Video Monitors inc

OPERATING MANUAL

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SERVICING AND OPERATING SAFETY

GROUND THE PRODUCT SECURELY

This product is designed to be grounded through the chassis. To avoid electrical shock, extreme care should be used to ensure that the chassis is solidly grounded. Units with the AC power supply option may be grounded through the grounding connector of the power cord.

CAUTION: upon loss of the protective ground connection, all accessible conductive parts can render an electric shock.

USE THE PROPER FUSE.

To avoid fire hazard, use only those fuses of the correct type, voltage rating, and current rating as specified in the parts list for your product.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE

To avoid explosion, do not operate this product in an explosive atmosphere.

DO NOT SERVICE THIS PRODUCT ALONE

Do not perform internal adjustment or service of this product unless another person capable of rendering first aid is present.

USE CAUTION WHEN SERVICING WITH THE POWER ON

Dangerous voltages are present at several points in this product. To avoid injury, do not touch exposed connections and components while the power is on.

Disconnect power before soldering or replacing components.

USE THE PROPER POWER SUPPLY

This product is designed to operate with a power supply that will supply no more than 250 volts rms between the supply conductors or between either supply conductor and ground.

A protective ground connection is essential for safe operation.

SECTION I. GENERAL INFORMATION

1.1 MONITOR DESCRIPTION

The M series monitor is a solid-state display for use in systems requiring exceptionally high quality video. Printed circuit board construction coupled with the all solid-state circuitry provides high reliability and uniformity Synchronization circuitry has been designed to simplify the interfacing of this monitor with users systems. Separate vertical and horizontal sync signals are used to eliminate the need for composite sync generation in the standard unit.

Composite sync is available as an option.

1.2 ELECTRICAL SPECIFICATIONS

INPUT DATA SPECIFICATIONS	VIDEO	VERTICAL SYNC	HORIZONTAL SYNC
PULSE RATE OR WIDTH	11 nsec.	49-61/sec.	See specific model details
AMPLITUDE SINGLE ENDED	Black = 0V White = .7V	Low = 0 + 0.4 -0.0 Volts High = 4 ± 1.5 Volts	
ECL DIFFERENTIAL OPTIONAL	Low = - .9V High = - 1.35V		
RISE AND FALL (10% - 90%)	5 nsec. max.	100 nsec. max.	100 nsec. max.
INPUT SIGNAL	See Figure No. 1		
COMPOSITE	0.7V min. 2.0V max.	35-45% of video amplitude	

CONNECTOR SPECIFICATIONS	10 PIN Edge Card (Cinch #50-20A-30 or EQ.)	10 PIN Ribbon (ECL) (3M #3473-3000 or EQ)
HORIZONTAL SYNC	9	1
VERTICAL SYNC	10	3
VIDEO POSITIVE	1	5
VIDEO NEGATIVE	N/C	6
GROUND	AF	2,4,7,10
BRIGHTNESS POSITIVE	7	
BRIGHTNESS NEGATIVE	8	
BRIGHTNESS WIPER	6	
KEY WAY	3	
CONTRAST	2	

INPUT IMPEDANCE		MINIMUM RESISTANCE
VIDEO INPUT	Single Ended	75 Ohm or 20 K Min. Switch selectable
	ECL Input	112 Ohm Balanced
HORIZONTAL SYNC		One LS-TTL Load
VERTICAL SYNC		One LS-TTL Load

POWER REQUIREMENTS

MONITORS USING AN EXTERNAL DC POWER SUPPLY

INPUT CONNECTOR (Pin #2 is positive #1 gnd)	Molex: Receptacle #03-09-1022 02091103 - 1 ea. 02042102 - 1 ea.
INPUT VOLTAGE*	55V to 70VDC
INPUT CURRENT	See specific model *

* Internal regulation is provided

MONITORS WITH INTEGRAL POWER SUPPLY

INPUT VOLTAGE	100, 120, 220, 260V RMS 50/60 Hz switch selectable
INPUT POWER	125W (Nominal) See specific model

NOTE: Power transformers must be of low external flux design or well removed from CRT.

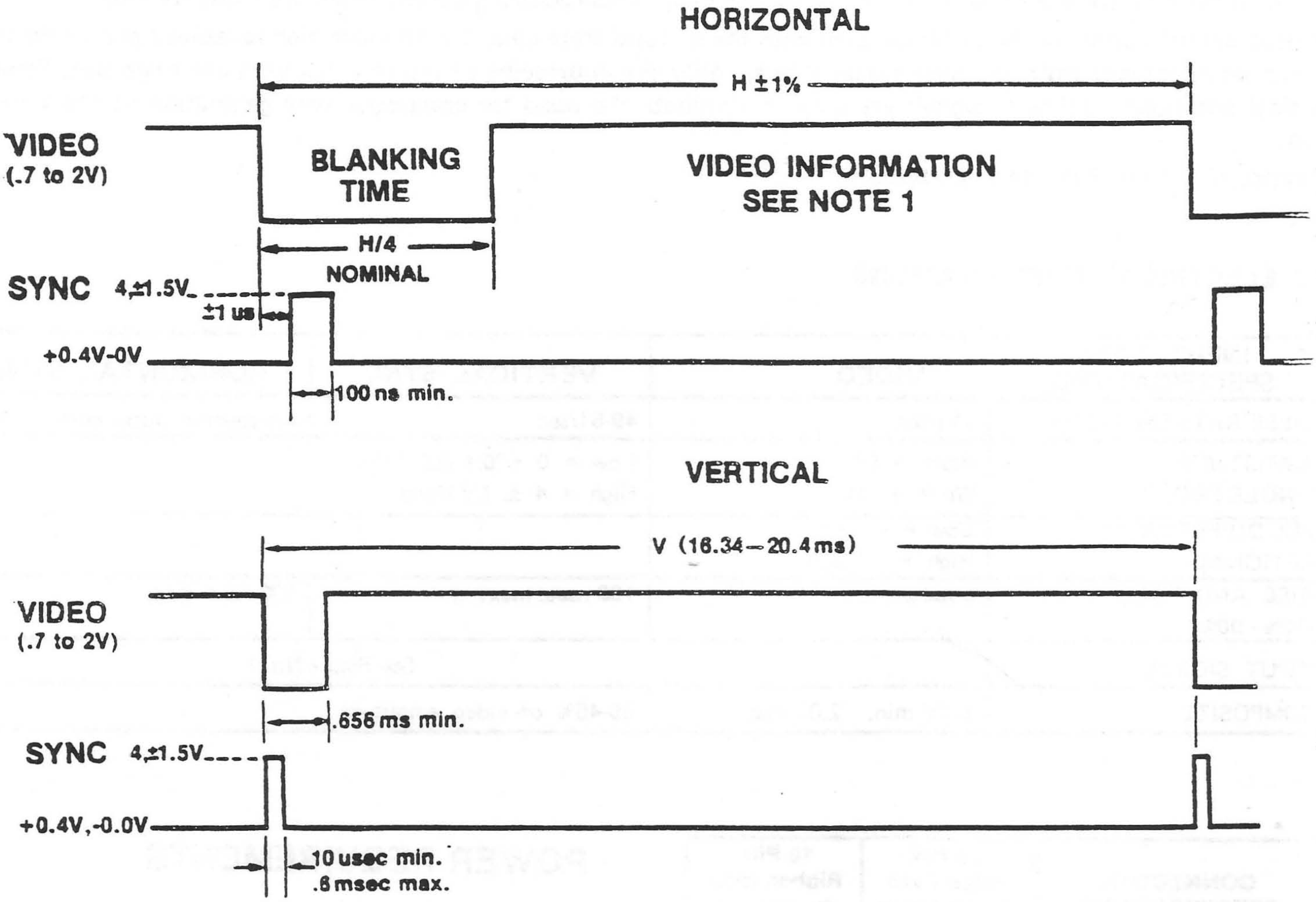
* 1.25A

VIDEO AMPLIFIER

Rise and fall time (10% to 90% amplitude) 5 nsec.

LINEARITY

Vertical and horizontal linearity will be within ± 1% of the major axis.



Notes: 1. Video pulse width should be 11 nsec or greater.
2. Blanking times are indicative of monitor timing. User must supply blanking in video signal.
3. H=Time from beginning of one scan to the beginning of the next scan.
4. V=Time from beginning of one frame to the beginning of the next frame.
5. Horizontal sync required during vertical retrace.

Fig. 1 SEPARATE SYNC TIMING REQUIREMENTS

1.3 ENVIRONMENTAL SPECIFICATIONS

HUMIDITY

5 to 80 percent (noncondensing)

ALTITUDE

Operating Range — up to 10,000 feet

TEMPERATURE

Operating Range — 5° to 55° ambient

Storage — -40° to 65° c

1.4 HUMAN FACTOR SPECIFICATIONS

X RAY RADIATION

These units comply with DHEW Rules 21-CFR-Subchapter J.

1.5 CONTROLS

INTERNAL SET UP CONTROLS (See Fig. 2)

- P1 Video gain
- P2 Video bias
- P3 Brightness
- P4 G2 voltage
- P5 DC Focus
- P6 Horizontal delay (Sync delay)
- P7 Horizontal centering (not supplied on models with overscan)
- P10 Vertical size
- P11 Vertical shape
- P12 Vertical linearity
- P13 Corner focus
- P14 Scan focus
- P15 Sweep focus
- P33 Vertical centering
- T4 Focus phase
- SW1 Termination switch
- L3 Horizontal width
- L4 Horizontal linearity

1.6 CONNECTORS (See Fig. 2)

- J1 Power input
- J2 Yoke connector
- J3 Vertical transformer
- J4 Flyback connector
- J5 Composite video input
- J8 Separate video input

REMOTE CONTROLS (Customer Acces

BRIGHTNESS: 100k Ohm potentiome
1/2 Watt m

NOTE: Internal brightness control w
function as a range control wh
external brightness control is us

CONTRAST: 250 Ohm Potentiomet
1/4 Watt mi
(with remote contrast optio

FOCUS: 5M Ohm Potentiometer
1/2 Watt min. 1k
(with remote focus option)

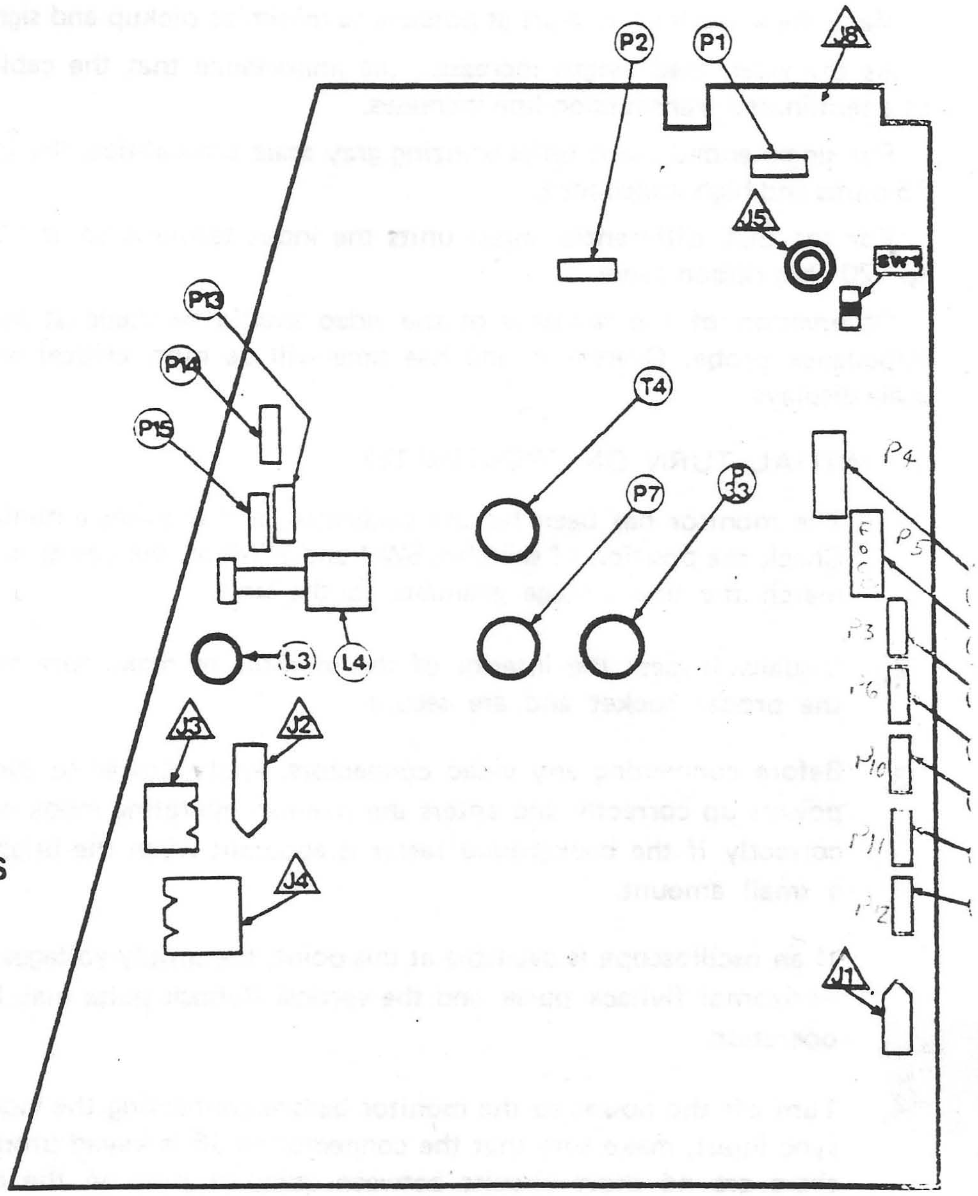


Fig. 2 CONNECTOR AND CONTROL LOCATIONS

SECTION 2

OPERATING PROCEDURES

INSTALLATION

Power for the M series monitors is supplied in one of two ways, depending on the model. The model with built-in low voltage supply is powered directly from 120 VAC (100/220/240 VAC switch selectable). Units without a built-in low voltage supply are supplied from an external unregulated DC supply. See section one for connector assignments.

Video and sync signals are fed to the appropriate pin as in section one connector description. Mount the monitor so that the ambient temperature surrounding the monitor does not exceed 55^0c.

2.2 GROUNDING TECHNIQUES

Arc bypasses are returned to ground at the origin of the driving signals. In turn, all grounds are connected to the monitor chassis. Normally, it is assumed that the chassis of the monitor will be connected to the system ground via the mounting. If this is true, no further grounding should be required. However, ground pins are provided in the I/O connector and should be connected to the driving source to maintain proper impedances and minimize cross talk in the cable.

Due to the high frequency video supplied to the monitor, care should be exercised in the routing and the shielding of the I/O cable.

2.3 VIDEO LEAD

Make the video lead as short as possible to minimize pickup and signal distortion.

As the video lead length increases, the importance that the cable be made to meet the requirements of a terminated transmission line increases.

For single ended input units utilizing gray scale capabilities, the input termination is switched between 75 ohms and high impedance.

For the ECL differential input units the input termination is 112 ohms. This provides a close match to 120 ohm ribbon cable.

Observation of the response of the video should be made at the monitor with a low capacity, high impedance probe. Overshoot and rise time will be most critical with the single ended input with gray scale displays.

2.4 INITIAL TURN ON PROCEDURES

1. The monitor has been factory calibrated, and requires a minimum of adjustment after installation. Check the position of switches SW-1 and SW-2 on the power supply to ensure that the switch settings match the line voltage available to the unit.

2. Visually inspect the interior of the monitor to make sure that ALL connectors are plugged into the proper socket and are secure.

3. Before connecting any video connectors, apply power to the monitor, making sure that monitor powers up correctly and enters the free-run operating mode with no problems. The unit is operating correctly if the background raster is apparant when the brightness pot, P3, is turned clockwise by a small amount.

   If an oscilloscope is available at this point, the supply voltages (+48V, +HV, +5V, -5V, and +6V), the horizontal flyback pulse, and the vertical flyback pulse may be monitored briefly to verify correct operation.

4. Turn off the power to the monitor before connecting the video input. If the monitor has a separate sync input, make sure that the connector to J8 is keyed properly (pin 3), and is inserted such that there are no short circuits between adjacent pins on the edge connector.

5. Check the position of SW-1 on the main PC board to insure that the proper video termination is selected.

Apply the video signal to the unit, and then apply power to the unit.

Allow approximately 15 minutes to warm-up.

Adjust the video bias to the DC level specified by the unit specification using the bias pot, P2.

Adjust the video gain to the range specified by the unit specifications using the gain pot, P1.

Center the picture within the screen by adjusting the horizontal delay pot, P6.

Adjust the brightness of the image to the desired level by adjusting the brightness pot, P3. (If an external brightness control is being used, adjust the internal control to provide the desired range on the external control).

SECTION 3
THEORY OF OPERATION

VIDEO AMPLIFIER

The video amplifier consists of an input buffer, a differential input transistor pre-amplifier, and a high voltage cascode output stage.

The input buffer consists of transistors Q4 and Q15 acting as emitter followers to provide a high input impedance to give isolation and minimize loading of the drive signal. The output from the emitter of Q15 is AC coupled to the pre-amplifier through capacitors C1 and C2. Gain control is provided by P1 which can be adjusted to give a 5 to 1 attenuation. The diode CR5 acts as a clamp to provide DC restoration to maintain the black level.

The pre-amplifier is a differential amplifier comprised of Q1 and Q3. The base of Q3 is connected to a reference voltage which is set by P2. Transistor Q1 drives the base of Q2, and the collector of Q2 provides the output of the pre-amplifier. The peramp has a nominal gain of 3, which is controlled by R5 and R6. Resistor R6 sets the basic gain of the preamp. Resistor R5 provides feedback to the emitter of the output stage for stability and gain control. R12 and C3 provide high frequency compensation for the preamp. If any additional compensation is needed, C26 is added. Diode CR1 gives base protection to Q1. Resistor R11 acts as the load resistance to the circuit.

Transistors Q7 and Q8 form the differential amplifier which is the driver for the output stage. In the output stage, the output signal from the preamp is applied to the base of Q7. Transistor Q8 provides bias reference and temperature compensation. The gain is set by R22 and R23. Capacitor C10 couples resistor R21 with R22 and R23, to provide high frequency boost gain. Transistor Q7 operates in the linear mode with a minimum quiescent current of approximately 30 ma. The collector of Q7 drives the emitter of Q6 which is connected as a grounded base with its base biased at +5 volts. The 30 ma. quiescent current of Q7 keeps Q6 from being completely turned off, thus holding its collector voltage at approximately 40 volts.

The bias control, P2 is used to adjust the quiescent operating point of the Q6 collector. With the input a positive video signal, the Q7 collector current will rise, thus lowering the video output voltage. This will cause the screen to display a white signal. Note that too high a video signal will cause Q6 to saturate and the resulting excessive turn-off times will result in smearing of the white to black transitions.

Current through inductor L5 provides boost or peaking voltage. The diode CR4 clamps to 48 volts to protect Q6 from arcs. Resistor R17 and the 48 ohm resistor provide current limiting against arc transients. Component AG1 is a neon arc gap, which fires at 70 to 75 volts, providing voltage protection against arc transients.

3.2 HORIZONTAL DEFLECTION

Pin 12 of one shot Z1, and Pin 13 of one shot Z2 are outputs of the two sections of the horizontal oscillator. In the absence of the horizontal sync input, this oscillator will free-run at a nominal frequency which is approximately 10 percent faster than the locked-in frequency. When horizontal sync signal is presented to pin 2 of Z1, the oscillator locks into synchronization with the input signal with a phase difference that is determined by the setting of P6. Adjustments on P6 determine the horizontal delay

Pin 5 of Z2 is the output pin of the drive section of the oscillator. The pulse width of this section is set to provide a duty cycle of approximately 40 percent at the locked-in frequency.

Transistor Q10 is an emitter follower buffer which supplies sufficient current gain to drive Q11. Transistor Q11 is an inverter. When the voltage from pin 5 of Z2 rises, Q10 turns on, supplying current to Q11 which also turns on, pulling current through the primary of transformer T3. Since the primary of T3 acts as an inductor, no current flows initially, and thus the voltage at the collector of Q11 is pulled down. This accomplished four objectives:

1.) Energy is stored in T3
(This energy will be used to turn Q12 on during the second half of the cycle.)
2.) The base of Q12 is driven negative, turning Q12 off quickly.
3.) A positive pulse is driven through diode CR23 charging capacitor C53 giving raw 10 volts.
4.) Current flows through CR24 which charges C51 to produce minus 5 voltage supply.
(CR24 is also used to protect the base against overshoot.)

Diode CR25 is present to provide a low impedance path during turn-off to drive the base of Q12 harder. Inductor LI is a high frequency filter for the minus 5 volt supply.

When the voltage from pin 5 of Z2 drops, Q10 turns off, which causes Q11 to turn off. The inductive energy present in T3 swings the collector of Q11 positive to approximately 90 volts. Diodes CR21, and CR22 provide over-voltage protection to Q11 by clamping at 100 volts, via a zener drop through CR21 to 48 volts. In normal operation, the collector of Q11 will never reach 100 volts.

This voltage rise causes the base of Q12 to be driven positive at a 1:8 voltage ratio. The amount of base current is determined by R61. (Base current is approximately 0.4 amps when Q12 is an MJ10009, and is approximately 0.2 amps when Q12 is an SVT6253.)

Capacitors C46, 47, and 48 provide AC decoupling. R89 and C49 form an AC snubber, which prevents voltage at the collector of Q11 from rising instantaneously. This provides noise reduction and reduces dissipation in Q11. Resistor R61 provides current limitation during start up.

3.3 HORIZONTAL OUTPUT

Shortly before the end of the sweep, while the beam is at the right hand side of the screen, Q12 is still turned on, effectively shorting C64 and C65. At this time the currents from the flyback transformer T2, the yoke L2, the width coil, L3, and the linearity coil L4, are flowing into the collector of Q12. When horizontal sync arrives and Q12 turns off, current continues to flow through T2, L2, L3, and L4 due to the energy stored by the inductance of these components. This current charges up capacitors C64 and C65, which are no longer shorted out by Q12. Thus the voltage across capacitors C64 and C65, rises until the energy in T2, L2, L3, and L4 is depleted. At this point, the current through the inductors is zero and the voltage across C64 and C65 is at a maximum (approximately 450 volts), the middle of the flyback has been reached and the beam is in the center of the screen.

Once the energy in the coils has been discharged into the capacitors, the current reverses, and begins flowing from the capacitors back into the coils. This process constitutes the second half of the flyback operation. Current continues to flow back into T2, L2, L3, and L4 from the capacitor until the voltage across the capacitor reaches zero. At this point, current flow into the windings is at a maximum, and the beam is at the left of the screen.

The current continues to flow in the reverse direction, through the yoke and the transformer and would tend to charge C64 and C65 in the reverse direction. This is prevented by the damping diode which is internal to Q12. These voltage and current waveforms are exhibited in figure 3.

The desired waveform for the current through the yoke is an "s" shaped curve as shown in figure 3. This is primarily because the beam must travel slower at the edges of the screen than it does in the center. This waveform is approximated by the natural resonance of the tuned circuit that is formed by the yoke, L2, and the capacitor, C62. Due to the resistances inherant in these devices, these oscillations decay at an exponential rate. Because of this, the beginning of the sweep has more amplitude than the end of the sweep causing the left side of the screen to be too wide. This effect is compensated by the linearity coil which as an inductance which is inversely proportional to current. This decrease in inductance with increasing current compensates for the resistive loss and linearizes the sweep.

The width coil, L3, is a variable inductor which varies the amount of current through the yoke, thus adjusting width. The RC network composed of R63 and C61, provides damping to eliminate oscillations at the end of the flyback pulse.

Capacitor C62 is present for two reasons. First, it adds to the "s" shaped component of the current waveform of the yoke. Second, its voltage waveform is the integral of the current waveform, thus giving the parabolic waveform used for dynamic horizontal focus.

3.4 FLYBACK OUTPUTS

Pin 1 = G2 voltage = 1kv during flyback
CR11 and C34 rectifies and filters the raw G2 voltage.

Pin 4 = -150 V pulse during flyback
This is rectified and filtered by CR12 and C35. Resistor R43 provides current limitation to protect CR12.

The second anode provides 17 kv to the CRT. 17 kv.

The raw G2 voltage is fed to P4, which adjusts the G2 voltage to approximately 750 volts.

P3 sets the brightness operating point of the external brightness pot on J8.
Resistors R40 and R41 control the net range of the external brightness control.
Capacitors C30, C32, and C33 are arc capacitors to control transients.

3.5 VERTICAL DEFLECTION

Vertical sweep is generated by a free running oscillator consisting of a programmable unijunction transistor and its associated circuitry. The three resistors, R79, R82, and R83, determine the switching threshold of the unijunction transistor, Q21. Transistor Q20 operates as a switch which adds R79 to the circuit when the vertical sync pulse arrives to change the switching threshold of the unijunction.

This oscillator free runs at a slightly lower frequency than the lock-in frequency. This free run frequency is primarily determined by the RC network formed by R84 and C72 and C74 in combination with the switching threshold of the unijunction Q21.

Vertical size is adjusted by P10 which adjusts the supply voltage to the unijuntion. Transistor Q22 acts as a buffer to drive Q23 without loading Q21.

Feedback networks, R87, P12, and R86, P11, C73 modify the ramp waveform which is the normal output of the oscillator into an "s" shaped curve for vertical linearity.

Transformer T1 provides DC isolation, impedance matching and curve shaping to drive the vertical deflection yoke.

R93 and P33 provide DC bias current through the yoke for vertical centering. Resistor R90 provides damping on the yoke at the end of retrace. The capacitor C76 integrates the current to give the voltage parabolla waveform needed for dynamic vertical focusing.

During retrace, current continues to flow through T1 causing the voltage to rise. C42 and C43 clamps this voltage at 150 volts above the horizontal clamp of 100V (i.e. Vertical is clamped at 25V). This large positive voltage pulse reverses the current in the yoke and moves the beam from the bottom to the top of the screen.

3.6 CRT PROTECTION CIRCUIT

In the event of a failure in the horizontal or vertical deflection electonics, the brightness voltage to the CRT is switched to -150 volts (black level) to prevent phospher burns on the CRT, face plate. This protection is accomplished in the following manner:

Transistor Q25 supplies +48 volts to the top end of the brightness potentiometer. When Q25 is turned off the brightness voltage drops to -150 volts, and the CRT screen becomes black.

In normal operation both the horizontal parabolic waveform and the vertical parabolic waveform are present. The vertical parabolic waveform is presented to the base of transistor Q26, causing this transistor to shut off once each vertical cycle. This allows the horizontal parabola from C62 to activate transistor Q24. Capacitor C68 is thus discharged each cycle, and transistor Q25 remains turned on.

In the event of a failure in the horizontal drive circuitry, the horizontal parabola will not be present at the base of Q24 to turn it on. This allows capacitor C68 to charge up, shutting off transistor Q25, and preventing damage to the CRT.

If the failure is in the vertical drive circuit, the vertical parabola will not be generated. In the situation, capacitor C91 will charge up, causing transistor Q26 to saturate, which shorts out the base of Q24. Thus Q24 remains off, capacitor C68 charges up, transistor Q25 shuts off, and the +48 volt supply to the CRT is shut off.

3.7 STANDARD DYNAMIC FOCUS

The vertical focus parabola from C76 is supplied to the emitter of Q32 through P15 which acts as an attenuator. C98, and R122 provide DC biasing.

The horizontal parabola from C62 is supplied to the base of Q32 through P14 which acts as an attenuator. R117 and C69 provide DC biasing.

The collector of Q32 supplies the amplified sum of the horizontal and vertical parabolas. This is fed into the focus grid through C103 which provides AC coupling. Resistors R44 and R66 provide current limiting for Q32 from the focus grid and the focus wiper respectively. The zener diodes CR36 and CR37, limit the maximum voltage at the collector of Q32 to 360 volts. The diode, CR29, and capacitor, C66, rectify the peak voltage from the flyback pulse to produce approximately 450 volts for the supply voltage needed by the dynamic focus amplifier. The dynamic focus is AC coupled to P5 and therefore rests at the DC focus voltage.

The normal adjustment procedure is to:

1.) Turn P14, P15, and P5 off.
2.) Adjust P5 until the center of the screen is in focus.
3.) Adjust P14 until the top of the screen is in focus.
4.) Adjust P15 until the left side of the screen is in focus.

3.8 LOW VOLTAGE REGULATED SUPPLY

The on-board power supply converts a raw DC voltage which varies between 60 volts and 70 volts to a regulated supply of 48 volts, and a regulated High Voltage supply which is also set to 48 volts.

Transistor Q30 provides preregulation at a nominal voltage of 56 volts. This level is set by CR50. The biasing of Q30 is provided by R100 and CR50. The diode CR49 protects the base of Q30 during the power down cycle. Capacitor C81 provides a soft power on.

Regulators, Z3 and Z4, regulate the +48 volt output and the High Voltage output respectively. The output voltage of Z3 is set by the voltage dividers R102 and R101. The output voltage of Z4 is set by the voltage dividers R104 and R103. The two diodes, CR51 and CR52, limit the voltage across Z3 and Z4 to 39 volts for protection during short circuits.

The High Voltage power supply has a crowbar circuit to comply with HEW regulations. The High Voltage supply is monitored by the diode CR53. When the HV supply rises above 52 volts, the voltage across the gate of the silicon controlled rectifier, CR54, causes that device to trigger. The triggering of CR54 crowbars the power supply off.

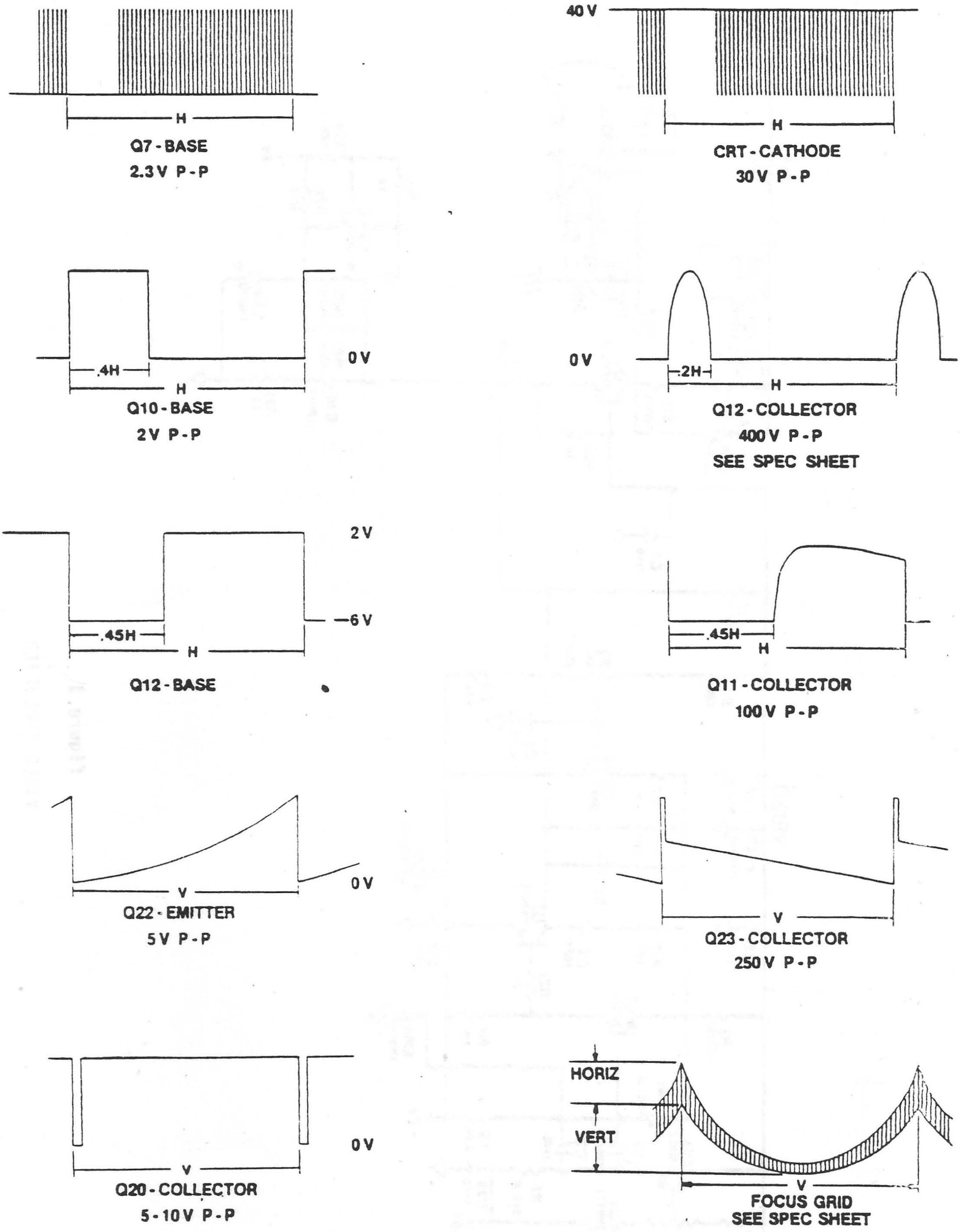


FIG. 3 VOLTAGE WAVEFORMS

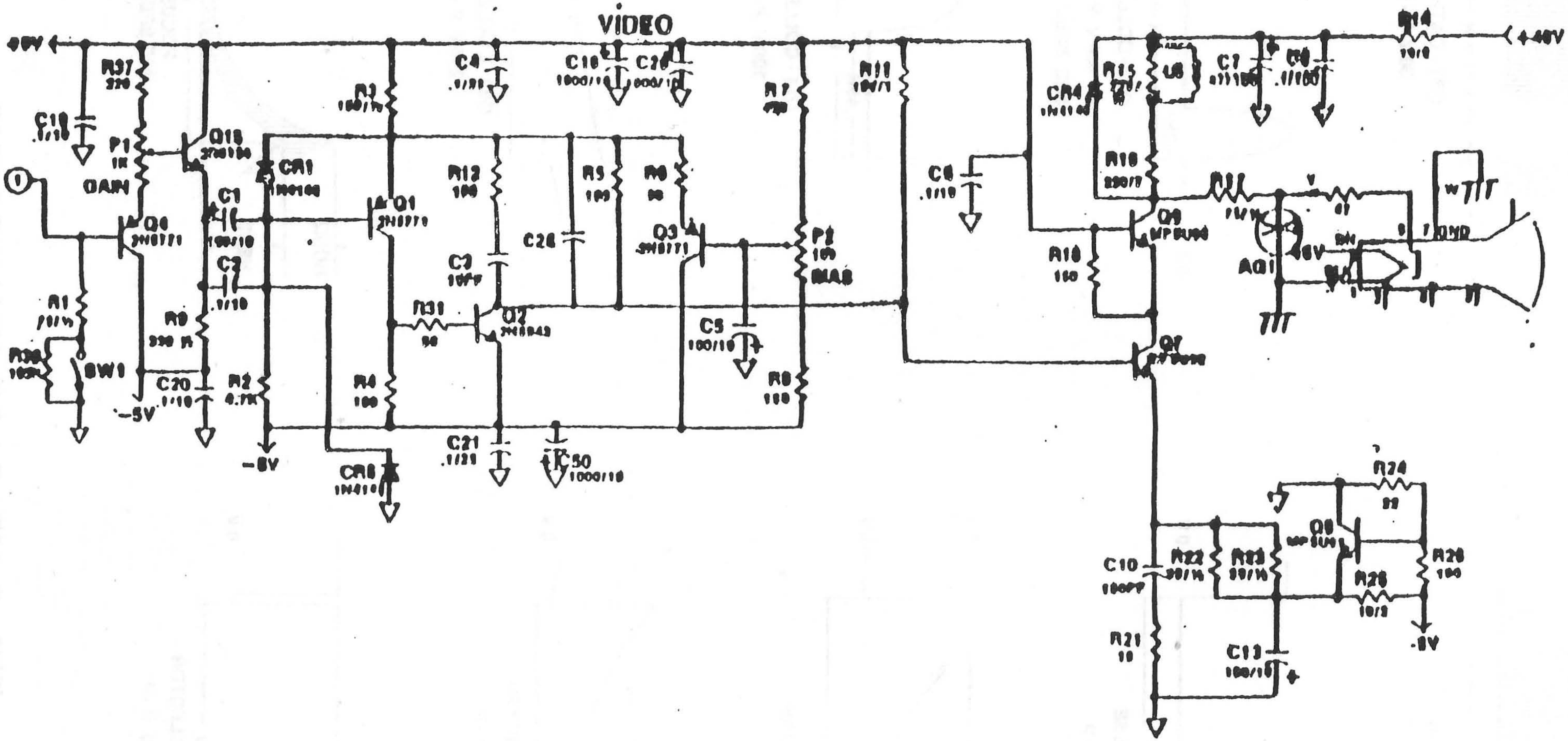


Figure 1

VIDEO AMPLIFIER

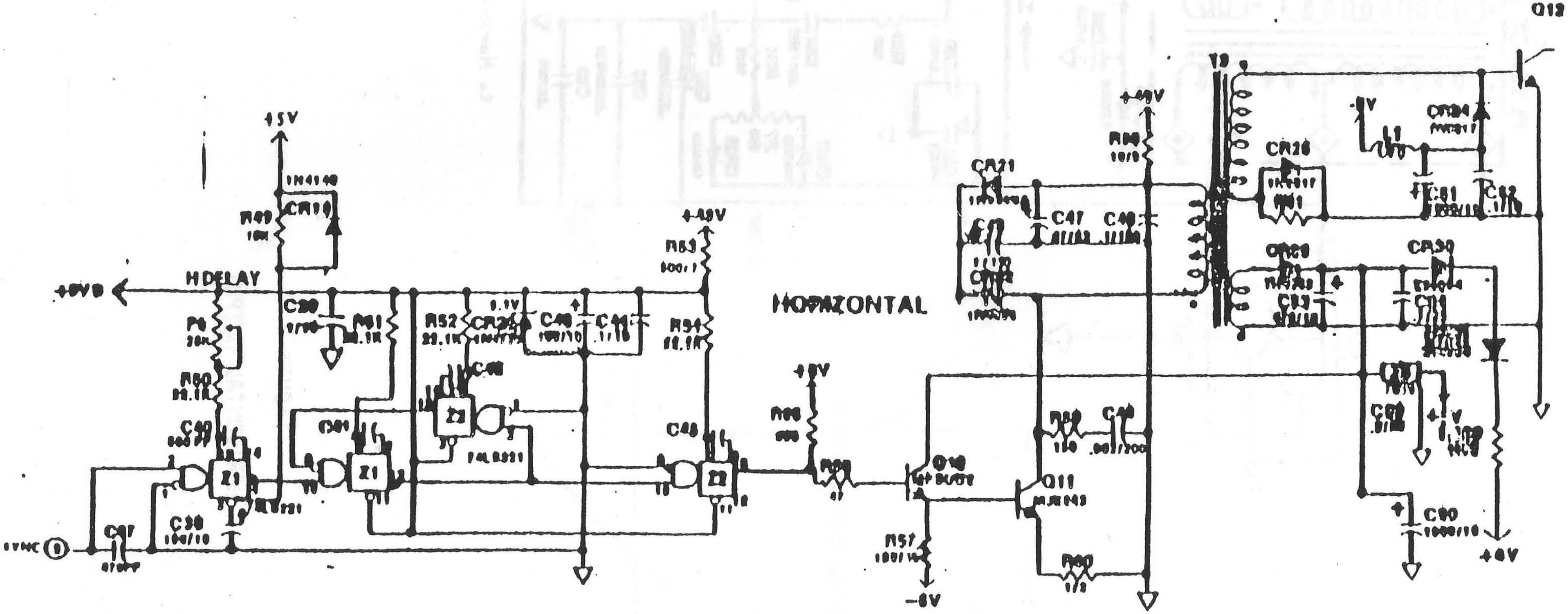


Figure 2

HORIZONTAL DEFLECTION

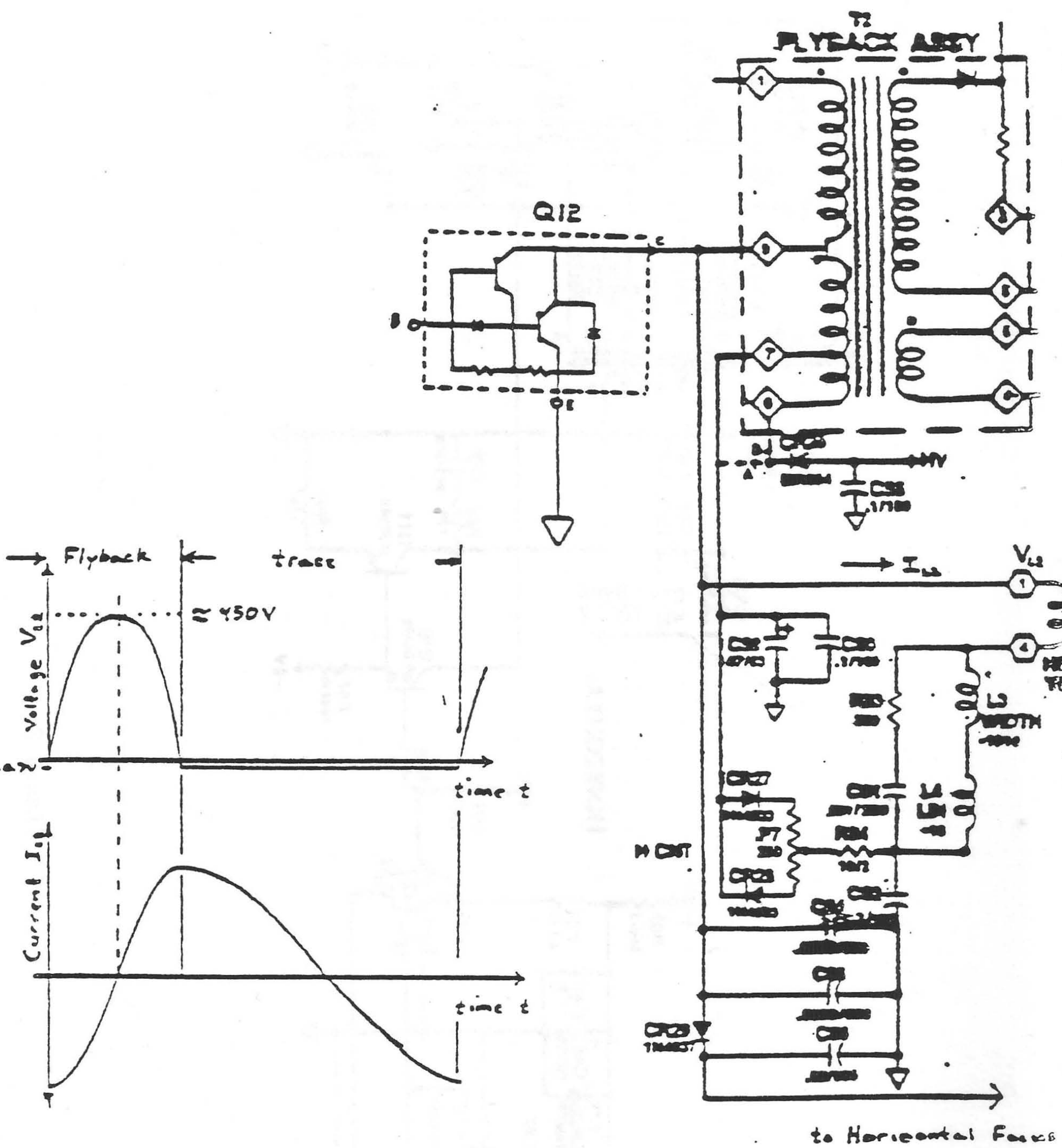


figure 3

HORIZONTAL OUTPUT

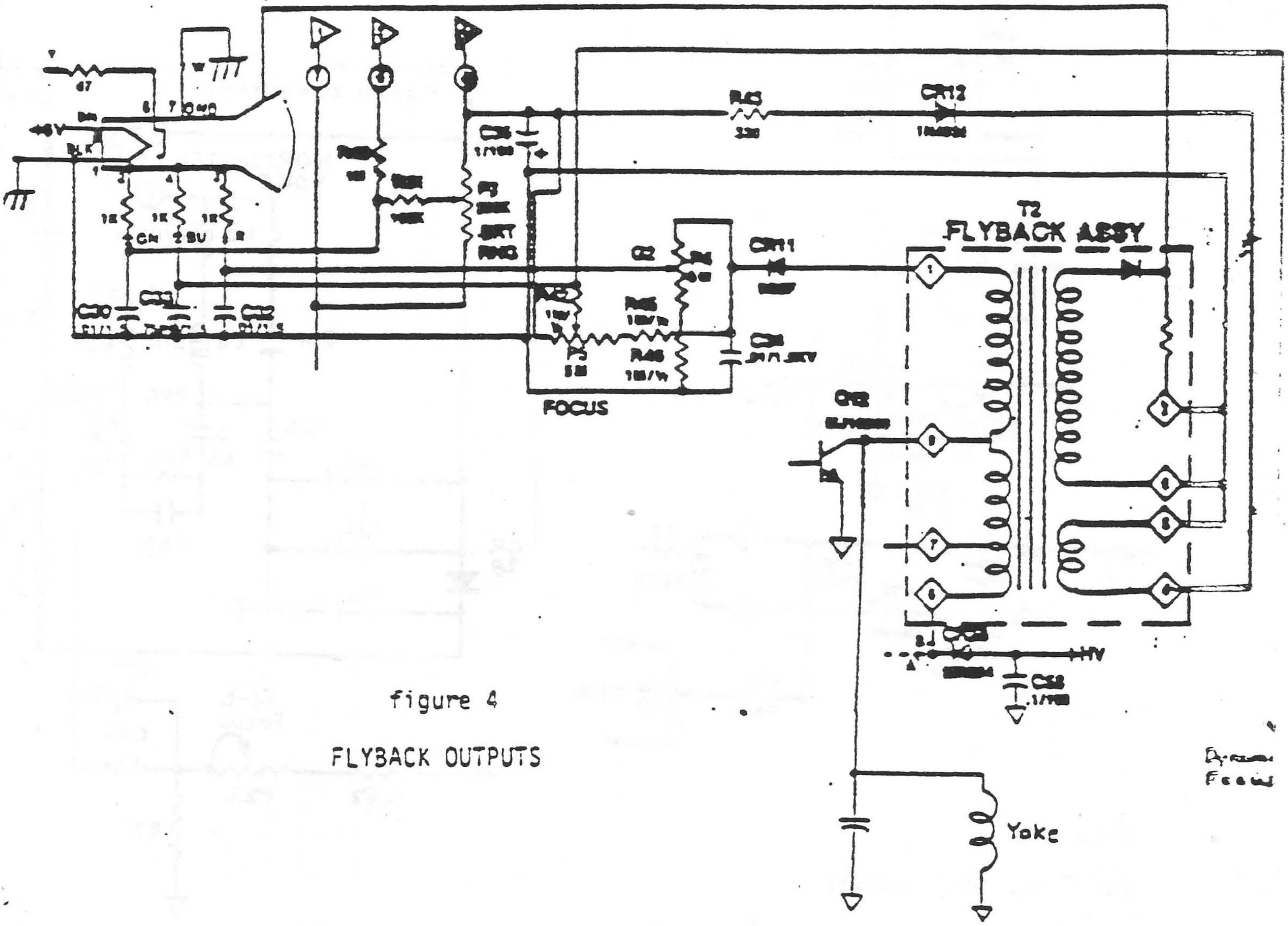


figure 4

FLYBACK OUTPUTS

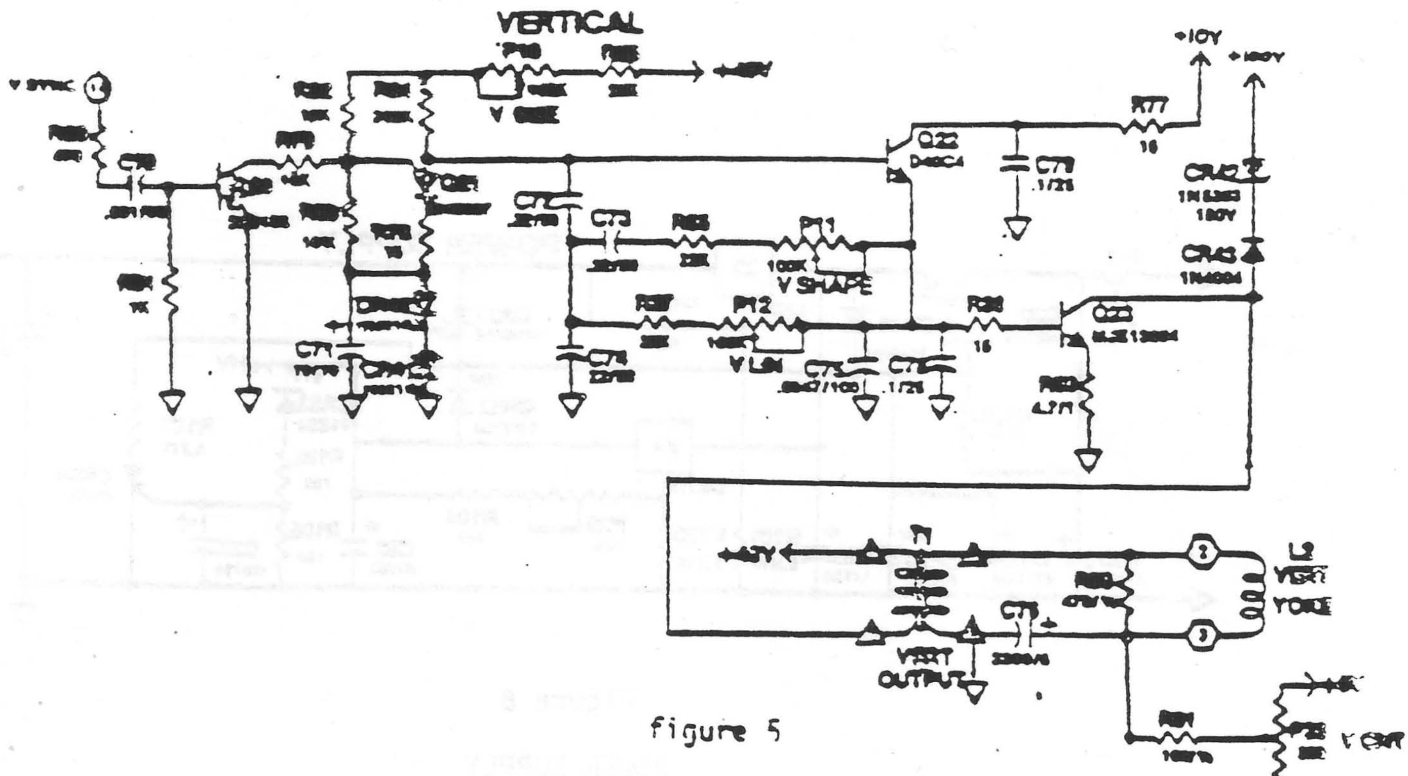


figure 5

VERTICAL DEFLECTION

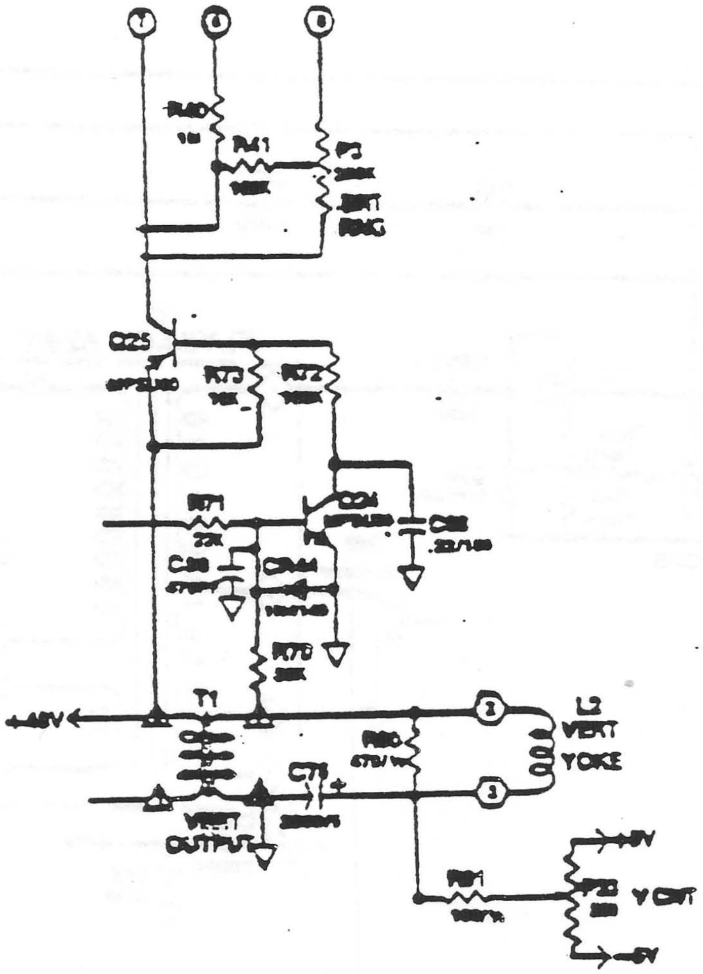


Figure 6

VERTICAL SHUT DOWN

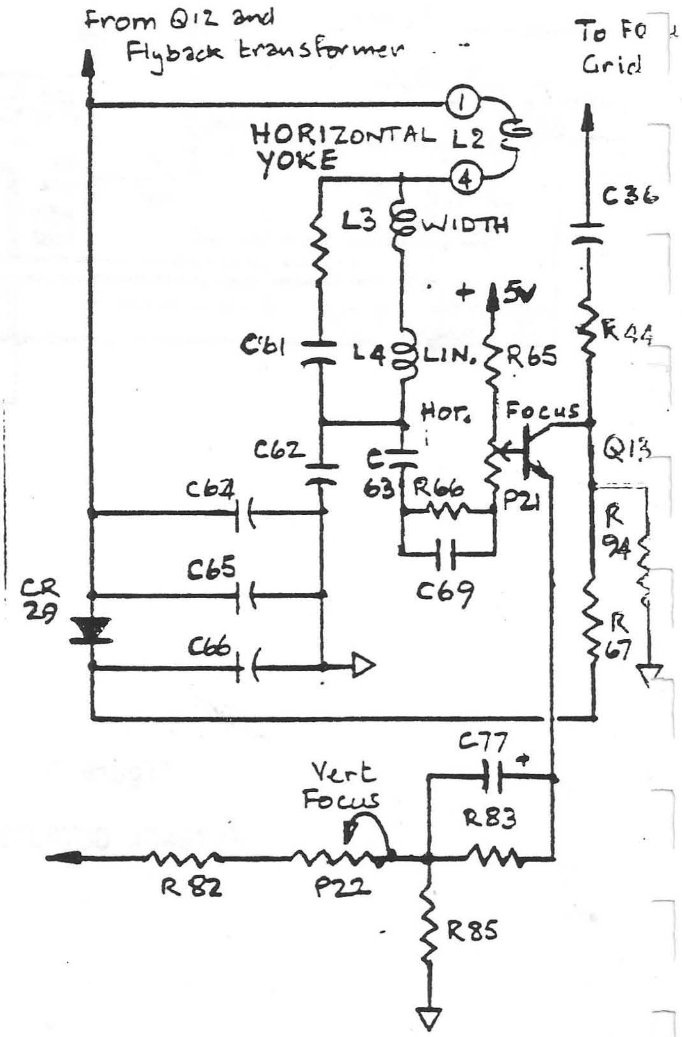


Figure 7. DYNAMIC FOCUS

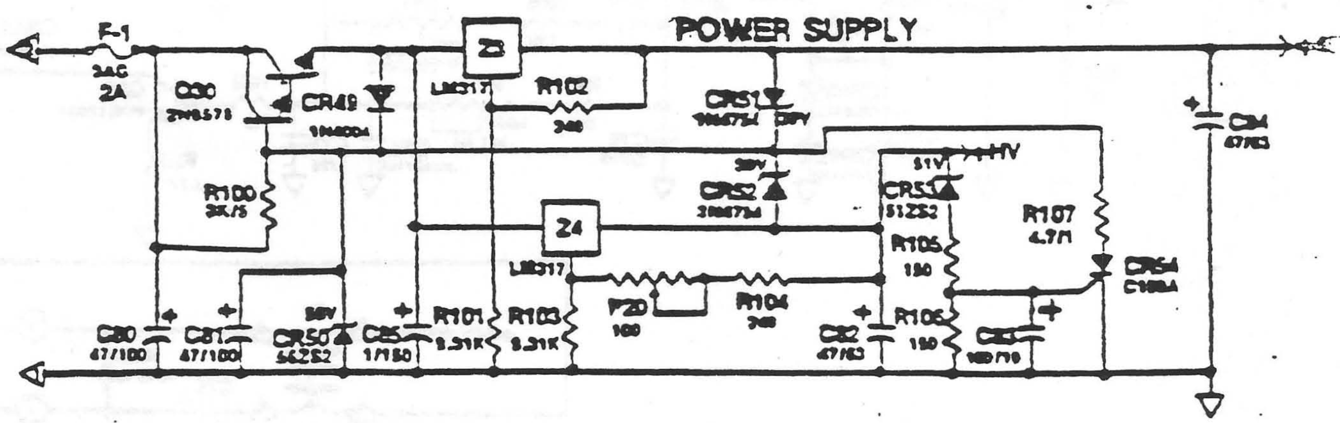
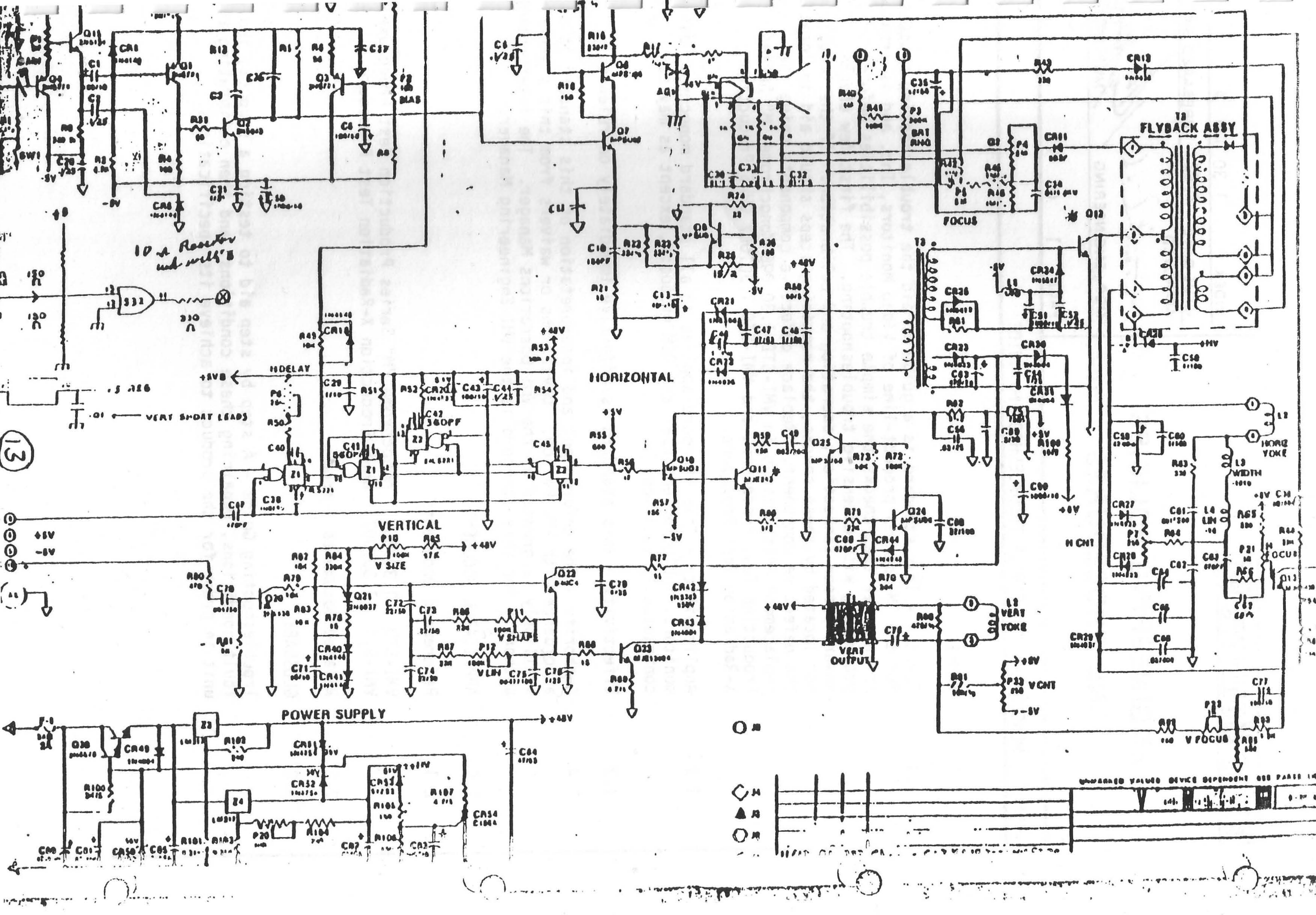


Figure 8

POWER SUPPLY



FLYBACK ASSY
FOCUS
HORIZONTAL
H DELAY
VERT SHORT LEADS
VERTICAL
V SIZE
V SHAPE
V LIN
VERT OUTPUT
VERT YOKE
HORZ YOKE
WIDTH
LIN
H CNT
V CNT
V FOCUS
BIAS
BRT RNG
POWER SUPPLY
+48V
+5V
-5V
+HV
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Video Monitors inc

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ENGINEERING POLICIES AND PROCEDURES

Subject MONOCHROME "M" SERIES TROUBLESHOOTING GUIDE

1.0 SCOPE

1.1 Purpose - This standard is a guide to aid the troubleshooting process for the "M" series product-line of Video Monitors, Inc. and is arranc in an order that checks the simple trouble possibilities before proceeding with extensive troubleshooting. The first few checks ensure proper connection, operation and calibration. If the trouble not located by these checks, the remaining steps should aid in locati the defective component. Replace defective components using the replacement instructions in VMI-STD 1.30.006 Monochrome "M" Series Production Test Procedure, and VMI-STD 1.30.007 DHHS Production X-Radiation Test Procedure.

1.2 Applicability - This standard applies to all standard monochrome disp monitors, including end-user and OEM products, except as may be contractually modified.

1.3 Effectivity - This standard is effective immediately on release.

1.4 Authority - The enforcement and interpretation of this standard is in accordance with VMI Policy. Deviations or waivers from this standard shall only be granted by the VMI Operations Manager. The interpreting authority for this standard is the VMI Engineering Manager.

2.0 APPLICABLE DOCUMENTS

2.1 Referenced Documents

VMI-STD 1.30.006 Monochrome "M" Series Production Test Procedure
VMI-STD 1.30.007 DHHS Production X-Radiation Test Procedure

2.2 Related Documents - None

3.0 GLOSSARY

Troubleshooting Guide - A step by step aid to testing a product, isol fault conditions, repairing these conditions, and then calibrating th unit in order for the product to achieve its specifications.

4.0 REQUIREMENTS

4.1 Troubleshooting Techniques

4.1.1 Check Monitor Specifications

4.1.1.1 Incorrect monitor specifications can indicate a trouble that does not exist. If there is any question about the correct function or operation of any monitor, see the Design Engineering Department.

4.1.2 Check Associated Equipment

4.1.2.1 Before proceeding with troubleshooting, check that the equipment used with this monitor is operating correctly. Check that the signal is properly connected and that the interconnecting cables are not defective. Also, check the power source.

4.1.3 Check the calibration of this monitor, or the affected circuit if the trouble exists in one circuit. The apparent trouble may only be misadjustment that can be corrected by calibration. Complete calibration instructions are given in VMI-STD 1.30.006 Monochrome "M" Series Production Test Procedure.

4.1.4 Visual Check

4.1.4.1 Visually check the portion of the monitor in which the trouble is located. Many troubles can be located by visual indications such as unsoldered connections, broken wires, damaged circuit boards, and damaged components.

4.1.5 Isolate Trouble to a Circuit

4.1.5.1 Isolate trouble to a particular circuit. The symptom often identifies the defective circuit. Trouble appearing in more than one circuit can indicate possible power supply problems.

4.1.6 Check Circuit Board Interconnections

4.1.6.1 After the trouble has been isolated to a particular circuit, check for loose or broken connections, improperly installed and/or heat damaged components.

4.1.7 Check Voltages and Waveforms

4.1.7.1 Often the defective component can be located by checking for the correct voltage or waveform in the circuit. Typical voltages and waveforms are diagrammed in VMI-STD 1.30.006 Monochrome "M" Series Production Test Procedure.

4.2 Specific Symptoms and Remedies

4.2.1 Symptom - Presence of background raster but absence of video image- This symptom indicates that the failure is in the video portion. The presence of background raster indicates that the rest of the drive circuitry is functional. Note: Video measurements should be made by probes with short ground return leads.

4.2.1.1 Possible Problem: Video amplifier is not biased correctly.

1. Remedy: Monitor collector of Q6 with oscilloscope probe (scale = 10 v/div@ 5 ms/div). Adjust bias control pot, P2, until video signal reaches 40 volts peak (50 volts, for units with 10 volt boost). Adjust gain control pot, P1, until video signal range is 30 volts peak-to-peak (40 volts peak to peak for units with 10 volt video boost).
2. Remedy: If output of Q6 is correct, troubleshoot the tube socket and tube.

4.2.1.2 Possible Problem: +5 volt supply not functioning (check J8-Pin 4)

1. Remedy: Troubleshoot the raw +10 volt supply at input of +5 volt regulator Z5.
2. Remedy: Examine +5 volt supply line for short circuits or poor solder joints. Note: +5 volt supply will indicate a 0 volt reading due to current limiting action if a short is present on the supply line.
3. Remedy: Replace +5 volt regulator Z5.
4. Remedy: Replace any active or passive component along the supply line that seems suspect.

4.2.1.3 Possible Problem: -5 volt supply not functioning (check J8-Pin 5).

1. Remedy: Troubleshoot -5 supply line as in section 4.2.1.2.

4.2.1.4 Possible Problem: Incorrect video input. The input video voltage ran should be 0.7 volts minimum and 2.5 volts maximum.

1. Remedy: Check the video termination switch. The impedance at the input of the last unit should match the impedance of the cable
2. Remedy: Check out video generator.
3. Remedy: Check R1 and R36 for proper value.

4.2.1.5 Possible Problem: Non functional input buffer - This buffer is a non-inverting emitter follower buffer composed of Q4 and Q15 with a gain adjustment provided by P1. When properly adjusted, the video range at the emitter of Q15 should be 0.7 volts.

1. Remedy: Check for shorts, opens, and poor solder connections visu
2. Remedy: Check values of all passive components.
3. Remedy: Troubleshoot Q4 and Q15.

4.2.1.6 (cont'd)
Possible Problem: Non-functional preamplifier - The preamplifier is composed of Q1, Q2, and Q3 with a bias adjustment provided by bias pot, P2. The collector of Q2 should have a waveform similar to the input, amplified about 25x.

1. Remedy: Check for shorts, opens, solder voids, etc. Measure passive resistors. Troubleshoot Q1, Q2, and Q3. NOTE: Voltage measurements should be taken with no input signal and by varying the bias pot.

4.2.1.7 Possible Problem: Nonfunctional output stage - The output stage is a differential amplifier comprised of Q7 and Q8, with an output transistor, Q5 and a total gain of 16. (The gain is 24 for units with the 10 volt boost video option).

1. Remedy: Make sure supply voltage (+48V for standard units, +58V for units with 10 volt boost) is present at one end of R15. Make sure that there is continuity between this supply voltage and the collector of Q6. (Possible 216 ohms or 432 ohms).
2. Remedy: Troubleshoot, Q6, Q7, Q8, CR4, and other suspect components.

4.2.2 Symptom - Absence of background raster - This failure mode causes the screen to become dark. Verification of this failure mode can be made by turning the brightness pot, P3, clockwise until background raster can be observed. If the potentiometer hits the stop before raster appears, this failure mode is evident.

4.2.2.1 Possible Problem: +48V supply or +HV supply not functioning - The outputs of both Z3 and Z4 should be +48VDC.

1. Remedy: Check fuses - 2 amp fuse of PC board and 1.5 amp fuse in Power Supply.
2. Remedy: Make sure unit is not in crowbar condition (Power down unit, short across CR54 temporarily, power unit back up, and check for correct video image).
3. Remedy: Check input to Q30 to insure that 60 VDC is present. If not, troubleshoot the off-board power supply.
4. Remedy: Check the output of Q30 (voltage level should be approx. 56 volts). An incorrect level at this point indicates a failure in one of the following components: CR50, Q30, CR51, CR52, CR49, R100, Z3, or Z4.
5. Remedy: Check the output of Z3 (voltage level should be approx. 48 VDC). An incorrect level at this point indicates a possible failure in one of the following components: Z3, R102, or R101. A resistance of less than 1K ohm at the output of Z3 indicates a loading of the supply. Check Q11 and Q23 and other +48 V inputs.
6. Remedy: Check the output of Z4 (approx. 48 VDC). An incorrect level at this point indicates a failure in one of the following components: Z4, R103, R104, Q12, CR26, CR54, horizontal centering circuit, or the flyback transformer. NOTE: Disconnect flyback and recheck.

4.2.2.2 (cont'd)
Possible Problem: Missing horizontal deflection - This problem is evidenced by the absence of the horizontal flyback pulse at the collector of Q12.

1. Remedy: Check Z2 pin 5 for presence of horizontal oscillator puls[e]. Pulses should have standard TTL signal levels and occur at the horizontal scan rate with a duty cycle of 28-36%. Absence of pulse indicates a failure in Z1, Z2, or drive 5V supply.
2. Remedy: Check collector Q11 for proper output (see waveform guide at the back of the Operating Manual). In absence of correct signal troubleshoot Q11, Q10, 100V supply, +5V and -5V lines.
3. Remedy: Check collector Q12 for correct output. Possible failure include: Flyback, Q12, CR25, CR24, and poor connections.

4.2.2.3 Possible Problem: Absence of vertical deflection - The absence of vertical deflection will cause the unit to enter the vertical shutdown mode, which has the effect of turning the screen dark. If the vertical deflection waveform is absent from the collector of Q23, this problem exists. (See waveform guide in Operating Manual).

1. Remedy: Check the output of Q21 for a ramp waveform. If it is not present, troubleshoot the vertical oscillator circuit. NOTE: isol[ate] circuit by removing Q22.
2. Remedy: Check for Raw +10 volt supply at the collector of Q22.
3. Remedy: Troubleshoot Q23, Q22, CR43, CR42, and R89.
4. Remedy: Check for open circuits across T1, and in the vertical yo[ke].

4.2.2.4 Possible Problem: Absence of +6 volt heater supply

1. Remedy: Check continuity of tube socket, R109, CR31, and CR30.
2. Remedy: Check +10 volt raw supply at input of Z6, CR14 and L7.

4.2.2.5 Possible Problem: Failure in vertical shutdown circuit.

1. Remedy: Check for presence of +48 volts at collector of Q25. If voltage is incorrect, troubleshoot Q23, Q24, and Q25.

4.2.2.6 Possible Problem: Absence of G2 supply voltage. NOTE: Use of high voltage probe required.

1. Remedy: Check pin 1 of flyback connector for unfiltered G2 supply voltage (1.2 KV peak). Absence of this voltage indicates flyback failure. NOTE: Use caution and a X100 scope probe.
2. Remedy: Check for G2 supply voltage at red lead on PCB. Troubleshoot CR11, P4, C34, and tube socket continuity.

4.2.2.7 Possible Problem: Absence of 17KV supply voltage. NOTE: Use of high voltage probe required.

1. Remedy: Check second anode from flyback for proper supply voltage by inserting tip of high voltage probe between the rubber cap of th[e] anode lead and the CRT (See unit specification for value of correc[t] voltage). Incorrect value is indicative of flyback failure. If shield is used, connect VMI second anode probe. CAUTION: VERY HIGH VOLTAGE.

.2.2.8 (cont'd)
Possible Problem: Bent pins on the CRT.

1. Remedy: Straighten all pins on the CRT.

4.2.3 Symptom - Poor Focus

4.2.3.1 Possible Problem: Misadjusted focus pots.

1. Remedy: Follow adjustment procedure in VMI-STD 1.30.006 Monochrome "M" Series Production Test Procedure to readjust focus.

4.2.3.2 Possible Problem: Failure in focus circuit.

1. Remedy: Check DC focus range of pot P5 (should be -150V to +800V range).
2. Remedy: Check for presence of horizontal focus parabola at base of Q32.
3. Remedy: Check for presence of vertical focus parabola at the emitter of Q32.
4. Remedy: Replace Q32.

4.2.4 Symptom - Insufficient, varying or excessive brightness.

4.2.4.1 Possible Problem: Poorly adjusted video bias and gain.

1. Remedy: See section 4.2.1.1.

4.2.4.2 Possible Problem: Incorrect brightness supply voltage.

1. Remedy: Check collector of Q25 (should be approximately 48VDC). If value is incorrect, see section 2.1 and 2.5 for correction.
2. Remedy: Check adjustability of pot P3.
3. Remedy: Check tube socket continuity.

4.2.4.3 Possible Problem: Incorrect G2 Voltage.

1. Remedy: See section 4.2.2.6.

4.2.4.4 Possible Problem: Incorrect HV supply voltage.

1. Remedy: See section 4.2.2.1.

4.2.4.5 Possible Problem: Incorrect 17KV supply voltage.

1. Remedy: See section 4.2.2.7.

4.4.2.6 Possible Problem: Incorrect heater voltage (+6 volt supply).

1. Remedy: See section 4.2.2.4.

4.2.4.7 (cont'd)
Possible Problem: Inoperative black clamp.

1. Remedy: For units with separate sync input, check the value of R2, and check operation of Q5.
2. Remedy: For units with composite sync, sync stripper circuit (Collector of Q5 should be +5 volt positive pulse at time of horizontal sync).

   Verify the correct operation of the black clamp circuit (the collector of Q14 should produce a clamping pulse at the trailing edge of the horizontal sync pulse).

4.2.4.8 Possible Problem: Inoperative CRT

1. Remedy: Check for bent CRT socket pins.
2. Remedy: Replace CRT.

4.2.5 Symptom - Rolling Picture.

4.2.5.1 Possible Problem: Missing horizontal sync signal.

1. Remedy: For separate sync units, check the horizontal sync input, J8-Pin 9.
2. Remedy: For composite sync units, check the video input for proper sync waveform.
3. Remedy: Troubleshoot Z1 and Z7.

4.2.5.2 Possible Problem: Faulty sync strip circuit (not present on separate sync units).

1. Remedy: See section 4.2.4.7.
2. Remedy: Troubleshoot Q5 and Z7.

4.2.5.3 Possible Problem: Missing vertical sync signal.

1. Remedy: For separate sync units, check the vertical sync input, J8-Pin 10.
2. Remedy: For composite sync units, check the video input for proper vertical sync waveform.
3. Remedy: Troubleshoot Q20.

4.2.5.4 Possible Problem: Faulty sync separator (not present on separate sync units).

1. Remedy: Troubleshoot Z1, Z7, Q20 and Q21.

ENGINEERING POLICIES AND PROCEDURES

Subject MONOCHROME "M" SERIES PRODUCTION TEST PROCEDURE

1.0 SCOPE

1.1 Purpose - This standard establishes the production test requirements for the "M" series product-line of Video Monitors, Inc.

1.2 Applicability - This standard applies to all standard monochrome display monitors, including end-user and OEM products, except as may be contractually modified.

1.3 Effectivity - This standard is effective immediately on release.

1.4 Authority - The enforcements and interpretation of this standard is in accordance with VMI Policy. Deviations or waivers from this standard shall only be granted by the VMI Operations Manager. The interpreting authority for this standard is the VMI Engineering Manager.

2.0 APPLICABLE DOCUMENTS

2.1 Referenced Documents

VMI-STD 1.30.007 DHHS Production X-Radiation Test Procedure
VMI-STD 1.30.009 Monochrome "M" Series Troubleshooting Guide

2.2 Related Documents - None

3.0 GLOSSARY

Test Procedure - A step by step approach to testing a product, isolating fault conditions, repairing these conditions, and then calibrating the unit in order for the product to achieve its specifications.

4.0 REQUIREMENTS

4.1 General Instructions

4.1.1 Power Source - This product is intended to operate from a power source that will not apply more than 250 volts rms between the supply conductors or between either supply conductor and ground.

4.1.2 Grounding the Product - This product is grounded through the grounding conductor of the power cord. To avoid electrical shock, plug the power cord into a properly wired receptacle before connecting to the product input terminals. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

4.1.3 (cont'd)
Proper Fuse - To avoid fire hazard, use only the fuse of correct type, voltage rating and current rating as specified in the product parts list.

4.1.4 Power-on Testing - Dangerous voltages exist at several points in this product. To avoid personal injury, do not touch exposed connections and components while power is on. Disconnect power before removing shields, soldering, or replacing components.

4.1.5 Special Components - This product contains components that are critical with respect to increasing the maximum allowable radiation emissions from the product. These components are listed per DHHS rules 21-CFR Subchapter J. When replacing these components refer to VMI-STD 1.30.0 DHHS Production X-Radiation Test Procedure.

4.2 Soldering Techniques

4.2.1 Use ordinary 60/40 solder and a 15 watt pencil-type soldering iron for most soldering. Using a soldering iron with higher wattage-rating on etched circuit boards can cause the etched circuit wiring to separate from the board base material.

4.2.2 The following techniques should be used to replace a component on the circuit board. Most components can be replaced without removing the boards from the instruments.

1. Grip the component lead with long-nose pliers. Touch soldering iron to lead at solder connection. Do not lay iron directly on board.
2. When solder begins to melt, pull lead out gently. This should leave clean hole in board. If not, hole can be cleaned by reheating solder and placing sharp object (e.g. toothpick) into the hole to clean it out. A vacuum-type desoldering tool can also be used for this purpose.
3. Bend leads of new component to fit holes in board. If component replaced while board is mounted in instrument, cut leads so they just protrude through board. Insert leads into holes in board with component firmly seated against board (or as positioned originally). If it does not seat properly, heat solder and gently press component into place.
4. Touch the iron to the connection and apply a small amount of solder to make a firm solder joint. To protect heat-sensitive components, hold the lead between the component body and the solder joint with pair of long-nose pliers or other heat sink.
5. Clip excess lead that protrudes through board (if not clipped in step 3).
6. Clean area around solder connection with flux-remover solvent.

4.3 Test Equipment

4.3.1 Preferred Test Equipment - The following is a listing of required test equipment or their equivalents that is required to properly test this product.

1. Tektronics 455 oscilloscope
2. Data Precision 1351 DVOM
3. Data Precision 548 frequency counter
4. Data Precision V41A high voltage probe
5. Variac WSMT3 autotransformer
6. VMI video generator
7. VMI second anode tester

4.4 Test Preparation

4.4.1 Check the position of switches SW1 and SW2 on the power supply to ensure that the switch settings match the line voltage available to the unit.

4.4.2 Visually inspect the monitor to insure that ALL connectors are plugged into the proper socket and are secure.

4.4.3 Verify that all hardware on the PC board is secure.

4.4.4 Preadjust the potentiometers as follows:

1. Adjust the G2 pot, P4, 3/4 turn clockwise.
2. Adjust the DC focus pot, P5, 1/4 turn clockwise.
3. Adjust the Brightness Range pot, P3, counterclockwise.
4. Adjust the Vertical Height pot, P10, counterclockwise.
5. Adjust the Vertical Shape pot, P11, 3/4 turn clockwise.
6. Adjust the Vertical Lin pot, P12, 1/4 turn clockwise.
7. Adjust the High Voltage Supply pot, P20, 3 turns counterclockwise.
8. Adjust the Gain pot, P1, 1/2 turn clockwise.
9. Adjust the Bias pot, P2, 1/2 turn clockwise.

4.4.5 Connect the test equipment to the monitor as follows:

1. Connect the DVOM current meter in series between the power supply and the PC board.
2. Connect the high voltage probe to the +Vdc receptical of the DVOM.
3. Connect the VMI second anode probe in series between the flyback high voltage lead and the CRT. CAUTION: VERY HIGH VOLTAGE. It is possible for the CRT to maintain a charge of 10-20KV. Extreme caution must be used when connecting any probe to the 2nd Anode of the CRT.
4. Connect the X1 DVOM probe to the +Vdc receptical of the DVOM.
5. The final configuration should be as shown in Figure 1.

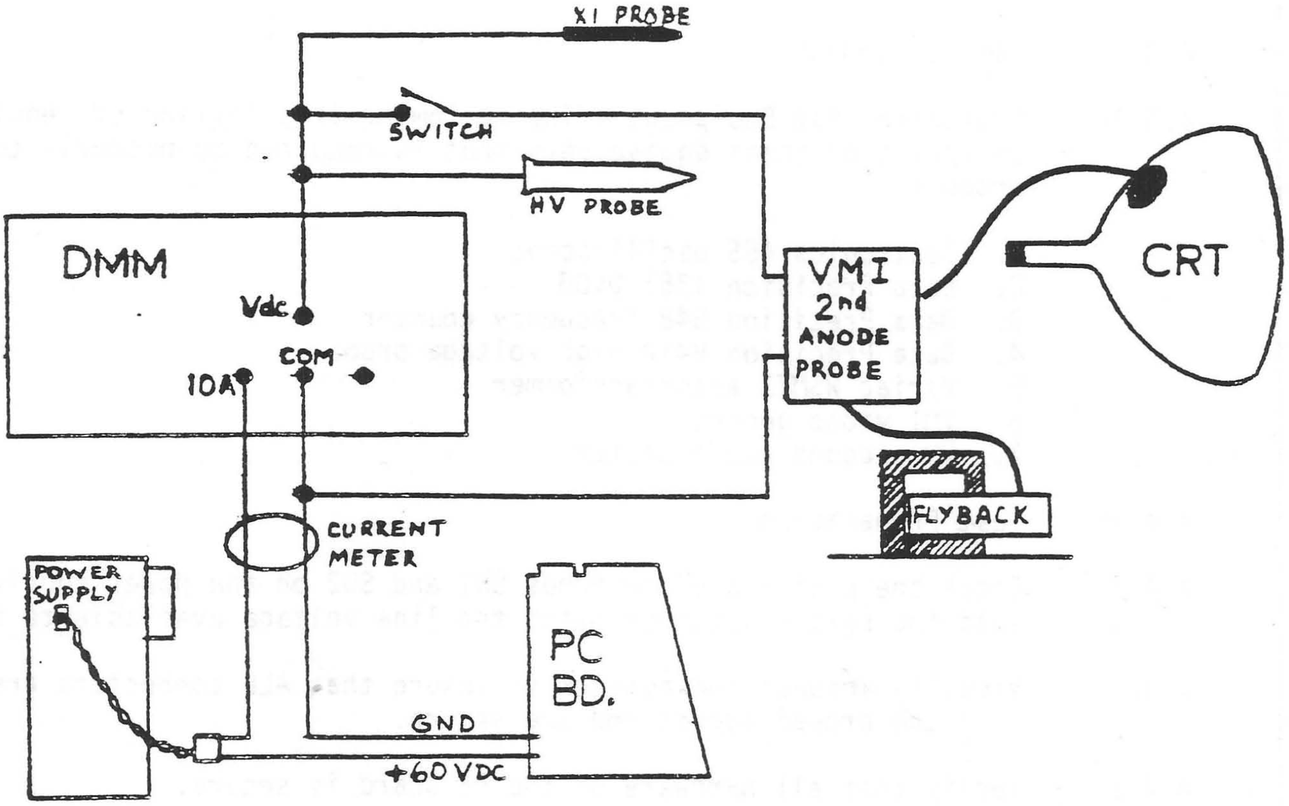


FIGURE 1

NOTE: While the current meter is connected to the DVOM, resistance can only be measured with reference to ground. There will still be a ground loop if the generator, power supply and scope ground are connected.

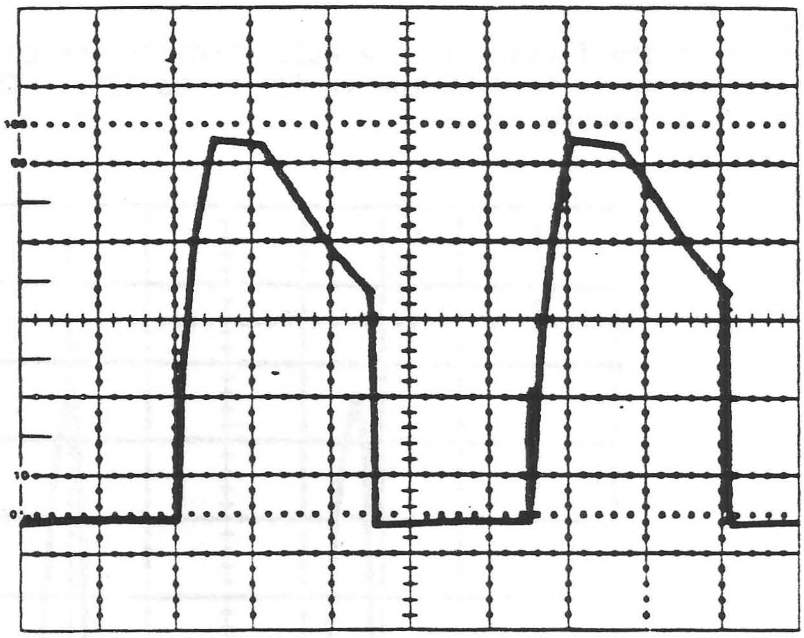
4.4.6 (cont'd)
Connect the A.C. power cord between the monitor power supply and the variac.

4.4.7 Set up the Video Pattern Generator to generate the nominal video signal specified by the model's test specification.

4.4.8 Check the +48V, +HV, +5V, -5V, and +10V supplies with the DVOM X1 probe for a grounded condition.

4.4.9 Check the continuity with the DVOM X1 probe between the chassis ground (located at the white ground return lead on the CRT brace) and the ground screw in the lower right corner of the PC board.

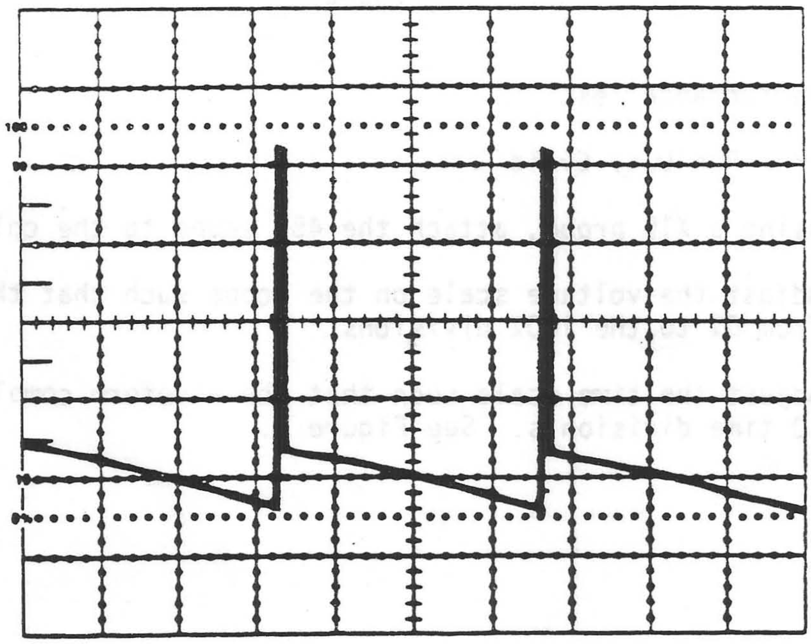
4.4.10 Disconnect the flyback from PCB. Monitor the waveform at the collector of Q11 with the scope while slowly turning the variac voltage up to 120 volts and back to 0 volts. The waveform should be similar to Figure 2.



Q11 Collector

FIGURE 2

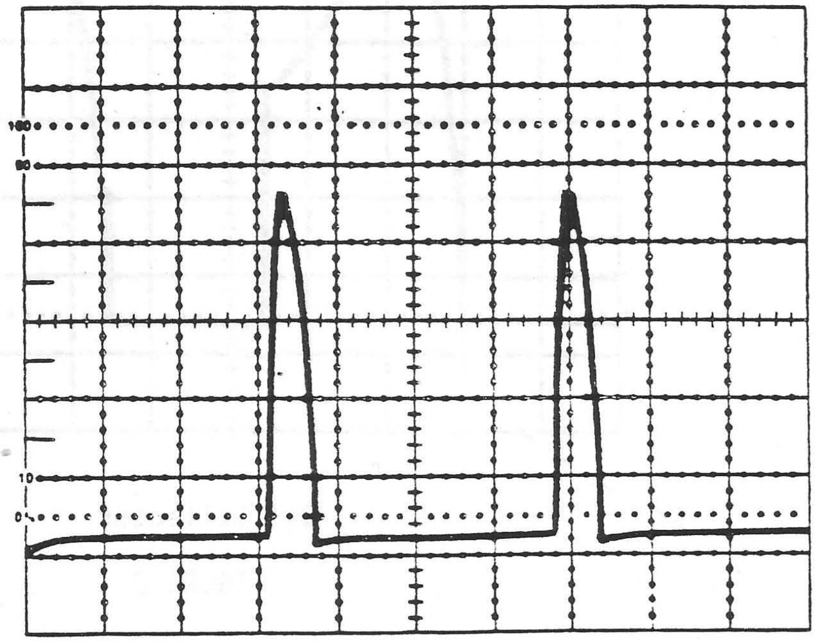
4.4.11 Attach the probe to the collector of Q23, and repeat 4.4.9. The waveform should be similar to Figure 3.



Q23 Collector

FIGURE 3

4.4.12 (cont'd)
Reconnect the flyback to the PCB. Monitor the collector of Q12 with the scope while turning the variac up to 120V. The waveform should be similar to Figure 4.



Q12 Collector

FIGURE 4

4.5 Performance Test

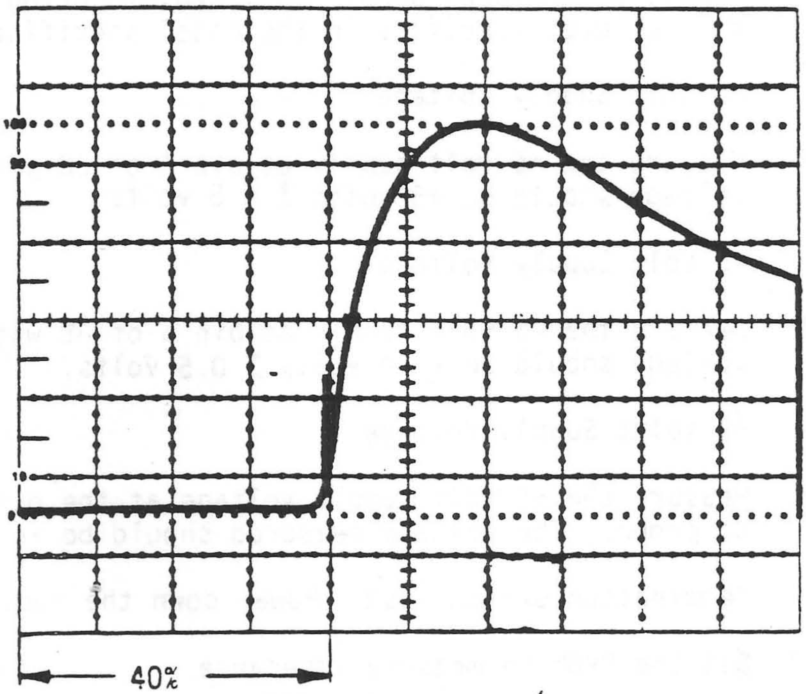
4.5.1 Free Run Duty Cycle

4.5.1.1 Using a X10 probe, attach the 455 scope to the collector of Q11.

4.5.1.2 Adjust the voltage scale on the scope such that the waveform ranges from 0% to the 100% divisions.

4.5.1.3 Adjust the time scale such that the waveform completely spans the 10 time division's. See Figure 5.

4.5.1.3 (cont'd)



Q11 Collector

FIGURE 5

4.5.1.4 Measure the free run duty cycle at the 10% level as shown above, and insure that it meets the monitor specification.

4.5.2 Free Run Scan Frequency

4.5.2.1 Place the frequency counter probe at pin 5 of Z2, and measure the frequency. This frequency should fall within the monitor specification.

4.5.3 Free Run Sweep Frequency

4.5.3.1 Monitor the gate of Q21 with the frequency counter and make sure that this frequency meets the model specification.

4.5.4 Q30 Emitter Voltage

4.5.4.1 Place the DVOM X1 probe at the emitter of Q30, and measure the voltage level. The voltage should be 56 volts ± 2 volts.

4.5.5 +48 Volt Supply Voltage

4.5.5.1 Measure the +48 volt supply voltage at the output of Z3 with the DVOM X1 probe. The voltage measured should be 48 volts ± 2 volts.

4.5.6 Flyback Supply Voltage

4.5.6.1 Place the DVOM X1 probe at the output of Z4, and monitor the voltage lev

4.5.6.2 (cont'd)
Adjust the flyback supply pot, P20, to bring the flyback supply voltage to the level specified in the model specification.

4.5.7 +5 Volt Supply Voltage

4.5.7.1 Measure the +5 volt supply at pin 4 of J8 with the DVOM X1 probe. This voltage should be +5 volts ± 0.5 volts.

4.5.8 -5 Volt Supply Voltage

4.5.8.1 Measure the -5 volt supply at pin 5 of J8 with the DVOM X1 probe. This voltage should be -5.4 volts ± 0.5 volts.

4.5.9 +6 Volts Supply Voltage

4.5.9.1 Measure the +6 volt supply voltage at the output of Z6 with the DVOM X1 probe. The voltage measured should be +6 volts ± 0.5 volts.

4.5.10 Termination Switch Test. Power down the monitor.

4.5.10.1 Set the DVOM to measure impedance.

4.5.10.2 Place the DVOM X1 probe at pin 1 of J8, and measure the impedance of the video amplifier with the video termination switch, SW1, set to "HI". The impedance measured should be greater than 20K ohms.

4.5.10.3 Measure the impedance of the video amplifier (pin 1, J8) with the video termination switch, SW1, set to "75". The impedance measured should be 75 ohms ± 1 ohm.

4.5.11 Video Bias Adjustment

4.5.11.1 Connect the video generator to the monitor. Power up the video generator and then the video monitor.

4.5.11.2 Place the X10 probe of the 455 scope on the junction between AG1 and R17, and monitor waveform.

4.5.11.3 Select the full white field pattern from the video generator.

4.5.11.4 Adjust the Bias pot, P2, until the bias voltage, as measured at the reference black level is within the range specified in the model specification.

4.5.12 Video Gain Adjustment

4.5.12.1 Monitor the video output waveform as before. Adjust the Gain pot, P1, until the video signal swing meets the range specified in the model specification.

4.5.13 (cont'd)
Black Level Stability

4.5.13.1 Monitor the video output waveform as before. Switch the video invert switch on the video generator alternatively on and off, and measure the voltage shift of the black level of the video amplifier output waveform. This d.c. shift must be less than or equal to 1 volt.

4.5.14 Remote Contrast Test (For units with the remote contrast option only)

4.5.14.1 Monitor the video output as before. Connect the remote contrast potentiometer. Adjust the potentiometer, and observe the change in the video output waveform. Turning the remote contrast potentiometer from maximum to minimum should decrease the range of the video output, but the reference black level should not change by more than 1.0 volts d.c.

4.5.14.2 Remove the remote contrast pot before proceeding.

4.5.15 Brightness Supply Voltage

4.15.1 Measure the brightness supply voltage at pin 8 of J8 with the DVOM, ensuring that this voltage is -130 volts ± 20 volts.

4.5.16 G2 Setting

4.5.16.1 Place the DVOM high voltage probe on the red lead wire of the tube socket, J9, and monitor the voltage level. CAUTION: HIGH VOLTAGE MAY BE PRESENT.

4.5.16.2 Adjust the G2 pot, P4, until the G2 voltage is at the level specified in the model specification.

4.5.17 Brightness Setting

4.5.17.1 Switch the video invert switch of the video generator to select a full black field. Observe the faceplate of the monitor, and adjust the G1 pot, P3, until the background raster is just short of being visible.

4.5.18 Video Shutdown

4.5.18.1 Switch the video input switch of the video generator to select a full white display.

4.5.18.2 Ground the base of Q23 with a jumper wire.

4.5.18.3 If the video shutdown circuit is operating correctly, the monitor's display should be shut off completely.

4.5.19 Horizontal Delay Range

4.5.19.1 Place the X10 scope of the 455 scope on Z1 pin 4.

4.5.19.2 (cont'd)
Adjust the Horizontal Delay pot, P6, to the maximum possible delay, and measure the negative-going pulse width. This pulse width should be within the range specified in the model specification.

4.5.19.3 Adjust the Horizontal Delay pot to the minimum possible delay and measure the negative-going pulse width. This pulse width should be within the range specified in the model's specification.

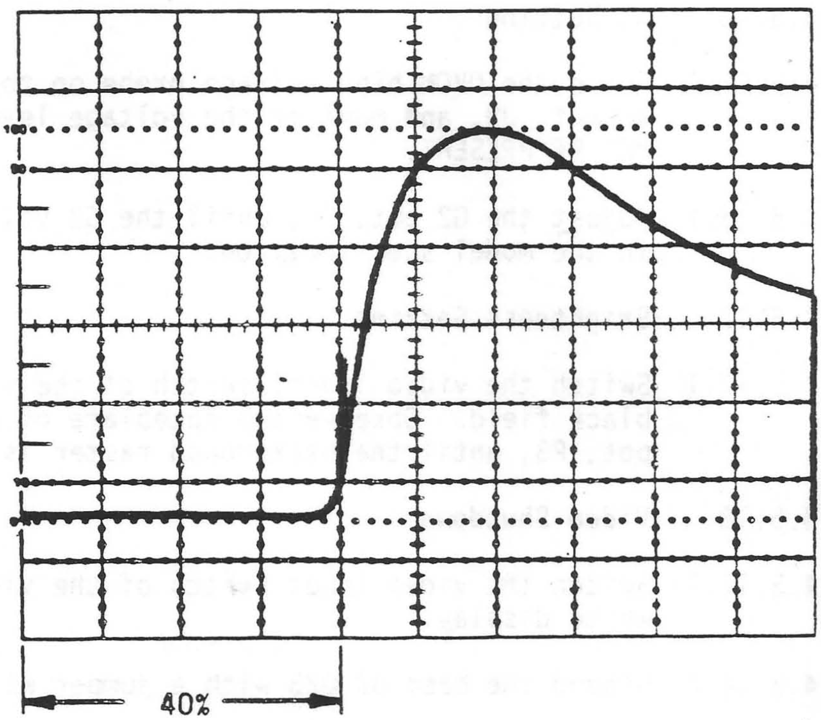
4.5.20 Locked-In Duty Cycle

4.5.20.1 Using a X10 probe, attach the 455 scope to the collector of Q11.

4.5.20.2 Adjust the voltage scale on the scope such that the waveform ranges from the 0% to the 100% divisions.

4.5.20.3 Adjust the time scale such that the waveform completely spans the 10 time division's. See Figure 6.

4.5.20.4 Measure the locked-in duty cycle at the 10% level as shown in Figure 6 and insure that it meets the monitor specifications.



Q11 Collector

FIGURE 6

4.5.21 (cont'd)
Linearity and Pincushioning Adjustments

4.5.21.1 Select the linearity slide set up for the specified picture size, and place it into the slide projector.

4.5.21.2 Adjust the height of the projector such that the center of the lens is at the same height as the center of the monitor's CRT.

4.5.21.3 Adjust the distance between the projector and the monitor such that the outside rows of donuts projected on the CRT phosphor are at the size specified in the model specification.

4.5.21.4 Adjust the projector orientation with respect to the monitor such that the projected donut pattern is square.

4.5.21.5 Select the positive grid pattern of the video generator. Adjust the video pattern generator such that the number of grid lines generated equals the number of donut rows in the horizontal and vertical directic

4.5.21.6 Adjust the linearity and pincushion the monitor using the following guideline:

1. Scan Linearity

- Adjust the Linearity Coil, L4 until the displayed scan width is at a maximum.
- Use the Width Coil, L3, and the Scan Delay pot, P6, to bring the right side of the display into alignment with the center row of projected donuts.
- Use the Linearity Coil and Scan Delay pot to bring the left side into alignment with the central row of donuts.
- Check the central Vertical and Horizontal grid lines for straightness. If necessary, correct with ring magnets located on the yok

2. Vertical Linearity

- Use Vertical Center Pot, P33, Vertical size pot, P10, Vertical shape pot, P12, and Vertical Linearity pot, P11, to align grid lines in central column of CRT with the projected donuts.
- Vertical Center Pot moves entire display in Vertical direction.
- Vertical size pot increases and decreases size of display in Vertical direction.
- Vertical Shape pot adjusts the top line spacing and slightly affects the bottom line spacing.
- Vertical Linearity Pot adjusts the bottom line spacing while slightly affecting top line spacing.

4.5.21.6 (cont'd)

3. Pincushioning - Vertical and Horizontal edges should be adjusted to within ± 1.0% at the center of all four outside grid lines.

- To pincushion a yoke, begin by checking to see if the yoke is orthagonal (whether the vertical and horizontal center lines are perpendicular to one another). To check this, turn yoke until the horizontal center line agrees with the horizontal center line of the donut pattern. Now observe the vertical center line. line must be within ± 1.0% of the vertical center line of the donut pattern. If yoke is orthagonal, reference yoke rejection procedure.
- Using permanent magnets pull the side as straight as possible, yet leave the top and bottom half of the side symmetrical. See Figure 7. The same procedure is used on top and bottom.
- Start with the upper left corner and take a 1-5 Gauss magnet and push the corner in until the side and the top create a 90° angle. Repeat the procedure with the corners. Then move to the right side and do the same. Then touch up by pulling and/or pushing where needed to achieve monitor specification.
- Longer magnets will affect larger areas. When pushing a corner take the pushing magnet and slide it from one side to the adjoining side while keeping the magnet perpendicular to the corner. Use only small amounts of hot melt gue to secure magnets. Glue all magnets to the yoke chassis with hot melt glue. Upon completion of pincushioning cover magnets with permanent glue.

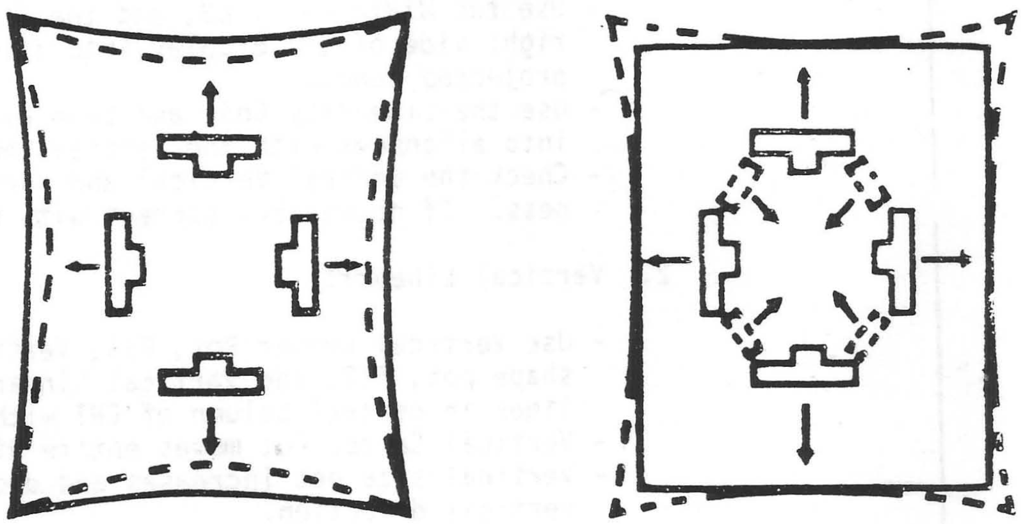


FIGURE 7

4.5.21.7 (cont'd)
The maximum acceptable linearity deviation shall be such that each intersection of the displayed grid pattern falls within the outside border of a projected donut, as shown in Figure 8.

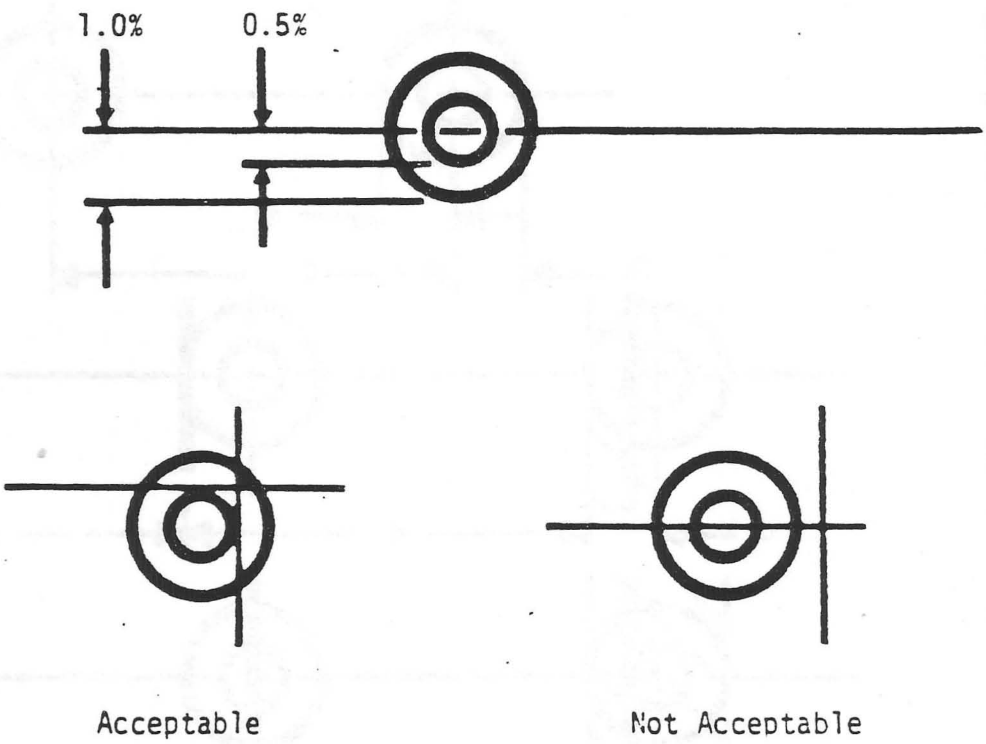
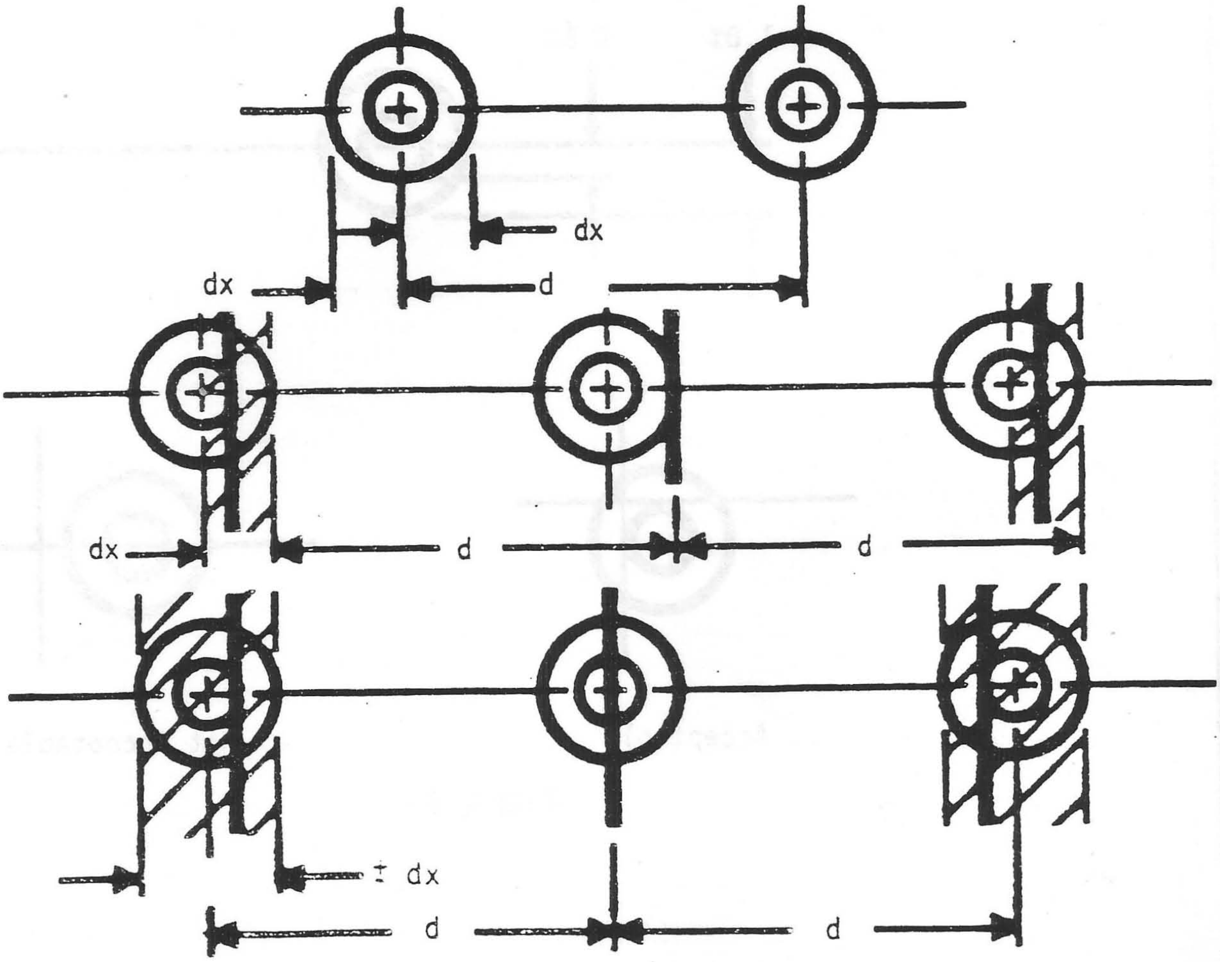


FIGURE 8

4.5.21.8 (cont'd)
The maximum acceptable incremental deviation in linearity shall be such that each grid line shall be spaced within d ± dx as shown in Figure 9

Acceptable



Not Acceptable

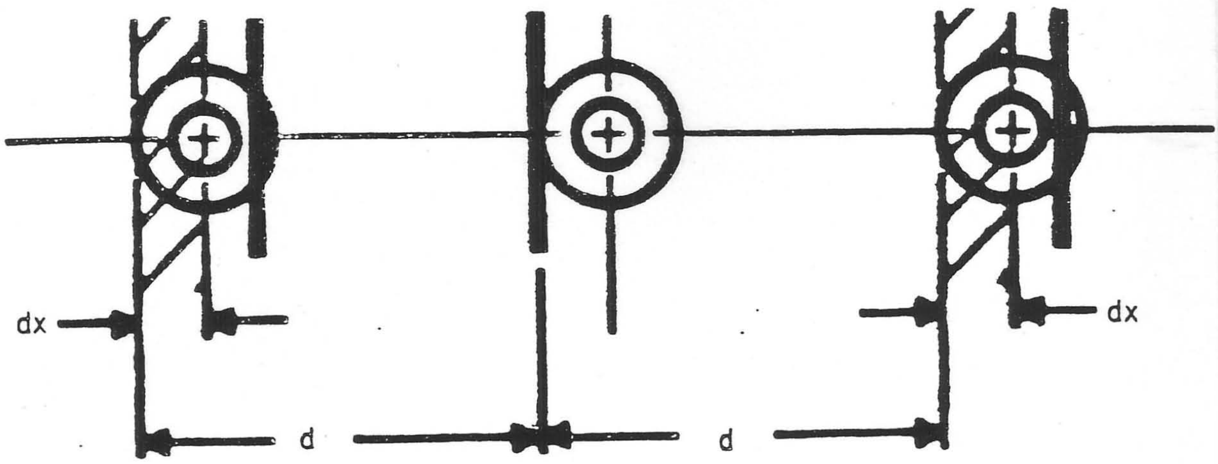


FIGURE 9

4.5.21.9 (cont'd)
The maximum acceptable pincushion deviation shall be such that the edge of the display shall pass through each donut, with a maximum incremental deviation of ± 0.5%. See Figure 10.

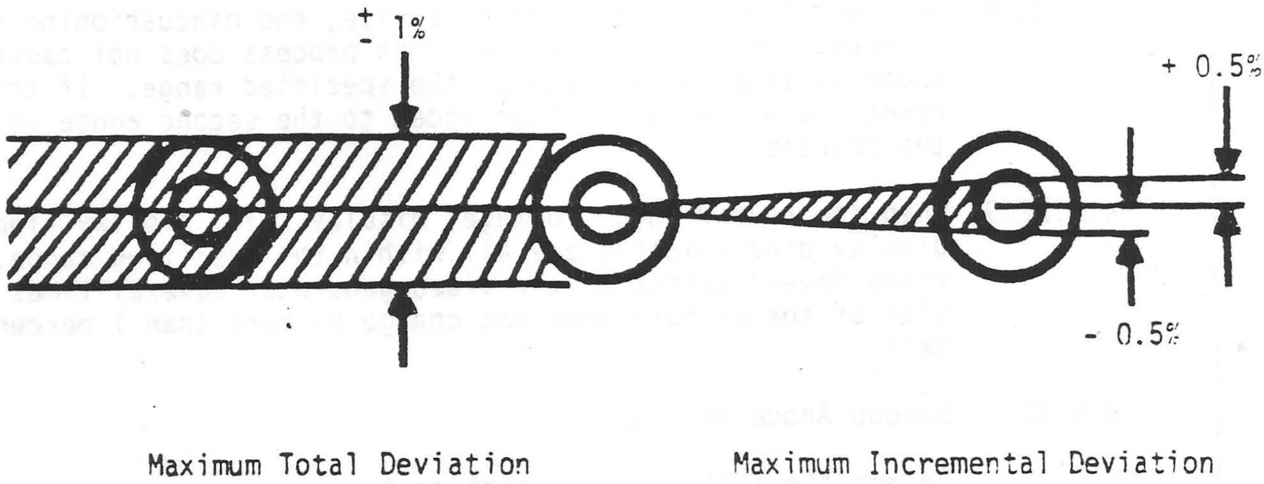


FIGURE 10

4.5.22 Size Stability

4.5.22.1 If the monitor has the High Voltage Regulation option, skip to section 4.5.22.4.

4.5.22.2 Switch the video invert switch of the video generator alternatively on and off. Observe the change in the size of the display. The picture size change of monitors without the High Voltage Regulation option should be less than 5% of the major axis.

4.5.22.3 Monitors with the High Voltage Regulation option must have the High Voltage Regulator adjusted in order to maintain picture size. If the monitor does not have this option, disregard the following sections and skip to test 4.5.23.

4.5.22.4 Switch the video invert switch of the video generator, causing it to transmit an inverted grid pattern.

4.5.22.5 (cont'd)
Monitor the second anode voltage at the flyback outout with the DVOM and the VMI second anode probe. CAUTION: HIGH VOLTAGE - If the VMI second anode probe has not been previously set up, refer to section 4.

4.5.22.6 With potentiometer, P1, on the high voltage regulator board, turn the high voltage regulator off. Note the second anode voltage at this poi

4.5.22.7 Switch the video invert switch of the video generator again, causing it to transmit a non-inverted grid pattern. Turn potentiometer, P1, of the high voltage regulator board clockwise, until the second anode voltage of the unit under test rises to the level noted in section 4.5.22.6. Make sure that this process does not cause the second anod voltage to fall outside the specified range.

4.5.22.8 Readjust the linearity, picture size, and pincushioning of the monit if necessary. Make sure that this process does not cause the second anode voltage to fall out of the specified range. If this does happen, reset the amount of voltage added to the second anode voltage and repea the process.

4.5.22.9 When the second anode voltage, display size, display linearity and display pincushioning are all within the specified range, switch the video invert switch on the video generator several times and insure t size of the picture does not change by more than 1 percent of the major axis.

4.5.23 Second Anode Voltage

4.5.23.1 Select the full black pattern on the video generator.

4.5.23.2 Measure the second anode voltage with the DVOM and the VMI second anod probe. CAUTION: HIGH VOLTAGE - For probe set up, refer to section 4

4.5.24 Flyback Pulse Width

4.5.24.1 Monitor the collector of Q12 with the 455 scope and a X10 probe.

4.5.24.2 Adjust the voltage range of the 455 scope such that the flyback pulse ranges from the 0% and the 100% voltage scale lines on the 455 scope.

4.5.24.3 Measure the flyback pulse width at the 10% time division, as in Figure 11.

4.5.24.3 (cont'd)

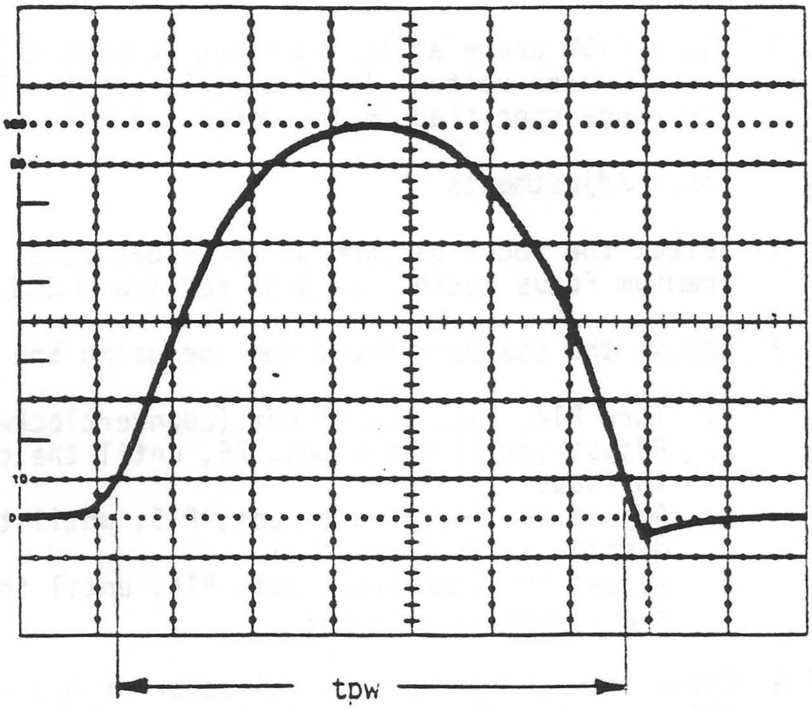


FIGURE 11

4.5.25 Flyback Ringing

4.5.25.1 Place the X10 probe of the 455 scope between the flyback core and the top of the flyback.

4.5.25.2 Adjust the voltage scale range of the 455 scope such that displayed waveform ranges between the 0% and the 100% scale lines.

4.5.25.3 Measure the flyback ringing as in Figure 12.

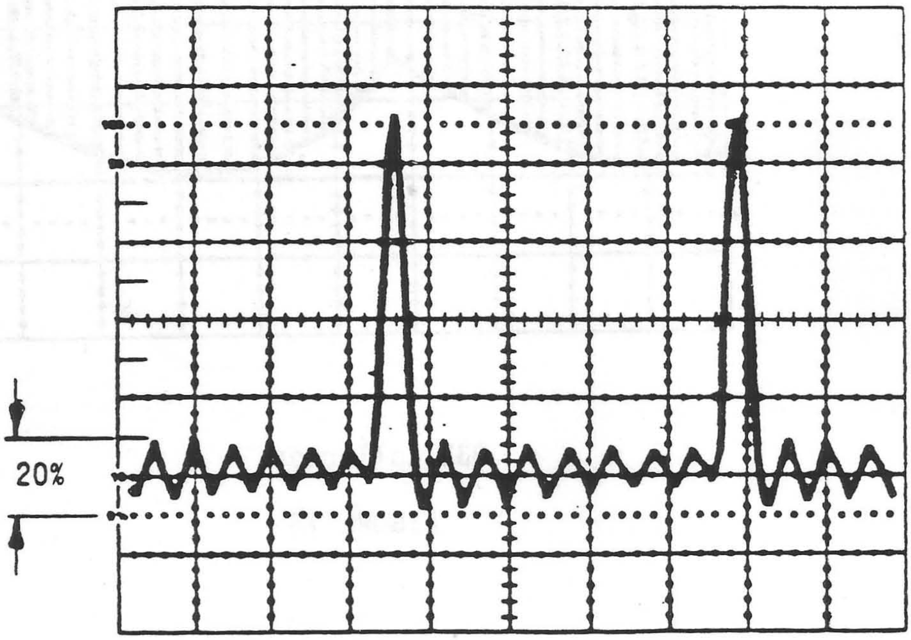


FIGURE 12

4.5.26 (cont'd)
Flyback Voltage

4.5.26.1 Place DVOM probe at the junction between CR29 and C66, and measure the peak flyback voltage level at this point. This voltage should be within the range specified in the model specification.

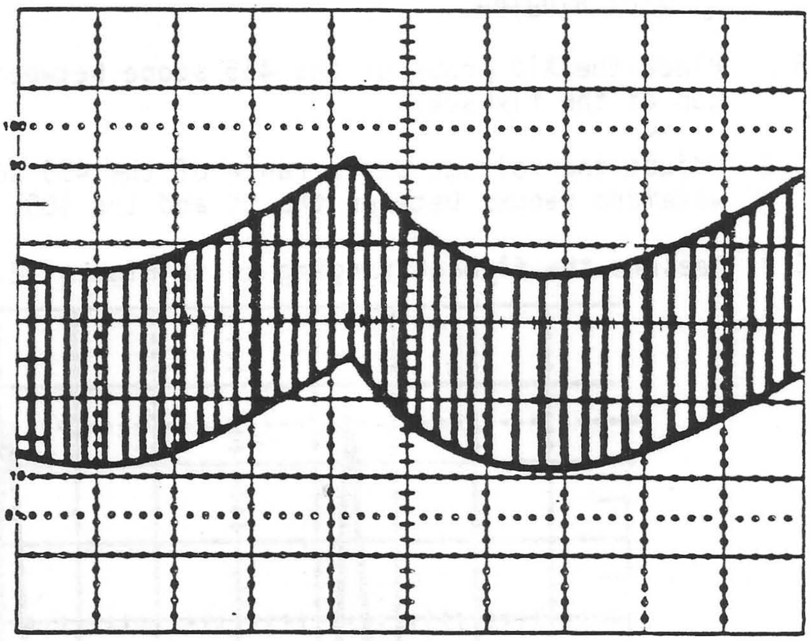
4.5.27 Focus Adjustments

4.5.27.1 Select the focus pattern on the video generator. If the monitor has the Premium Focus option, skip to section 4.5.28.

4.5.27.2 Adjust the standard focus monitor using the following procedure:

1. Turn P14, P15, and P5 off (counterclockwise).
2. Adjust the DC Focus pot, P5, until the center of the display is in focus.
3. Adjust the Sweep Focus pot, P15, until the top and bottom of the display is in focus.
4. Adjust the Scan Focus pot, P14, until the left and right side of the screen is in focus.

4.5.27.3 Check the waveform at the collector of Q32 with the 455 scope and the X10 probe to insure that the focus amplifier is not in saturation. See Figure 13 for correct focus waveform.



Q32 Collector

FIGURE 13

4.5.28 Premium Focus Option (Disregard for standard models)

4.5.28.1 Adjust the premium focus monitor using the following procedure:

1. Monitor the Focus Grid (blue wire lead) with a X10 scope probe on channel 1 of the oscilloscope.
2. Monitor the collector of Q12 with a X10 scope probe on channel 2 of the oscilloscope.
3. Set the Sweep pot, P15, and the Corner pot, P13, counterclockwise to minimum. Set the Scan pot, P14, clockwise to maximum.
4. Adjust the slug of transformer, T4, to center the phase of the waveform at Q31 between the flyback pulses at Q12 as shown in Figure 14.

Focus Grid

Q12, Collector

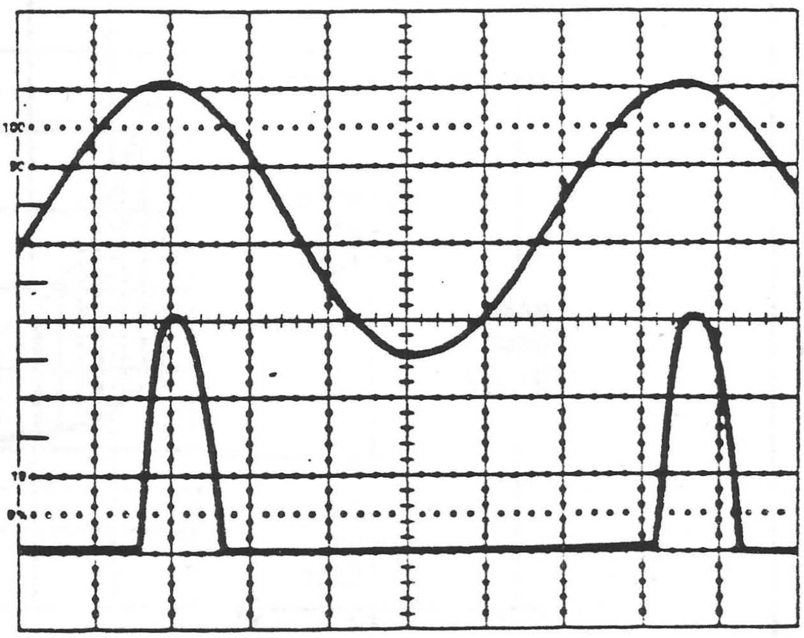


FIGURE 14

5. Remove the scope probe from the Focus Grid and turn the Scan pot, P14, counterclockwise to minimum.
6. Adjust the DC Focus pot, P5, for best center focus.
7. Adjust the Scan Control pot for best focus at the extremes of the scan.
8. Adjust the Sweep Control pot for best focus at the extremes of the sweep.
9. Adjust the Corner Control pot for best focus at the corners.
10. Minor differences in the corner focus may be improved by adjusting the phase by turning the adjusting screw of Transformer, T4.

4.5.29 (cont'd)
Peak Focus Voltage

4.5.29.1 Place the X10 scope probe on the Focus Grid and measure the Peak focus voltage at this point. This voltage must meet the model's specification

4.5.30 Peak Dynamic Focus Voltage

4.5.30.1 With the same procedure indicated in 4.5.29.1, measure the peak dynamic focus voltage. This voltage must be within the range specified in the model specification. The waveform will be similar to Figure 15.

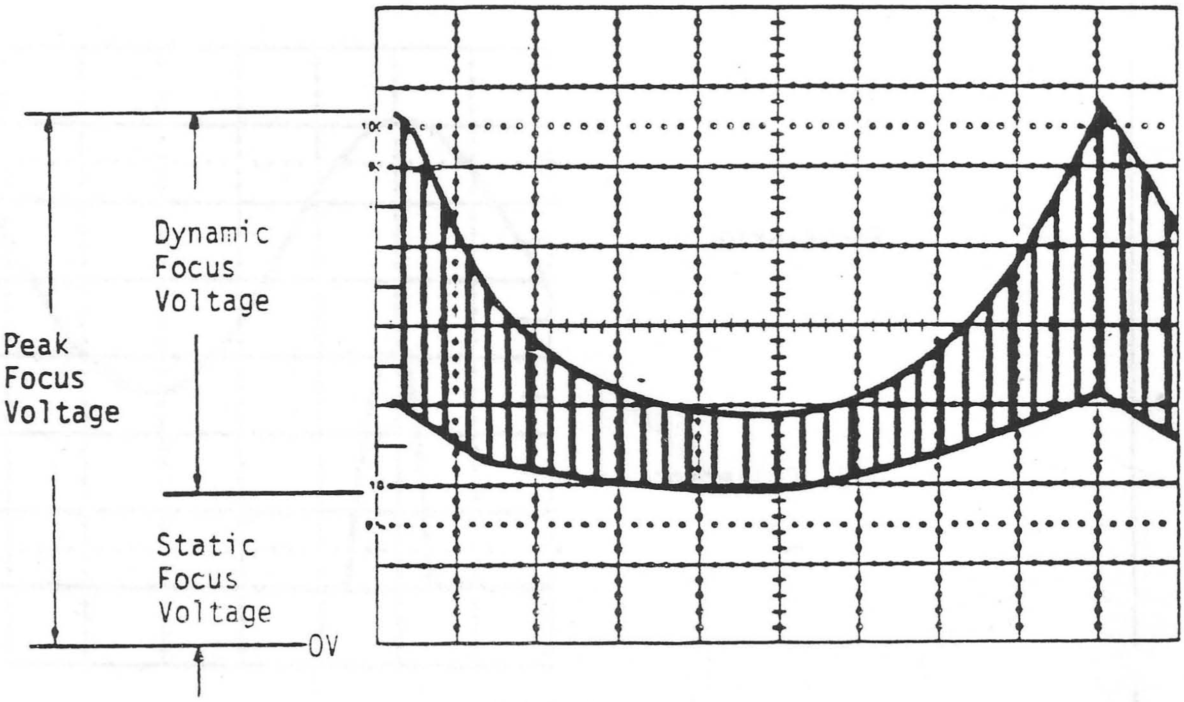


FIGURE 15

4.5.31 Interlace

4.5.31.1 Set the video generator to run interlaced by changing the scan lines counter to an even number. (This number should be no more than one increment from the nominal setting.)

4.5.31.2 Observe the display through a X10 ocular. Adjust the interlace pot, P131, such that the interlace factor is greater than 0.85.

4.5.31.3 Reset the video generator to run non-interlaced.

4.5.32 Mid-Frequency Response

4.5.32.1 Select the positive multiple window pattern of the video generator.

4.5.32.2 Observe the display, and make sure there is no discernable streaking present.

4.5.33 (cont'd)
Transient Response

4.5.33.1 Observe the displayed video pattern. There should be no discernable overshoot in the video signal during the white to black transitions or the black to white transitions.

4.5.34 Input Current

4.5.34.1 Switch the DVOM to measure current, and measure the d.c. current into the PC board. This current must be within the model's specification.

4.5.35 Remote Brightness

4.5.35.1 Power down the video monitor, and connect the Remote Brightness Potentiometer to J8. Power the monitor back up.

4.5.35.2 Observe the change in brightness so the Remote Brightness Potentiometer is turned from maximum to minimum.

4.5.35.3 Power down the video monitor and disconnect the Remote Brightness Pot. Power the monitor back up.

4.5.36 Crowbar Test

4.5.36.1 Place 1.5K ohm resistor from the adjustment pin to the output of Z4.

4.5.36.2 If the crowbar circuit is operating correctly, the monitor should power down.

4.5.36.3 Turn the variac off, and wait for 20 seconds. Turn the variac power back on. The monitor should power up correctly.

4.5.37 Low Line Test

4.5.37.1 Monitor the collector of Q30 with the DVOM X1 probe.

4.5.37.2 Slowly turn down the variac until the voltage at the collector of Q30 reaches 55 volts d.c.

4.5.37.3 Observe the displayed video signal for any degradation in appearances.

4.6 Troubleshooting Techniques

4.6.1 Troubleshooting Procedure - Refer to VMI-STD 1.30.009 Monochrome "M" Series Troubleshooting Guide.

4.7 Final Quality Preparations.

4.7.1 Subject unit to environmental test per Quality Control environmental specifications. Retest unit to assure monitor performs at model specifications and submit to Quality Control for final QA checks.

4.7.2 At completion of environmental test, retest flyback supply voltage per section 4.5.6, and seal potentiometer P20 with epoxy.