.40    | 28.46    | 25.26    |
|                | 83.413  | 25.99    | 27.54    | 36.33    | 24.53    | 23.90    | 27.41    | 24.34    |
|                | 101.727 | 25.30    | 27.03    | 35.43    | 23.65    | 23.00    | 26.76    | 23.74    |
|                | 120.041 | 24.71    | 26.59    | 34.81    | 22.91    | 22.22    | 26.24    | 23.22    |
|                | 138.355 | 24.15    | 26.16    | 34.29    | 22.19    | 21.43    | 25.74    | 22.69    |
|                | 156.669 | 23.57    | 25.72    | 34.02    | 21.43    | 20.75    | 25.27    | 22.17    |
|                | 175.00  | 23.01    | 25.22    | 34.07    | 20.74    | 20.09    | 24.76    | 21.57    |
|                |         |          |          |          |          |          |          |          |
| VSWR           | MHz     | #S VSWR  | #1 VSWR  | #2 VSWR  | #3 VSWR  | #4 VSWR  | #5 VSWR  | #6 VSWR  |
|                | 1.00    | 1.12     | 1.11     | 1.10     | 1.10     | 1.11     | 1.09     | 1.10     |
|                | 10.00   | 1.25     | 1.09     | 1.07     | 1.08     | 1.09     | 1.06     | 1.12     |
|                | 27.36   | 1.26     | 1.08     | 1.07     | 1.08     | 1.08     | 1.04     | 1.11     |
|                | 53.40   | 1.30     | 1.08     | 1.08     | 1.08     | 1.09     | 1.05     | 1.09     |
|                | 88.12   | 1.37     | 1.08     | 1.09     | 1.09     | 1.09     | 1.05     | 1.11     |
|                | 105.48  | 1.39     | 1.08     | 1.10     | 1.09     | 1.09     | 1.05     | 1.12     |
|                | 122.84  | 1.40     | 1.08     | 1.11     | 1.10     | 1.10     | 1.05     | 1.13     |
|                | 140.20  | 1.39     | 1.08     | 1.11     | 1.10     | 1.10     | 1.05     | 1.15     |
|                | 157.56  | 1.37     | 1.08     | 1.12     | 1.11     | 1.11     | 1.05     | 1.15     |
|                | 175.00  | 1.34     | 1.09     | 1.13     | 1.13     | 1.13     | 1.05     | 1.16     |

In Stock... Immediate Delivery



# Power Splitter/Combiners

8 WAY-O°

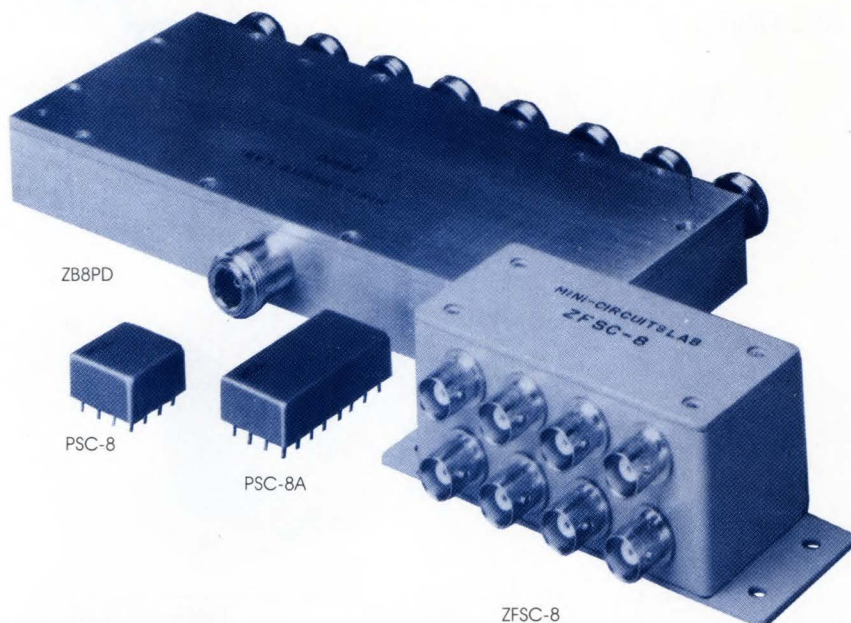
10 KHz to 4.2 GHz

performance data

curves, tables, page 4 Model Index

case style selection

outline drawings see page 3



| MODEL NO.                                                                                                                | FREQ. RANGE MHz<br>$f_L$ - $f_U$ | ISOLATION dB |      |      |      |      |      | INSERTION LOSS, dB<br>Above 9dB |      |      |      |      |      | PHASE UNBALANCE Degrees |      |      | AMPLITUDE UNBALANCE dB |      |     | PRICE, \$ |       |
|--------------------------------------------------------------------------------------------------------------------------|----------------------------------|--------------|------|------|------|------|------|---------------------------------|------|------|------|------|------|-------------------------|------|------|------------------------|------|-----|-----------|-------|
|                                                                                                                          |                                  | L            |      | M    |      | U    |      | L                               |      | M    |      | U    |      | L                       | M    | U    | L                      | M    | U   | Ea.       | Qty.  |
|                                                                                                                          |                                  | Typ.         | Min. | Typ. | Min. | Typ. | Min. | Typ.                            | Max. | Typ. | Max. | Typ. | Max. | Max.                    | Max. | Max. | Max.                   | Max. |     |           |       |
| PSC-8-1                                                                                                                  | 0.5-175                          | 30           | 25   | 30   | 20   | 25   | 18   | 0.8                             | 1.2  | 0.8  | 1.2  | 1.0  | 1.6  | 1.0                     | 2.5  | 5.0  | 0.2                    | 0.2  | 0.3 | 68.95     | (1-5) |
| PSC-8-1-75                                                                                                               | 0.5-175                          | 25           | 20   | 30   | 20   | 25   | 20   | 0.5                             | 1.0  | 0.6  | 1.1  | 0.7  | 1.3  | 1.0                     | 2.5  | 5.0  | 0.2                    | 0.2  | 0.3 | 69.95     | (1-5) |
| PSC-8-6                                                                                                                  | 0.01-10                          | 40           | 30   | 40   | 25   | 28   | 23   | 0.3                             | 0.7  | 0.5  | 1.0  | 0.6  | 1.1  | 1.0                     | 2.5  | 4.0  | 0.1                    | 0.2  | 0.3 | 79.95     | (1-5) |
| PSC-8A-4                                                                                                                 | 5-500                            | 25           | 20   | 23   | 18   | 20   | 15   | 0.7                             | 1.2  | 1.0  | 1.8  | 1.4  | 2.0  | 3.0                     | 8.0  | 16.0 | 0.2                    | 0.3  | 0.5 | 89.95     | (1-4) |
| PSC-8A4-75                                                                                                               | 1-300                            | 26           | 20   | 30   | 25   | 30   | 23   | 0.8                             | 1.2  | 0.7  | 1.1  | 0.9  | 1.3  | 1.0                     | 3.0  | 8.0  | 0.2                    | 0.2  | 0.4 | 79.95     | (1-4) |
| ZFSC-8-1                                                                                                                 | 0.5-175                          | 30           | 25   | 30   | 20   | 25   | 18   | 0.8                             | 1.2  | 0.8  | 1.2  | 1.0  | 1.6  | 1.0                     | 2.5  | 5.0  | 0.2                    | 0.2  | 0.3 | 89.95     | (1-4) |
| ZFSC-8-1-75                                                                                                              | 0.5-175                          | 25           | 20   | 30   | 20   | 25   | 20   | 0.5                             | 1.0  | 0.6  | 1.1  | 0.7  | 1.3  | 1.0                     | 2.5  | 5.0  | 0.2                    | 0.3  | 0.5 | 90.95     | (1-4) |
| ZFSC-84-75                                                                                                               | 1-300                            | 26           | 20   | 30   | 25   | 30   | 23   | 0.8                             | 1.2  | 0.7  | 1.1  | 0.9  | 1.3  | 1.0                     | 3.0  | 8.0  | 0.2                    | 0.2  | 0.4 | 119.95    | (1-4) |
| ZFSC-8375                                                                                                                | 50-90                            | 30           | 30   | 30   | 25   | 25   | 25   | 1.0                             | 1.0  | 1.0  | 1.3  | 1.3  | 1.3  | 2.0                     | 2.0  | 2.00 | 0.2                    | 0.2  | 0.2 | 119.95    | (1-4) |
| ZFSC-8-4                                                                                                                 | 5-700                            | 35           | 25   | 25   | 20   | 20   | 17   | 0.8                             | 1.2  | 1.2  | 1.8  | 1.8  | 2.5  | 2.0                     | 5.0  | 15.0 | 0.2                    | 0.4  | 0.7 | 129.95    | (1-4) |
| ZFSC-8-43                                                                                                                | 30-1000                          | 23           | 20   | 25   | 20   | 26   | 20   | 1.0                             | 1.3  | 1.4  | 1.8  | 2.1  | 2.7  | 5.0                     | 10.0 | 20.0 | 0.2                    | 0.4  | 0.7 | 139.95    | (1-4) |
| ZFSC-8-6                                                                                                                 | 0.01-10                          | 40           | 30   | 40   | 25   | 28   | 23   | 0.3                             | 0.7  | 0.5  | 1.0  | 0.6  | 1.1  | 1.0                     | 2.5  | 4.0  | 0.1                    | 0.2  | 0.3 | 109.95    | (1-4) |
| ZB8PD-2                                                                                                                  | 1-2                              | 24           | 16   | 24   | 16   | 24   | 16   | 0.8                             | 1.3  | 0.8  | 1.3  | 0.8  | 1.3  | 1.3                     | 1.3  | 1.3  | 0.7                    | 0.7  | 0.7 | 149.00    | (1-9) |
| ZB8PD-4                                                                                                                  | 2-4.2                            | 23           | 16   | 23   | 16   | 23   | 16   | 0.8                             | 1.4  | 0.8  | 1.4  | 0.8  | 1.4  | —                       | —    | —    | 0.9                    | 0.9  | 0.9 | 149.00    | (1-9) |
| L = low range ( $f_L$ to $10 f_L$ )      M = mid range ( $10 f_L$ to $f_U/2$ )      U = upper range ( $f_U/2$ to $f_U$ ) |                                  |              |      |      |      |      |      |                                 |      |      |      |      |      |                         |      |      |                        |      |     |           |       |

L = low range ( $f_L$  to 10  $f_L$ )

M = mid range (10  $f_L$  to  $f_U/2$ )

U = upper range ( $f_U/2$  to  $f_U$ )

## NOTES:

■ Denotes 75 ohm models, 75 ohm BNC connectors are standard.

1. Matched power rating, 1 watt.  
internal load dissipation, 0.62 watts.
2. Refer to table of contents for quality control procedures,  
environmental specifications, and absolute maximum ratings.
3. For connector types, see case style outline drawing.
4. Prices and specifications subject to change without notice.

## pin connections

see case style outline drawing

| Series | Sum Port | Port 1 | Port 2 | Port 3 | Port 4 | Port 5 | Port 6 | Port 7 | Port 8 | Ground                                                                     | Not Used |
|--------|----------|--------|--------|--------|--------|--------|--------|--------|--------|----------------------------------------------------------------------------|----------|
| PSC-8  | 2        | 1      | 5      | 9      | 13     | 16     | 12     | 8      | 4      | 3,6,7,14,15                                                                | 10,11    |
| PSC-8A | 29       | 7      | 16     | 31     | 24     | 9      | 2      | 26     | 17     | 1,3,4,5,6,8,10,11,<br>12,13,14,15,18,<br>19,20,21,22,23,25,<br>27,28,30,32 |          |

**Mini-Circuits**

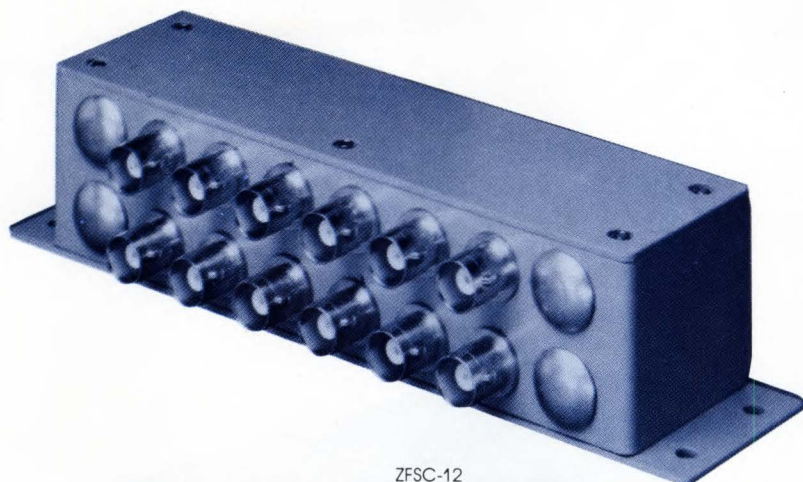
P.O. BOX 166, Brooklyn, New York 11235 (718) 934-4500

50 ohms and 75 ohms

# Mini-Circuits

## 12 WAY-O°

1 MHz to 300 MHz



ZFSC-12

| MODEL NO.  | FREQ. RANGE MHz<br>$f_L$ - $f_U$ | ISOLATION dB |        |        |        |      |      | INSERTION LOSS, dB<br>Above 10.8dB |        |        |        |      |      | PHASE UNBALANCE Degrees |        |        | AMPLITUDE UNBALANCE dB |        |        | PRICE, \$ |       |
|------------|----------------------------------|--------------|--------|--------|--------|------|------|------------------------------------|--------|--------|--------|------|------|-------------------------|--------|--------|------------------------|--------|--------|-----------|-------|
|            |                                  | Typ.         | L Min. | M Min. | U Min. | Typ. | Min. | Typ.                               | L Max. | M Max. | U Max. | Typ. | Max. | L Max.                  | M Max. | U Max. | L Max.                 | M Max. | U Max. | Ea.       | Qty.  |
| ZFSC-12-1  | 1-200                            | 30           | 25     | 35     | 30     | 28   | 20   | 0.8                                | 1.2    | 1.1    | 1.4    | 1.3  | 1.6  | 2.0                     | 4.0    | 6.0    | 0.1                    | 0.2    | 0.3    | 174.95    | (1-4) |
| ZFSC-12-11 | 10-300                           | 28           | 20     | 33     | 25     | 28   | 20   | 1.1                                | 1.3    | 1.1    | 1.5    | 1.5  | 1.8  | 2.0                     | 4.0    | 6.0    | 0.2                    | 0.3    | 0.4    | 174.95    | (1-4) |

L = low range ( $f_L$  to  $10 f_L$ )

M = mid range ( $10 f_L$  to  $f_U/2$ )

U = upper range ( $f_U/2$  to  $f_U$ )



**computer-automated performance data**  
typical production unit / for data of other models consult factory

### PSC-8A-4

| INSERTION LOSS, dB | MHz    | S-1   | S-2   | S-3   | S-4   | S-5   | S-6   | S-7   | S-8   | UNBAL. |
|--------------------|--------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
|                    | 5.00   | 9.60  | 9.60  | 9.60  | 9.62  | 9.62  | 9.62  | 9.59  | 9.60  | .03    |
|                    | 31.05  | 9.66  | 9.68  | 9.68  | 9.67  | 9.65  | 9.67  | 9.65  | 9.67  | .03    |
|                    | 57.11  | 9.78  | 9.80  | 9.81  | 9.80  | 9.79  | 9.77  | 9.77  | 9.78  | .04    |
|                    | 109.21 | 10.00 | 10.01 | 10.02 | 10.02 | 9.96  | 9.96  | 9.96  | 9.97  | .06    |
|                    | 161.32 | 10.35 | 10.36 | 10.36 | 10.36 | 10.27 | 10.27 | 10.26 | 10.29 | .10    |
|                    | 213.42 | 10.54 | 10.53 | 10.55 | 10.54 | 10.42 | 10.41 | 10.42 | 10.43 | .14    |
|                    | 265.53 | 10.72 | 10.69 | 10.72 | 10.70 | 10.56 | 10.55 | 10.57 | 10.59 | .17    |
|                    | 317.63 | 10.78 | 10.75 | 10.79 | 10.77 | 10.62 | 10.61 | 10.64 | 10.67 | .18    |
|                    | 395.79 | 10.79 | 10.76 | 10.79 | 10.79 | 10.63 | 10.60 | 10.65 | 10.68 | .19    |
|                    | 500.00 | 10.86 | 10.85 | 10.89 | 10.90 | 10.77 | 10.71 | 10.78 | 10.81 | .19    |
|                    |        |       |       |       |       |       |       |       |       |        |
| ISOLATION, dB      | MHz    | 1-2   | 1-3   | 1-8   | 3-4   | 5-6   | 5-7   | 7-8   |       |        |
|                    | 5.00   | 26.25 | 37.38 | 50.07 | 27.19 | 26.02 | 37.42 | 26.55 |       |        |
|                    | 31.05  | 23.99 | 34.75 | 46.72 | 24.18 | 23.73 | 34.49 | 24.07 |       |        |
|                    | 57.11  | 22.23 | 31.50 | 43.09 | 22.40 | 22.17 | 31.09 | 22.36 |       |        |
|                    | 109.21 | 21.46 | 27.29 | 38.07 | 21.86 | 22.23 | 26.78 | 21.88 |       |        |
|                    | 161.32 | 21.22 | 24.76 | 35.44 | 21.85 | 23.18 | 24.25 | 21.99 |       |        |
|                    | 213.42 | 21.19 | 23.24 | 33.61 | 22.06 | 24.75 | 22.78 | 22.46 |       |        |
|                    | 265.53 | 21.39 | 22.41 | 32.29 | 22.47 | 27.11 | 22.02 | 23.28 |       |        |
|                    | 317.63 | 21.84 | 22.04 | 31.09 | 22.98 | 30.46 | 21.84 | 24.52 |       |        |
|                    | 395.79 | 22.53 | 22.23 | 29.80 | 23.70 | 36.05 | 22.56 | 27.24 |       |        |
|                    | 500.00 | 22.74 | 24.07 | 28.71 | 23.44 | 31.27 | 25.96 | 30.63 |       |        |
|                    |        |       |       |       |       |       |       |       |       |        |
| VSWR               | MHz    | #S    | #1    | #2    | #3    | #4    | #5    | #6    | #7    | #8     |
|                    | 5.00   | 1.30  | 1.36  | 1.36  | 1.38  | 1.38  | 1.35  | 1.35  | 1.37  | 1.37   |
|                    | 31.05  | 1.33  | 1.31  | 1.31  | 1.32  | 1.32  | 1.30  | 1.30  | 1.31  | 1.31   |
|                    | 57.11  | 1.38  | 1.27  | 1.28  | 1.28  | 1.28  | 1.25  | 1.26  | 1.27  | 1.27   |
|                    | 109.21 | 1.51  | 1.28  | 1.29  | 1.29  | 1.29  | 1.23  | 1.24  | 1.26  | 1.26   |
|                    | 161.32 | 1.63  | 1.30  | 1.31  | 1.32  | 1.31  | 1.23  | 1.24  | 1.26  | 1.27   |
|                    | 213.42 | 1.71  | 1.32  | 1.33  | 1.33  | 1.32  | 1.22  | 1.23  | 1.26  | 1.26   |
|                    | 265.53 | 1.73  | 1.32  | 1.32  | 1.33  | 1.32  | 1.20  | 1.21  | 1.25  | 1.25   |
|                    | 317.63 | 1.68  | 1.31  | 1.31  | 1.31  | 1.30  | 1.17  | 1.18  | 1.23  | 1.23   |
|                    | 395.79 | 1.50  | 1.28  | 1.27  | 1.27  | 1.26  | 1.15  | 1.15  | 1.20  | 1.21   |
|                    | 500.00 | 1.19  | 1.27  | 1.25  | 1.23  | 1.23  | 1.17  | 1.15  | 1.22  | 1.22   |



# Power Splitter/Combiners

## 16 WAY-O°

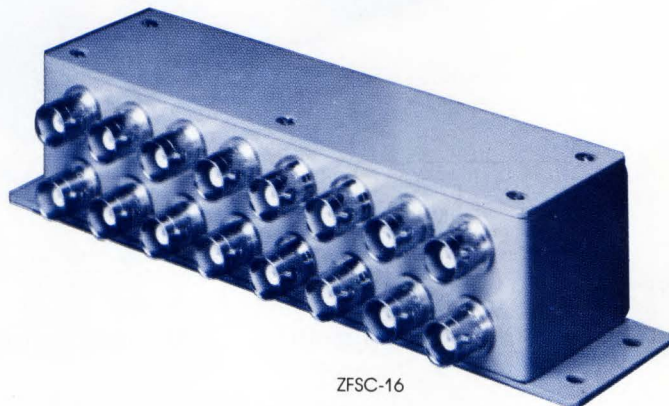
10 KHz to 200 MHz

performance data

curves, tables, page 4 Model Index

case style selection

outline drawings see page 3



ZFSC-16

| MODEL NO.   | FREQ. RANGE MHz<br>$f_L$ - $f_U$ | ISOLATION dB |        |    |      |    |      | INSERTION LOSS, dB<br>Above 12dB |        |     |      |     |      | PHASE UNBALANCE Degrees |     |     | AMPLITUDE UNBALANCE dB |     |     | PRICE, \$ |       |
|-------------|----------------------------------|--------------|--------|----|------|----|------|----------------------------------|--------|-----|------|-----|------|-------------------------|-----|-----|------------------------|-----|-----|-----------|-------|
|             |                                  | Typ.         | L Min. | M  | Typ. | U  | Min. | Typ.                             | L Max. | M   | Typ. | U   | Max. | L                       | M   | U   | L                      | M   | U   | Ea.       | Qty.  |
| ZFSC-16-1   | 0.5-125                          | 30           | 24     | 25 | 18   | 20 | 15   | 1.0                              | 1.2    | 1.1 | 1.3  | 1.2 | 1.4  | 1.0                     | 3.0 | 5.0 | 0.1                    | 0.2 | 0.5 | 174.95    | (1-4) |
| ZFSC-16-3   | 1-30                             | 45           | 40     | 45 | 40   | 41 | 35   | 0.5                              | 0.9    | 0.5 | 0.9  | 0.5 | 0.9  | 1.0                     | 2.0 | 3.0 | 0.1                    | 0.1 | 0.1 | 174.95    | (1-4) |
| ZFSC-16-675 | 0.01-25                          | 25           | 20     | 40 | 25   | 25 | 20   | 0.8                              | 1.1    | 0.4 | 0.8  | 1.0 | 1.6  | 1.0                     | 3.0 | 5.0 | 0.1                    | 0.2 | 0.4 | 189.95    | (1-4) |
| ZFSC-16-12  | 0.1-200                          | 33           | 20     | 27 | 20   | 26 | 20   | 0.6                              | 1.5    | 0.7 | 1.0  | 0.9 | 1.2  | 2.0                     | 6.0 | 9.0 | 0.1                    | 0.2 | 0.4 | 189.95    | (1-4) |

L = low range ( $f_L$  to  $10 f_L$ )

M = mid range ( $10 f_L$  to  $f_U/2$ )

U = upper range ( $f_U/2$  to  $f_U$ )

### NOTES:

■ Denotes 75 ohm models, 75 ohm BNC connectors are standard.

1. Matched power rating, 1 watt  
Internal load dissipation, 0.87 watt.
2. Refer to table of contents for quality control procedures, environmental specifications, and absolute maximum ratings.
3. For connector types, see case style outline drawing.
4. Prices and specifications subject to change without notice.

MIL-P-23971, \*NSN GUIDE

MCL NO.

NSN

ZFSC-16-1

5820-01-120-9321

\*Units are not QPL listed.



**Mini-Circuits**

P.O. BOX 166, Brooklyn, New York 11235 (718) 934-4500

50 ohms and 75 ohms

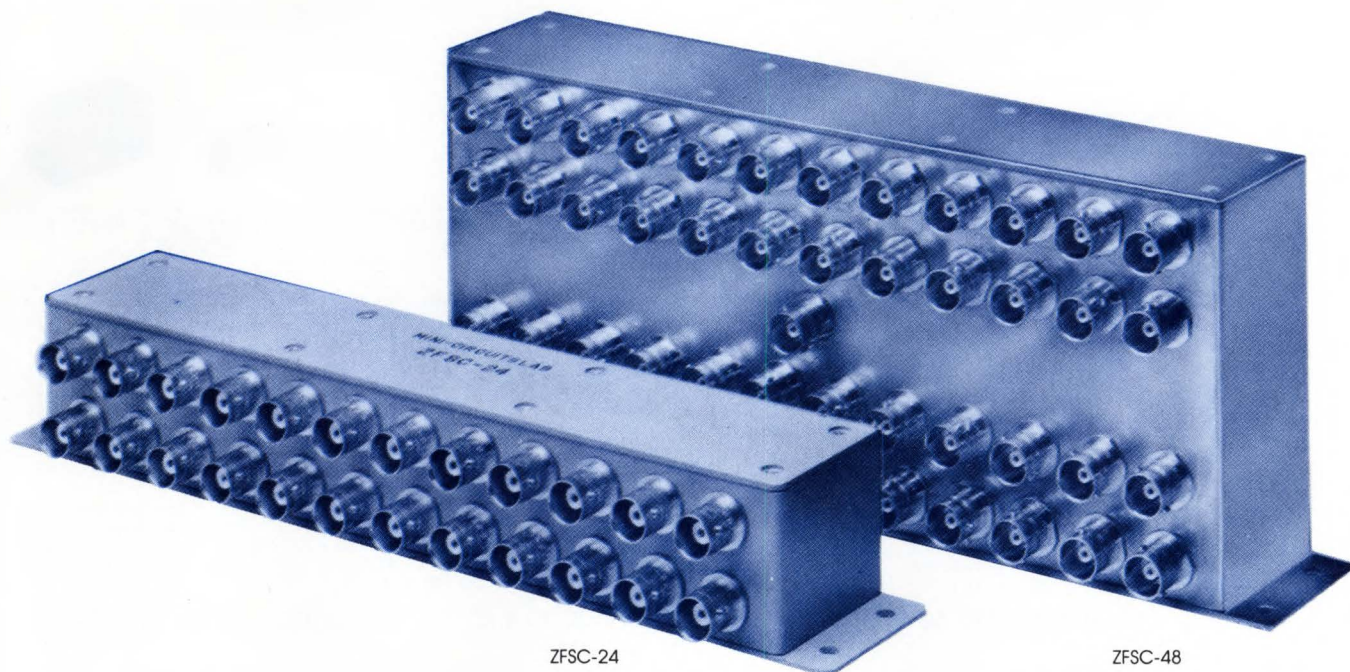
# Mini-Circuits

## 24 WAY-O°

25 KHz to 200 MHz

## 48 WAY-O°

10 MHz to 300 MHz



ZFSC-24

ZFSC-48

| MODEL NO.            |              | FREQ. RANGE<br>MHz<br>$f_L$ - $f_U$ | ISOLATION<br>dB |    |                |    |                |    | INSERTION LOSS, dB<br>24 way (above 13.8dB)<br>48 way (above 16.8dB) |     |                |     |                |     | PHASE UNBALANCE<br>Degrees |           |           | AMPLITUDE UNBALANCE<br>dB |           |           | PRICE, \$ |       |
|----------------------|--------------|-------------------------------------|-----------------|----|----------------|----|----------------|----|----------------------------------------------------------------------|-----|----------------|-----|----------------|-----|----------------------------|-----------|-----------|---------------------------|-----------|-----------|-----------|-------|
|                      |              |                                     | L<br>Typ. Min.  |    | M<br>Typ. Min. |    | U<br>Typ. Min. |    | L<br>Typ. Max.                                                       |     | M<br>Typ. Max. |     | U<br>Typ. Max. |     | L<br>Max.                  | M<br>Max. | U<br>Max. | L<br>Max.                 | M<br>Max. | U<br>Max. | Ea.       | Qty.  |
| ZFSC-24<br>case R31  | ZFSC-24-1    | 0.2-100                             | 25              | 20 | 25             | 20 | 25             | 20 | 1.0                                                                  | 2.0 | 1.0            | 2.0 | 1.0            | 2.0 | 2.0                        | 3.0       | 5.0       | 0.2                       | 0.4       | 0.5       | 264.95    | (1-4) |
|                      | ZFSC-24-11   | 1-200                               | 33              | 25 | 22             | 20 | 20             | 17 | 0.4                                                                  | 0.8 | 0.6            | 1.0 | 1.3            | 2.0 | 2.0                        | 4.0       | 8.0       | 0.2                       | 0.4       | 0.6       | 274.95    | (1-4) |
|                      | ZFSC-24-6    | 0.025-50                            | 30              | 25 | 39             | 30 | 30             | 25 | 0.4                                                                  | 1.0 | 0.4            | 0.8 | 0.6            | 1.2 | 2.0                        | 4.0       | 6.0       | 0.2                       | 0.3       | 0.4       | 274.95    | (1-4) |
| ZFSC-48<br>case HH68 | ZFSC-48-1    | 10-300                              | 30              | 25 | 28             | 20 | 23             | 20 | 1.0                                                                  | 1.5 | 1.8            | 2.2 | 2.0            | 2.5 | —                          | —         | —         | 0.6                       | 0.7       | 0.9       | 595.00    | (1-4) |
|                      | ZFSC-48-1-75 | 10-300                              | 30              | 25 | 28             | 20 | 23             | 20 | 1.2                                                                  | 2.0 | 2.1            | 2.5 | 2.3            | 3.0 | —                          | —         | —         | 0.6                       | 0.7       | 1.0       | 595.00    | (1-4) |

L = low range ( $f_L$  to  $10 f_L$ )

M = mid range ( $10 f_L$  to  $f_U/2$ )

U = upper range ( $f_U/2$  to  $f_U$ )

**In Stock... Immediate Delivery**



# very broadband Directional Couplers

10 to 30dB

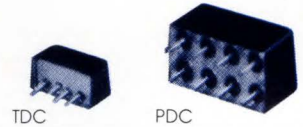
10KHz to 2000 MHz

performance data

curves, tables, page 4 Model Index

case style selection

outline drawings see page 3



|                 | MODEL NO.    | FREQUENCY | COUPLING |       | MAINLINE LOSS*                 |      |          |      |      |      | DIRECTIVITY |      |      |      |      |      | VSWR | POWER INPUT, W |       |        | PRICE, \$ |      |
|-----------------|--------------|-----------|----------|-------|--------------------------------|------|----------|------|------|------|-------------|------|------|------|------|------|------|----------------|-------|--------|-----------|------|
|                 |              | MHz       | dB       | dB    | L                              |      | M        |      | U    |      | L           |      | M    |      | U    |      | Typ. | L              | MU    | Ea.    | Qty.      |      |
|                 |              |           |          |       | f <sub>L</sub> -f <sub>U</sub> | Nom. | Flatness | Typ. | Max. | Typ. | Max.        | Typ. | Max. | Typ. | Min. | Typ. |      |                |       |        |           | Min. |
| TDC<br>case B02 | TDC 10-1     | 1-400     | 10.0±0.5 | ±0.5  | 1.2                            | 1.5  | 1.0      | 1.3  | 1.2  | 1.5  | 35          | 25   | 30   | 20   | 20   | 15   | 1.5  | 1              | 2     | 15.95  | (5-49)    |      |
| PDC<br>case A01 | PDC-10-1     | 0.5-500   | 11.5±0.5 | ±0.6  | 0.85                           | 1.3  | 0.65     | 1.0  | 0.85 | 1.3  | 32          | 25   | 32   | 25   | 22   | 15   | 1.2  | 1.5            | 3     | 11.95  | (5-49)    |      |
|                 | PDC-10-2     | 250-1000  | 10.5±0.5 | ±1.0  | 1.1                            | 1.4  | —        | —    | 1.6  | 1.9  | 40          | 30   | 30   | 20   | 20   | 15   | 1.5  | —              | 5     | 27.95  | (5-49)    |      |
|                 | ▲PDC-10-21   | 1-1000    | 11±0.5   | ±0.5  | 1.2                            | 1.7  | 1.2      | 1.2  | 1.6  | 2    | 40          | 30   | 25   | 20   | 25   | 20   | 1.2  | 1              | 2     | 24.95  | (5-49)    |      |
|                 | PDC-10-22    | 5-750     | 11±0.5   | ±0.5  | 1.1                            | 1.6  | 1.2      | 1.7  | 1.6  | 1.9  | 35          | 30   | 25   | 20   | 25   | 20   | 1.25 | 1              | 2     | 19.95  | (5-49)    |      |
|                 | PDC-15-6     | 0.01-35   | 15±0.5   | ±0.5  | 0.3                            | 0.6  | 0.2      | 0.4  | 0.3  | 0.6  | 38          | 30   | 35   | 25   | 28   | 20   | 1.15 | 2              | 4     | 19.95  | (5-49)    |      |
|                 | †PDC-20-1    | 25-400    | 21±0.75  | ±0.5  | 0.2                            | 0.25 | 0.3      | 0.35 | 0.35 | 0.5  | 25          | 20   | 35   | 25   | 25   | 20   | 1.25 | 3              | 5     | 19.95  | (5-49)    |      |
|                 | PDC-20-3     | 0.2-250   | 19.5±0.5 | ±0.5  | 0.35                           | 0.6  | 0.25     | 0.5  | 0.35 | 0.6  | 36          | 30   | 33   | 25   | 25   | 20   | 1.2  | 1.5            | 4     | 13.95  | (5-49)    |      |
|                 | ■PDC-10-4-75 | 1-250     | 10.5±0.5 | ±0.75 | 1.1                            | 1.5  | 1.1      | 1.5  | 1.1  | 1.5  | 30          | 20   | 30   | 20   | 30   | 20   | 2    | 2              | 4     | 12.95  | (5-49)    |      |
| ■PDC-15-6-75    | 0.02-35      | 14.5±0.5  | ±0.5     | 0.3   | 0.7                            | 0.3  | 0.7      | 0.3  | 0.7  | 35   | 20          | 35   | 20   | 35   | 20   | 1.3  | 1.5  | 4              | 20.95 | (5-49) |           |      |
| ■PDC-20-3-75    | 1-150        | 19.5±0.5  | ±0.75    | 0.35  | 0.8                            | 0.35 | 0.8      | 0.35 | 0.8  | 25   | 20          | 25   | 20   | 25   | 20   | 2    | 2    | 4              | 12.95 | (5-49) |           |      |

L=low range ( $f_L$  to 10  $f_L$ )

M=mid range (10 $f_L$  to  $f_U/2$ )

U=upper range ( $f_U/2$  to  $f_U$ )

## NOTES:

- \* Includes theoretical power loss at coupled port.
- Denotes 75 ohm models, 75 ohm BNC connectors are standard.
- † Models PDC-20-1, ZDC-20-1, ZMDC-20-1:  
L=25-50 MHz, M=50-300 MHz, U=300-400 MHz
- Model ZFDC-20-5: above 1000 MHz, coupling flatness ±1.5dB
- ▲ Models PDC-10-21, ZFDC-10-21: Upper range coupling ±0.75dB
- 1. For quality control procedures, see page 6.
- 2. For environmental specifications see page 7.
- 3. For connector types and case mounting options, see case style outline drawing.
- 4. Prices and specifications subject to change without notice.
- 5. All models are licensed under U.S. Patent 3,426,298.

## MIL-M-15370/18, NSN GUIDE\*

| MCL NO.      | NSN              | MIL-M-15370/18* |
|--------------|------------------|-----------------|
| PDC-10-1     |                  | 002             |
| PDC-10-2     |                  | 008             |
| PDC-10-21    | 5985-01-130-0177 | 003             |
| PDC-20-3     | 5985-01-076-8477 | 001             |
| ZDC-10-1-BNC | 5985-01-125-3467 |                 |
| ZDC-20-3-BNC | 5985-01-096-5007 |                 |
| ZFDC-20-5    | 5985-01-097-2192 |                 |

\*units are not QPL listed

## pin and coaxial connections

see case style outline drawing

| Series                    | In | Out | Cpl | Case Ground | Not Used |
|---------------------------|----|-----|-----|-------------|----------|
| PDC                       | 1  | 4   | 3   | 2,5,7,8     | 6        |
| TDC                       | 1  | 2   | 4   | 3           | —        |
| ZEDC                      | 1  | 2   | 3   | —           | —        |
| ZMDC                      | 3  | 2   | 1   | —           | —        |
| ZDC                       | 3  | 2   | 1   | —           | —        |
| ZFDC<br>(except 20-4, -5) | 1  | 2   | 3   | —           | —        |
| ZFDC 20-4, -5             | 3  | 1   | 2   | —           | —        |

50 ohms and 75 ohms

# Mini-Circuits



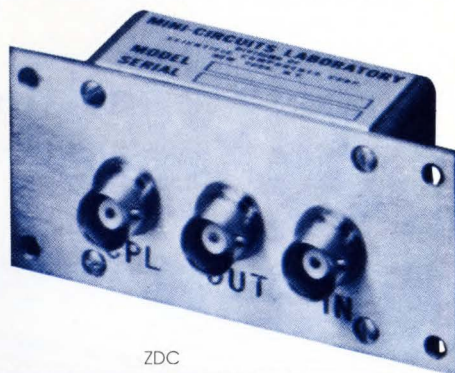
ZEDC



ZFDC



ZMDC



ZDC

|                | MODEL NO.     | FREQ. MHz<br><br>f <sub>L</sub> -f <sub>U</sub> | COUPLING dB |          | MAINLINE LOSS* dB |      |      |      |      |      | DIRECTIVITY dB |      |      |      |      |      | VSWR | POWER INPUT, W |       |        | PRICE, \$ |  |
|----------------|---------------|-------------------------------------------------|-------------|----------|-------------------|------|------|------|------|------|----------------|------|------|------|------|------|------|----------------|-------|--------|-----------|--|
|                |               |                                                 | Nom.        | Flatness | L                 |      | M    |      | U    |      | L              |      | M    |      | U    |      |      | L              | MU    | Ea.    | Qty.      |  |
|                |               |                                                 |             |          | Typ.              | Max. | Typ. | Max. | Typ. | Max. | Typ.           | Min. | Typ. | Min. | Typ. | Min. |      |                |       |        |           |  |
| ZEDC case V37  | ZEDC-10-2     | 1-1000                                          | 11±0.5      | ±0.75    | 1.3               | 1.5  | 1.5  | 1.8  | 1.5  | 1.8  | 35             | 30   | 30   | 20   | 18   | 13   | 1.3  | 1.5            | 3     | 54.95  | (4-24)    |  |
|                | ZEDC-15-2     | 1-1000                                          | 15±0.5      | ±0.5     | 0.5               | 1.0  | 0.8  | 1.2  | 1.0  | 1.4  | 35             | 30   | 30   | 25   | 25   | 15   | 1.15 | 1.5            | 3     | 54.95  | (4-24)    |  |
| ZFDC case K18  | ZFDC-10-1     | 1-500                                           | 10.5±0.25   | ±0.6     | 1.0               | 1.3  | 0.8  | 1.1  | 1.0  | 1.3  | 32             | 25   | 33   | 25   | 22   | 15   | 1.2  | 1.5            | 3     | 29.95  | (4-24)    |  |
|                | ZFDC-10-2     | 10-1000                                         | 10.75±0.5   | ±0.5     | 1.5               | 2.0  | 1.2  | 1.6  | 1.5  | 2.0  | 35             | 28   | 30   | 25   | 27   | 20   | 1.5  | 1.5            | 3     | 39.95  | (4-24)    |  |
|                | ▲ZFDC-10-21   | 1-1000                                          | 11±0.5      | ±0.5     | 1.2               | 1.7  | 1.2  | 1.7  | 1.6  | 2.0  | 40             | 30   | 25   | 20   | 25   | 20   | 1.2  | 1              | 2     | 44.95  | (4-24)    |  |
|                | ZFDC-10-22    | 1-750                                           | 11±0.5      | ±0.5     | 1.1               | 1.6  | 1.2  | 1.7  | 1.4  | 1.9  | 35             | 30   | 25   | 20   | 25   | 20   | 1.25 | 1              | 2     | 34.95  | (4-24)    |  |
|                | ZFDC-15-6     | 0.03-35                                         | 15±0.5      | ±0.5     | 0.3               | 0.6  | 0.2  | 0.4  | 0.3  | 0.6  | 38             | 30   | 35   | 25   | 28   | 20   | 1.15 | 2              | 4     | 34.95  | (4-24)    |  |
|                |               |                                                 |             |          |                   |      |      |      |      |      |                |      |      |      |      |      |      |                |       |        |           |  |
|                | ZFDC-20-3     | 0.2-250                                         | 19.5±0.5    | ±0.25    | 0.35              | 0.6  | 0.25 | 0.5  | 0.35 | 0.6  | 36             | 25   | 33   | 25   | 25   | 20   | 1.2  | 1.5            | 4     | 29.95  | (4-24)    |  |
|                | ZFDC-20-4     | 1-1000                                          | 19.5±0.5    | ±0.5     | 1.2               | 1.5  | 0.6  | 0.8  | 1.2  | 1.5  | 36             | 28   | 27   | 20   | 23   | 18   | 1.1  | 5              | 2     | 59.95  | (1-4)     |  |
|                | ●ZFDC-20-5    | 0.1-2000                                        | 19.5±0.5    | ±0.5     | 0.3               | 1    | 0.7  | 1.4  | 1.5  | 2.3  | 30             | 20   | 27   | 20   | 22   | 10   | 1.2  | .5             | 2     | 79.95  | (1-4)     |  |
|                | ■ZFDC-15-6-75 | 0.02-35                                         | 14.5±0.5    | ±0.5     | 0.3               | 0.7  | 0.3  | 0.7  | 0.3  | 0.7  | 35             | 20   | 35   | 20   | 35   | 20   | 1.3  | 1.5            | 4     | 35.95  | (4-24)    |  |
| ZMDC case M21  | ZMDC-10-1     | 0.5-500                                         | 11.5±0.5    | ±0.6     | 0.85              | 1.3  | 0.65 | 1.0  | 0.85 | 1.3  | 32             | 25   | 32   | 25   | 22   | 15   | 1.2  | 1.5            | 3     | 39.95  | (4-24)    |  |
|                | ZMDC-10-2     | 250-1000                                        | 10.5±0.5    | ±0.5     | 1.1               | 1.4  | —    | —    | 1.6  | 1.9  | 40             | 30   | 30   | 20   | 20   | 15   | 1.5  | —              | 5     | 47.95  | (4-24)    |  |
|                | ZMDC-15-6     | .01-35                                          | 15±0.5      | ±0.5     | 0.4               | 0.6  | 0.2  | 0.4  | 0.4  | 0.6  | 38             | 30   | 35   | 25   | 28   | 20   | 1.15 | 2              | 4     | 47.95  | (4-24)    |  |
|                | †ZMDC-20-1    | 25-400                                          | 21±0.75     | ±0.5     | 0.2               | 0.25 | 0.3  | 0.35 | 0.35 | 0.5  | 25             | 20   | 35   | 25   | 25   | 20   | 1.25 | 3              | 5     | 47.95  | (4-24)    |  |
|                | ZMDC-20-3     | 0.2-250                                         | 19.5±0.5    | ±0.5     | 0.35              | 0.5  | 0.25 | 0.5  | 0.35 | 0.6  | 36             | 30   | 33   | 25   | 25   | 20   | 1.2  | 1.5            | 4     | 39.95  | (4-24)    |  |
|                | ZMDC-30-1     | 0.1-250                                         | 30±0.5      | ±0.5     | 0.4               | 0.6  | 0.5  | 0.8  | 0.55 | 0.85 | 23             | 18   | 20   | 15   | 17   | 10   | 1.5  | 1.0            | 3     | 39.95  | (4-24)    |  |
|                |               |                                                 |             |          |                   |      |      |      |      |      |                |      |      |      |      |      |      |                |       |        |           |  |
| ZDC case M22   | ZDC-10-1      | 0.5-500                                         | 11.5±0.5    | ±0.6     | 0.85              | 1.3  | 0.65 | 1.0  | 0.85 | 1.3  | 32             | 25   | 32   | 25   | 22   | 15   | 1.2  | 1.5            | 3     | 29.95  | (4-24)    |  |
|                | ZDC-10-2      | 250-1000                                        | 10.5±0.5    | ±0.5     | 1.1               | 1.4  | —    | —    | 1.6  | 1.9  | 40             | 30   | 30   | 20   | 20   | 15   | 1.5  | —              | 5     | 37.95  | (4-24)    |  |
|                | ZDC-15-6      | .01-35                                          | 15±0.5      | ±0.5     | 0.3               | 0.6  | 0.2  | 0.4  | 0.3  | 0.6  | 38             | 30   | 35   | 25   | 28   | 20   | 1.15 | 2              | 4     | 37.95  | (4-24)    |  |
|                | †ZDC-20-1     | 25-400                                          | 21±0.75     | ±0.5     | 0.2               | 0.25 | 0.3  | 0.35 | 0.35 | 0.5  | 25             | 20   | 35   | 25   | 25   | 20   | 1.25 | 3              | 5     | 37.95  | (4-24)    |  |
|                | ZDC-20-3      | 0.2-250                                         | 19±0.5      | ±0.5     | 0.35              | 0.6  | 0.25 | 0.5  | 0.35 | 0.6  | 36             | 30   | 33   | 25   | 25   | 20   | 1.2  | 1.5            | 4     | 29.95  | (4-24)    |  |
|                |               |                                                 |             |          |                   |      |      |      |      |      |                |      |      |      |      |      |      |                |       |        |           |  |
|                | ■ZDC-10-1-75  | 1-250                                           | 10.5±0.5    | ±0.75    | 1.1               | 1.5  | 1.1  | 1.5  | 1.1  | 1.5  | 30             | 20   | 30   | 20   | 30   | 20   | 2    | 2              | 4     | 29.95  | (4-24)    |  |
|                | ■ZDC-15-6-75  | .02-35                                          | 14.5±0.5    | ±0.6     | 0.3               | 0.6  | 0.2  | 0.4  | 0.4  | 0.6  | 35             | 30   | 35   | 25   | 28   | 20   | 1.5  | 2              | 4     | 38.95  | (4-24)    |  |
|                | ■ZDC-20-3-75  | 1-150                                           | 19.5±0.5    | ±0.75    | 0.35              | 0.8  | 0.35 | 0.8  | 0.35 | 0.8  | 25             | 20   | 25   | 20   | 25   | 15   | 2    | 2              | 4     | 30.95  | (4-24)    |  |
|                | ■ZDC-2375     | 55-85                                           | 10.5±0.5    | ±0.5     | 1.6               | 2.1  | 1.6  | 2.1  | 1.6  | 2.1  | 35             | 30   | 35   | 30   | 35   | 30   | 1.3  | —              | 4     | 38.95  | (4-24)    |  |
| ■ZDC-20-3-75-1 | 55-90         | 18.6±0.5                                        | ±0.3        | 0.4      | 0.6               | 0.4  | 0.6  | 0.4  | 0.6  | 35   | 30             | 35   | 30   | 35   | 30   | 1.2  | —    | 4              | 38.95 | (4-24) |           |  |

L = low range ( $f_L$  to 10  $f_L$ )

M = mid range (10  $f_L$  to  $f_U/2$ )

U = upper range ( $f_U/2$  to  $f_U$ )

PDC-10-1



computer-automated performance data  
typical production unit / for data of other models consult factory

| FREQUENCY (MHz) | MAINLINE LOSS (dB) | COUPLING (dB) | DIRECTIVITY (dB) | IN   | VSWR OUT | CPL  |
|-----------------|--------------------|---------------|------------------|------|----------|------|
| .50             | .73                | 11.17         | 37.21            | 1.11 | 1.13     | 1.09 |
| 26.789          | .62                | 11.50         | 36.92            | 1.10 | 1.13     | 1.06 |
| 53.078          | .66                | 11.49         | 36.96            | 1.09 | 1.13     | 1.08 |
| 105.656         | .72                | 11.52         | 36.48            | 1.06 | 1.14     | 1.09 |
| 158.234         | .74                | 11.52         | 35.07            | 1.04 | 1.14     | 1.12 |
| 210.812         | .81                | 11.60         | 32.60            | 1.02 | 1.15     | 1.12 |
| 263.39          | .84                | 11.59         | 30.32            | 1.01 | 1.15     | 1.12 |
| 315.968         | .92                | 11.56         | 27.36            | 1.01 | 1.15     | 1.13 |
| 368.546         | .95                | 11.50         | 24.22            | 1.01 | 1.15     | 1.15 |
| 421.124         | 1.02               | 11.49         | 21.84            | 1.01 | 1.14     | 1.17 |
| 500.00          | 1.12               | 11.43         | 18.71            | 1.01 | 1.12     | 1.22 |

In Stock... Immediate Delivery

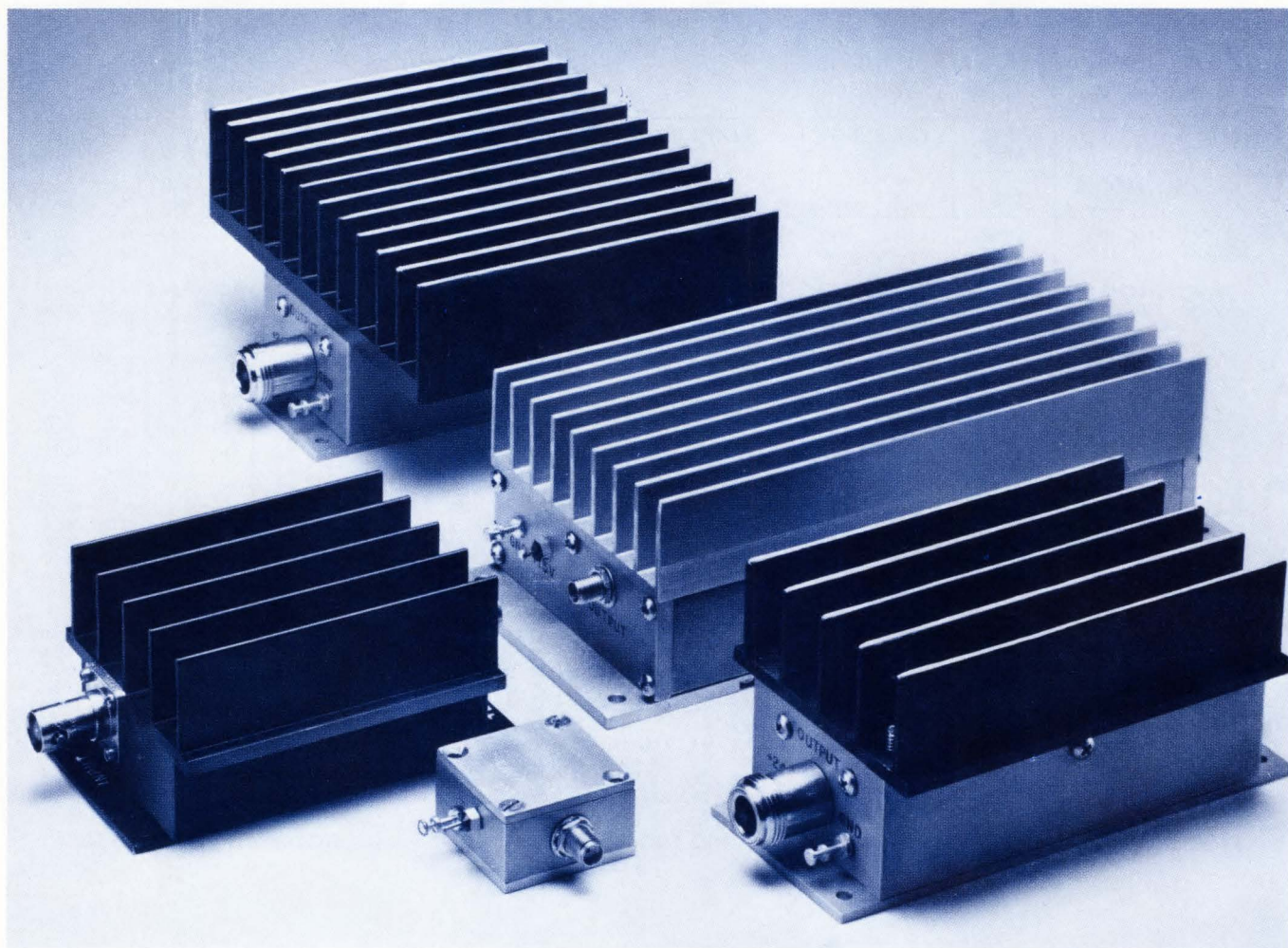


broadband linear

# Power Amplifiers

up to 2 Watts (+33 dBm)

50 KHz to 4.2 GHz



Up to 1 watt linear output at 4.2 GHz, 2 watts at 800 MHz are now available at exceptionally low prices with Mini-Circuits' line of broadband amplifiers. Ultra-linear Class A design provides unconditional stability so any load impedance may be connected without concern for damage or oscillation. These amplifiers are ideally suited for TACAN, mobile radio, telemetry, anti-collision and satellite communications systems. Use these amplifiers to boost signal/sweep generator output to achieve broadband isolation, and to provide four test setups, using only one generator with a 4-way splitter...to name just a few applications.

 **Mini-Circuits**

P.O. BOX 166, Brooklyn, New York 11235 (718) 934-4500



50 ohms

# Mini-Circuits

up to 1 Watt (+30 dBm)

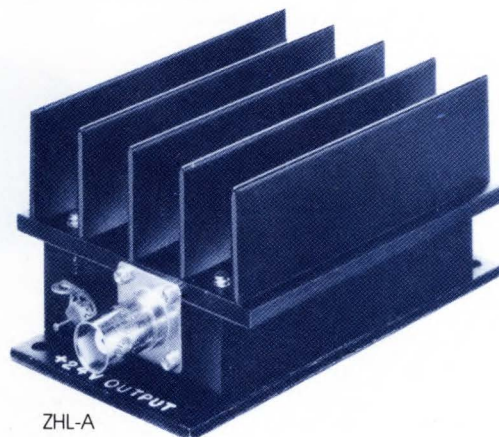
50 KHz to 500 MHz

performance data

curves, tables, page 4 Model Index

case style selection

outline drawings see page 3



ZHL-A

ZHL-A  
case S 32

| MODEL NO. | FREQUENCY MHz | GAIN, dB |               | MAXIMUM POWER, dBm       |                   | DYNAMIC RANGE |                                   | VSWR |     | DC POWER |         | PRICE \$ |      |
|-----------|---------------|----------|---------------|--------------------------|-------------------|---------------|-----------------------------------|------|-----|----------|---------|----------|------|
|           |               | Min.     | Flatness Max. | Output (1dB) Compression | Input (no damage) | NF, dB Typ.   | Intercept pt., dBm 3rd order Typ. | In   | Out | Volt.    | Current | Ea.      | Qty. |
| ZHL-1A    | 2-500         | 16       | ±1.0          | +28                      | +20               | 11            | +38                               | 2:1  | 2:1 | +24V     | 0.6A    | 199      | 1-9  |
| ZHL-3A    | 0.4-150       | 24       | ±1.0          | +29.5                    | +10               | 11            | +38                               | 2:1  | 2:1 | +24V     | 0.6A    | 199      | 1-9  |
| ZHL-32A   | 0.05 -130     | 25       | ±1.0          | +29                      | +10               | 10            | +38                               | 2:1  | 2:1 | +24V     | 0.6A    | 199      | 1-9  |

#### NOTES:

1. Operating temperature  $-20^{\circ}\text{C}$  to  $+65^{\circ}\text{C}$ .  
Storage temperature  $-55^{\circ}\text{C}$  to  $+100^{\circ}\text{C}$ .
2. With no load on output, derate maximum input power (no damage) by 10dB.
3. Prices and specifications subject to change without notice.

MIL-M-28837/1A, NSN GUIDE

MCL NO.

NSN

ZHL-1A

6130-01-088-2322



computer-automated performance data  
typical production unit / for data of other models consult factory

#### ZHL-1A

| FREQ.<br>(MHz) | GAIN (dB) |       |       |       | REVERSE GAIN (dB) |       |       |       | VSWR (IN) |       |      |      | VSWR (OUT) |      |      |      |
|----------------|-----------|-------|-------|-------|-------------------|-------|-------|-------|-----------|-------|------|------|------------|------|------|------|
|                | 12V       | 15V   | 20V   | 24V   | 12V               | 15V   | 20V   | 24V   | 12V       | 15V   | 20V  | 24V  | 12V        | 15V  | 20V  | 24V  |
| 2.00           | 17.90     | 18.27 | 18.46 | 18.52 | 29.03             | 29.07 | 28.96 | 28.88 | 1.09      | 1.13  | 1.14 | 1.14 | 1.10       | 1.16 | 1.15 | 1.15 |
| 28.21          | 17.88     | 18.27 | 18.48 | 18.52 | 29.53             | 29.72 | 29.54 | 29.24 | 1.09      | 1.11  | 1.13 | 1.14 | 1.20       | 1.19 | 1.19 | 1.18 |
| 54.42          | 17.88     | 18.33 | 18.54 | 18.59 | 29.57             | 29.62 | 29.58 | 29.39 | 1.12      | 1.12  | 1.13 | 1.14 | 1.24       | 1.24 | 1.24 | 1.24 |
| 80.63          | 17.94     | 18.41 | 18.65 | 18.70 | 29.91             | 29.78 | 29.64 | 29.56 | 1.19      | 1.17  | 1.16 | 1.16 | 1.30       | 1.29 | 1.30 | 1.30 |
| 106.84         | 17.90     | 18.41 | 18.69 | 18.78 | 29.85             | 30.12 | 29.97 | 29.75 | 1.31      | 1.24  | 1.21 | 1.21 | 1.36       | 1.36 | 1.37 | 1.37 |
| 133.05         | 17.91     | 18.42 | 18.75 | 18.83 | 30.02             | 30.06 | 30.15 | 29.87 | 1.42      | 1.32  | 1.28 | 1.27 | 1.41       | 1.41 | 1.42 | 1.44 |
| 159.26         | 17.68     | 18.34 | 18.71 | 18.81 | 30.25             | 30.32 | 30.03 | 30.00 | 1.56      | 1.42  | 1.36 | 1.34 | 1.46       | 1.48 | 1.50 | 1.52 |
| 185.47         | 17.64     | 18.34 | 18.78 | 18.84 | 30.50             | 30.36 | 30.12 | 29.99 | 1.71      | 1.553 | 1.45 | 1.43 | 1.50       | 1.53 | 1.57 | 1.60 |
| 211.68         | 17.52     | 18.25 | 18.74 | 18.82 | 30.50             | 30.64 | 30.19 | 30.05 | 1.83      | 1.63  | 1.52 | 1.50 | 1.51       | 1.56 | 1.63 | 1.67 |
| 237.89         | 17.46     | 18.20 | 18.73 | 18.81 | 30.85             | 30.64 | 30.35 | 30.32 | 1.96      | 1.72  | 1.59 | 1.57 | 1.52       | 1.58 | 1.67 | 1.73 |
| 264.10         | 17.34     | 18.09 | 18.66 | 18.74 | 30.99             | 30.75 | 30.40 | 30.43 | 2.04      | 1.79  | 1.64 | 1.62 | 1.48       | 1.56 | 1.66 | 1.75 |
| 290.31         | 17.28     | 18.03 | 18.58 | 18.69 | 31.08             | 30.89 | 30.66 | 30.58 | 2.14      | 1.86  | 1.69 | 1.66 | 1.44       | 1.53 | 1.66 | 1.76 |
| 316.52         | 17.33     | 18.08 | 18.69 | 18.79 | 30.64             | 30.77 | 30.51 | 30.49 | 2.16      | 1.88  | 1.70 | 1.67 | 1.40       | 1.50 | 1.64 | 1.75 |
| 342.73         | 17.32     | 18.06 | 18.69 | 18.79 | 30.50             | 30.44 | 30.41 | 30.44 | 2.17      | 1.87  | 1.69 | 1.65 | 1.33       | 1.43 | 1.59 | 1.71 |
| 368.94         | 17.30     | 18.04 | 18.71 | 18.79 | 30.09             | 30.23 | 30.24 | 30.27 | 2.09      | 1.81  | 1.63 | 1.59 | 1.27       | 1.35 | 1.49 | 1.62 |
| 395.15         | 17.23     | 18.02 | 18.67 | 18.82 | 29.81             | 29.95 | 29.91 | 30.18 | 2.03      | 1.75  | 1.57 | 1.53 | 1.24       | 1.28 | 1.41 | 1.55 |
| 421.36         | 17.32     | 18.13 | 18.83 | 18.98 | 29.19             | 29.36 | 29.52 | 29.85 | 1.96      | 1.68  | 1.49 | 1.44 | 1.32       | 1.29 | 1.36 | 1.50 |
| 447.57         | 17.37     | 18.23 | 18.96 | 19.08 | 28.50             | 28.79 | 29.05 | 29.22 | 1.90      | 1.61  | 1.41 | 1.36 | 1.47       | 1.36 | 1.34 | 1.43 |
| 473.78         | 17.17     | 18.10 | 18.90 | 19.08 | 27.94             | 28.28 | 28.64 | 28.82 | 1.93      | 1.64  | 1.42 | 1.37 | 1.68       | 1.51 | 1.39 | 1.42 |
| 500.00         | 17.07     | 18.14 | 19.06 | 19.26 | 27.68             | 27.17 | 28.22 | 28.50 | 2.07      | 1.79  | 1.57 | 1.54 | 1.01       | 1.79 | 1.61 | 1.58 |

In Stock... Immediate Delivery



# Power Amplifiers

up to 2 Watts (+33 dBm)

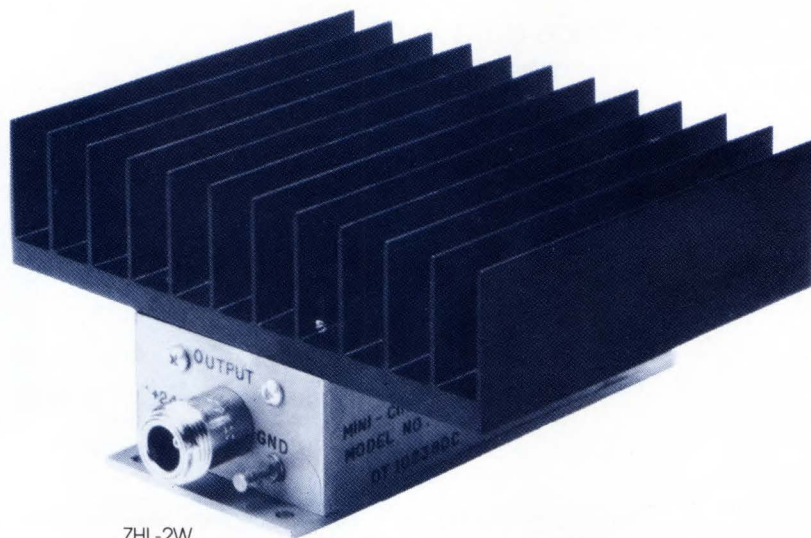
5 MHz to 800 MHz

performance data

curves, tables, page 4 Model Index

case style selection

outline drawings see page 3



ZHL-2W

| MODEL NO.        | FREQUENCY MHz      | GAIN, dB |               | MAXIMUM POWER, dBm       |                   | DYNAMIC RANGE |                                   | VSWR |     | DC POWER |         | PRICE \$ |      |
|------------------|--------------------|----------|---------------|--------------------------|-------------------|---------------|-----------------------------------|------|-----|----------|---------|----------|------|
|                  |                    | Min.     | Flatness Max. | Output (1dB) Compression | Input (no damage) | NF, dB Typ.   | Intercept pt., dBm 3rd order Typ. | In   | Out | Volt.    | Current | Ea.      | Qty. |
| ZHL-2W case T 35 | ZHL-1-2W NEW 5-500 | 29       | ±1.0          | +33                      | +10               | 12            | +44                               | 2:1  | 2:1 | +24V     | 0.9A    | 495      | 1-9  |
|                  | ZHL-7-2W 600-800   | 28       | ±1.0          | +33                      | +10               | 12            | +43                               | 2:1  | 2:1 | +24V     | 0.9A    | 525      | 1-9  |

## NOTES:

1. Operating temperature  $-20^{\circ}\text{C}$  to  $+65^{\circ}\text{C}$ .  
Storage temperature  $-55^{\circ}\text{C}$  to  $+100^{\circ}\text{C}$ .
2. With no load on output, derate maximum input power (no damage) by 10dB.
3. Prices and specifications subject to change without notice.

## ZHL-1-2W

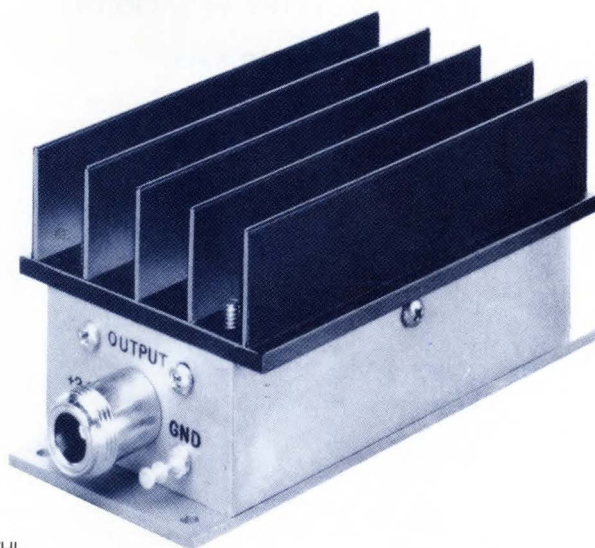
| FREQ. (MHz) | GAIN (dB) | REVERSE GAIN (dB) | in   | VSWR out | LINEARITY P <sub>out</sub> (dBm) | Comp. (dB) |
|-------------|-----------|-------------------|------|----------|----------------------------------|------------|
| 5.00        | 32.25     | 16.59             | 1.46 | 1.65     | 32.86                            | 0.25       |
| 031.05      | 31.64     | 17.55             | 1.39 | 1.67     | 32.74                            | 0.26       |
| 057.10      | 31.58     | 16.46             | 1.38 | 1.70     | 32.70                            | 0.36       |
| 083.15      | 31.59     | 17.70             | 1.36 | 1.74     | 32.58                            | 0.42       |
| 109.20      | 31.51     | 16.92             | 1.33 | 1.80     | 32.56                            | 0.39       |
| 135.25      | 31.43     | 17.30             | 1.28 | 1.85     | 32.48                            | 0.51       |
| 161.30      | 31.49     | 17.02             | 1.22 | 1.91     | 32.49                            | 0.52       |
| 187.35      | 31.46     | 16.61             | 1.15 | 1.99     | 32.39                            | 0.61       |
| 213.40      | 31.39     | 16.91             | 1.08 | 2.05     | 32.38                            | 0.60       |
| 239.45      | 31.39     | 17.63             | 1.03 | 2.07     | 32.38                            | 0.62       |
| 265.50      | 31.32     | 16.44             | 1.12 | 2.03     | 32.34                            | 0.66       |
| 291.55      | 31.25     | 17.19             | 1.24 | 1.89     | 32.31                            | 0.64       |
| 317.60      | 31.22     | 18.48             | 1.36 | 1.67     | 32.38                            | 0.64       |
| 343.65      | 31.11     | 20.85             | 1.49 | 1.43     | 32.33                            | 0.70       |
| 369.70      | 30.89     | 21.35             | 1.59 | 1.20     | 32.35                            | 0.58       |
| 395.75      | 30.74     | 15.87             | 1.67 | 1.04     | 32.43                            | 0.66       |
| 421.80      | 30.70     | 15.95             | 1.73 | 1.24     | 32.41                            | 0.67       |
| 447.85      | 30.73     | 15.78             | 1.78 | 1.49     | 32.38                            | 0.64       |
| 473.90      | 31.07     | 15.83             | 1.83 | 1.76     | 32.31                            | 0.77       |
| 500.00      | 31.95     | 15.87             | 1.90 | 1.99     | 32.02                            | 1.00       |

50 ohms

up to 1 Watt (+30 dBm)

10 MHz to 1200 MHz

# Mini-Circuits



ZHL

| MODEL NO.  | FREQUENCY MHz | GAIN, dB |              | MAXIMUM POWER, dBm       |                   | DYNAMIC RANGE |                                  | VSWR |     | DC POWER |         | PRICE \$ |      |
|------------|---------------|----------|--------------|--------------------------|-------------------|---------------|----------------------------------|------|-----|----------|---------|----------|------|
|            |               | Min.     | Flatness Max | Output (1dB Compression) | Input (no damage) | NF, dB Typ.   | Intercept pt, dBm 3rd order Typ. | In   | Out | Volt.    | Current | Ea.      | Qty. |
| ZHL        | 10-1000       | 16       | ±1.0         | +29                      | +20               | 18            | +38                              | 2:1  | 2:1 | +24V     | 0.6A    | 349      | 1-9  |
| ZHL-2-8    | 10-1000       | 27       | ±1.0         | +29                      | +10               | 10            | +38                              | 2:1  | 2:1 | +24V     | 0.6A    | 474      | 1-9  |
| ZHL-2-12 * | 10-1200       | 24       | ±1.0         | +29*                     | +10               | 10            | +38                              | 2:1  | 2:1 | +24V     | 0.75A   | 599      | 1-9  |

\* +28.5 dBm maximum output 1000 to 1200 MHz; available only with SMA



computer-automated performance data  
typical production unit / for data of other models consult factory

## ZHL-2

## ZHL-2-8

| FREQ. (MHz) | GAIN (dB) | REVERSE (dB) | GAIN (dB) | VSWR in out | LINEARITY Pout (dBm) | Comp. (dB) |
|-------------|-----------|--------------|-----------|-------------|----------------------|------------|
| 10.00       | 16.85     | 39.91        | 1.12      | 1.88        | 29.81                | 0.24       |
| 62.05       | 17.06     | 39.66        | 1.19      | 1.80        | 29.77                | 0.27       |
| 114.10      | 17.19     | 39.40        | 1.28      | 1.70        | 29.66                | 0.32       |
| 166.15      | 12.18     | 39.08        | 1.38      | 1.61        | 29.50                | 0.42       |
| 218.20      | 17.17     | 39.18        | 1.49      | 1.54        | 29.46                | 0.48       |
| 270.25      | 17.23     | 38.58        | 1.57      | 1.48        | 29.51                | 0.40       |
| 322.30      | 17.29     | 37.81        | 1.64      | 1.44        | 29.45                | 0.58       |
| 374.35      | 17.15     | 37.43        | 1.68      | 1.42        | 29.41                | 0.53       |
| 426.40      | 17.10     | 36.70        | 1.70      | 1.36        | 29.42                | 0.59       |
| 478.45      | 17.11     | 36.23        | 1.72      | 1.28        | 29.39                | 0.55       |
| 530.50      | 17.09     | 35.35        | 1.75      | 1.19        | 29.37                | 0.59       |
| 582.55      | 17.15     | 35.20        | 1.77      | 1.14        | 29.37                | 0.63       |
| 634.60      | 17.38     | 34.64        | 1.74      | 1.29        | 29.41                | 0.59       |
| 686.65      | 17.28     | 33.51        | 1.69      | 1.53        | 29.39                | 0.52       |
| 738.70      | 17.14     | 32.25        | 1.67      | 1.71        | 29.39                | 0.57       |
| 790.75      | 17.25     | 30.98        | 1.71      | 1.76        | 29.37                | 0.56       |
| 842.80      | 17.32     | 29.64        | 1.80      | 1.61        | 29.27                | 0.72       |
| 894.85      | 17.44     | 28.71        | 1.90      | 1.31        | 29.25                | 0.66       |
| 946.90      | 17.49     | 28.01        | 1.88      | 1.12        | 29.22                | 0.75       |
| 999.00      | 16.89     | 28.24        | 1.63      | 1.48        | 29.06                | 0.96       |

| GAIN (dB) | REVERSE (dB) | GAIN (dB) | VSWR in out | LINEARITY Pout (dBm) | Comp. (dB) |
|-----------|--------------|-----------|-------------|----------------------|------------|
| 39.33     | 50.00        | 2.48      | 2.74        | 39.73                | 0.40       |
| 29.38     | 40.00        | 1.41      | 1.66        | 29.51                | 0.45       |
| 29.22     | 40.00        | 1.36      | 1.60        | 29.46                | 0.54       |
| 29.13     | 40.00        | 1.31      | 1.59        | 29.40                | 0.63       |
| 29.08     | 40.00        | 1.26      | 1.61        | 29.37                | 0.67       |
| 29.03     | 40.00        | 1.23      | 1.66        | 29.27                | 0.71       |
| 28.97     | 40.00        | 1.27      | 1.74        | 29.29                | 0.72       |
| 29.00     | 40.00        | 1.36      | 1.81        | 29.37                | 0.64       |
| 28.82     | 40.00        | 1.45      | 1.80        | 29.40                | 0.64       |
| 28.58     | 40.00        | 1.53      | 1.68        | 29.41                | 0.52       |
| 28.39     | 40.00        | 1.58      | 1.50        | 29.51                | 0.59       |
| 28.30     | 40.00        | 1.59      | 1.29        | 29.45                | 0.60       |
| 28.47     | 40.00        | 1.55      | 1.08        | 29.36                | 0.61       |
| 28.73     | 40.00        | 1.47      | 1.13        | 29.43                | 0.53       |
| 28.94     | 40.00        | 1.42      | 1.34        | 29.52                | 0.49       |
| 29.04     | 40.00        | 1.48      | 1.50        | 29.45                | 0.48       |
| 28.99     | 40.00        | 1.62      | 1.51        | 29.42                | 0.60       |
| 28.86     | 40.00        | 1.76      | 1.41        | 29.38                | 0.62       |
| 28.61     | 40.00        | 1.82      | 1.36        | 29.24                | 0.73       |
| 28.11     | 40.00        | 1.83      | *1.53       | 29.14                | 0.81       |

In Stock... Immediate Delivery



# broadband linear Power Amplifiers

up to 50mW (+17 dBm)

10 MHz to 2000 MHz

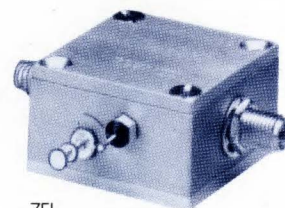
performance data

curves, tables, page 4 Model Index

case style selection

outline drawings see page 3

NEW



ZFL

| MODEL NO. | FREQUENCY MHz | GAIN, dB |              | MAXIMUM POWER, dBm       |                   | DYNAMIC RANGE |                                   | VSWR |     | DC POWER |         | PRICE \$ |       |
|-----------|---------------|----------|--------------|--------------------------|-------------------|---------------|-----------------------------------|------|-----|----------|---------|----------|-------|
|           |               | Min.     | Flatness Max | Output (1dB) Compression | Input (no damage) | NF, dB Typ.   | Intercept pt., dBm 3rd order Typ. | In   | Out | Volt.    | Current | Ea.      | Qty.  |
| ZFL-2000  | 10-2000       | 20       | ±1.5         | +17*                     | +5                | 7.0           | +25                               | 2:1  | 2:1 | +15V     | 100mA   | 179      | (1-9) |

ZFL  
case Y 39

## NOTES:

\* +16dBm at 1000 MHz.

1. Operating temperature -55°C to +100°C

Storage temperature -55°C to +100°C

2. With no load output, derate maximum input power (no damage) by 10 dB.

3. Prices and specifications subject to change without notice.



ZFL-2000

| FREQUENCY (MHz) | GAIN (dB) | REVERSE GAIN (dB) | VSWR |      | LINEARITY  |            |
|-----------------|-----------|-------------------|------|------|------------|------------|
|                 |           |                   | in   | out  | Pout (dBm) | Comp. (dB) |
| 10.00           | 22.68     | 33.41             | 1.44 | 1.28 | 15.44      | 1.26       |
| 105.42          | 22.58     | 33.31             | 1.46 | 1.21 | 15.35      | 1.26       |
| 200.83          | 22.60     | 33.35             | 1.44 | 1.13 | 15.32      | 1.30       |
| 296.25          | 22.48     | 33.37             | 1.35 | 1.09 | 15.24      | 1.28       |
| 391.67          | 22.32     | 33.45             | 1.24 | 1.13 | 15.19      | 1.05       |
| 487.08          | 21.96     | 33.60             | 1.18 | 1.14 | 15.11      | 0.92       |
| 582.50          | 21.63     | 34.05             | 1.21 | 1.18 | 14.74      | 0.80       |
| 677.92          | 21.60     | 34.33             | 1.37 | 1.24 | 14.86      | 0.82       |
| 773.33          | 22.03     | 34.03             | 1.48 | 1.30 | 15.28      | 0.74       |
| 868.75          | 22.42     | 33.59             | 1.53 | 1.36 | 15.74      | 0.71       |
| 964.17          | 22.64     | 33.12             | 1.49 | 1.45 | 15.98      | 0.62       |
| 1059.40         | 22.89     | 32.74             | 1.39 | 1.59 | 16.25      | 0.68       |
| 1154.70         | 23.14     | 32.22             | 1.25 | 1.71 | 16.42      | 0.79       |
| 1250.20         | 23.44     | 31.64             | 1.05 | 1.76 | 16.54      | 0.88       |
| 1345.80         | 23.34     | 31.15             | 1.19 | 1.67 | 16.57      | 0.73       |
| 1441.00         | 23.18     | 30.81             | 1.44 | 1.52 | 16.55      | 0.63       |
| 1535.90         | 22.96     | 30.64             | 1.64 | 1.31 | 16.45      | 0.49       |
| 1631.50         | 22.64     | 30.73             | 1.77 | 1.10 | 16.22      | 0.38       |
| 1726.90         | 22.32     | 30.57             | 1.78 | 1.11 | 15.97      | 0.33       |
| 1822.20         | 22.08     | 30.05             | 1.67 | 1.28 | 15.80      | 0.26       |
| 1917.60         | 21.70     | 29.21             | 1.54 | 1.43 | 15.67      | 0.03       |
| 2014.80         | 21.03     | 29.26             | 1.55 | 1.53 | 15.58      | -0.46      |
| 2108.20         | 20.24     | 28.70             | 1.97 | 1.57 | 15.20      | -0.89      |
| 2204.00         | 19.23     | 28.44             | 2.93 | 1.48 | 14.47      | -1.17      |
| 2299.70         | 18.26     | 28.28             | 4.15 | 1.29 | 13.35      | -1.11      |

**Mini-Circuits**

P.O. BOX 166, Brooklyn, New York 11235 (718) 934-4500

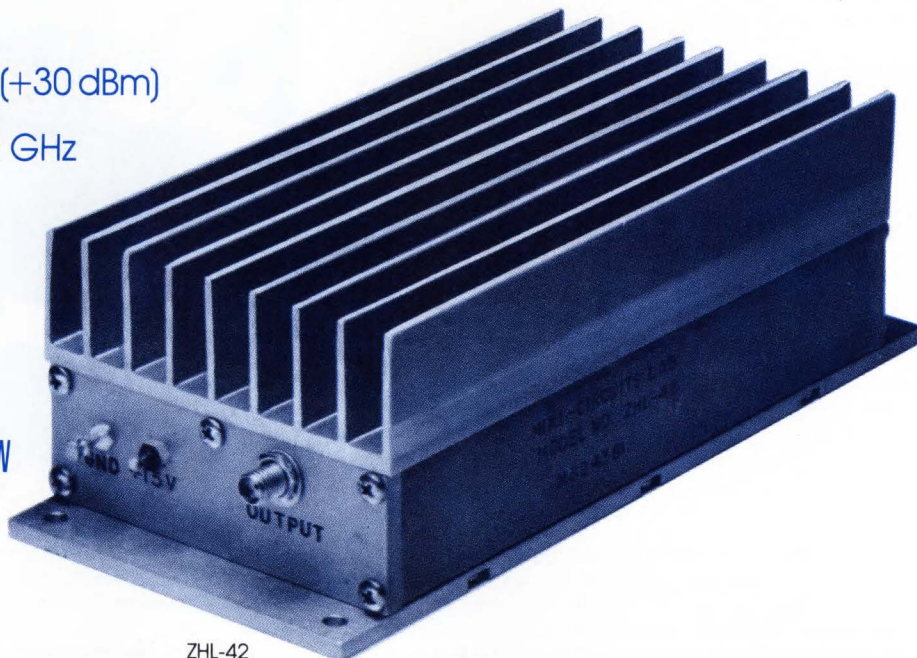
50 ohms

# Mini-Circuits

up to 1 Watt (+30 dBm)

700 MHz to 4.2 GHz

NEW



ZHL-42

| MODEL NO.           | FREQUENCY GHz | GAIN, dB |              | MAXIMUM POWER, dBm       |                   | DYNAMIC RANGE |                                   | VSWR  |       | DC POWER |         | PRICE \$ |       |
|---------------------|---------------|----------|--------------|--------------------------|-------------------|---------------|-----------------------------------|-------|-------|----------|---------|----------|-------|
|                     |               | Min.     | Flatness Max | Output (1dB) Compression | Input (no damage) | NF, dB Typ.   | Intercept pt., dBm 3rd order Typ. | In    | Out   | Volt.    | Current | Ea.      | Qty.  |
| ZHL-42<br>case U 36 | 0.7-4.2       | 30       | ±1.0         | +29                      | +10               | 10            | +38                               | 2.5:1 | 2.5:1 | 15       | 0.69A   | 895      | (1-9) |

#### NOTES:

1. Operating temperature -20°C to +65°C  
Storage temperature -55°C to +100°C
2. With no load output, derate maximum input power (no damage) by 10 dB.
3. Prices and specifications subject to change without notice.



computer-automated performance data  
typical production unit / for data of other models consult factory

| ZHL-42 | FREQUENCY (MHz) | GAIN (dB) | REVERSE GAIN (dB) | VSWR in | out  | LINEARITY Pout (dBm) | Comp. (dB) |
|--------|-----------------|-----------|-------------------|---------|------|----------------------|------------|
|        | 700.25          | 33.56     | 47.42             | 1.57    | 1.98 | 28.91                | 1.18       |
|        | 845.84          | 33.44     | 47.61             | 1.54    | 1.67 | 28.82                | 1.05       |
|        | 991.85          | 33.61     | 47.66             | 1.51    | 1.42 | 29.29                | 0.86       |
|        | 1137.60         | 34.37     | 47.97             | 1.46    | 1.37 | 29.98                | 0.93       |
|        | 1283.50         | 34.54     | 47.96             | 1.43    | 1.36 | 30.42                | 0.61       |
|        | 1429.70         | 34.09     | 48.08             | 1.60    | 1.33 | 30.65                | 0.07       |
|        | 1575.50         | 34.06     | 48.00             | 1.67    | 1.47 | 30.53                | 0.16       |
|        | 1720.90         | 34.65     | 48.03             | 1.72    | 1.43 | 30.65                | 0.80       |
|        | 1866.60         | 35.05     | 48.15             | 1.62    | 1.32 | 30.46                | 1.41       |
|        | 2013.10         | 35.42     | 48.30             | 1.57    | 1.20 | 30.57                | 1.75       |
|        | 2158.00         | 35.21     | 48.36             | 1.47    | 1.21 | 30.53                | 1.40       |
|        | 2304.20         | 34.72     | 48.35             | 1.48    | 1.16 | 30.13                | 1.30       |
|        | 2448.60         | 34.42     | 48.27             | 1.49    | 1.15 | 29.77                | 1.22       |
|        | 2595.20         | 34.55     | 48.36             | 1.51    | 1.18 | 29.91                | 1.05       |
|        | 2741.40         | 33.78     | 48.26             | 1.37    | 1.24 | 30.01                | 0.31       |
|        | 2887.60         | 34.03     | 48.29             | 1.34    | 1.52 | 30.35                | 0.32       |
|        | 2999.40         | 34.25     | 48.39             | 1.28    | 1.94 | 30.38                | 0.49       |
|        | 3033.30         | 34.05     | 48.50             | 1.24    | 1.99 | 30.50                | 0.29       |
|        | 3179.70         | 33.85     | 48.35             | 1.24    | 1.74 | 30.27                | 0.36       |
|        | 3324.30         | 34.01     | 48.62             | 1.30    | 1.56 | 30.04                | 0.77       |
|        | 3470.30         | 34.34     | 48.51             | 1.39    | 1.43 | 30.19                | 0.79       |
|        | 3616.70         | 34.49     | 48.76             | 1.58    | 1.28 | 29.91                | 1.07       |
|        | 3763.00         | 34.65     | 48.61             | 1.67    | 1.11 | 29.73                | 0.72       |
|        | 3909.00         | 32.36     | 48.49             | 1.54    | 1.21 | 29.69                | 0.33       |
|        | 4053.50         | 33.32     | 48.74             | 1.39    | 1.39 | 30.30                | 0.05       |
|        | 4199.90         | 34.60     | 48.69             | 1.44    | 1.84 | 30.04                | 0.08       |

In Stock... Immediate Delivery



wideband

# RF Transformers

3KHz to 800MHz

performance data

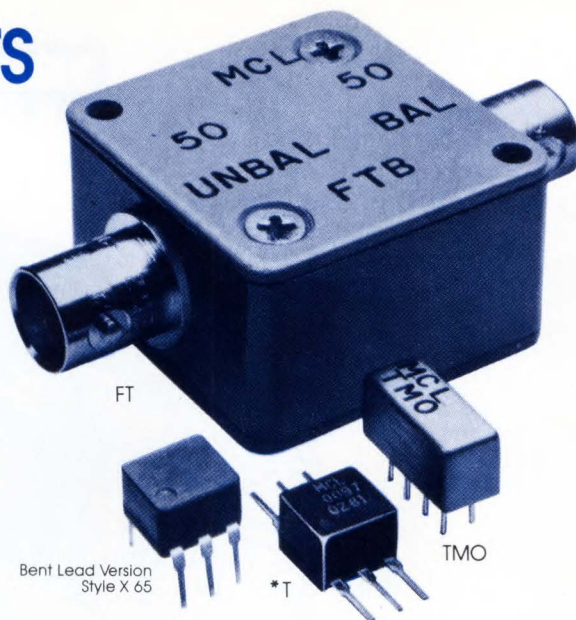
curves, tables, page 4 Model Index

## case style selection

outline drawings see page 3

T, TH, case W 38, X 65\*  
TMO, case A 11, †case B 13  
FT, FTB, case H 16

\*Surface Mounting Available  
See case KK81, page 18



For PC applications, select from the low-cost, plastic-case T series (small enough to be inserted into a standard 1/3 DIP socket), or the hermetically-sealed RFI shielded TMO metal-case series (requiring less PC area than a flatpack or TO-5 can), or the plastic-case T-H series designed to handle up to 100 mA in the primary winding without appreciable saturation or change in RF characteristics.

Transformer core saturation is influenced by (1) dc current through the winding, (2) RF input power, and (3) frequency of operation. These three variables interact to affect the point at which saturation occurs, see Figs. (1) and (2). These curves show the point where distortion occurs, by visual observation, and illustrate how saturation is influenced by dc current through the winding, RF input power level and frequency of operation: See that (1) if the dc current through the winding increases, the allowable RF input power decreases and the minimum frequency of operation will increase, (2) if RF input power increases, the maximum allowable dc current through the winding will decrease and the minimum frequency of operation will increase, (3) if the frequency of operation increases, then the RF input power can be increased and the dc current through the winding can also be increased.

Now comparing the T-H series to the conventional T-series in Figs. (1) and (2), note that saturation effects are negligible with the T16-1H; so for wide dynamic range applications, specify the T-H series.

Coaxial connector models are available from 10 KHz to 500 MHz and are offered with 50 ohm and 75 ohm impedances; 75 ohm connectors are used at 75 ohm ports. The FT 1.5-1, with unbalanced input and output, is especially useful for 50 ohm to 75 ohm matching applications. The FTB series with unbalanced output and balanced input (connector ground insulated from the case) helps eliminate ground loop problems, especially when long cable runs are involved.

As shown in the data chart on the following page, models are available in five basic configurations.

These transformers may be operated as low as 12.5 ohms at the primary with essentially the same impedance matching ratio and only a slight change in frequency response.

For each RF transformer model, the minimum and maximum frequency is given for the insertion loss at the 3 dB, 2 dB and 1 dB points, as shown in Fig. (3) and listed in the data chart. For example, the T1-1 insertion loss is 1 dB from 2 to 50 MHz and 3 dB from 0.15 to 400 MHz.

## performance saturation curves T, TH series

(RF power & DC current at which signal saturation begins)

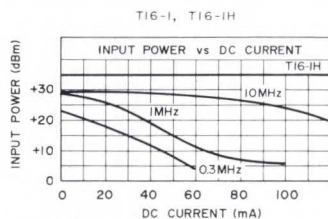


FIG. 1

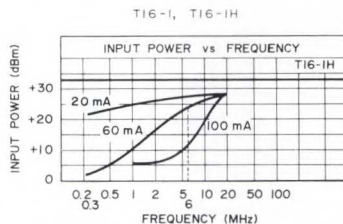


FIG. 2

## frequency response curve

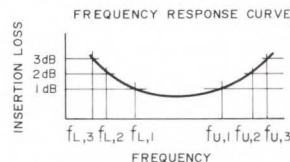


FIG. 3

## NSN GUIDE

| MCL NO. | NSN              |
|---------|------------------|
| T1-1    | 5950-01-128-3745 |
| T2-1    | 5950-01-106-1218 |
| T4-1    | 5950-01-024-7626 |
| TMO4-1  | 5950-01-067-1012 |
| TMO4-2  | 5950-01-091-3553 |
| T9-1    | 5950-01-105-8153 |
| TMO9-1A | 5950-01-098-6315 |
| T16-1   | 5950-01-094-7439 |

## \*FOR A AND B CONFIGURATIONS

Maximum Amplitude Unbalance  
0.1 dB over 1 dB frequency range  
0.5 dB over entire frequency range

Maximum Phase Unbalance  
1.0° over 1 dB frequency range  
5.0° over entire frequency range

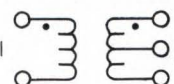
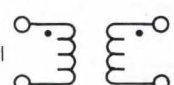
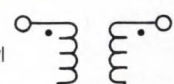
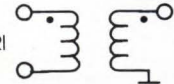
## NOTES:

■ Denotes 75 ohm models, 75 ohm BNC connectors are standard.

1. For Quality Control procedures, see page 6.
2. For environmental specifications see page 7.
3. Absolute Maximum Ratings, see page 7, except for T & TH Series, temperature range is -20 to +85°C.
4. For connector types and case mounting options, see case style outline drawings.
5. Prices and specifications subject to change without notice.

**Mini-Circuits**

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| case style number<br>see opposite page. |                                                                                     | MODEL<br>NO. | $\Omega$<br>RATIO | FREQUENCY<br>MHz | INSERTION LOSS |            |            | PRICE \$ |         |
|-----------------------------------------|-------------------------------------------------------------------------------------|--------------|-------------------|------------------|----------------|------------|------------|----------|---------|
|                                         |                                                                                     |              |                   |                  | 3dB<br>MHz     | 2dB<br>MHz | 1dB<br>MHz | Ea.      | Qty.    |
| A*                                      |    | T T1-1T      | 1                 | .05-200          | .05-200        | .08-150    | .2-80      | 3.95     | (10-49) |
|                                         |                                                                                     | T1-6T        | 1                 | .003-300         | .003-300       | .01-150    | .02-50     | 5.95     | (10-49) |
|                                         |                                                                                     | T2-1T        | 2                 | .07-200          | .07-200        | .1-100     | .5-50      | 4.25     | (10-49) |
|                                         |                                                                                     | T2.5-6T      | 2.5               | .01-100          | .01-100        | .02-50     | .05-20     | 4.25     | (10-49) |
|                                         |                                                                                     | T3-1T        | 3                 | .05-250          | .05-250        | .1-200     | .5-70      | 3.95     | (10-49) |
|                                         |                                                                                     | T4-1         | 4                 | .2-350           | .2-350         | .35-300    | 2-100      | 2.95     | (10-49) |
|                                         |                                                                                     | T4-6T        | 4                 | .02-250          | .02-250        | .05-150    | 0.1-100    | 3.95     | (10-49) |
|                                         |                                                                                     | T5-1T        | 5                 | .3-300           | .3-300         | .6-200     | .5-100     | 4.25     | (10-49) |
|                                         |                                                                                     | T8-1T        | 8                 | .03-140          | .03-140        | .10-90     | 1-60       | 6.95     | (10-49) |
|                                         |                                                                                     | T13-1T       | 13                | .3-120           | .3-120         | .7-80      | 5-20       | 4.25     | (10-49) |
|                                         |                                                                                     | T16-6T       | 16                | .03-75           | .03-75         | .06-30     | .1-20      | 4.95     | (10-49) |
|                                         |                                                                                     | TH T4-1H     | 4                 | 8-350            | 8-350          | 15-300     | 25-200     | 4.95     | (10-49) |
|                                         |                                                                                     | TMO TMO1-1T  | 1                 | .05-200          | .05-200        | .08-150    | .2-80      | 6.45     | (10-49) |
|                                         |                                                                                     | TMO2-1T      | 2                 | .07-200          | .07-200        | .1-100     | .5-50      | 6.75     | (10-49) |
|                                         |                                                                                     | TMO2.5-6T    | 2.5               | .01-100          | .01-100        | .02-50     | .05-20     | 6.75     | (10-49) |
|                                         |                                                                                     | TMO3-1T      | 3                 | .05-250          | .05-250        | .1-200     | .5-70      | 6.45     | (10-49) |
|                                         |                                                                                     | TMO4-1       | 4                 | .2-350           | .2-350         | .35-300    | 2-100      | 4.95     | (10-49) |
|                                         |                                                                                     | TMO5-1T      | 5                 | .3-300           | .3-300         | .6-200     | 5-100      | 6.75     | (10-49) |
|                                         |                                                                                     | TMO13-1T     | 13                | .3-120           | .3-120         | .7-80      | 5-20       | 6.75     | (10-49) |
| B*                                      |    | TT T11-6     | 1                 | .004-500         | .004-500       | .02-200    | .1-50      | 5.95     | (10-49) |
|                                         |                                                                                     | TT15-1       | 1.5               | .075-500         | .075-500       | .2-100     | .1-50      | 4.95     | (10-49) |
|                                         |                                                                                     | TT2.5-6      | 2.5               | .01-50           | .01-50         | .025-25    | .05-10     | 5.25     | (10-49) |
|                                         |                                                                                     | TT4-1        | 4                 | .05-200          | .05-200        | .2-50      | 1-30       | 4.95     | (10-49) |
|                                         |                                                                                     | TT25-1       | 25                | .02-30           | .02-30         | .05-20     | .1-10      | 7.95     | (10-49) |
|                                         |                                                                                     | TTMO T11-1   | 1                 | .005-100         | .005-100       | .01-75     | .05-40     | 10.95    | (10-49) |
| C                                       |    | T T1-1       | 1                 | .15-400          | .15-400        | .35-200    | 2-50       | 2.95     | (10-49) |
|                                         |                                                                                     | T1-6         | 1                 | .01-150          | .01-150        | .02-100    | .05-50     | 4.95     | (10-49) |
|                                         |                                                                                     | T1.5-6       | 1.5               | .1-300           | .1-300         | .2-150     | .5-80      | 3.95     | (10-49) |
|                                         |                                                                                     | T1.5-6       | 1.5               | .02-100          | .02-100        | .05-50     | 0.1-25     | 4.95     | (10-49) |
|                                         |                                                                                     | T2.5-6       | 2.5               | .01-100          | .01-100        | .02-50     | .05-20     | 3.95     | (10-49) |
|                                         |                                                                                     | T4-6         | 4                 | .02-200          | .02-200        | .05-150    | .1-100     | 3.95     | (10-49) |
|                                         |                                                                                     | T9-1         | 9                 | .15-200          | .15-200        | .3-150     | 2-40       | 3.45     | (10-49) |
|                                         |                                                                                     | T16-1        | 16                | .3-120           | .3-120         | .7-80      | 5-20       | 3.95     | (10-49) |
|                                         |                                                                                     | T36-1        | 36                | .03-20           | .03-20         | .05-10     | .1-5       | 5.95     | (10-49) |
|                                         |                                                                                     | TH T11-1H    | 1                 | 8-300            | 8-300          | 10-200     | 25-100     | 4.95     | (10-49) |
|                                         |                                                                                     | T9-1H        | 9                 | 2-90             | 2-90           | 3-75       | 6-50       | 5.45     | (10-49) |
|                                         |                                                                                     | T16-1H       | 16                | 7-85             | 7-85           | 10-65      | 15-40      | 5.95     | (10-49) |
|                                         |                                                                                     | TMO TMO1-1   | 1                 | .15-400          | .15-400        | .35-200    | 2-50       | 4.95     | (10-49) |
|                                         |                                                                                     | TMO1.5-1     | 1.5               | .1-300           | .1-300         | .2-150     | .5-80      | 6.75     | (10-49) |
|                                         |                                                                                     | TMO2.5-6     | 2.5               | .01-100          | .01-100        | .02-50     | .05-20     | 6.45     | (10-49) |
|                                         |                                                                                     | TMO4-6       | 4                 | .02-200          | .02-200        | .05-150    | .1-100     | 6.45     | (10-49) |
|                                         |                                                                                     | TMO6-1       | 6                 | .3-200           | .3-200         | .5-150     | 5-50       | 6.45     | (10-49) |
|                                         |                                                                                     | TMO9-1       | 9                 | .15-200          | .15-200        | .3-150     | 2-40       | 6.45     | (10-49) |
|                                         |                                                                                     | TMO16-1      | 16                | .3-120           | .3-120         | .7-80      | 5-20       | 6.45     | (10-49) |
| D                                       |  | T T2-1       | 2                 | .025-600         | .025-600       | .05-400    | .5-200     | 3.45     | (10-49) |
|                                         |                                                                                     | T3-1         | 3                 | .5-800           | .5-800         | .2-400     | —          | 4.25     | (10-49) |
|                                         |                                                                                     | T4-2         | 4                 | .2-600           | .2-600         | .5-500     | .2-250     | 4.45     | (10-49) |
|                                         |                                                                                     | T8-1         | 8                 | .15-250          | .15-250        | .25-200    | 2-100      | 3.45     | (10-49) |
|                                         |                                                                                     | T14-1        | 14                | .2-150           | .2-150         | .5-100     | 2-50       | 4.25     | (10-49) |
|                                         |                                                                                     | TMO TMO2-1   | 2                 | .025-600         | .025-600       | .05-400    | .5-200     | 5.95     | (10-49) |
|                                         |                                                                                     | TMO3-1       | 3                 | .5-800           | .5-800         | .2-400     | —          | 6.95     | (10-49) |
|                                         |                                                                                     | TMO4-2       | 4                 | .2-600           | .2-600         | .5-500     | .2-250     | 5.95     | (10-49) |
|                                         |                                                                                     | TMO8-1       | 8                 | .15-250          | .15-250        | .25-200    | 2-100      | 5.95     | (10-49) |
|                                         |                                                                                     | TMO14-1      | 14                | .2-150           | .2-150         | .5-100     | 2-50       | 6.75     | (10-49) |
| E                                       |  | FT FT1.5-1   | 1.5               | .1-400           | .1-400         | .5-200     | 1-100      | 29.95    | (1-4)   |
|                                         |                                                                                     | FTB FTB1-1   | 1                 | .2-500           | .2-500         | .5-300     | 10-100     | 29.95    | (1-4)   |
|                                         |                                                                                     | FTB1-6       | 1                 | .01-125          | .01-125        | .05-50     | .1-25      | 29.95    | (1-4)   |
|                                         |                                                                                     | FTB1-1-75    | 1                 | .5-500           | .5-500         | 5-300      | 10-100     | 29.95    | (1-4)   |

### pin connections see case style outline drawings

| CONFIGURATION | *A<br>DC Isolated<br>Center-Tap Secondary |     | *B<br>DC Isolated<br>Center-Tap Primary, Secondary |     | C,E<br>DC Isolated |     | D<br>Unbalanced<br>Primary, Secondary |     |
|---------------|-------------------------------------------|-----|----------------------------------------------------|-----|--------------------|-----|---------------------------------------|-----|
|               | T, TH                                     | TMO | T                                                  | TMO | T, TH              | TMO | T                                     | TMO |
| Primary DOT   | 4                                         | 1   | 4                                                  | 1   | 4                  | 1   | 6                                     | 1   |
| Primary       | 6                                         | 5   | 6                                                  | 5   | 6                  | 5   | 3◇                                    | 6◇◇ |
| Primary CT    | —                                         | —   | 5                                                  | 3   | —                  | —   | —                                     | —   |
| Secondary Dot | 3                                         | 2   | 3                                                  | 2   | 3                  | 2   | 1                                     | 2   |
| Secondary     | 1                                         | 6   | 1                                                  | 6   | 1                  | 6   | 3◇                                    | 6◇◇ |
| Secondary CT  | 2                                         | 4   | 2                                                  | 4   | —                  | —   | —                                     | —   |
| Case Gnd.     | —                                         | 7,8 | —                                                  | 7,8 | —                  | 7,8 | —                                     | 7,8 |

◇ pin 3 must be grounded  
◇◇ pin 6 must be grounded



highest figure of merit

# Phase Detectors

1000mV DC output, +7dBm RF

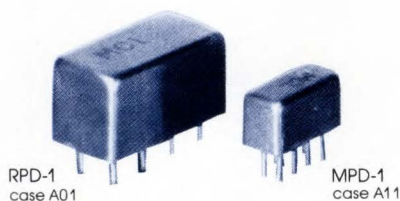
1MHz to 100 MHz

performance data

curves, tables, page 4 Model Index

case style selection

outline drawings see page 3



## description

These new high efficiency phase detectors are the only units in the world offering a figure-of-merit greater than 125 for only \$15.95.

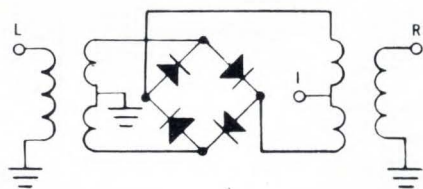
The figure-of-merit M or efficiency of a phase detector can be defined as the ratio of maximum DC output voltage (in mV) divided by the RF power (in dBm). The maximum DC output from these units is 1000 mV with +7 dBm applied to the LO and RF ports, and DC offset is typically 400 micro-volts. Thus, its figure-of-merit M is 143, which indicates a highly efficient phase detector. For comparison, a double-balanced mixer used as a phase detector offers 350 mV DC output with the same LO and RF inputs for a figure-of-merit M of 50.

Both the RPD-1 and MPD-1 are packaged in a hermetically-sealed EMI-shielded metal case. The miniature RPD-1 measures 0.4 x 0.8 x 0.4 in. and the micromin MPD-1 is only 0.2 x 0.5 x 0.25 in.

So when your system requires a high output phase detector, specify the new RPD or MPD series.

## NOTES:

1. Maximum RF input power, 50mW.  
peak IF current, 20mA.
2. Refer to table of contents for quality control procedures, environmental specifications, absolute maximum ratings, and hi-rel testing.
3. Prices and specifications subject to change without notice.



## pin connections

see case style outline drawing

| Series    |   | RPD-1   | MPD-1   |
|-----------|---|---------|---------|
| REF.      | L | 8       | 8       |
| RF in:    | R | 1       | 1       |
| DC out:   | I | *3,4    | *3,4    |
| GND.      |   | 2,5,6,7 | 2,5,6,7 |
| CASE GND. |   | 2       | 2       |

\*pins must be externally connected together

## applications

- Radar
- ECM Systems
- Test Instruments
- Phase-lock loops

## cost (5-24)

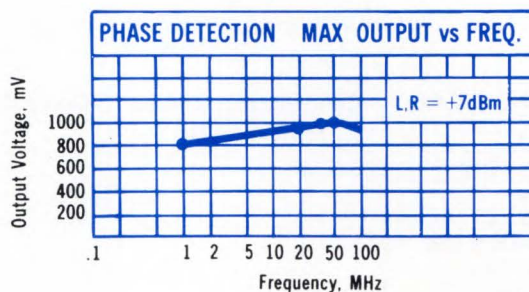
RPD-1 \$15.95

MPD-1 \$18.95

## RPD-1, MPD-1 specifications

|                                          |                           |
|------------------------------------------|---------------------------|
| FREQUENCY RANGE:                         |                           |
| L and R ports                            | 1-100 MHz                 |
| Output ports                             | DC-50 MHz                 |
| SCALE FACTOR                             | 8 mV/Degree               |
| IMPEDANCE                                |                           |
| L and R ports                            | 50 ohms                   |
| I port                                   | 500 ohms                  |
| L and R SIGNAL LEVELS                    | +7 dBm                    |
| ISOLATION, L-R                           | 40 dB min                 |
| MAXIMUM DC OUTPUT, mV                    | 1000 mV typ<br>750 mV min |
| DC OUTPUT POLARITY<br>(L and R in-phase) | Negative                  |
| DC OUTPUT OFFSET                         | 0.2 mV typ<br>1 mV max    |
| FIGURE-OF-MERIT, M                       | 143 Typical               |
| SIZE                                     |                           |
| RPD-1                                    | 0.4 X 0.8 X 0.4           |
| MPD-1                                    | 0.2 X 0.5 X 0.25          |

## Model RPD-1



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broadband, minimal phase change

# Limiters

50 ohms

 **Mini-Circuits**

+ 3 to + 20 dBm input

3 KHz to 900 MHz

performance data

curves, tables, page 4 Model Index

case style selection

outline drawings see page 3



PLS

PLS  
case A01

| Model No. | FREQUENCY MHz<br>$f_L$ $f_U$ | INPUT dBm |      | *OUTPUT dBm | CONTROL CURRENT (mA)<br>Typ. | Input range, dBm                | LIMITING $\Delta$ Output/ $\Delta$ 1dB Input |                   | PRICE, \$ |      |
|-----------|------------------------------|-----------|------|-------------|------------------------------|---------------------------------|----------------------------------------------|-------------------|-----------|------|
|           |                              | Min.      | Max. | Typ.        |                              |                                 | amp, dB                                      | phase, deg.       | Ea.       | Qty. |
| PLS-1     | 0.1-150                      | 6         | 20   | -1.6        | 3                            | 6 to 10<br>10 to 16<br>16 to 20 | 0.1<br>0.1<br>0.2                            | 0.5<br>0.5<br>1.0 | 18.95     | 5-49 |
| PLS-2     | 100-900                      | 3         | 15   | -5.0        | 10                           | 3 to 8<br>8 to 12<br>12 to 15   | 0.2<br>0.4<br>0.2                            | 2.0<br>2.0<br>2.0 | 18.95     | 5-49 |
| PLS-6     | 0.003-1                      | 6         | 20   | -3.0        | 5                            | 6 to 10<br>10 to 16<br>16 to 20 | 0.2<br>0.1<br>0.2                            | 1.0<br>1.0<br>1.0 | 29.95     | 5-49 |

\* Typical output level at typical control current.  
Level may be changed by varying current.

## pin connections

see case style outline drawing

| Series    | PLS     |         |         |
|-----------|---------|---------|---------|
| Model     | - 1     | - 2     | - 6     |
| INPUT     | 1       | 1       | 1       |
| OUTPUT    | 8       | 8       | 8       |
| CONTROL   | *3,4    | *3,4    | *3,4    |
| GND.      | 2,5,6,7 | 2,5,6,7 | 2,5,6,7 |
| CASE GND. | 2       | 2,5,6,7 | —       |

\*Pins must be externally connected together

## NOTES:

1. Maximum RF input power, 100mW.  
Maximum control current, 10 mA.
2. Refer to table of contents for quality control procedures; environmental specifications, absolute maximum ratings, and hi-rel testing.
3. Prices and specifications subject to change without notice.

## NSN GUIDE

MCL NO. NSN  
PLS-1 5825-01-105-7820

## PLS-1 LIMITING



computer-automated performance data  
typical production unit / for data of other models consult factory

| MHz     | Output (20 dBm IN) | Output (16 dBm IN) | Output (10 dBm IN) | Output (6 dBm IN) | Delta, Out (20 to 16 dBm IN) | Delta, Out (16 to 10 dBm IN) | Delta, Out (10 to 6 dBm IN) |
|---------|--------------------|--------------------|--------------------|-------------------|------------------------------|------------------------------|-----------------------------|
| 100     | -1.36              | -1.47              | -1.77              | -2.15             | .11                          | .30                          | .38                         |
| 7.990   | -.77               | -1.02              | -1.28              | -1.65             | .25                          | .26                          | .37                         |
| 15.880  | -.81               | -.97               | -1.35              | -1.65             | .16                          | .38                          | .30                         |
| 23.769  | -.79               | -.95               | -1.35              | -1.64             | .16                          | .40                          | .29                         |
| 31.658  | -.77               | -.94               | -1.38              | -1.54             | .17                          | .44                          | .16                         |
| 39.547  | -.71               | -.93               | -1.34              | -1.47             | .22                          | .41                          | .13                         |
| 47.437  | -.86               | -1.08              | -1.41              | -1.46             | .22                          | .33                          | .05                         |
| 55.327  | -.88               | -1.03              | -1.40              | -1.73             | .15                          | .37                          | .33                         |
| 63.217  | -.86               | -1.05              | -1.48              | -1.63             | .19                          | .43                          | .15                         |
| 71.105  | -1.02              | -1.01              | -1.42              | -1.78             | -.01                         | .41                          | .36                         |
| 78.995  | -1.05              | -1.05              | -1.37              | -1.57             | 0.00                         | .32                          | .20                         |
| 86.884  | -.95               | -1.08              | -1.49              | -1.78             | .13                          | .41                          | .29                         |
| 94.775  | -.98               | -1.12              | -1.40              | -1.73             | .14                          | .28                          | .33                         |
| 102.661 | -1.06              | -1.15              | -1.50              | -1.59             | .09                          | .35                          | .09                         |
| 110.551 | -1.14              | -1.29              | -1.58              | -2.32             | .15                          | .29                          | .74                         |
| 118.440 | -1.09              | -1.19              | -1.58              | -1.98             | .10                          | .39                          | .40                         |
| 126.330 | -1.03              | -1.21              | -1.53              | -1.65             | .18                          | .32                          | .12                         |
| 134.221 | -1.10              | -1.31              | -1.59              | -2.28             | .21                          | .28                          | .69                         |
| 142.111 | -1.19              | -1.44              | -1.70              | -1.98             | .25                          | .26                          | .28                         |
| 150.000 | -1.16              | -1.47              | -1.72              | -2.07             | .31                          | .25                          | .35                         |

REMARK: Control Current: 5.6mA

**In Stock... Immediate Delivery**



low current, low voltage

# Electronic Attenuators/Switches

1.4 to 60 dB 1 MHz to 2.5 GHz

performance data

curves, tables, page 4 Model Index

case style selection

outline drawings see page 3



|                  |         | FREQUENCY<br>MHz |                                | INSERTION LOSS<br>dB |               |      |                | IN-OUT ISOLATION<br>dB |      |      |      |      |      | IN-CON ISOLATION<br>dB |      |      |      |      |      | PRICE, \$ |        |      |
|------------------|---------|------------------|--------------------------------|----------------------|---------------|------|----------------|------------------------|------|------|------|------|------|------------------------|------|------|------|------|------|-----------|--------|------|
|                  |         | MODEL<br>NO.     | IN                             | CON                  | Mid-Band<br>m |      | Total<br>Range |                        | L    |      | M    |      | U    |                        | L    |      | M    |      | U    |           | Ea.    | Qty. |
|                  |         |                  | f <sub>L</sub> -f <sub>U</sub> |                      |               | Typ. | Max.           | Typ.                   | Max. | Typ. | Min. | Typ. | Min. | Typ.                   | Min. | Typ. | Min. | Typ. | Min. | Typ.      |        |      |
| PAS<br>case A01  | PAS-1   | 5-450            | DC-0.05                        | 3.5                  | 4.0           | 3.5  | 4.7            | 65                     | 50   | 45   | 35   | 35   | 25   | 35                     | 25   | 25   | 15   | 20   | 10   | 27.95     | (5-24) |      |
|                  | PAS-2   | 10-1000          | DC-0.05                        | 4.0                  | 6.0           | 6.5  | 8.5            | 50                     | 40   | 40   | 30   | 35   | 25   | 30                     | 20   | 17   | 10   | 17   | 10   | 37.95     | (5-24) |      |
|                  | PAS-3   | 1-200            | DC-0.05                        | 1.4                  | 2.0           | 1.6  | 2.5            | 65                     | 50   | 50   | 40   | 50   | 35   | 35                     | 25   | 20   | 15   | 15   | 10   | 28.95     | (5-24) |      |
| ZFAS<br>case K18 | ZFAS-15 | 10-2500          | DC-200                         | 3.5                  | 4.0           | 3.5  | 5.0            | 20                     | 18   | 35   | 25   | 30   | 20   | 19                     | 15   | 28   | 20   | 20   | 15   | 89.95     | (1-4)  |      |
| ZMAS<br>case M21 | ZMAS-1  | 5-450            | DC-0.05                        | 3.5                  | 4.0           | 3.5  | 4.7            | 65                     | 50   | 55   | 45   | 35   | 25   | 35                     | 25   | 25   | 15   | 20   | 10   | 55.95     | (4-24) |      |
|                  | ZMAS-3  | 1-200            | DC-0.05                        | 1.4                  | 2.0           | 1.6  | 2.5            | 65                     | 50   | 50   | 40   | 50   | 35   | 35                     | 25   | 20   | 15   | 15   | 10   | 56.95     | (4-24) |      |
| ZAS<br>case M22  | ZAS-1   | 5-450            | DC-0.05                        | 3.5                  | 4.0           | 3.5  | 4.7            | 65                     | 50   | 55   | 45   | 35   | 25   | 35                     | 25   | 25   | 15   | 20   | 10   | 45.95     | (4-24) |      |
|                  | ZAS-3   | 1-200            | DC-0.05                        | 1.4                  | 2.0           | 1.6  | 2.5            | 65                     | 50   | 50   | 40   | 50   | 35   | 35                     | 25   | 20   | 15   | 15   | 10   | 46.95     | (4-24) |      |

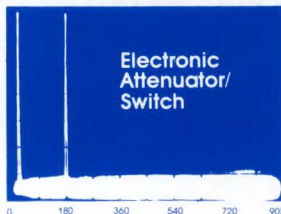
L = low range ( $f_L$  to  $10 f_L$ )

M = mid range ( $10 f_L$  to  $f_U/2$ )

U = upper range ( $f_U/2$  to  $f_U$ )

m = mid band ( $2 f_L$  to  $f_U/2$ )

typical harmonic spectrum comparing attenuators  
Double Balanced Mixer Vs. Electronic Attenuator



NOTES: (both pages)

1. Maximum RF input power, 1 watt.  
Maximum control current, 40 mA.
2. Refer to table of contents for quality control procedures, environmental specifications, absolute maximum ratings, and hi-rel testing.
3. For connector types and case mounting options, see case style outline drawings.
4. For PSW and ZMSW models
  - a) VSWR 1.5 max. ("on" state)
  - b) Switching speed 1  $\mu$  sec. max.
  - c) Maximum RF input +20 dBm
  - d) Control voltage +5V (5mA max.) on condition 0V off condition
5. Prices and specifications subject to change without notice.

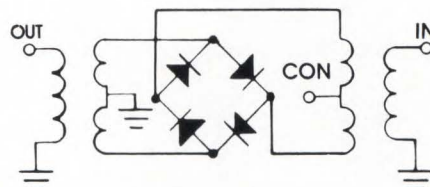
pin and coaxial connections

see case style outline drawings

| Series   | PAS     |         | ZFAS       | ZMAS       | ZAS        |
|----------|---------|---------|------------|------------|------------|
| Models   | -1      | -2      | all models | all models | all models |
| OUT      | 8       | 8       | 1          | 1          | 1          |
| IN       | 1       | 1       | 2          | 3          | 3          |
| CONTROL  | *3,4    | *3,4    | 3          | 2          | 2          |
| GND      | 2,5,6,7 | 2,5,6,7 | —          | —          | —          |
| CASE GND | 2       | 2,5,6,7 | —          | —          | —          |

\*pins 3 and 4 must be connected together externally

schematic



NSN GUIDE

MCL NO. NSN

PAS-3

5985-01-067-3035

**Mini-Circuits**

P.O. BOX 166, Brooklyn, New York 11235 (718) 934-4500

pin diode

# Switches

SPST/SPDT

10 to 2500 MHz

# Mini-Circuits



| MODEL NO.         |           | TYPE | FREQUENCY MHz<br><br>f <sub>L</sub> -f <sub>U</sub> | INSERTION LOSS dB<br><br>low-band lw      Upper band U |     |      |     | IN-OUT ISOLATION dB<br><br>L                                  M                                  U |    |      |    |      |    | PRICE, \$ |        |     |      |
|-------------------|-----------|------|-----------------------------------------------------|--------------------------------------------------------|-----|------|-----|----------------------------------------------------------------------------------------------------|----|------|----|------|----|-----------|--------|-----|------|
|                   |           |      |                                                     | Typ.                                                   |     | Max. |     | Typ.                                                                                               |    | Max. |    | Typ. |    | Min.      |        | Ea. | Qty. |
|                   |           |      |                                                     |                                                        |     |      |     |                                                                                                    |    |      |    |      |    |           |        |     |      |
| PSW<br>case A06   | PSW-1111  | SPST | 10-2500                                             | 1.1                                                    | 1.7 | 1.7  | 2.7 | 50                                                                                                 | 40 | 35   | 30 | 28   | 22 | 29.95     | (6-24) |     |      |
|                   | PSW-1211  | SPDT | 10-2500                                             | 1.1                                                    | 1.7 | 1.7  | 2.7 | 50                                                                                                 | 40 | 35   | 30 | 28   | 22 | 29.95     | (6-24) |     |      |
| ZMSW<br>case JJ77 | ZMSW-1111 | SPST | 10-2500                                             | 1.1                                                    | 1.7 | 1.7  | 2.7 | 50                                                                                                 | 45 | 35   | 30 | 28   | 22 | 59.95     | (1-4)  |     |      |
|                   | ZMSW-1211 | SPDT | 10-2500                                             | 1.1                                                    | 1.7 | 1.7  | 2.7 | 50                                                                                                 | 45 | 35   | 30 | 28   | 22 | 59.95     | (1-4)  |     |      |

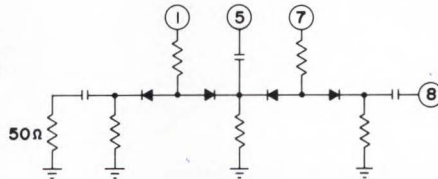
L = low range ( $f_L$  to  $10 f_L$ )

M = mid range ( $10 f_L$  to  $f_U/2$ )

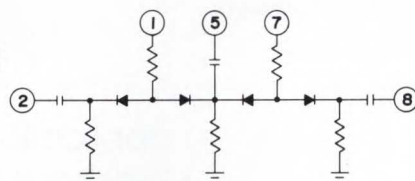
U = upper range ( $f_U/2$  to  $f_U$ )

lw = low-band ( $f_L$  to  $f_U/2$ )

Model  
PSW-1111



Model  
PSW-1211



## pin and coaxial connections

see case style outline drawings

| Series         | PSW  |      | ZMSW |      |
|----------------|------|------|------|------|
| Models         | 1111 | 1211 | 1111 | 1211 |
| RF COMMON      | 5    | 5    | com  | com  |
| RF-1 port      | 8    | 2    | —    | RF-1 |
| RF-2 port      | —    | 8    | RF-2 | RF-2 |
| CONTROL RF-1   | 7    | 1    | —    | 1    |
| CONTROL RF-2   | —    | 7    | 2    | 2    |
| CONTROL 50 ohm | 1    | —    | 1    | —    |
| TERMINATION    | —    | —    | —    | —    |
| GND            | 2,4  | 4    | —    | —    |
| CASE GND       | 3,6  | 3,6  | —    | —    |



## computer-automated performance data

typical production unit / for data of other models consult factory

PSW-1211

| RF (MHz) | INSERTION LOSS, dB |          | ISOLATION, dB |          |
|----------|--------------------|----------|---------------|----------|
|          | com RF-1           | com RF-2 | com RF-1      | com RF-2 |
| 10       | -1.29              | -1.38    | -49.04        | -49.44   |
| 110      | -.93               | -.97     | -49.74        | -49.78   |
| 210      | -.91               | -.90     | -48.87        | -44.32   |
| 310      | -.92               | -.84     | -44.55        | -45.60   |
| 410      | -.83               | -.71     | -42.88        | -44.53   |
| 610      | -1.09              | -.96     | -39.47        | -39.28   |
| 810      | -1.13              | -1.12    | -37.53        | -36.80   |
| 1010     | -1.12              | -1.09    | -35.83        | -34.95   |
| 1310     | -1.14              | -1.10    | -33.28        | -32.77   |
| 1510     | -1.16              | -1.12    | -32.93        | -32.41   |
| 1810     | -1.30              | -1.26    | -31.80        | -31.32   |
| 2010     | -1.40              | -1.32    | -30.31        | -29.93   |
| 2110     | -1.45              | -1.34    | -28.33        | -28.99   |
| 2310     | -1.44              | -1.31    | -28.08        | -28.09   |
| 2510     | -1.59              | -1.45    | -27.89        | -28.11   |

**In Stock... Immediate Delivery**



high rejection of 1st and 3rd harmonics

# Frequency Doublers

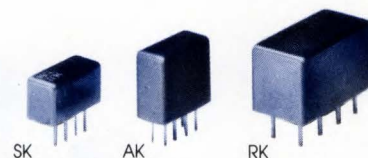
input power 0 to +20dBm

performance data

curves, tables, page 4 Model Index

case style selection

outline drawings see page 3



| MODEL NO.      | FREQUENCY MHz |         | RF INPUT PWR. dBm |      | CONVERSION LOSS, dB |      |      | *HARMONIC OUTPUT, dB |    |    |    |    |    | PRICE, \$ |        |
|----------------|---------------|---------|-------------------|------|---------------------|------|------|----------------------|----|----|----|----|----|-----------|--------|
|                | Input         | Output  | Min.              | Max. | Input freq.         | Typ. | Max. | F1                   |    | F3 |    | F4 |    | Ea.       | Qty.   |
| SK<br>case B02 | 1-500         | 2-1000  | 1                 | 15   | 1-100               | 13.0 | 15.0 | 40                   | 30 | 50 | 40 | 16 | 12 | 21.95     | (5-24) |
|                |               |         |                   |      | 100-300             | 13.5 | 15.5 | 25                   | 20 | 40 | 30 | 16 | 12 |           |        |
|                |               |         |                   |      | 300-500             | 14.0 | 16.5 | 20                   | 15 | 30 | 25 | 16 | 12 |           |        |
| AK<br>case A03 | 1-500         | 2-1000  | 1                 | 15   | 1-100               | 13.0 | 15.0 | 40                   | 30 | 50 | 40 | 16 | 12 | 19.95     | (5-24) |
|                |               |         |                   |      | 100-300             | 13.5 | 15.5 | 25                   | 20 | 40 | 30 | 16 | 12 |           |        |
|                |               |         |                   |      | 300-500             | 14.0 | 16.5 | 20                   | 15 | 30 | 25 | 16 | 12 |           |        |
| RK<br>case A01 | 1-500         | 2-1000  | 1                 | 15   | 1-100               | 13.0 | 15.0 | 40                   | 30 | 50 | 40 | 16 | 12 | 15.95     | (5-24) |
|                |               |         |                   |      | 100-300             | 13.5 | 15.5 | 25                   | 20 | 40 | 30 | 16 | 12 |           |        |
|                |               |         |                   |      | 300-500             | 14.0 | 16.5 | 20                   | 15 | 30 | 25 | 16 | 12 |           |        |
| RK-3<br>NEW    | 0.05-150      | 0.1-300 | 0                 | 13   | 0.05- 50            | 11.0 | 13.0 | 40                   | 30 | 45 | 30 | 16 | 12 | 14.95     | (5-24) |
|                |               |         |                   |      | 50-150              | 11.5 | 15.0 | 35                   | 20 | 40 | 20 | 16 | 12 |           |        |
| RK-6           | 0.005-25      | 0.01-50 | 0                 | 10   | 0.005-1             | 11.0 | 13.0 | 40                   | 30 | 45 | 30 | 16 | 12 | 21.95     | (5-24) |
|                |               |         |                   |      | 1-25                | 11.5 | 15.0 | 35                   | 20 | 40 | 20 | 16 | 12 |           |        |

\*Harmonic Output below power of F2.

## NOTES:

1. Maximum RF input power, 200mW.
2. Refer to table of contents for quality control procedures; environmental specifications, absolute maximum ratings, and hi-rel testing.
3. For connector types and case mounting options, see case style outline drawings.
4. Prices and specifications subject to change without notice.

## pin connections

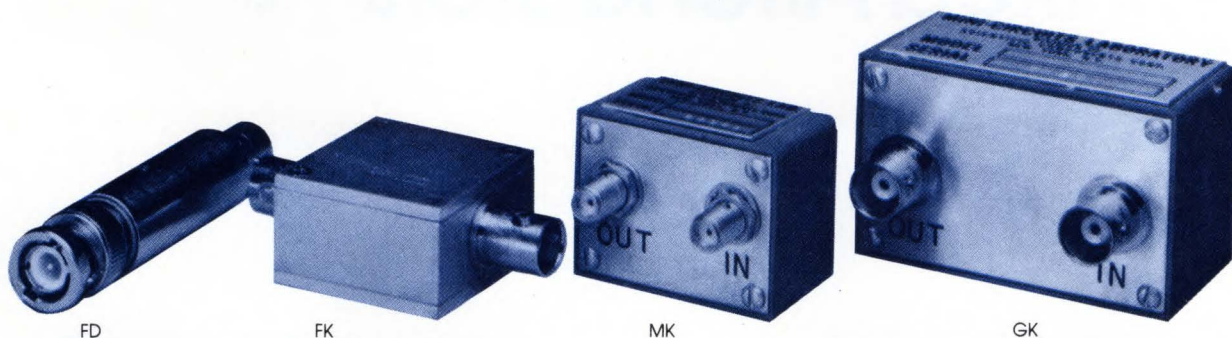
see case style outline drawing

| Series   | SK         | RK      |         |         | AK         |
|----------|------------|---------|---------|---------|------------|
| Models   | all models | - 2     | - 3     | - 6     | all models |
| IN       | *1,2       | *1,3,4  | *1,3,4  | *1,3,4  | *1,3,4     |
| OUT      | 4          | 8       | 8       | 8       | 8          |
| GND      | 3          | 2,5,6,7 | 2,5,6,7 | 2,5,6,7 | 2,5,6,7    |
| CASE GND | 3          | 2,5,6,7 | 2       | —       | 2,5,6,7    |

\*pins must be connected together externally

## applications

- Wideband frequency multiplier chains
- Low spurious frequency multiplier chains
- FM, PM modulation chains
- Double frequency range of signal generators



| MODEL NO. | FREQUENCY MHz |         | RF INPUT PWR. dBm |      | CONVERSION LOSS, dB |      |      | *HARMONIC OUTPUT, dB |    |    |    |    |    | PRICE, \$ |       |
|-----------|---------------|---------|-------------------|------|---------------------|------|------|----------------------|----|----|----|----|----|-----------|-------|
|           | Input         | Output  | Min.              | Max. | Input freq.         | Typ. | Max. | F1                   |    | F3 |    | F4 |    | Ea.       | Qty.  |
| FD-2      | 1-500         | 2-1000  | 1                 | 15   | 1-100               | 13.0 | 15.0 | 40                   | 30 | 50 | 40 | 16 | 12 | 32.95     | (1-4) |
|           |               |         |                   |      | 100-300             | 13.5 | 15.5 | 25                   | 20 | 40 | 30 | 16 | 12 |           |       |
|           |               |         |                   |      | 300-500             | 14.0 | 16.5 | 20                   | 15 | 30 | 25 | 16 | 12 |           |       |
| FK-5      | 10-1000       | 20-2000 | **10              | 20   | 10-600              | 13.0 | 15.0 | 20                   | 15 | 25 | 20 | —  | —  | 59.95     | (1-4) |
| 600-1000  | 14.0          | 17.0    |                   |      |                     |      |      |                      |    |    |    |    |    |           |       |
| MK-2      | 1-500         | 2-1000  | 1                 | 15   | 1-100               | 13.0 | 15.0 | 40                   | 30 | 50 | 40 | 16 | 12 | 42.95     | (1-4) |
|           |               |         |                   |      | 100-300             | 13.5 | 15.5 | 25                   | 20 | 40 | 30 | 16 | 12 |           |       |
|           |               |         |                   |      | 300-500             | 14.0 | 16.5 | 20                   | 15 | 30 | 25 | 16 | 12 |           |       |
| MK-3      | 0.05-150      | 0.1-300 | 0                 | 13   | 0.05-50             | 11.0 | 13.0 | 40                   | 30 | 45 | 30 | 16 | 12 | 37.95     | (1-4) |
|           |               |         |                   |      | 50-150              | 11.5 | 15.0 | 35                   | 20 | 40 | 20 | 16 | 12 |           |       |
| MK-5      | 10-1000       | 20-2000 | **10              | 20   | 10-600              | 13.0 | 15.0 | 20                   | 15 | 25 | 20 | —  | —  | 67.95     | (1-4) |
| 600-1000  | 14.0          | 17.0    |                   |      |                     |      |      |                      |    |    |    |    |    |           |       |
| GK-2      | 1-500         | 2-1000  | 1                 | 15   | 1-100               | 13.0 | 15.0 | 40                   | 30 | 50 | 40 | 16 | 12 | 32.95     | (1-4) |
|           |               |         |                   |      | 100-300             | 13.5 | 15.5 | 25                   | 20 | 40 | 30 | 16 | 12 |           |       |
|           |               |         |                   |      | 300-600             | 14.0 | 16.5 | 20                   | 15 | 30 | 25 | 16 | 12 |           |       |
| GK-3      | 0.05-150      | 0.1-300 | 0                 | 13   | 0.05- 50            | 11.0 | 13.0 | 40                   | 30 | 45 | 30 | 16 | 12 | 30.95     | (1-4) |
|           |               |         |                   |      | 50-150              | 11.5 | 15.0 | 35                   | 20 | 40 | 20 | 16 | 12 |           |       |
| GK-5      | 10-1000       | 20-2000 | **10              | 20   | 10-600              | 13.0 | 15.0 | 20                   | 15 | 25 | 20 | —  | —  | 57.95     | (1-4) |
| 600-1000  | 14.0          | 17.0    |                   |      |                     |      |      |                      |    |    |    |    |    |           |       |

\*Harmonic Output below power of F2.

\*\*ABOVE 700 MHz, min. input power +13dBm


**computer-automated performance data**  
 typical production unit / for data of other models consult factory

## harmonic\* attenuation tables

| IN FREQ. MHz | MODEL FD-2         |      |      |      |      |  | IN FREQ. MHz | MODEL FK-5          |      |      |      |      |  |
|--------------|--------------------|------|------|------|------|--|--------------|---------------------|------|------|------|------|--|
| 30           | 47.1               | 13.4 | 51.3 | 14.9 | 55.4 |  | 10           | 14.9                | 13.6 | 34.7 | 18.1 | 34.1 |  |
| 35           | 47.0               | 13.5 | 51.0 | 14.8 | 54.0 |  | 20           | 16.5                | 13.0 | 34.8 | 17.3 | 34.5 |  |
| 40           | 46.5               | 13.6 | 50.9 | 15.0 | 52.6 |  | 50           | 15.3                | 13.4 | 31.0 | 17.5 | 32.8 |  |
| 45           | 45.9               | 13.6 | 50.7 | 15.2 | 51.4 |  | 100          | 15.2                | 13.1 | 26.9 | 16.5 | 29.5 |  |
| 50           | 45.4               | 13.5 | 49.8 | 15.8 | 50.6 |  | 250          | 16.0                | 12.8 | 21.7 | 17.4 | 29.4 |  |
| 55           | 43.7               | 13.4 | 47.4 | 15.8 | 50.2 |  | 500          | 25.4                | 12.6 | 33.6 | 22.5 | 45.7 |  |
| 60           | 43.7               | 13.7 | 46.5 | 15.6 | 49.3 |  | 600          | 22.8                | 13.0 | 31.2 | 16.3 | 28.9 |  |
| 65           | 43.4               | 13.7 | 45.4 | 14.7 | 48.7 |  | 700          | 22.5                | 13.9 | 38.1 | 16.2 | 26.7 |  |
| 70           | 43.1               | 13.7 | 44.7 | 14.5 | 47.7 |  | 800          | 17.7                | 14.6 | 30.6 | 14.6 | 35.4 |  |
| 75           | 43.1               | 13.7 | 44.2 | 14.2 | 47.2 |  | 900          | 17.5                | 14.6 | 28.0 | 16.2 | 37.2 |  |
| 80           | 43.1               | 13.7 | 43.6 | 13.9 | 46.5 |  | 999          | 19.1                | 14.2 | 19.7 | 20.3 | 41.6 |  |
|              | 1                  | 2    | 3    | 4    | 5    |  |              | 1                   | 2    | 3    | 4    | 5    |  |
|              | Harmonics Order    |      |      |      |      |  |              | Harmonics Order     |      |      |      |      |  |
|              | INPUT POWER, +5dBm |      |      |      |      |  |              | INPUT POWER, +13dBm |      |      |      |      |  |

\* all harmonics except 2nd order, are relative to F2  
second order is relative to IN PWR



rugged, one-piece design

# Fixed Attenuators

NEW

3 to 40 dB

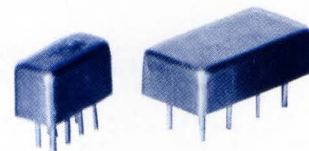
DC to 1500 MHz

performance data

curves, tables, page 4 Model Index

case style selection

outline drawings see page 3



MAT

AT

| MODEL NO.       | FREQUENCY MHz | ATTENUATION dB |          |            | VSWR Max.   |             | PRICE \$ |              |
|-----------------|---------------|----------------|----------|------------|-------------|-------------|----------|--------------|
|                 |               | Nom.           | Flatness | DC-1000MHz | Total Range | DC-1000 MHz | Ea.      | Qty.         |
| MAT<br>case A11 | MAT-3         | DC-1500        | 3 ± 0.2  | 1.0        | 0.6         | 1.5         | 1.3      | 4.95 (10-49) |
|                 | MAT-6         | DC-1500        | 6 ± 0.3  | 0.8        | 0.6         | 1.5         | 1.3      | 4.95 (10-49) |
|                 | MAT-9         | DC-1500        | 9 ± 0.3  | 0.8        | 0.6         | 1.5         | 1.3      | 4.95 (10-49) |
|                 | MAT-10        | DC-1500        | 10 ± 0.4 | 0.8        | 0.6         | 1.5         | 1.3      | 4.95 (10-49) |
|                 | MAT-12        | DC-1500        | 12 ± 0.4 | 0.8        | 0.6         | 1.5         | 1.3      | 4.95 (10-49) |
|                 | MAT-15        | DC-1500        | 15 ± 0.4 | 0.8        | 0.6         | 1.5         | 1.3      | 4.95 (10-49) |
|                 | MAT-20        | DC-1500        | 20 ± 0.5 | 1.0        | 0.6         | 1.5         | 1.3      | 4.95 (10-49) |
|                 | MAT-30        | DC-1000        | 30 ± 0.5 | —          | 1.0         | —           | 1.5      | 4.95 (10-49) |
|                 | AT-3          | DC-1500        | 3 ± 0.2  | 1.0        | 0.6         | 1.5         | 1.3      | 3.95 (10-49) |
|                 | AT-3-75       | DC-1000        | 3 ± 0.3  | —          | 1.0         | —           | 1.5      | 3.95 (10-49) |
| AT<br>case A04  | AT-6          | DC-1500        | 6 ± 0.3  | 0.8        | 0.6         | 1.5         | 1.3      | 3.95 (10-49) |
|                 | AT-6-75       | DC-1000        | 6 ± 0.4  | —          | 1.0         | —           | 1.5      | 3.95 (10-49) |
|                 | AT-10         | DC-1500        | 10 ± 0.3 | 0.8        | 0.6         | 1.5         | 1.3      | 3.95 (10-49) |
|                 | AT-10-75      | DC-1000        | 10 ± 0.5 | —          | 1.0         | —           | 1.5      | 3.95 (10-49) |
|                 | AT-20         | DC-1500        | 20 ± 0.4 | 0.8        | 0.6         | 1.5         | 1.3      | 3.95 (10-49) |
|                 | AT-20-75      | DC-1000        | 20 ± 0.6 | —          | 1.2         | —           | 1.5      | 3.95 (10-49) |
|                 | AT-30         | DC-1000        | 30 ± 0.5 | —          | 1.0         | —           | 1.5      | 3.95 (10-49) |
|                 | AT-40         | DC-500         | 40 ± 0.6 | 1.0        | —           | 1.5         | —        | 3.95 (10-49) |

designers kit available

KAT-1... 4 of each (3, 6, 10, 20 dB), only \$39.95

KMAT-1... 2 of each (3, 6, 9, 10, 12, 15, 20), only \$39.95

## NOTES:

■ Denotes 75 ohm models, 75 ohm BNC connectors are standard.

1. For quality control procedures, see page 6.
2. For environmental specifications see page 7.
3. Absolute Maximum Ratings, see page 7; maximum RF power; AT, CAT, NAT, TAT series (1 watt). MAT, SAT series (0.5 watt).
4. Connector models available with female/male connectors. For other versions consult factory.
5. Prices and specifications subject to change without notice.

## pin connections

see case style outline drawing

| SERIES | In | Out | Ground      |
|--------|----|-----|-------------|
| MAT    | 1  | 8   | 2,3,4,5,6,7 |
| AT     | 1  | 8   | 2,3,4,5,6,7 |

50 ohms and 75 ohms

# Mini-Circuits



| MODEL*<br>NO.     | FREQUENCY<br>MHz | ATTENUATION<br>dB |             |            | VSWR<br>Max. |             | PRICE, \$ Ea. |       |       |        |
|-------------------|------------------|-------------------|-------------|------------|--------------|-------------|---------------|-------|-------|--------|
|                   |                  | Nom.              | Flatness    |            | Total Range  | DC-1000 MHz | NAT           | TAT   | CAT   | Qty.   |
|                   |                  |                   | Total Range | DC-1000MHz |              |             |               |       |       |        |
| —AT-3             | DC-1500          | 3±0.2             | 1.0         | 0.6        | 1.5          | 1.3         | 15.95         | 12.95 | 11.95 | (1-49) |
| ■ CAT-3-75        | DC-1000          | 3±0.3             | —           | 1.0        | —            | 1.5         | 15.95         | 12.95 | 11.95 | (1-49) |
| —AT-6             | DC-1500          | 6±0.3             | 0.8         | 0.6        | 1.5          | 1.3         | 15.95         | 12.95 | 11.95 | (1-49) |
| *NAT ■ CAT-6-75   | DC-1000          | 6±0.4             | —           | 1.0        | —            | 1.5         | 15.95         | 12.95 | 11.95 | (1-49) |
| case FF57 ■ AT-10 | DC-1500          | 10±0.3            | 0.8         | 0.6        | 1.5          | 1.3         | 15.95         | 12.95 | 11.95 | (1-49) |
| *TAT ■ CAT-10-75  | DC-1000          | 10±0.5            | —           | 1.0        | —            | 1.5         | 15.95         | 12.95 | 11.95 | (1-49) |
| case FF58 —AT-20  | DC-1500          | 20±0.4            | 0.8         | 0.6        | 1.5          | 1.3         | 15.95         | 12.95 | 11.95 | (1-49) |
| *CAT ■ CAT-20-75  | DC-1000          | 20±0.6            | —           | 1.2        | —            | 1.5         | 15.95         | 12.95 | 11.95 | (1-49) |
| case FF55 —AT-30  | DC-1000          | 30±0.5            | —           | 1.0        | —            | 1.5         | 15.95         | 12.95 | 11.95 | (1-49) |
| —AT-40            | DC-500           | 40±0.5            | 1.0         | —          | 1.5          | —           | 15.95         | 12.95 | 11.95 | (1-49) |

\*add suffix letter N, T, or C to —AT, where applicable.

| SAT       |        |         |        |     |     |     | SAT |              |
|-----------|--------|---------|--------|-----|-----|-----|-----|--------------|
| case FF56 | SAT-3  | DC-1500 | 3±0.2  | 1.0 | 0.6 | 1.5 | 1.3 | 14.95 (1-49) |
|           | SAT-6  | DC-1500 | 6±0.3  | 0.8 | 0.6 | 1.5 | 1.3 | 14.95 (1-49) |
|           | SAT-9  | DC-1500 | 9±0.3  | 0.8 | 0.6 | 1.5 | 1.3 | 14.95 (1-49) |
|           | SAT-10 | DC-1500 | 10±0.4 | 0.8 | 0.6 | 1.5 | 1.3 | 14.95 (1-49) |
|           | SAT-12 | DC-1500 | 12±0.4 | 0.8 | 0.6 | 1.5 | 1.3 | 14.95 (1-49) |
|           | SAT-15 | DC-1500 | 15±0.4 | 0.8 | 0.6 | 1.5 | 1.3 | 14.95 (1-49) |
|           | SAT-20 | DC-1500 | 20±0.5 | 1.0 | 0.6 | 1.5 | 1.3 | 14.95 (1-49) |
|           | SAT-30 | DC-1000 | 30±0.5 | —   | 1.0 | —   | 1.5 | 14.95 (1-49) |



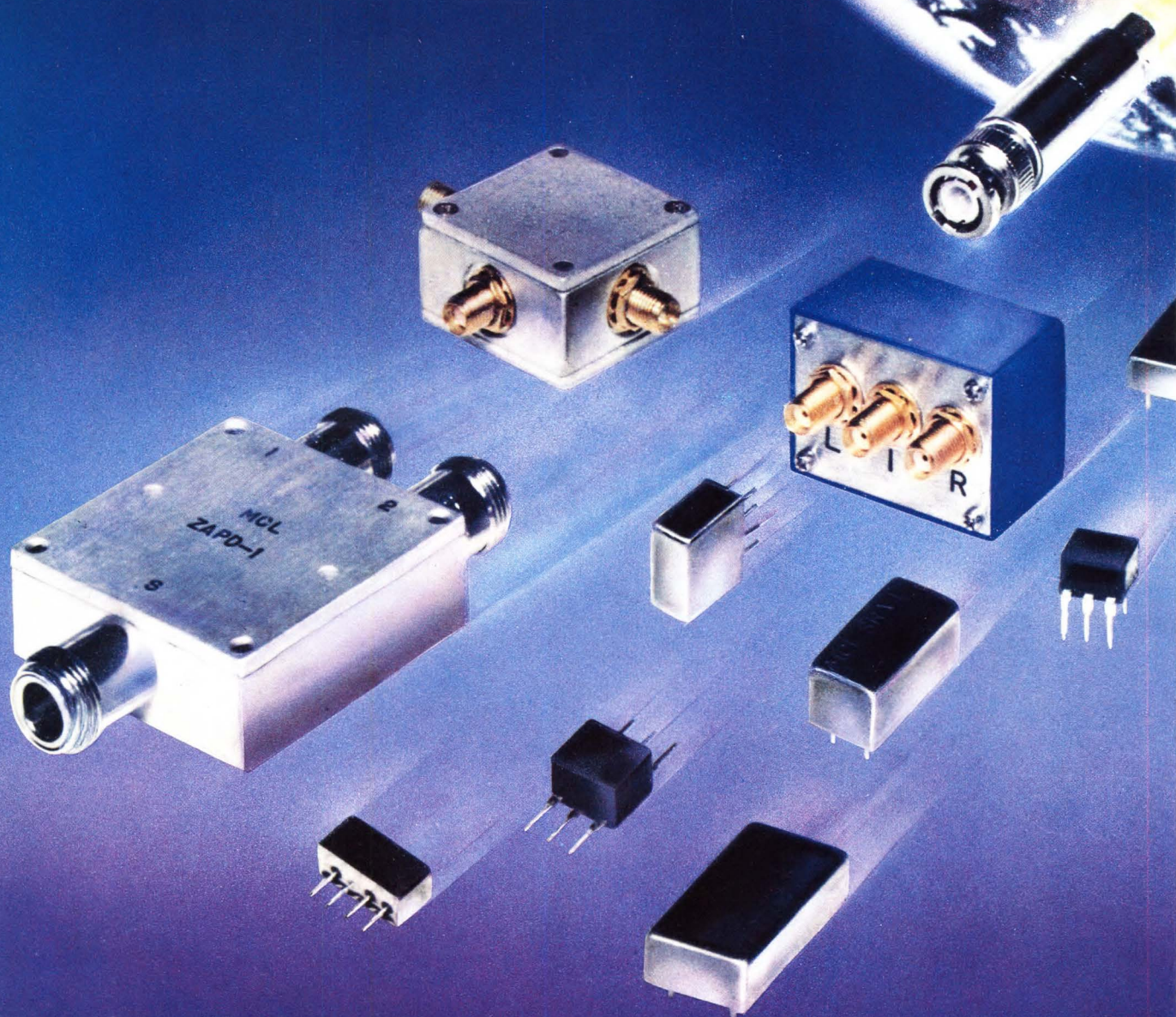
computer-automated performance data  
typical production unit / for data of other models consult factory

| SAT-SERIES | FREQUENCY (MHz) | SAT-3 | SAT-6 | SAT-10 | SAT-20 |
|------------|-----------------|-------|-------|--------|--------|
|            | 1.00            | 2.93  | 5.86  | 9.87   | 19.97  |
|            | 53.526          | 2.98  | 5.87  | 9.91   | 20.01  |
|            | 106.052         | 3.01  | 5.90  | 9.93   | 20.01  |
|            | 158.578         | 3.02  | 5.92  | 9.94   | 20.02  |
|            | 211.104         | 3.03  | 5.92  | 9.95   | 20.02  |
|            | 263.63          | 3.05  | 5.93  | 9.95   | 20.02  |
|            | 316.156         | 3.09  | 5.96  | 9.97   | 20.06  |
|            | 368.682         | 3.08  | 5.97  | 9.99   | 20.04  |
|            | 421.208         | 3.07  | 5.94  | 9.96   | 20.01  |
|            | 473.734         | 3.12  | 5.98  | 9.98   | 20.00  |
|            | 526.26          | 3.11  | 5.96  | 9.98   | 19.99  |
|            | 578.786         | 3.11  | 5.94  | 9.96   | 19.96  |
|            | 631.312         | 3.14  | 5.98  | 9.98   | 19.97  |
|            | 683.838         | 3.18  | 6.01  | 10.04  | 19.99  |
|            | 736.364         | 3.19  | 5.99  | 10.01  | 19.94  |
|            | 788.89          | 3.23  | 6.03  | 10.04  | 19.95  |
|            | 841.416         | 3.21  | 6.01  | 10.00  | 19.89  |
|            | 893.942         | 3.25  | 6.04  | 10.05  | 19.92  |
|            | 946.468         | 3.26  | 6.01  | 9.99   | 19.82  |
|            | 999.00          | 3.33  | 6.06  | 10.07  | 19.85  |
|            | 1250.00         | 3.52  | 6.20  | 10.36  | 19.77  |
|            | 1500.00         | 3.65  | 6.29  | 10.52  | 19.77  |

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