# CONTENTS

## I GENERAL INFORMATION
1.1 General Description 1-1
1.2 Electrical Specifications 1-1
1.3 Environmental Specifications 1-2
1.4 Human Factors Specifications 1-3
1.5 Controls 1-3

## II INSTALLATION AND OPERATING PROCEDURES
2.1 General 2-1
2.2 Power 2-1
2.3 Location 2-1
2.4 Grounding Techniques 2-2
2.5 Video Lead Routing 2-2
2.6 Initial Turn On Procedure 2-2

## III THEORY OF OPERATION
3.1 Video Amplifier 3-1
3.2 Vertical Deflection 3-1
3.3 Horizontal Deflection 3-2
3.4 Low Voltage Power Supply 3-4
3.4.1 Standard Low Voltage Power Supply 3-4
3.4.2 IC Low Voltage Supply 3-5

## IV PRELIMINARY ADJUSTMENTS
4.1 Synchronization and Drive Signals 4-1
4.2 Low Voltage Supply 4-1
4.3 Brightness 4-1
4.4 Video Contrast 4-1
4.5 Vertical Adjustments 4-1
4.6 Horizontal Adjustments 4-2
4.7 Focus Adjustment 4-2
4.8 Centering 4-3

## V TROUBLESHOOTING AND MAINTENANCE
5.1 Troubleshooting Guide 5-1

## VI PARTS LIST

## VII ORDERING AND RETURNING PARTS
7.1 Ordering Parts 7-1
7.2 Returning Parts 7-1
<table>
<thead>
<tr>
<th>Figure</th>
<th>Illustration Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Synchronization and blanking generator waveforms</td>
<td>1-4</td>
</tr>
<tr>
<td>2</td>
<td>Voltage Waveform</td>
<td>5-2</td>
</tr>
<tr>
<td>3</td>
<td>Interconnecting Cabling Diagram</td>
<td>5-3</td>
</tr>
<tr>
<td>4</td>
<td>Circuit Board Components Location</td>
<td>5-4</td>
</tr>
</tbody>
</table>
Section 1
GENERAL INFORMATION

1.1 GENERAL DESCRIPTION

The TV data display monitor is a solid state unit for use in industrial and commercial installations where reliability and high quality video reproduction are desired.

The monitor features printed circuit board construction for reliability and uniformity. All circuits of the monitor are transistorized. The synchronization circuits have been custom designed to accept vertical and horizontal drive signals thus enabling the interfacing of this monitor with industrial or simple sync sources. This feature simplifies the user's sync processing and mixing and allows the unit to operate without requiring composite sync. The electronic packaging has been miniaturized for compatibility with small volume requirements.

1.2 ELECTRICAL SPECIFICATIONS

Input Data Specifications

Input Connector: PWB edge connector, Viking #2VK10S/1-2, Amphenol #225-21031-101, Cinch #250-10-30-170 (BBRC Part Number 1-039-0119)

Input Amplitude: Low zero + 0.4V - 0.0V
                  High 4.0V ± 1.5V

Video Pulse Width: 100ns or greater

Vertical Drive Rate: 47 to 63 Hz

Horizontal Drive Rate: 15,250 to 16,250 Hz

Rise and Fall Time (10 to 90% amplitude)
    Vertical: Less than 100ns
    Horizontal: Less than 50ns
    Video: Less than 20ns

Input Signal Format: Refer to Figure 1.

Data Display Specifications

<table>
<thead>
<tr>
<th>Input Impedance</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Video Input (Class A):</td>
<td>Shunt Resistance</td>
<td>Capacitance</td>
</tr>
<tr>
<td>3.3 KΩ</td>
<td>40-60pF</td>
<td></td>
</tr>
<tr>
<td>Vertical Drive Input:</td>
<td>1.2 KΩ</td>
<td>40pF</td>
</tr>
<tr>
<td>Horizontal Drive Input:</td>
<td>470 Ω</td>
<td>40pF</td>
</tr>
</tbody>
</table>

Video Amplifier

(a) Bandwidth: 12 MHz (-3 dB)
(b) Rise and Fall Times
    (10 to 90% amplitude): Less than 35ns (linear mode)
(c) Storage Time: 15ns max. (linear mode)
Retrace and Delay Times
(a) Vertical: 900μs retrace max.
(b) Horizontal: 7μs retrace plus 4μs delay max.

Display Specifications
Cathode Ray Tube (without bonded panel)

<table>
<thead>
<tr>
<th>Nominal Diagonal Measurement (inches)</th>
<th>Phosphor</th>
<th>Resolution (TV lines) Center</th>
<th>Corner</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>P4</td>
<td>650 at 60 fL</td>
<td>.550 at 60 fL</td>
</tr>
<tr>
<td>9</td>
<td>P4</td>
<td>800 at 40 fL</td>
<td>650 at 40 fL</td>
</tr>
<tr>
<td>12</td>
<td>P4</td>
<td>900 at 40 fL</td>
<td>750 at 40 fL</td>
</tr>
<tr>
<td>12</td>
<td>P39</td>
<td>900 at 20 fL</td>
<td>750 at 20 fL</td>
</tr>
</tbody>
</table>

*Resolution is measured in accordance with EIA RS-375 except Burst Modulation (or Depth of Modulation) is adjusted for 100 percent.

Geometric Distortion
The perimeter of a full field of characters shall approach an ideal rectangle to within ± 1.5% of the rectangle height.

Power Requirements
TV 9 and 12 with low voltage supply:
  Input connector (customer supplied)
    Molex connector shell, male, 4 contact, 03-06-1041 (BBRC P/N 1-034-0309)
    Molex contacts .063 dia for 20-22 AWG, 4529T (BBRC P/N 1-034-0289)
  Input Voltages: 105 to 130 VAC, 50/60 Hz (optional) 220/240 VAC, 50/60 Hz

TV 5, 9 and 12 using external DC power supply:
  Input connector (customer supplied)
  Input voltage 15V DC ± .2V 12V DC ± .2V
  Ripple <100mV p-p <100mV p-p
  Input Current 900mA DC nominal 650mA DC nominal
  *1.5A DC max. *1.0A DC max.

*Brightness and contrast controls adjusted for worst case condition.

1.3 ENVIRONMENTAL SPECIFICATIONS

Temperature (Chassis or Custom Unit)
- Operating Range: 5°C to 55°C Ambient
- Storage Range: -40°C to 65°C
Humidity
   5 to 80% (noncondensing)

Altitude
   Operating Range                  Up to 10,000 feet

1.4 HUMAN FACTORS SPECIFICATIONS

X-Ray Radiation
The TV units comply with DHEW Radiation Performance Standards
21CFR, subchapter J.

1.5 CONTROLS

Customer Access - Necessary Accessories (Available)
(1) Contrast, 500Ω potentiometer carbon composition 1/8 Watt
(2) Brightness, 100kΩ potentiometer 1/8 Watt
   Optional: The brightness control can be mounted on the
   printed circuit board as an internal set up control.

Internal Set Up Controls
(1) Height
(2) Vertical Linearity
(3) Vertical Frequency
(4) Focus
(5) Width
(6) Low Voltage Adjust
NOTES:
1. t₁ and t₂ initiate horizontal and vertical retrace respectively. The relative difference between t₁ and t₂, and t₃ and t₄, should be chosen to center the video within the raster horizontally and vertically.
2. H = time from start of one line to start of next line.
3. V = time from start of one field to start of next field.
4. Video pulse width should be equal to or greater than 100ns.

Fig 1  Synchronization and blanking generator waveforms.
Section 2
INSTALLATION AND OPERATING PROCEDURES

2.1 GENERAL
This section describes the installation procedures of the TV monitor. It also contains information on the power, location, installation and initial turn-on procedures.

2.2 POWER
The power requirements for the TV units that have a self contained power supply is 120 VAC, 50/60 Hz except for units that are wired for 220/240 V, 50/60 Hz operation.

The AC voltage is applied to the unit via a 4 contact female connector shell (Molex #03-06-2041) with male contacts (Molex #1560T).

The power supply mating connector (supplied by the customer) is a 4 contact male connector shell (Molex #03-06-1041) with female contacts (Molex #4529T).

2.3 LOCATION
The TV unit shall not be located in an area that restricts a flow around the unit. Nor shall it be placed near any heat generating sources, since this may cause the unit to overheat.

2.4 GROUNDING TECHNIQUES
The method of interconnecting and grounding the equipment is a function of the signal frequency; and optimum grounding depends largely on the system in which the equipment is used.

The following grounding technique is recommended when installing a TV Data Display Monitor.

The vertical/video, horizontal drive, vertical drive, and CRT arc bypass are all returned to the TV chassis plate ground through single molex connections. Normally, it is assumed that the frame and chassis plate of the monitor will be installed in a system where they will be an integral part of system ground. If this is true, then further grounding should not be necessary. The mating of monitor's frame with the system or the generator's signal source ground must be electrically good. Good electrical metal-to-metal contact must be assured.

Where strong radiated noise and signal fields inhibit the monitor's operation or where a signal's waveform is deteriorated by long or poorly selected cabling, the proper shielded cable should be used. When using shielded cable, careful attention must be given to proper grounding of the outer conductor. Improper grounding can cause ground loops. In some cases, transistor failures can be traced to poor grounding techniques.
The TV monitor has provisions at the printed circuit board edge connector to pick up the ground returns for the vertical/video, horizontal drive, and vertical drive circuits. If these connections must be used, it is likely that the single molex connection associated with each ground return may have to be opened to minimize ground loops. Reducing the number of ground connections reduces the number of possible ground loops with the ultimate being one system ground connection at the source.

IMPORTANT - - One pin on the printed circuit board edge connector is to be used specifically for the CRT arc bypass and must not be used as a signal ground return (see schematic).

2.5 VIDEO LEAD ROUTING
The video lead probably will carry high frequency signals and should be given the following considerations:

A. To minimize distributed capacity and capacitive pickup of nearby radiated fields, route the video leads separately and away from all other wiring.

B. Make the lead length as short as possible, consistent with the packaging requirements.

C. Ideally, the video line should meet the requirements of a terminated coaxial system; i.e., the video line should exhibit a constant impedance from source to load. An effective method of testing the video line is as follows:
   a. Establish a configuration and keep the foregoing requirements in mind.
   b. Drive the source end of the video line with the output of TTL logic or an equivalent pulse generator capable of providing pulses with rise and fall times of typically 10 nanoseconds and pulse widths of approximately 100 nanoseconds. Any convenient duty cycle and repetition rate may be used. The generator should be capable of supplying +2.5 Volt pulse.
   c. Observe the pulse at the receiving end of the video line with a low capacitance (less than 5pF) oscilloscope probe. Adjust the routing and termination of the video line to maintain rise and fall times of 20 nanoseconds or less and overshoots within 10 percent of the pulse amplitude.

2.6 INITIAL TURN-ON PROCEDURE
Connect the video and synchronization signals to the monitor and then apply power to the unit. Place the power switch (external or internal) in the ON position. Adjust the brightness and contrast controls for desired effect and stabilize the picture with the vertical hold control. Adjust the focus control to produce optimum focus over the entire area of the CRT.

For normal operation of the monitor after it has been adjusted, turn on power and adjust contrast and brightness controls.
Section 3
THEORY OF OPERATION

3.1 VIDEO AMPLIFIER

The video amplifier consists of Q101 and its associated circuitry. The incoming video signal is applied to the monitor through the contrast control and R109 to the base of transistor Q101.

Transistor Q101 and its components comprise the video output driver with a gain of about 17. Q101 operates as a class B amplifier and remains cutoff until a DC-coupled, positive-going signal arrives at its base. R111 provides series feedback which makes the terminal-to-terminal voltage gain relatively independent of transistor variations as well as stabilizes the device against voltage and current changes caused by ambient temperature variation. C118 bypasses the AC signal around the bias network.

The negative going signal at the collector of Q101 is DC-coupled to the cathode of the CRT. The class B biasing of the video driver allows a larger video output signal to modulate the CRT's cathode and results in a maximum available contrast ratio.

The overall brightness at the screen of the CRT is determined by the negative potential at the grid and is varied by the brightness control.

3.2 VERTICAL DEFLECTION

Transistor Q102 is a programmable unijunction transistor, and together with its external circuitry, forms a relaxation oscillator operating at the vertical rate. Resistor R115, variable resistor R116 and capacitors C105 and C106 form a RC network providing proper timing.

When power is applied, C105 and C106 charge exponentially through R115 and R116 until the voltage at the junction of R116 and C105 equals the anode "A" firing voltage. At this time, one of the unijunction's diodes that is connected between the anode and anode gate "G" becomes forward biased allowing the capacitors to discharge through another diode junction between the anode gate and the cathode "K" and on through R120.

R117 and R118 control the voltage at which the diode (anode-to-anode gate) becomes forward biased. This feature "programs" the firing of Q102 and prevents the unijunction from controlling this parameter. Therefore, the changing of firing points from one device to another, together with the temperature dependency of this parameter, is no longer a problem as it can be with conventional unijunction transistors.

The vertical oscillator is synchronized externally to the vertical interval from the vertical drive pulse at R115. At the time of the vertical interval, an external negative pulse is applied.
through R113, C104, and CR101 to the gate of Q102, causing the firing level of the unijunction to decrease.

The sawtooth voltage at the anode of Q102 is directly coupled to the base of Q103. Q103 is a driver amplifier and has two transistors wired as a Darlington pair; their input and output leads exit as a three-terminal device. This device exhibits a high input impedance to Q102, and thereby maintains excellent impedance isolation between Q102 and Q104.

The output waveform from the unijunction oscillator is not suitable, as yet, to produce a satisfactory vertical sweep. Such a waveform would produce severe stretching at the top of the picture and compression at the bottom. C105 and C106 modify the output waveform to produce satisfactory linearity. The sawtooth waveform output at Q103 is coupled through R122, the vertical linearity control R121, and on to C106 where the waveform is shaped into a parabola. This parabolic waveform is then added to the oscillator's waveform and changes its slope. Slope change rate is determined by the position of R121.

Q103 supplies base current through R123 and R124 to the vertical output transistor, Q104. Height control R124 varies the amplitude of the sawtooth voltage present at the base of Q104 and varies the size of the vertical raster on the CRT.

The vertical output stage, Q104, uses a power type transistor which operates as a class A amplifier. No output transformer is required since the output impedance of the transistor permits a proper impedance match with the yoke connected directly to the collector. C107 is a DC blocking capacitor which allows only AC voltages to produce yoke current. L1 is a relative high impedance compared to the yoke inductance. During retrace time, a large positive pulse is developed by L1 which reverses the current through the yoke and moves the beam from the bottom of the screen to the top. Resistor R126 prevents oscillations by providing damping across the vertical deflection coils.

3.3 HORIZONTAL DEFLECTION

A driver stage consisting of Q105 and T101 is used to obtain a signal to drive Q106, the horizontal output transistor. The circuitry associated with Q105 and Q106 has been designed to optimize the efficiency and reliability of the horizontal deflection circuits.

A positive going pulse is coupled through R127 to the base of Q105. The amplitude and duty cycle of this waveform must be as indicated in the electrical specifications (Section 1.2) for proper circuit operation.

The driver stage is either cut off or driven into saturation by the base signal. The output signal appears as a rectangular waveform and is transformer-coupled to the base of the horizontal output stage. The polarity of the voltage at the secondary of the
driver transformer is chosen such that Q106 is cut off when Q105 conducts and vice versa.

During conduction of the driver transistor, energy is stored in the coupling transformer. The voltage at the secondary is then positive and keeps Q106 cut off. As soon as the primary current of T101 is interrupted due to the base signal driving Q105 into cut off, the secondary voltage changes polarity. Q106 starts conducting and its base current starts to flow. This gradually decreases at a rate determined by the transformer inductance and circuit resistance.

The horizontal output stage has five main functions; to supply the yoke with the correct horizontal scanning current; develop 340V (5") or 400V (9" & 12") for use with the CRT; develop 26V (5") or 34V (9" & 12") for the video output stage; and develop -120V (5") or -160V (9" & 12") for the CRT bias.

Q106 acts as a switch which is turned on or off by the rectangular waveform on the base. When Q106 is turned on, the supply voltage plus the charge on C113 causes yoke current to increase in a linear manner and moves the beam from near the center of the screen to the right side. At this time, the transistor is turned off by a positive voltage on its base which causes the output circuit to oscillate. A high reactive voltage in the form of a half cycle negative voltage pulse is developed by the yoke's inductance and the primary of T2. The peak magnetic energy which was stored in the yoke during scan time is then transferred to C109 and the yoke's distributed capacity. During this cycle, the beam is returned to the center of the screen.

The distributed capacity now discharges into the yoke and induces a current in a direction opposite to the current of the previous part of the cycle. The magnetic field thus created around the yoke moves the scanning beam to the left of the screen.

After slightly more than half a cycle, the voltage across C109 biases the damper diode CR103 into conduction and prevents the flyback pulse from oscillating. The magnetic energy that was stored in the yoke from the discharge of the distributed capacity is released to provide sweep for the first half of scan and to charge C113 through the rectifying action of the damper diode. The beam is then at the center of the screen. The cycle will repeat as soon as the base voltage of Q106 becomes negative.

C113, in series with the yoke, also serves to block DC currents through the yoke and to provide "S" shaping of the current waveform. "S" shaping compensates for stretching at the left and right sides of the picture tube because the curvature of the CRT face and the deflected beam do not describe the same arc.

L101 is an adjustable width control placed in series with the horizontal deflection coils. The variable inductive reactance allows a greater or lesser amount of the deflection current to flow through the horizontal yoke and, therefore, varies the width of the horizontal scan.
The negative flyback pulse developed during horizontal retrace
time is rectified by CR104 and filtered by C110. This voltage
is coupled through the brightness control to the grid of the CRT
(V1).

This same pulse is transformer-coupled to the secondary of trans-
former T2 where it is rectified by CR2, CR106 and CR105 to pro-
vide the CRT ultor voltage, the focus and video amplifier op-
erating voltages.

3.4 LOW VOLTAGE POWER SUPPLY

The TV 9 and 12 are available with two internal power supplies.
The standard supply consists of a power supply module with a
separate regulator board. The optional supply consists of a
power supply module with the series pass transistor replaced
with an IC regulator in a TO-3 package.

The 120 VAC primary voltage (220/240V, optional) is stepped down
at the secondary of T1 and is rectified by a full wave bridge
CR1. Capacitor C1 is used to smooth out the rectified output
of CR1.

3.4.1 STANDARD LOW VOLTAGE POWER SUPPLY

This power supply uses a series pass transistor Q1 and a low
voltage regulator board to maintain a constant DC output. A
current limiting circuit is incorporated to protect the trans-
istor in the 15 volt line from accidental short circuit and load
malfunction.

Q1 is in series with the load and its output voltage will vary
with change in line voltage and circuit loading. Q202 is a DC
amplifier and compares the output voltage to a reference volt-
age provided by VR201 (5.6V zener). An error voltage is applied
to the base of Q201, an emitter follower which regulates Q1 out-
put voltage.

Assume that the output voltage has increase above the nominal set-
ting of 15V. This raises the voltage at the base of Q202 and
change the bias voltage of Q201. Since the emitter of Q201 is
direct coupled to the base of Q1, it causes Q1 to conduct less
and brings the regulated voltage back to 15V.

For short circuit protection or current limiting action, assume
the 15V line is shorted to ground. The reduce output voltage
decrease the base potential of Q202 and drives it to cutoff.
Simultaneously, the increase current through R204 increases the
emitter base voltage of Q203 and turns it on. Prior to the short
circuit condition, Q203 is at cutoff. The increase collector
current through R202 changes the base voltage of Q1 and causes
its output current to decrease accordingly. This closed loop
operation maintains the current available to any transistor con-
ected to the 15V line at a safe level during the short circuit
condition.
3.4.2 IC LOW VOLTAGE SUPPLY

The series pass transistor has been replaced with an IC regulator. The resistor R1 across the input/output terminal is used to limit the power dissipation of the IC. The regulator maintains the output voltage at 15V and provides current limiting and short circuit protection.
4.1 SYNCHRONIZATION AND DRIVE SIGNALS

Apply horizontal and vertical drive signals to the horizontal and vertical drive terminals as indicated on your schematic. Adjust their levels to a nominal +4V peak-to-peak. The duty cycle of each signal must be adjusted as described in Section 1.2.

The horizontal drive signal is required to initiate horizontal scan and high voltage, and should be connected before applying power to the monitor.

4.2 LOW VOLTAGE SUPPLY

For units which have a self-contained low voltage power supply, set the DC voltage by variable resistor R208 to 15V. This voltage can be monitored at the junction of R114 and R130.

Monitors that use an external DC supply must supply the voltage as specified in Section 1.2.

4.3 BRIGHTNESS

Normally, the monitor will be used to display alphanumeric or other black and white information. Moreover, the video polarity is usually white characters on a black background.

The brightness control should be adjusted at a point where the white raster is just extinguished. The CRT will then be at its cutoff point, and a maximum contrast ratio can be obtained when a video signal is applied.

4.4 VIDEO CONTRAST

Q101 is designed to operate linearly when a +2.5V signal is applied to its base. Some models incorporate a 500 ohm external contrast control to maintain this level. This control, or a fixed resistor, should be adjusted for a typical signal level of +2.5V peak-to-peak when measured at the video input terminal of the printed circuit board edge connector. (Refer to the schematic.)

In all cases, the output DC impedance of the video signal source must be 500 ohms, or less.

4.5 VERTICAL ADJUSTMENTS

There is a slight interaction among the vertical frequency, height, and linearity control. A change in the height of the picture may affect linearity.

(1) Apply video and synchronization signals to the monitor.

(2) Set the vertical frequency control R116 near the mechanical center of its rotation.
(3) Adjust the vertical height control R124 for desired height.
(4) Adjust the vertical linearity control R121 for best vertical linearity.
(5) Remove the vertical drive signal from the unit. Or, alternatively, use a short jumper lead, and short the vertical drive input terminal of the printed circuit card edge connector to ground.
(6) Readjust the vertical frequency control R116 until the picture rolls up slowly.
(7) Restore vertical drive to the monitor.
(8) Recheck height and linearity.

4.6 HORIZONTAL ADJUSTMENTS

Raster width is affected by a combination of the low voltage supply, width coil L101, and the horizontal linearity sleeve located on the neck of the CRT beneath the yoke.

(1) Apply video and synchronization signals to the monitor. Insert the horizontal linearity sleeve about 2/3 of its length under the yoke. (If you received a monitor from the factory in which the placement of the linearity sleeve has been determined, make a mark on the sleeve and re-insert the sleeve to this mark when removal of the yoke and linearity sleeve are required.)

If the linearity sleeve is inserted farther than necessary, excessive power will be consumed, and the horizontal output circuitry could be overstressed.

(2) Adjust the horizontal width coil L101 for the desired width.
(3) Insert the linearity sleeve farther under the yoke to obtain the best linearity. Although this adjustment will affect the raster width, it should not be used solely for that purpose. The placement of the linearity sleeve should be optimized for the best linearity.
(4) Readjust L101 for proper width.
(5) Observe final horizontal linearity and width, and touch up either adjustment if needed.

No horizontal hold control is used in this monitor. The raster should be properly locked and centered when the horizontal drive signals as described in Section 1.2 are used.

4.7 FOCUS ADJUSTMENT

The focus control R107 provides an adjustment for maintaining best overall display focus. This control does not have a large effect on focus because of the CRT gun assembly construction.
4.8 CENTERING

If the raster is not properly centered, it may be repositioned by rotating the ring magnets behind the deflection yoke.

The ring magnets should not be used to offset the raster from its nominal center position because it would degrade the resolution of the display.

If the picture is tilted, rotate the entire yoke.
# Section 5
## TROUBLESHOOTING AND MAINTENANCE

### 5.1 TROUBLESHOOTING GUIDE

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Check</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>No control of brightness level</td>
<td>Check for a DC volt- at pin 4 of 10 pin edge connector (or wiper of brightness control) for a -150V DC to +30V DC as brightness control is rotated</td>
<td>If -150V DC isn't present check CR105. If -150V DC is present replace CRT.</td>
</tr>
<tr>
<td>Insufficient Vert Hold Range</td>
<td></td>
<td>Replace Q102</td>
</tr>
<tr>
<td>Low High Voltage</td>
<td></td>
<td>Replace HV rectifier CR2.</td>
</tr>
<tr>
<td>Hum in raster</td>
<td>Shunt C1 with equivalent capacitor.</td>
<td>If symptoms are removed replace C1.</td>
</tr>
<tr>
<td>Hum in raster &amp; PS doesn't regulate</td>
<td>Check Q1 for short.</td>
<td></td>
</tr>
<tr>
<td>No brightness</td>
<td>Observe lighted filament in CRT</td>
<td>If filament isn't lighted, check with ohmmeter. If no continuity, replace CRT.</td>
</tr>
<tr>
<td>Monitor is dead</td>
<td>Check for HV on CRT anode (11kV) If no HV is present, check LV supply +15V DC NOTE: LV supply will indicate low or 0 volts due to its current limiting action if a short is evident in the &quot;A&quot; volt line.</td>
<td>If LV isn't present, remove plug P104. If B+ is restored replace Q106. With P104 removed and B+ is still not present, check for approximately 22V DC on collector of Q1. If voltage is present, with P104 removed check Q202 Q203, and VR201. On models without PS check fuse F101.</td>
</tr>
</tbody>
</table>

The voltage waveforms are shown in Fig. 2 and Fig. 3 is the interconnecting cabling diagram. Fig. 4 shows the circuit board component locations.
Fig. 2 Voltage Waveform
Fig. 3 Interconnecting Cabling Diagram
NOTE:
F101 and R108 are used only when low voltage power supply is not supplied.

C116 is used on 5 inch models only.
R102 (brightness pot) is optional.

Fig. 4 Circuit Board Components Location
<table>
<thead>
<tr>
<th>SYM</th>
<th>DESCRIPTION</th>
<th>BBRC PART NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>3500; 600V, electrolytic</td>
<td>1-012-2156</td>
</tr>
<tr>
<td>C101</td>
<td>0.01; 1000V, ceramic arc gap</td>
<td>1-012-0112</td>
</tr>
<tr>
<td>C102</td>
<td>0.01; 1000V, ceramic arc gap</td>
<td>1-012-0112</td>
</tr>
<tr>
<td>C103</td>
<td>0.01; 1000V, ceramic arc gap</td>
<td>1-012-0112</td>
</tr>
</tbody>
</table>
| C104| 0.001 ± 10%; 1000V, ceramic disc or 0.005 ± 20%; 500V, ceramic disc | 1-012-0540 /
|     | 10-12-7508 | |
| C105| 0.47 ± 10%; 100V, mylar | 1-012-1005 |
| C106| 0.47 ± 10%; 100V, mylar | 1-012-1005 |
| C107| 500; 6V, electrolytic | 1-012-2158 |
| C108| 100; 6V, electrolytic | 1-012-2160 |
| C109| 0.022 ± 10%; 400V, mylar or 0.033 ± 10%; 400V, mylar or 0.015 ± 10%; 400V, mylar or 0.027 ± 10%; 400V, mylar | 1-012-0800 /
|     | 1-012-0804 | /
|     | 1-012-2153 | /
|     | 1-012-2237 | |
| C110| 0.047 ± 10%; 200V, mylar | 1-012-2240 |
| C111| 0.02 ± 20%; 1000V, ceramic disc | 1-012-0780 |
| C112| 50; 50V, electrolytic | 1-012-2157 |
| C113| 10 ± 10%; 63V, mylar or 10 ± 10%; 63V, polycarbonate | 1-012-1130 /
|     | 1-012-2255 | /
|     | 1-012-2159 | |
| C114| 200; 25V, electrolytic | 1-012-2165 |
| C115| 50; 25V, electrolytic | 1-012-2165 |
| C116| 20; 150V, electrolytic (S" only) | 1-012-1260 |
| C117| 6uf; 25V, electrolytic | 1-012-2066 |
| C118| 820pf ± 5%; 500V, dipped mica or 470pf ± 5%; 500V, dipped mica (TV-B12) or 360pf ± 5%; 500V, dipped mica or 100pf ± 5%; 500V, dipped mica or 680pf ± 5%; 300V, dipped mica | 1-012-0482 /
|     | 1-012-0460 | /
|     | 1-012-2241 | /
|     | 1-012-0300 | /
|     | 10-57-5681 | |
| C119| 25; 50V, electrolytic | 1-012-2193 |
| C120| 0.01 ± 20%; 1000V, ceramic disc | 1-012-0740 |
| C201| 50; 50V, electrolytic | 1-012-2157 |
| C202| 0.01 ± 20%; 1000V, ceramic disc | 1-012-0780 |
| C203| 50; 50V, electrolytic | 1-012-2157 |
| CR1 | VS148, bridge rectifier | 1-021-0413 |
| CR2 | HS10, high voltage rectifier | 1-021-0424 |
| CR101| IN3605 | 1-021-0410 |
| CR102| IN3605 | 1-021-0410 |
| CR103| IN4785 | 1-021-0360 |
| CR104| IN3279 | 1-021-0380 |
| CR105| IN3279 | 1-021-0380 |
| CR106| IN3279 | 1-021-0380 |
| CR107| IN3279 | 1-021-0380 |
| CR108| IN3605 | 1-021-0410 |
F1 or Fuse, 0.6A-250V, ¾ X 1¼, slo-blo
or Fuse, 0.6A-250V, 9/32 X 1¼, slo-blo (TV0B12)
or Fuse, 0.3A ¾ X ₁/₁₄ or Fuse, 0.3A 1¼ X 9/32
F101 Fuse, 2A-125V, picofuse
L1 Vertical choke (TV S & 12)
or Vertical choke (TV 9)
L101 Coil, width
or coil, width
or Coil, width

TRANSISTOR
Q1 2N3055
Q101 2N5830
Q102 2N6027
Q103 MPSA14
Q104 MJE3055
Q105 MPS-U05
Q106 B1182
or B1182, orange dot
or B1182
or B1182, blue dot
or B1196
Q107 2N4124
Q201 2N3053
Q202 2N3903
Q203 2N3903

RESISTOR, Film ½W ± 5%; unless otherwise stated
R101 2.7k
R102 Var; 100k ± 20%; 1/8W (optional)
R103 82k
R104 100k
R105 Not Used
R106 100k
R107 Var; 2.5M ± 20%; 1/8W, composition
R108 15Ω, (TV 12 W/O power supply)
or 22Ω, 1W, composition (TV-C12 only)
R109 47Ω
R110 820Ω
R111 47Ω
R112 220Ω
R113 470Ω
R114 150Ω, (TV 9 & 12)
or 68Ω, (TV 5)
R115 82k
R116 Var; 100k ± 20%; 1/8W, composition
R117 4.7k
or 1k
R118 8.2k
or 1.8k
<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
<th>Remarks</th>
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<tbody>
<tr>
<td>R119</td>
<td>100k</td>
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<tr>
<td>R120</td>
<td>560Ω</td>
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<td>or</td>
<td>150Ω</td>
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<tr>
<td>R121</td>
<td>Var; 10k ± 20%; 1/8W, composition</td>
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<td>R122</td>
<td>4.7k</td>
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<tr>
<td>R123</td>
<td>56Ω</td>
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<td>or</td>
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<tr>
<td>R124</td>
<td>Var; 250Ω ± 20%; 1/8W, composition</td>
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<td>R125</td>
<td>6.8Ω ± 10%; 2W, wirewound</td>
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<tr>
<td>or</td>
<td>1.8Ω ± 10%; 2W, wirewound</td>
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<tr>
<td>R126</td>
<td>680Ω</td>
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<tr>
<td>R127</td>
<td>470Ω</td>
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<td>R128</td>
<td>2.7k</td>
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<tr>
<td>R129</td>
<td>3Ω</td>
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<tr>
<td>or</td>
<td>10Ω</td>
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<td>R130</td>
<td>1.2Ω ± 10%; 2W, wirewound</td>
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<tr>
<td>R131</td>
<td>3.3k</td>
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<td>R132</td>
<td>82Ω ± 10%; 2W, wirewound</td>
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<tr>
<td>R133</td>
<td>4.7k; ¼ W</td>
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<tr>
<td>R134</td>
<td>Not used</td>
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<tr>
<td>R135</td>
<td>22k; ¼ W</td>
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<tr>
<td>R136</td>
<td>22k; ¼ W</td>
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<tr>
<td>R137</td>
<td>68k; 1W</td>
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<tr>
<td>R138</td>
<td>1k, 100Ω</td>
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<tr>
<td>R201</td>
<td>1k</td>
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<tr>
<td>R202</td>
<td>470Ω</td>
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<tr>
<td>R203</td>
<td>10k</td>
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<td>R204</td>
<td>0.56Ω ± 10%; 2W, wirewound</td>
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<tr>
<td>R205</td>
<td>1.5k</td>
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<tr>
<td>R206</td>
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<tr>
<td>R207</td>
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<tr>
<td>R208</td>
<td>Var; 500Ω ± 20%; 1/5W, composition</td>
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<tr>
<td>R209</td>
<td>470Ω</td>
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</tbody>
</table>

**Transformer**

- **T1**: Power
- **T2**: High voltage (TV 12C, TV A12, TV E12)
- or: High voltage (TV B12, TV C12, TV C12)
- or: High voltage (TV 9, TI)
- or: High voltage (5" CRT)
- or: High voltage (TV 5/I)
- or: High voltage (TV 9)
- or: High voltage (TV-12/CC)
- or: High voltage (TV J12)
- or: High voltage (TV M12)
- or: High voltage (TV 9/NC)

**T101**: Horizontal driver

- or: horizontal driver

**VR101**: 1N758

**VR102**: VR56

**VR201**: 1N752
### MISCELLANEOUS

<table>
<thead>
<tr>
<th>Component</th>
<th>Part Number</th>
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<tbody>
<tr>
<td>Socket, CRT (TV 12)</td>
<td>1-022-0427</td>
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<tr>
<td>Socket, CRT (TV 5)</td>
<td>1-022-0430</td>
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<tr>
<td>Fuseholder, extractor post, fuse size: ¾ X 1¼</td>
<td>1-028-0210</td>
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<tr>
<td>Fuseholder, extractor post, fuse size: 9/32 X 1¼ (TV B12 only)</td>
<td>1-028-0246</td>
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<td>Low voltage circuit board assembly</td>
<td>6-002-0459</td>
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<tr>
<td>Main chassis circuit board assy. (TV 12, TV B12, TV E12, and TV D12) W/PS</td>
<td>6-002-0500</td>
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<td>Cable assy.; 6 inch</td>
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<td>Power supply module (TV-12, 120VAC)</td>
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<td>Power supply module (TV-12, 220VAC)</td>
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Power supply module (TV-9, 120VAC) 6-003-0369
Power supply module (TV-B12, 120VAC) 6-003-0368
Power supply module (TV-B12, 220VAC) 6-003-0370
Power supply module (TV-9, 220VAC) 6-003-0376
Deflection coil assy. (TV-12 and 5) 6-004-0321
Deflection coil assy. (TV-9) 6-004-0325

or CRT, 12", P4 phosphor 1-014-0737
or CRT, 5", P4 phosphor 1-014-0725
or CRT, 9", P4 phosphor 1-014-0748
Power Cable assy., 120 VAC 6-003-0645
Power Cable assy., 220 VAC 6-003-0652