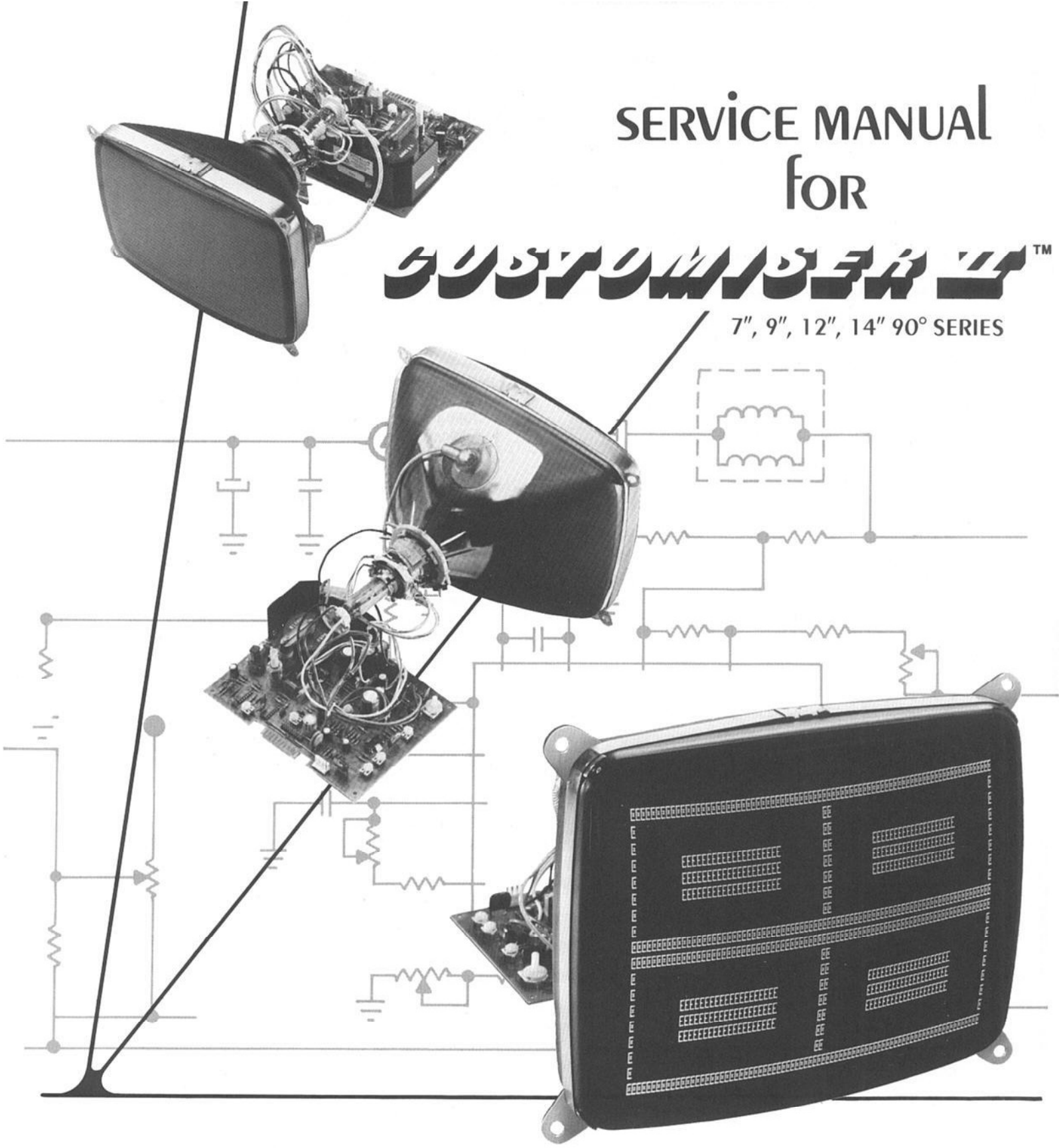
SERVICE MANUAL FOR CUSTOMISER II™

7", 9", 12", 14" 90° SERIES



WELLS-GARDNER ELECTRONICS CORPORATION
2701 N. Kildare, Chicago, IL 60639
312/252-8220 TELEX: 25-3286

SERVING CONSUMER AND INDUSTRIAL ELECTRONICS FOR MORE THAN HALF A CENTURY

THE CUSTOMISER II™
BY
WELLS-GARDNER

SPECIFICATIONS

CRT
- **7″, 9″, 12″, or 14″** diagonal measure
- **90° deflection**
- Aspect ratio of 3 x 4 standard, 4 x 5 optional on 9″ and 12″ models.
- P4 phosphor standard, optional EIA phosphors available.
- Variety of faceplate treatments including polished, PPG and direct etch.

MECHANICAL
- **Kit standard.** Design flexibility for your compact system. Best fit, least cost.
- Custom chassis available with minimum order.

VIDEO PERFORMANCE
- **Resolution** is 900 lines center, 750 lines at corners (P4 phosphor).
- **Frequency response** is within 3 dB, from 10 Hz to 30 MHz.

POWER REQUIREMENTS
- Choice of +12 VDC or +15 VDC inputs at 1 amp typical.

SYNCHRONIZATION
- **Horizontal:** Choice of 15.7 kHz, 18.6 kHz, 20.7 or 22.6 kHz ±500 Hz is standard. Other frequency options are available.
- Centering of ±10 µs with 6 µs typical retrace time.
- **Vertical:** 47 to 63 Hz with a 600 µs typical retrace time.

INPUT SIGNALS
- **Horizontal:** 4 to 40 µs, positive 2.0 to 5.0 V P-P.
- **Vertical:** 50 to 1500 µs negative (positive optional) 2.0 to 5.0 V P-P.
- **Video:** Positive white 2.0 to 4.0 V P-P (2.5 V typical).

GEOMETRY
—Pin and Barrel—
- Sides equal less than 1.5% of vertical height.
- Top and bottom equal less than 1.5% of width.

LINEARITY
- Character height or width will not vary more than 10% from the average character size.
- Adjacent characters will not vary more than 10%.

CONTROLS
- **Internal:** Horizontal centering, master bright, focus, vertical hold, vertical linearity, vertical size, and optional contrast.
- **External:** Operator remote brightness and video level (contrast) connections are available at the input connector.

INTERCONNECT TO CUSTOMER SYSTEM
- Standard 10-pin edge connector and/or 20-pin mass terminator.

ENVIRONMENT
- **Temperature:** Operating 0° to +55°C and storage from −40°C to +65°C. Note: CRT's with PPG should not be subjected to storage or operating temperatures above 50°C.
- **Humidity:** Operating, 80% and storage to 90% non-condensing.
- **Altitude:** Operating to 10,000 ft. and shipment or storage to 40,000 ft.
- Designed to comply with U.L. and C.S.A. specifications.

●●●SPECIFICATIONS ARE SUBJECT TO CHANGE IN ORDER TO ASSURE YOU THE LATEST IN DISPLAY TECHNOLOGY.●●●

NOTE: An index for this manual will be found on page 32.

WARNINGS

X-RAY RADIATION WARNING NOTICE

1. **WARNING:** PARTS WHICH INFLUENCE X-RAY RADIATION IN HORIZONTAL DEFLECTION, HIGH VOLTAGE CIRCUITS AND PICTURE TUBE ETC. ARE INDICATED BY (★) IN THE PARTS LIST. FOR REPLACEMENT PURPOSES, USE ONLY THE TYPE SHOWN IN THE PARTS LIST.

PRODUCT SAFETY NOTICE

WARNING: FOR CONTINUED SAFETY REPLACE SAFETY CRITICAL COMPONENTS ONLY WITH MANUFACTURER RECOMMENDED PARTS. THESE PARTS ARE IDENTIFIED BY SHADING AND BY (⚠) ON THE SCHEMATIC DIAGRAM.

ADVERTISSEMENT: POUR MAINTENIR LE DEGRE DE SECURITE DE L'APPAREIL NE REMPLACER LES COMPOSANTS DONT LE FONCTIONNEMENT EST CRITIQUE POUR LA SECURITE QUE PAR DES PIECES RECOMMANDEES PAR LE FABRICANT.

For replacement purposes, use the same type or specified type of wire and cable, ensuring that the positioning of the wires is followed (especially for H.V. and power supply circuits). Use of alternative wiring or positioning could result in damage to the monitor or in a shock or fire hazard.

2. **Power Up Warning—**
An isolation transformer must be used between the AC supply and the AC connector of the monitor (if applicable) before servicing or testing is performed. Before servicing is performed, read all the precautions labeled on the CRT and chassis.

3. **High Voltage—**
This monitor contains HIGH VOLTAGES derived from power supplies capable of delivering LETHAL quantities of energy. Do not attempt to service until all precautions necessary for working on HIGH VOLTAGE equipment have been observed.

4. **CRT Handling—**
Extreme care should be used in handling the picture tube as rough handling may cause it to implode due to atmospheric pressure. Do not nick or scratch glass or subject it to any undue pressure in removal or installation. When handling, safety goggles and heavy gloves should be worn for protection. Discharge picture tube by shorting the anode connection to chassis ground. When discharging, go from ground to anode. Do not handle CRT by the neck.

CAUTION: *No work should be attempted on an exposed monitor chassis by anyone not familiar with servicing procedures and precautions.*

5. **General Safety Requirements—**
Be sure to read all instructions and any other explanatory material thoroughly before attempting to install or service these units.

DISPLAY ALIGNMENT PROCEDURE

NOTE: *The following procedures are outlined to check operation of the monitor and perform simple preinstallation adjustments. Display alignment may not be required prior to installation but it should be checked after service or component replacement.*

A. Perform the procedures in the sequence presented.

B. Connect the appropriate power supply voltage to the monitor.

C. Allow at least three (3) minutes warm-up before adjusting the monitor.

D. All display alignment has been factory preset by Wells-Gardner (W.G.E.C.). Note the statements in adjustment VI ("Raster Geometry Adjustments") regarding influence of metal mounting brackets.

At the time of installation or after "kit" has been placed in final mounting (with any metal around it placed as in final installation) observe Raster Geometry Alignment. (Figures 5 and 6). Reposition Yoke Adjusting Magnets ONLY IF NECESSARY. Refer to pages 6 and 7.

If a considerable amount of adjustment seems to be necessary, try to determine the cause. For example, determine whether a magnet was pushed off the yoke during unpacking. In other words, it is more efficient to check for the cause of a gross mis-adjustment than it would be to make improper adjustments.

IMPORTANT: *We recommend using a non-metallic adjustment tool when performing the following.*

NOTE:

CCW = Counterclockwise Rotation.
CW = Clockwise Rotation.
(as viewed from component side [upper side] of PC Board)

E. Refer to Figure 1 for location of adjustable controls, optional controls, etc.

F. Connect signals and make adjustments after referring to "INSTALLATION" section for required specifications, cautions, et cetera. Refer to Figure 7 or 8 for input connections.

1. Perform the steps below in the order indicated.

2. Connect signal generator to circuit card edge connector or 20-pin mass terminator.

3. Adjust vertical hold (R5), if necessary, until display is synchronized. Adjust horizontal centering (R34) for centered video.

I. **Brightness and Contrast Adjustment**

1. Remove video drive from pin 8 of the edge connector or, if contrast control is available, set control to minimum. Refer to Figures 7 and/or 1. If unit is connected to a 20-pin mass terminator, remove video drive from P2/pins 15-16.

2. Set master brightness control R1 fully CCW to minimum.

3. Rotate external brightness control to maximum, if external brightness control is used in the model being adjusted.

4. Advance R1 until raster just appears, then set R1 back to the point at which the raster is extinguished.

5. Connect video to pin 8 of the card edge connector or adjust contrast control for desired level. Refer to Figures 7 and/or 1 if unit has a card edge connector. Refer to Figures 8 and/or 1 if unit has a 20-pin mass terminator.

II. **Horizontal Size Adjustment**

Using hex alignment tool, turn slug of L2 for desired width.

III. **Height and Linearity Adjustment**

1. Connect power drive signals to the edge connector or 20-pin mass terminator. Refer to Figure 7 or 8.

2. Rotate the height control R10 to obtain the desired display size.

3. Adjust the vertical linearity control R12 until the extreme top and bottom characters are equal in height. Refer to Figure 2, areas A and B.

4. Readjustment of R10 may be required again to obtain desired height setting.

IV. **Focus Adjustment**

To obtain best focus uniformity over the entire viewing area, R48 should be set for best focus when viewing the characters at a point near center and 1/3 down from the top of the display.

V. **Raster and Video Centering Adjustment**

CAUTION: *Do the raster centering magnets really need repositioning?*

NOTE: *Refer to Figure 3; Figure 1 shows adjustable controls. Readjust brightness control for visible raster.*

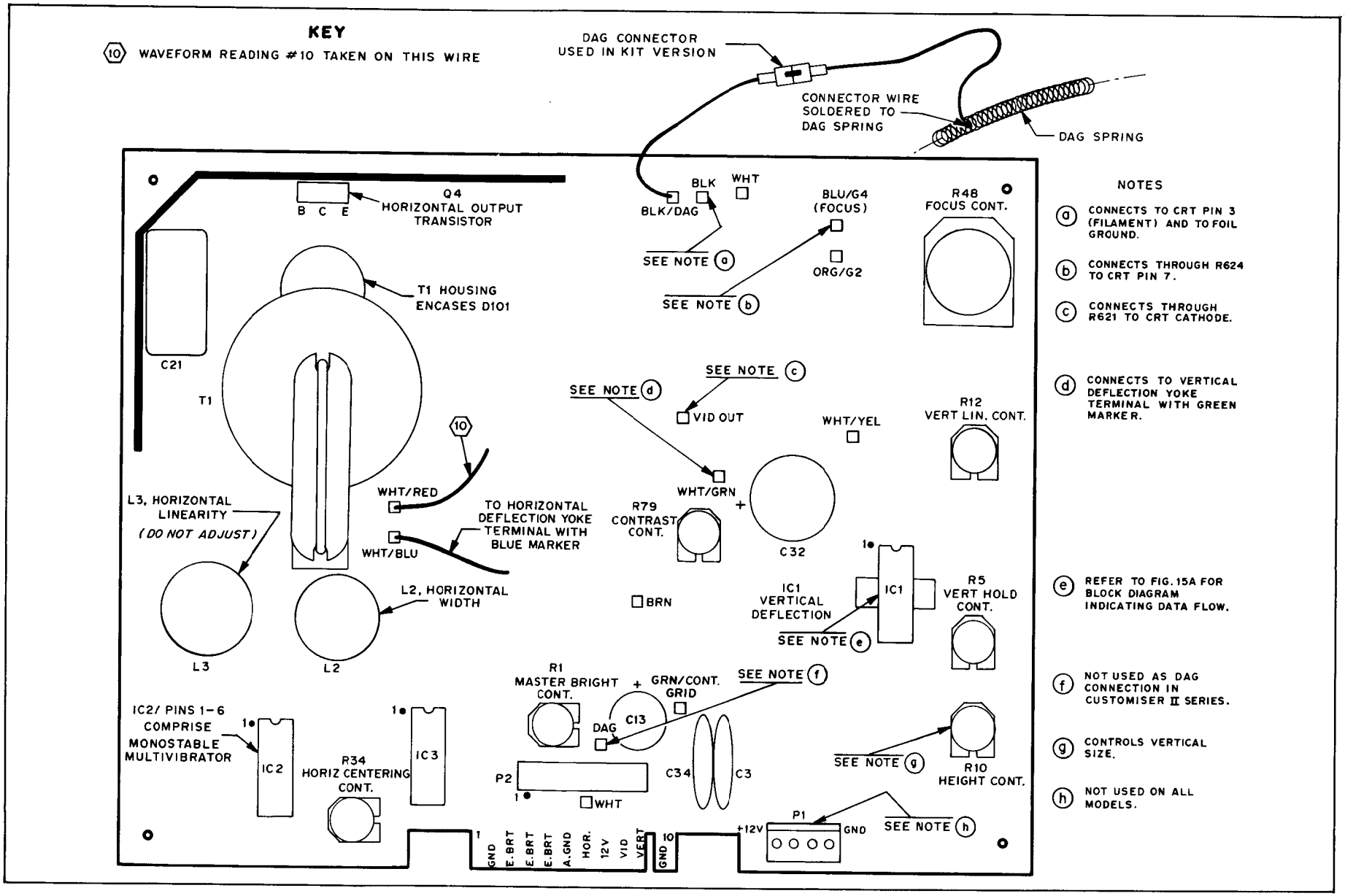


FIGURE 1: Partial View, Main PC Board and Dag Connections (12-Volt Kit Version Shown)

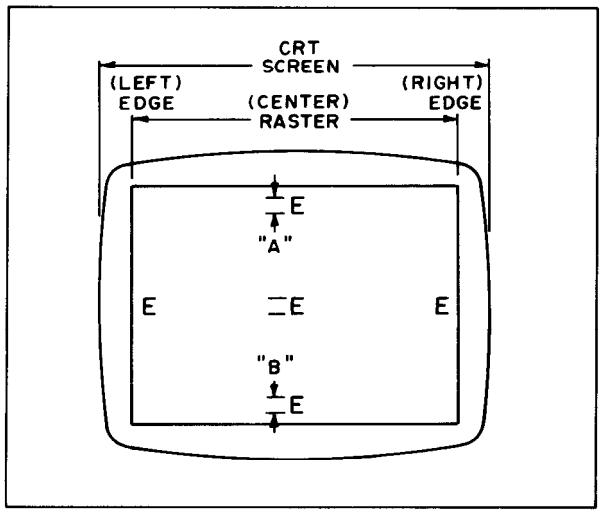


FIGURE 2: Partial CRT Raster Display of Characters for Adjustment

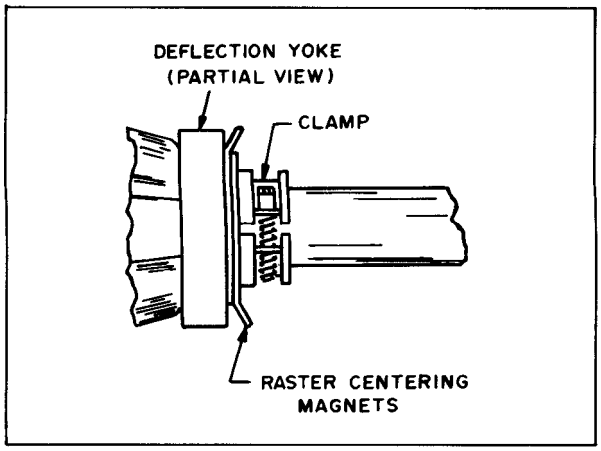


FIGURE 3: Partial View of CRT Neck/Deflection Yoke

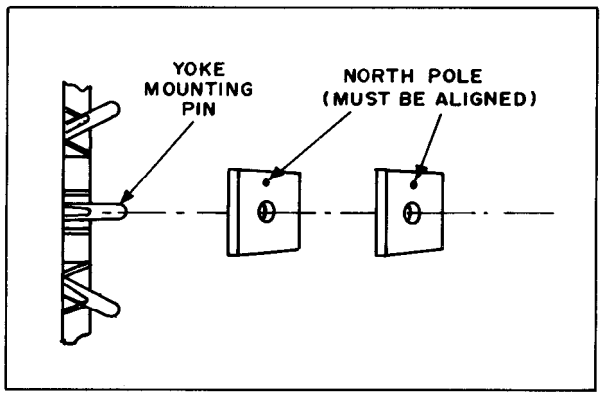


FIGURE 4: Yoke Adjusting Magnets

1. Height control R10 and horizontal width coil L2 should be set so all raster edges are visible.

2. Position the raster centering magnets for best centering of display raster.

CAUTION: *Do not readjust raster centering magnets after performing the Raster Geometry Adjustments which follow or after final installation. CRT raster geometry will be affected.*

3. Adjust R34, horizontal centering control, for best left to right video centering (Figure 1).

4. Return vertical and horizontal adjustments to the desired settings.

WARNING: *High voltages are present at the deflection yoke and are a potential shock hazard. Exercise caution when performing any adjustment procedures in the vicinity of the yoke.*

VI. Raster Geometry Adjustments

NOTE: *These adjustments should not be required unless yoke and/or CRT have been replaced. Very minor adjustment may be required due to magnetic influence of metal mounting brackets.*

A. PINCUSHION OR BARREL CORRECTION FOR TOP, BOTTOM AND SIDES

Perform this adjustment if raster exhibits the abnormal effects shown in Figure 5.

1. Select distorted area and push a magnet on the yoke pin which corresponds to that area.

2. Rotate the magnet to obtain the desired raster line labeled normal in Figure 5.

3. In extreme cases, a second magnet will be needed on the same post. Both magnets must be aligned as shown in Figure 4 and rotated simultaneously.

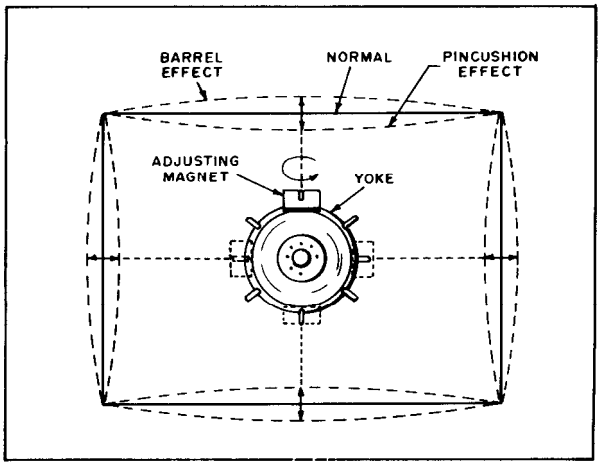


FIGURE 5: Pincushion/Barrel Adjustments

B. TRAPEZOIDAL CORRECTION

Perform this adjustment if raster exhibits the abnormal effects shown in Figure 6.

1. Push a magnet onto the yoke mounting pin as shown in Figure 4. Magnet should be placed only on the pin which corresponds to the affected area.

2. Rotate the magnet to obtain a normal raster.

3. If unable to obtain the desired raster, add a second magnet to the yoke mounting pin. Both magnets must be aligned as shown in Figure 4 and rotated simultaneously.

NOTE: *When geometry adjustments have been completed, not every yoke pin may require a magnet. Normal installation range is 2 to 5 magnets.*

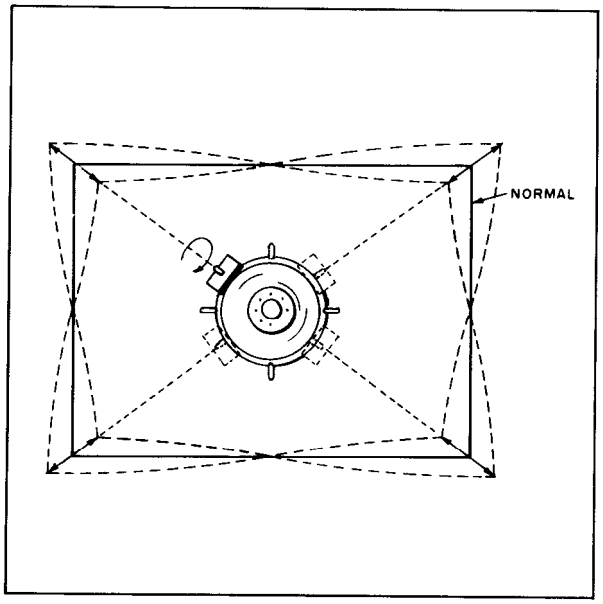


FIGURE 6: Trapezoidal Adjustments

INSTALLATION

A. **Kit Versions**

GENERAL
The Wells-Gardner Data Display Monitor may be installed into many different types of cabinets, housings, etc. Therefore, it is not the intention of these brief installation instructions to describe the many installation possibilities. Instead, only some of the more important installation limitations will be mentioned. Before starting an installation, it will be necessary to read and understand the following paragraphs.

CAUTION: *NO WORK SHOULD BE ATTEMPTED ON ANY EXPOSED MONITOR KIT COMPONENTS BY ANYONE NOT THOROUGHLY FAMILIAR WITH PROPER SERVICING PROCEDURES AND PRECAUTIONS. REFER TO PAGE 11 FOR ADDITIONAL WARNINGS AND CAUTIONS.*

1. Be sure that the CRT high voltage cap has a minimum of one-inch clearance from any metal shield, bracket, etc.

2. Do not allow any wires to lay on top of, or alongside any power transistor heat sinks. High heat could be damaging to insulation.

3. Be sure proper grounding connection has been made between Deflection PC Board and chassis.

4. A DAG SPRING should connect the CRT AQUADAG COATING to ground. In the event an alternate method of AQUADAG grounding is chosen, be sure the grounding is safe and in accordance with applicable codes. Refer to Figure 1.

CAUTION: *Failure to properly ground the AQUADAG COATING could result in serious electrical shock and damage to the Data Display Unit.*

5. Before unit is put into operation, perform "CURRENT LEAKAGE TEST" shown on page 11. Do not allow units to stay in operation if current leakage is excessive, as indicated by the test(s). Excessive current leakage indicates a potential shock hazard.

6. Inspect all leads to make sure that they are not pinched or that hardware is not lodged between the chassis and other metal parts in the monitor.

B. **Electrical and Signal Connections**

1. A regulated power supply delivering the appropriate DC voltage must be connected to pin 7 of card edge connector (Figure 7) or pins 13 and 14 of twenty pin mass terminator (Figure 8). The DC voltage input must have the following characteristics:

	Maximum Fluctuation	Maximum Ripple
Asynchronous	12 or 15 VDC ±0.1 V	≤ 5 mV
Synchronous	12 or 15 VDC ±0.1 V	≤ 50 mV

TABLE 1: Required Specifications, 12- or 15-Volt Supply

2. Be sure Horizontal and Vertical Input Signals are TTL-compatible, ie., 4.0 V P-P ±1.5 V.

3. Refer to Figures 7 and 8 for connections.

4. The customer-supplied external brightness control would normally have a value of 200 kΩ.

C. **Mechanical Installation**

1. Refer to Figure 9 for mounting hole dimensions and other mounting information.

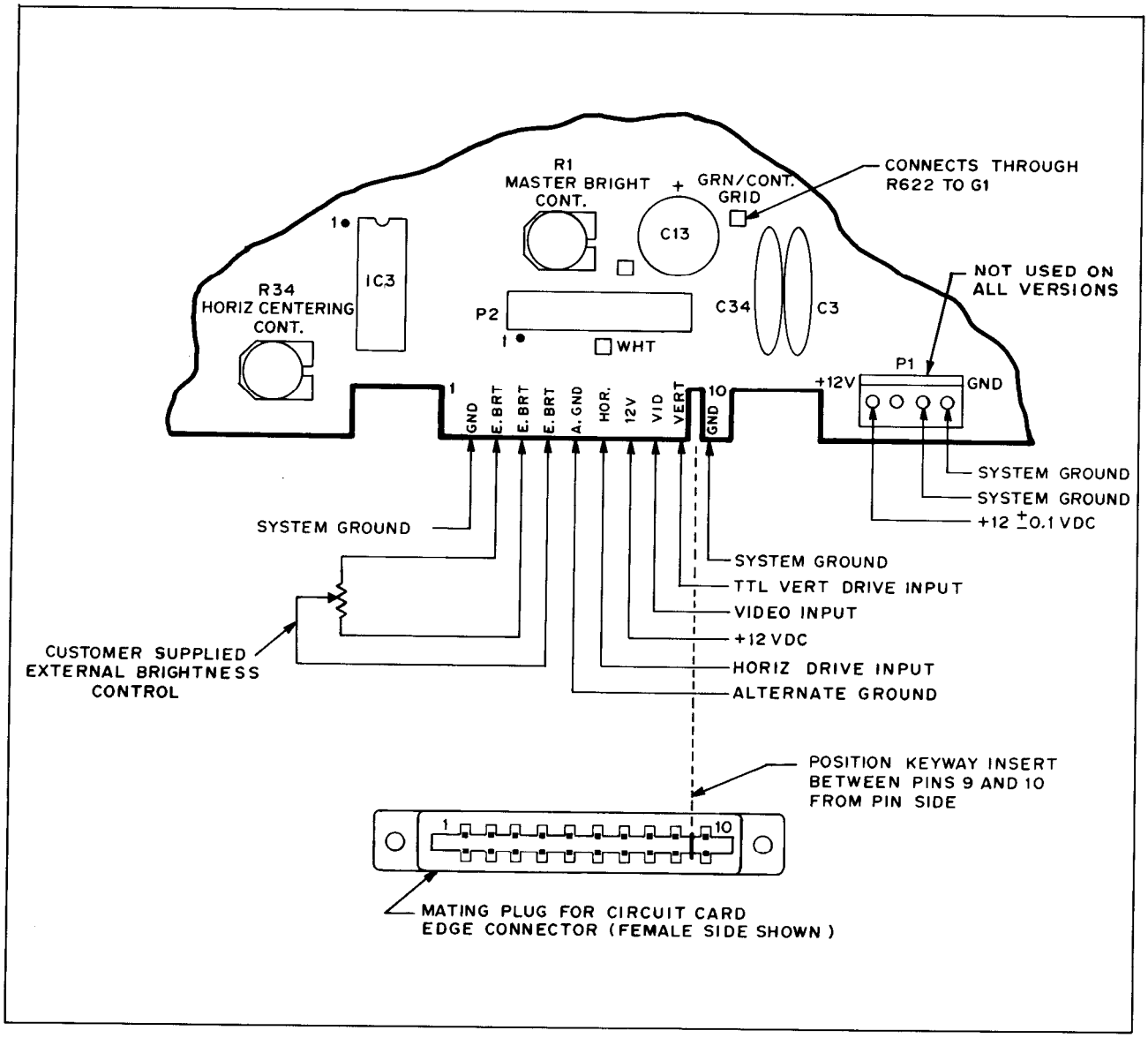


FIGURE 7: Connections for Signal Input and Power Showing Card Edge Connector and P1 (Partial View, Main PC Board of 12-V Version Included Above)

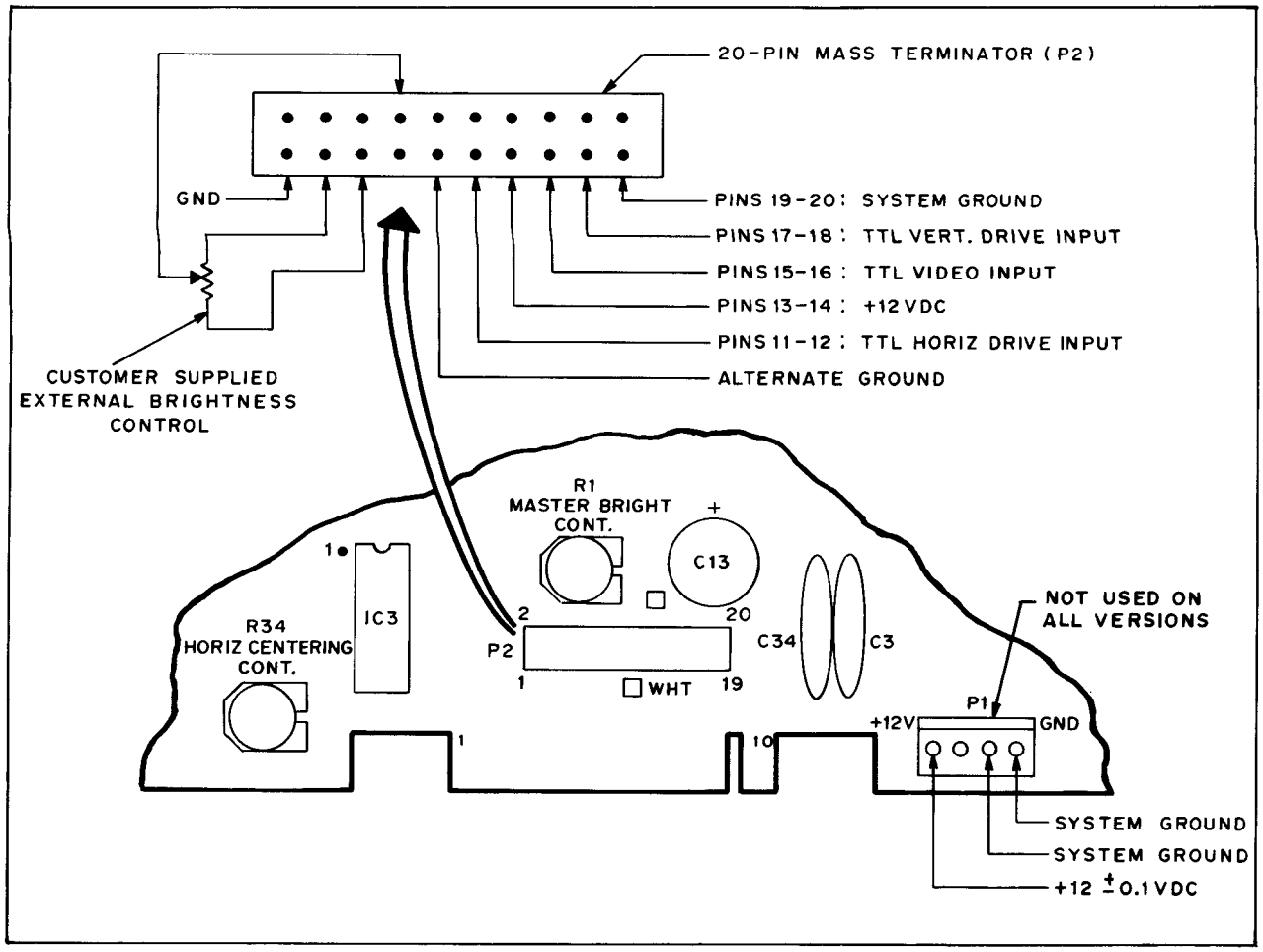


FIGURE 8: Connections for Signal Input and Power (When 20-Pin Mass Terminator and P1 are used)

NOTE: Partial View, Main PC Board of 12-V Version shown above.

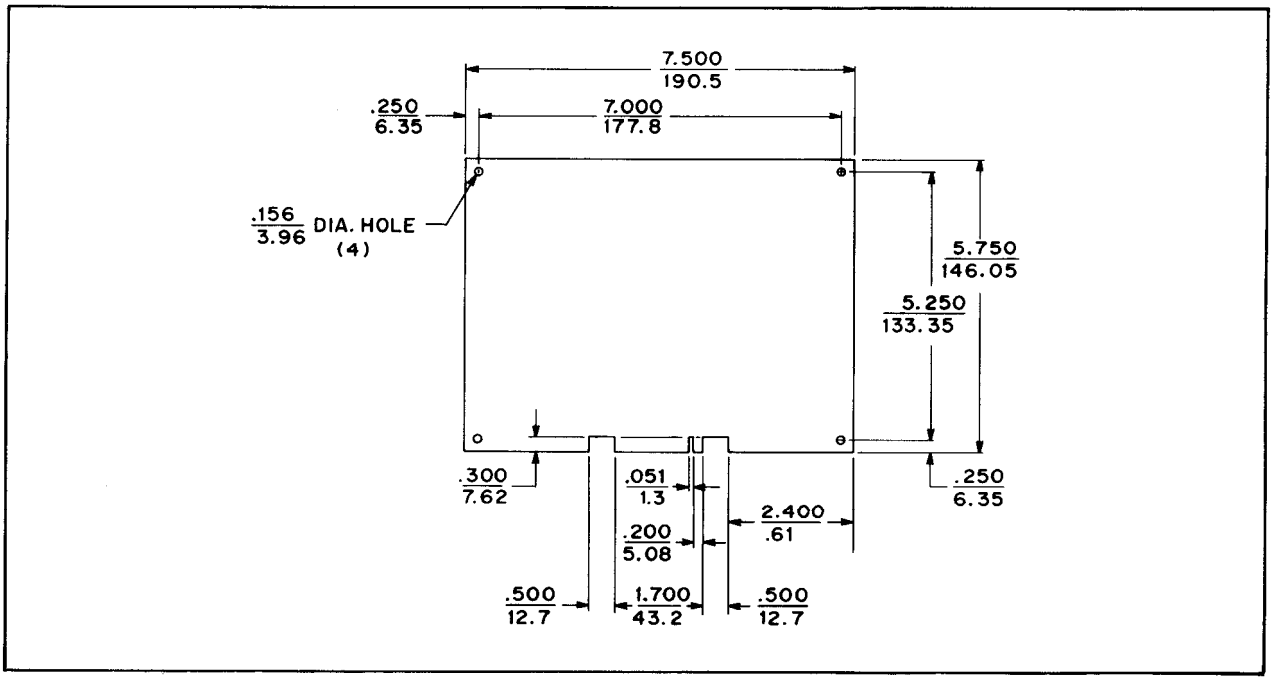


FIGURE 9: Main PC Board Dimensions (Typical CUSTOMISER II Kit Version Shown)

IMPORTANT SERVICE NOTES

WARNING: *Work on these models should be performed only by qualified service personnel thoroughly familiar with the necessary precautions required when working on high voltage equipment.*

Avoid working in close proximity to second anode leads, poke lugs, CRT or power transistor(s) when power is applied. Contact with the latter items may result in serious electrical shock or damage to the data display unit.

Always connect the aquadag ground wire from CRT tube to the deflection board ground via the dag spring and lead assembly. Maintain solid grounds in all models at all times.

CAUTION: *No modification of any circuit should be attempted unless Wells-Gardner has specifically authorized a competent technician to complete a particular modification.*

Certain HV failures can increase X-ray radiation. Monitors should not be operated with HV (High Voltage) levels exceeding the specified rating for their chassis type. Refer to Table 2 on page 31 for the nominal second anode operating voltage.

Refer to page 8 for Table 1 (Required Specifications, 12- or 15-Volt Supply).

To determine the presence of high voltage, use an accurate high impedance, HV meter connected between second anode lead and metal chassis frame only. When servicing the High Voltage System, remove static charge from it by connecting a 10-kΩ resistor in series with an insulated wire (such as a test probe) between picture tube dag and second anode lead. Input plug would be disconnected from unit.

The picture tube used in this monitor employs integral implosion protection. Replace with tube of the same type number for continued safety. Do not lift picture tube by the neck. Handle the picture tube only when wearing shatterproof goggles and after discharging the high voltage completely. Keep others without shatterproof goggles away.

When returning monitor to user, perform the following safety checks:

1. Inspect all lead dress to make certain that leads are not pinched or that hardware is not lodged between the chassis and other metal parts in the monitor.

2. Replace all protective devices such as non-metallic control knobs, insulating fishpapers, adjustment and compartment covers or shields.

3. A check for the presence of leakage current should be made at each exposed metal chassis part after monitor kit is installed or reinstalled in complete unit containing power supply.

To be sure that no electrical shock hazard exists, proceed with this test in the following manner:

"CURRENT LEAKAGE TEST"
Apply power to unit (DO NOT use an isolation transformer during these checks). All checks must be repeated with the AC line cord plug connections reversed. The chassis ground return lead should not be connected for this test.

If available, measure current using an accurate leakage current tester. Any reading of 0.5 mA or more is excessive and indicates a potential shock hazard which must be corrected before returning the monitor to the owner.

If a reliable leakage current tester is not available, this alternate method of measurement should be used. Using two clip leads, connect a 1500-Ω, 10-watt resistor paralleled by a 0.15-μF, AC type capacitor in series with a known good earth ground (such as a water pipe or conduit) and the metal part to be checked. Using an AC voltmeter with 10,000 ohms/volt or more sensitivity, measure the AC voltage drop across the resistor. Any reading of 0.75 volt RMS or more is excessive and indicates a potential shock hazard which must be corrected before returning the monitor to the owner. Refer to Figure 10.

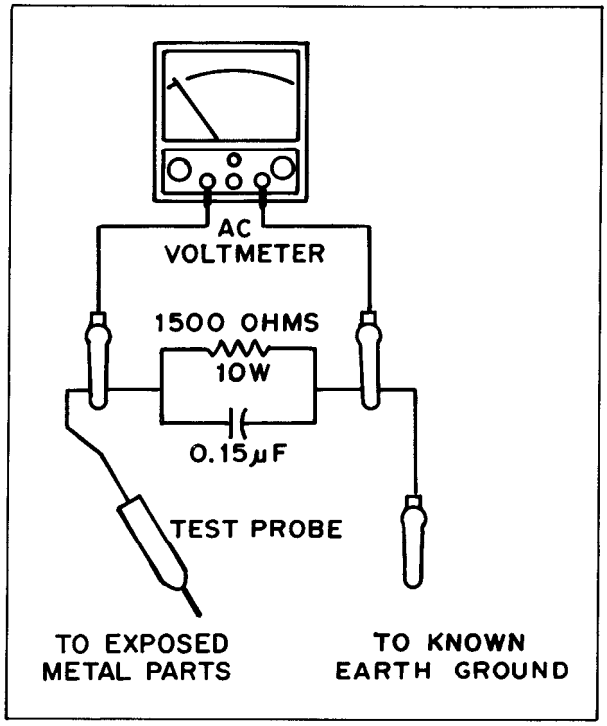


FIGURE 10: Alternate Test for Leakage (AC)

POWER TRANSISTOR REPLACEMENT:

WARNING: *Remove all power to unit before servicing!*

When replacing any transistor, such as Q4, please observe the following precautions and note the general warnings and/or precautions stated elsewhere in this manual.

1. The metal bracket, or other metal mount for certain transistors, also serves as a heat sink. After turning off power, be sure heat sink has cooled sufficiently to avoid burns.

2. When installing transistor, shoulder washer and mica insulator must be held in its proper location. Observe location when transistor is removed.

3. When replacing transistor Q4, thermal silicone grease must be applied evenly to both sides of the mica insulator. The mica insulator will be placed between transistor and heat sink.

4. All transistor mounting screws must be tight before applying power to the display.

CAUTION: *Do not apply excessive torque to transistor mounting screw. Four in.-lbs. should be sufficient.*

FAILURE TO COMPLY WITH THESE INSTRUCTIONS COULD RESULT IN FAILURE OF THE TRANSISTOR AND/OR OTHER COMPONENTS IN THE CIRCUIT.

CRT REMOVAL AND REPLACEMENT

CAUTION: *Handle CRT with great care, since rough handling may cause it to implode due to atmospheric pressure.*

Refer to page 3.

It is essential to order the correct replacement CRT. Refer to the parts list for the particular model being serviced.

1. Disconnect power supply from monitor. Connect a 10-kΩ resistor in series with an insulated wire (such as a test probe).

2. Remove 2nd anode lead. Discharge CRT by shorting 2nd anode to a good ground (such as the aquadag grounding spring) with resistor and insulated wire mentioned in step one.

3. Remove CRT socket by pulling straight off tube.

4. Remove deflection yoke by loosening clamp screw. Mark yoke, if necessary, to be sure it is replaced on new CRT with same orientation as existed on original CRT.

5. Remove CRT from front of chassis or enclosure.

6. Reverse the above steps to re-install the new CRT. Delete step one. When tightening clamp holding deflection yoke to CRT, use caution to avoid excessive torque.

7. After installation, perform display alignment procedures. Disregard such statements as: "all display alignment has been factory preset by Wells-Gardner." All adjustments of alignment will need to be checked.

NOTE: *Since additional magnet(s) could be required when installing new CRT, it would be best to obtain these spare magnets prior to CRT change.*

8. Be sure the AQUADAG GROUNDING SPRING has not come loose and be sure this spring is in contact with the AQUADAG COATING to provide a proper ground.

THEORY OF OPERATION

The display consists of a "Beam Down Circuit," a "Spot Kill Circuit" and a video amplifier in addition to horizontal and vertical deflection circuits. This theory of operation assumes a 12-VDC operated monitor.

BEAM DOWN CIRCUIT

Purpose: The "Beam Down" circuit is designed to assure operator safety in the event the 12-VDC supply to the monitor should develop a voltage which is too high.

Circuit Description: The "Beam Down" circuit consists of active components ZD1, Q11, Q10 and Q9. Under normal operating conditions (ie., when 12-VDC supply is within normal tolerance) the zener diode ZD1 is not conducting. This means that the base of Q11 is at or near 0.0 VDC. With no applied base voltage, Q11 is in cutoff condition and the collector of Q11 will be high. When there is no conduction path through Q11, R74 will provide base voltage and emitter-base current to Q10, causing it to turn on and saturate.

When Q10 turns on, it allows current to flow through R73 and R78 to the +50-volt supply. This action causes the emitter-base junction of Q9 to become forward biased and Q9 turns on or saturates. With Q9 providing a complete circuit between the +50-volt supply and the brightness control connected to its collector, normal brightness control and range is assured.

Circuit Activation: Assume that, for some unknown reason, the 12-VDC supply has increased to 15 VDC momentarily. Zener diode ZD1 is a 13-volt diode. When the voltage across ZD1 is more than 13 volts, the diode will conduct through current-limiting resistor R75;

(Cont'd on Page 15)

NOTE: *Pin numbers shown are for card edge connector only. Equivalent pin numbers for 20-pin mass terminator are found on Schematic Diagrams, Figures 19 and 21.*

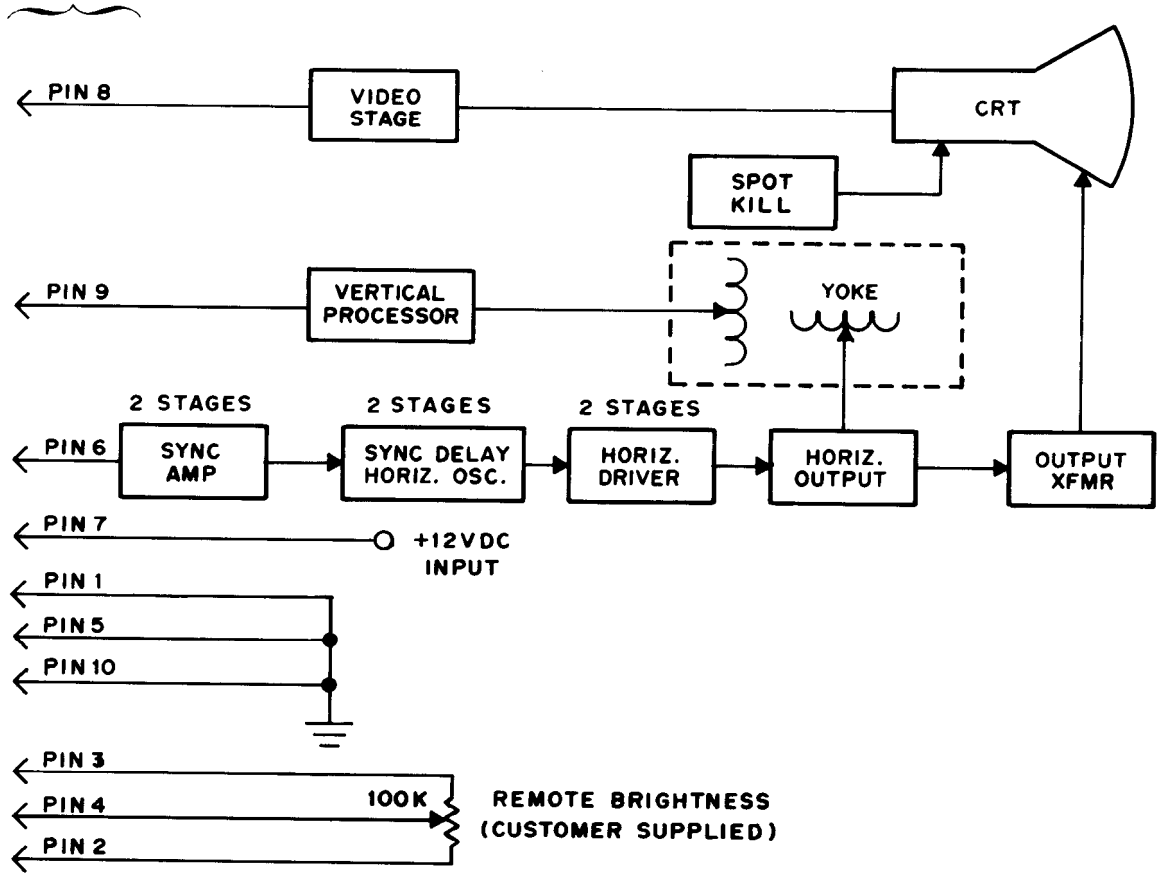


FIGURE 11: Block Diagram

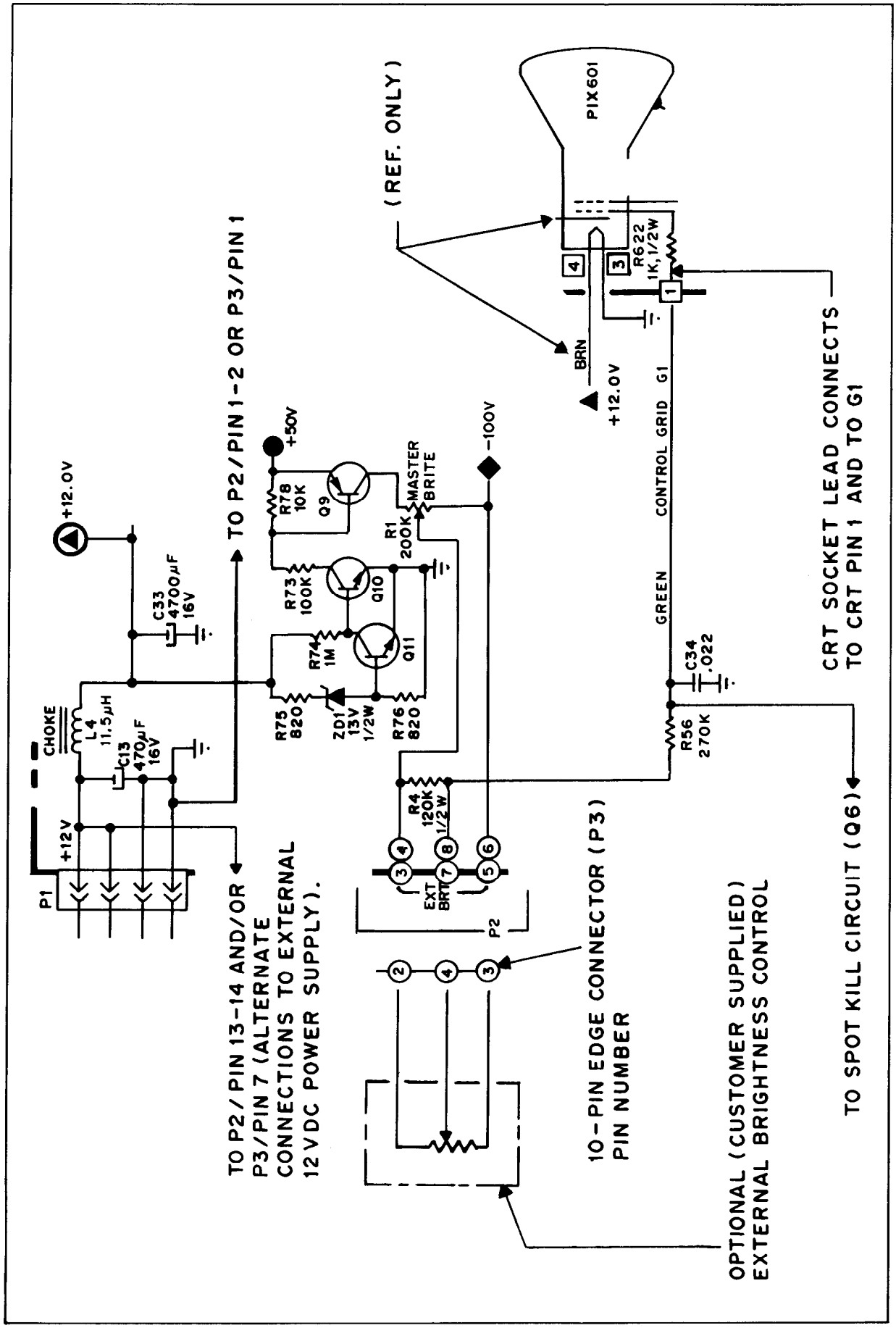


FIGURE 12: Beam Down Circuit Plus Optional External Brightness Connections

emitter-base current will be provided to Q11 and it will turn on or saturate. The collector of Q11 will draw enough current to cause the emitter-base voltage of Q10 to fall below 0.6 volt and Q10 will turn off. When Q10 turns off, the emitter-base current in Q9 falls to such a low level that Q9 turns off. When Q9 turns off, the +50-volt supply is no longer connected to the upper end of R1, the master brightness control. Since there is no longer any current flow through R1, there is no voltage drop across it. The negative 100-volt supply voltage is therefore coupled from the wiper arm of R1 through R4 and decoupling resistor R56 to the G1 control grid of the CRT. This action reduces beam current to zero, and allows symptoms of "no brightness" on CRT screen similar to "no video signal" and/or "no raster." This completes the "beam down" cycle.

The emitter-base resistors R76 and R78 are used to prevent false turn-on of Q11 and Q9 by collector-base leakage at high operating temperatures.

Resistor R56 and capacitor C34 form an integrator for circuit noise which may be impressed on Q9 collector. Resistor R622, in the CRT socket lead, limits arcing current.

COMPONENTS CONNECTED TO B+ POWER SUPPLY

Refer to Figures 12, 19 or 21. Components L4, C13, C33, R77 and C32 are filter components for the 12-volt supply. The filters act in both directions, reducing incoming noise from the supply line and preventing fluctuations caused by normal circuit operations from being coupled back to the incoming supply line.

SPOT KILL (Figure 13)

Purpose: The purpose of the "Spot Kill Circuit" is to prevent CRT burn due to residual CRT high voltage and high beam current occurring while the beam is stationary in the horizontal and vertical axes. The function of "spot kill" is to turn the CRT *on* very hard to discharge any remaining high voltage and to do so before the vertical and horizontal sweeps have collapsed. "Spot kill" is always activated when the display unit is turned off.

Circuit Description: When power is supplied to the unit, C29 is charged up to 0.6 V less than the +50-volt supply via diode D10. Since the base of Q6 is held more positive than the emitter by current flow through R60, R64 and R59, Q6 is cut off during normal operation.

When power to the unit is turned off, the +50-volt supply falls rapidly, reversing the flow of current through R59 and R64—to try to discharge C29. This causes the base of Q6 to become sufficiently negative with respect to its emitter that Q6 turns on, thereby raising the CRT grid G1 positive to within a volt of C29. This momentarily forces a large beam current in the CRT which discharges the high voltage supply before the sweep can collapse and form a spot which could damage the phosphor screen.

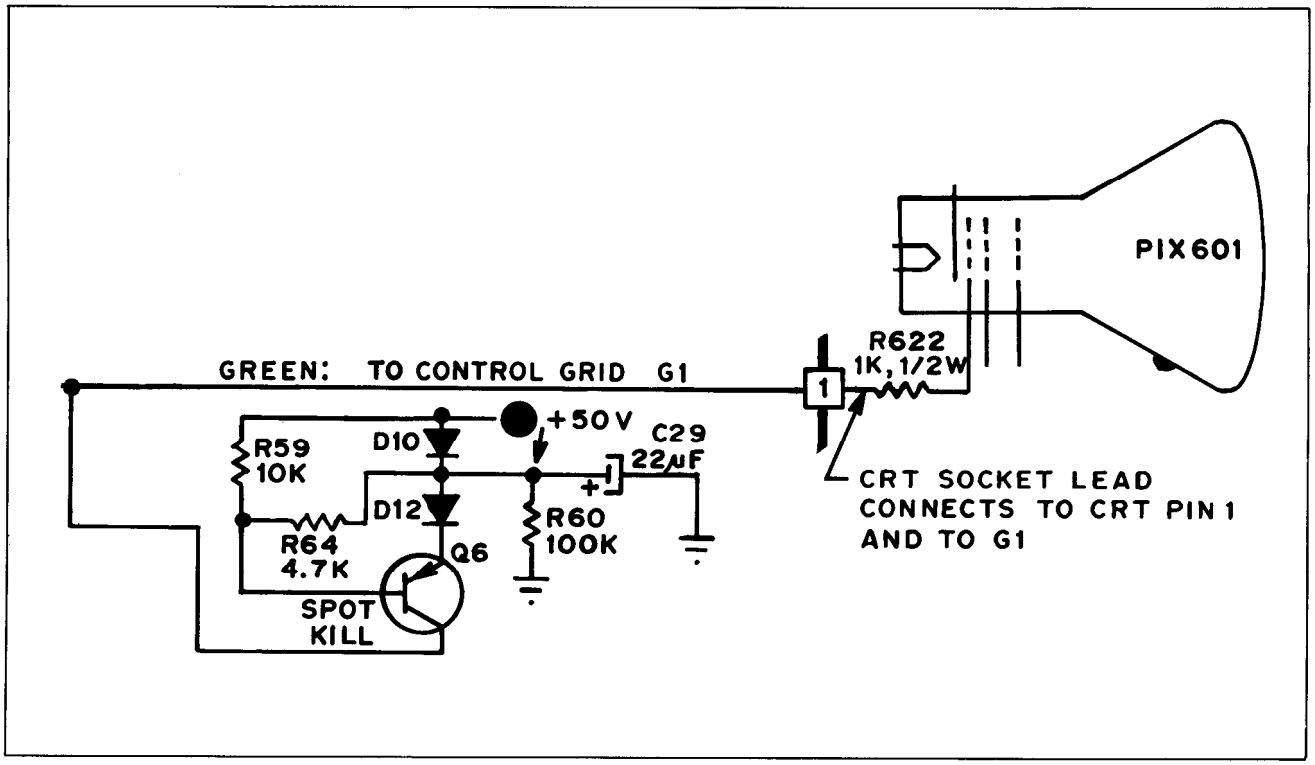


FIGURE 13: Spot Kill Circuit

VIDEO AMPLIFIER (Figure 14)

Purpose: The purpose of the video amplifier is to process low voltage pulse information into a useable level which can drive a CRT.

Circuit Configuration: The video amplifier consists of two transistors configured in a cascode arrangement. This configuration is used because of its stability, gain, and relatively great bandwidth. In this cascode, transistor Q3 is used as the output device and transistor Q5 is its driver.

Input Signal: A positive video signal of at least 2.0 V P-P must be applied to pin 8 of the circuit card edge connector. It should be noted that pins 15-16 of the 20-pin mass terminator are electrically equivalent to pin 8 of the circuit card edge connector.

Signal Path and Circuit Operation: The signal at pin 8 is applied via contrast control R79 to the junction of R19 and R20. The signal is then applied to the base of Q5 through current-limiting resistor R20. Resistors R26 and R27 establish a positive bias voltage of about 6 VDC on the base of Q3.

L1 and R25 form a complex collector load for transistor Q3. With no input signal, the video amplifier is normally off and the collector of Q3 will have full supply voltage on it.

When the video input signal is applied to the base of Q5, it forward biases the emitter-base junction of Q5, causing Q5 to conduct. Turned on, Q5 provides current for the emitter-base junction of Q3, causing a collector current to flow in Q3. Current flow through R25 causes a voltage drop across R25. This negative going voltage is coupled directly to the CRT cathode. Emitter resistor R21 sets the gain of the entire video stage. Resistor R22 and capacitor C12 boost the high frequency gain by lowering the impedance across R21 at higher frequencies. The capacitor C11 is necessary to maintain the base of Q3 at AC ground. R23 is used to establish the impedance of Q5 when it is in a cutoff condition.

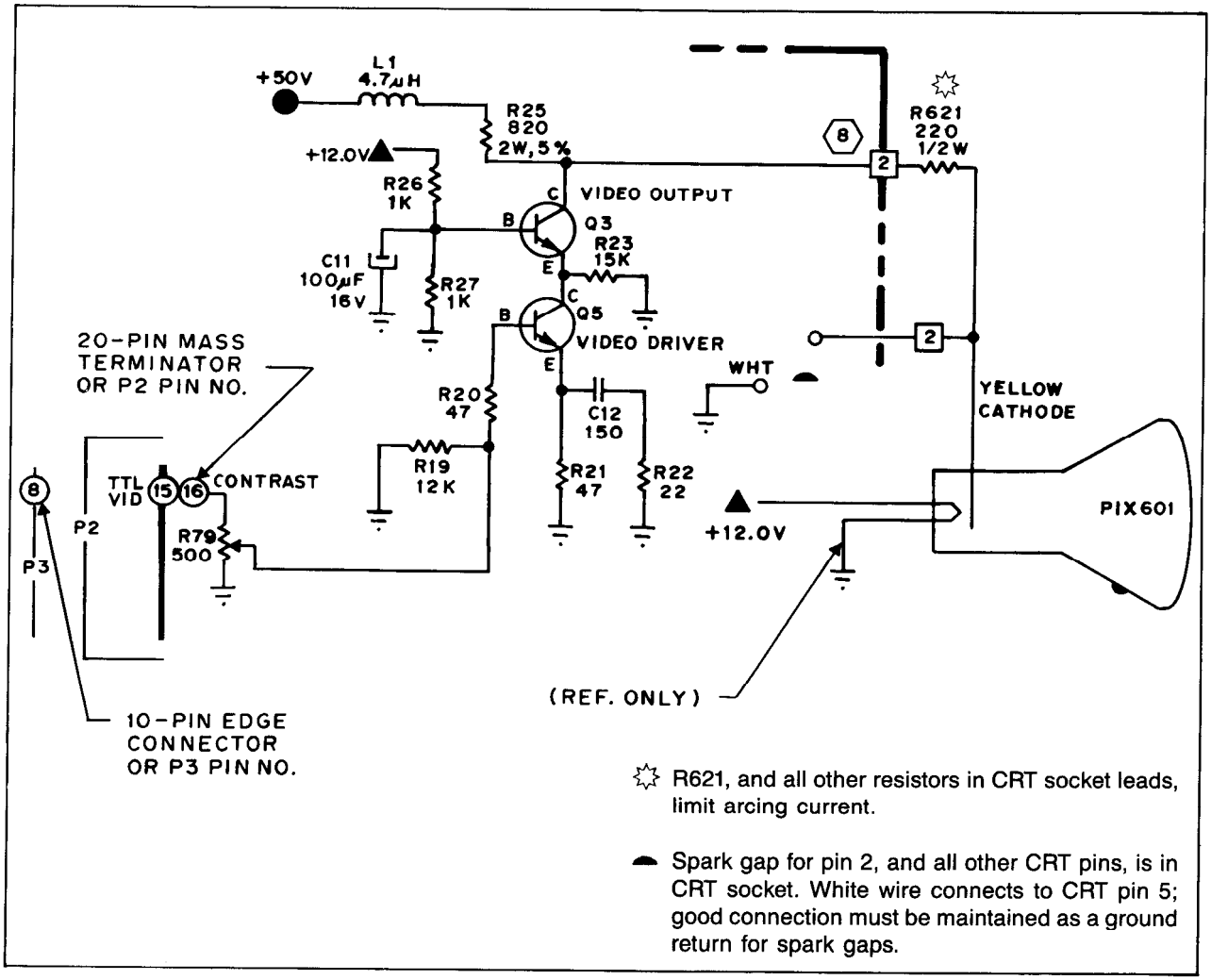


FIGURE 14: Video Amplifier

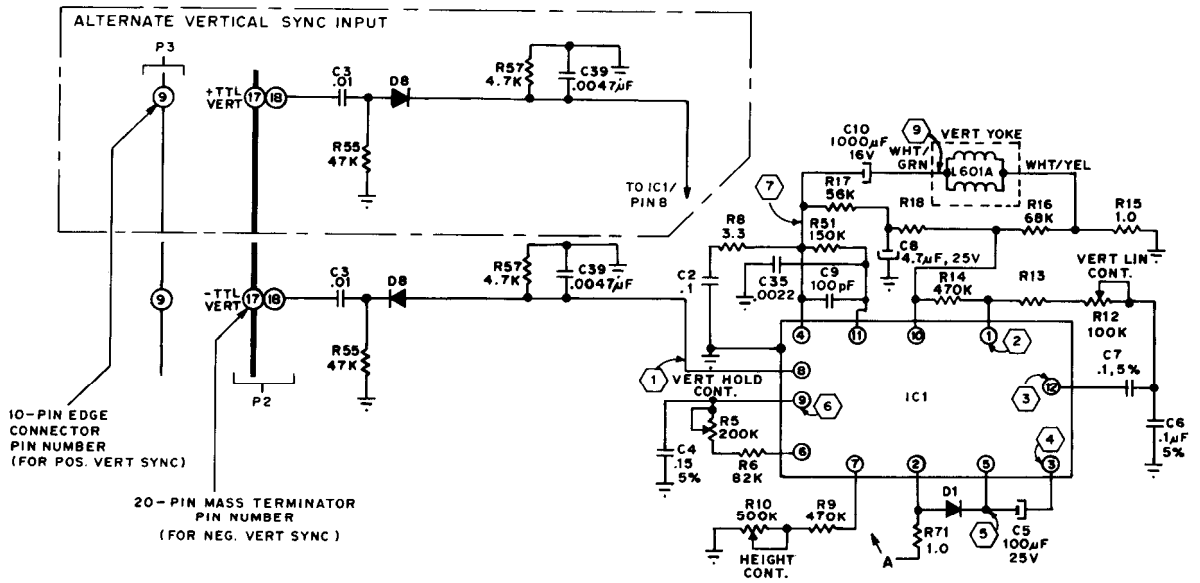


FIGURE 15: Vertical Deflection Circuitry.

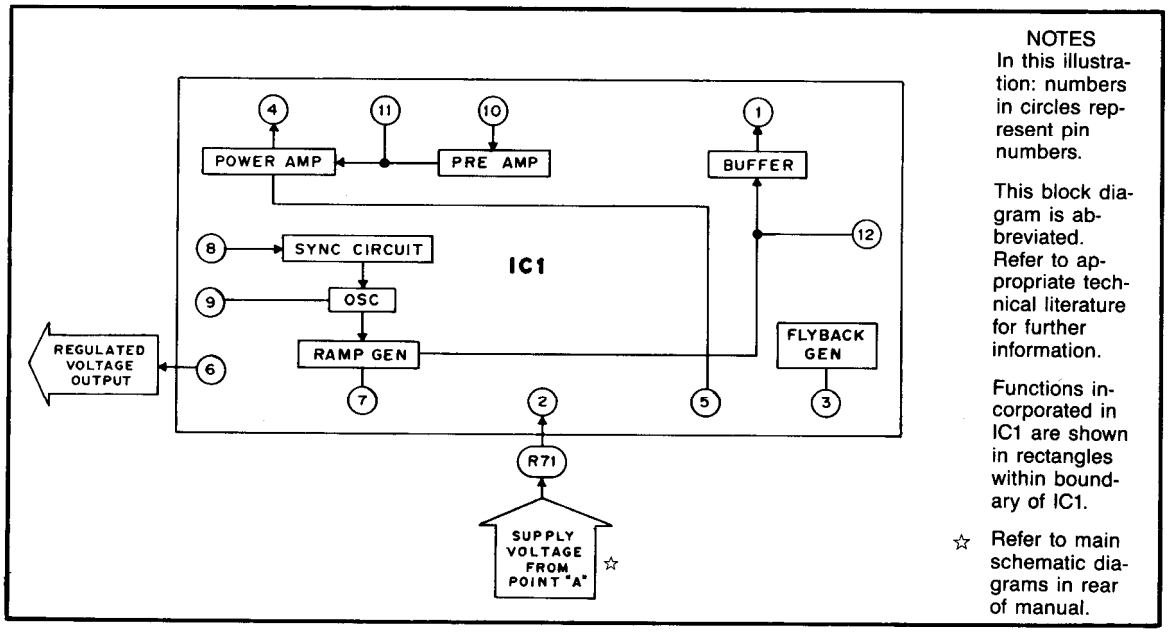


FIGURE 15A: Partial Block Diagram IC1

NOTE: Refer to pages 29-31 for an explanation of schematic symbols. Refer to page 26 for an explanation of schematic reference designator numbers.

VERTICAL DEFLECTION (Figure 15)

Purpose: The purpose of vertical scan is to move the electron beam in a linear manner from top to bottom of the CRT screen at the vertical rate and to retrace it quickly from bottom to top. This is accomplished by deflecting the electron beam from the zero yoke current point to some other point toward the bottom of the CRT screen. When this second point is reached the beam is forced to retrace quickly to the third point which is past the center toward the top of the CRT. From this point near the top of the screen, the beam moves back to the starting point or the vertical zero current axis. This completes one vertical cycle.

Circuit Configuration: Vertical deflection is accomplished by means of a linear vertical integrated circuit. This IC (IC 1) is the TDA-1170S. The TDA-1170S consists of 5 major circuit areas. These circuit areas are vertical oscillator, current source and ramp generator, high power gain amplifier (output stages), voltage regulator and flyback generator.

Vertical Sync and Deflection: In order to synchronize the vertical system, a TTL signal of either positive going or negative going direction must be applied to pin 9 of the edge connector or pins 17 and 18 of the 20-pin mass terminator. For this example we will assume that negative going vertical sync has been selected.

When a TTL signal with active low is applied to pin 9 of P3 (the edge connector), it is applied to differentiating network C3 and R55.

Diode D8 blocks the positive going output from the differentiator and conducts on the negative going pulse.

The negative pulse is then coupled to pin 8 of IC1 and vertical lock is achieved. R57 and C39 filter high frequency noise. R6, R5 (vertical hold control) and C4 determine the normal vertical frequency and the vertical frequency range. R9 and R10 (height control) set the vertical size range. C7 and C6 are the ramp-forming capacitors. C7 and C6 have been placed in series so that their junction can be provided with dynamic drive through R13 and R12 (vertical linearity control) to give linearity correction. Resistor R14 is part of the gain setting network of IC1. R17 and C8 form an integrator which takes the vertical drive at pin 4 and shapes it into a parabola for feedback through R18 for linearity correction. Resistors R17, R18 and R16 also provide a DC feedback path for pin 10 of IC1. Resistor R15 is the primary gain setting resistor for IC1. Capacitors C9, C35 and resistor R51 provide damping and oscillation suppression. R8 and C2 form a filter network which adds to general system stability. R71 is a current-limiting resistor. Capacitor C5 is the flyback storage capacitor and Diode D1 provides decoupling of the B+ line during retrace. All of the previously mentioned functions result in an output voltage ramp on pin 4 of IC1. This voltage is then coupled to the deflection yoke by capacitor C10 and yoke current is produced which causes beam movement in the vertical direction or vertical deflection.

HORIZONTAL SYNC AMPLIFIER AND OSCILLATOR

Purpose: The purpose of the horizontal sync amplifier and oscillator can be divided into:

a.) processing the horizontal sync signal and
b.) providing the network which will facilitate horizontal video positioning and
c.) providing the drive signal for the horizontal output system.

Circuit Description: The main components of the horizontal sync amplifier and oscillator are two CMOS quad 2-input NOR gates (IC2 and IC3) in addition to external timing components used as two 2-gate horizontal centering monostable multivibrators, two 1-gate pulse conditioners and a two-NOR-gate asymmetrical astable multivibrator. Refer to Figures 16 and 17.§

Circuit Activation: A positive going, TTL level horizontal sync signal is applied to pin 6 of the card edge connector or pins 11-12 of the 20-pin mass terminator (Figures 7, 8 and 16). This signal is applied, through R54, to the base of Q8, wired as an inverter. The output of Q8 is DC-coupled to sync amplifier Q7, which increases the signal level to approximately 10 V P-P. The amplified signal is sent directly to a monostable multivibrator consisting of two dual input NOR gates, IC2/A and IC2/B. Output of the monostable multivibrator at pin 4 is approximately 5% more than half of the horizontal period. The timing components for this multivibrator are C17 and R29.

The negative edge of this pulse is detected by NOR gate IC2/C at pin 9. This gate generates a positive 2-µs pulse at pin 10 of IC2. Duration of the pulse at IC2/B is controlled by R33 and C18. The action of monostable multivibrator IC3/B and IC3/A is almost identical to that of IC2/A and IC2/B with one important difference. The resistive branch R34 and R35 is variable, so the period of this multivibrator is variable. R34 is the horizontal phase (video centering) control. R34 allows adjustment of the video position on the raster of approximately 30% of the horizontal period. The negative edge of the adjustable pulse is detected by gate IC2/D, converted into a 2-µs positive pulse and used to trigger the astable multivibrator.

IC3/D and IC3/C form a two-NOR-gate asymmetrical astable multivibrator which is the horizontal oscillator. The oscillator parameters are chosen for a free-running frequency which is lower than the synchronized horizontal frequency. The oscillator keeps the horizontal scan circuitry running in the absence of a horizontal sync pulse.

The astable multivibrator synchronizes when triggered by the delayed pulse from gate IC2/D. Components R37, R38, R39 and D3 determine the period (timing) of circuit oscillation in the astable multivibrator. These four components also determine the asymmetrical characteristics of this multivibrator.

During the period when pin 10 of IC3/C is high, emitter follower Q1 is turned on. Emitter current flows through R41 and also via coupling capacitor C20, current-limiting resistor R42, and the base-emitter junction of the horizontal driver, Q2. C20 is charged during this process. When pin 10 of IC3/C goes low, Q1 is turned off. C20 discharges through R41, R42 and R43, turning off Q2. Note that if horizontal drive is lost with pin 10 of IC3/C in either the high or low condition, then Q2 will assume a fully saturated condition with its collector voltage low.

R32 and R36 are current-limiting resistors. R68 and C14 decouple the horizontal synchronizing and oscillator circuits from the +12-volt supply.

HORIZONTAL OUTPUT SYSTEM (Figure 18)

Purpose: The horizontal output system's primary purpose is to move the CRT beam in a linear manner from left edge to right edge of the raster and then to return the beam from right to left as rapidly as feasible. As secondary results of this process, it also develops the

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§**NOTE:** *All gates in Figure 16 indicate the IC number by the following: "IC2/" or "IC3/".*

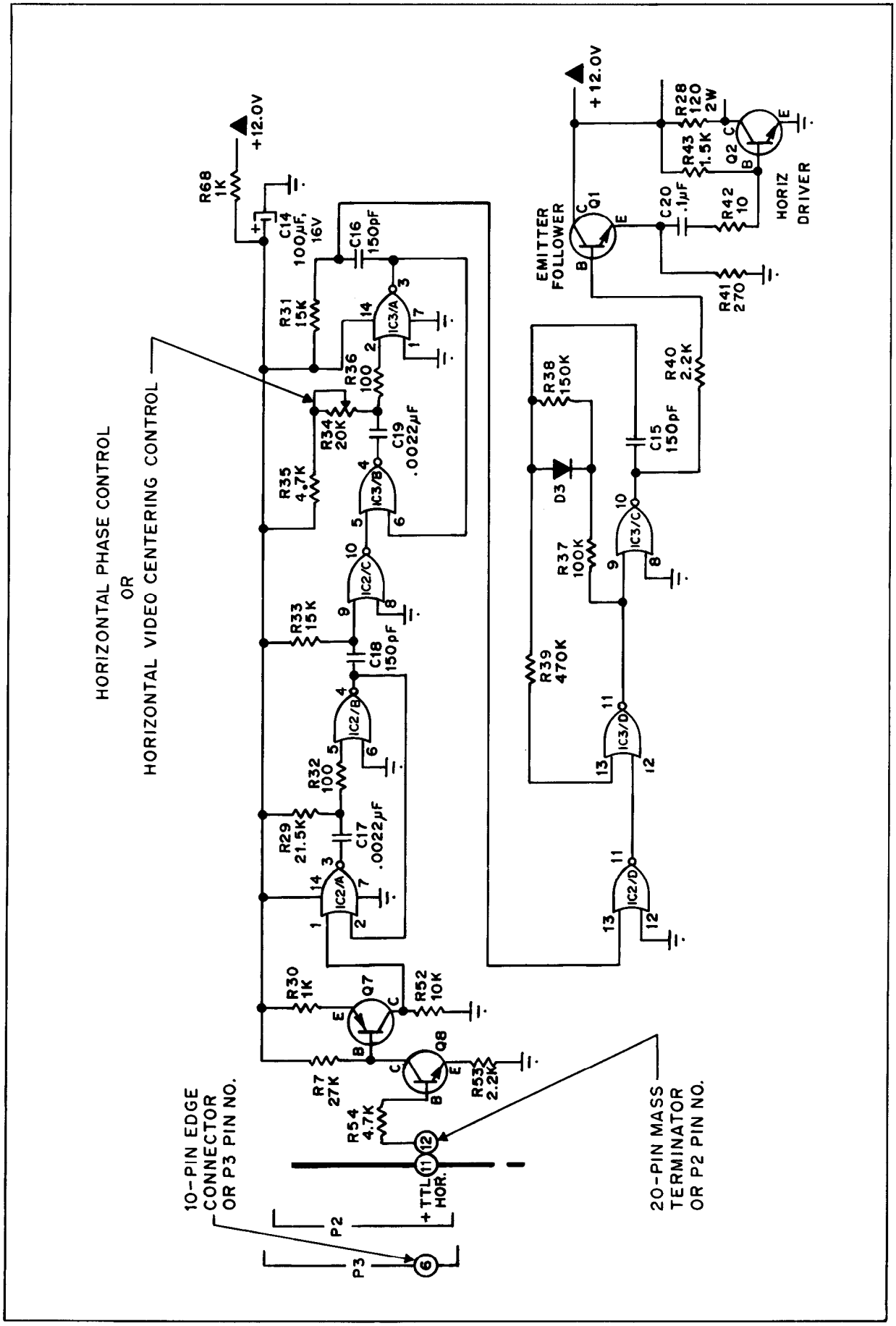


FIGURE 16: Horizontal Sync Amplifier and Oscillator

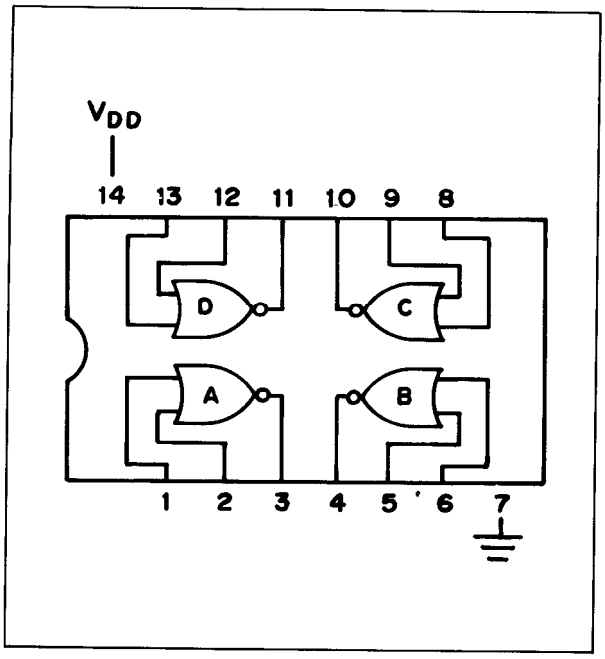


FIGURE 17: Functional Diagram, 4001 Quad 2-Input NOR Gate

anode voltage for the CRT as well as positive 50-volt, positive 600-volt and negative 100-volt supplies used elsewhere.

To describe the operation of the horizontal output system we will assume that the system is being driven in a normal manner by the gated horizontal oscillator. When the magnetic field of the horizontal yoke is zero, the beam is centered in the CRT screen. C38 is charged positively. Q2 is off and base current is flowing in Q4 via R45 and R28 to the +12-volt supply. Therefore, Q4 is on and saturated so the junction of L3 and C21 is close to ground potential and C21 is discharged.

Picking up the sweep cycle at this point, C38 discharges through the yoke branch composed of L601B, L2 and L3; this discharge causes a nearly linearly increasing electron flow from left to right (Figure 18) through the horizontal yoke, L601B. The electron flow causes a directly proportional magnetic field to be formed, deflecting the CRT electron beam toward the right edge of the CRT screen. Simultaneously, current flows into terminal 3 of the primary of T1, also building up a magnetic field in T1. This process continues until the horizontal oscillator output switches on causing the emitter of Q1 to go high. This turns on and saturates the horizontal driver Q2 whose collector goes low. The voltage across C30 cannot change instantaneously so the base of Q4 is driven hard negative and Q4 is turned off rapidly.

When Q4 is turned off, the current path from ground through Q4 is eliminated. The deflection yoke, L601B, has a large amount of energy stored in its magnetic field. The yoke branch still has access to ground through C21, and, in parallel with the primary winding of T1, forms a resonant circuit with C21.

When Q4 is turned off, the magnetic fields around the yoke and T1 begin to collapse, generating a voltage that forces the current to continue flowing in the same direction through the yoke but with diminishing volume. This continues for the first quarter cycle of the oscillation with C21. At the end of the first quarter cycle of oscillation, the current in the yoke and its magnetic field, has fallen to zero. The rate of change of current has reached its maximum; therefore the voltage across the yoke and T1, as well as the charge in C21, is maximum and the beam has returned rapidly to the center of the screen. During the second quarter cycle of the oscillation C21 discharges. This causes current to be drawn through the yoke and C38 (in the opposite direction to that indicated immediately above) which builds up a magnetic field deflecting the beam rapidly to the left edge of the screen.

At the start of what would be the second half cycle of oscillation, the yoke's collapsing magnetic field generates a voltage that starts to drive the collector of Q4 negative. This turns on the damper diode, D4, effectively isolating C21 from the yoke branch. The oscillation is stopped and the yoke current and magnetic field diminish linearly at the scan rate, returning the beam to the center of the screen to complete one scan cycle. Note that, at the appropriate time during the damper diode conduction cycle, the horizontal oscillator turns the horizontal driver Q2 off causing base current to begin flowing in Q4 and turning Q4 on.

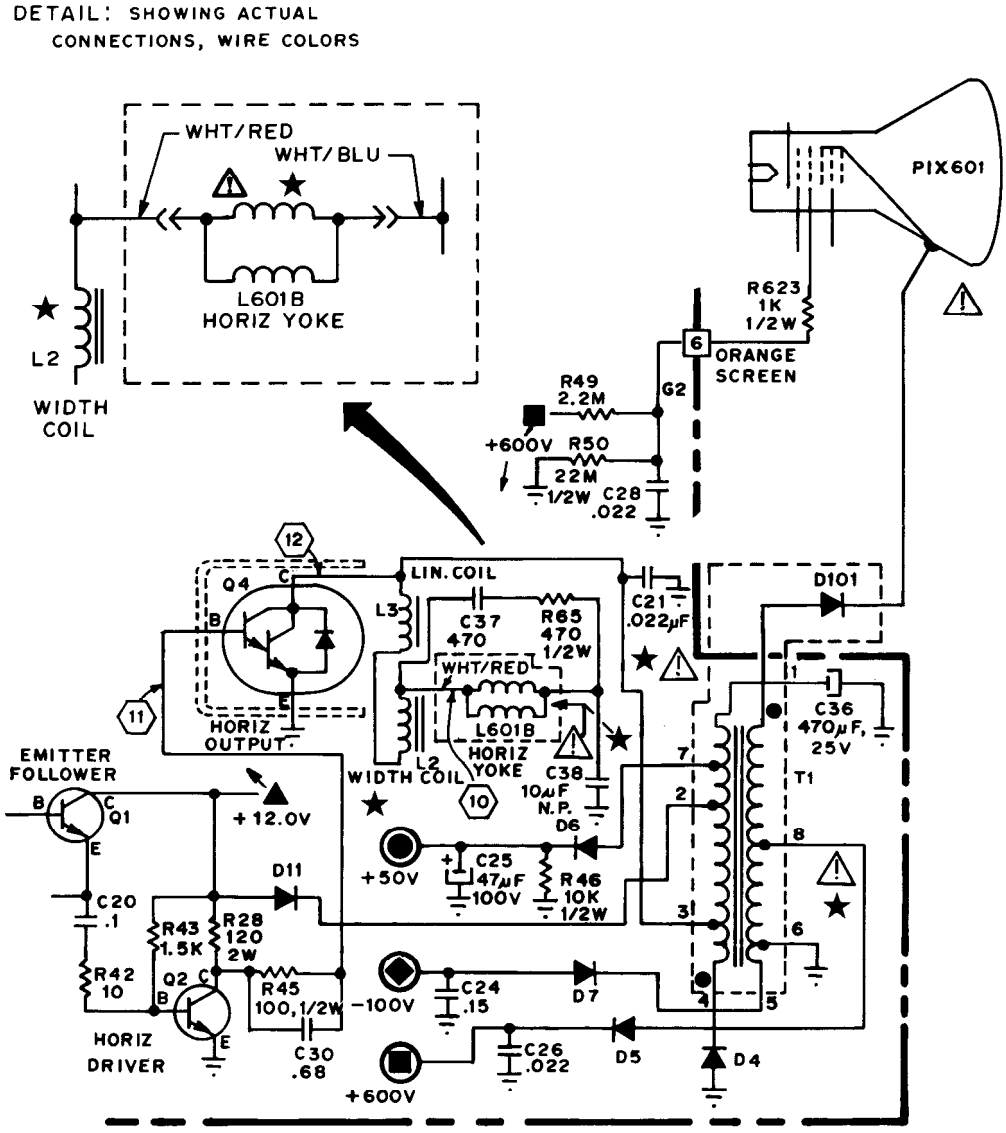
T1 AND CONNECTING CIRCUITRY

As previously noted, terminal 3 of T1 is connected to the junction of the yoke branch and C21 so that during the retrace time the approximately 200-volt pulse appearing at that junction also appears at terminal 3. By autotransformer action the pulse is reduced at terminal 7, rectified by D6 and filtered by C25 to provide the +50-volt supply used for the video amplifier, brightness, beam down and spot kill circuits. R46 is a bleeder resistor used to stabilize the +50-volt supply for changes in current drain.

In a similar manner, diode D11 and capacitor C36 provide the boosted B+ supply for the horizontal output stage.

Diode D101 rectifies the stepped up secondary voltage to provide the anode voltage for the CRT.

(Cont'd on Page 22)



NOTES:

1. NUMBERS IN HEXAGONS (⬡) INDICATE LOCATIONS OF WAVEFORM READINGS.
2. (DOT UNATTACHED)● INDICATES POSITIVE POLARITY.

CAUTION: ⚠ REPLACE SAFETY CRITICAL COMPONENTS ONLY WITH MANUFACTURER'S RECOMMENDED PARTS.
★ X-RAY RADIATION RELATED PARTS. REPLACE ONLY WITH SAME TYPE PARTS SHOWN IN PARTS LIST.

FIGURE 18: Horizontal Output System and G2 Supply

The secondary voltage at terminal 8 is rectified by diode D5 and filtered by capacitor C26 to provide the +600-volt supply used for focus voltage and CRT screen (G2) voltage.

The secondary voltage at terminal 5 is rectified by diode D7 and filtered by capacitor C24 to provide the negative 100-volt supply for the negative sides of the focus control and the master brightness control.

Terminal 2 of T1 is connected to the +12-volt supply through diode D11. All of the power consumed in the horizontal output system is replaced when terminal 2 tries to fall below approximately 11.4 volts.

Components C37 and R65 comprise a damping network for the horizontal yoke branch coils.

COMPONENTS CONNECTED TO G2 OF CRT

Refer to Figure 18. R49 and R50 form a voltage divider to set the correct screen voltage. C28 is a decoupling capacitor.

COMPONENTS CONNECTED TO G4 OF CRT

Refer to Figures 19 and 21, the schematic diagrams, to locate the following components: Voltage divider resistors R66 and R47 limit the range of voltage delivered to the focus potentiometer R48. Capacitor C27 filters focus voltage and R624 limits arcing current.

NOTES

TYPICAL REPLACEMENT PARTS LIST
covering Models 12V3015 and 14V3017

NOTE: *This monitor contains circuits and components included specifically for safety purposes.*

For continued protection no changes should be made to the original design, and components shown in shaded areas of schematic diagram, or ⚠ ★ on parts list should be replaced with exact factory replacement parts.

The use of substitute parts may create a shock, fire, x-radiation or other hazard. Service should be performed by qualified personnel only.

P351 PC Board Assembly and
P375 PC Board Assembly

Ref. No.	Part No.	Description
		CAPACITORS
C2	349X1044-100	0.1 µF, 20%, 100 V
C3	80X0099-010	0.01 µF, 20%, Z5U, 500 V, Cer. Disc
C4	349X1541-100	0.15 µF, 5%, 100 V, Mylar
C5	45X0560-005	100 µF/25 V, Lytic
C6	349X1041-100	0.1 µF, 5%, 100 V, Mylar
C7	349X1041-100	0.1 µF, 5%, 100 V, Mylar
C8	45X0560-001	4.7 µF/25 V, Lytic
C9	80X0099-121	100 pF, 5%, NPO, 500 V, Cer. Disc
C10	45X0560-006	1000 µF/16 V, Lytic
C11	45X0560-004	100 µF/16 V, Lytic
C12	47X0787-005	150 pF, 5%, 50 V, Mica
C13	45X0524-053	470 µF/16 V, Lytic
C14	45X0560-004	100 µF/16 V, Lytic
C15	80X0099-194	150 pF, 5%, NPO, Cer. Disc
C16	80X0099-194	150 pF, 5%, NPO, Cer. Disc
C17	46X0544-001	0.0022 µF, 2%, 100 V, Polyprop.
C18	80X0099-194	150 pF, 5%, NPO, Cer. Disc
C19	46X0544-001	0.0022 µF, 2%, 100 V, Polyprop.
C20	349X1044-100	0.1 µF, 20%, 100 V
★ ⚠ C21	46X0536-019	0.022 µF, 5%, 400 V, Polyprop.
C24	343X1544-040	0.15 µF, 20%, 400 V, Mtlz. Mylar
C25	45X0560-011	47 µF/100 V, Lytic
C26	80X0099-195	0.022 µF, 1 kV, Cer. Disc
C27	80X0099-200	6800 pF, 20%, Z5U, 1 kV
C28	80X0099-195	0.022 µF, 1 kV, Cer. Disc
C29	45X0560-002	22 µF/63 V, Lytic
C30	46X0542-002	0.68 µF, 20%, 100 V, Mtlz. Mylar
C32	45X0560-007	4700 µF/16 V, Lytic
C33	45X0560-007	4700 µF/16 V, Lytic
C34	80X0099-195	0.022 µF, 1 kV, Cer. Disc
C35	46X0544-001	0.0022 µF, 2%, 100 V, Polyprop.
C36	45X0562-001	470 µF/25 V, High Ripple Current, Lytic
C37	80X0099-152	470 pF, 10%, Z5F, 500 V, Cer. Disc
C38	45X0561-004	10 µF/25 V, NP, Lytic
C39	80X0099-196	0.0047 µF, 20%, Z5U, 100 V, Cer. Disc

Ref. No.	Part No.	Description
	RESISTORS/CONTROLS	
R1	40X0639-002	Trim Pot, 200 kΩ
R4	340X3124-934	120 kΩ, 5%, 0.5 W
R5	40X0639-002	Trim Pot, 200 kΩ
R6	340X2823-934	82 kΩ, 5%, 0.25 W
R7	340X2273-934	27 kΩ, 5%, 0.25 W
R8	340X2033-934	3.3 Ω, 5%, 0.25 W
□ R9	340X2224-934	220 kΩ, 5%, 0.25 W
● R9	43X0469-008	470 kΩ, 5%, 100PPM, 0.25 W
R10	40X0639-004	Trim Pot, 500 kΩ
□ R11	43X0469-008	470 kΩ, 5%, 100PPM, 0.25 W
R12	40X0639-001	Trim Pot, 100 kΩ
● R13	340X2683-934	68 kΩ, 5%, 0.25 W
□ R13	340X2473-934	47 kΩ, 5%, 0.25 W
R14	43X0469-008	470 kΩ, 5%, 100PPM, 0.25 W
R15	43X0469-009	1.0 Ω, 5%, 200PPM, 0.25 W
R16	43X0469-004	68 kΩ, 5%, 100PPM, 0.25 W
R17	340X2563-934	56 kΩ, 5%, 0.25 W
● R18	340X2563-934	56 kΩ, 5%, 0.25 W
□ R18	340X2823-934	82 kΩ, 5%, 0.25 W
R19	340X2123-934	12 kΩ, 5%, 0.25 W
R20	340X2470-934	47 Ω, 5%, 0.25 W
R21	340X2470-934	47 Ω, 5%, 0.25 W
R22	340X2220-934	22 Ω, 5%, 0.25 W
R23	340X2153-934	15 kΩ, 5%, 0.25 W
R25	340X5821-733	820 Ω, 5%, 2 W
R26	340X2102-934	1 kΩ, 5%, 0.25 W
R27	340X2102-934	1 kΩ, 5%, 0.25 W
R28	340X5121-933	120 Ω, 5%, 2 W
R29	43X0469-033	21.5 kΩ, 5%, 100PPM, 0.25 W
R30	340X2102-934	1 kΩ, 5%, 0.25 W
R31	43X0469-002	15 kΩ, 5%, 100PPM, 0.25 W
R32	340X2101-934	100 Ω, 5%, 0.25 W
R33	43X0469-002	15 kΩ, 5%, 100PPM, 0.25 W
R34	40X0639-009	Control, 20 kΩ
□ R35	43X0469-027	4.7 kΩ, 5%, 100PPM, 0.25 W
● R35	340X2332-934	3.3 kΩ, 5%, 0.25 W
R36	340X2101-934	100 Ω, 5%, 0.25 W
□ R37	43X0469-005	100 kΩ, 5%, 100PPM, 0.25 W
● R37	43X0469-004	68 kΩ, 5%, 100PPM, 0.25 W
● R38	43X0469-022	180 kΩ, 5%, 100PPM, 0.25 W
□ R38	43X0469-018	150 kΩ, 5%, 100PPM, 0.25 W
R39	43X0469-008	470 kΩ, 5%, 100PPM, 0.25 W
R40	340X2222-934	2.2 kΩ, 5%, 0.25 W
R41	340X2271-934	270 Ω, 5%, 0.25 W
R42	340X2100-934	10 Ω, 5%, 0.25 W
R43	340X2152-934	1.5 kΩ, 5%, 0.25 W
R45	340X3101-934	100 Ω, 5%, 0.5 W
R46	340X3103-934	10 kΩ, 5%, 0.5 W
R47	340X2473-934	47 kΩ, 5%, 0.25 W
R48	40X0642-001	Trim Pot, 2.2 MΩ 1 kV
R49	340X2225-934	2.2 MΩ, 5%, 0.25 W
R50	340X3226-244	22 MΩ, 10%, 0.5 W
R51	340X2154-934	150 kΩ, 5%, 0.25 W
R52	340X2103-934	10 kΩ, 5%, 0.25 W
R53	340X2222-934	2.2 kΩ, 5%, 0.25 W
R54	340X2472-934	4.7 kΩ, 5%, 0.25 W
R55	340X2473-934	47 kΩ, 5%, 0.25 W
R56	340X2274-934	270 kΩ, 5%, 0.25 W
R57	340X2472-934	4.7 kΩ, 5%, 0.25 W
R59	340X2103-934	10 kΩ, 5%, 0.25 W
R60	340X2104-934	100 kΩ, 5%, 0.25 W
R64	340X2472-934	4.7 kΩ, 5%, 0.25 W
R65	340X3471-844	470 Ω, 10%, 0.5 W
R66	340X2104-934	100 kΩ, 5%, 0.25 W
R68	340X2102-934	1 kΩ, 5%, 0.25 W
R71	43X0469-009	1.0 Ω, 5%, 200PPM, 0.25 W
R73	340X2104-934	100 kΩ, 5%, 0.25 W
R74	340X2105-934	1 MΩ, 5%, 0.25 W
R75	340X2821-934	820 Ω, 5%, 0.25 W
R76	340X2821-934	820 Ω, 5%, 0.25 W
□ R77	340X2010-934	1 Ω, 5%, 0.25 W
● R77	340X2047-934	4.7 Ω, 5%, 0.25 W
R78	340X2103-934	10 kΩ, 5%, 0.25 W
R79	40X0639-011	Trim Pot, 500 Ω

Ref. No.	Part No.	Description
	COILS AND TRANSFORMERS	
L1	09A2763-011	Peaking Coil, 4.7 µH
★ L2	09A2804-002	Width Coil, Standard
★ ● L3	09A2803-003	Linearity Coil
★ □ L3	09A2803-005	Linearity Coil
L4	09A2796-001	Inductor, Fixed 11.5 µH
★ ⚠ T1	53X0509-001	Flyback Transformer, 18.6 kHz, 12 V

Ref. No.	Part No.	Description
		SEMICONDUCTORS
D1	66X0071-001	Diode, 1N4001
D3	66X0046-001	Diode, Silicon, FDH-444
D4	66X0078-001	Diode, High Speed, RGP 30G
D5	66X0081-001	Diode, High Speed, RGP 10M
D6	66X0083-001	Diode, High Speed, RGP 10G
D7	66X0075-001	Diode, 1N4005 S1-6
D8	66X0046-001	Diode, Silicon, FDH-444
D10	66X0075-001	Diode, 1N4005 S1-6
D11	66X0078-001	Diode, High Speed, RGP 30G
D12	66X0075-001	Diode, 1N4005 S1-6
Q1	86X0071-001	Transistor, NPN, MPS-A 06
Q2	86X0071-001	Transistor, NPN, MPS-A 06
Q3	86X0115-001	Transistor, NPN, D40P3
Q4	86X0142-001	Transistor, Horiz. Output, BU806
Q5	86X0113-001	Transistor, NPN, 2N3904
Q6	86X0133-001	Transistor, PNP, MPS-A 92
Q7	86X0066-001	Transistor, PNP, MPS-A 70 or FMPS-A 70
Q8	86X0121-001	Transistor, NPN, MPS-A 20
Q9	86X0133-001	Transistor, PNP, MPS-A 92
Q10	86X0071-001	Transistor, NPN, MPS-A 06
Q11	86X0071-001	Transistor, NPN, MPS-A 06
IC1	86X0136-001	Vert. IC, TDA 1170S (SGS)
IC2	86X0122-001	Quad 2-input NOR, CD4001BE
IC3	86X0122-001	Quad 2-input NOR, CD4001BE
ZD1	66X0040-032	Zener, 13 V, 0.5 W, 3%, GZA13Y

Ref. No.	Part No.	Description
		MISCELLANEOUS
P1	06A0403-004	4-Pin Header, AMP 640445-4
● P2	06A0409-003	20-Pin Connector
□ P2	06A0409-004	20-Pin Connector
►	38A5915-000	Connector and Wire Assembly
►	03A0639-004	Receptacle Housing, AMP #640426-4
	03A0635-001	Connector Housing Cap
	06A0407-001	Connector Housing, Plug
	13X1209-006	CRT Socket
	38A5919-000	CRT Socket and Poke Lug Assy.
	38A5901-000	Dag Return Lead Assy.
★ ⚠ L601	09A2805-001	Deflection Yoke and Clamp
	38A6014-000	Deflection Yoke Connector Assy.
	38A5866-000	Gnd and Dag Spring Assy.
►	03A0640-002	Housing, Molex #03-09-2021
	74X0009-002	Magnet, Yoke
	30X0768-001	Pin, Female
	30X0748-001	Pin, Male
★⚠□ V601	88X0171-506	Pix Tube CE555M14K164GR
☆★ ⚠ V601	88X0172-506	Pix Tube CE745M12H164GRZ
☆★ ⚠ V601	88X0187-506	Pix Tube CE745M12K39GR
☆★ ⚠ V601	88X0187-506	Pix Tube CE745L12K39GR
☆★ ⚠ V601	88X0188-506	Pix Tube CE745M12H4GRZ
☆★ ⚠ V601	88X0188-506	Pix Tube CE745L12H4GRZ
☆★ ⚠ V601	88X0191-506	Pix Tube CE745M12K134GR
☆★ ⚠ V601	88X0191-506	Pix Tube CE745L12K134GR
	28X0707-000	Spring, Aquadag
	30X0621-000	Terminal
	30X0763-001	Terminal, Malco
►	30X0779-001	Terminal, Molex #02-09-6135
	01X0657-001	Washer, Mica
	38A5916-000	P351 PC Board Assembly, Complete
	38A5996-000	P375 PC Board Assembly, Complete

Symbols Used in Schematics and Parts Lists

⚠ Safety Critical Component. Replace only with manufacturer's recommended part. Refer to page 3.

★ X-Ray radiation related part. Replace with same type parts shown in parts list. Refer to page 3.

Symbols Used in Parts Lists

● Used in Model 12V3015 which incorporates PC Board P351 or part number 38A5916-000

□ Used in Model 14V3017 which incorporates PC Board P375 or part number 38A5996-000

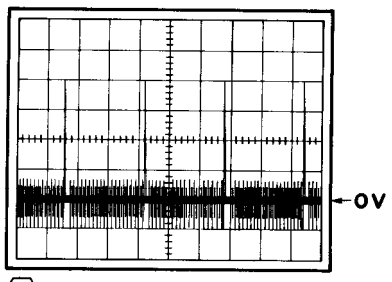
► May be used in certain models.

☆ Alternate Pix Tubes for Model 12V3015

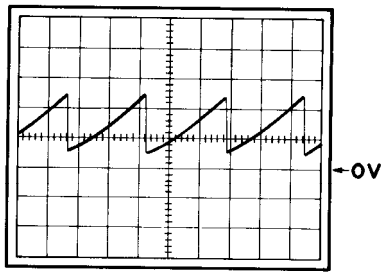
SCHEMATIC REFERENCE DESIGNATORS	
Circuit Symbol Number Series	**Where designator number is found**
1-200	Main PC Board
300	Reference number for a PC Board. Not used as a part number. Refer to parts list and/or supplement(s) for part number(s).
600	Not mounted on a PC Board

NOTES

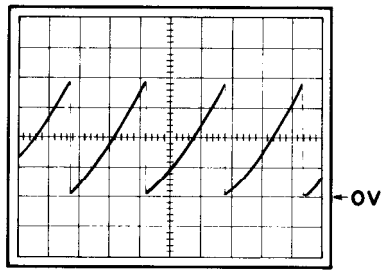
WAVEFORMS



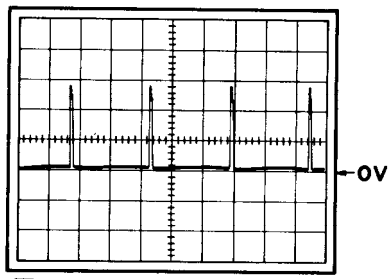
〈1〉 5 ms/div. 0.2 V/div.



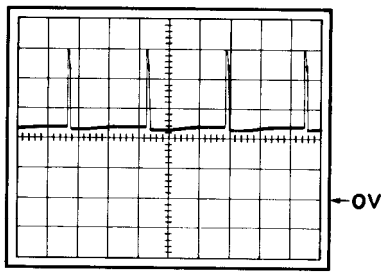
〈2〉 5 ms/div. 2 V/div.



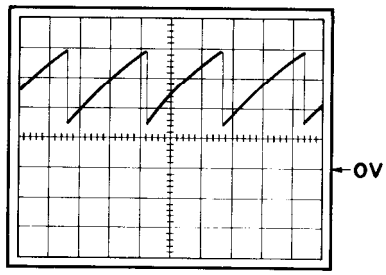
〈3〉 5 ms/div. 1 V/div.



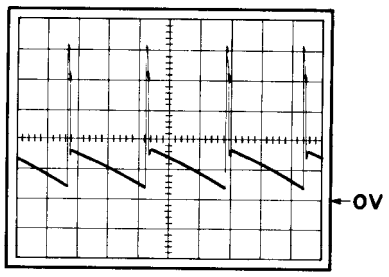
〈4〉 5 ms/div. 5 V/div.



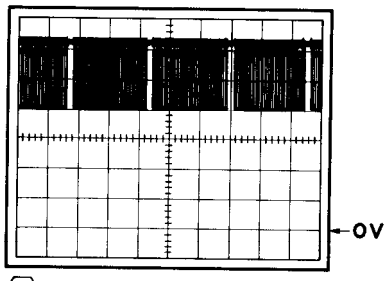
〈5〉 5 ms/div. 5 V/div.



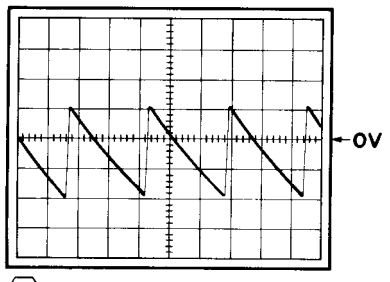
〈6〉 5 ms/div. 1 V/div.



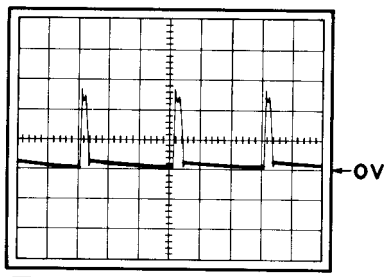
〈7〉 5 ms/div. 5 V/div.



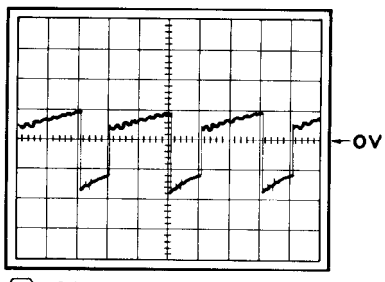
〈8〉 5 ms/div. 10 V/div.



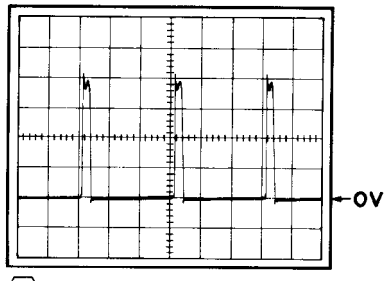
〈9〉 5 ms/div. 2 V/div.



〈10〉 20 µs/div. 50 V/div.



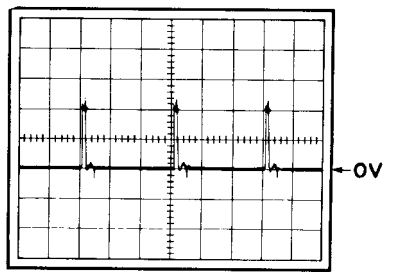
〈11〉 20 µs/div. 2 V/div.



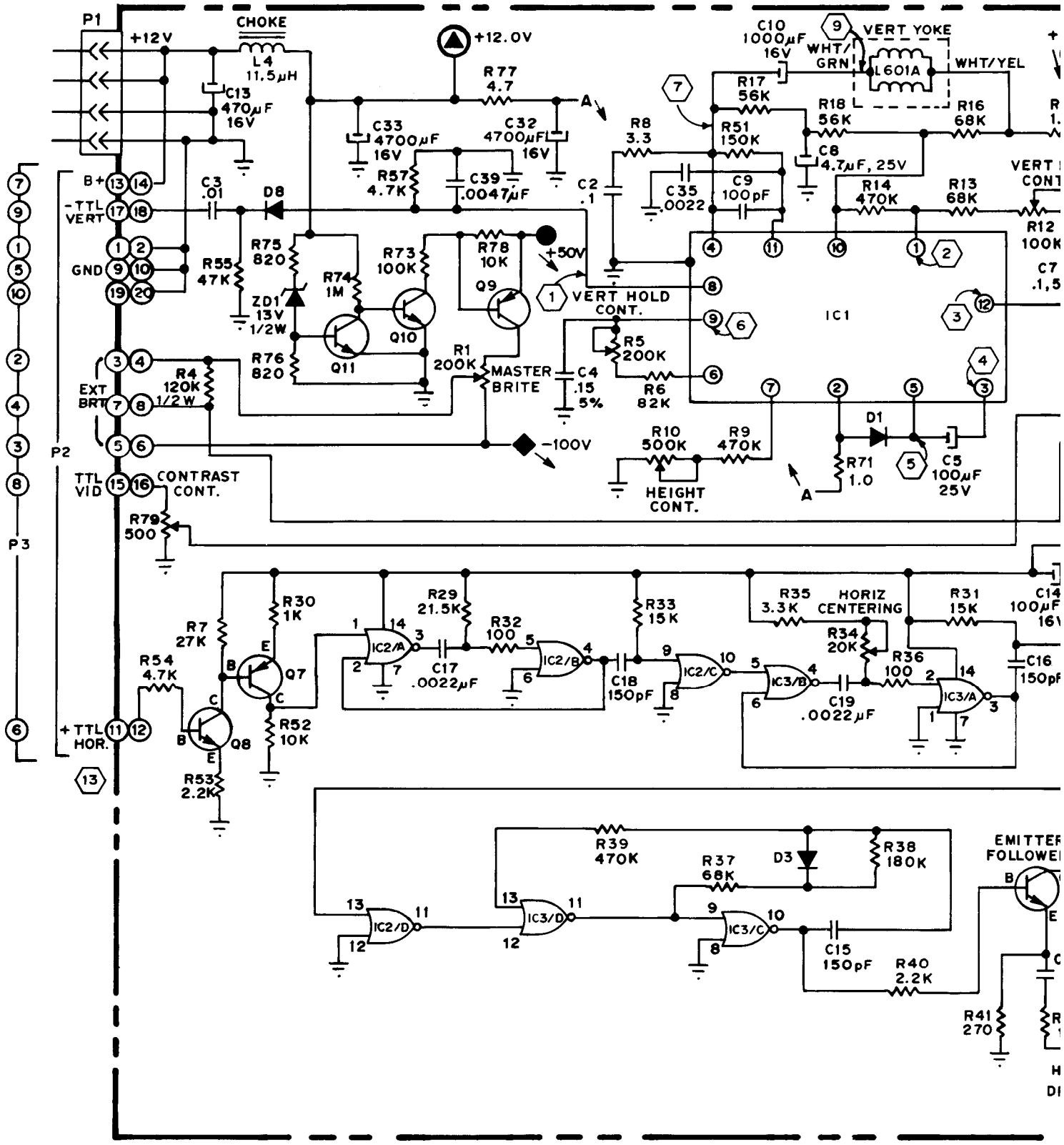
〈12〉 20 µs/div. 50 V/div.

NOTE: *All waveforms were taken with a wideband (>10MHz) oscilloscope in DC mode. Voltages and waveforms may vary with control setting.*

Input Signal Frequency: Horiz.: 16.7 kHz
Vert.: 77.5 Hz with positive Vertical Sync.



〈13〉 20 µs/div. 2 V/div.

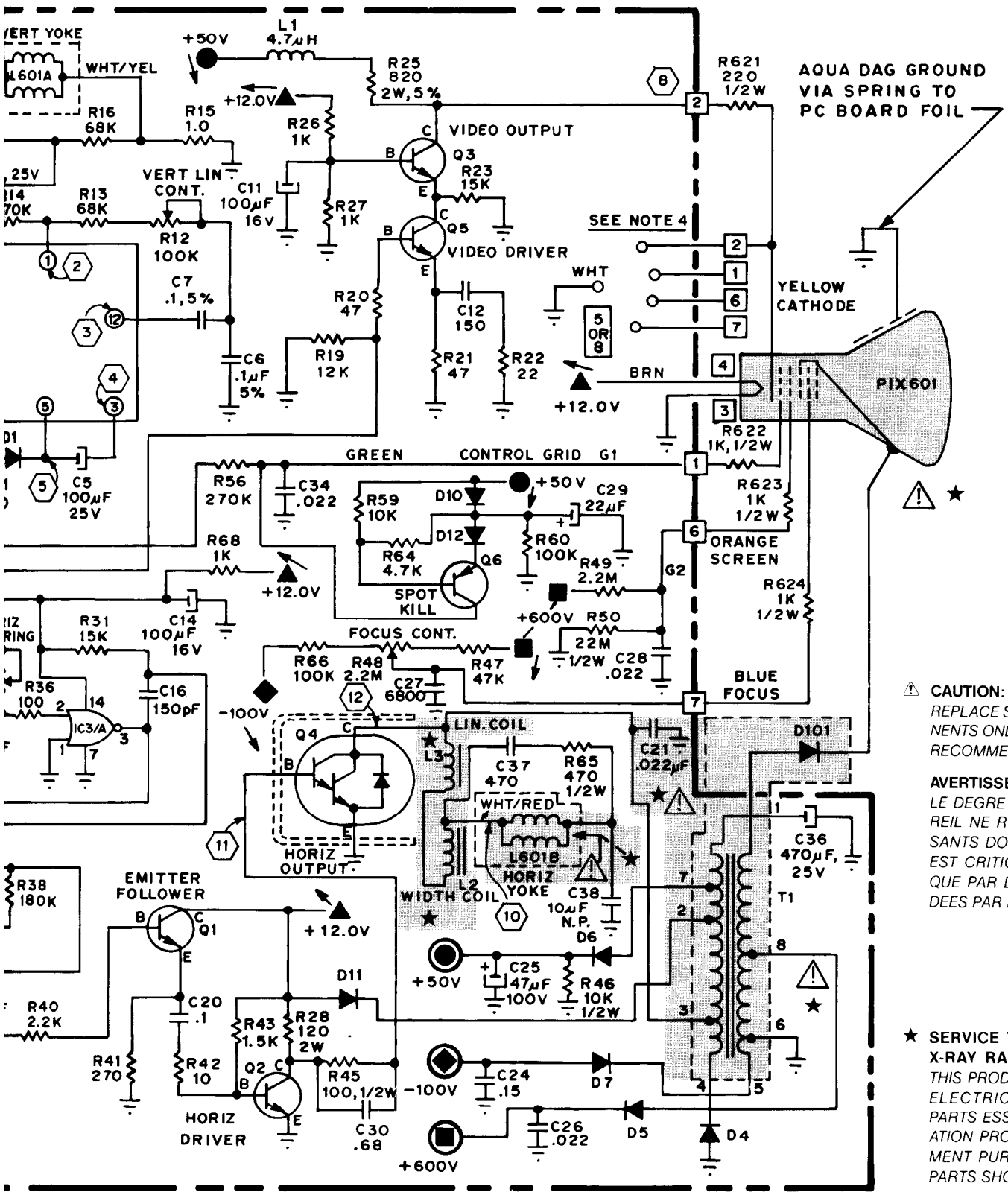


NOTES:

1. ALL RESISTORS ARE IN OHMS, 5% 1/4W UNLESS SPECIFIED OTHERWISE.
2. CAPACITANCE VALUES OF 1 OR LESS ARE IN MICROFARADS; ABOVE 1 IN PICOFARADS, UNLESS OTHERWISE INDICATED.
3. PIN NUMBERS FOR EDGE CONNECTOR (P3) AND 20-PIN MASS TERMINATOR (P2) ARE INDICATED IN CIRCLES. NUMBERS IN SQUARES INDICATE PIX SOCKET PIN TO WHICH WIRE CONNECTS.
4. PIN 5 OF PIX SOCKET IS GROUND RETURN FOR SPARK GAPS TO PINS 1, 2, 6 AND 7.
5. CIRCUIT SYMBOL NUMBERS IN 600 SERIES INDICATE: "NOT MOUNTED ON A PC BOARD".
6. SOURCE VOLTAGE SYMBOLS CIRCLED. ARROWS POINT TO SOURCE.

FIGURE 19: Typical Schematic Diagram of CUSTOMISER II Monitor

T SCHEMATIC



⚠ **CAUTION:** *FOR CONTINUED SAFETY, REPLACE SAFETY CRITICAL COMPONENTS ONLY WITH MANUFACTURER'S RECOMMENDED PARTS.*

AVERTISSEMENT: *POUR MAINTENIR LE DEGRE DE SECURITE DE L'APPAREIL NE REMPLACER LES COMPOSANTS DONT LE FONCTIONNEMENT EST CRITIQUE POUR LA SECURITE QUE PAR DES PIECES RECOMMANDEES PAR LE FABRICANT.*

★ **SERVICE TECHNICIAN WARNING; X-RAY RADIATION PRECAUTION:** *THIS PRODUCT CONTAINS CRITICAL ELECTRICAL AND MECHANICAL PARTS ESSENTIAL FOR X-RAY RADIATION PROTECTION. FOR REPLACEMENT PURPOSES, USE ONLY TYPE PARTS SHOWN IN THE PARTS LIST.*

7. NUMBERS IN HEXAGONS (⬡) INDICATE LOCATIONS OF WAVEFORM READINGS.

SS OTHERWISE

CATED IN CIRCLES.

IMPORTANT: *This schematic may be used when servicing Model 12V3015*

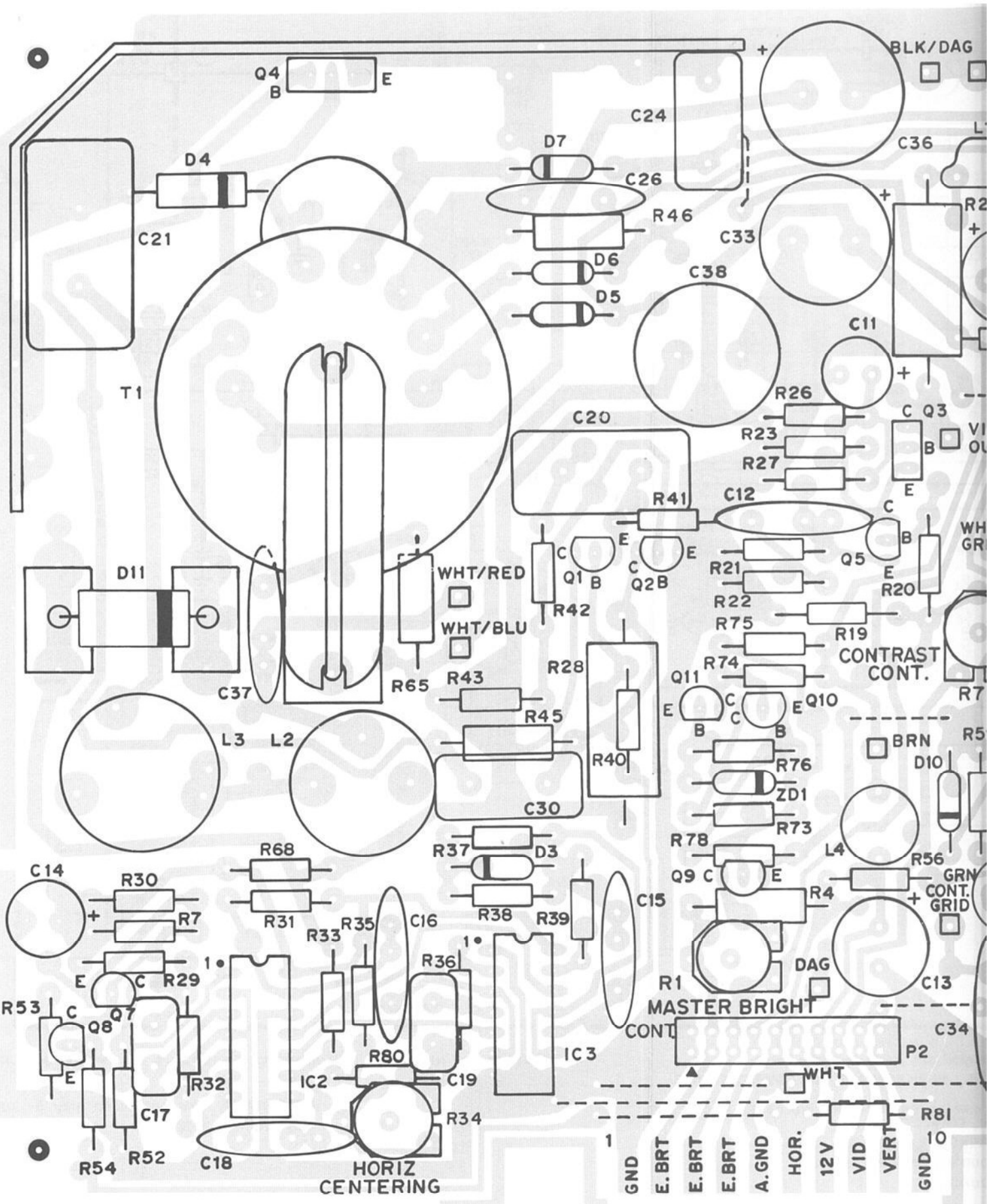
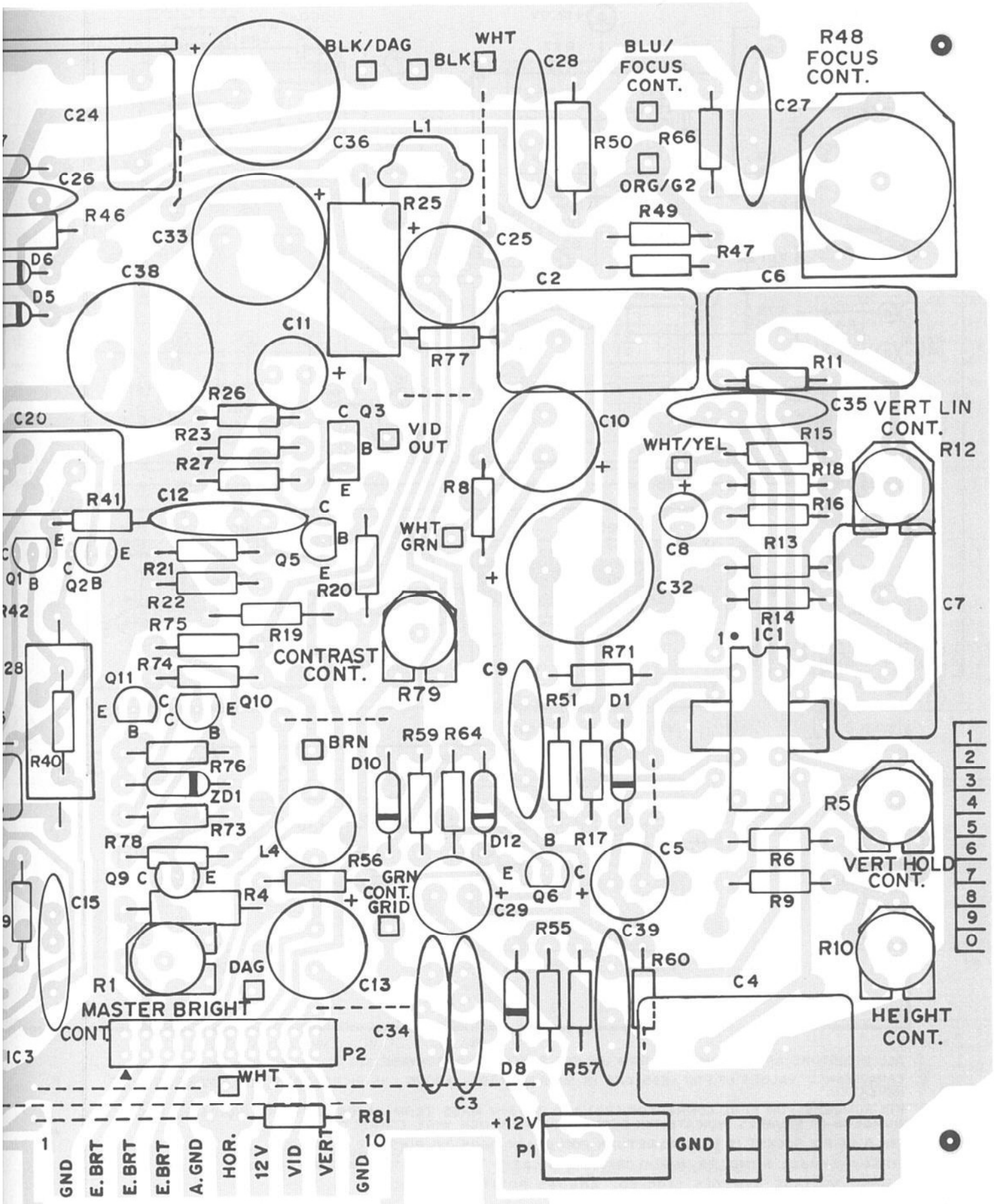


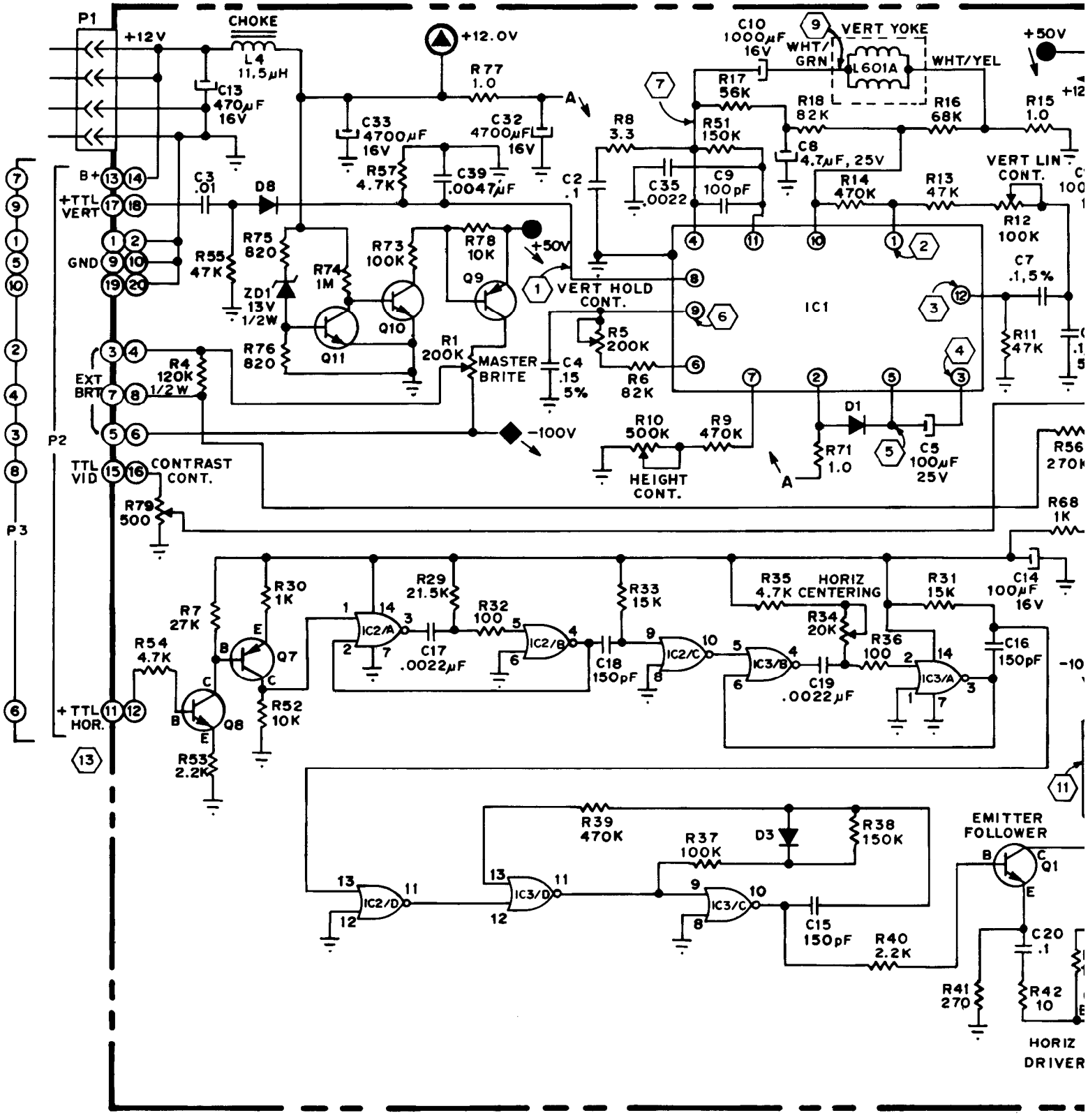
FIGURE 20: Typical Main PC Board (12-Volt Kit Version Shov



URE 20: Typical Main PC Board (12-Volt Kit Version Shown)

NOTE: *The polarity of D8, as illustrated, would be required for NEGATIVE VERTICAL SYNC.*

MONITOR KIT SCHEMATIC



NOTES:

1. ALL RESISTORS ARE IN OHMS, 5% 1/4W UNLESS SPECIFIED OTHERWISE.
2. CAPACITANCE VALUES OF 1 OR LESS ARE IN MICROFARADS; ABOVE 1 IN PICOFARADS, UNLESS OTHERWISE INDICATED.
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4. PIN 5 OF PIX SOCKET IS GROUND RETURN FOR SPARK GAPS TO PINS 1, 2, 6 AND 7.
5. CIRCUIT SYMBOL NUMBERS IN 600 SERIES INDICATE: "NOT MOUNTED ON A PC BOARD".
6. SOURCE VOLTAGE SYMBOLS CIRCLED. ARROWS POINT TO SOURCE.

FIGURE 21: Typical Schematic Diagram of CUSTOMISER II Monito

MATIC

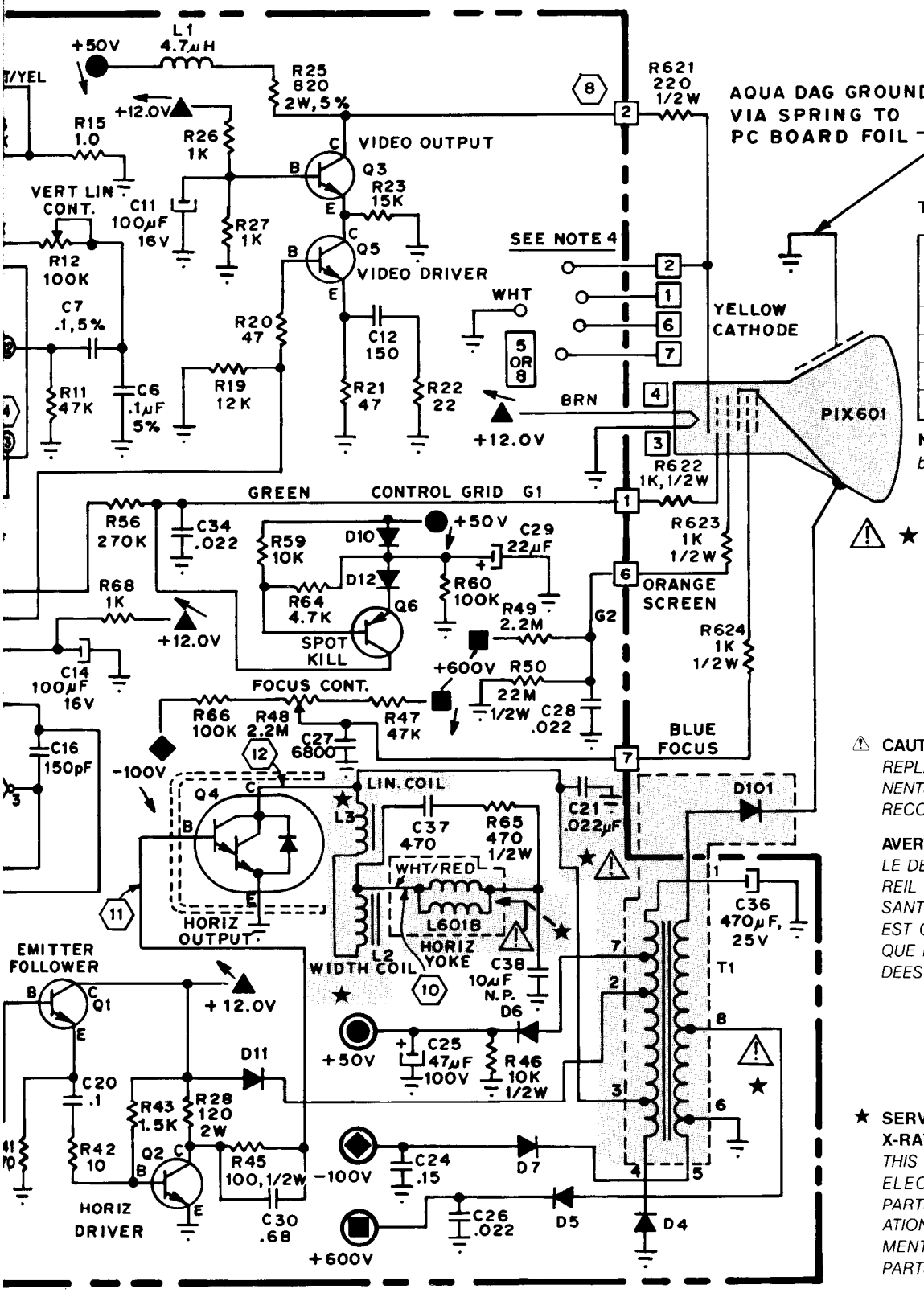

TABLE 2

Diagonal Measurement of Pix Tube	Nominal High Voltage on 2nd Anode at No Brightness
7"	10.5 kV
9"	12.0 kV
12"	13.0 kV
14"	13.0 kV

NOTE: *Voltage reading will vary with brightness level.*

⚠ **CAUTION:** *FOR CONTINUED SAFETY, REPLACE SAFETY CRITICAL COMPONENTS ONLY WITH MANUFACTURER'S RECOMMENDED PARTS.*

AVERTISSEMENT: *POUR MAINTENIR LE DEGRE DE SECURITE DE L'APPAREIL NE REMPLACER LES COMPOSANTS DONT LE FONCTIONNEMENT EST CRITIQUE POUR LA SECURITE QUE PAR DES PIECES RECOMMANDEES PAR LE FABRICANT.*

★ **SERVICE TECHNICIAN WARNING; X-RAY RADIATION PRECAUTION:** *THIS PRODUCT CONTAINS CRITICAL ELECTRICAL AND MECHANICAL PARTS ESSENTIAL FOR X-RAY RADIATION PROTECTION. FOR REPLACEMENT PURPOSES, USE ONLY TYPE PARTS SHOWN IN THE PARTS LIST.*

7. NUMBERS IN HEXAGONS (⬡) INDICATE LOCATIONS OF WAVEFORM READINGS.

IE

CLES.

IMPORTANT: *This schematic may be used when servicing Model 14V3017*

INDEX