

**B/W  
MONITOR  
USERS  
MANUAL**

**VME/10  
Microcomputer System  
Monochrome Monitor  
User's Manual**

**MICROSYSTEMS**

**QUALITY • PEOPLE • PERFORMANCE**

JANUARY 1984

VME/10  
MICROCOMPUTER SYSTEM  
MONOCHROME MONITOR  
USER'S MANUAL

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WARNING

THIS EQUIPMENT GENERATES, USES, AND CAN RADIATE RADIO FREQUENCY ENERGY. THIS EQUIPMENT HAS BEEN TESTED AS A CLASS A COMPUTING DEVICE AND HAS BEEN FOUND TO COMPLY WITH PART 15 OF FCC RULES. HOWEVER, OPERATION OF THIS EQUIPMENT MAY CAUSE INTERFERENCE, IN WHICH CASE THE USER, AT HIS OWN EXPENSE, WILL BE REQUIRED TO TAKE WHATEVER MEASURES MAY BE REQUIRED TO CORRECT THE INTERFERENCE.

First Edition

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## **SAFETY SUMMARY**

### **SAFETY DEPENDS ON YOU**

*The following general safety precautions must be observed during all phases of operation, service, and repair of this equipment. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the equipment. Motorola Inc. assumes no liability for the customer's failure to comply with these requirements. The safety precautions listed below represent warnings of certain dangers of which we are aware. You, as the user of the product, should follow these warnings and all other safety precautions necessary for the safe operation of the equipment in your operating environment.*

#### **GROUND THE INSTRUMENT.**

To minimize shock hazard, the equipment chassis and enclosure must be connected to an electrical ground. The equipment is supplied with a three-conductor ac power cable. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adapter, with the grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet. The power jack and mating plug of the power cable meet International Electrotechnical Commission (IEC) safety standards.

#### **DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE.**

Do not operate the equipment in the presence of flammable gases or fumes. Operation of any electrical equipment in such an environment constitutes a definite safety hazard.

#### **KEEP AWAY FROM LIVE CIRCUITS.**

Operating personnel must not remove equipment covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

#### **DO NOT SERVICE OR ADJUST ALONE.**

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

#### **USE CAUTION WHEN EXPOSING OR HANDLING THE CRT.**

Breakage of the Cathode-Ray Tube (CRT) causes a high-velocity scattering of glass fragments (implosion). To prevent CRT implosion, avoid rough handling or jarring of the equipment. Handling of the CRT should be done only by qualified maintenance personnel using approved safety mask and gloves.

#### **DO NOT SUBSTITUTE PARTS OR MODIFY EQUIPMENT.**

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification of the equipment. Contact Motorola Microsystems Warranty and Repair for service and repair to ensure that safety features are maintained.

#### **DANGEROUS PROCEDURE WARNINGS.**

Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed. You should also employ all other safety precautions which you deem necessary for the operation of the equipment in your operating environment.

#### **WARNING**

**Dangerous voltages, capable of causing death, are present in this equipment. Use extreme caution when handling, testing, and adjusting.**



## PREFACE

The monochrome monitor in the VME/10 display unit does not contain a power supply (ac to dc conversion circuitry). The monitor is powered by an externally regulated 24 Vdc power source (from the VME/10 control unit chassis). Throughout this manual, all power supply references should be ignored.

Refer to the VME/10 Microcomputer System Equipment Manual, publication number M68KVSEM, for all external signal and power wiring information to the monochrome monitor.



**MOTOROLA**

**GENERAL INFORMATION**

The monitors described herein are fully transistorized (except CRT) and applicable for displaying alphanumeric characters. The DS3000, DS3003 series monitors use a 12-inch CRT and the DS4000, DS4003 series monitors use a 15-inch CRT. Each monitor accepts a TTL non-composite video, with separate TTL horizontal and vertical sync pulses. Additional inputs include optional TTL StepScan, and/or optional +24VDC to operate the monitor.

A universal power transformer permits operating the monitor from 120, 220 or 240 volts AC, 50/60 Hz. A built-in regulated power supply provides operating voltages of +24V, +13V and +5V.

Input and output connections for the monitor are made through a standard 10-pin edge connector, (or optional 20-pin connector) on the circuit card. Inputs consist of non-composite video, horizontal sync, vertical sync, and signal ground. The optional TTL level StepScan and +24VDC are also connected to the monitor via the 10-pin edge connector. Three pins on the edge connector are also provided for alternate interconnecting of the remote brightness control.

Circuitry consists of two stages for non-composite video amplification, one integrated circuit for vertical sync and deflection processing, five stages for horizontal sync and deflection processing, and a three stage regulated power supply. All models also contain dynamic focusing and spot kill circuitry.

**SERVICE MANUAL**

**— VP38 —**

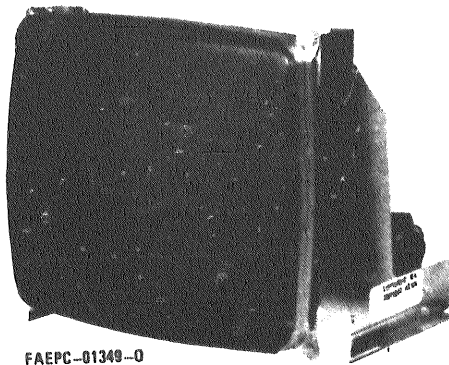
**TTL INPUT  
CRT DISPLAY MONITORS**

**DS3000, 3003 SERIES  
(12-INCH)**

**DS4000, 4003 SERIES  
(15-INCH)**

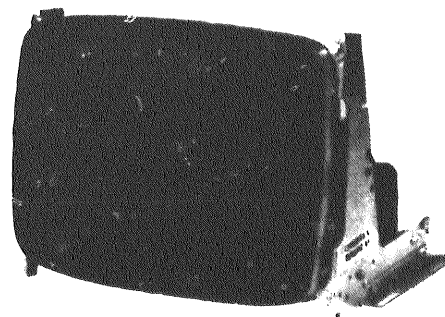
**StepScan™**  
 **MOTOROLA**

One etched circuit card is utilized, which contains all necessary circuitry. Components are mounted on the top of the circuit card and plated copper foil on the bottom. Schematic reference numbers are printed on the top and bottom of each circuit card to aid in the location and identification of components for servicing. All standard operating/adjustment controls are mounted in a convenient manner on the circuit card.



FAEPC-01349-0

*Model DS4000, DS4003 Series (15" CRT)*



*Model DS3000, DS3003 Series (12" CRT)*




**MOTOROLA INC.**

**Display Systems**

1298 E. Algonquin Road, Schaumburg, IL. 60196 (312) 397-8000

MANUAL VP38  
10/81

PART NO. 68P25253A82-1  
 MOTOROLA, INC. 1981

## SAFETY WARNING

**CAUTION: NO WORK SHOULD BE ATTEMPTED ON AN EXPOSED MONITOR CHASSIS BY ANYONE NOT FAMILIAR WITH SERVICING PROCEDURES AND PRECAUTIONS.**

1. **SAFETY PROCEDURES** should be developed by habit so that when the technician is rushed with repair work, he automatically takes precautions.

2. A **GOOD PRACTICE**, when working on any unit, is to first ground the chassis and to use only one hand when testing circuitry. This will avoid the possibility of carelessly putting one hand on chassis or ground and the other on an electrical connection which could cause a severe electrical shock.

3. Extreme care should be used in **HANDLING THE PICTURE TUBE** as rough handling may cause it to implode due to atmospheric pressure (14.7 lbs. per sq. in.). Do not nick or scratch glass or subject it to any undue pressure in removal or installation. When handling, safety goggles and heavy gloves should be worn for protection. Discharge picture tube by shorting the anode connection to chassis ground (not cabinet or other mounting parts). When discharging, go from ground to anode or use a well insulated piece of wire. When servicing or repairing the monitor, if the cathode ray tube is replaced by a type of tube other than that specified under the Motorola Part Number as original equipment in this Service Manual, then avoid prolonged exposure at close range to unshielded areas of the cathode ray tube. Possible danger of personal injury from unnecessary exposure to X-ray radiation may result.

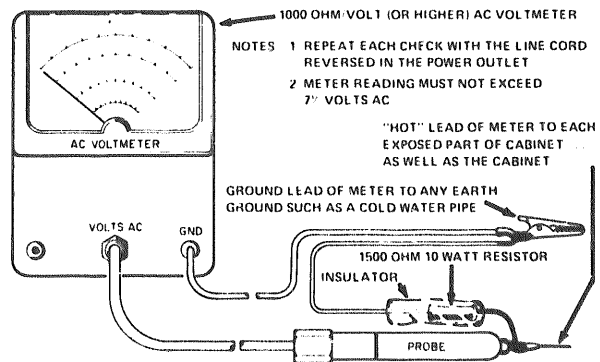
4. An **ISOLATION TRANSFORMER** should always be used during the servicing of a unit whose chassis is connected to one side of the power line. Use a transformer of adequate power rating as this protects the serviceman from accidents resulting in personal injury from electrical shocks. It will also protect the chassis and its components from being damaged by accidental shorts of the circuitry that may be inadvertently introduced during the service operation.

5. Always **REPLACE PROTECTIVE DEVICES**, such as fishpaper, isolation resistors and capacitors and shields after working on the unit.

6. If the **HIGH VOLTAGE** is adjustable, it should always be **ADJUSTED** to the level recommended by the manufacturer. If the voltage is increased above the normal setting, exposure to unnecessary X-ray radiation could result. High voltage can accurately be measured with a high voltage meter connected from the anode lead to chassis.

7. **BEFORE RETURNING A SERVICED UNIT**, the service technician must thoroughly test the unit to be certain that it is completely safe to operate without danger of electrical shock. **DO NOT USE A LINE ISOLATION TRANSFORMER WHEN MAKING THIS TEST.**

In addition to practicing the basic and fundamental electrical safety rules, the following test, which is related to the minimum safety requirements of the Underwriters Laboratories should be performed by the service technician before any unit which has been serviced is returned.



Voltmeter Hook-up for Safety Check

A 1000 ohm per volt AC voltmeter is prepared by shunting it with a 1500 ohm, 10 watt resistor. The safety test is made by contacting one meter probe to any portion of the unit exposed to the operator such as the cabinet trim, hardware, controls, knobs, etc., while the other probe is held in contact with a good "earth" ground such as a cold water pipe.

The AC voltage indicated by the meter may not exceed 7½ volts. A reading exceeding 7½ volts indicates that a potentially dangerous leakage path exists between the exposed portion of the unit and "earth" ground. Such a unit represents a potentially serious shock hazard to the operator.

The above test should be repeated with the power plug reversed, when applicable.

**NEVER RETURN A MONITOR** which does not pass the safety test until the fault has been located and corrected.

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\* Service schematic diagrams and electrical/mechanical parts list for the basic DS-Series CRT monitors are not included in this manual; instead, they accompany this manual as a separate supplement (VP38-S1), Motorola Part No. 68P25253A84.

For users of unique variations of the DS-Series (TTL Input) CRT monitors, however, order the schematic diagram by its complete model number.

## SPECIFICATIONS

### DISPLAY

- **DS3000** – 12" diagonal measure
- **DS4000** – 15" measured diagonally, 14" diagonal viewable area
- 110° deflection angle
- 3 x 4 aspect ratio
- P4 phosphor standard (other EIA phosphors available)
- T band U.L. implosion protection
- Direct etch and PPG optional
- **Standard Display Size:** (DS3000) 8.5 X 6.0, (DS4000) 10.0 x 7.5
- Capable of displaying over 3400 characters.

### VIDEO PERFORMANCE

- **Resolution:** 1200 lines center 950 lines corners (P4 phosphor)
- **Bandwidth:** within 3 dB, 10 Hz to 30 MHz is typical.

### PERFORMANCE FEATURES

- **StepScan™:** Stepped vertical scanning option provides an increased capacity display at any horizontal frequency, thus conserving bandwidth and in many cases, eliminating the need for a higher frequency clock for increased performance.
- **Dynamic Focus:** Excellent corner focus is achieved by supplying dynamic voltage to the focus element of the cathode ray tube.

### SYNCHRONIZATION

- **Horizontal:** 15.7 kHz  $\pm$  500 Standard, 18.7 kHz  $\pm$  500 optional
- **Vertical:** 47 to 63 Hz
- **Horizontal Blanking:** 11  $\mu$ Sec minimum (for scanning frequency of 15.7 kHz), 10  $\mu$ Sec minimum (at 18.7 kHz). Time includes retrace and delay.
- **Vertical Blanking:** 800  $\mu$ Sec (includes retrace and video delay)

### INPUT SIGNALS

- **Horizontal:** 4 to 32  $\mu$ Sec, input TTL compatible, positive-going (negative optional), 4.0V PP  $\pm$  1.5
- **Vertical:** 50 to 1400  $\mu$ Sec, input TTL compatible, positive (negative optional), 4.0V PP  $\pm$  1.5
- **Video:** positive white, input termination 470 ohms  $\pm$  5%, 2.5 - 5.0V PP  
Composite video input with DHHS protection circuit optionally available.

### POWER INPUT

- 120/240V AC (105-135), 50/60 Hz, 65VA max.
- 24V DC optional

### INTERCONNECT TO CUSTOMER SYSTEM

- 10 pin edge connector standard
- 20 pin ribbon cable optional

### CONTROLS

- **Internal:** Horizontal size, horizontal video centering, brightness, focus, vertical hold, vertical size, vertical linearity. (All controls adjustable from top or back of unit).
- **External:** Brightness (as an operator control).
- Optional contrast control available.

### GEOMETRY (Pin & Barrel)

- Sides equal less than 1% of height.
- Top and bottom equal less than 1% of width.

### LINEARITY

- Character height or width will not vary  $\pm$  7% from the average character size.
- Adjacent characters will not vary more than 5%.

### ENVIRONMENT

- **Operating Temperature:** 0° to +55°C
- **Storage Temperature:** -40°C to +65°C  
**Note:** CRT's with bonded etched panels should not be subjected to storage or operating temperatures above 50°C
- **Operating Altitude:** 10,000 ft. max.

Designed to comply with DHHS Radiation Performance Standards, U.L. and C.S.A. specifications.

\*In a continual effort to upgrade our standard products as new technological advances are made, specifications are subject to change without notice.

— NOTE —

This manual is up-to-date and correct as of the printing date.

— CAUTION —  
NO WORK SHOULD BE ATTEMPTED ON ANY EXPOSED  
MONITOR CHASSIS BY ANYONE NOT FAMILIAR WITH  
SERVICING PROCEDURES AND PRECAUTIONS.

## SERVICE NOTES

### BLOCK/SCHEMATIC DIAGRAMS

Refer to Figure 1 for a functional view of an DS-Series Display Monitor in block form. It will help in becoming familiar with the overall schematic diagram, which accompanies this manual as a separate supplement (VP38-S1), Motorola Part No. 68P25253A84.

### ELECTRICAL/MECHANICAL PARTS LISTS

A complete listing of field replaceable parts in alphanumeric sequence is also included with the separate supplement, VP38-S1.

### CIRCUIT TRACING

Component reference numbers are printed on the top and bottom of the circuit card to facilitate circuit tracing. In addition, top (component) and bottom (solder) view drawings are included for convenient viewing of the circuit card. Transistor elements are identified as follows:

E – emitter, B – base, and C – collector

### COMPONENT REMOVAL

On the circuit card, component removal requires the use of a "desoldering" iron, carefully applied to pre-

vent lifting of the foil from the circuit card. An iron with a temperature controlled heating element is recommended to reduce the possibility of card damage. Use latest recommended desoldering procedures. The nozzle of the solder extracting gun should be inserted directly over the component lead which is heated only long enough to melt the solder and draw it away. This should leave the component lead free of the circuit card.

### POWER TRANSISTOR REPLACEMENT

When replacing transistors Q101 (+24V Reg.) or Q402 (Horiz. Output), use the following information and observe all precautions:

1. There are no plug-in sockets; instead, two (2) screws are soldered from the bottom of the circuit card to protrude up through the circuit card and its bracket. The transistors are secured with two (2) nuts each on the top of the circuit card bracket, which also serves as a heat sink.
2. When replacing a transistor, silicone grease (Motorola Part No. 11M490487) should be applied evenly to the top of the heat sink (circuit card bracket) and bottom of the transistor. In addition, be sure a mica insulator is positioned properly between the transistor and heat sink.

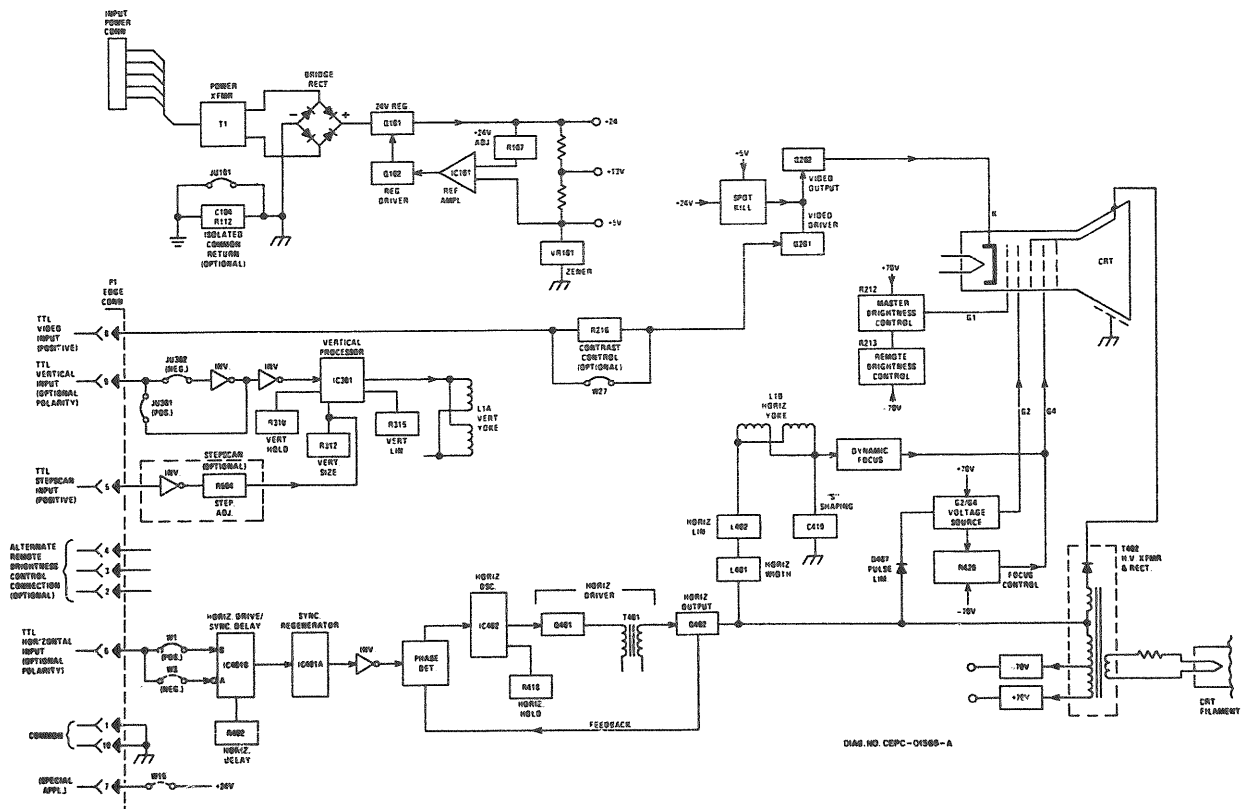


Figure 1. DS-Series Display Monitor – Functional Block Diagram

- The transistor mounting nuts must be tight before applying power to the monitor. This insures proper cooling and electrical connections. **NON-COMPLIANCE WITH THESE INSTRUCTIONS CAN RESULT IN FAILURE OF THE TRANSISTOR AND/OR ITS RELATED COMPONENTS.**

- NOTE -

Use caution when tightening transistor mounting nuts. If the screw or nut threads are stripped by excessive pressure, a poor electrical and mechanical connection will result.

### INSTALLATION—MOUNTING SLOT HOLE DIMENSIONS

Figure 2 is a bottom view drawing that clearly illustrates mounting slot hole dimensions. Use it to identify mounting clearances in the final installation.

### CRT REPLACEMENT

#### General

Use extreme care in handling the CRT as rough handling may cause it to implode due to high vacuum pressure.

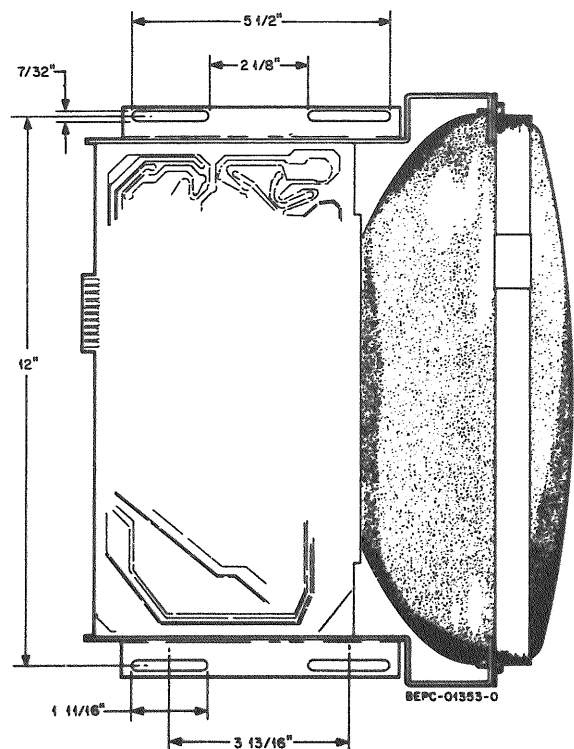


Figure 2. Mounting Slot Hole Dimensions

Do not nick or scratch glass or subject it to any undue pressure in removal or installation. Use goggles and heavy gloves for protection. Also, be sure to disconnect the monitor from all external voltage sources. Refer to Figure 5 for location of the CRT identification label. Information on the label is essential for ordering the correct replacement CRT!

#### Procedure

- Step 1. Connect a grounding strap (first) to the metal chassis for a good earth ground; then discharge CRT by shorting the H.V. 2nd anode to ground.
- Step 2. Remove the CRT socket, deflection yoke (loosen clamp screw) and 2nd anode lead.
- Step 3. Remove CRT from the front of the chassis by loosening and removing four screws, one at each corner of CRT.
- Step 4. Reverse the above steps to re-install the new CRT.
- Step 5. After installation perform operational check/adjustment procedures.

### SERVICE PHOTOGRAPHS

#### Figure 3:

Figure 3 shows the rear view of a typical DS-Series display monitor. Callouts identify the circuit card edge connector (P1) for signal inputs, a six (6) pin power input connector, and a remote brightness control (R213) soldered to the circuit card. Variations to the aforementioned will include a different type of power connector, and the remote brightness control can be interconnected via the circuit card edge connector.

#### Figure 4:

For convenient access to the component (top) side of the circuit card, reference Figure 4. Callouts accompanying the illustration are self-explanatory.

#### Figure 5:

For convenient unobstructed troubleshooting of the circuit card, stand the monitor on its side as shown in Figure 5. Notice also in this illustration the location of the CRT identification label. The information on this label is essential for ordering the correct replacement CRT.

#### Figure 6:

Reference Figure 6 for quick identification and location of adjustable controls, transistors, integrated circuits, etc.

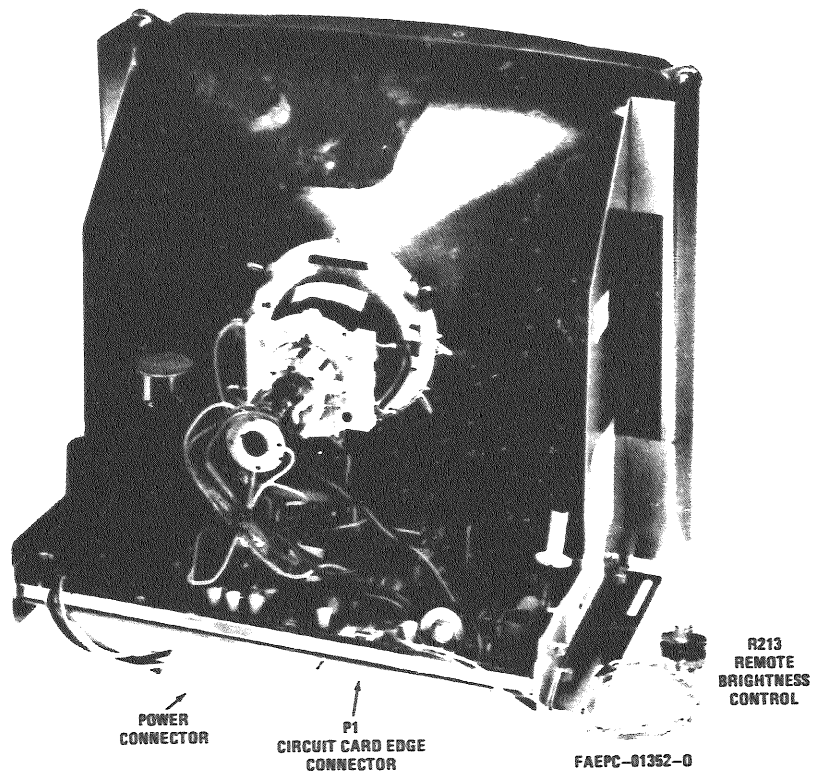


Figure 3. Typical DS-Series Display Monitor – Rear View

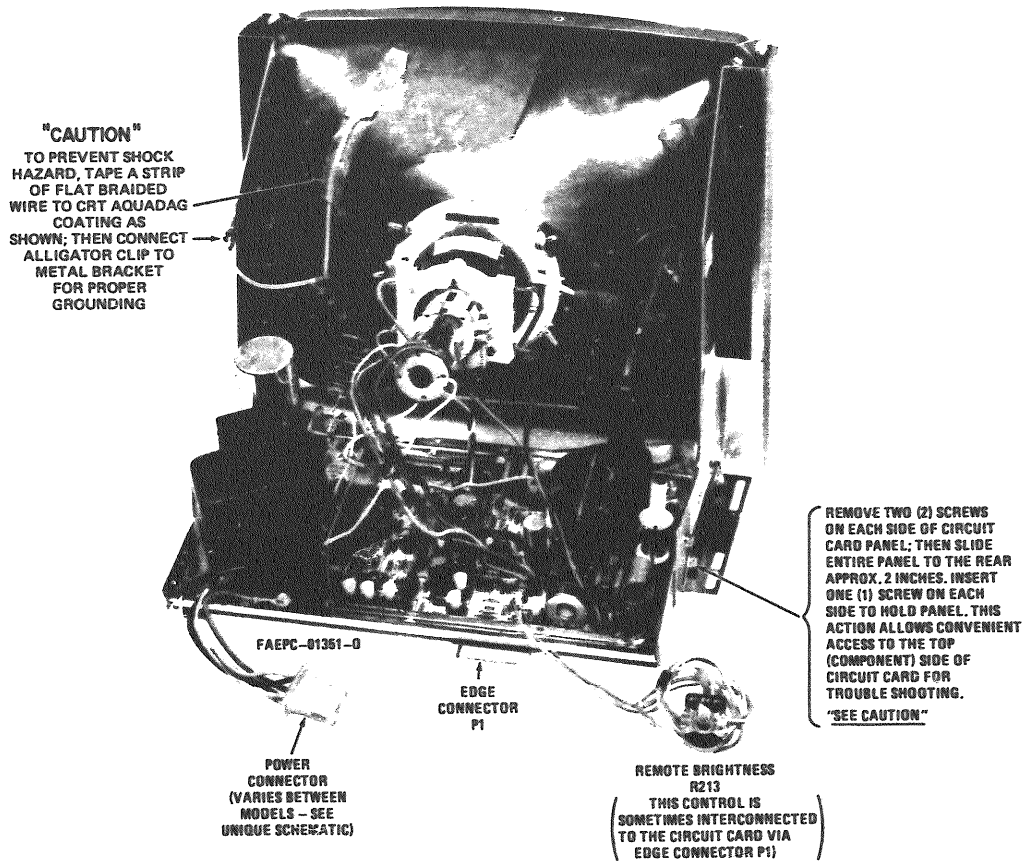


Figure 4. Circuit Card Troubleshooting from Component Side



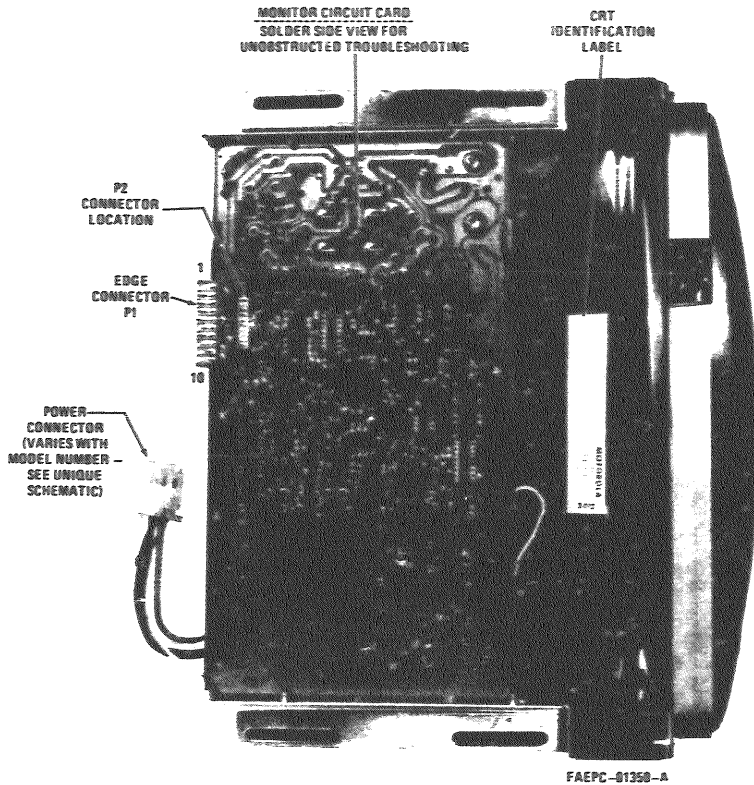


Figure 5. Circuit Card Troubleshooting from Solder Side

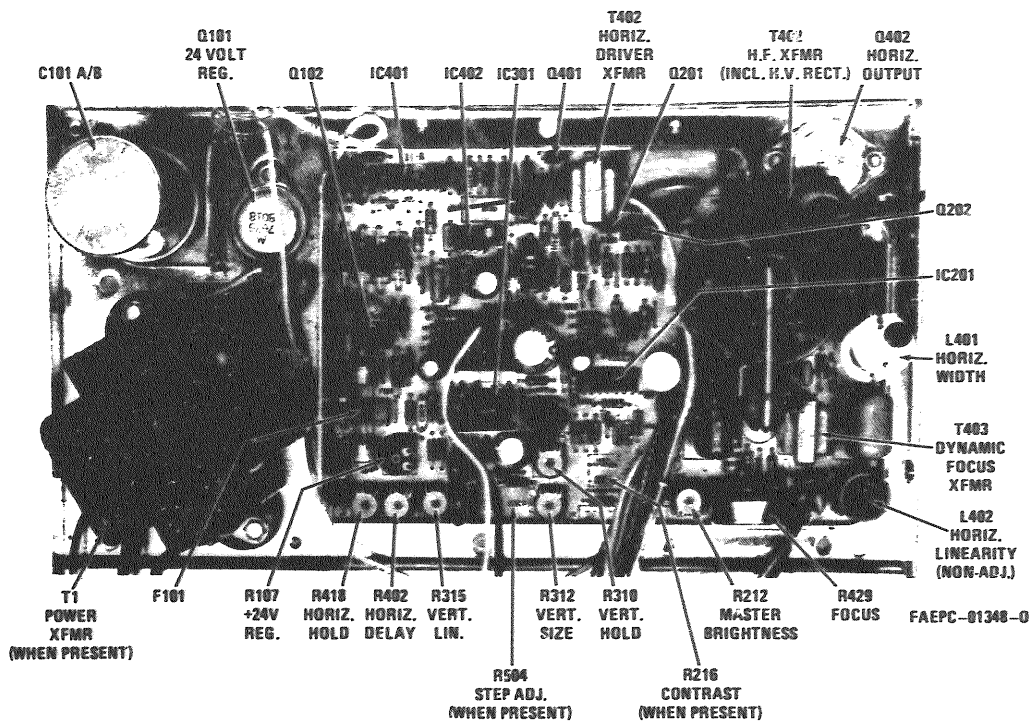


Figure 6. Identification and Location of Circuit Card Components — Adjustable Controls, Transistors, Integrated Circuits, Etc.

# ADJUSTMENTS

## OPERATIONAL CHECK/ADJUSTMENT PROCEDURES

### GENERAL

The following procedures are provided to check the operation of the monitor and perform simple preinstallation adjustments (if required), or readjust after servicing and component replacement.

When reference is made to adjust to a specific size display (vertically and horizontally), refer to original model specifications for correct dimensions by the monitor model number. This also applies to minimum and maximum tolerances when adjusting for correct CRT geometry, linearity, focus, etc.

#### — NOTE —

To assist in understanding more of the preceding terminology, refer to a separate Motorola Manual, "Incoming Inspection Guide" (Motorola part number 68P25253A71).

Perform the procedures in the sequence presented, and allow at least five (5) minutes warm-up before adjusting the monitor. In addition, when instructed to disconnect an input signal, do not ground the signal at the circuit card edge connector (P1). This action could damage the signal source generator. Instead, disconnect the signal at its source.

CCW = Counter Clockwise Rotation, CW = Clockwise Rotation. (As viewed from rear of circuit card.)

### EQUIPMENT REQUIRED

Variac (0-150 Volts AC)

Precision Digital Voltmeter

Non-Metallic Alignment Tool

Test Signals (Bench test signals must be same amplitude, polarity, and frequency as final installed operating signal source. Refer to original specifications for values by monitor model number.)

The following Motorola gauges are required for performing complete and accurate CRT geometry and linearity alignment. Refer to original model specifications for correct gauges to use.

Linearity Gauge

Slot Gauge

Parallelogram Gauge

### ISOLATED GROUND/Common RETURN CHECK

#### — CAUTION —

Do not connect power or signals to monitor.

**Procedure No. 1.** For monitors with circuit card common return foil isolated from metallic chassis/earth ground. Isolating components are R112 (22K resistor) and C104 (0.1  $\mu$ F capacitor); jumper JU101 is out.

Step 1. Connect ohmmeter leads between edge connector P1, pin 1, and chassis (earth) ground. Resistance reading should be 22K ohms,  $\pm$  5%.

Step 2. Connect ohmmeter leads between edge connector P1, pin 10, and chassis (earth) ground. Resistance reading should be 22k ohms,  $\pm$  5%.

#### — NOTE —

Step 3 is only for monitors that have their Remote Brightness control (R213) inter-connected to the circuit card via edge connector P1, pins 2, 3 and 4.

Step 3. Connect ohmmeter leads between edge connector P1, pin 2, and chassis (earth) ground. Resistance reading should be 22K ohms,  $\pm$  5%.

**Procedure No. 2.** For monitors with non-isolated circuit card common return foil; whereby, the foil is connected direct to the metallic chassis/earth ground via a (white) wire. (Jumper JU101 is in, while components R112 and C104 are out.)

Step 1. Measure between edge connector pins and chassis (earth) ground as described in Procedure No. 1. Resistance readings should be 0.2 ohms or less.

### +24V VOLTAGE REGULATOR CONTROL ADJUSTMENT

#### Procedure

Step 1. Connect monitor to AC line supply. Adjust supply to 120 volts.

Step 2. Apply signal connector to circuit card edge connector, P1.

Step 3. Adjust Vertical (R310) and Horizontal (R418) Hold controls until display is synced.

Step 4. Connect a DC digital voltmeter or other precision accuracy voltmeter to the collector (case) of the regulator output transistor, Q101.

Step 5. Adjust the +24V Voltage Regulator control, R107, for output of +24 volts  $\pm$  0.5 volts.

Step 6. When adjustment is complete, vary the AC line supply voltage between 105 and 135 volts to check for proper regulator operation. If regulator is operating properly there should be no change in display size.

## BRIGHTNESS/CONTRAST ADJUSTMENT

### Procedure

Step 1A. Disconnect video signal input (only) at pin 8 of edge connector P1 . . .

or

Step 1B. If monitor is equipped with a Contrast control (R216 on monitor circuit card or customer supplied off-circuit card), rotate to the position that cuts off the video input signal.

Step 2. Rotate Master Brightness control (R212) fully CCW (raster off).

Step 3. Rotate Remote Brightness control (R213) fully CCW (raster off).

Step 4. Rotate Master Brightness control (R212) until the raster just begins to appear on the CRT; then back off slightly to the threshold of raster cutoff.

Step 5A. Reconnect video signal . . .

or

Step 5B. Adjust Contrast control (if present) for desired video display level on CRT.

Step 6. Adjust Remote Brightness control (R213) for desired (overall) brightness level.

## HORIZONTAL OSCILLATOR ADJUSTMENT

### Procedure

Step 1. Disconnect horizontal sync input (only) at pin 6 of edge connector P1.

Step 2. Adjust Horizontal Hold control (R418) until video display approaches best horizontal sync condition. (Without the horizontal sync input connected, however, the display will never quite lock in.)

— NOTE —

It may be necessary to temporarily increase the raster brightness with the Remote Brightness control (R213) to view the raster edges.

Step 3. Reconnect the horizontal sync signal. (At this point the video display should be in sync.)

Step 4. Adjust the Horizontal Delay control (R402) until the video display is centered horizontally within the raster (as viewed from the left side to the right side of the raster).

## HORIZONTAL SIZE ADJUSTMENT

### Procedure

Adjust Horizontal Width coil (L401) for specified video width (horizontally).

— NOTE —

To increase width, rotate coil slug CCW (away from circuit card); to decrease width, rotate coil slug CW (toward circuit card).

## VERTICAL HOLD ADJUSTMENT

### Procedure

If video display is rolling, adjust the Vertical Hold control (R310) until the video display remains locked in.

## VERTICAL SIZE/LINEARITY ADJUSTMENT

### Procedure No. 1 (Monitors without StepScan)

Step 1. Adjust the Vertical Size control (R312) until the specified size display (vertically) is obtained.

Step 2. (Refer to Figure 7.) Adjust the Vertical Linearity control (R315) until the extreme top and bottom characters (designated "A" and "B") are equal in height to the center characters (designated "C").

Step 3. Readjust the Vertical Size control (R312), if necessary, for specified size display (vertically).

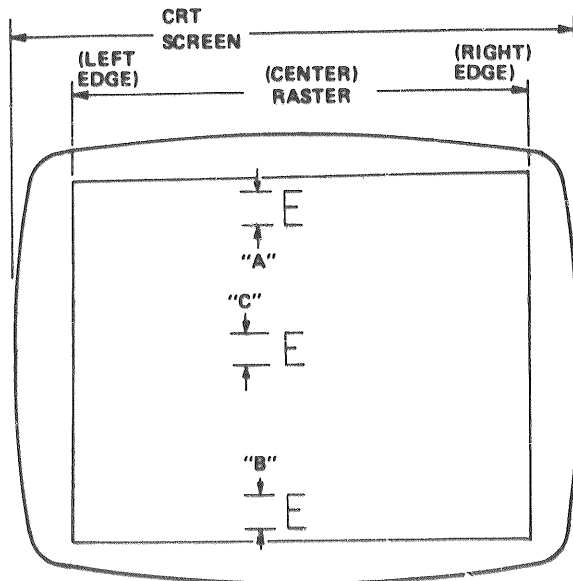
### Procedure No. 2 (Monitors with StepScan)

Step 1. With specified StepScan input connected to pin 5 of edge connector P1, rotate the Step Adjust control (R504) for minimum vertical size. (This control will be final adjusted later.)

Step 2. Adjust Vertical Size control (R312) for specified vertical size display — before StepScan is actively applied with Step Adjust control, R504.

Step 3. (Refer to Figure 7.) Adjust the Vertical Linearity control (R315) until the extreme top and bottom characters (designated "A" and "B") are equal in height to the center characters (designated "C").

Step 4. Readjust the Vertical Size control (R312), if necessary, for specified size display (vertically) as described in Step 2.



AEPC-01060-0

Figure 7. Partial CRT Display of Characters for Vertical Linearity Adjustment

#### STEPSCAN ADJUSTMENT (Applicable to monitors with StepScan only)

##### General

StepScan is a unique input signal that is accounted for, and incorporated, when the original video signal format is being developed. As a result, it cannot be connected to just any monitor, even if the monitor has the necessary StepScan circuitry. Check original video signal format specification.

##### Procedure:

- Step 1. Be sure specified positive-going TTL level Step-Scan signal is connected to pin 5 of edge connector P1.
- Step 2. Rotate the Step Adjust control (R504) through its entire range slowly, and observe that the display size increases vertically.
- Step 3A. Adjust the Step Adjust control (R504) for correct vertical size per original model specifications  
...
- or
- Step 3B. If the StepScan is not required in the final installed application, rotate the Step Adjust control (R504) for minimum vertical size. (See following NOTE.)

#### — NOTE —

In Step 3B this is applicable only if the StepScan input remains connected to the edge connector from its source. However, if the StepScan source is physically disconnected from pin 5 of the edge connector, pin 5 must be grounded to pin 1 or 10. In either of these conditions, proceed to Step 4.

- Step 4. Readjust Vertical Size control (R312) to desired height vertically.

**RASTER CENTERING ADJUSTMENT (Applicable only if the CRT and/or deflection yoke have been changed.)**

#### — NOTE —

Depending on the input signal format, the video display on some monitors will be down-centered more than normal within the raster. As a result, an up-centering resistor (R325) is added, which shifts the entire raster (and video display) up. (The shift will vary between 0.1 – 0.4 inches.) This action is necessary to minimize over-adjusting the Centering Magnets to recenter the video display. (Excessive adjustment of the Centering Magnets could cause geometric distortion.)

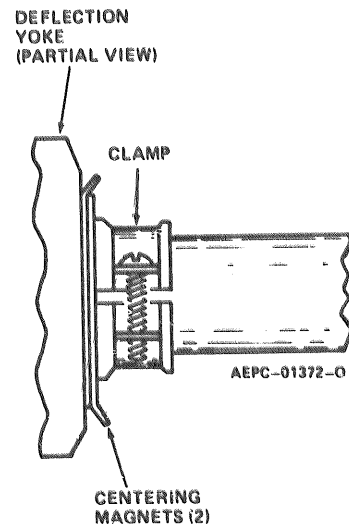


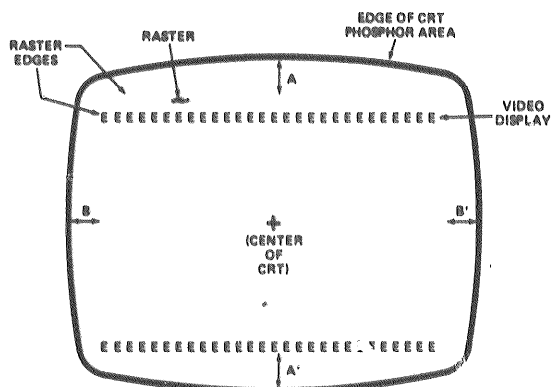
Figure 8. Partial View of CRT Neck/Deflection Yoke -- Centering Magnets

## General

This procedure should be performed while the monitor is free-standing on a bench, and in the correct sequence (preceding the Raster Geometry Adjustment procedure). Do not readjust after the monitor has been installed in a cabinet or terminal.

### Procedure No. 1 (For monitors without up-centering resistor R325.)

- Step 1. Turn up the Remote Brightness control (R213) until the four (4) edges of the raster are visible.
- Step 2. (Reference Figure 8.) Rotate the two (2) centering magnets (simultaneously) until the raster is centered (horizontally and vertically) within the active phosphor area of the CRT. (Reference Figure 9.)
- Step 3. Readjust the Remote Brightness control (R213) for desired (overall) brightness level.



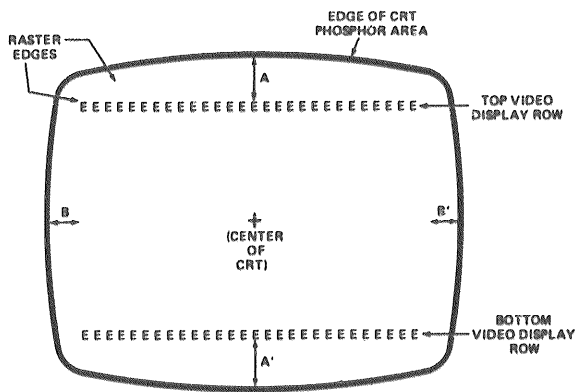
RASTER CENTERING (WITHOUT UP-CENTERING RESISTOR, R325)  
 VERTICAL:  $A = A'$  (TOP AND BOTTOM RASTER EDGES)  
 HORIZONTAL:  $B = B'$  (LEFT AND RIGHT RASTER EDGES)

AEPC-01374-0

Figure 9. Raster Centering Without Up-Centering Resistor, R325

### Procedure No.2 (For monitors with up-centering resistor R325.)

- Step 1. Turn up the Remote Brightness control (R213) until the four (4) edges of the raster are visible.
- Step 2. (Reference Figure 8.) Rotate the two (2) centering magnets (simultaneously) until the left and right edges of the raster are centered horizontally, and the top and bottom edges of the video display are centered vertically within the active phosphor area of the CRT. (Reference Figure 10.)



RASTER CENTERING (WITH UP-CENTERING RESISTOR, R325)  
 VERTICAL:  $A = A'$  (TOP AND BOTTOM VIDEO DISPLAY ROWS)  
 HORIZONTAL:  $B = B'$  (LEFT AND RIGHT RASTER EDGES)

AEPC-01375-0

Figure 10. Raster Centering With Up-Centering Resistor, R325

- Step 3. Readjust the Remote Brightness control (R213) for desired (overall) brightness level.

### — CAUTION —

Remember, do not readjust the centering magnets after performing the CRT Raster Geometry Adjustment procedure that follows, or after final installation. CRT raster geometry will be affected.

## RASTER GEOMETRY ADJUSTMENTS

### General

This adjustment is normally required only if the yoke and/or CRT have been replaced. Upon completion of the geometry adjustments, there may not be a yoke magnet installed on every yoke mounting pin. Normal installation ranges from one to four yoke magnets per deflection yoke. In addition, keep in mind that there will be some interaction between yoke magnets on the deflection yoke mounting pins. Whereby, as the geometry adjustment proceeds, it may be necessary to remove an earlier positioned magnet from one pin when a new magnet is positioned (or added) on a different pin.

There are two (2) different strength yoke magnets available for correcting CRT geometry. The soft core (or flexible) magnet is the stronger of the two magnets. (Reference Figure 11 to identify their north poles.) Pincushion and trapezoidal correction generally require high strength magnets, and barrel correction requires a lower strength magnet for correction.

— WARNING —

High voltages are present at the deflection yoke and are a potential shock hazard. Exercise caution when performing the following adjustment procedures.

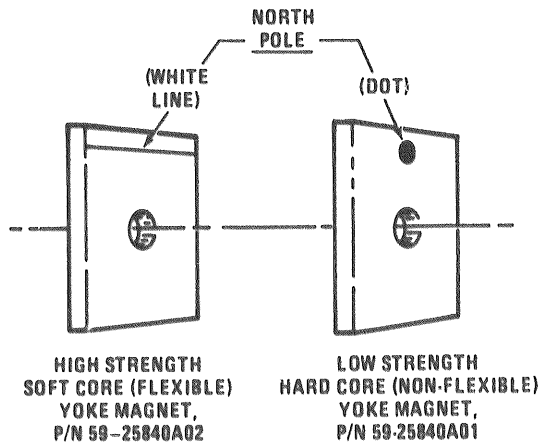


Figure 11. Yoke Magnet North Pole Identification

**Pincushion/Barrel Correction (top, bottom and sides) Procedure**

Perform this adjustment if the raster exhibits the abnormal effects shown in Figure 13.

- Step 1. Push a magnet on the yoke mounting pin as shown in Figure 13. A magnet should be placed only on the pin that corresponds to the affected area.
- Step 2. Rotate the magnet to obtain the desired raster, labeled "NORMAL" on Figure 13.
- Step 3. If the desired raster cannot be obtained, add a second magnet to the yoke mounting pin. Both magnets must be aligned as shown in Figure 12; then rotated simultaneously.

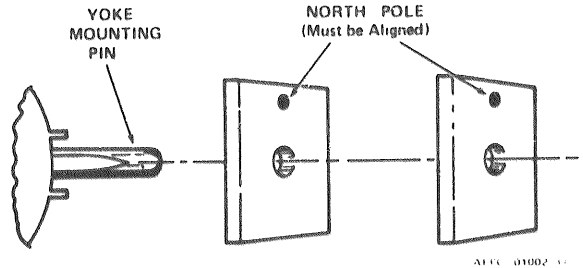


Figure 12. Installing a Second Yoke Magnet

**Trapezoidal Correction (corners) Procedure**

Perform this adjustment if the raster exhibits the abnormal effects shown in Figure 14.

- Step 1. Push a magnet onto the yoke mounting pin as shown in Figure 14. Magnet should be placed only on the pin that corresponds to the affected area.
- Step 2. Rotate the magnet to obtain the desired raster, labeled "NORMAL" in Figure 14.
- Step 3. If the desired raster cannot be obtained, add a second magnet to the yoke mounting pin. Both magnets must be aligned as shown in Figure 12; then rotated simultaneously.

**FOCUS ADJUSTMENT**

**Procedure**

The optimum focus of the display is obtained by adjusting the focus control, R429, for best focus at a point which is near the center and approximately one-third (1/3) down from the top of the display.

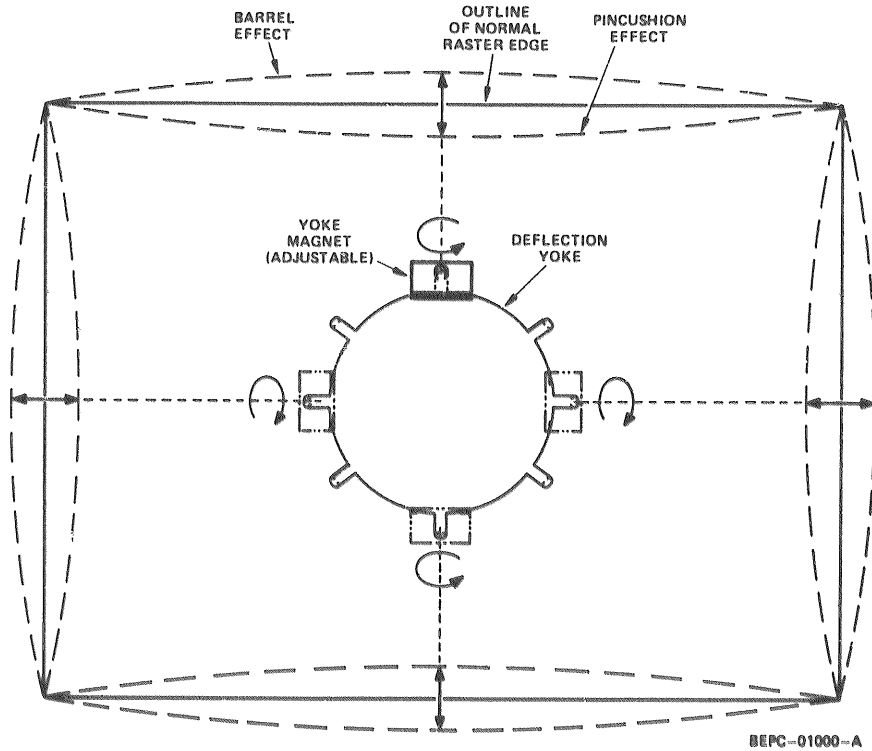


Figure 13. Pincushion/Barrel Effects and Adjustment

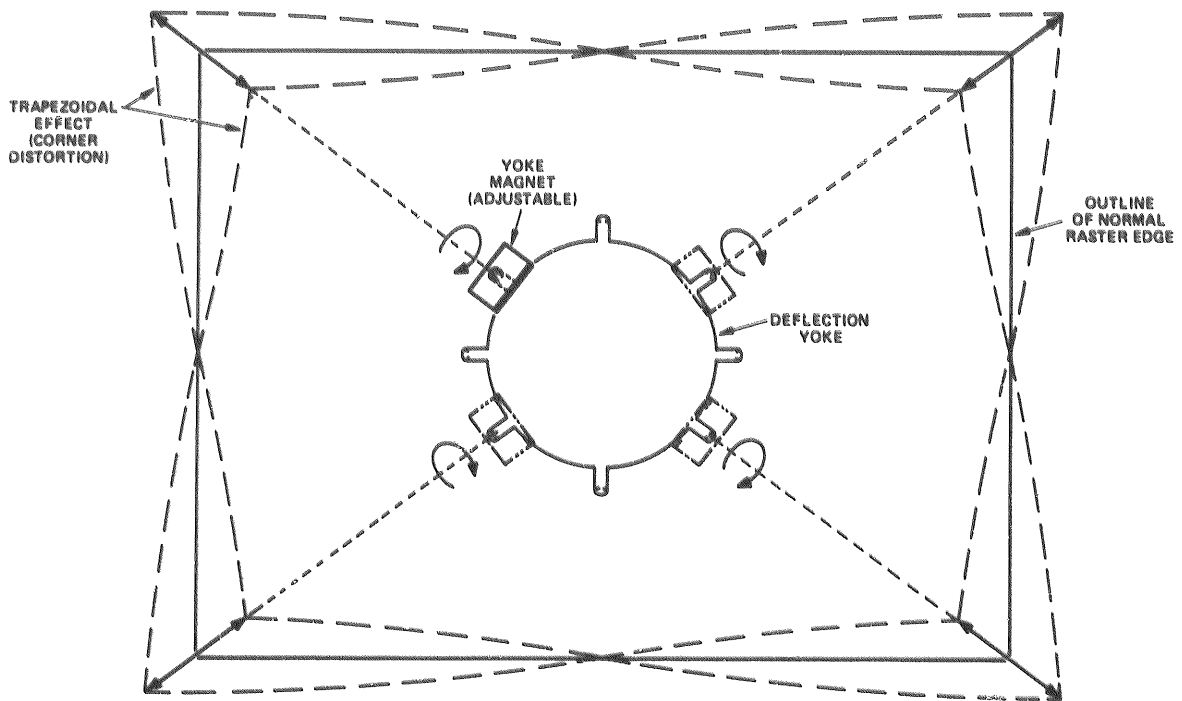


Figure 14. Trapezoidal Effect and Adjustment



## THEORY OF OPERATION

### POWER SUPPLY (Refer to Figure 15)

The power supply is a transformer operated, full wave, regulated series pass circuit that maintains a constant output voltage with line input variations of  $\pm 12.5\%$ . Depending on how connector S1 is wired, operation from 120, 220 or 240 volts, 50/60 Hz is possible. Integrated circuit IC101 is the reference amplifier, transistor Q102 is the regulated output driver, and Q101 is the series pass transistor.

The output voltage, +24V, appears at the collector of Q101. This voltage is divided between R106, R107 and R109. Resistor R108 limits the range of R107. The voltage appearing on the arm of potentiometer R107 (24V ADJ. control) is the reference input to the inverting input (-) of reference amplifier IC101.

A temperature compensated zener diode, VR101, establishes a fixed reference voltage at the non-inverting input (+) to IC101. Resistors R110 and R111 and diode D105 provide bias current for VR101. The junction of R110 and R111 is the +13V source for the horizontal oscillator, IC402. Regulator VR101 is also the 5 volt source for the monitor circuitry. Operating voltage for IC101 is derived from resistor network R101 and R105.

An increase in output current will cause a decrease in output voltage due to internal supply impedance. This will cause the voltage at the base of Q102 to become more positive via the inverting amplifier IC101. With the base more positive, Q102 will conduct more, increasing its collector current. This increases the base current in Q101. The result is increased output current from Q101, raising the output voltage and maintaining the proper output voltage level.

Electrolytic capacitor C101, section "A", filters the bridge rectifier (D101-D104) output, while section "B" provides additional filtering of the +24V regulator output. Capacitor C103 filters the +5 volt source. Resistor R102 is the load resistor for Q102. Resistors R103, R104 bias Q102. Capacitor C102 increases regulation at high frequencies for improved transient response.

### VIDEO AMPLIFIER (Refer to Figure 16)

The linear video amplifier consists of two stages, Q201 and Q202, which are connected in a cascode configuration. This common emitter-common base arrangement greatly reduces the effect of Miller capacity (when compared to a conventional single transistor video amplifier/output stage).

A TTL compatible non-composite video signal, approximately 4.0 volts P-P, is DC coupled to the base of Q201 via R202. Resistor R201 provides proper termination for the high frequency input video signal. R203 and C201 provide high frequency compensation to maintain a flat response when Q201 and Q202 conduct. Contrast control R216 (when present) is used to limit the input video signal, which indirectly varies the amplitude of the video drive to the CRT cathode. This action is necessary to provide a contrast function when more than one level of video is applied to the input. Capacitor C208 (when present) provides high frequency compensation for the input video signal.

During a no-signal condition, video driver transistor Q201 is off. At the same time, video output transistor Q202 is base

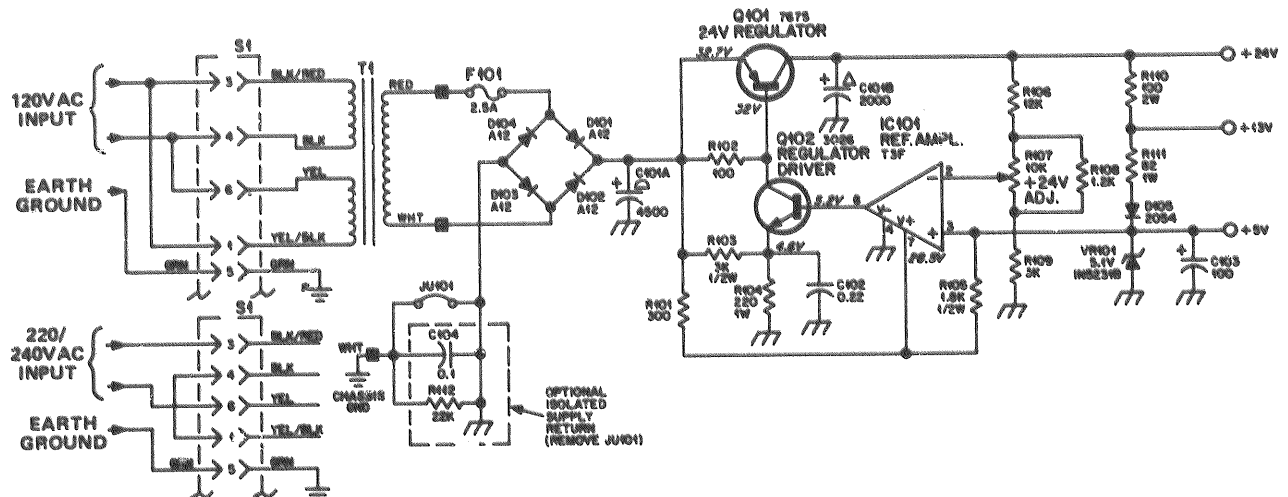


Figure 15. AC Power Input/Regulated Power Supply Output

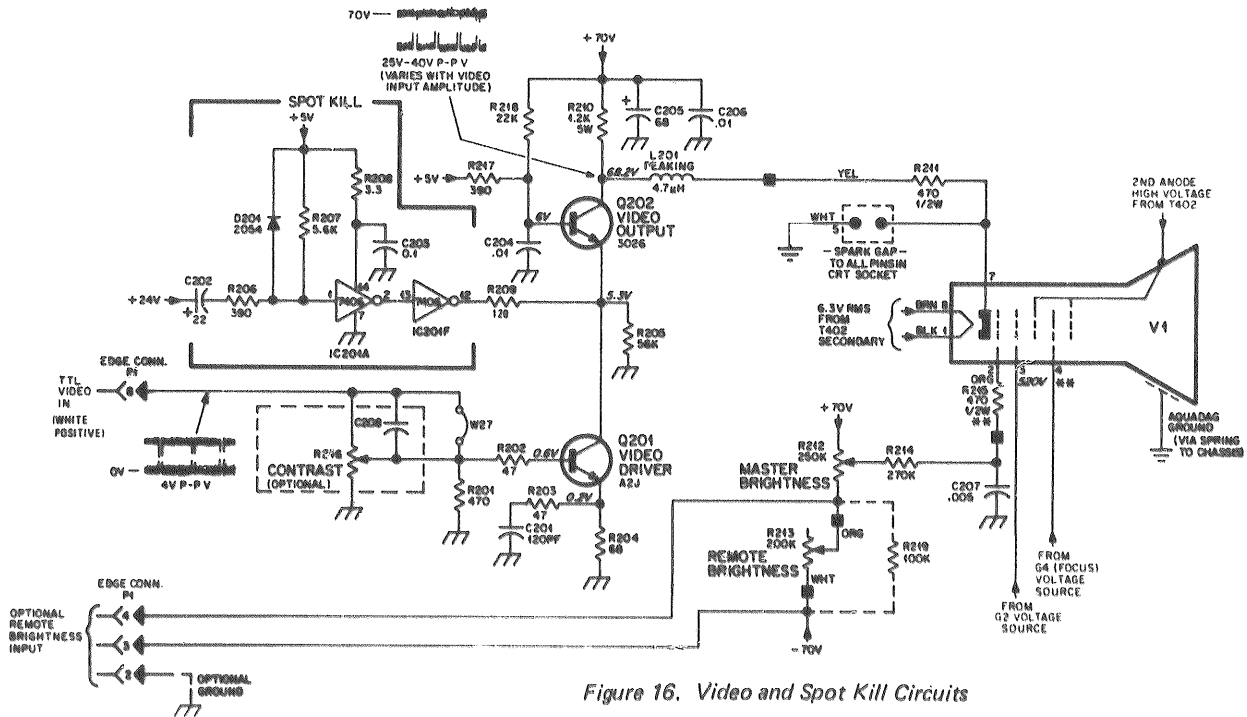


Figure 16. Video and Spot Kill Circuits

biased at 6.0V by R217 and R218. When a video signal is applied to the base of Q201, it turns on, allowing Q202 to conduct. The resultant output is developed across collector load resistor R210 and DC coupled to the CRT cathode via peaking coil L201 and resistor R211. Q202 is protected from CRT arcing by a spark gap built into the CRT socket, and R211 further isolates Q202 from transients. Capacitor C204 shorts video frequency signals from the base of Q202 to ground. Peaking coil L201 increases the high frequency response of the video amplifier. Capacitor C205 provides filtering of the +70V supply, while C206 is a high frequency AC bypass capacitor, to ground.

#### SPOT KILL (Refer to Figure 16)

When power is removed from the monitor, the horizontal and vertical scans collapse and a bright spot is left that will burn a spot in the phosphor screen unless prevented from doing so.

When the monitor is turned off, the decrease in the 24V supply voltage is coupled through capacitor C202 and resistor R206 to pin 1 of IC201A. This TTL input is normally held in the high state by resistor R207. The falling 24V supply switches IC201A to the low state at pin 1, which is inverted to a high at pin 2 of IC201A; then inverted to a low again by IC201F at pin 12. The open collector output of IC201F, now in the low state (conducting), pulls R209 to ground to become the emitter resistor of Q202. With 6.0 volts on its base, Q202 saturates. The resulting low collector voltage on Q202 is coupled to the CRT cathode causing it to conduct heavily. The large cathode current in the CRT discharges the second anode during scan collapse. The second anode is completely discharged before the scan currents collapse completely so that a spot can not form.

#### STEPSCAN FUNCTION (Reference Figure 17)

StepScan is useful when it is desired to display more rows of data characters than the existing "alphanumeric video" signal format will permit. A typical display consists of 240 horizontal scan lines which form character rows of data. Between each character row is a desired amount of blank spacing that is made up of horizontal scan lines without video information. By accelerating the vertical deflection between character rows, one (1) horizontal scan line could provide the spacing between rows that would normally be occupied by three (3) horizontal scan lines (see Figure 17). This would reduce the number of blank horizontal scan lines between character rows from three (3) down to one (1). However, the physical spacing between the character rows would not change. Since two (2) horizontal lines are saved between each row, a 24 row format will accumulate 48 unused scan lines. These 48 extra scan lines will reside at the bottom of the display since the CRT still scans a total of 240 horizontal lines. Therefore, the 48 additional lines at the bottom can also be used to display data. This means an additional six (6) rows of characters can be displayed. (For example, 7 lines for char. height plus 1 line for spacing = 8 lines per char. block. 48 unused lines divided by 8 char. block lines = 6 additional rows.)

#### — NOTE —

StepScan does not actually produce the six (6) additional rows; instead, it simply provides space (and horizontal lines) for them. The six (6) additional rows of video must be designed into the original video signal format during its development.

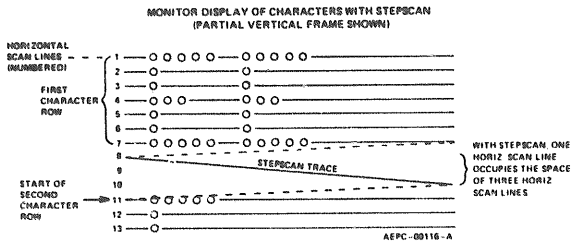


Figure 17. Displaying Characters on a Monitor with StepScan

### STEPSCAN CIRCUIT (Refer to Figure 18)

The StepScan circuit requires an external TTL positive-going pulse of approximately 4.0 volts P-P. These pulses are applied to pin 5 of IC201C through the protective network R501, D501 and D502. These pulses switch the TTL input of IC201C from the low state, normally maintained by resistor R502, to the high state. The open collector output of IC201C, pin 6, conducts during these pulses. These current pulses, regulated by control R504, are applied to the height adj. pin (7) of the vertical processor, IC301. The slope of the output sawtooth current is increased during these pulses to "step" the vertical position to the next character.

The rate at which the vertical processor "steps" is determined by the repetition rate of the incoming StepScan pulses. The slope (charge rate) of the stepped portion of the sawtooth is adjustable with the STEP ADJ. control, R504, which varies the spacing between the character rows. With the vertical sawtooth thus modified, the yoke vertical deflection current will be "stepped" during the line between character rows chosen. One additional component associated

with StepScan operation is capacitor C307. It increases the response of IC301 internal amplifier output (pin 4) by coupling the leading edge of the StepScan pulses into the amplifier input of IC301 (pin 10).

### VERTICAL SCAN (Refer to Figure 18)

Input TTL level pulses pass through resistor R301 and protective diodes D301 and D302 to IC201B or IC201E inputs. The input to IC201B accepts, through jumper JU302, negative vertical sync and the input to IC201E accepts, through jumper JU301, positive vertical sync. R303 holds the input of IC201B low to prevent its output, an open collector, from shorting the input to IC201E when negative sync is not selected.

Output pulses from IC201E (pin 10) are differentiated by capacitor C301 and resistor R306. Diode D303 couples only the negative-going spikes from the differentiator circuit to the sync input of IC301 (pin 8). R307 and R308 provide input current limiting. The sync input (pin 8) performs several functions. It strips away any random noise that may be present on the input line and conditions the vertical pulses for processing. It also converts the input voltage pulses to current to control the internal oscillator. The oscillator generates a non-symmetrical square wave with a short duty cycle at the vertical scan frequency (50 to 60 Hz). Components R310, R311 and C304 determine the frequency. This square wave signal is applied to a ramp generator whose slope and amplitude is determined by R312, R313, C305 and C306. The ramp voltage signal is applied to a buffer stage which isolates the ramp generator from the output stages and reduces any loading effect on the previous stages. Components R314, R316 and R315 reshape the ramp voltage to make it extremely linear.

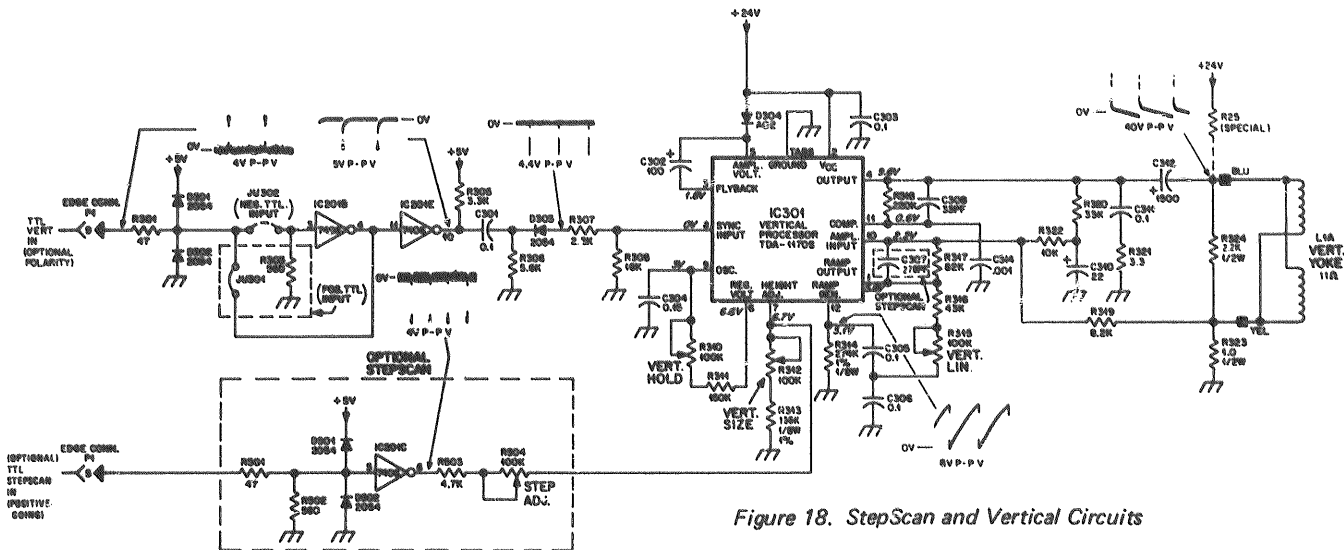


Figure 18. StepScan and Vertical Circuits

The output signal from pin 4 (IC301) drives the vertical deflection coils directly via coupling capacitor C312. Components R321 and C311 provide damping to prevent any oscillations in the output circuit. R320, R322, R319, R318, R323, C310 and C308 provide AC and DC feedback for the output stage to maintain proper gain and linearity. When the scan reaches the bottom of the screen a sync pulse initiates retrace. To insure a quick return to the top of the screen the voltage across the yoke is doubled during retrace to quickly discharge the yoke inductance. This voltage doubling circuit consists of diode D304, capacitor C302 and a transistor network in IC301. Capacitor C314 provides additional (external) compensation for IC301, pin 11. Resistor R325 (when present) is used to up-center the raster and video display.

### HORIZONTAL DRIVE/SYNC DELAY AND REGENERATOR (Refer to Figure 19)

TTL horizontal rate sync is coupled to the input of IC401B through the protective network consisting of resistor R401 and diodes D401 and D402. Capacitor C426 prevents non-horizontal rate transients from false-triggering IC401B. Jumpers W1 or W2 and W3 select positive or negative sync respectively. IC401B is a monostable multivibrator with its time constant being established by resistor R403, HORIZ. DELAY control R402, and capacitor C401. A positive pulse appears at pin 13 of IC401B, the leading edge coincident with the selected leading edge of horizontal sync and the trailing edge determined by the HORIZ. DELAY control, R402.

The falling edge of this pulse triggers IC401A, another monostable multivibrator, whose time constant (established by R406 and C403) regenerate a positive pulse at pin 5 of IC401A. Pulse width at this point is approximately equal to the input sync pulse. This pulse is inverted and increased in amplitude to 24V P-P by IC201D.

### PHASE DETECTOR (Refer to Figure 19)

The phase detector consists of two diodes (D403 and

D404) in a keyed clamp circuit. Its function is to develop a control voltage for synchronizing the horizontal oscillator with the incoming sync pulses. Two inputs are required to generate the required output; one from the horizontal sync regenerator IC401A, and one from the horizontal output circuit, Q402. The required output must be of the proper polarity and amplitude to correct phase differences between the input horizontal sync pulses and the horizontal time base. Each pulse from the collector of the horizontal output, Q402, is integrated into a sawtooth by R411 and C405. Capacitor C406 blocks DC from the collector of Q402. The output transistor of IC201D is normally at cut-off and its collector voltage rests at approximately 24 volts. Since C404 is connected to the output of IC201D, it will charge up to the collector voltage. When a pulse turns on and saturates the output of IC201D, its collector voltage drops to near ground potential. C404 will now discharge, coupling a negative-going sync pulse to the cathodes of D403 and D404. This negative potential is sufficient to forward bias both diodes to conduct and discharge any positive or negative charge on C405 to ground. In other words, it clamps the voltage on capacitor C405 during sync pulse time to approximately zero volts.

Without considering the sync pulses, the sawtooth wave would cause current flow into capacitor C405 when it is negative, and out of C405 when it is positive. Since the sawtooth is symmetrical about its AC axis, the charge and discharge currents of C405 are equal. C405 would therefore average a zero voltage level. A sync pulse (waveform A, Figure 20) clamping the sawtooth as it passes through its AC axis (waveform B, Figure 20), will not affect its positive and negative symmetry. Therefore, the average voltage on C405 would remain zero. However, if the horizontal time base begins to lag, the sync pulse will clamp the sawtooth to ground at a point below its AC axis, resulting in a non-symmetrical charge on C405. This clamping action will cause the sawtooth's AC axis to shift to a point above the

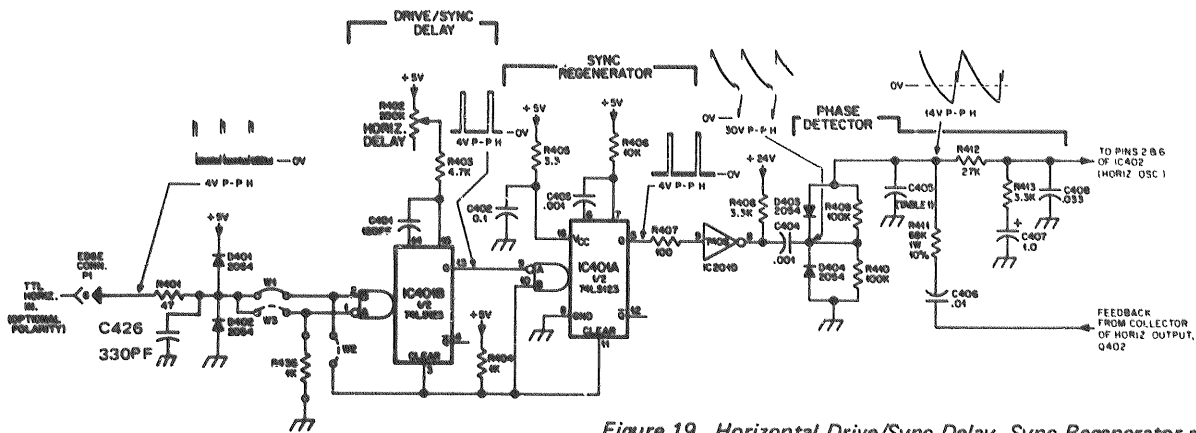


Figure 19. Horizontal Drive/Sync Delay, Sync Regenerator and Phase Detector Circuits

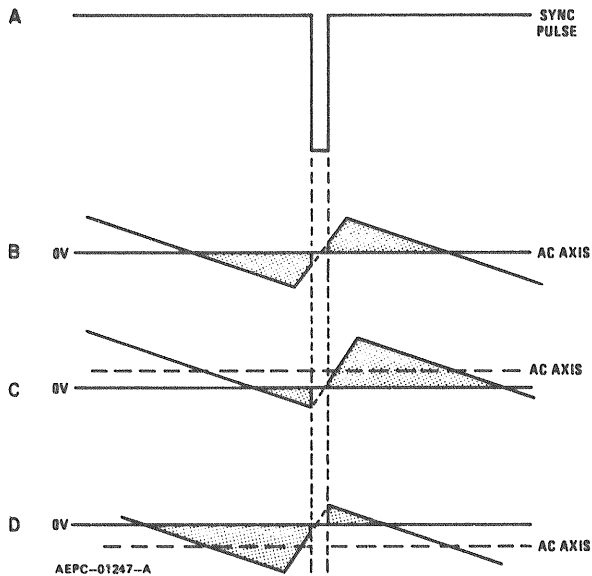


Figure 20. Phase Synchronization Waveforms

ground reference (waveform C, Figure 20). Therefore, most of the sawtooth's waveform is now above ground which will produce a positive voltage on C405. This is the correct polarity to cause the horizontal oscillator to speed up to correct the phase lag. Likewise, if the horizontal time base is leading the sync pulse, the sawtooth will be clamped to ground at a point above its AC axis. This clamping action will cause the sawtooth's AC axis to shift to a point below the ground reference (waveform D, Figure 20). Now most of the sawtooth's waveform is below ground, which will produce a negative voltage on C405. This is the correct polarity to cause the horizontal oscillator to slow down. The voltage level on C405 is dependent upon which point of the sawtooth is clamped. This also determines how far its AC axis will shift above or below ground.

R412, C407, R413 and C408 comprise the phase detector filter. The bandpass of this filter is designed to provide correction of horizontal oscillator phase without ringing or hunting.

#### HORIZONTAL OSCILLATOR/DRIVER (Refer to Figure 21)

Integrated circuit timer IC402 operates as an astable square wave oscillator. Its free running frequency is determined by resistors R415, R416, and capacitor C409. The phase detector correction voltage is coupled through resistor R414 to pins 2 and 6 of IC402 to vary the frequency of the oscillator. A second input to IC402, pin 5, allows control of the oscillator free-run frequency by means of R418, HORIZ. HOLD control.

The non-symmetrical output of IC402 (pin 3) is coupled to the horizontal driver transistor, Q401, through C411 and current limiting resistor R419. D405 protects Q401 from

reverse base-emitter voltage. Q401 operates as a switch to drive the horizontal output transistor Q402 through transformer T401. T401 is a voltage stepdown transformer to provide a low impedance drive to Q402. R421 is a current limiting resistor for Q401 and C414 is an AC bypass capacitor. R420 and C413 damp the transformer to prevent ringing when Q401 goes into cutoff.

#### HORIZONTAL OUTPUT (Refer to Figure 21)

The secondary of T401 provides the required low drive impedance for Q402. Components R422 and C415 form a time constant for fast turn-off of Q402. The horizontal output transistor, Q402, is simply a switch that is turned on and off at the horizontal scan rate by the drive signal applied to its base. A sawtooth current through the deflection coils is required to sweep the beam linearly across the CRT screen. The sweep begins at the center of the CRT and sweeps to the right. This happens when Q402 is turned on and its collector voltage drops to near zero. C419 begins discharging through the deflection coils to deflect the beam to the right edge of the CRT. At this time, Q402 cuts off and C419 ceases to supply current to the deflection coils. However, an induced voltage appears across the deflection coil as the magnetic field collapses, and an oscillation occurs between the deflection coils and C416.

During the first half cycle of this oscillation, the induced voltage is felt across the collector of now cut off Q402, C416, and the primary of T402, the flyback transformer. This voltage is stepped up by T402 and rectified to produce the required high voltage that is applied to the 2nd anode of the CRT. The electron beam is also deflected to the left edge of the CRT at this time because the collapsing magnetic field of the deflection coils reverses polarity.

During the second half cycle of the deflection coils/C416 oscillation, the voltage on the collector of still cut off Q402 becomes negative. At this time, damper diode D406 becomes forward biased and begins conduction. The deflection coil current gradually decreases to zero during damper conduction allowing the beam to sweep linearly to the center of the screen.

The horizontal retrace pulse charges C422 through D407 to provide operating voltage for G2 of the CRT. Momentary transients at the collector of Q402, should they occur, are limited to the voltage on C422 since D407 will conduct if the collector voltage exceeds this value. Coil L402 is a magnetically biased Horiz. Linearity coil that shapes the deflection current for optimum trace linearity. Coil L401 is a series Horiz. Width control. Components R425 and C418, R424 and C417 are damping network components for the Horizontal Linearity (L402) coil and WIDTH (L401) control.

The 24 volt supply to the horizontal output is coupled through diode D409 to pin 3 of the transformer, T402. Autoformer action of the transformer boosts the effec-

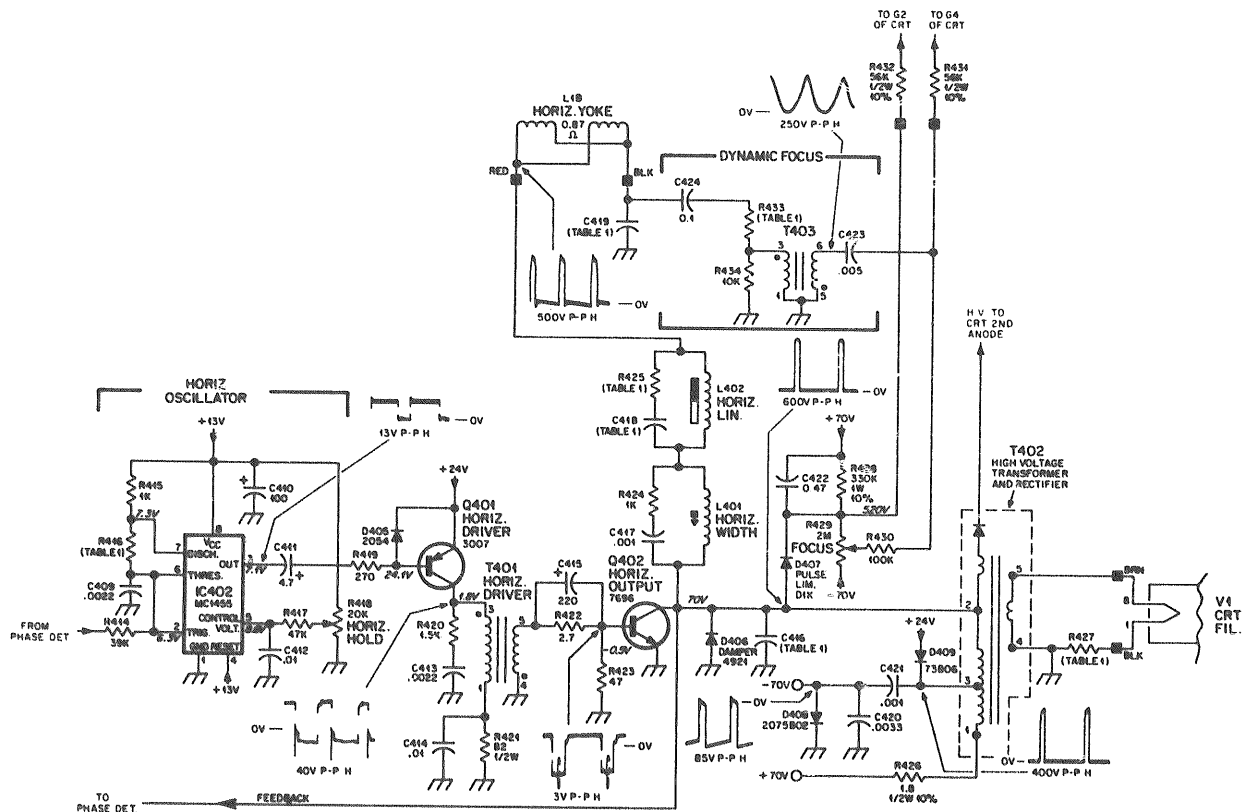


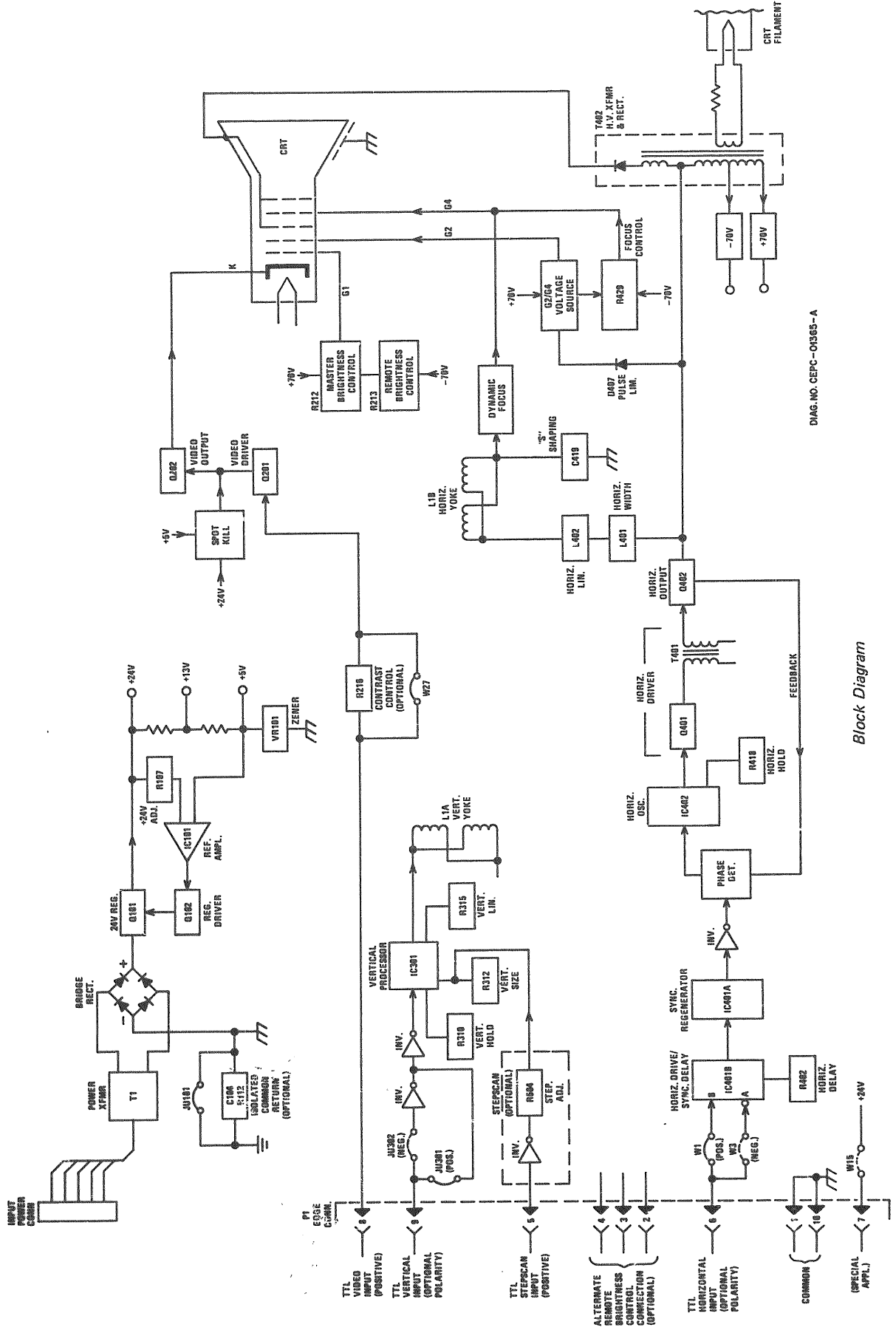
Figure 21. Horizontal Oscillator, Driver and Output Circuits, and Dynamic Focus Circuit

tive supply voltage to the transformer to the 70 volts appearing on pin 1 of T402. This voltage is filtered by C205 and provides the 70 volt source for the chassis. A capacitive divider, C421 and C420, and diode D408 provides a -70 volt supply for the CRT G1 electrode.

#### DYNAMIC FOCUS (Refer to Figure 21)

Due to the geometry of a CRT, the electron beam travels a greater distance when deflected to a corner as compared to the distance traveled at the center of the CRT screen. As a result of these various distances traveled, optimum focus can be obtained at only one point. For general applications, an adequate adjustment can be realized by setting the focus while viewing some point mid-way between the center of the CRT screen and a corner, thus optimizing the overall screen focus. When an application requires a

tighter specification, one of the simplest methods for improvement is to modulate the focus voltage at a horizontal sweep rate. Now optimum focus voltage is made variable on the horizontal axis of the CRT, which compensates for the beam travel along this axis. The AC component of the focus voltage is developed by stepping up the voltage across capacitor C419 via transformer T403. The linear current ramp in the horizontal yoke winding, L1B, also flows through capacitor C419. The ramp is integrated, the result being a parabolic waveform. This parabola is coupled through capacitor C424 and resistor R433 to the primary of transformer T403. The approximately 250V P-P parabola present at pin 6 of T403 is superimposed on the DC voltage from the FOCUS control, R429, via capacitor C423. This mixed AC and DC voltage results in a waveform of proper phase and amplitude, which is coupled through isolating resistor R431 to the CRT focus anode.

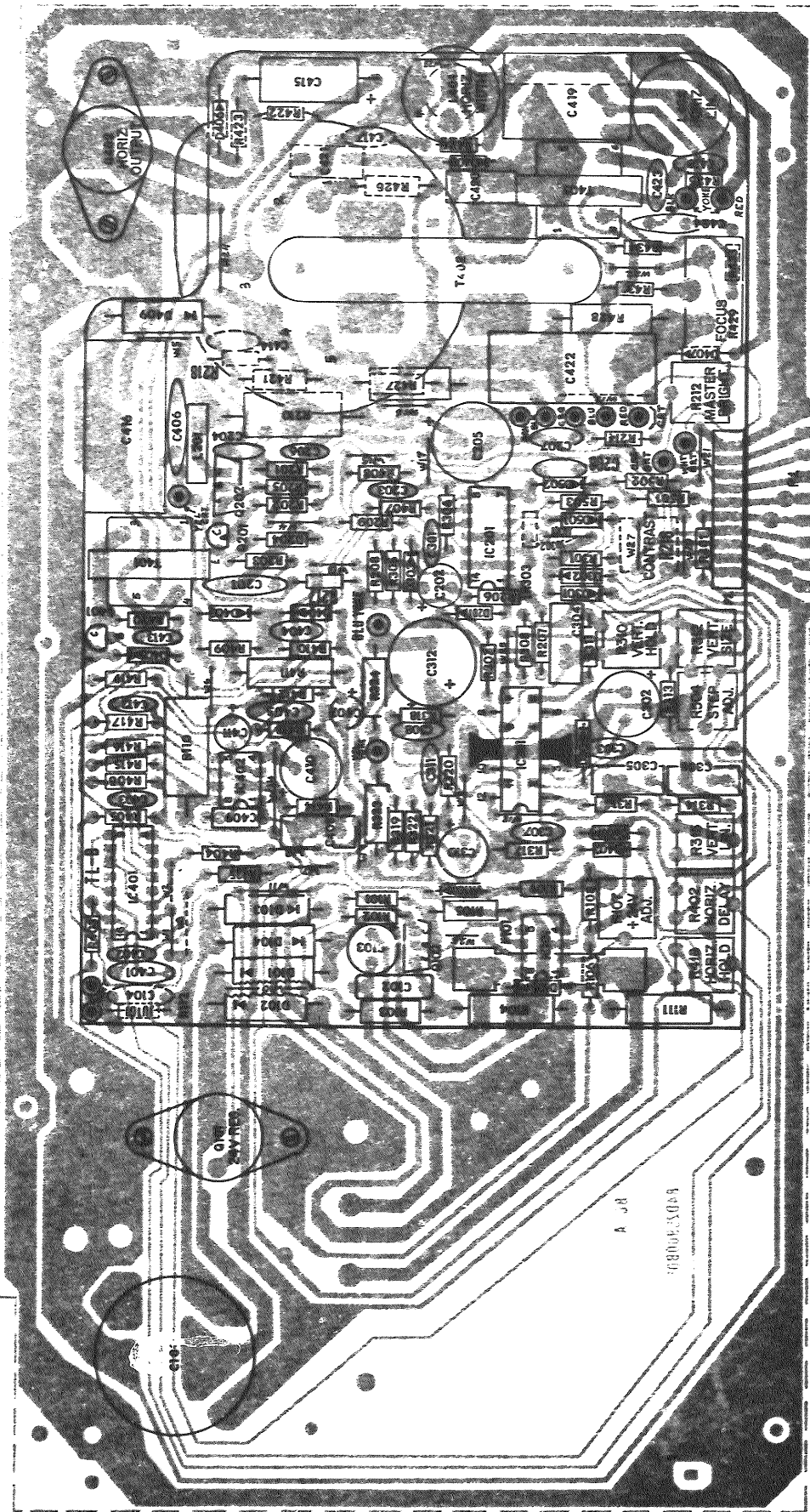


DIAG. NO. CEPC-0365-A

Block Diagram



— COMPONENT SIDE SHOWN —



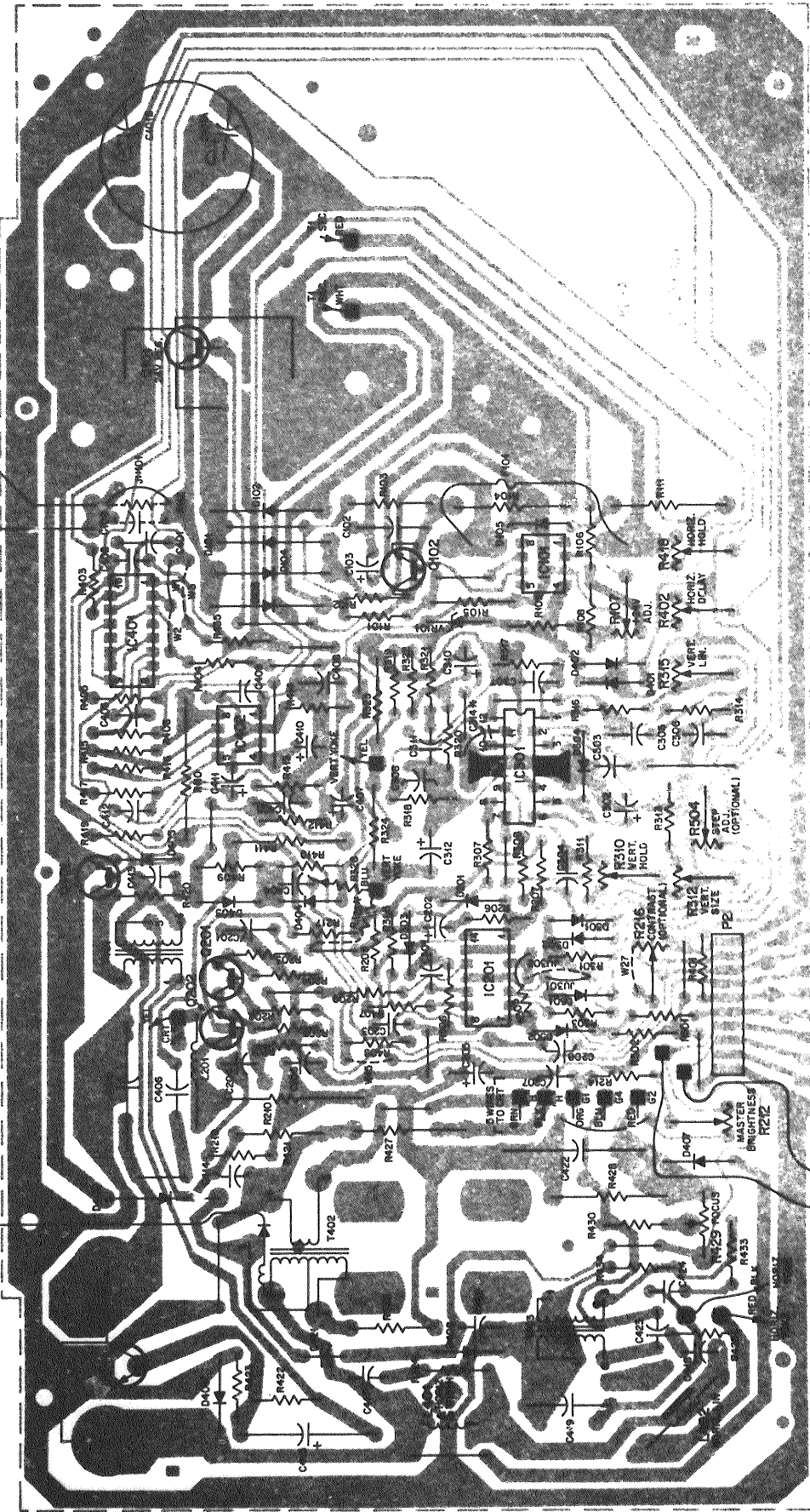
SOLDER ART DEPC-01546-0  
 OVERLAY DEPC-01585-0

- GROUND
- TTL VERTICAL INPUT
- TTL VIDEO INPUT
- SPECIAL INPUT
- HORIZONTAL TTL INPUT
- GROUND
- R213
- REMOTE BRIGHTNESS CONTROL
- ALTERNATE INTERCONNECT METHOD
- TTL STEERSCAN INPUT (OPTIONAL)

Monitor Circuit Card Layout — Component Side



— SOLDER SIDE SHOWN —



FROM CRT SOCKET, PIN 5  
WHT

CHASSIS/  
EARTH  
GROUND  
WHT

TO CRT  
2ND ANODE

SOLDER SIDE FOIL DEPC-01346-0  
OVERLAY DEPC-01347-0

\* LOCATED ON SOLDER SIDE  
OF CIRCUIT CARD

- P1 EDGE CONNECTOR
- GROUND
- TTL VERTICAL INPUT
- TTL VIDEO INPUT
- +24V INPUT (OPTIONAL)
- TTL HORIZONTAL INPUT
- ORG WHT
- TO REMOTE BRIGHTNESS R215
- GROUND
- GROUND
- R213 (PRIMARY INTERCONNECT METHOD)
- R215 (ALTERNATE INTERCONNECT METHOD)
- TTL STEPCAN INPUT (OPTIONAL)

Monitor Circuit Card Layout — Solder Side



**MOTOROLA**

VP38-S1

## DISPLAY MANUAL SUPPLEMENT

### INSTRUCTION MANUAL AFFECTED:

Service Manual VP38  
Motorola Part No. 68P25253A82

### PURPOSE:

Provide service information for the DS-Series TTL Input CRT Display Monitors in the form of a replacement parts list and two (2) schematics. The information contained in this supplement is to be used in conjunction with a separate Motorola service manual, part no. 68P25253A82 (File VP38).

### DESCRIPTION:

The two (2) schematics represent the following models:

DS3000, 3003 - 100 thru _00	}	TTL input <u>without</u> StepScan
DS4000, 4003 - 100 thru _00		
DS3000, 3003 - 140 thru _40	}	TTL input <u>with</u> StepScan
DS4000, 4003 - 140 thru _40		

The replacement parts list is integrated to represent all standard models, with or without StepScan.

(Page 1 of 4)



**MOTOROLA INC.**

**Display Systems**

1299 East Algonquin Road, Schaumburg, IL. (312) 397-8000

(VP38-S1)  
3/82

68P25253A34-2  
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DS SERIES (TTL VERSION WITH AND WITHOUT STEPSCAN) REPLACEMENT PARTS LIST

- NOTE -

When a component requires replacement, it is recommended that only Motorola part numbers be used. This is necessary to ensure optimum performance and reliability from selected components with specific operating characteristics. When a part number is not listed, however, an equivalent may be substituted.

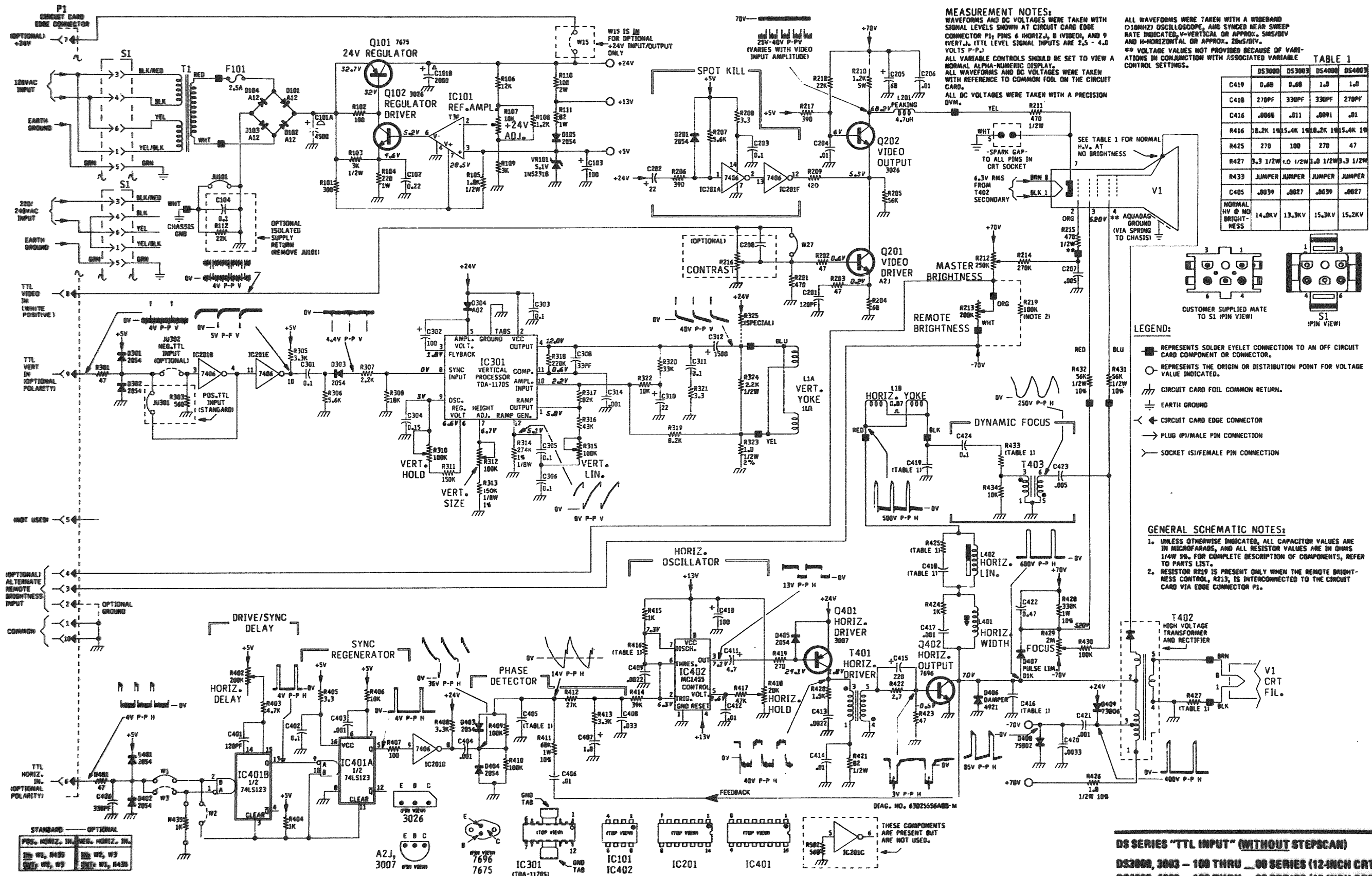
The following parts list represents components for the four (4) basic CRT display models; DS3000, DS3003, DS4000 and DS4003 (100, 200, 300, etc., and 140, 240, 340, etc.) Series. For replacement of components that differ in unique CRT display models, compared to the four (4) basic models, order by the unique model number, schematic designator and description.

REF. NO.	CIRCUIT CARD ASSEMBLY: (Order by model number only)	DESCRIPTION	REF. NO.	PART NO.	DESCRIPTION	REF. NO.	PART NO.	DESCRIPTION	REF. NO.	PART NO.	DESCRIPTION
C101	23R22964A05	4800/60V, 2000/30V; Lytic	C418	21S180E78	270 pF 10%, X5F, 500V; Cer.	R104	6S126A33	FCC: 220.5%, 1W	T402	24D25291A13	Transformer, High Voltage; Incl. H.V. Rect. (DS4003)
C102	23R22964A12	0.22 10%, 50V; Poly	C419	8R22961A07	1.0 10%, 200V; Poly	R107	18D2590A06	Control, Var.; 10k (±24V Adj.)	T402	24D25291A10	Transformer, High Voltage; Incl. H.V. Rect. (DS3000)
C103	23R22964A21	100, 10V; Lytic	C420	8R22961A08	.068 10%, 200V; Poly Carb	R110	6S127A25	FCC: 100.5%, 2W (Standup Type)	T402	24D25291A11	Transformer, High Voltage; Incl. H.V. Rect. (DS3003)
C104	8R22966A77	0.1 10%, 200V; Poly	C421	8R22967A31	.0033 10%, 200V; Poly	R111	6S128A23	FCC: 82.5%, 1W	T403	26D25727E05	Transformer, Dynamic Focus
C201	21S180E50	120 pF 5%, NPO, 100V; Cer.	C422	8R22967A35	.001 10%, 600V; Poly	R120	17-136187	Control, Var.; 250k (Master Brightness)	ZENER DIODES:		
C202	23R22914A77	22, 35V; Lytic	C423	21S180A62	0.47 10%, 600V; Mitz; Poly	R210	18D2590A02	Control, Var.; 200k (Fluoresc. Brightness)	VR101	48S10813A06	Diode, Zener; 5.1V (IN62318)
C203	21R22964A05	0.1 ±80-20%, 25V, 100V; Cer.	C424	21R22964A05	.005 20%, 25V, 500V; Cer.	R212	18D2590A02	Control, Var.; 200k (Fluoresc. Brightness)	CHASSIS MOUNTED COMPONENTS: (Not part of circuit card)		
C204	21R22964A06	0.1 ±80-20%, 25V, 100V; Cer.	C425	21S131625	0.1 ±80-20%, 25V, 100V; Cer.	R213	18D25212A39	Control, Var.; 200k (Fluoresc. Brightness)	L1	24D25687818	Yoke, Deflection (DS4000 Series)
C205	21R22964A08	69, 100V; Lytic	C426	21S131625	330 pF 10%, X5F, 500V; Cer.	R214	6S124B08	FCC: 270k	L1	24D25687819	Yoke, Deflection (DS4003 Series)
C206	21R22964A08	0.1 ±80-20%, 25V, 100V; Cer.	C427	21-180D24	.0015 10%, X5F, 100V; Cer. Disc.	R215	18D2590A04	Control, Var.; 100k (Vert. Lin.)	L1	24D25687816	Yoke, Deflection (DS3000 Series)
C207	21S180A82	.005 20%, 25V, 500V; Cer.	C428	21-180D24	.0015 10%, X5F, 100V; Cer. Disc.	R216	6S124B08	FCC: 270k	L1	15R22982A06	Housing, Recept.; 6-Contact (Ilex contacts)
C208	21R22964A05	0.1 ±80-20%, 25V, 100V; Cer.	D101-D104	48R181A12	Rectifier, Silicon; (91A12)	R217	18D2590A04	Control, Var.; 100k (Optional)	L1	39S107184A64	Contact, Recept.; Female (S1 requires 5)
C301	21R22964A06	100, 50V; Lytic	D105	48R02056A00	Silicon Diode, Gen. Purpose; (20564)	R218	18D2590A04	Control, Var.; 100k (Vert. Hold)	T1	1V25684B27	Transformer, Power (Incl. Conn S1)
C302	21R22964A06	0.1 ±80-20%, 25V, 100V; Cer.	D201	48R02056A00	Silicon Diode, Gen. Purpose; (20564)	R219	18D2590A12	Control, Var.; 100k (Vert. Size)	T1	26D25239B49	Transformer, Power (Lvs Conn. S1)
C303	21R22964A06	0.1 ±80-20%, 25V, 100V; Cer.	D301-D303	48R191A02	Rectifier, Silicon; (91A02)	R312	6S10821E08	FMF: 150k 1%, 1/W			
C304	8R22967C51	0.1 10%, 100V; Poly	D304	48R191A02	Silicon Diode, Gen. Purpose; (2054)	R313	6S10821E31	FMF: 274k 1%, 1/W			
C305	8R22967C59	270 pF 10%, X5F, 500V; Cer.	D401-D406	48R02064A00	Silicon Diode, Demarr; 800V (4921)	R314	6S10821C83	FMF: 8.25k 1%, 1/W			
C307	21S180E78	(Models with StepScan only)	D406	48R02064A00	Silicon Diode; (D1K)	R315	6S10821C83	FMF: 8.25k 1%, 1/W			
C308	21S180E94	33 pF 10%, NPO, 500V; Cer.	D407	48R134978	Diode, Fast Recovery; 200V (75R972)	R319	6S10164H99	FCC: 8.2k			
C309	(Not Used)		D408	48R02075B02	Diode, Fast Recovery; 200V (75R972)	R320	6S10821D53	FMF: 43.2k 1%, 1/W			
C310	23R22914A77	22, 35V; Lytic	D409	48R02073B06	Diode, Fast Recovery; 600V (73R906)	R322	6S10164J14	FCC: 33k (Models without StepScan)			
C311	23R22914A58	0.1 ±80-20%, 25V, 100V; Cer.	D501-1	48R02064A00	Silicon Diode, Gen. Purpose; (2054)	R323	6S10821C91	FMF: 10k 1%, 1/W			
C312	23R22914A58	1600, 25V; Lytic	F008S:		(Models with StepScan only)	R324	6S10821C91	FMF: 10k 1%, 1/W			
C313	(Not Used)		F101	6S5129421	2.5 Amp., 280V (120, 220 240VAC Operation)	R325	6S10164J02	FCC: 10k			
C314	21S180E51	.001 10%, X5F, 500V; Cer.	INTEGRATED CIRCUITS:			R326	6S10164J02	FCC: 10k			
C401	21S180E50	120 pF 5%, NPO, 100V; Cer.	IC101	61R10732A01	IC, Op. Ampl.; T3F	R327	6R29872J01	MOF: 1.0 2%, 1/2W			
C402	23R22964A06	0.1 ±80-20%, 25V, 100V; Cer.	IC201	61R08438A00	IC, 6 Inverter; 7406	R328	6-128B69	FCC: 3.9 5%, 1W			
C403	21S180E51	.0027 10%, X5F, 500V; Cer.	IC301	61R08015A00	IC, Vert. Processor; TDA11705	R402	18D2590A03	Control, Var.; 200k (Horiz. Delay)			
C405	21S180C41	.0027 10%, 25F, 100V; Cer.	IC401	61R06821A00	IC, Dual Retrigger, Monostable; 74LS123	R411	6S124A81	FCC: 68k 10%, 1W			
C406	21S180E91	.0039 10%, 25F, 100V; Cer.	IC402	61R06832A00	IC, Timing; NE555	R415	6R22891A19	FCC: 15.4k 1%, 1/W (DS3003, 4003)			
C407	23R10229A32	0.1 20%, 25V, 10V; Cer.	IC01S:			R416	6R22891A28	FMF: 18.2k 1%, 1/W (DS3000, 4000)			
C408	8R22967A36	1.0 10%, 10V; Lytic	L401	24D25603A10	Coil, 4.7 uH; (Peaking)	R418	18D2590A08	Control, Var.; 20k (Horiz. Hold)			
C409	21R22964A06	0.200 pF 2%, NPO, 100V; Cer.	L402	24D25600A10	Coil, Horiz. Size	R426	6S10053J04	MOF: 82.5%, 1/2W			
C410	23R22914A40	4.7, 35V; Lytic	L402	24D25600A13	Coil, Horiz. Linearity (DS4000)	R427	6S10053J05	FCC: 1.0 5%, 1/2W			
C411	23R22914A73	100, 50V; Lytic	L402	24D25600A11	Coil, Horiz. Linearity (DS4003)	R428	6S125783	FCC: 30k 10%, 1W			
C412	21S180E60	0.022 10%, 25F, 50V; Cer.	L402	24D25600A12	Coil, Horiz. Linearity (DS3000)	R429	18C25126A14	Control, Var.; 2M (Focus)			
C413	21S180E60	0.022 10%, 25F, 50V; Cer.	TRANSISTORS:			R429	18D2590A04	Control, Var.; 100k (Step Scan Only)			
C414	21S132462	.01 ±80-20%, 25V, 100V; Cer.	G101	48R137875	PNP; 7575 (24V Reg.)	R604	18D2590A04	(Models with StepScan Only)			
C415	23S102568E81	220, 10V; Lytic	G102	48R03026A00	PNP; 3026 (Reg. Driver)	TRANSFORMERS:					
C416	23S102568E46	.0091 5%, 1200V; Poly Carb	G201	48R134962	PNP; A2J (Video Driver)	T401	25D25772A04	Transformer, Horiz. Driver			
C416	8R229630E46	.01 5%, 1200V; Poly Carb	G202	48R03026A00	PNP; 3026 (Video Output)	T402	24D25291A12	Transformer, High Voltage; Incl. H.V. Rect. (DS4000)			
C418	8R229630E41	.0068 5%, 1200V; Poly Carb	G401	48R03007A00	PNP; 3007 (Horiz. Driver)						
C418	8R229630E41	(DS3000)	G402	48R137885	PNP; 7885 (Horiz. Output)						
C416	8R229630E77	.011 5%, 1200V; Poly Carb									
C417	21S180E91	.001 10%, X5F, 500V; Cer.									
C418	21S131625	330 pF 10%, X5F, 500V; Cer.									

- CRT REPLACEMENT NOTE -  
Order replacement CRT's by referring to the CRT Identification Label on the ball of the tube. There will be a manufacturers Type Number, and a Motorola Part Number that begins with a 96 prefix. (An example of the complete Motorola No. would be 96R02500B004.) If the label is not present, or legible, order the replacement CRT by the complete model number; such as a DS4000-100, DS3000-140, etc. . .

MECHANICAL PARTS LIST

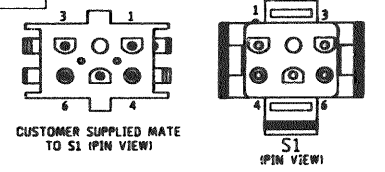
REF. NO.	PART NO.	DESCRIPTION
41C2593A02	41C2593A02	Spring, Aquadag
42R25158C01	42R25158C01	Clamp, Deflection
1V25574A01	1V25574A01	Socket, CRT (Incl. leads and resistors)
14S562353	14S562353	Insulator, Transistor
7D25901A01	7D25901A01	Bracket, Side; Right-Hand (DS4000, 4003)
7D25901A02	7D25901A02	Bracket, Side; Left-Hand (DS4000, 4003)
7C25902A01	7C25902A01	Bracket, Mounting Foot (2 Feet C.)
7C25926A04	7C25926A04	Heat Sink/Support (IC301)
42S10122A12	42S10122A12	Clip, Fuse; F101 (2 Req'd.)
7D25307C01	7D25307C01	Bracket, Side; Right-Hand (DS3000, 3003)
7D25307C02	7D25307C02	Bracket, Side; Left-Hand (DS3000, 3003)
58R2594A01	58R2594A01	Adapter, Adjusting Control
58R2594A01	58R2594A01	Magnet, Yoke; Non-Flexible Hard Core
58R2594A02	58R2594A02	Magnet, Yoke; Flexible Soft Core



**MEASUREMENT NOTES:**  
 WAVEFORMS AND DC VOLTAGES WERE TAKEN WITH SIGNAL LEVELS SHOWN AT CIRCUIT CARD EDGE CONNECTOR P1, PINS 4 (HORIZ.), 8 (VIDEO), AND 9 (VERT.). TTL LEVEL SIGNAL INPUTS ARE 2.5 - 4.0 VOLTS P-P.  
 ALL VARIABLE CONTROLS SHOULD BE SET TO VIEW A NORMAL ALPHA-NUMERIC DISPLAY.  
 ALL WAVEFORMS AND DC VOLTAGES WERE TAKEN WITH REFERENCE TO COMMON FOIL ON THE CIRCUIT CARD.  
 ALL DC VOLTAGES WERE TAKEN WITH A PRECISION DVM.  
 \*\* VOLTAGE VALUES NOT PROVIDED BECAUSE OF VARIATIONS IN CONJUNCTION WITH ASSOCIATED VARIABLE CONTROL SETTINGS.

**TABLE 1**

	DS3000	DS3003	DS4000	DS4003
C419	0.68	0.68	1.0	1.0
C418	270PF	330PF	330PF	270PF
C416	.0068	.011	.0091	.01
R416	18.2K	190.5.4K	190.2K	190.5.4K
R425	270	100	270	47
R427	3.3 1/2W	1.0 1/2W	1.0 1/2W	3.3 1/2W
R433	JUMPER	JUMPER	JUMPER	JUMPER
C405	.0039	.0027	.0039	.0027
NORMAL HV @ NO BRIGHTNESS	14.8KV	13.3KV	15.3KV	15.2KV



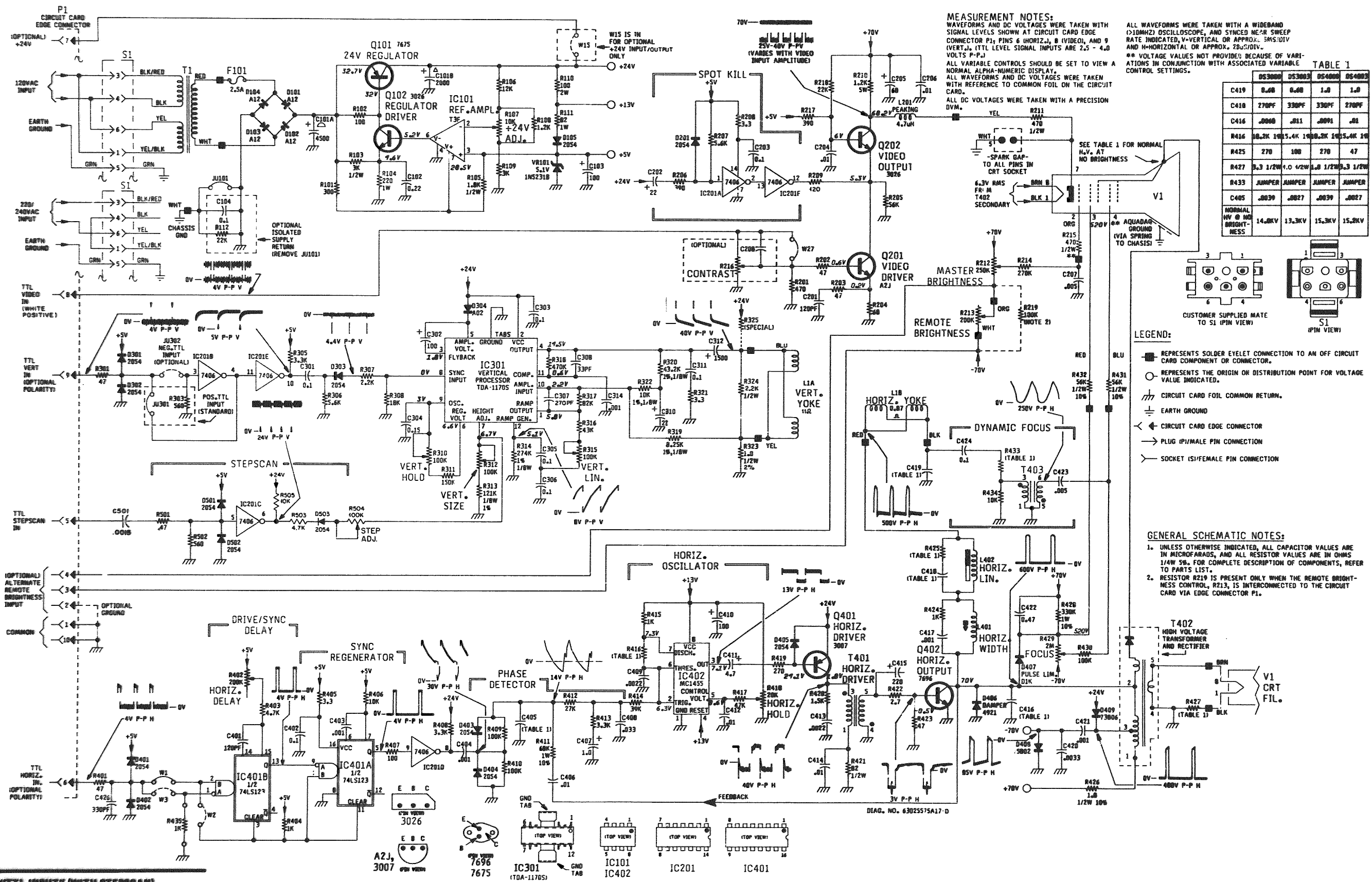
- LEGEND:**
- REPRESENTS SOLDER EYELET CONNECTION TO AN OFF CIRCUIT CARD COMPONENT OR CONNECTOR.
  - REPRESENTS THE ORIGIN OR DISTRIBUTION POINT FOR VOLTAGE VALUE INDICATED.
  - /—/— CIRCUIT CARD FOIL COMMON RETURN.
  - ⊥ EARTH GROUND.
  - ◀ CIRCUIT CARD EDGE CONNECTOR.
  - PLUG (P)/MALE PIN CONNECTION.
  - ⊃ SOCKET (S)/FEMALE PIN CONNECTION.

- GENERAL SCHEMATIC NOTES:**
- UNLESS OTHERWISE INDICATED, ALL CAPACITOR VALUES ARE IN MICROFARADS, AND ALL RESISTOR VALUES ARE IN OHMS 1/4W 50. FOR COMPLETE DESCRIPTION OF COMPONENTS, REFER TO PARTS LIST.
  - RESISTOR R219 IS PRESENT ONLY WHEN THE REMOTE BRIGHTNESS CONTROL, R213, IS INTERCONNECTED TO THE CIRCUIT CARD VIA EDGE CONNECTOR P1.

**STANDARD - OPTIONAL**

POS. HORIZ. IN.	NEG. HORIZ. IN.
W1, W4, W5	W2, W3
W1, W4, W5	W2, W3

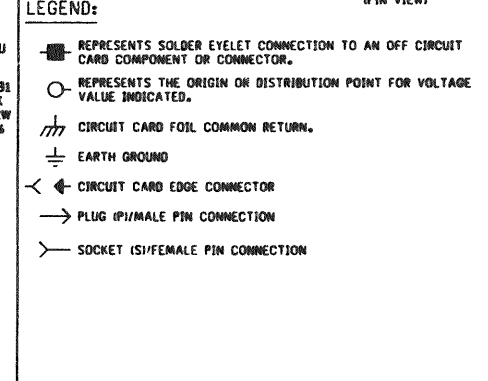
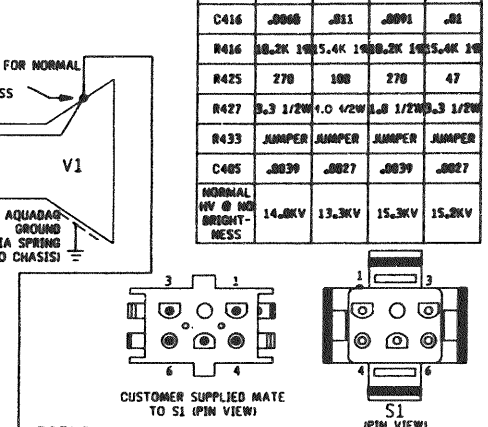
**DS SERIES "TTL INPUT" (WITHOUT STEPCAN)**  
 DS3000, 3003 - 100 THRU \_00 SERIES (12-INCH CRT)  
 DS4000, 4003 - 100 THRU \_00 SERIES (15-INCH CRT)  
 SCHEMATIC DIAGRAM



**MEASUREMENT NOTES:**  
 WAVEFORMS AND DC VOLTAGES WERE TAKEN WITH SIGNAL LEVELS SHOWN AT CIRCUIT CARD EDGE CONNECTOR P1; PINS 6 (HORIZ.), 8 (VIDEO), AND 9 (VERT.). TTL LEVEL SIGNAL INPUTS ARE 2.5 - 4.0 VOLTS P-P.  
 ALL VARIABLE CONTROLS SHOULD BE SET TO VIEW A NORMAL ALPHA-NUMERIC DISPLAY.  
 ALL WAVEFORMS AND DC VOLTAGES WERE TAKEN WITH REFERENCE TO COMMON FOIL ON THE CIRCUIT CARD.  
 ALL DC VOLTAGES WERE TAKEN WITH A PRECISION DVM.  
 \* VOLTAGE VALUES NOT PROVIDED BECAUSE OF VARIATIONS IN CONJUNCTION WITH ASSOCIATED VARIABLE CONTROL SETTINGS.

**TABLE 1**

	DS3000	DS3003	DS4000	DS4003
C419	0.08	0.08	1.0	1.0
C418	270PF	330PF	330PF	270PF
C416	.0008	.011	.0001	.01
R426	10.2K	10.5.4K	10.2K	10.5.4K
R425	270	100	270	47
R427	3.3	1/2W 4.0	4/2W 1.8	1/2W 3.3
R433	JUMPER	JUMPER	JUMPER	JUMPER
C405	.0039	.0027	.0039	.0027
NORMAL HV @ NO BRIGHTNESS	14.8KV	13.3KV	15.3KV	15.8KV



**DS SERIES "TTL INPUT" (WITH STEPCAN)**  
 DS3000, 3003 - 140 THRU \_40 SERIES (12-INCH CRT)  
 DS4000, 4003 - 140 THRU \_40 SERIES (15-INCH CRT)  
**SCHEMATIC DIAGRAM**

**STANDARD - OPTIONAL**

POS. HORIZ. IN.	NEG. HORIZ. IN.
RES: W1, R435	RES: W2, W3
SOFT: W2, W3	SOFT: W1, R435

