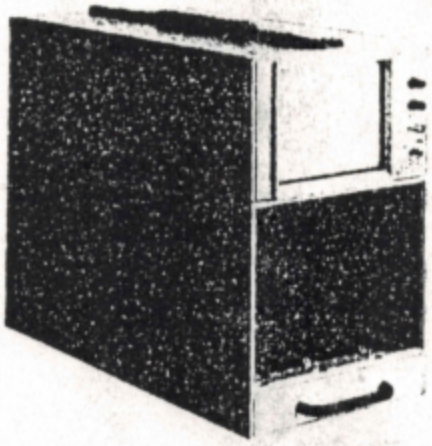
INSTRUCTION MANUAL



MAINFRAME

MODEL 1038-D10
MODEL 1038-D11

SERIAL NUMBER 551

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SECTION 1

GENERAL INFORMATION

1.1 PACIFIC MEASUREMENTS MODEL 1038 POWER SUPPLY/AMPLIFIER MODULE.

The Model 1038 Power Supply/Amplifier Module is an interconnection unit connecting the plug-ins to the display module. Together with a display module, it comprises the System Mainframe. In addition to providing for interconnecting the plug-ins to the display unit, the module supplies power to the system, amplifies the vertical and horizontal signals from the plug-ins and provides for auxiliary output and inputs on its rear panel. Electronic switching between the two vertical channels is provided, allowing them to time-share the beam for simultaneous presentation of both channels.

The auxiliary inputs and outputs are located on the rear panel. Inputs provide access to the vertical and horizontal channels. The three output BNC connectors provide voltages proportional to the beam deflection for the horizontal and each of the two vertical channels. The four contact microphone-type connector is used to connect a Pacific Measurements Model 1001 or 1005 to the measurement system. (The Model 1001 or 1005 drives an X-Y recorder to make a plot of any repetitive waveform displayed.) An additional input/output connector is a multi-pin interface connector with various connections required to operate auxiliary equipment.

1.2 DISPLAY UNIT

The Display Unit is manufactured by Tektronix, Inc. Specifications relating to it are in the Tektronix Manual included with this instruction book. Normally, nonstorage display units will be supplied with a P-7 phosphor. This phosphor has a blue fluorescence when the beam strikes it followed by a yellow phosphorescence. The yellow light decays to about one-third its original intensity one second after excitation is removed. For slow sweep displays, the phosphorescence retains the shape of the curve. An orange-yellow filter reduces the glare from the fluorescence, thereby eliminating much of the flicker from such displays. Filters are available from Tektronix, or may be ordered through Pacific Measurements.

1.3 MODEL 1038 MAINFRAME PERFORMANCE SPECIFICATIONS

The specifications for the Model 1038 mainframe apply only when connected with a display unit. The specifications given below in Table 1-1 are for the external connections accessible at the rear of the unit; other specifications affecting the unit's ability to power plug-ins and the display units are contained in Section 6.

TABLE 1-1

SPECIFICATIONS

REAR PANEL CONNECTORS	
A CHAN, B CHAN and HORIZ	
Connector	BNC Jack
Output Coefficient	100 mV/Division
Coefficient Accuracy	±2%
Output voltage with spot centered on CRT graticule	0 V, within 20 mV
Impedance	Approximately 50 Ω
CRT DISPLAY CONVERTER	
Compatible with Pacific Measurements Model 1001 and 1005.	
Connector	Switchcraft type B4M
Vertical Coefficient	100 mV/Division
Horizontal Coefficient	600 mV/Division
Coefficient Accuracy	±2%
Output voltage with spot centered on CRT graticule	0 V, within 20 mV vertical and within 120 mV horizontal.
AUXILIARY INPUT A AND B	
Connector	BNC Jack
Signals	Dependent upon plug-ins
INPUT/OUTPUT	
Connector	Amphenol type 57-40360 (Mates with type 57-30360)
Signals	See Table 1-2 and plug-in manuals.
TEMPERATURE RANGE	
Operating	0 to +50°C (+32 to +122°F)
Non-operating	-40 to +70°C (-40 to +158°F)
ALTITUDE	
Operating	to 4600 m (15,000 ft.)
Non-operating	to 15,000 m (50,000 ft.)
DIMENSIONS	
Bench (HxWxD)	38.4 cm x 21.3 cm x 49.0 cm (15.1" x 8.4" x 19.3")
Rack (HxWxD)	17.8 cm x 48.3 cm x 48.8 cm (7.0" x 19.0" x 19.2")
WEIGHT	14 kg. (30 pounds)
POWER REQUIREMENTS	115 or 230 Vrms within 10% 50 to 60 Hz. (Upper frequency limited by fan requirements. Otherwise the upper frequency would be 400 Hz.)

TABLE 1-2

INPUT/OUTPUT CONNECTOR PIN ASSIGNMENTS

Pin No.	Connection	Pin No.	Connection
1	+15 V	19	+15 V
2	-15 V	20	-15 V
3	15 V Common	21	15 V Common
4	-30 V	22	+30 V
5	A Channel Output	23	30 V Common
6	+200 V	24	B Channel Output
7	+5 V	25	+5 V
8	5 V Common	26	5 V Common
9	+20 V	27	+ 20 V
10	20 V Common	28	20 V Common
11	*	29	*
12	*	30	External Intensity
13	*	31	*
14	Input/Output Aux 2 Common	32	Input/Output Aux 2
15	*	33	*
16	Horizontal Output	34	Line Frequency
17	*	35	*
18	Input/Output Aux 1	36	*

*Connection to interface board, see schematic DWG. 12583 for detail. Signal appearing on pin depends upon plug-in unit installed.

SECTION 2

INITIAL INSTRUCTIONS

2.1 RECEIVING INSPECTION

Unpack the instrument carefully and check for any obvious shipment damage. If damage is evident, file a claim against the carrier. The carrier will normally supply appropriate forms.

2.2 POWER REQUIREMENTS

The unit is normally connected at the factory for operation from 105 volts to 125 volts ac at 50 to 60 Hz. The unit may be changed for operation from 210 volts to 250 volts ac if required. Conversion from one voltage to another may be made by changing the position of a rear panel switch. In either position, the switch exposes numbers indicating the correct operating line voltage. To change the position of the switch, insert a small screwdriver in the slot provided and push the switch in the desired direction. To provide greater protection for 230 V operation, change the fuse as indicated on the display module.

2.3 CHASSIS GROUNDING

The instrument is supplied with a three-conductor NEMA type power cord. The instrument will be properly grounded if the plug is connected into a properly installed three-prong receptacle. If a three-prong to two-prong adapter is used, be sure that the pigtail lead of the adapter is grounded.

WARNING

FAILURE TO PROPERLY GROUND THE INSTRUMENT CAN ALLOW DANGEROUS VOLTAGES TO BUILD UP ON THE CHASSIS WHICH COULD BECOME DANGEROUS TO OPERATING PERSONNEL.

2.4 RETURNING THE INSTRUMENT

If it is necessary to return the instrument to Pacific Measurements, authorization must first be obtained from our Sales Department or local representative. Before packaging, the instrument should be wrapped in a protective material such as polyethylene to protect it from marring. If you do not have the original shipping container, wrap the instrument in a large quantity of protective padding material such as foam or hair flex and use a rugged cardboard or wooden container as a packing carton. Pack the instrument firmly so that it will not move around in the container. A letter containing all pertinent information should be included with the package unless you have already sent such a letter to our Sales Department.

2.5 ACCESSORIES

Qty.	Part No.	Description
1	-------	Instruction Manual

2.6 CERTIFICATION

Pacific Measurements Incorporated certifies that this instrument was thoroughly tested and inspected and found to meet all its published specifications when it was shipped from the factory. Pacific Measurements Incorporated further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facility.

2.7 WARRANTY AND ASSISTANCE

All Pacific Measurements products are warranted against defects in materials and workmanship. This warranty applies for one year from date of delivery or, in the case of certain major components listed in the instruction manual, for the specific period. Pacific Measurements Incorporated will repair or replace products which prove to be defective during the warranty period free of charge. No other warranty is expressed or implied. We are not liable for consequential damages.

For assistance contact your nearest Pacific Measurements franchised representative office or the factory in Palo Alto, California.

SECTION 3

OPERATION

3.1 INTRODUCTION

The Model 1038 Measurement System Mainframe consists of the Power Supply/Amplifier Module and a display unit. The display unit is manufactured by Tektronix, Inc. Included with this manual is a Tektronix Manual for the Display Unit. The Display Unit is standard except that the Calibration Loop is not supplied. The operating instructions in the Display Unit manual apply, except for those relating to the use of Tektronix plug-in units. Tektronix plug-in units do not fit the Model 1038.

The Power Supply/Amplifier Module provides the necessary signals and power to operate the display unit and the plug-ins. The following material describes the features of this part of the mainframe.

3.2 REAR PANEL CONNECTORS.

A photograph of the rear panel appears in Figure 2-1.

a. AUXILIARY INPUT/OUTPUT #1 BNC JACK. This connector provides access to the horizontal plug-in, and in some cases all three plug-ins.

b. AUXILIARY INPUT/OUTPUT #2 BNC JACK. This connector provides access to the left-hand plug-in.

c. A CHANNEL VERTICAL OUTPUT BNC JACK. This connector supplies a voltage proportional to the A Channel vertical CRT deflection. The voltage is available whenever a vertical deflection signal is present, even though the display mode selected does not display the signal. The output voltage is very nearly zero when the beam is centered and changes 100 mV for each division that the spot moves on the CRT. Impedance is approximately 50 ohms.

d. B CHANNEL VERTICAL OUTPUT BNC JACK. This connector supplies a voltage proportional to the B Channel vertical CRT deflection. Its characteristics are similar to the A Channel connector described in c.

e. HORIZONTAL OUTPUT CONNECTOR. This connector supplies a voltage proportional to the horizontal CRT deflection. Its characteristics are similar to the A Channel connector described in c.

f. CRT DISPLAY CONVERTER OUTPUT CONNECTOR. This connector supplies voltages suitable for driving Pacific Measurements Model 1001 or Model 1005 CRT Display Converters. These converters drive X-Y recorders to make plots of waveforms displayed on the CRT. Since they will only plot one channel at a time, it is required to select the vertical channel to be plotted. The switch located to the right of this connector makes this selection.

g. INPUT/OUTPUT CONNECTOR. This connector provides for signal and power interchange for accessory equipment. Specifications depend upon the plug-ins used with the instrument.

3.3 OPERATING PROCEDURE.

The controls relating to the Display Unit are described in the manual for that unit. The operation of the plug-ins is described in their corresponding manual(s).

SECTION 4

PERFORMANCE CHECKS

4.1 PURPOSE

The checks given in this section are primarily useful for periodic evaluation of performance of the mainframe. If the instrument fails to meet one or more of the performance criteria listed here, refer to Section 6 for instructions on making the necessary adjustments. These checks may also be used for incoming inspection. However, since the instrument is ordinarily shipped with plug-in units installed it will be more useful to check the system performance including the plug-ins. Instructions for doing this are given in the manuals pertaining to the specific plug-in units installed.

4.2 EQUIPMENT REQUIRED

The only item of equipment required to make the performance checks is the special Plug-in Extender and Calibration Fixture kit. Pacific Measurements part number 12715. The kit consists of a shorting board, Assembly No. 12719, and an extender, Assembly No. 12716.

4.3 DISPLAY UNIT

Install the shorting board, Assembly No. 12719 in the left-hand plug-in connector and place the extender, Assembly No. 12716 in the middle plug-in connector. The switch on the shorting board should be thrown to A CHAN ON. The switches on the extender should be thrown to: CAL, VERT. and CENTER.

a. Turn the INTENSITY control all the way counterclockwise. The spot should be extinguished. Turn the control clockwise and see that the spot can be made to de-focus or 'bloom'. Reduce the intensity until a dim spot is displayed.

b. Adjust the FOCUS control and determine that the beam can be focused to display a small spot.

c. Throw the switch on the extender board to +3 DIV. Press the BEAM FINDER button. The spot should brighten noticeably and move slightly downward. Return the switch to CENTER.

4.4 DEFLECTION SYSTEM

Install the test fixture as described in Section 4.3.

a. Set the switches as described in Section 4.3. The beam should be in the center of the CRT, within 0.1 division.

b. Move the switch on the extender to +3 DIV. The spot should move three divisions up from the point it was found to be in step a. within 0.03 divisions.

c. Exchange the position of the two test boards, so that the extender is in the left-hand slot and the shorting board is in the middle slot. Check to be sure that the switch is still in the +3 DIV position and that the other switches are set to CAL, HORIZ, and A CHANNEL ON. Check that the beam is now 3 divisions to the right of the point where it was in step a., within 0.03 divisions.

This completes the performance checks for the Model 1038 Mainframe.

SECTION 5

CIRCUIT DESCRIPTION

5.1 INTRODUCTION

This section of the manual contains a description of the electrical circuits of the Power Supply/Amplifier Module part of the Model 1038. Details of the Display Unit will be found in the Tektronix manual supplied herewith. An overall block diagram is given in Figure 5-1. Circuit schematic diagrams are found in the rear of the manual. Waveforms of significance and dc voltages found at various points in the circuits will be found in Section 6.

5.2 BLOCK DESCRIPTION

The auxiliary board accepts signals from the left and right vertical plug-in units for display on the CRT. In the case of single-beam CRT displays, the board selects which channel is to be displayed. The selection is made in a fraction of a microsecond, so the channels can time-share the beam in a chopped or alternate sequence as desired. A differential amplifier on the interface board provides additional gain ahead of the deflection circuit. In the case of dual-beam CRT displays, the board re-routes the right-hand vertical plug-in signal to the lower-beam deflection circuits, and supplies necessary additional gain.

A differential amplifier, similar to the one in the vertical circuit, amplifies the signal from the horizontal plug-in unit and supplies the deflection circuits in the display section. Signals from the horizontal plug-in control the logic circuits which, in turn, control the state of the switches on the auxiliary board.

Isolating amplifiers supply the vertical and horizontal signals to rear panel connectors. Signals from these connectors are used for making X-Y plots and operating auxiliary equipment, including the Model 1001 or 1005 CRT display converter.

The power supply circuits provide regulated precise dc voltages for operation of the display unit and plug-ins. Unregulated voltages are provided to points where precise voltages are not required and current consumption is high.

5.3 AUXILIARY BOARD

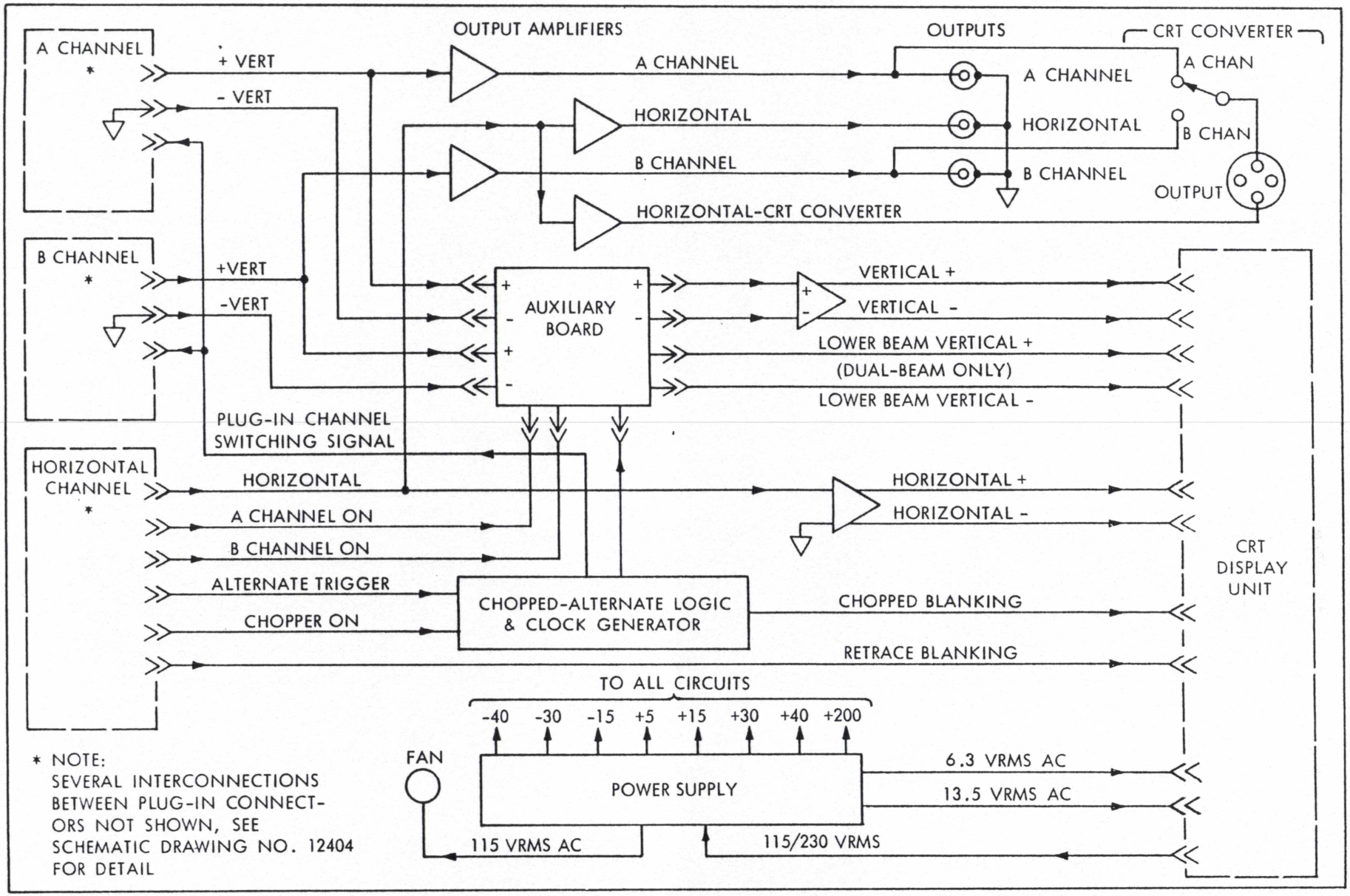
Because switching between plug-ins is required for simultaneous viewing of displays on single-beam CRTs, and not required for dual-beam CRTs, an auxiliary board is supplied with each display unit to provide signals corresponding to the type of CRT used. It plugs into J604 on the interface board. The board accepts vertical deflection signals from each of the two vertical channels, two vertical channel "on" signals (one for each vertical channel) derived from contact closures to -30 in the horizontal plug-in and a TTL logic signal providing for chopped or alternate display of the channels (if both are "on". The effect of the chopped or alternate display is to give the appearance of simultaneous display of both signals. A logic circuit on the interface board generates the required drive signals.

On the auxiliary board, emitter followers Q701, Q703, Q711 and Q713 provide a high impedance input to two pairs of grounded-gate FET amplifiers, Q702-Q704 and Q712-Q714. The switching circuit consists of Q721 and Q722, connected as a comparator. Plug-in "on" signals (-30 V) are applied to the switching circuit in addition to the logic signal. The comparator is biased in such a way that it will be insensitive to the state of the logic signal unless both "on" signals are present. The switching circuit allows only one pair of amplifiers to be on at a time, thus permitting only one of the two vertical plug-in signals to pass to the vertical amplifier. In the chopped mode, the switching between pairs of amplifiers occurs at a 50 kilohertz rate. In the alternate mode switching occurs at the end of every second sweep. If no "on" logic level is applied to the switching circuit from either vertical plug-in, Q702 and Q704 will remain on, passing the signal from the left vertical plug-in.

The dual-beam auxiliary board has no switching circuit. It routes the signal from the left vertical plug-in to the vertical amplifier circuit on the interface board, and amplifies the signal from the right vertical plug-in. The amplifier circuit on the dual-beam auxiliary board is identical to the vertical amplifier on the interface board, to be discussed below. It consists of Q701, Q702, Q711 and Q712. The output of this amplifier is sent directly to the lower-beam deflection amplifier in the display unit.

5.4 VERTICAL AND HORIZONTAL DIFFERENTIAL AMPLIFIERS

The vertical and horizontal differential amplifiers are identical. The circuits themselves are symmetrical about an imaginary line through the center of the 422 ohm feedback divider resistor and continuing through the common junction of the two 10 k ohm collector feed resistors. Each half of the amplifier is a feedback pair. The input transistor converts the voltage difference between its base and emitter into a collector current. The second-stage transistor amplifies this current, feeding it to the output resistors where the signal is converted back to a voltage. A portion of this voltage is fed back to the input emitter by a resistive voltage divider consisting of the 2.00 k series resistor and one half of the 422 ohm shunt resistor. The action of the amplifier is such that a change in input voltage will result in a voltage fed back to the emitter that is almost equal to the input voltage, the difference being just enough to account for the finite open-loop gain of the amplifier. The closed-loop gain



MODEL 1038 MAINFRAME BLOCK DIAGRAM

FIGURE 5-1

is almost the feedback divider ratio, in this case approximately 10.5. A balance control shifts the input bias current between the two input transistors to adjust for differences between the components comprising the amplifier halves, so that with equal signals (or zero signal) applied to the differential inputs the output differential voltage will be zero.

5.5 SWITCHING LOGIC CIRCUITS

The switching logic circuits control which of the available signals will be displayed, and if more than one signal is to be displayed they control the display sequence. For rapid sweeps, the signal controlling the display sequence is taken from the 'A GATE' line, which goes positive at the beginning of each sweep. This signal causes the flip-flops (U2) which determine the signal to be displayed to change to the next state in its sequence. The result is that a different signal will be displayed for each sweep, until the flip-flops are once again back in their beginning state. For slower sweeps it is better to display the signals in a very rapid sequence as the sweep moves across the screen, to give the appearance of a simultaneous display.

In this (chopped) mode, the signal to drive the flip-flops comes from a clock generator, consisting of U1 and Q1 and associated components. U1, R4, R5, and C7 act as a one-shot circuit sensitive to negative-going pulses applied at pin 13 of U1. Immediately following the arrival of a negative pulse, pin 11 develops a positive 1 microsecond pulse and pin 8 supplies a negative pulse. Triggers are generated by Q1, with their timing dependent upon R1 and C6. During the period when pin 11 has a positive pulse voltage, C6 charges through the base of Q1. This takes less than 1 microsecond so Q1 turns off in less than the period of the pulse, as soon as C6 finishes charging. During this period R1 is essentially grounded through pin 8. When the one microsecond pulse terminates, C6 is driven negative and the top end of R1 is driven to almost the 5V supply voltage. C6 now charges through R1 toward +5V, in time reaching the turn-on point for Q1, causing its collector to drive pin 13 negative and initiating a new cycle.

Part of U1 is used to supply the one microsecond pulse to the CRT blanking circuits so that the beam will be turned off during the period when the display is switching between channels. The remaining portion of U1 performs the 'OR' function so that either the clock pulses or the A GATE sweep termination pulse will trigger the display sequencing flip-flops.

The display sequencing flip-flops generate four time slots for the displaying the vertical signals. Pin 13 provides a signal for use in multi-channel plug-ins. It changes state every 5 microseconds. Pin 9 supplies the signal to the auxiliary board to select whether the right or left channel will be displayed. It changes states every 10 microseconds. Thus there is time for each of two signals for 5 microseconds before the auxiliary board selects the other plug-in.

Pin 9 of U1 is a logic input used to turn on the clock when a chopped display is desired. A logic '1' turns on the clock.

5.6 ISOLATION AMPLIFIERS

Each of the four isolation amplifiers consists of one half of a CA3026 integrated differential pair of transistors supplied from a current source and an output transistor. The differential pair amplifies the difference between the input signal and the feedback signal from the feedback resistive divider. The output transistor further amplifies the signal and supplies the current necessary to drive the output load. The feedback divider divides by 2 for the two vertical output amplifiers and the horizontal output amplifier. It divides by 12 for the horizontal driver for the CRT Display Converter. A series resistor isolates the amplifier from any load connected to the output BNC or CRT Converter connector and provides a source impedance to match cables connected to the output.

5.7 POWER SUPPLY CIRCUITS

There are five bridge rectifier assemblies feeding capacitor input filters used to supply dc power to the instrument. The +200 V, +40 V and -40 V supply currents are drawn directly from the filter capacitors and are not regulated; there actual value will depend upon the line voltage. A 20 V auxiliary supply is available to the plug-ins directly from a filter capacitor. Other supply voltages are regulated.

5.7.1 30 VOLT POWER SUPPLIES

The + and - 30 V power supplies are similar with the only difference being the source for the reference voltage. The -30 V supply uses a 6.2 V zener diode as its reference; the +30 V supply uses the -30 V supply. In operation, a portion of the output voltage is fed back to the integrated circuit differential amplifier where it is compared with the reference and any difference amplified. A transistor connected to the output of the input amplifier provides additional gain to drive the series pass transistor. There is sufficient gain in the circuit that very little difference voltage is required at the input to drive the series pass transistor, thus the voltage is primarily dependent upon the voltage divider ratio and the reference voltage. A resistor in series with the emitter of the series pass transistor develops a voltage proportional to the load current. If this voltage exceeds about 0.6 V, diodes connected to the base of the series transistor extract current from its base, limiting its current. This provides protection from overloads. Since the supply uses its own output voltages to operate the differential amplifier, a diode-resistor network provides a source of voltage during turn-on.

5.7.2 15 VOLT POWER SUPPLIES

The + and - 15 V power supplies are similar to the V supplies described above. Since these supplies are used for reference voltages in the plug-ins, they must be very tightly regulated; therefore an additional transistor is used to provide more gain. Because the voltage is desired to be precisely regulated at the plug-in connectors and there is some voltage drop in the wires between the power supply circuit and the interface board, remote sensing leads are used to connect the feedback divider to the supply voltage at the plug-in connectors.

5.7.3 +5 VOLT POWER SUPPLY

The output voltage is fed back to the first stage amplifier transistor through the 3.9 V zener diode. The amplifier emitter-base voltage (0.6 V) plus the drop across the adjustment resistor plus the 3.9 V zener diode voltage will just equal the supply voltage. There is sufficient gain in the two amplifier transistors and the series pass transistor to maintain the output voltage constant by feedback action. The current limit circuit works the same way as the one in the 30 V supplies described above. Because the +5 V supply is used to furnish voltage to logic type integrated circuits that are extremely sensitive to overvoltage, protection is provided. A transistor, zener diode and forward-biased diode are used as a shunt regulator which comes into action if the power supply voltage exceeds approximately 5.5 V. The circuit has enough capacity to burn out the fuse, so that even if the series pass transistor becomes shorted, the supply will be protected.

5.7.4 LINE FREQUENCY SIGNAL

A resistive attenuator supplies a low voltage line frequency signal for use in the plug-ins. The source is the secondary winding of the power transformer used with the 40 V supply.

5.7.5 CRT HEATER WINDINGS

Two separate secondary windings are provided for the CRT writing-fun heaters and the flood-gun heaters. The writing-gun heaters are elevated to -3500 V in the CRT circuit (display unit) to maintain a potential near that of the CRT cathode.

SECTION 6

MAINTENANCE

6.1 PERIODIC MAINTENANCE

The following maintenance should be performed once each year unless the instrument is operated in an extremely dirty or chemically contaminated environment, or is subjected to severe abuse. In such cases, more frequent maintenance is indicated.

a. Blow out all accumulated dust with forced air under moderate pressure.

b. Inspect the instrument for loose wires and damaged components. Check to see that the plug-in PC board is properly seated in its socket and that all wire lead connectors are properly seated on their PC board pins.

c. Make a performance check in accordance with the procedure of Section 4. If the performance is within specifications, no further service is required.

6.2 INTERNAL ADJUSTMENTS AND TEST POINTS

The following is a list of adjustments and test points supplied for ready reference. Do not attempt to make any adjustments until you have read the material in Section 6.3.

6.2.1 DESCRIPTION OF ADJUSTMENTS

The function of each adjustment is described below. Descriptive material relating to the adjustments in the display portion of the system will be found in the Tektronix Manual supplied herewith.

a. A1R11 HORIZONTAL BALANCE CALIBRATION ADJUSTMENT. Used to center the beam on the CRT in the horizontal direction with the horizontal input shorted to ground.

b. A1R22 A CHANNEL BALANCE CALIBRATION ADJUSTMENT. Used to center the beam on the CRT in the vertical direction with the A Channel vertical input shorted to ground.

c. A1R31 B CHANNEL BALANCE CALIBRATION ADJUSTMENT. Used to center the beam on the CRT in the vertical direction with B Channel vertical input shorted to ground.

d. A2R8 +5 V POWER SUPPLY CALIBRATION ADJUSTMENT. Used to set the +5 V power supply to within 100 mV of +5 V.

e. A2R29 +30 V POWER SUPPLY CALIBRATION ADJUSTMENT. Used to set the +30 V power supply to within 30 mV of +30 V.

f. A2R32 -30 V POWER SUPPLY CALIBRATION ADJUSTMENT. Used to set the -30 V power supply to within 30 mV of -30 V.

g. A2R54 +15 V POWER SUPPLY CALIBRATION ADJUSTMENT. Used to set the +15 V power supply to within 10 mV of +15 V.

h. A2R57 -15 V POWER SUPPLY CALIBRATION ADJUSTMENT. Used to set the -15 V power supply to within 10 mV of -15 V.

6.2.2 DESCRIPTION OF TEST POINTS

The following test points permit the measurement of the power supply voltages.

a. A2J1 +5 V. Measure between A2J1 and common A2J2. The dc voltage should be 5.0 V ± 0.10 V.

b. A2J2 +5 V COMMON.

c. A2J3 +30 V. Measure between A2J3 and common, A2J4. The dc voltage should be 30 V ± 30 mV.

d. A2J4 ± 30 V COMMON.

e. A2J5 -30 V. Measure between A2J5 and common, A2J4. The dc voltage should be 30 V ± 30 mV.

f. A2J6 +15 V. Measure between A2J6 and common, A2J7. The dc voltage should be 15 V ± 10 mV.

g. A2J7 ± 15 V COMMON.

h. A2J8 -15 V. Measure between A2J8 and common, A2J7. The dc voltage should be 15 V ± 10 mV.

6.3 CALIBRATION

6.3.1 EQUIPMENT REQUIRED FOR CALIBRATION

a. A digital or differential voltmeter with .01% resolution and accuracy at 15 and 30 Vdc.

b. Pacific Measurements Part Number 12715, Plug-in Extender and Calibration Fixture Kit.

6.3.2 CALIBRATION PROCEDURE

The Model 1038 employs solid state components exclusively. These are extremely reliable and generate

little heat; consequently there is little drift due to component aging and adjustments to the instrument are rarely required. We therefore strongly recommend that if measurements indicate that an adjustment is set within the stated range that you do not attempt to put it "right on". It is often the case that variations in the equipment used to test the instrument account for small differences in measured values. Other adjustments that depend upon a given adjustment will be affected if it is reset. In short, BE ABSOLUTELY SURE THAT AN ADJUSTMENT IS REALLY REQUIRED BEFORE MAKING IT.

If a component is replaced, depending upon where in the circuit it is located, only certain of the calibration steps need be performed. In general, only those steps shown in the section pertaining to the specific circuit repaired need be carried out.

6.3.2.1 POWER SUPPLIES

The 5 V power supply is independent. The +30 V depends upon the -30 V and the +15 V depends upon the -15 V supply. Therefore it is important to adjust the - supply before adjusting the corresponding + supply, and the steps below should be performed in the order listed.

a. Remove the bottom plate just below the air outlet opening by removing four screws. Remove the two round-head screws directly holding the board and remove the three flat-head screws fastening the power supply assembly to the chassis. Swing the power supply assembly down to gain access to the test points and adjustments.

b. Connect the voltmeter between TP25 and TP24. Adjust R32 for a reading of -30 V within 30 mV.

c. Remove the probe of the voltmeter from TP25 and move it to TP23. Adjust R29 for a reading of +30 V within 30 mV.

d. Remove both probes of the voltmeter from the test points and connect them between TP28 and TP27. Adjust R57 for a reading of -15 V within 10 mV.

e. Remove the probe from TP28 and move it to TP26. Adjust R54 for +15 V within 10 mV.

f. Remove both probes and connect them between TP21 and TP22. Adjust R8 for +5V within 100 mV.

6.3.2.2 CRT OPERATION

The adjustments affecting the operation of the CRT are located within the display unit. See the Tektronix manual pertaining to the display unit for their location. The procedure for adjustment is somewhat different from that of Tektronix because the unit is calibrated using a Pacific Measurements test fixture, rather than Tektronix Plug-ins.

The operating voltages supplied to the CRT are large and very stable. Also, the characteristics of the CRT are dependent only upon the mechanical spacing of the electrodes, which in turn is dependent upon a rigid glass and metal structure. Therefore, unless the CRT has been replaced or an electrical component associated with the CRT has failed and been replaced, it is unlikely that any adjustments should be required during the operating life of the CRT. If calibration is required, use the procedure below.

The following steps should be performed in the order listed.

a. Be sure that the power supplies are within their specifications, as listed in Section 6.2.2. Check the high voltage supply using the procedure outlined in the calibration section of the Tektronix manual.

b. Place the shorting board, Assembly No. 12719 in the horizontal (left hand) plug-in connector, and place the extender, Assembly No. 12716 in the middle plug-in connector. The switch on the shorting board should be thrown to A CHAN ON. The switches on the extender should be thrown to: CAL, VERT, and CENTER.

c. Set the FOCUS control midrange. Advance the INTENSITY control clockwise and check that a spot can be obtained, then turn the control fully counterclockwise.

d. Using an insulated screwdriver, obtain a spot by setting the Intensity Range control fully to maximum. Then press the BEAM FINDER button and slowly adjust the control until the spot just disappears. Release the BEAM FINDER button and adjust the INTENSITY control for a dim spot.

e. Adjust the front panel FOCUS control and the internal Astigmatism control for the smallest and roundest spot obtainable.

f. In order to set the Geometry adjustment, it is required to have a horizontal trace on the CRT. To get a horizontal trace use whatever standard plug-in units are available and apply an appropriate ac signal, to sweep the beam horizontally. Using any suitable plug-in in the vertical slot, move the trace to the top of the screen then to the bottom. Adjust the Geometry control for minimum bowing. Alternatively, if you do not have plug-ins capable of providing a horizontal trace that can be moved vertically to the top and bottom of the screen, use the following procedure: Center the spot on the screen as in step b. Measure the dc voltage on the

collectors of the four output transistors of the deflection amplifiers. This voltage appears on their metal cans. Add the voltages and divide by 4, then set the Geometry adjustment so that the voltage measured on the arm of the geometry potentiometer is equal to this average voltage.

6.3.2.3 CRT DEFLECTION SYSTEM

If you are beginning calibration with this step, follow the instructions given in Section 6.3.2.2b. Adjust the INTENSITY and FOCUS for a visible, but not bright, spot.

a. Adjust A1R11, Horizontal Balance, to bring the spot to the center of the screen in horizontal direction. (This adjustment is on the PC board located at the end of the plug-in opening. It is adjacent to the left-hand plug, just below the center of the board.)

b. Adjust A1R22, A Channel Balance, to bring the spot to the center of the screen in the vertical direction. (This adjustment is located to the right of the Horizontal Balance Adjustment.)

c. Set the switch on the extender board to +3 DIV and set the Vert. Gain Adjustment on the Display Unit so that the spot is three divisions up from the center. Return the switch to CENTER and check to see that the spot is still centered; if not, repeat step b. If necessary, repeat until the spot is centered when the switch is in the CENTER position and the spot is three divisions up when the switch is in the +3 position. Return the switch to CENTER.

d. Move the extender board to the right-hand connector. Set the switch on the shorting board to B CHAN ON. Set A1R31 B Channel Balance to center the spot. This adjustment is found below the Horizontal Balance Adjustment.

e. Exchange the positions of the two plug-in boards so that the extender (Assembly 12716) is in the left-hand connector and the shorting board (Assembly 12719) is in the middle connector. The extender switches should be set to CAL, HORIZ, and +3 DIV. The Shorting board should be set to A CHANNEL ON. Set the Hor. Gain Adjustment on the display unit so that the spot is 3 divisions to the right on center. Set the switch to CENTER and readjust A1R11, if required to bring the spot to the center. Repeat until spot moves exactly 3 divisions to the right and is centered for the respective switch positions. Remove the extender and shorting boards.

This completes the calibration procedure.

6.4 TROUBLE SHOOTING

In order to localize the source of trouble in an instrument it is required to understand its operation. Section 5 is a detailed circuit description written to assist you to understand the instrument. You are urged to read it before starting to look for trouble. The block diagram in Section 5 together with the circuit schematic diagrams in Section 7 will help you find the various components.

The dc voltages found at each lead of every transistor are indicated adjacent its symbol on the schematic diagrams. In addition, Figure 6-1 shows the waveforms to be expected at various points in the logic circuits. The conditions under which the data were taken are as follows:

Power Supply	115V line, no plug-ins installed.
Differential Amplifiers	Input to each amplifier shorted using the shorting board.
Output Amplifiers	Same as for differential amplifiers.
Logic Circuits	Chopped mode, obtained by tying the 'chopper actuate' line to +5 V, or using a horizontal plug-in calling for both channels to be displayed.

Voltages were measured by a voltmeter with 10 M ohms input resistance. Waveforms were measured using an oscilloscope probe of 1 M ohm resistance with a shunt capacity of less than 70 pF.

6.4.1 SEMICONDUCTORS

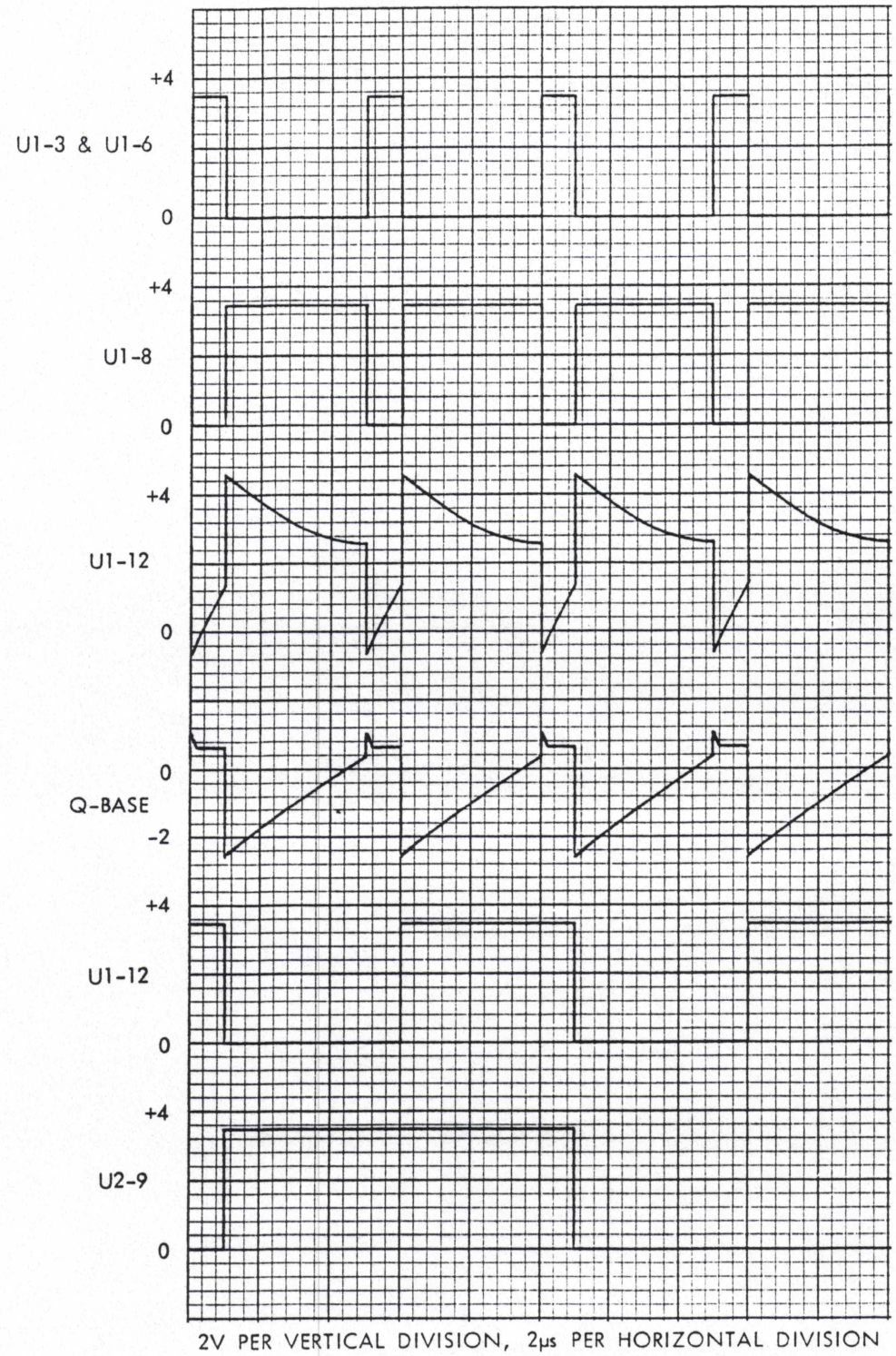
Semiconductor type numbers are shown on schematic diagrams and in the parts list. The numbers shown are either EIA registered numbers or manufacturers' numbers. These numbers are listed in order to make it possible to obtain replacement parts from local sources. The parts actually installed during manufacture may not bear the same number as shown in this manual, but a device may be replaced with one corresponding to the number specified herein.

6.5 PARTS REPLACEMENT AND ACCESS TO PC BOARDS

Refer to Figure 6-2.

6.5.1 INTERFACE PC BOARD ASSEMBLY, A1

By removing the side covers, access is provided to the front of the board and limited access is provided to the rear. To gain more complete access to the rear of the board, it may be removed as part of a



NOTE: WAVEFORMS ARE FOR THE CHOPPED MODE
CHOPPING ACTION CAN BE OBTAINED BY
CONNECTING THE CHOPPER ACTUATE LINE TO +5V

SWITCHING WAVEFORMS
GENERATED BY THE LOGIC CIRCUITS

FIGURE 6-1

major assembly along with the Rear Panel and PC Board A3. Proceed as follows:

a. Disconnect the oscilloscope lead plugs from A1 and A3.

b. Remove the shield from the high voltage circuit in the oscilloscope and disconnect the heater leads.

c. Remove the filter from the rear panel and remove the 8 screws that secure the rear panel to the frame.

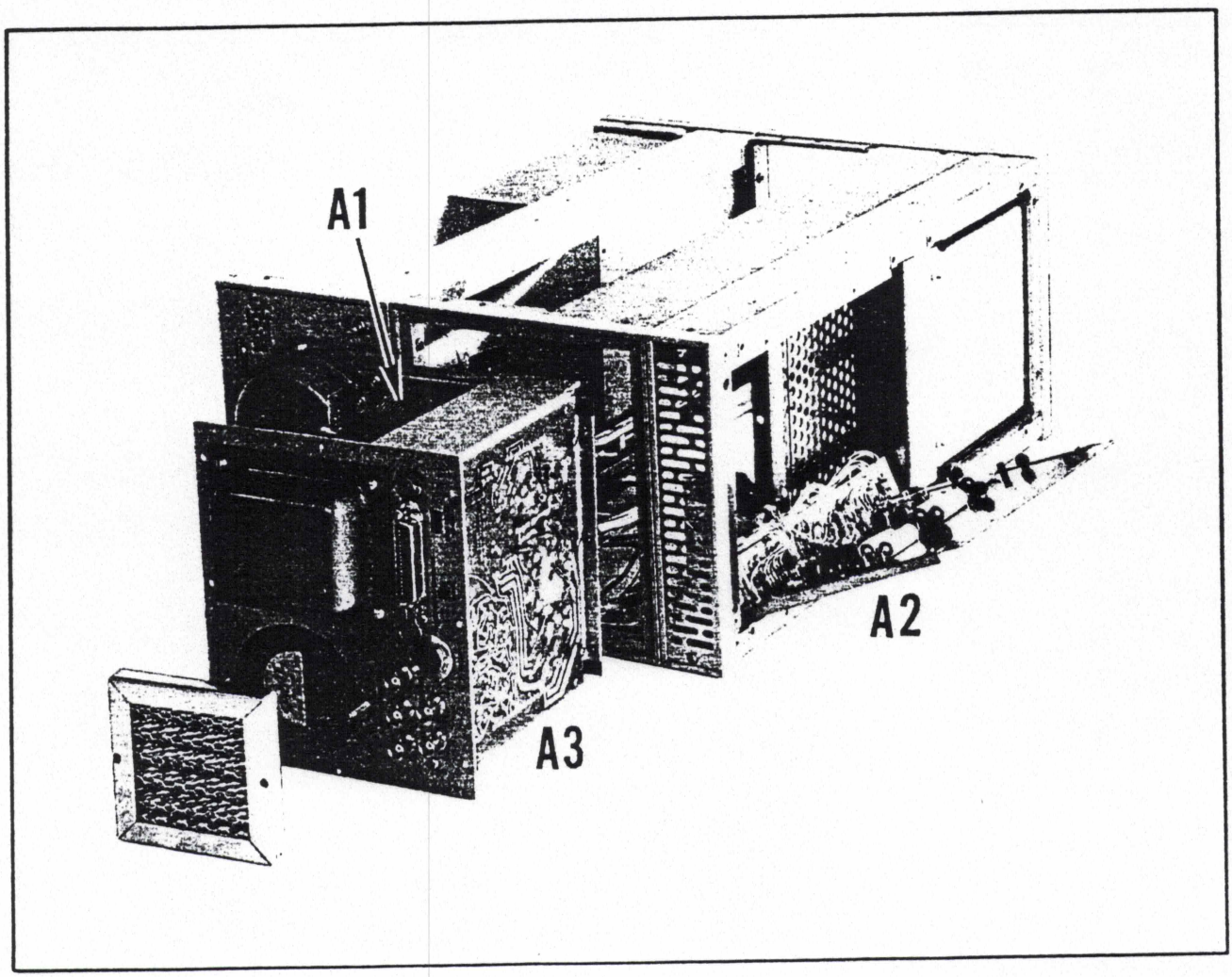
d. PC Assemblies A1, A3 and the Rear Panel may now be removed as an assembly. It is not necessary to disconnect the cable to Assembly A2 as it has sufficient length to allow removal of the major assembly.

6.5.2 POWER SUPPLY PC BOARD ASSEMBLY, A2.

By removing the rear portion of the bottom cover, access is provided to the rear of the PC board. To gain access to the front of the PC board, remove two pan head screws and three flat head screws that secure the board in place. The board may now be swung out on its pivot.

6.5.3 ISOLATION AMPLIFIER AND RECTIFIER PC BOARD ASSEMBLY, A3.

For access to the rear of the board, remove the rear portion of the bottom cover and swing out PC Board Assembly A2 as indicated in paragraph 6.5.2. If the instrument is assembled in the rack mounting configuration, it is only necessary to remove the bottom cover. Limited access is provided to the front of the board by removing the side covers. For more complete access to the board, it may be removed as part of a major assembly as indicated in paragraph 6.5.1.



ACCESS TO PC BOARDS

FIGURE 6-2

SECTION 7

SCHEMATIC DIAGRAMS

Schematic diagrams in this section are filed in the order of their drawing numbers.

Reference Designator	Title	Drawing Number
--	MAINFRAME	12583
A1	INTERFACE (2 sheets)	12404
A2	POWER SUPPLY (2 sheets)	12400
A3	ISOLATION AMPLIFIER AND RECTIFIER	12459

ASSEMBLY 12399
REFERENCE DISIGNATORS ARE ABBREVIATED
PREFIX WITH A2

F1 2 AMP
R1 1K
R2 680
R3 .24, 1W
R4 22
R5 680
R6 220
R7 47
R8 100 +5V ADJ.
R9 100
C1 .001
C2 .01
C3 250 35V
C4 .01
C19 .001
CR1 IN4148
CR2 IN4383
CR3 IN4383
CR4 IN4148
CR5 IN5229B
CR6 IN5229B
CR7 IN4383
Q1 2N6107 ON HEATSINK
Q2 2N3053
Q3 TIS97
Q4 2N5497 ON OLI HEATSINK
J1 TP21
J2 TP22
+5V
+5V COM

R10 1.5, 1W
R11 1.5, 1W
R12 220K
R13 6.8K
R14 6.8K
R15 2.2K
R16 2.2K
R17 2.2K
R18 100K
R19 100K
C5 100PF
C6 100PF
CR8 IN4383
CR9 IN4383
CR10 IN4148
CR11 IN4383
CR12 IN4383
CR13 IN4148
CR14 IN4148
Q5 2N6107 ON HEATSINK
Q6 2N5492 ON HEATSINK
Q7 2N5785
Q8 2N4314
J3 TP23
+30V

R20 3.3K
R21 33K
R22 1K
R23 4.7K
R24 10K
R25 3.3K
R26 33K
R27 6.19K 1%
R28 6.19K 1%
R29 100 +30V ADJ.
R30 1.27K 1%
R31 5.11K 1%
R32 200 -30V ADJ.
C7 .01
C8 250 35V
C9 250 35V
C10 .01
CR15 IN823
CR16 IN4148
U1 ½ CA3026
J4 TP24
J5 TP25
30V COM
-30V

NOTES:
1. UNLESS OTHERWISE SPECIFIED, RESISTOR VALUES ARE IN OHMS AND ARE ±5% ¼W. CAPACITOR VALUES ARE IN MICROFARADS.

LIST OF MATERIAL

NEXT ASSY

PACIFIC MEASUREMENTS INCORPORATED

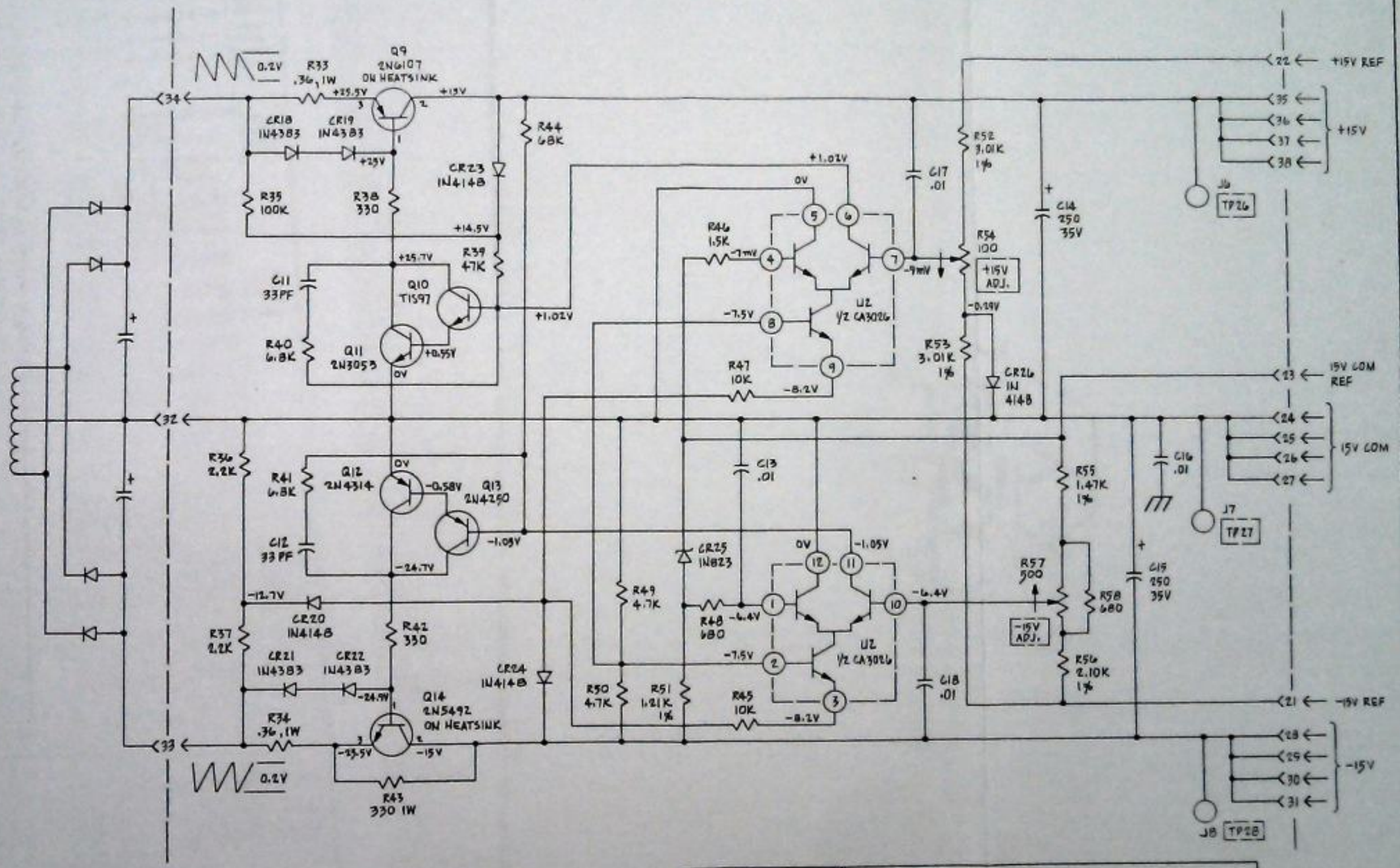
VC	6-25-79
RHB	2-8-79

POWER SUPPLY

12400 A

SHEET 1 OF 2

ASSEMBLY 12399
REFERENCE DISIGNATORS ARE ABBREVIATED
PREFIX WITH A2



NOTES
1. UNLESS OTHERWISE SPECIFIED, RESISTOR VALUES ARE IN OHMS AND ARE ±5% ¼W. CAPACITOR VALUES ARE IN MICROFARADS.
2. * DENOTES FACTORY SELECTED VALUES.

LIST OF MATERIAL

NEXT ASSY

PACIFIC MEASUREMENTS INCORPORATED

POWER SUPPLY

12400 B

SHEET

ASSEMBLY 12403

REFERENCE DESIGNATORS ARE ABBREVIATED PREFIX WITH A1

TO SHT 2 OF 2: HORIZ AMP IN (−), HORIZ AMP IN (+), A GATE, CHOPPER ACTUATE

P611: CHOPPER BLANKING, BLANKING, INTENSIFY, A GATE, SWEEP LOCKOUT, SINGLE SWEEP RESET, + HORIZ SIGNAL, − HORIZ SIGNAL — FROM SHT 2 OF 2

PB50: +5V, COM, +200V UNREG, +40V UNREG, −40V UNREG, FLOOD GUN HEATER, +30V, −30V, COM

J1 HORIZ: 15V COM, 30V COM, −30V, +30V, FLOOD GUN HEATER, −40V UNREG, +40V UNREG, +200V UNREG, +5V, +15V, −15V, 5V COM, HORIZ (+ OUT), IN/OUT AUX 2, LINE TRIGGER, A-CHAN (+ OUT), B-CHAN (+ OUT)

J604

+15V, R31 10K B-CHAN BAL., R30 33K, −15V, R29 100, R32 1K, R36 100K

J2 A-CHANNEL

J3 B-CHANNEL

P612: − VERT OUT, + VERT OUT — DUAL BEAM ONLY; FROM SHT 2 OF 2: − VERT SIGNAL, + VERT SIGNAL

TO SHT 2 OF 2: CHANNEL SWITCHING SIGNAL, VERT AMP IN (−), VERT AMP IN (+)

R33 220, R34 220, R35 220

IN/OUT AUX 1, INTENSITY, 20V COM, +20V UNREG, N.C., −15V REF, +15V REF, COM REF

NOTES:
1. UNLESS SPECIFIED OTHERWISE, RESISTOR VALUES ARE IN OHMS AND ARE ±5%, ¼W. CAPACITOR VALUES ARE IN MICROFARADS.

LIST OF MATERIAL

NEXT ASSY

PACIFIC MEASUREMENTS INCORPORATED

INTERFACE

12404 B

SHEET 1 OF 2

ASSEMBLY 12403
REFERENCE DESIGNATORS ARE ABBREVIATED
PREFIX WITH A1

N.C. → (12)

+5V

C1 .01

CHANNEL SWITCHING SIGNAL

U2 SN7473N

U2 SN7473N

C4 .01

+5V COM

C5 .01

A GATE

U1 SN7400N

R6 4.7K

R1 15.4K 1%

R2 4.7K

U1 SN7400N

C7 .001

R4 2.2K

U1 SN7400N

CHOPPER BLANKING

Q1 2N3640

C6 330

R5 2.2K

CHOPPER ACTUATE

R3 470

+ HORIZ SIGNAL

+5V

+30V

C2 .01

R7 39.2K 1%

R8 39.2K 1%

CR1 IN4148

4.3V

R17 100

C8 .01

Q4 2N4121

3.6V

HORIZ AMP IN (+)

0V

Q2 TIS97

R13 2.00K, 1%

+0.23V

HORIZ BAL.

R9 22K

-0.58V

R15 10K

R11 10K

R12 422 1%

R14 2.00K, 1%

R16 10K

R10 22K

-0.58V

HORIZ AMP IN (-)

0V

Q3 TIS97

+0.23V

3.6V

Q5 2N4121

CR2 IN4148

4.3V

-30V

C3 .01

-HORIZ SIGNAL

-0.54V

VERT AMP IN (+)

R18 39.2K 1%

R19 39.2K 1%

CR3 IN4148

4.25V

R28 100

C9 .01

Q8 2N4121

3.56V

Q6 TIS97

R24 2.00K, 1%

-0.38V

+VERT SIGNAL

A-CHAN BAL.

R20 22K

-1.1V

R26 10K

R22 10K

R23 422 1%

R25 2.00K, 1%

R27 10K

R21 22K

-1.1V

-0.38V

-VERT SIGNAL

Q7 TIS97

3.56V

Q9 2N4121

CR4 IN4148

4.25V

-0.54V

VERT AMP IN (-)

NOTES:
1. UNLESS SPECIFIED OTHERWISE, RESISTOR VALUES ARE IN OHMS AND ARE ±5%, 1/4W. CAPACITOR VALUES ARE IN MICROFARADS.

LIST OF MATERIAL

NEXT ASSY

8-21-73

RHB 8-74

PACIFIC MEASUREMENTS INCORPORATED

INTERFACE

12404

SHEET 2 OF 2

ASSEMBLY 12948
REFERENCE DESIGNATORS ARE ABBREVIATED
PREFIX WITH A3

+15V →41 R1 10 C1 .01 C17 .01

CHAN A / CHAN B — S1 — R36 47

R46 680 CR9 1N4383

Q5 2N4250 — R47 330 — C19 10pF — Q6 2N3569

31 ← CRT DISPLAY VERTICAL
34 ←
35 ← A CHAN OUT
33 ← B CHAN OUT
32 ←
36 ← CRT DISPLAY HORIZ

R37 47 — R38 68 — R48 220

+14.7V

R7 2.74K 1% — Q1 2N4250 — R13 2.74K 1% — Q2 2N4250 — R20 2.74K 1% — R45 * — R49 10 — C20 .001 — Q3 2N4250 — R27 2.74K 1% — Q4 2N4250

+14.1V

U1 ½-CA3026 — U1 ½-CA3026 — U2 ½-CA3026 — U2 ½-CA3026

R9 470 — R16 470 — R23 470 — R30 470

C2 4.7pF — C5 4.7pF — C6 100pF — C8 4.7pF

A CHAN IN →45 — R2 470 — R3 100K — R10 1.00K 0.1% — R11 1.00K 0.1% — R12 1.5K — R8 20.5K 1% — C3 .01

R17 1.00K 0.1% — R18 1.00K 0.1% — R19 1.5K — R21 1K — R22 20.5K 1% — C7 .01

R24 11.0K 0.1% — R25 7900 0.1% — R26 2.7K — R28 470 — R29 20.5K 1% — R31 1.00K 0.1% — R32 1.00K 0.1% — R33 2.2K

R14 470 — R15 20.5K 1%

R34 1.47K 1% — R35 10.0K 1% — -1.96V

R39 47 — 39 ← HORIZ OUT — 38 ←

COMMON →42 — R4 10 — C4 .01 — -14.7V

C18 .01 — 37 ← OUTPUT COMMON

-15V →40

B CHAN IN →44

HORIZ IN →43

FAN 14 — G-BK 16 — Y-BK 19 — R-BK 18 — FAN 17 — BK 15 — S2 115V 230V — TO 115/230VAC

R5 100K — R6 100K

CR1 PE-10 — C10 2200 — C11 2200

R40 6.8K — CR2 PE-10 — C9 .047 — R41 4.7K — R42 3.3K

CR3 PE-10 — C14 2200 — R43 10K

CR4 PE-10 — C15 7600

CR5 IN4385 — CR6 IN4385 — CR7 IN4385 — CR8 IN4385 — C16 250 — F1 0.25A — R44 150K

46 ← 30 ← LINE TRIG
1 ← 2 ← +200V UNREG
9 ← +30V
8 ← 7 ← FLOOD GUN HEATER

28 BR — 29 BR — 27 W-BR — -15V UNREG →52 — 15V COM →53 — +15V UNREG →56 — 26 BL — 25 BL — 24 W-BL — -35V UNREG →50 →49 — 35V COM →51 — +35V UNREG →48 →47 — 22 Y — 23 Y — 20V COM UNREG →4 →3 — +20V UNREG →6 →5 — 20 O — 21 O — 5V COM →54 — +5V UNREG →55 — 12 R — 13 R — 10 Y — 11 Y

NOTES:
1. UNLESS OTHERWISE SPECIFIED, RESISTOR VALUES ARE IN OHMS AND ARE ±5% ¼ WATT. CAPACITOR VALUES ARE IN MICROFARADS.
2. * DENOTES FACTORY SELECTED VALUES.

LIST OF MATERIAL — NEXT ASSY

	YD	7-14-75	PACIFIC MEASUREMENTS INCORPORATED
	PMB	2-8-74	ISOLATION AMP & RECTIFIER
			12459 B

J7
INPUT OUTPUT

17 R 34
36 BK 33
35 W 32
35
31 G-BK 28
13 27
29 BK 30
12 W 26
11 R 25
24
15 Y-W 20
33 G-W 19

A1
ASSY 12403
INTERFACE BOARD

N.C. 21
N.C. 22
1 15V COM
2 +15V
3 -15V
4 -30V
5 +30V
11 +5V
12 5V COM
13 30V COM
38 +15V REF
39 -15V REF
40 COM REF
9 30V COM
12 -30V
N.C. 41
N.C. 42
9 +40V UNREG
8 -40V UNREG
6 FLOOD GUN HTR
7
10 +200V UNREG
14 B CHAN (+OUT)
15 A CHAN (+OUT)
16 HORIZ (+OUT)
23 LINE TRIGGER
36 20V COM
37 +20V UNREG

J1
W-BK
31
INPUT/ OUTPUT AUX 1
J7
INPUT OUTPUT
G-W 18
J2
32
O-BK 14
18
17 G-BK
INPUT/ OUTPUT AUX 2
GY-W 30
29
BK
EXTERNAL INTENSITY

8 BL-W 3 5V COM
26 BL-W 4 5V COM
25 BR-Y 7 +5V
7 BR-Y 6 +5V
23 BK-W 10 30V COM
4 V-Y 13 -30V
22 O-Y 19 +30V
3 BK-W 25 15V COM
21 BK-W 26 15V COM
2 V-W 29 -15V
20 V-W 30 -15V
1 R-W 36 +15V
19 R-W 37 +15V

A2
ASSY 12399
POWER SUPPLY

1 Y-W 54 5V COM
2 G-W 55 +5V UNREG
15 W 51 40V COM
16 BR-W 50 -40V UNREG
17 O-W 48 +40V UNREG
18 O-Y 9 +30V
24 BK-W 42 15V COM
28 V-W 40 -15V
32 O-W 53 15V COM
33 G-Y 52 -15V UNREG
34 BL-W 56 +15V UNREG
35 R-W 41 +15V

34 GY-W 30 LINE TRIG
24 G-W 33 B CHAN OUT +
5 BL-W 35 A CHAN OUT +
16 W 39 HORIZ OUT +
10 BL-W 4 20V COM
9 GY-W 6 +20V UNREG
6 R-Y 2 +200V UNREG
27 GY-W
28 BL-W

A3
ASSY 12948
ISOLATION AMPLIFIER & RECTIFIER BOARD

J6
CRT DISPLAY VERT 31 BR-W 4
CRT DISPLAY HORIZ 36 BL-W 1
OUTPUT COMMON 37 BK-W 6
32 O-W J3 B CHAN OUT
34 Y-W J4 A CHAN OUT
38 GY-W J5 HORIZ OUT
14 BR-W
17 BR-W
P
B1
FB01
2
115/230VAC

10 11 12 13 20 21 22 23 25 24 26 28 27 29 16 18 15 17
BL BL-W BL BR BR-W BR G-BK R-BK BK Y-BK

LIST OF MATERIAL

	YO	9-3-73	
	RHB	2-8-74	

PACIFIC MEASUREMENTS INCORPORATED

MAIN FRAME

12583 A

SHEET 1 OF 1

SECTION 8

REPLACEABLE PARTS LIST

CIRCUIT REFERENCE	DHM PART NO.	DESCRIPTION
		MAINFRAME MODEL 1038/D10 (ASSY. 12570) MODEL 1038/D11 (ASSY. 12676)
--	12659-1	Display D10 (Used on Model 1038/D10 Only)
--	12659-2	Display D11 (Used on Model 1038/D11 Only)
A1	12403	Interface PC board Assembly
A2	12399	Power Supply PC Board Assembly
A3	12458	Isolation Amplifier and Rectifier PC Board Assembly
B1	12426	Fan
--	12410	Fan Air Filter
J1	10048	BNC UG-1094/U
J2	10048	BNC UG-1094/U
J3	10048	BNC UG-1094/U
J4	10048	BNC UG-1094/U
J5	10048	BNC UG-1094/U
J6	12427	Jack, 4 Conductor
J7	11334	Connector, 36 Pins
P270	--	Connector - 2 Contact
	12495-1	Receptacle
	12496-1	Housing
T1	12338	Transformer
		INTERFACE PC BOARD ASSEMBLY 12403
A1C1	10000-11	Ceramic, .01 µF, +80-20%, 100 V
A1C2	10000-11	Ceramic, .01 µF, +80-20%, 100 V
A1C3	10000-11	Ceramic, .01 µF, +80-20%, 100 V
A1C4	10000-11	Ceramic, .01 µF, +80-20%, 100 V
A1C5	10000-11	Ceramic, .01 µF, +80-20%, 100 V
A1C6	10585-2	Ceramic, 330 pF, ±5%, 1000 V
A1C7	10000-4	Ceramic, .001 µF, ±20%, 1000 V
A1C8	10000-11	Ceramic, .01 µF, +80-20%, 100 V
A1C9	10000-11	Ceramic, .01 µF, +80-20%, 100 V
A1CR1	10043	1N4148
A1CR2	10043	1N4148
A1CR3	10043	1N4148
A1CR4	10043	1N4148
A1J1	12816	Connector, 22 Pins
A1J2	12816	Connector, 22 Pins
A1J3	12816	Connector, 22 Pins
A1J604	12440-1	Connector, 18 Pins
A1Q1	10018	2N3646
A1Q2	11507	T1S97
A1Q3	11507	T1S97
A1Q4	10398	2N4121
A1Q5	10398	2N4121
A1Q6	11507	T1S97
A1Q7	11507	T1S97
A1Q8	10398	2N4121
A1Q9	10398	2N4121
A1R1	10015-51	Metal Film 15.4 KΩ, ±1%, 1/4 W
A1R2	10013-33	Carbon Film 4.7 KΩ, ±5%, 1/4 W
A1R3	10013-21	Carbon Film 470 Ω, ±5%, 1/4 W
A1R4	10013-29	Carbon Film 2.2 KΩ, ±5%, 1/4 W
A1R5	10013-29	Carbon Film 2.2 KΩ, ±5%, 1/4 W
A1R6	10013-33	Carbon Film 4.7 KΩ, ±5%, 1/4 W
A1R7	10015-61	Metal Film 39.2 KΩ, ±1%, 1/4 W
A1R8	10015-61	Metal Film 39.2 KΩ, ±1%, 1/4 W
A1R9	10013-41	Carbon Film 22 KΩ, ±5%, 1/4 W
A1R10	10013-41	Carbon Film 22 KΩ, ±5%, 1/4 W
A1R11	12441-1	Variable Cermet 10 KΩ, ±20%, 1/2W
A1R12	10015-29	Metal Film 422 Ω, ±1%, 1/4 W
A1R13	10015-74	Metal Film 2 KΩ, ±1%, 1/4 W
A1R14	10015-74	Metal Film 2 KΩ, ±1%, 1/4 W
A1R15	10013-37	Carbon Film 10 KΩ, ±5%, 1/4 W
A1R16	10013-37	Carbon Film 10 KΩ, ±5%, 1/4 W
A1R17	10013-13	Carbon Film 100 Ω, ±5%, 1/4 W
A1R18	10015-61	Metal Film 39.2 KΩ, ±1%, 1/4 W
A1R19	10015-61	Metal Film 39.2 KΩ, ±1%, 1/4 W
A1R20	10013-41	Carbon Film 22 KΩ, ±5%, 1/4 W
A1R21	10013-41	Carbon Film 22 KΩ, ±5%, 1/4 W
A1R22	12441-1	Variable Cermet 10 KΩ, ±20%, 1/2 W
A1R23	10015-29	Metal Film 422 Ω, ±1%, 1/4 W
A1R24	10015-74	Metal Film 2 KΩ, ±1%, 1/4 W
A1R25	10015-74	Metal Film 2 KΩ, ±1%, 1/4 W
A1R26	10013-37	Carbon Film 10 KΩ, ±5%, 1/4 W
A1R27	10013-37	Carbon Film 10 KΩ, ±5%, 1/4 W
A1R28	10013-13	Carbon Film 100 Ω, ±5%, 1/4 W
A1R29	10013-13	Carbon Film 100 Ω, ±5%, 1/4 W
A1R30	10013-43	Carbon Film 33 KΩ, ±5%, 1/4 W
A1R31	12441-1	Variable Cermet 10 KΩ, ±20%, 1/2W
A1R32	10013-25	Carbon Film 1KΩ, ±5%, 1/4 W
A1R33	10013-17	Carbon Film 220 Ω, ±5%, 1/4 W
A1R34	10013-17	Carbon Film 220 Ω, ±5%, 1/4 W
A1R35	10013-17	Carbon Film 220Ω, ±5%, 1/4 W
A1R36	10013-45	Carbon Film 100 KΩ, ±5% 1/4 W
A1U1	11270-1	SN7400N
A1U2	11270-8	SN7473N
		POWER SUPPLY PC BOARD ASSEMBLY 12399
A2C1	10000-4	Ceramic .001 µF, ±20%, 1000 V
A2C2	10000-11	Ceramic .01 µF, +80-20%, 100 V
A2C3	10003-6	Electrolytic 250 µF, +50-10%, 35 V
A2C4	10000-11	Ceramic .01 µF, +80-20%, 100 V
A2C5	10001-7	Ceramic NPO 100 pF, ±5%, 1000 V
A2C6	10001-7	Ceramic NPO 100 pF, ±5%, 1000 V
A2C7	10000-11	Ceramic .01 µF, +80-20%, 100 V
A2C8	10003-6	Electrolytic 250 µF, +50-10%, 35 V
A2C9	10003-6	Electrolytic 250 µF, +50-10%, 35 V
A2C10	10000-11	Ceramic .01 µF, +80-20%, 100 V
A2C11	10001-5	Ceramic NPO 33 pF, ±5%, 1000 V
A2C12	10001-5	Ceramic NPO 33 pF, ±5%, 1000 V
A2C13	10000-11	Ceramic .01 µF, +80-20%, 100 V
A2C14	10003-6	Electrolytic 250 µF, +50-10%, 35 V
A2C15	10003-6	Electrolytic 250 µF, +50-10%, 35 V
A2C16	10000-11	Ceramic .01 µF, +80-20%, 100 V
A2C17	10000-11	Ceramic .01 µF, +80-20%, 100 V
A2C18	10000-11	Ceramic .01 µF, +80-20%, 100 V
A2C19	10000-4	Ceramic .001 µF, +80-20%, 1000 V

CIRCUIT REFERENCE	PART NO.	DESCRIPTION
A2CR1	10043	1N4148
A2CR2	10044-1	1N4383
A2CR3	10044-1	1N4383
A2CR4	10043	1N4148
A2CR5	12814	1N5228B
A2CR6	11868	1N5229B
A2CR7	10044-1	1N4383
A2CR8	10044-1	1N4383
A2CR9	10044-1	1N4383
A2CR10	10043	1N4148
A2CR11	10044-1	1N4383
A2CR12	10044-1	1N4383
A2CR13	10043	1N4148
A2CR14	10043	1N4148
A2CR15	10045	1N823
A2CR16	10043	1N4148
A2CR17	--	Not Used
A2CR18	10044-1	1N4383
A2CR19	10044-1	1N4383
A2CR20	10043	1N4148
A2CR21	10044-1	1N4383
A2CR22	10044-1	1N4383
A2CR23	10043	1N4148
A2CR24	10043	1N4148
A2CR25	10045	1N823
A2CR26	10043	1N4148
A2F1	10064-8	Fuse, 3 AG 2 Amp, 250 V Standard
A2J1	10140-1	Test Jack, Red
A2J2	10140-3	Test Jack, Black
A2J3	10140-1	Test Jack, Red
A2J4	10140-3	Test Jack, Black
A2J5	10140-1	Test Jack, Red
A2J6	10140-1	Test Jack, Red
A2J7	10140-3	Test Jack, Black
A2J8	10140-1	Test Jack, Red
A2Q1	12437	2N6107
A2Q2	10206	2N3053
A2Q3	11507	T1S97
A2Q4	12438	2N5492
A2Q5	12437	2N6107
A2Q6	12438	2N5492
A2Q7	12439	2N5785
A2Q8	10927	2N4314
A2Q9	12437	2N6107
A2Q10	11507	T1S97
A2Q11	10206	2N3053
A2Q12	10927	2N4314
A2Q13	11119	2N4250
A2Q14	12438	2N5492
A2R1	1013-25	Carbon Film 1 KΩ, ±5%, 1/4 W
A2R2	10013-23	Carbon Film 680 Ω, ±5%, 1/4 W
A2R3	10633-2	Wirewound .24 Ω, ±5%, 1 W
A2R4	10013-5	Carbon Film 22 Ω, ±5%, 1/4 W
A2R5	10013-23	Carbon Film 680 Ω, ±5%, 1/4 W
A2R6	10013-17	Carbon Film 220 Ω, ±5%, 1/4 W
A2R7	10013-9	Carbon Film 47 Ω, ±5%, 1/4 W
A2R8	10046-9	Variable Comp. 100 Ω, ±20%, 0.2W
A2R9	10013-13	Carbon Film 100 Ω, ±5%, 1/4 W
A2R10	10633-4	Wirewound 1.5 Ω, ±5%, 1 W
A2R11	10633-4	Wirewound 1.5 Ω, ±5%, 1 W
A2R12	10013-53	Carbon Film 220 KΩ, ±5%, 1/4 W
A2R13	10013-35	Carbon Film 6.8 KΩ, ±5%, 1/4 W

CIRCUIT REFERENCE	PART NO.	DESCRIPTION
A2R14	10013-35	Carbon Film 6.8 KΩ, ±5%, 1/4 W
A2R15	10013-29	Carbon Film 2.2 KΩ, ±5%, 1/4 W
A2R16	10013-29	Carbon Film 2.2 KΩ, ±5%, 1/4 W
A2R17	10013-29	Carbon Film 2.2 KΩ, ±5%, 1/4 W
A2R18	10013-49	Carbon Film 100 KΩ, ±5%, 1/4 W
A2R19	10013-49	Carbon Film 100 KΩ, ±5%, 1/4 W
A2R20	10013-31	Carbon Film 3.3 KΩ, ±5%, 1/4 W
A2R21	10013-43	Carbon Film 33 KΩ, ±5%, 1/4 W
A2R22	10013-25	Carbon Film 1 KΩ, ±5%, 1/4 W
A2R23	10013-33	Carbon Film 4.7 KΩ, ±5%, 1/4 W
A2R24	10013-37	Carbon Film 10 KΩ, ±5%, 1/4 W
A2R25	10013-31	Carbon Film 3.3 KΩ, ±5%, 1/4 W
A2R26	10013-43	Carbon Film 33 KΩ, ±5%, 1/4 W
A2R27	10015-105	Metal Film 6.19 KΩ, ±1%, 1/4 W
A2R28	10015-105	Metal Film 6.19 KΩ, ±1%, 1/4 W
A2R29	10046-9	Variable Comp 100 Ω, ±20%, 0.2 W
A2R30	10015-42	Metal Film 1.27 KΩ, ±1%, 1/4 W
A2R31	10015-36	Metal Film 5.11 KΩ, ±1%, 1/4 W
A2R32	10046-6	Variable Comp 200Ω, ±20%, 0.2 W
A2R33	10633-3	Wirewound .36Ω, ±5%, 1 W
A2R34	10633-3	Wirewound .36Ω, ±5%, 1 W
A2R35	10013-49	Carbon Film 100 KΩ, ±5%, 1/4 W
A2R36	10013-29	Carbon Film 2.2 KΩ ±5%, 1/4 W
A2R37	10013-29	Carbon Film 2.2 KΩ, ±5%, 1/4 W
A2R38	10013-19	Carbon Film 330 Ω, ±5%, 1/4 W
A2R39	10013-45	Carbon Film 47 KΩ, ±5%, 1/4 W
A2R40	10013-35	Carbon Film 6.8 KΩ, ±5%, 1/4 W
A2R41	10013-35	Carbon Film 6.8 KΩ, ±5%, 1/4 W
A2R42	10013-19	Carbon Film 330 Ω, ±5%, 1/4 W
A2R43	13146-1	Metal Glaze 330 Ω ±5% 1 W
A2R44	10013-47	Carbon Film 68 KΩ, ±5% 1/4 W
A2R45	10013-37	Carbon Film 10 KΩ, ±5%, 1/4 W
A2R46	10013-27	Carbon Film 1.5 KΩ, ±5%, 1/4 W
A2R47	10013-37	Carbon Film 10 KΩ, ±5%, 1/4 W
A2R48	10013-23	Carbon Film 680 Ω, ±5%, 1/4 W
A2R49	10013-33	Carbon Film 4.7 KΩ, ±5%, 1/4 W
A2R50	10013-33	Carbon Film 4.7 KΩ, ±5%, 1/4 W
A2R51	10015-217	Metal Film 1.21 KΩ, ±1%, 1/4 W
A2R52	10015-110	Metal Film 3.01 KΩ, ±1%, 1/4 W
A2R53	10015-110	Metal Film 3.01 KΩ, ±1%, 1/4 W
A2R54	10046-9	Variable Comp. 100 Ω, ±20%, 0.2 W
A2R55	10015-50	Metal Film 1.47 KΩ, ±1%, 1/4 W
A2R56	10015-84	Metal Film 2.10 KΩ, ±1%, 1/4 W
A2R57	11711-1	Variable Comp. 500 Ω, ±20% 20 turns
A2R58	10013-23	Carbon Film 680 Ω, ±5%, 1/4 W
A2U1	11117	CA 3026
A2U2	11117	CA 3026

ISOLATION AMPLIFIER & RECTIFIER PC BOARD ASSEMBLY 12948

A3C1	10000-11	Ceramic .01 µF, ±20%, 100 V
A3C2	10001-2	Ceramic 4.7 pF, ±5%, 1000 V
A3C3	10000-11	Ceramic .01 µF, ±20%, 100 V
A3C4	10000-11	Ceramic .01 µF, ±20%, 100 V
A3C5	10001-2	Ceramic 4.7 pF, ±5%, 1000 V
A3C6	10001-7	Ceramic 100 pF, ±5%, 1000 V
A3C7	10000-11	Ceramic .01 µF, ±20%, 100 V
A3C8	10001-2	Ceramic 4.7 pF, ±5%, 1000 V
A3C9	10007-6	Mylar .047 µF, ±10%, 200 V
A3C10	12813-2	Electrolytic 2200 µF 40 V
A3C11	12813-2	Electrolytic 2200 µF 40 V
A3C12	12813-1	Electrolytic 1500 µF 50 V
A3C13	12813-1	Electrolytic 1500 µF 50 V
A3C14	12813-2	Electrolytic 2200 µF 40 V
A3C15	12812-1	Electrolytic 7600 µF 15 V
A3C16	12812-2	Electrolytic 250 µF, 250 V
A3C17	10000-11	Ceramic .01 µF ±20% 100 V

CIRCUIT REFERENCE	PART NO.	DESCRIPTION
A3C18	10000-11	Ceramic .01 µF ±20% 100 V
A3C19	10001-3	Ceramic 10 pF ±5% 1000 V
A3C20	10000-4	Ceramic .001 µF ±20% 1000 V
A3CR1	12409	Rectifier Bridge PE-10
A3CR2	12409	Rectifier Bridge PE-10
A3CR3	12409	Rectifier Bridge PE-10
A3CR4	12409	Rectifier Bridge PE-10
A3CR5	10044-2	1N4385
A3CR6	10044-2	1N4385
A3CR7	10044-2	1N4385
A3CR8	10044-2	1N4385
A3CR9	10044-1	1N4383
A3F1	10064-7	Fuse, 3 AG, .25A, 250 V, Standard
A3Q1	11119	2N4250
A3Q2	11119	2N4250
A3Q3	11119	2N4250
A3Q4	11119	2N4250
A3Q5	11119	2N4250
A3Q6	10017	2N3569
A3R1	10013-1	Carbon Film 10 Ω, ±5%, 1/4 W
A3R2	10013-21	Carbon Film 470 Ω, ±5%, 1/4 W
A3R3	10013-49	Carbon Film 100 KΩ, ±5%, 1/4 W
A3R4	10013-1	Carbon Film 10 Ω, ±5%, 1/4 W
A3R5	10013-49	Carbon Film 100 KΩ, ±5% 1/4 W
A3R6	10013-49	Carbon Film 100 KΩ, ±5%, 1/4 W
A3R7	10015-211	Metal Film 2.74 KΩ, ±1%, 1/4 W
A3R8	10015-101	Metal Film 20.5 KΩ, ±1% 1/4 W
A3R9	10013-21	Carbon Film 470 Ω, ±5%, 1/4 W
A3R10	12449-19	Metal Film 1.00 KΩ, ±0.1%
A3R11	12449-19	Metal Film 1.00 KΩ, ±0.1%
A3R12	10013-27	Carbon Film 1.5 KΩ, ±5%, 1/4 W
A3R13	10015-211	Metal Film 2.74 KΩ, ±1%, 1/4 W
A3R14	10013-21	Carbon Film 470 Ω, ±5%, 1/4 W
A3R15	10015-101	Metal Film 20.5 KΩ, ±1%, 1/4 W
A3R16	10013-21	Carbon Film 470 Ω, ±5%, 1/4 W
A3R17	12449-19	Metal Film 1.00 KΩ, ±0.1%
A3R18	12449-19	Metal Film 1.00 KΩ, ±0.1%
A3R19	10013-27	Carbon Film 1.5 KΩ, ±5%, 1/4 W
A3R20	10015-211	Metal Film 2.74 KΩ, ±1%, 1/4 W
A3R21	10013-25	Carbon Film 1 KΩ, ±5%, 1/4 W
A3R22	10015-101	Metal Film 20.5 KΩ, ±1%, 1/4 W
A3R23	10013-21	Carbon Film 470 Ω, ±5%, 1/4 W
A3R24	12449-20	Metal Film 11.00 KΩ ±.1%, 1/8 W
A3R25	12449-24	Metal Film 990.0 Ω ±0.1% 1/8 W
A3R26	10013-30	Carbon Film 2.7 KΩ, ±5%, 1/4 W
A3R27	10015-211	Metal Film 2.74 KΩ, ±1%, 1/4 W
A3R28	10013-21	Carbon Film 470 Ω, ±5%, 1/4 W
A3R29	10015-101	Metal Film 20.5 KΩ, ±1%, 1/4 W
A3R30	10013-21	Carbon Film 470 Ω, ±5%, 1/4 W
A3R31	12449-19	Metal Film 1.00 KΩ, ±0.1%, 1/8 W
A3R32	12449-19	Metal Film 1.00 KΩ, ±0.1%, 1/8 W
A3R33	10013-29	Carbon Film 2.2 KΩ, ±5%, 1/4 W
A3R34	10015-59	Metal Film 1.47 KΩ, ±1%, 1/4 W
A3R35	10015-7	Metal Film 10.0 KΩ, ±1%, 1/4 W
A3R36	10013-9	Carbon Film 47 Ω, ±5%, 1/4 W
A3R37	10013-9	Carbon Film 47 Ω, ±5%, 1/4 W
A3R38	10013-11	Carbon Film 68 Ω, ±5%, 1/4 W
A3R39	10013-9	Carbon Film 47 Ω, ±5%, 1/4 W
A3R40	10013-35	Carbon Film 6.8 KΩ, ±5%, 1/4 W
A3R41	10013-33	Carbon Film 4.7 KΩ, ±5%, 1/4 W
A3R42	10013-31	Carbon Film 3.3 KΩ, ±5%, 1/4 W
A3R43	10013-37	Carbon Film 10 KΩ, ±5%, 1/4 W
A3R44	10013-51	Carbon Film 150 KΩ, ±5%, 1/4 W
A3R45	--	Factory Selected
A3R46	10013-23	Carbon Film 680 Ω ±5% 1/4 W
A3R47	10013-19	Carbon Film 330 Ω ±5% 1/4 W
A3R48	10013-17	Carbon Film 220 Ω ±5% 1/4 W
A3R49	10013-1	Carbon Film 10 Ω ±5% 1/4 W
A3S1	10059	Slide DPDT
A3S2	11160	Slide "115-230"
A3U1	11117	CA 3026
A3U2	11117	CA 3026
A3XF1	10065	Fuseholder

PART NO. CROSS REFERENCE		
PM PART NO.	MFGR. CODE	MFGR. PART NO.
10000-4	56289	5GA-D10
10000-11	72982	805-000-X5V0-103Z
10001-1	56289	10TCC-V22
10001-2	56289	10TCC-V47
10001-3	56289	10TCC-Q10
10001-5	56289	10TCC-Q33
10001-7	56289	10TCC-T10
10003-6	25088	B41010-250/35/8212
10007-6	01002	75F1R2A473
10013-1	73445	B803 104NB 100
10013-5	73445	B803 104NB 220
10013-9	73445	B803 104NB 470
10013-11	73445	B803 104NB 680
10013-13	73445	B803 104NB 101
10013-17	73445	B803 104NB 221
10013-19	73445	B803 104NB 331
10013-21	73445	B803 104NB 471
10013-23	73445	B803 104NB 681
10013-25	73445	B803 104NB 102
10013-27	73445	B803 104NB 152
10013-29	73445	B803 104NB 222
10013-30	73445	B803 104NB 272
10013-31	73445	B803 104NB 332
10013-33	73445	B803 104NB 472
10013-35	73445	B803 104NB 682
10013-37	73445	B803 104NB 103
10013-41	73445	B803 104NB 223
10013-43	73445	B803 104NB 333
10013-45	73445	B803 104NB 473
10013-47	73445	B803 104NB 683
10013-49	73445	B803 104NB 104
10013-51	73445	B803 104NB 154
10013-53	73445	B803 104NB 224
10015-7	91637	RN55D, 10.0 KΩ 1%
10015-29	91637	RN55D, 422 Ω 1%
10015-36	91637	RN55D, 5.11 KΩ 1%
10015-42	91637	RN55D, 1.27 KΩ 1%
10015-50	91637	RN55D, 1.47 KΩ 1%
10015-51	91637	RN55D, 15.4 KΩ 1%
10015-61	91637	RN55D, 39.2 KΩ 1%
10015-65	91637	RN55D, 4.99 KΩ 1%
10015-74	91637	RN55D, 2.00 KΩ 1%
10015-84	91637	RN55D, 2.10 KΩ 1%
10015-101	91637	RN55D, 20.5 KΩ 1%
10015-105	91637	RN55D, 6.19 KΩ 1%
10015-110	91637	RN55D, 3.01 KΩ 1%
10015-211	91637	RN55D, 2.74 KΩ 1%
10015-217	91637	RN55D, 1.21 KΩ 1%
10017	07263	2N3569
10018	07263	2N3646
10043	09214	1N4148
10044-1	11711	1N4383
10044-2	11711	1N4385

PART NO. CROSS REFERENCE		
PM PART NO.	MFGR. CODE	MFGR. PART NO.
10045	07910	1N823
10046-6	71450	X201R201B
10046-9	71450	X201R101B
10048	02660	31-221-1050
10059	79727	G-126
10064-7	75915	312.250
10064-8	75915	312002
10065	75915	357001
10140-1	74970	105852
10140-3	74970	105853
10206	07263	2N3053
10398	07263	2N4121
10585-2	56289	C028B0 102F 331J
10633-2	81483	BW-20, 0.2Ω, 5%
10633-3	81483	BW-20, 036Ω, 5%
10633-4	81483	BW-20, 1.5Ω, 5%
10927	02735	2N4314
11117	02735	CA3026
11119	07263	2N4250
11160	82389	46256LF
11270-1	01295	SN7400N
11270-8	01295	SN7473N
11334	02660	57-40360
11507	01295	TIS 97
11868	04713	1N5229B
12338	28821	12338
12399	28821	12399
12403	28821	12403
12409	83701	PE10
12410	28821	12410
12426	32284	SP2A2
12427	82389	B4M
12429-1	99392	10C15 FB 782
12429-2	99392	10C50 FB 212
12429-3	99392	10C250 FF 251
12437	02735	2N6107
12438	02735	2N5492
12439	02735	2N5785
12440-1	02660	225-21821-110
12441-1	71450	360T103B
12449-19	14298	EE 1/8 C2 1.00 KΩ 0.1%
12449-20	14298	EE 1/8 C2 11.0 KΩ 0.1%
12449-24	14298	EE 1/8 C2 990.0 Ω 0.1%

PART NO. CROSS REFERENCE			PART NO. CROSS REFERENCE		
PM PART NO.	MFGR. CODE	MFGR. PART NO.	PM PART NO.	MFGR. CODE	MFGR. PART NO.
12458	28821	12458			
12495-1	22526	47712			
12496-1	22526	65359-030			
12659-1	28821	12659-1			
12659-2	28821	12659-2			
12812-1	99392	12C15FC762			
12812-2	99392	12C250FF251			
12813-1	99392	23C50TS152			
12813-2	99392	23C40TA222			
12814	04713	1N5228B			
12816	28821	12816			

FEDERAL SUPPLY CODE FOR MANUFACTURERS

The following five-digit code numbers are listed in numerical sequence along with the manufacturer's name and address to which the code has been assigned.

The Federal Supply Code has been taken from Cataloging Handbook H 4-2, Code to Name.

00303	Shelly Associates Inc. El Segundo, California.
00656	Aerovox Corp. New Bedford, Massachusetts
00779	AMP Inc. Harrisburg, Pennsylvania
01002	General Electric Co. Capacitor Dept. Hudson Falls, New York
01121	Allen-Bradley Co. Milwaukee, Wisconsin
01295	Texas Instruments, Inc. Semiconductor Components Div. Dallas, Texas
01961	Pulse Engineering Inc. Santa Clara, California
02114	Ferroxcube Corp. of America Saugerties, New York
02660	Amphenol-Borg Elect. Corp. Broadview, Illinois
02735	Radio Corp. of America Semiconductor and Materials Div. Somerville, New Jersey
04062	Elmenco Products Co. New York, N.Y.
04713	Motorola, Inc. Semiconductor Products Div. Phoenix, Arizona
07263	Fairchild Camera and Inst. Corp. Semiconductor Div. Mountain View, California
07910	Continental Device Corp. Hawthorne, California
09214	General Electric Co. Semiconductor Products Dept. Auburn, New York
09353	C and K Components Inc. Newton, Massachusetts
11711	General Instruments Inc. Semiconductor Div. Newark, New Jersey
12674	Syncro Corp. Hicksville, Ohio
12954	Dickson Electronics Corp. Scottsdale, Arizona
14298	American Components, Inc. Conshohocken, Pennsylvania
18324	Signetics Corp. Sunnyvale, Calif.
24931	Speciality Connector Co. Inc. Indianapolis, Indiana
25088	Siemens America Corp. Iselin, New Jersey
27014	National Semiconductor Corp. Santa Clara, California
27556	IMB Electronic Products Santa Fe Springs, California
28480	Hewlett-Packard Co. Palo Alto, California
28821	Pacific Measurements Inc. Palo Alto, California
56289	Sprague Electric Co. North Adams, Massachusetts
71034	Bliley Electric Co. Erie, Pa.
70903	Belden Mfg. Co. Chicago, Illinois
71400	Bussman Mfg. Div. of McGraw-Edison Co. St. Louis, Missouri
71450	CTS Corp. Elkhart, Indiana
72982	Erie Tech. Products Inc. Erie, Pennsylvania
73138	Beckman Instruments Inc. Helipot Division Fullerton, California
73445	Amperex Electronic Corp. Hicksville, New York.

74970	E. F. Johnson Co. Waseca, Minnesota
75915	Littlefuse Inc. Des Plaines, Illinois
76854	Oak Mfg. Co. Crystal Lake, Illinois
76493	J. W. Miller Company Compton, Calif.
76541	Monsanto Commercial Products Co. Cupertino, Calif.
79727	Continental-Wirt Electronics Corp. Philadelphia, Pa.
82389	Switchcraft Inc. Chicago, Illinois
83594	Burroughs Corp. Electronic Components Div. Plainfield, New Jersey
84171	Arco Electronics Inc. Great Neck, New York
90634	Gulton Industries Inc. Metuchen, New Jersey
91418	Radio Materials Co. Chicago, Illinois
91637	Dale Electronics Inc. Columbus, Nebraska
91929	Honeywell Inc. Microswitch Div. Freeport, Illinois
94144	Raytheon Co. Components Div. Quincy, Massachusetts
99800	Delavan Electronics Corp. East Aurora, New York.

ADDITIONAL FEDERAL SUPPLY CODE FOR MANUFACTURERS

07126	Digitran Co. Pasadena, Calif.
17856	Siliconix Santa Clara, Calif.
19447	Electro-Technique Inc. Oceanside, Calif.
22526	Berg Electronics Corp. York Expressway New Cumberland, Pa. 17070
32284	Rotron Manufacturing Co. Inc. Woodstock, New York
71590	Centralab Electronics Milwaukee, Wisconsin
81095	Traid Transformer Corp Venice, California
81483	International Rectifier Corp. El Segundo, Calif.
83330	H. H. Smith, Inc. Brooklyn, New York
83701	Electronic Devices, Inc. Yonkers, New York 10710
95146	Alco Electronics Lawrence, Mass.
99392	STM Corp. Oakland, Calif. 94601

INSTRUCTION MANUAL

Serial Number B091865

D10 SINGLE BEAM DISPLAY UNIT

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070-1132-00

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Abbreviations and symbols used in this manual are based on or taken directly from IEEE Standard 260 "Standard Symbols for Units", MIL-STD-12B and other standards of the electronics industry. Change information, if any, is located at the rear of this manual.

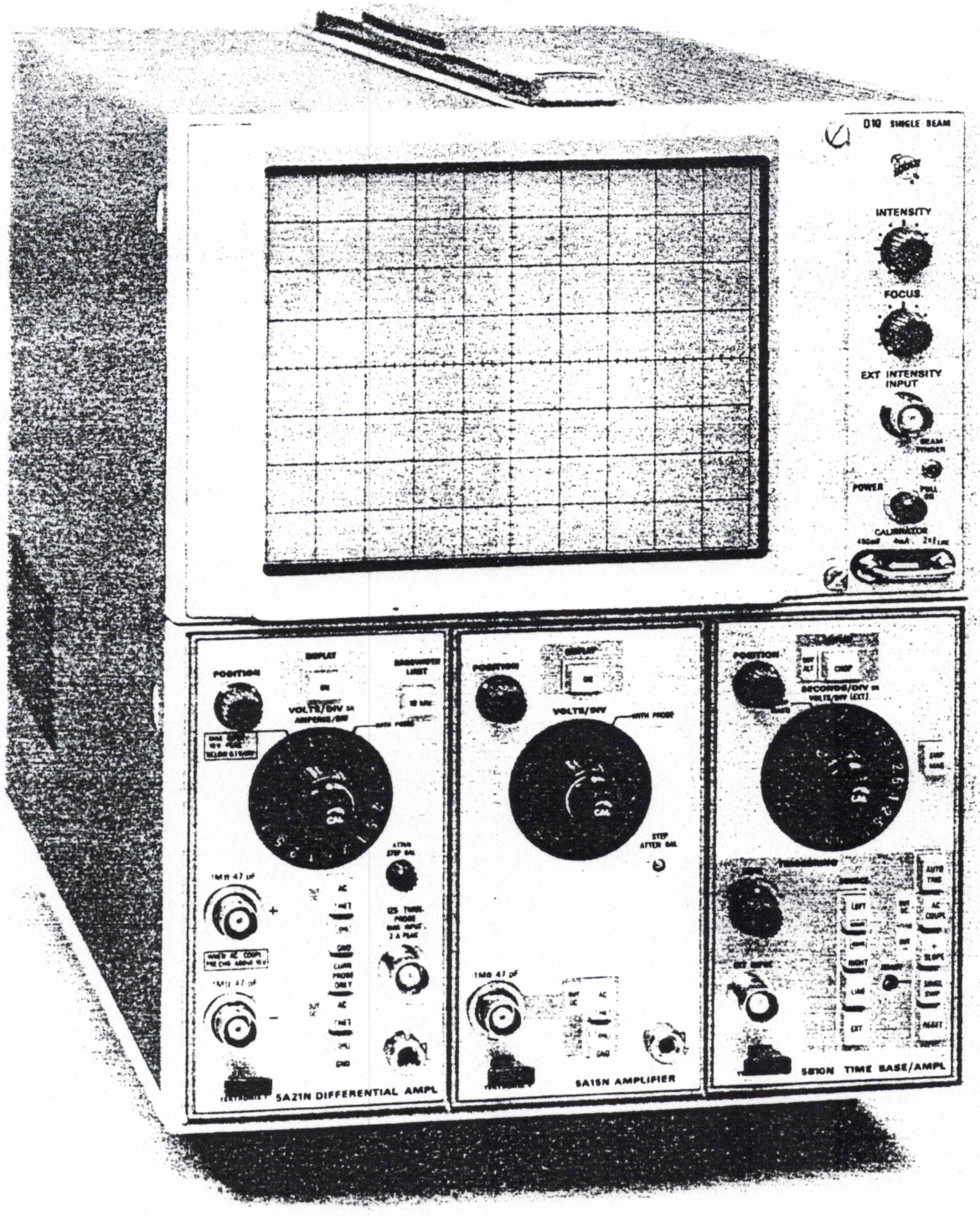


Fig. 1-1. 5103N Oscilloscope with a D10 Single Beam Display Unit.

SECTION 1
D10 SPECIFICATION

Change information, if any, affecting this section will be found at the rear of this manual.

Introduction

The D10 Single-Beam Display unit provides a single-beam cathode-ray tube (CRT) display for Tektronix 5100-series Oscilloscopes. The D10 module is operated with a power supply/amplifier module, and comprises one-half of the oscilloscope mainframe. It has an electrostatic-deflection CRT with an 8 X 10 division (one-half inch per division) internal black graticule. A bright display is provided by a 3.5-kilovolt accelerating potential. Provision is made for application of Z-axis signals, and a front-panel loop provides a calibration signal.

The following electrical characteristics apply over an ambient temperature range of 0°C to +50°C. Refer to the 5100-series Oscilloscope System manual for environmental specifications.

TABLE 1-1

ELECTRICAL CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information
Cathode-Ray Tube		
Phosphor	P31 standard.	
CRT Accelerating Voltage		3.5 kilovolts.
Orthogonality		90°, within 1°.
Geometry		0.1 division or less.
External Intensity Input		
Useful Input Voltage	+5 volts will turn on display to a normal brightness level from an off level; −5 volts will turn display off from a normal brightness level.	
Usable Frequency Range	DC to one megahertz.	
Input R and C		About 10 kilohms, paralleled by about 40 picofarads.
Maximum Safe Input		±50 volts (DC + peak AC).
Calibrator		
Voltage	400 millivolts, within 1%.	
Current	4 milliamperes, within 1%.	
Frequency	Twice the line frequency.	
Power Input		
Line Voltage (RMS)		
With standard transformer	Nominal 110 V, 120 V; within 10%.	
With optional export transformer	Nominal 100 V, 110 V, 120 V, 200 V, 220 V, 240 V; within 10%.	

ELECTRICAL CHARACTERISTICS (cont)

Characteristics	Performance Requirement	Supplemental Information
Line Frequency Range		
With standard transformer		60 hertz and 400 hertz.
With optional export transformer		50 to 60 hertz and 400 hertz.
Power Consumption (including Power Supply/ Amplifier module)		140 watts maximum.

SECTION 2
OPERATING INSTRUCTIONS

Change information, if any, affecting this section will be found at the rear of this manual.

Introduction

The D10 Single Beam display module operates with a Tektronix 5100-series power supply/amplifier module to form an oscilloscope mainframe. An understanding of the D10 operation and capabilities is essential for obtaining best results. This section of the manual gives a brief functional description of the front-panel controls and connectors, a familiarization procedure, and general operating information.

Preliminary Information

The Operation Instructions section of the 5100-series Oscilloscope System instruction manual should be referred to for initial preparation. It contains information for installation of modules and plug-ins, correct operating voltage and temperature, and general oscilloscope usage.

CONTROLS AND CONNECTORS

This is a brief description of the function or operation of the front-panel controls and connectors. More detailed information is given under General Operating Information.

INTENSITY	Controls display brightness.
FOCUS	Provides adjustment to obtain a well-defined display.
POWER	Used to turn instrument power on or off.
BEAM FINDER	Brings beam on-screen; limits display to area inside graticule and intensifies beam.
CALIBRATOR Loop	Provides positive-going accurate 400-millivolt and 4-milliampere square wave at a frequency of twice the line frequency for calibration and probe compensation.
EXT INTENSITY INPUT Connector	Permits application of Z-axis signals to the CRT (DC coupled). Positive-going signal increases intensity.
TRACE ROTATION (Rear Panel)	Permits alignment of the trace with respect to the graticule lines.

BASIC OPERATION

General

The following steps demonstrate the use of the controls and connectors of the D10. It is recommended that this procedure be followed completely for familiarization with this instrument.

Setup Information

1. Make sure the oscilloscope system is complete. The D10 must be properly connected to the power supply/amplifier module and the single-beam auxiliary board must be installed on the plug-in interface board. A 5A-series amplifier plug-in should be in one of the vertical (left or center) plug-in compartments and a 5B-series time-base plug-in should be in the horizontal (right) compartment.

2. Set the POWER switch to off (pushed in) and connect the D10 to a power source that meets the voltage and frequency requirements of this instrument. See Operating Voltage (Preliminary Procedure) in the Operating Instructions section of the 5100-Series Oscilloscope System manual.

3. Turn the INTENSITY control counterclockwise and pull the POWER switch out to turn the instrument on. Set the front-panel controls as follows:

D10

FOCUS	Centered

Amplifier Plug-in

Display	On
Position	Centered
Volts/Div	.1
Variable Volts/Div	Cal (fully clockwise)
Input Coupling	DC

Time-Base Plug-in

Display	Alternate (button out)
Position	Centered
Seconds/Div	5 ms
Variable Seconds/Div	Cal (fully clockwise)
Sweep Magnifier	Off
Triggering Level	Counterclockwise

Triggering Source	Left (or Right if the amplifier plug-in is in the center compartment)
Triggering/Sweep Mode	Auto Trig, DC Coupling, + Slope, Normal Sweep

4. Advance the INTENSITY control until the trace is at the desired viewing level. The trace should appear near the graticule center.

5. Connect a 1X probe or test lead from the CALIBRATOR loop to the amplifier plug-in input connector.

6. Turn the Triggering Level control clockwise until a stable display is obtained. Adjust the vertical and horizontal Position controls so the display is centered vertically and starts at the left edge of the graticule.

7. Adjust the FOCUS control for a sharp, well-defined display over the entire trace length.

8. Disconnect the input signal and position the trace vertically so it coincides with the center horizontal line of the graticule.

9. If the trace is not parallel with the center horizontal line, see Trace Alignment Adjustment in this section.

Calibration Check

10. Move the trace two divisions below graticule center and reconnect the calibrator signal to the amplifier plug-in input connector.

11. The display should be four divisions in amplitude with six complete cycles (five complete cycles for 50-hertz line frequency) shown horizontally. An incorrect display indicates that the oscilloscope mainframe or plug-ins need to be recalibrated. See the Operating Instructions section of the 5100-Series Oscilloscope System manual for complete information.

Beam Finder

12. Move the display off-screen with the vertical Position control.

13. Push the BEAM FINDER button and observe that the display compresses into the screen area. Reposition the display to screen center and release the BEAM FINDER button.

External Intensity Input

14. Move the calibrator signal from the amplifier plug-in input connector to the EXT INTENSITY INPUT connector.

15. Set the Triggering Source to Line and slowly rotate the INTENSITY control counterclockwise until the trace appears to be a series of dimmed and brightened segments. The brightened segments correspond with the tops of the calibrator square waves.

This completes the description of the basic operating procedure for the D10. Instrument operations not explained here, or operations which need further explanation are discussed under General Operating Information.

GENERAL OPERATING INFORMATION

Graticule

The graticule of the D10 is internally marked on the faceplate of the CRT to provide accurate no-parallax measurements. The graticule is marked with eight vertical and ten horizontal divisions. Each division is one-half inch square. In addition, each major division is divided into five minor divisions. The vertical gain and horizontal timing are calibrated to the graticule so accurate measurements can be made from the graticule.

Intensity Control

The intensity of the display on the CRT is controlled by the INTENSITY control. This control is adjusted so the display is easily visible but not overly bright. It will probably require readjustment for different displays or sweep rates. Particular care should be exercised when only a spot is displayed. A high-intensity spot may burn the CRT phosphor and cause permanent damage to the CRT if allowed to remain too long.

Display Focus

If a well-defined display cannot be obtained with the FOCUS control, even at low intensity settings, adjustment of the internal astigmatism control may be required.

To check for proper setting of the Astig control, slowly turn the FOCUS control through the optimum setting with a signal displayed on the CRT screen. If the Astig control is correctly set, the vertical and horizontal portions of the trace will come into sharpest focus at the same position of the FOCUS control.

Trace Alignment Adjustment

If a free-running trace is not parallel with the horizontal graticule lines, set the TRACE ROTATION adjustment (rear panel) as follows: Position the trace to the center horizontal line and adjust the TRACE ROTATION control so the trace is parallel with the horizontal graticule lines.

Beam Finder

The BEAM FINDER switch provides a means of locating a display which overscans the viewing area either vertically or horizontally. When the BEAM FINDER switch is pressed, the display is compressed within the graticule area. To locate and reposition an overscanned display, use the following procedure:

1. Press the BEAM FINDER switch, and while holding it in, increase the vertical and horizontal deflection factors until the display is reduced to about two divisions vertically and four divisions horizontally (the horizontal deflection needs to be reduced only when in the X-Y mode of operation).

2. Adjust the vertical and horizontal position controls to center the display about the vertical and horizontal centerlines.

3. Release the BEAM FINDER switch; the display should remain within the viewing area.

Intensity Modulation

Intensity (Z-axis) modulation can be used to relate a third item of electrical phenomena to the vertical (Y-axis) and the horizontal (X-axis) coordinates without affecting the waveshape of the displayed signal. The Z-axis modulating signal applied to the EXT INTENSITY INPUT changes the intensity of the displayed waveform to provide this type of display. The voltage amplitude required for visible trace modulation depends on the setting of the INTENSITY control. About +5 volts will turn on the display to a normal brightness level from an off level, and about −5 volts will turn the display off from a normal brightness level. "Gray scale" intensity modulation can be obtained by applying signals between these levels. Maximum safe input voltage is + or −50 volts. Usable frequency range of the Z-axis circuit is DC to one megahertz.

Time markers applied to the EXT INTENSITY INPUT provide a direct time reference on the display. With uncalibrated horizontal sweep or X-Y operation, the time markers provide a means of reading time directly from the display. However, if the markers are not time-related to the displayed waveform, a single-sweep display should be used (for internal sweep only) to provide a stable display.

Calibrator

The internal calibrator of the D10 provides a convenient signal source for checking basic vertical gain and sweep timing. The calibrator signal is also very useful for adjusting probe compensation as described in the probe instruction manual. The output square-wave voltage is 400 millivolts, within 1%, and the square-wave current is 4 milliamperes, within 1%. The frequency of the square-wave signal is twice the power-line frequency. The signal is obtained by clipping the probe to the loop.

Display Photography

A permanent record of the CRT display can be obtained with an oscilloscope camera system. The CRT bezel of the D10 provides integral mounting for a Tektronix oscilloscope camera. A camera with a light source is required to illuminate the graticule. The instruction manuals for the Tektronix oscilloscope cameras include complete instructions for obtaining waveform photographs.

Oscilloscope Applications

The 5100-Series Oscilloscope, including its associated display module and plug-in units, provides a very flexible measurement system. Specific applications for the individual plug-ins are described in the manuals for those units. Refer to the Operating Instructions section of the 5100-Series Oscilloscope System manual for basic oscilloscope applications, including peak-to-peak AC voltage measurements, instantaneous DC voltage measurements, comparison measurements, time duration measurements, determining frequency, risetime measurements, and X-Y phase measurements.

SECTION 3
CIRCUIT DESCRIPTION

Change information, if any, affecting this section will be found at the rear of this manual.

Introduction

This section of the manual contains an electrical description of the circuits in the D10 Single-Beam Display Unit. An overall block diagram of the unit and complete schematics are given on pullout pages at the rear of this manual.

BLOCK DIAGRAM DESCRIPTION

The Vertical and Horizontal Deflection Amplifiers provide final amplification for the signals from the plug-in units. They produce push-pull outputs suitable to drive the CRT vertical and horizontal deflection plates. Beam-finding circuitry is incorporated to limit the display within the screen area when the front-panel BEAM FINDER button is pressed. A variable capacitor between the output lines of the Vertical Deflection Amplifier permits adjustment of the inherent phase shift between the vertical and horizontal deflection systems to zero degrees.

The CRT Circuit produces the high voltage (about −3.4 kilovolts) and contains the controls necessary for operation of the cathode-ray tube. The CRT Circuit also contains the Z-Axis Amplifier, which provides the drive signal to control the intensity level of the display.

DETAILED CIRCUIT DESCRIPTION

Deflection Amplifiers

Vertical Deflection Amplifier. The Vertical Deflection Amplifier provides the final amplification of signals applied to the vertical plug-in units. It produces a push-pull output sufficient to drive the CRT vertical deflection plates. The amplifier consists of Q104, Q106, Q114, and Q116, connected in a differential configuration.

The input signal arrives via P612 from the plug-in interface circuit (power supply/amplifier module). The output signal is developed across the collector-load resistors, R104 and R114, and is about 50 times the magnitude of the input signal. R116, Vert Gain, provides Q106-Q116 emitter degeneration to set the gain of the stage to provide a calibrated vertical display.

Horizontal Deflection Amplifier. The Horizontal Deflection Amplifier consists of Q124, Q126, Q134, and Q136, and is basically the same as the Vertical Deflection Amplifier just described. It provides final amplification of signals from the horizontal plug-in unit, which arrive via P611. Gain of the stage is set by R136, Horiz Gain, to provide a calibrated horizontal display.

Beam Finder. If a high-amplitude signal or a misadjusted control has deflected the trace or display off screen, it can be located by pressing the front-panel BEAM FINDER pushbutton. This opens S125, allowing current through R125 into the emitter circuits of both deflection amplifiers. R125 limits the current available to the transistors, and hence, to the collector-load resistors. Thus the dynamic range of the deflection plates is limited to an on-screen level, and the display is compressed within the viewing area.

Also, when the BEAM FINDER switch is pressed, the Z Axis Amplifier in the CRT Circuit senses the slight increase in voltage level at the R108-R118-R128-R138 junction. The Z Axis Amplifier produces a slight increase in CRT beam intensity, allowing the trace to be displayed even though the INTENSITY control may be fully counterclockwise.

X-Y Phasing. Variable capacitor C115, Phase, is connected across the output collectors of the Vertical Deflection Amplifier. This capacitor is adjusted to eliminate the inherent phase difference between the vertical and horizontal deflection systems when operating in the X-Y mode.

CRT Circuit

General. The CRT Circuit produces the high-voltage potential and provides the control circuits necessary for operation of the cathode-ray tube (CRT). This circuit also includes the Z-Axis Amplifier stage to set the intensity of the CRT display.

Z-Axis Amplifier. The Z-Axis Amplifier is a current driven shunt-feedback operational amplifier with a voltage output, and consists of Q222, Q226, and Q234. The feedback path is from the collectors of Q226 and Q234 through R227-C227 to the base of Q222. Q226 and Q234 are connected as a collector-coupled complementary amplifier to provide a fast, linear output signal while consuming minimum quiescent power. The output voltage provides the drive signal to control the CRT intensity level through the Control-Grid Supply.

The output level of the Z-Axis Amplifier is established by the voltage drop across R227 in reference to virtual ground at the base of Q222 (the operational amplifier summing point). The current through R227 is determined by the input current from any combination of several sources, such as from the front-panel INTENSITY control, plug-in interface (blanking, intensification, etc.), and from Q214. Q214 is an operational amplifier with two inputs; one from the front-panel EXT INTENSITY INPUT connector and the other from the front-panel BEAM FINDER switch. It sets those input signals to a level suitable for proper response by the Z-Axis Amplifier.

High-Voltage Regulator

High-Voltage Primary. A repetitive, non-sinusoidal signal is produced by a phase-modulated switching circuit in the primary of T240 and induced into the secondaries. Current drive for the primary winding is furnished by Q252 in its conduction state. Q252 is turned on by positive-going feedback applied through C259, L259, and R259 from the feedback winding, and then turned off by switching action from Q262. A sample of the output DC voltage is modulated by the AC from another feedback winding at the gate of Q278 to establish the conduction time of Q252 and thus maintain the proper output level. Q252 delivers energy to T240 only once each cycle.

Assuming Q262 and Q264 are off initially, R262 provides base drive for Q252, causing it to deliver current to T240 primary. As Q252 conducts, the increasing current through the primary winding induces a voltage into the secondaries. The gate of Q278 is driven negative by the voltage from the feedback winding, switching Q264 and Q262 on. With conduction of Q262, base drive for Q252 is removed.

With Q252 off, the transformer field collapses, reversing the polarity of the voltage induced into the secondaries. When the gate of Q278 is driven sufficiently positive to switch Q264 and Q262 off, Q252 is switched on again. Q252 again delivers energy to the primary winding and the action is repeated.

High-Voltage Regulation. Regulation is accomplished as follows: Feedback from the −3400-volt cathode supply is summed with low-voltage levels through the voltage divider consisting of resistors R272B-E, R275, and R276 to establish the DC level at the gate of Q278. The AC component, which is the switching signal, is derived from the transformer as described previously. If the output level of the cathode supply drops below the nominal −3400 volts (becomes more positive), the level at the gate of Q278 rises. A new point is selected on the varying AC component to cause switching of Q262-Q264 later and hence increase conduction time of Q252. This allows more energy to be delivered to the primary winding of T240, resulting in an increase of voltage in the secondaries. Conversely, if the output level increases, Q252 is allowed to conduct for a shorter length of time. The DC level at the gate of Q278 is adjusted by R275, H.V. Adj, to set the output at exactly −3400 volts.

High Voltage Outputs

Transformer T240 has two high-voltage output windings which provide the potentials required for the CRT cathode and control grid supplies. The −3400-volt accelerating potential for the cathode is supplied by half-wave rectifier CR247. The cathode heater is elevated to the cathode potential through R273.

Half-wave rectifier CR241 provides about −3450 volts to establish bias voltage on the CRT control grid. This voltage (and hence the CRT beam current) is dynamically controlled by the Z-Axis Amplifier, which contains the INTENSITY control, blanking inputs, and intensification inputs. R245, Int Range, provides a fine adjustment of the quiescent grid voltage to bias the CRT just below cutoff when the Z-Axis Amplifier output is at its minimum quiescent level (INTENSITY control counterclockwise and no intensifying or blanking inputs).

Neon bulbs DS271, DS272, and DS273 provide protection to the CRT if the voltage difference between the control grid and the cathode exceeds about 180 volts.

CRT Control Circuits

In addition to the INTENSITY control discussed previously, front-panel FOCUS and internal astigmatism controls have been incorporated for arriving at an optimum CRT display. FOCUS control R295 provides the correct voltage for the second anode in the CRT. Proper voltage for the third anode is obtained by adjusting Astig control R286. In order to obtain optimum spot size and shape, both the FOCUS and Astig controls are adjusted to provide the proper electrostatic lens configuration in the CRT.

The Geom adjustment R285 varies the positive level on the horizontal deflection plate shields to control the overall geometry of the display. The TRACE ROTATION control, R291, permits adjustment of the DC current through beam-rotation coil L291 to align the display with the horizontal graticule lines.

SECTION 4
CALIBRATION

Change information, if any, affecting this section will be found at the rear of this manual.

Introduction

This section of the manual contains a procedure to return the circuits of the D10 to within their designed operating capabilities. Calibration is generally required after a repair has been made, or after long time intervals in which normal aging of components may affect instrument accuracy. For initial inspection to verify instrument operation, the Basic Operation procedure in Section 2 should be used (the instrument is checked with its covers on, using a minimum of peripheral equipment).

Instrument Maintenance

Before complete calibration, thoroughly clean and inspect this instrument as outlined in the Maintenance section of the Oscilloscope System manual. Also, the system manual contains information for general maintenance of this instrument, including preventive maintenance, component identification and replacement, etc.

Services Available

Tektronix, Inc. provides complete instrument repair and calibration at local Field Service Centers and at the Factory Service Center. Contact your local Tektronix Field Office or representative for further information.

TEST EQUIPMENT REQUIRED

General

The following test equipment and accessories, or the equivalent, is required for complete calibration of the D10. Specifications given for the test equipment are the minimum necessary for accurate calibration. Therefore, some of the specifications listed here may be less rigorous than the actual performance capabilities of the test equipment. All test equipment is assumed to be correctly calibrated and operating within the listed specifications.

Calibration Equipment Alternatives

If other test equipment is substituted, control settings or calibration setup may need altering to meet the requirements of the equipment used. Detailed operating instructions for the test equipment are not given in this procedure. Refer to the instruction manual for the test equipment if more information is needed.

Special Calibration Fixtures

Special Tektronix calibration fixtures are used in this procedure only where they facilitate instrument calibration. These special calibration fixtures are available from Tektronix, Inc. Order by part number through your local Tektornix Field Office or representative.

Test Instruments

1. Vertical plug-in unit. Any two Tektronix 5A-series amplifiers can be used. The units should be of the same type for checking X-Y phase relationship.

2. Time-base plug-in unit. Tektronix 5B10N recommended.

3. DC voltmeter. Minimum sensitivity rating, 3500 volts full scale with an accuracy of at least 3%.

4. Low-frequency sine-wave generator. Frequency, 2 kilohertz to at least 100 kilohertz; output amplitude, from about 0.1 volt to 20 volts peak to peak into 50 ohms. For example, General Radio 1310-B Oscillator (use a General Radio 274-QBJ Adapter to provide BNC output).

5. Standard amplitude calibrator. Frequency, about one kilohertz; square-wave output amplitude, 0.2 volt. DC voltage outputs, + and −5 volts for checking Z-Axis input. Tektronix Calibration Fixture 067-0502-01 has all of these requirements.

Accessories

1. Coaxial cable. 50 ohms impedance, 42-inch length, BNC connectors. Tektronix Part No. 012-0057-01.

2. Dual-input cable. Provides matched signal paths to the X and Y channels; BNC connectors. Tektronix Part No. 067-0525-00.

3. Test lead to connect signal from the CALIBRATOR loop to the vertical input.

SHORT-FORM PROCEDURE AND INDEX

D10 Serial No. _____

Calibration Date _____

Calibrated By _____

CALIBRATION PROCEDURE

Preparation

NOTE

This instrument should be adjusted at an ambient temperature between +20°C and +30°C (between +68°F and +86°F) for best overall accuracy.

1. The D10 is operated with a 5100-series Power Supply/Amplifier unit, forming an oscilloscope mainframe. Remove the right side and bottom cabinet panels.

2. Insert an amplifier plug-in unit in each vertical plug-in compartment (left and center). Insert a time-base plug-in unit in the horizontal (right) compartment.

3. Connect the oscilloscope to the power source for which it is wired.

4. Set the controls as given under Initial Control Settings. Refer to Fig. 4-1 for location of internal adjustments and test points.

5. Allow a 20 minute warm up time before performing the calibration procedure.

Initial Control Settings

NOTE

Do not preset internal controls unless they are known to be significantly out of adjustment, or unless repairs have been made in the circuit. In these instances, the particular controls can be set to midrange.

D10

INTENSITY	Counterclockwise
FOCUS	Midrange
POWER	ON

Amplifier Units (both)

Display	On
Position	Midrange
Volts/Div	50 mV
Variable	Calibrated (fully clockwise)
Input Coupling	DC, GND

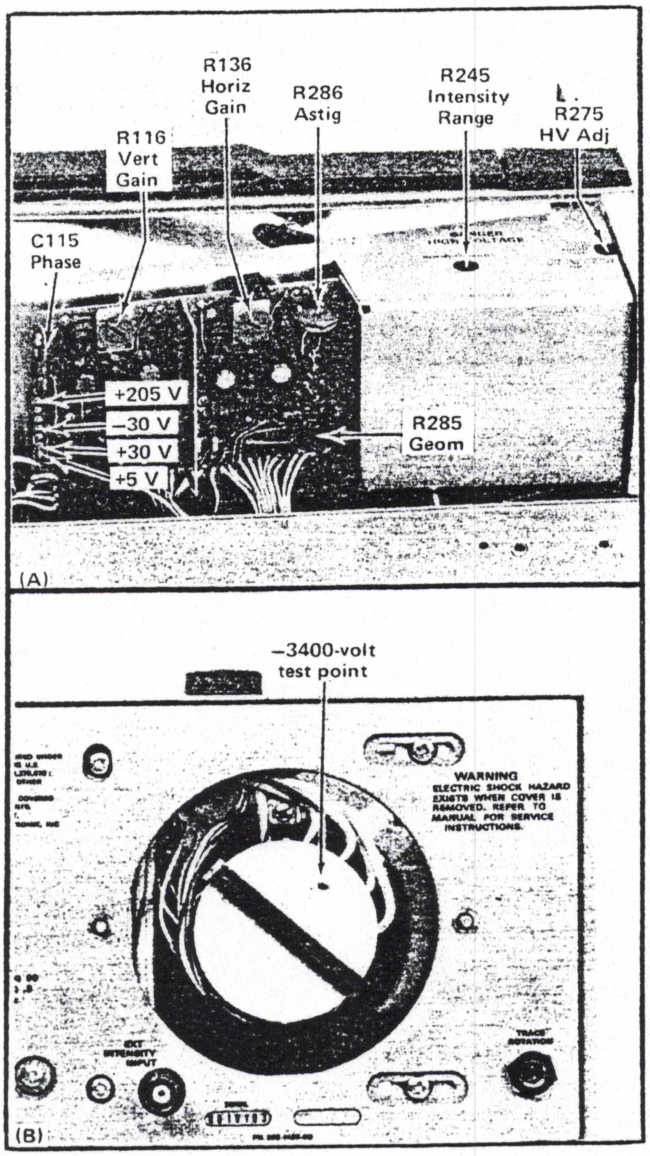


Fig. 4-1. Location of controls and test points.

Time Base Unit

Display	Alt (button out)
Position	Sweep starts at the left edge of the graticule
Seconds/Div	0.5 ms
Variable	Calibrated (fully clockwise)
Swp Mag	Off (button out)
Triggering Mode	Auto Trig, AC Coupling, + Slope
Triggering Source	Display (Left and Right buttons in)
Triggering Level	Midrange

1. Check/Adjust Power Supplies

LOW-VOLTAGE SUPPLIES

a. Connect the DC voltmeter between each low-voltage test point and ground. See Fig. 4-1 for test point locations.

b. CHECK—Each supply is within the tolerance listed in Table 4-1.

NOTE

The tolerances in Table 4-1 include the possible 3% measurement error of the VOM. If a supply is outside the listed tolerance, refer to the Calibration section of the 5100-series Oscilloscope System manual for complete calibration instructions.

TABLE 4-1

Supply	Tolerance
−30 V	−29.025 V to −30.975 V
+5 V	+4.75 V to +5.25 V
+30 V	+28.95 V to +31.07 V
+205 V	+175 V to +247.5 V

HIGH VOLTAGE SUPPLY

CAUTION

Turn off instrument power when connecting and disconnecting the DC voltmeter.

c. Connect the DC voltmeter (20 kΩ/volt VOM set to measure at least −3500 volts) between ground and the −3400-volt test point.

d. CHECK—Meter reading must be −3400 volts, ±170 volts.

ADJUST—R275, HV Adj, for −3400 volts.

e. Disconnect the DC voltmeter.

2. Check/Adjust CRT Operation

If you are beginning calibration with this step, set the front-panel controls as listed under Initial Control Settings except as follows:

Right Vertical Plug-in Display	Off (button out)

INTENSITY RANGE

a. Advance the INTENSITY control clockwise and check that a trace can be obtained, then turn the control fully counterclockwise.

b. ADJUST—Preset R245, Intensity Range, fully CCW. Press the BEAM FINDER button and slowly adjust R245 CW until the trace just appears. Release the BEAM FINDER button and adjust the INTENSITY CONTROL for a trace of normal brightness.

ASTIGMATISM

c. Connect the low-frequency sine-wave generator to the left vertical plug-in unit input connector through a coaxial cable. Set the sine-wave generator for a 2-kilohertz, minimum amplitude output.

d. Set the input coupling switch of the left vertical unit to DC and adjust the sine-wave generator for about 6 divisions of display amplitude. Adjust the time-base triggering controls for a stable display.

e. ADJUST—R286, Astig, and front-panel FOCUS control for best focus of overall display.

f. Disconnect the sine-wave signal from the vertical input connector.

TRACE ALIGNMENT

g. Move the trace to the center of the graticule (left plug-in unit Position control).

h. CHECK—Trace should be parallel to the center graticule line.

ADJUST—TRACE ROTATION control (rear-panel screwdriver adjustment) to align the trace horizontally.

GEOMETRY

i. Press in the Display On button of the right vertical plug-in unit to obtain a two-trace display. Position one of the traces to the top of the graticule and the other trace to the bottom.

j. CHECK—Bowing of the traces must not exceed 0.1 division.

ADJUST—R285, Geom, for minimum curvature of the two traces.

k. Interchange the time-base plug-in unit with either of the amplifier plug-in units to obtain a vertical sweep. Position the vertical trace to the right edge of the graticule. Readjust R285 if the bowing exceeds 0.1 division.

l. Replace the time-base plug-in unit in the horizontal compartment and the amplifier unit in the vertical compartment. Recheck horizontal geometry.

3. Check/Adjust CRT Deflection System

If you are beginning calibration with this step, set the front-panel controls as listed under Initial Control Settings, except as follows:

INTENSITY	Adjust for normal viewing brightness.
Input Coupling (both vertical plug-ins)	DC

HORIZONTAL CENTERING/SWEEP MAGNIFIER REGISTRATION

a. Set the standard amplitude calibrator for a 0.2-volt square wave and connect its output to the input connector of the left vertical plug-in unit through a coaxial cable. Position the rising edge of one of the square waves to the graticule center vertical line and push in the Swp Mag button on the time-base unit.

b. CHECK—The corresponding rising edge on the magnified sweep must be within two divisions of the graticule center.

ADJUST—While switching between magnified and unmagnified displays, alternately adjust R675, Horiz Cent (see Fig. 5-1 in the 5103N Oscilloscope System manual for location), and the horizontal Position control until the rising edge of both the unmagnified and magnified displays are at the graticule center.

VERTICAL AND HORIZONTAL AMPLIFIER GAIN

c. Temporarily disconnect the calibrator signal and remove the time-base unit from the oscilloscope mainframe. Move one of the amplifier units to the horizontal compartment, then reconnect the 0.2-volt calibrator signal through a dual-input cable to the input connectors of both amplifier units.

NOTE

Use two amplifier plug-ins known to be accurately calibrated, or verify their correct calibration by applying a known signal and measuring the differential output at pins A7 and B7 of the plug-in connector. The deflection factor at the output is 50 millivolts/division.

d. Set the input coupling of the amplifier unit in the horizontal compartment to DC. The display should be two dots joined by a diagonal line. The dots represent opposite corners of a square having sides 4 divisions in length. Adjust the Position controls to center the display.

e. CHECK—Vertical and horizontal deflection is 4 divisions, ±0.04 division.

ADJUST—R116, Vert Gain, and R136, Horiz Gain, so the vertical and horizontal deflection are each exactly 4 divisions.

X-Y PHASING

f. Set the low-frequency sine-wave generator for a 100-kilohertz, minimum amplitude output. Move the coaxial cable from the standard amplitude calibrator output to the sine-wave generator output to apply the sine-wave signal to the amplifier plug-in units.

g. Adjust the vertical and horizontal Position controls to center the diagonal display, then increase the sine-wave generator amplitude until the display is 6 divisions vertically and horizontally.

h. CHECK—The opening of the loop measured on the graticule center line is 0.07 division or less. This indicates a phase difference of 1° or less between the vertical and horizontal deflection systems.

ADJUST—C115, Phase, for minimum loop opening (a straight line) in the diagonal display.

i. Remove the low-frequency sine-wave generator. Move the amplifier unit back to the vertical compartment and re-install the time-base unit.

BANDWIDTH

The requirement of the deflection amplifiers with respect to bandwidth is that the response is sufficient to pass a signal from any 5A-series plug-in unit. To verify system bandwidth, refer to the calibration sections of the individual plug-in unit manuals.

4. Check Z Axis Amplifier

Set the front-panel controls as listed under Initial Control Settings, except as follows:

INTENSITY	Adjust for normal brightness.

EXTERNAL INTENSITY INPUT

a. Turn the INTENSITY control until the traces cannot be seen, but not fully counterclockwise.

b. Connect the standard amplitude calibrator output to the EXT INTENSITY INPUT connector. Set the standard amplitude calibrator for a +5-volt DC output.

c. CHECK—Traces of normal brightness are displayed.

d. Disconnect the calibrator signal and adjust the INTENSITY control for traces of normal brightness. Set the standard amplitude calibrator for a −5-volt DC output and reconnect the cable to the EXT INTENSITY INPUT connector.

e. CHECK—The traces are not visible.

f. Remove the standard amplitude calibrator.

BEAM FINDER

g. Press the BEAM FINDER button and observe that the traces brighten slightly and compress into the graticule area.

h. CHECK—While holding the BEAM FINDER button in, neither trace can be positioned off screen.

i. Reposition the traces as desired and release the BEAM FINDER.

5. Check Calibrator Loop

Set the front-panel controls as listed under Initial Control Settings, except as follows:

INTENSITY	Adjust for normal brightness.
Left Vertical Plug-in	
Volts/Div	.1
Input Coupling	DC
Right Vertical Plug-in	
Display	Off

a. Connect the front-panel CALIBRATOR loop to the left vertical plug-in unit input connector using a test lead. Adjust the time-base unit to trigger on the calibrator signal and set the Seconds/Div switch to display a few cycles of the waveform.

b. CHECK—Display amplitude is 4 divisions, ±0.04 division (400 millivolts). Frequency of the calibrator signal is twice the power-line frequency, which can be determined by measuring the length of time for two cycles of display and taking the reciprocal.

c. Disconnect all test equipment.

This completes the calibration procedure for the D10.

PARTS LIST ABBREVIATIONS

BHB	binding head brass
BHS	binding head steel
cap.	capacitor
cer	ceramic
comp	composition
conn	connector
CRT	cathode-ray tube
csk	countersunk
DE	double end
dia	diameter
div	division
elect.	electrolytic
EMC	electrolytic, metal cased
EMT	electrolytic, metal tubular
ext	external
F & I	focus and intensity
FHB	flat head brass
FHS	flat head steel
Fil HB	fillister head brass
Fil HS	fillister head steel
h	height or high
hex.	hexagonal
HHB	hex head brass
HHS	hex head steel
HSB	hex socket brass
HSS	hex socket steel
ID	inside diameter
inc	incandescent
int	internal
lg	length or long
met.	metal
mtg hdw	mounting hardware
OD	outside diameter
OHB	oval head brass
OHS	oval head steel
P/O	part of
PHB	pan head brass
PHS	pan head steel
plstc	plastic
PMC	paper, metal cased
poly	polystyrene
prec	precision
PT	paper, tubular
PTM	paper or plastic, tubular, molded
RHB	round head brass
RHS	round head steel
SE	single end
SN or S/N	serial number
S or SW	switch
TC	temperature compensated
THB	truss head brass
thk	thick
THS	truss head steel
tub.	tubular
var	variable
w	wide or width
WW	wire-wound

SECTION 5
ELECTRICAL PARTS LIST

Values are fixed unless marked Variable.

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
ASSEMBLIES				
A1	*670-1433-00	B010100	B029999	DEFLECTION AMPLIFIER/HIGH VOLTAGE Circuit Board Assembly
A1	*670-1433-01	B030000	B049999	DEFLECTION AMPLIFIER/HIGH VOLTAGE Circuit Board Assembly
A1	*670-1433-02	B050000		DEFLECTION AMPLIFIER/HIGH VOLTAGE Circuit Board Assembly
A2	*670-1454-00			AUXILIARY Circuit Board Assembly
CAPACITORS				
Tolerance ±20% unless otherwise indicated.				
C106	283-0684-00	B010100	B049999	620 pF, Mica, 300 V, 2%
C106	283-0596-00	B050000		528 pF, Mica, 300 V, 1%
C115	281-0027-00	B010100	B049999X	0.7-3 pF, Var, Tub.
C116	283-0598-00	B010100	B049999	253 pF, Mica, 300 V, 5%
C116	281-0180-00	B050000		18-115 pF, Var, Mica
C126	283-0596-00			528 pF, Mica, 300 V, 1%
C136	283-0672-00			200 pF, Mica, 500 V, 1%
C224	283-0065-00			0.001 µF, Cer, 100 V, 5%
C227	281-0537-00			0.68 pF, Cer, 500 V
C236	285-0526-00			0.1 µF, MT, 400 V
C241	283-0270-00			0.0068 µF, Cer, 4000 V, +80%-20%
C242	283-0261-00			0.01 µF, Cer, 4000 V
C248	283-0270-00			0.0068 µF, Cer, 4000 V, +80%-20%
C249	283-0270-00			0.0068 µF, Cer, 4000 V, +80%-20%
C251	290-0194-00			10 µF, Elect., 100 V
C252	283-0617-00			4700 pF, Cer, 300 V, 10%
C253	283-0003-00			0.01 µF, Cer, 150 V
C254	283-0059-00			1 µF, Cer, 25 V, +80%-20%
C258	283-0059-00			1 µF, Cer, 25 V, +80%-20%
C259	283-0198-00			0.22 µF, Cer, 50 V
C272	283-0021-00			0.001 µF, Cer, 5000 V
C273	283-0208-00			0.22 µF, Cer, 200 V
C274	283-0104-00	B010100	B039999	0.002 µF, Cer, 500 V, 5%
C274	283-0142-00	B040000		0.0027 µF, (nominal value), selected
C279	283-0065-00			0.001 µF, Cer, 100 V, 5%
C281	283-0003-00			0.01 µF, Cer, 150 V
C712	283-0000-00			0.001 µF, Cer, 500 V
C714	281-0628-00			15 pF, Cer, 600 V, 5%
C716	281-0628-00			15 pF, Cer, 600 V, 5%
C721	281-0628-00			15 µF, Cer, 600 V, 5%

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
SEMICONDUCTOR DEVICE, DIODES				
CR209	*152-0061-00			Silicon, Tek Spec
CR211	*152-0061-00			Silicon, Tek Spec
CR214	*152-0185-00			Silicon, replaceable by 1N4152
CR215	*152-0061-00			Silicon, Tek Spec
CR224	*152-0061-00			Silicon, Tek Spec
CR239	*152-0061-00			Silicon, Tek Spec
CR241	152-0409-00			Silicon, rectifier, fast recovery, 12,000 V, 5 mA
CR247	152-0409-00			Silicon, rectifier, fast recovery, 12,000 V, 5 mA
CR253	*152-0414-00			Silicon, rectifier, replaceable by 1N4935
CR255	*152-0185-00			Silicon, replaceable by 1N4152
CR256	*152-0061-00			Silicon, Tek Spec
CR262	*152-0185-00			Silicon, replaceable by 1N4152
CR264	*152-0185-00			Silicon, replaceable by 1N4152
CR269	*152-0061-00			Silicon, Tek Spec
CR702	*152-0185-00			Silicon, replaceable by 1N4152
CR704	*152-0185-00			Silicon, replaceable by 1N4152
CR712	*152-0185-00			Silicon, replaceable by 1N4152
CR714	*152-0185-00			Silicon, replaceable by 1N4152
CR721	*152-0185-00			Silicon, replaceable by 1N4152
CR722	*152-0185-00			Silicon, replaceable by 1N4152
VR237	152-0283-00			Zener, 1N976B, 400 mW, 43 V, 5%
VR258	152-0438-00			Zener, UZ709, 750 mW, 9.1 V, 5%
VR281	152-0357-00			Zener, 1N983B, 400 mW, 82 V, 5%
VR282	152-0255-00			Zener, 1N978B, 400 mW, 51 V, 5%
VR720	152-0149-00			Zener, 1N961B, 400 mW, 10 V, 5%
BULBS				
DS271	150-0030-00			Neon, NE 2V
DS272	150-0030-00			Neon, NE 2V
DS273	150-0030-00			Neon, NE 2V
FUSES				
F201	159-0003-00			1.6 A, 3AG, Slo-blo (Domestic)
F201	159-0019-00			1 A, 3AG, Slo-blo (Export)
CONNECTOR				
J210	131-0955-00			BNC, receptacle, electrical
INDUCTORS				
L259	*108-0564-00			75 uH
L291	*108-0644-00			Trace rotation
TRANSISTORS				
Q104	151-0279-00	B010100	B079999	Silicon, NPN, TO-39, SE7056
Q104	151-0150-00	B080000		Silicon, NPN, TO-5, 2N3440
Q106	151-0190-02	B010100	B069999	Silicon, NPN, TO-9, 2N3904
Q106	151-0190-00	B070000		Silicon, NPN, TO-92, 2N3904
Q114	151-0279-00	B010100	B079999	Silicon, NPN, TO-39, SE7056
Q114	151-0150-00	B080000		Silicon, NPN, TO-5, 2N3440
Q116	151-0190-02	B010100	B069999	Silicon, NPN, TO-92, 2N3904
Q116	151-0190-00	B070000		Silicon, NPN, TO-92, 2N3904
Q124	151-0279-00	B010100	B079999	Silicon, NPN, TO-39, SE7056
Q124	151-0150-00	B080000		Silicon, NPN, TO-5, 2N3440
Q126	151-0190-02	B010100	B069999	Silicon, NPN, TO-92, 2N3904
Q126	151-0190-00	B070000		Silicon, NPN, TO-92, 2N3904
Q134	151-0279-00	B010100	B079999	Silicon, NPN, TO-39, SE7056
Q134	151-0150-00	B080000		Silicon, NPN, TO-5, 2N3440
Q136	151-0190-02	B010100	B069999	Silicon, NPN, TO-92, 2N3904
Q136	151-0190-00	B070000		Silicon, NPN, TO-92, 2N3904
Q138	151-0341-00	XB050000		Silicon, NPN, TO-106, 2N3565
Q214	151-0341-00			Silicon, NPN, TO-016, 2N3565

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
TRANSISTORS (cont)				
Q222	151-0190-00			Silicon, NPN, TO-92, 2N3904
Q226	151-0179-00	B010100	B069999	Silicon, NPN, TO-18, 2N3877A
Q226	151-0347-00	B070000		Silicon, NPN, TO-92, 2N5551
Q234	*151-0228-00	B010100	B069999	Silicon, PNP, TO-5, Tek Spec
Q234	151-0350-00	B070000	B072987	Silicon, PNP, TO-92 2N5401
Q234	151-0406-00	B072988		Silicon, PNP, TO-5, selected from 2N3945
Q252	*151-0256-00			Silicon, NPN, TO-3, Tek Spec
Q262	151-0207-00			Silicon, NPN, TO-92, 2N3415
Q264	151-0342-00			Silicon, PNP, TO-106, 2N4249
Q278	151-1005-00			Silicon, FET, TO-18, N Channel, junction type
Q701	151-0341-00			Silicon, NPN, TO-106, 2N3565
Q702	151-1005-00			Silicon, FET, TO-18, N Channel, junction type
Q703	151-0341-00			Silicon, NPN, TO-106, 2N3565
Q704	151-1005-00			Silicon, FET, TO-18, N Channel, junction type
Q711	151-0341-00			Silicon, NPN, TO-106, 2N3565
Q712	151-1005-00			Silicon, FET, TO-18, N Channel, junction type
Q713	151-0341-00			Silicon, NPN, TO-106, 2N3565
Q714	151-1005-00			Silicon, FET, TO-18, N Channel, junction type
Q721	*151-0192-00			Silicon, NPN, TO-92, replaceable by MPS6521
Q722	*151-0192-00			Silicon, NPN, TO-92, replaceable by MPS6521
RESISTORS				
Resistors are fixed, composition, ±10% unless otherwise indicated.				
R101	315-0101-00			100 Ω, 1/4 W, 5%
R102	316-0470-00	B010100	B029999	47 Ω, 1/4 W
R102	316-0221-00			220 Ω, 1/4 W
R103	316-0390-00	XB030000		39 Ω, 1/4 W
R104	308-0668-00			6.2 kΩ, 7 W, WW, 3%
R106	321-0128-00			210 Ω, 1/8 W, Prec, 1%
R108	308-0539-00			2.25 kΩ, 3 W, WW, 1/2%
R112	316-0470-00	B010100	B029999	47 Ω, 1/4 W
R112	316-0221-00	B030000		220 Ω, 1/4 W
R113	316-0390-00	XB030000		39 Ω, 1/4 W
R114	308-0668-00			6.2 kΩ, 7 W, WW, 3%
R115	316-0470-00	XB030000	B049999X	47 Ω, 1/4 W
R116	311-1132-00			100 Ω, Var
R118	308-0539-00			2.25 kΩ, 3 W, WW, 1/2%
R122	316-0470-00	B010100	B029999	47 Ω, 1/4 W
R122	316-0221-00	B030000		220 Ω, 1/4 W
R123	316-0390-00	XB030000		39 Ω, 1/4 W
R124	308-0668-00			6.2 kΩ, 7 W, WW, 3%
R125	303-0751-00			750 Ω, 1 W, 5%
R126	321-0128-00			210 Ω, 1/8 W, Prec, 1%
R128	308-0539-00			2.25 kΩ, 3 W, WW, 1/2%
R132	316-0470-00	B010100	B029999	47 Ω, 1/4 W
R132	316-0221-00	B030000		220 Ω, 1/4 W
R133	316-0390-00	XB030000		39 Ω, 1/4 W
R134	308-0668-00			6.2 kΩ, 7 W, WW, 3%
R135	316-0470-00	XB030000	B049999X	47 Ω, 1/4 W
R136	311-1132-00			100 Ω, Var
R138	308-0539-00			2.25 kΩ, 3 W, WW, 1/2%
R140	316-0225-00	XB050000		2.2 MΩ, 1/4 W
R200	311-1160-00			100 kΩ, Var

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R202	315-0563-00			56 kΩ, 1/4 W, 5%
R203	316-0103-00			10 kΩ, 1/4 W, 5%
R206	315-0682-00			6.8 kΩ, 1/4 W, 5%
R207	316-0822-00			8.2 kΩ, 1/4 W
R208	316-0473-00			47 kΩ, 1/4 W
R209	316-0224-00	XB050000		220 kΩ, 1/4 W
R211	316-0103-00			10 kΩ, 1/4 W
R213	315-0623-00			62 kΩ, 1/4 W, 5%
R215	316-0103-00			10 kΩ, 1/4 W,
R216	315-0153-00			15 kΩ, 1/4 W, 5%
R217	316-0103-00			10 kΩ, 1/4 W,
R218	316-0183-00			18 kΩ, 1/4 W
R219	315-0683-00			68 kΩ, 1/4 W, 5%
R222	316-0102-00			1 kΩ, 1/4 W
R223	316-0472-00			4.7 kΩ, 1/4 W
R226	316-0101-00	XB050000		100 Ω, 1/4 W
R227	321-0399-00			140 kΩ, 1/8 W, Prec, 1%
R231	316-0472-00			4.7 kΩ, 1/4 W
R232	316-0274-00			270 kΩ, 1/4 W
R234	304-0223-00			22 kΩ, 1 W
R236	315-0101-00			100 Ω, 1/4 W, 5%
R239	315-0101-00			100 Ω, 1/4 W, 5%
R242	316-0223-00			22 kΩ, 1/4 W
R243	316-0105-00			1 MΩ, 1/4 W
R245	311-1135-00	B010100	B029999	1 MΩ, Var
R245	311-1205-00	B030000		2 MΩ, Var
R248	316-0223-00			22 kΩ, 1/4 W
R251	307-0058-00			5.6 Ω, 1/2 W, 5%
R252	308-0075-00			100 Ω, 3 W, WW, 5%
R254	308-0690-00			3 Ω, 3 W, WW
R257	306-0104-00			100 kΩ, 2 W
R262	302-0472-00			4.7 kΩ, 1/2 W
R263	316-0183-00			18 kΩ, 1/4 W
R266	316-0334-00			330 kΩ, 1/4 W
R267	316-0333-00			33 kΩ, 1/4 W
R268	316-0103-00			10 kΩ, 1/4 W
R269	315-0101-00			100 Ω, 1/4 W, 5%
R270	316-0223-00	XB060000		22 kΩ, 1/4 W
R271	316-0395-00			3.9 MΩ, 1/4 W
R272A				40 MΩ,
R272B				150 kΩ,
R272C	*307-0296-00			13 MΩ, Thick film
R272D				4 MΩ,
R272E				2.2 MΩ,
R273	315-0104-00			100 kΩ, 1/4 W, 5%
R274	316-0105-00			1 MΩ, 1/4 W
R275	311-1136-00			100 kΩ, Var
R276	316-0105-00			1 MΩ, 1/4 W
R278	316-0562-00			5.6 kΩ, 1/4 W
R279	315-0104-00			100 kΩ, 1/4 W, 5%

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R282	315-0163-00			16 kΩ, 1/4 W, 5%
R285	311-1136-00			100 kΩ, Var
R286	311-1136-00			100 kΩ, Var
R287	301-0183-00			18 kΩ, 1/2 W, 5%
R291	311-1189-00			5 kΩ, Var
R295	311-0254-00			5 MΩ, Var
R701	316-0103-00			10 kΩ, 1/4 W
R702	316-0103-00			10 kΩ, 1/4 W
R703	316-0103-00			10 kΩ, 1/4 W
R704	316-0103-00			10 kΩ, 1/4 W
R706	316-0103-00			10 kΩ, 1/4 W
R707	316-0103-00			10 kΩ, 1/4 W
R709	316-0103-00			10 kΩ, 1/4 W
R710	316-0103-00			10 kΩ, 1/4 W
R712	316-0472-00			4.7 kΩ, 1/4 W
R713	316-0332-00			3.3 kΩ, 1/4 W
R715	321-0402-00			150 kΩ, 1/8 W, Prec, 1%
R716	321-0356-00			49.9 kΩ, 1/8 W, Prec, 1%
R717	321-0350-00			43.2 kΩ, 1/8 W, Prec, 1%
R718	316-0153-00			15 kΩ, 1/4 W
R720	321-0385-00			100 kΩ, 1/8 W, Prec, 1%
R721	321-0356-00			49.9 kΩ, 1/8 W, Prec, 1%
R722	321-0365-00			61.9 kΩ, 1/8 W, Prec, 1%
R723	316-0153-00			15 kΩ, 1/4 W
R724	316-0272-00			2.7 kΩ, 1/4 W
SWITCHES				
Wired or Unwired				
S125	260-1238-00			Push, BEAM FINDER
S200	260-0227-00			Thermostatic, open 73.9° C, close 51.7° C
S201	260-1222-00			Push-pull, POWER
TRANSFORMERS				
T240	*120-0705-01	B010100	B049999	HV Power
T240	*120-0761-00	B050000		HV Power
ELECTRON TUBE				
V291	*154-0633-00	B010100	B069999	CRT standard phosphor
V291	*154-0633-05	B070000		CRT standard phosphor

SECTION 6

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols and Reference Designators

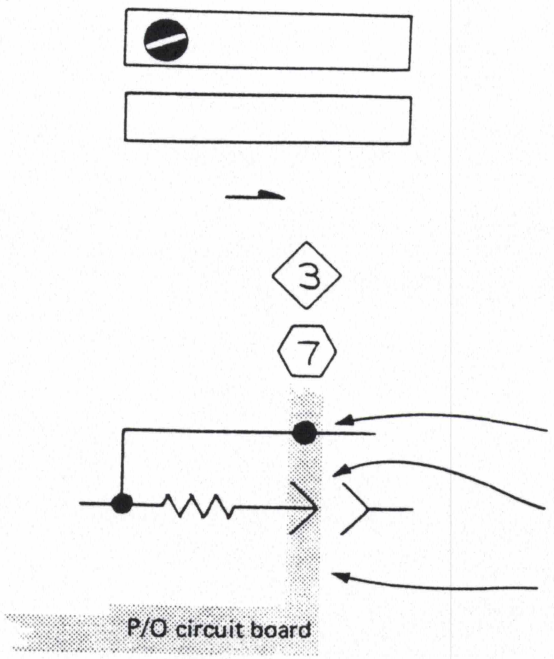
Electrical components shown on the diagrams are in the following units unless noted otherwise:

Capacitors = Values one or greater are in picofarads (pF).
Values less than one are in microfarads (μF).
Resistors = Ohms (Ω)

Symbols used on the diagrams are based on USA Standard Y32.2-1967.

Logic symbology is based on MIL-STD-806B in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

The following special symbols are used on the diagrams:



External Screwdriver adjustment.

External control or connector.

Clockwise control rotation in direction of arrow.

Refer to diagram number indicated in diamond.

Refer to waveform number indicated in hexagon.

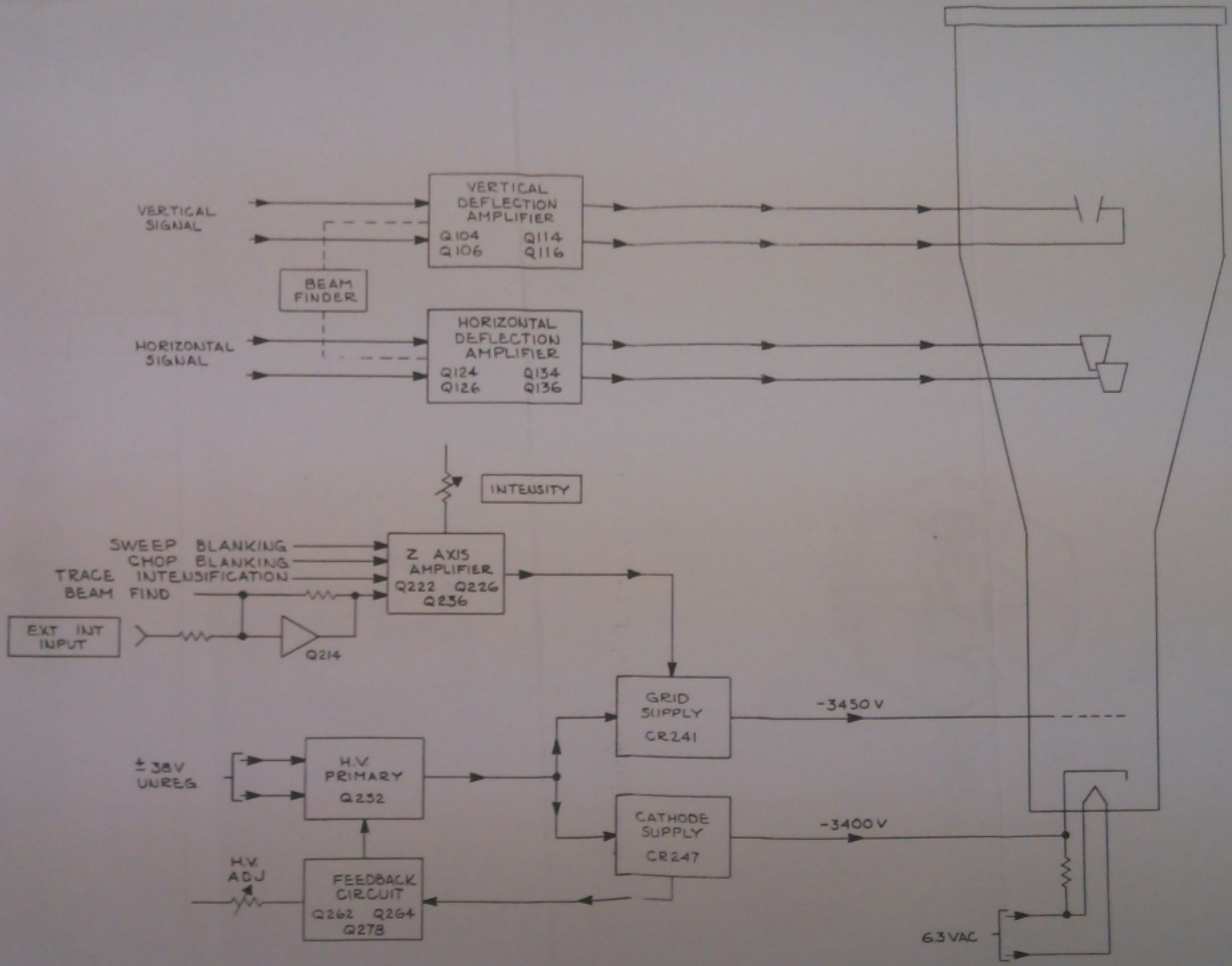
Connection soldered to circuit board.

Connection made to circuit board with interconnecting pin.

Blue tint encloses components located on circuit board.

The following prefix letters are used as reference designators to identify components or assemblies on the diagrams.

A	Assembly, separable or repairable (circuit board, etc.)
AT	Attenuator, fixed or variable
B	Motor
BT	Battery
C	Capacitor, fixed or variable
CR	Diode, signal or rectifier
DL	Delay line
DS	Indicating device (lamp)
F	Fuse
FL	Filter
H	Heat dissipating device (heat sink, heat radiator, etc.)
HR	Heater
J	Connector, stationary portion
K	Relay
L	Inductor, fixed or variable
LR	Inductor/resistor combination
M	Meter
Q	Transistor or silicon-controlled rectifier
P	Connector, movable portion
R	Resistor, fixed or variable
RT	Thermistor
S	Switch
T	Transformer
TP	Test point
U	Assembly, inseparable or non-repairable (integrated circuit, etc.)
V	Electron tube
VR	Voltage regulator (zener diode, etc.)
Y	Crystal



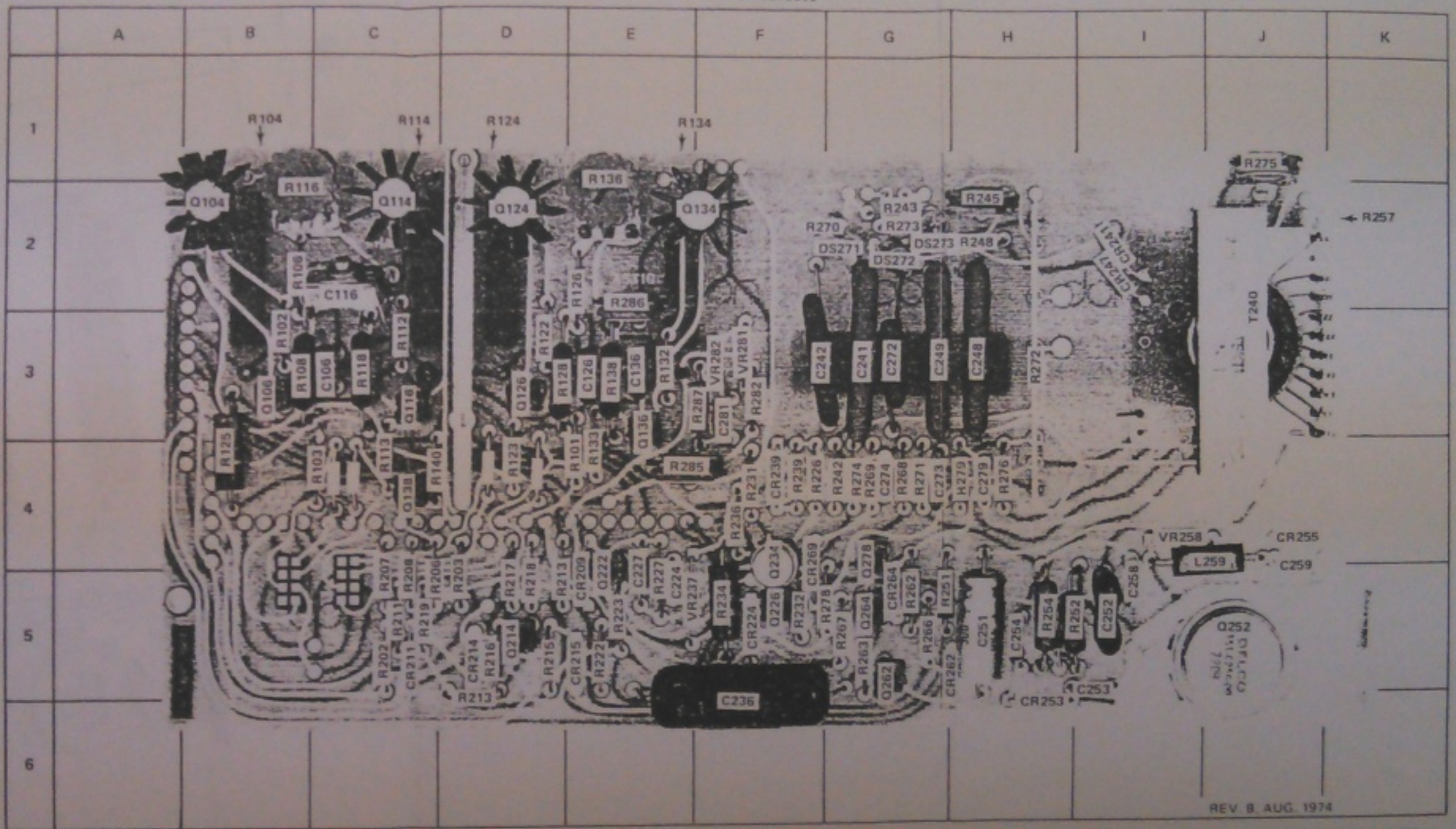
571
RHL

BLOCK DIAGRAM

Ⓐ

DEFLECTION AMPLIFIER/HIGH-VOLTAGE BOARD
PARTS LOCATION GRID

Above SN B050000



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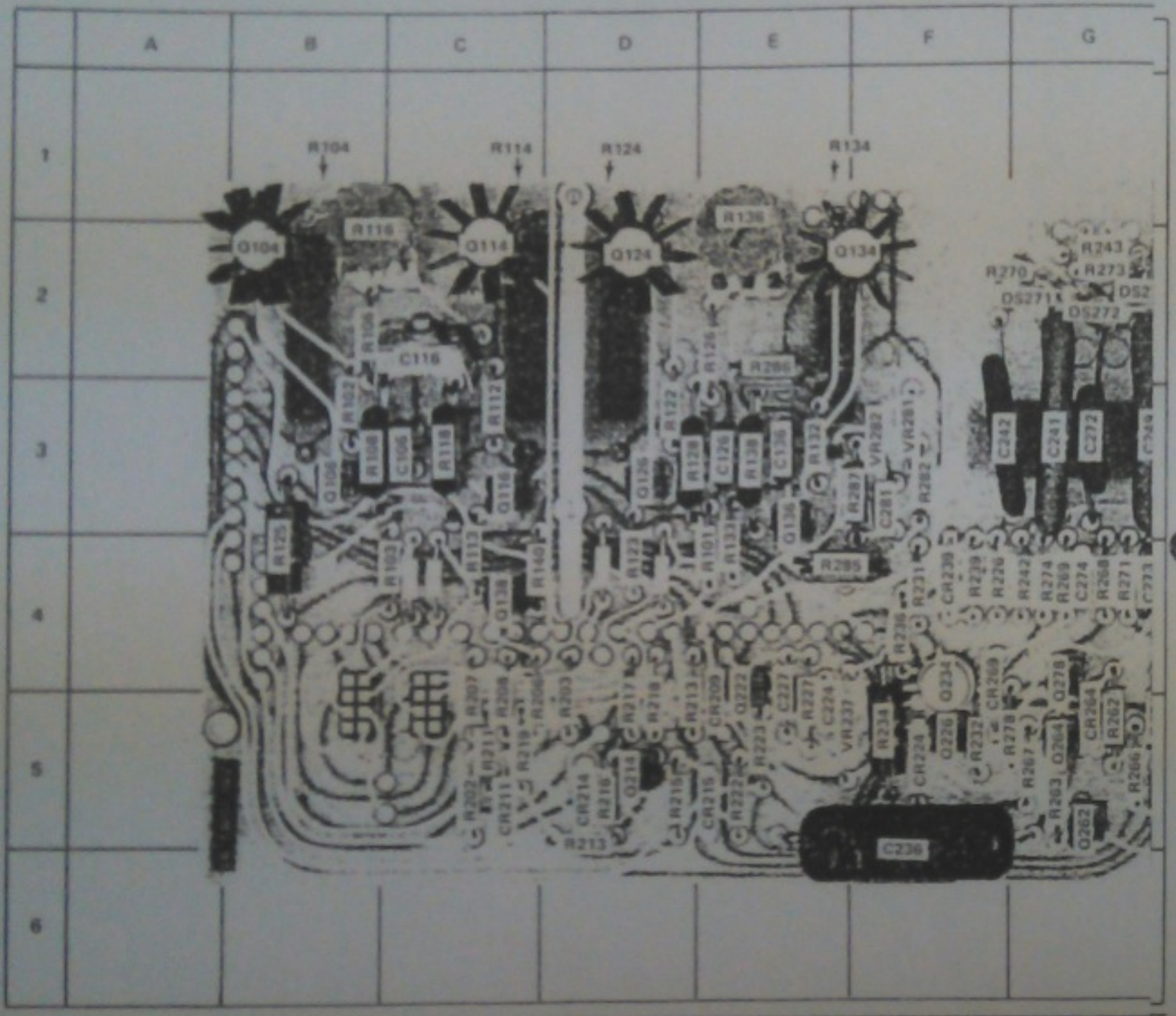
CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C106	C-3	C252	I-5	CR209	E-5	CR269	F-4	DS271	G-2	Q104	B-2	Q234	F-4	R101	E-4	R124	D-1	R206	E-5	R223	E-5	R251	G-5	R273	G-2
C116	C-2	C253	I-5	CR211	C-5			DS272	G-2	Q106	B-3	Q252	J-5	R102	B-3	R125	B-4	R207	C-5	R226	F-4	R252	H-5	R274	G-4
C126	E-3	C254	H-5	CR214	D-5			DS273	G-2	Q114	C-2	Q262	G-5	R103	C-4	R126	E-2	R208	C-5	R227	E-5	R254	H-5	R275	J-1
C136	E-3	C258	I-5	CR215	E-5					Q116	C-3	Q264	G-5	R104	B-1	R128	D-3	R209	D-5	R231	F-4	R257	J-2	R276	H-4
C224	E-5	C259	J-4	CR224	F-5					Q124	D-2	Q278	F-4	R106	B-2	R132	E-3	R211	C-5	R232	F-5	R262	G-5	R278	G-5
C227	E-5	C272	G-3	CR239	F-4					Q126	D-3			R108	B-3	R133	E-4	R213	D-5	R234	F-5	R263	G-5	R279	H-4
C236	F-5	C273	G-4	CR241	I-2					Q134	F-2			R112	C-3	R134	E-1	R215	D-5	R236	F-4	R266	G-5	R282	F-3
C241	G-3	C274	G-4	CR247	I-2	VR237	E-5	L259	J-4	Q136	E-3			R113	C-4	R136	E-2	R216	D-5	R239	F-4	R267	G-5	R285	E-4
C242	F-3	C279	H-4	CR253	H-6	VR258	I-4			Q138	C-4			R116	B-2	R138	E-3	R217	D-5	R242	G-4	R268	G-4	R286	E-2
C248	H-3	C281	F-4	CR255	J-4	VR281	F-3			Q214	D-5			R118	C-3	R140	C-4	R218	D-5	R243	G-2	R269	G-4	R287	E-3
C249	G-3			CR262	G-5	VR282	F-3			Q222	F-5			R122	D-2	R202	C-5	R219	C-5	R245	H-2	R270	G-2		
C251	H-5			CR264	G-5					Q226	F-5			R123	D-4	R203	D-5	R222	E-5	R248	H-2	R271	G-4		

DEFLECTION AMPLIFIER/HIGH VOLTAGE BO
PARTS LOCATION GRID

Above SN B050000



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C106	C-3	C252	I-5	CR209	E-5	CR269	F-4	DS271	G-2	Q104	B-2	Q234	F-4	R101	E-4	R124
C116	C-2	C253	I-5	CR211	C-5			DS272	G-2	Q106	B-3	Q252	J-5	R102	B-3	R125
C126	E-3	C254	H-5	CR214	D-5			DS273	G-2	Q114	C-2	Q262	G-5	R103	C-4	R126
C136	E-3	C258	I-5	CR215	E-5					Q116	C-3	Q264	G-5	R104	B-1	R128
C224	E-5	C259	J-4	CR224	F-5					Q124	D-2	Q278	F-4	R106	B-2	R132
C227	E-5	C272	G-3	CR239	F-4					Q126	D-3			R108	B-3	R133
C236	F-5	C273	G-4	CR241	I-2					Q134	F-2			R112	C-3	R134
C241	G-3	C274	G-4	CR247	I-2	VR237	E-5	L259	J-4	Q136	E-3			R113	C-4	R136
C242	F-3	C279	H-4	CR253	H-6	VR258	I-4			Q138	C-4			R116	B-2	R138
C248	H-3	C281	F-4	CR255	J-4	VR281	F-3			Q214	D-5			R118	C-3	R140
C249	G-3			CR262	G-5	VR282	F-3			Q222	F-5			R122	D-2	R202
C251	H-5			CR264	G-5					Q226	F-5			R123	D-4	R203

GE BOARD

DEFLECTION AMPLIFIER/HIGH-VOLTAGE BOARD
PARTS LOCATION GRID

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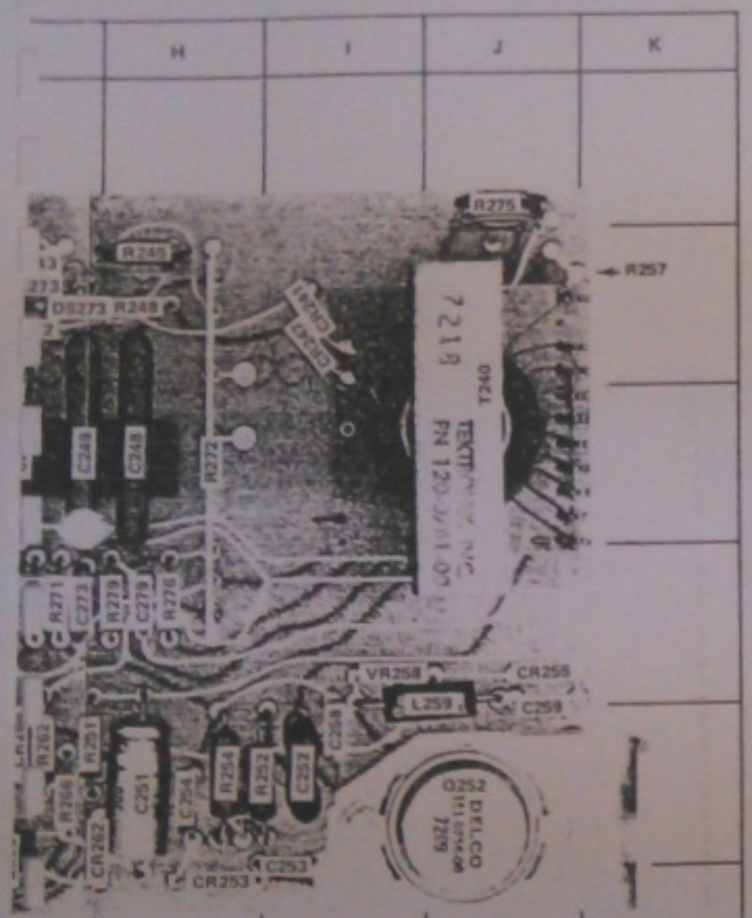
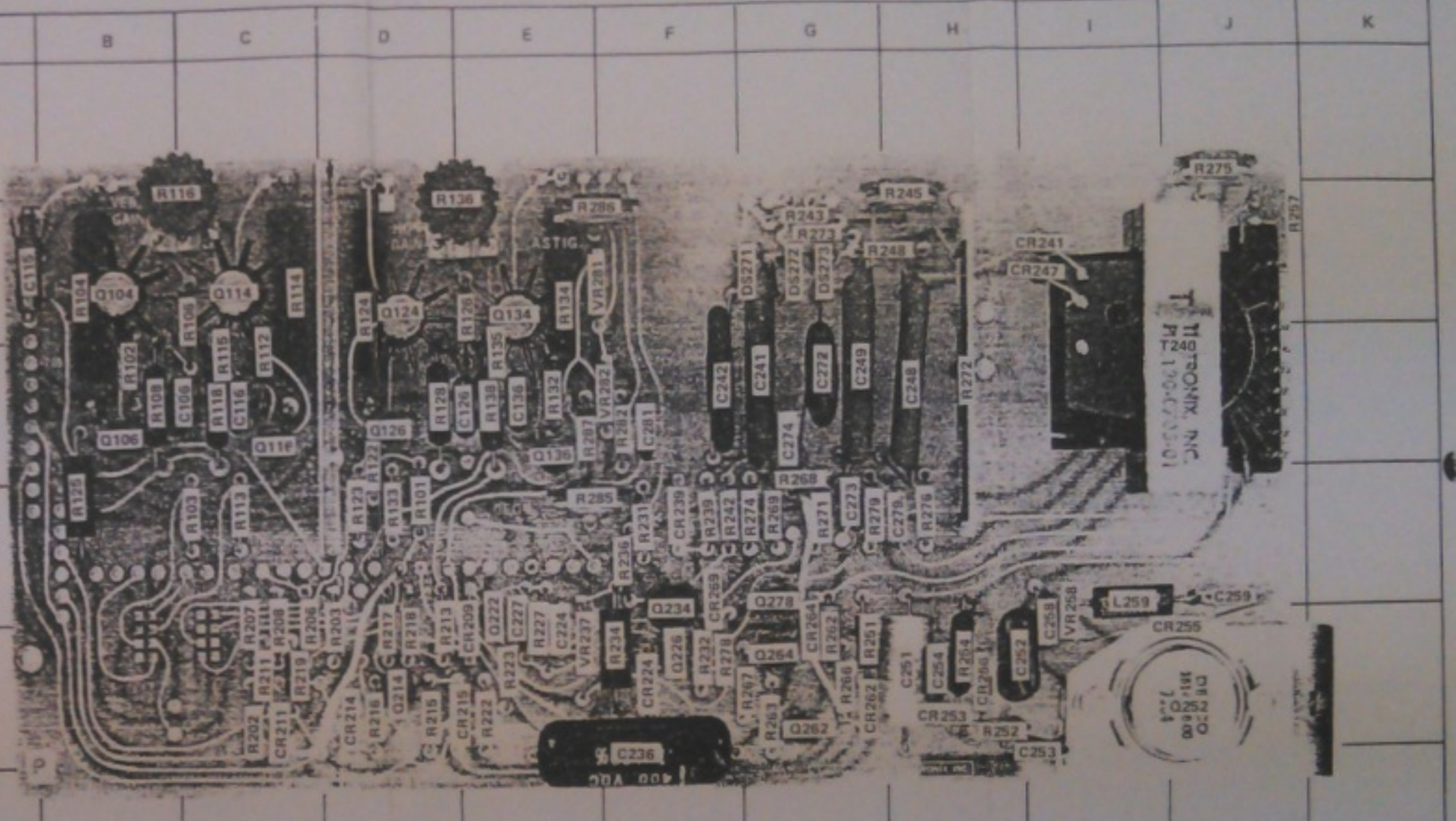




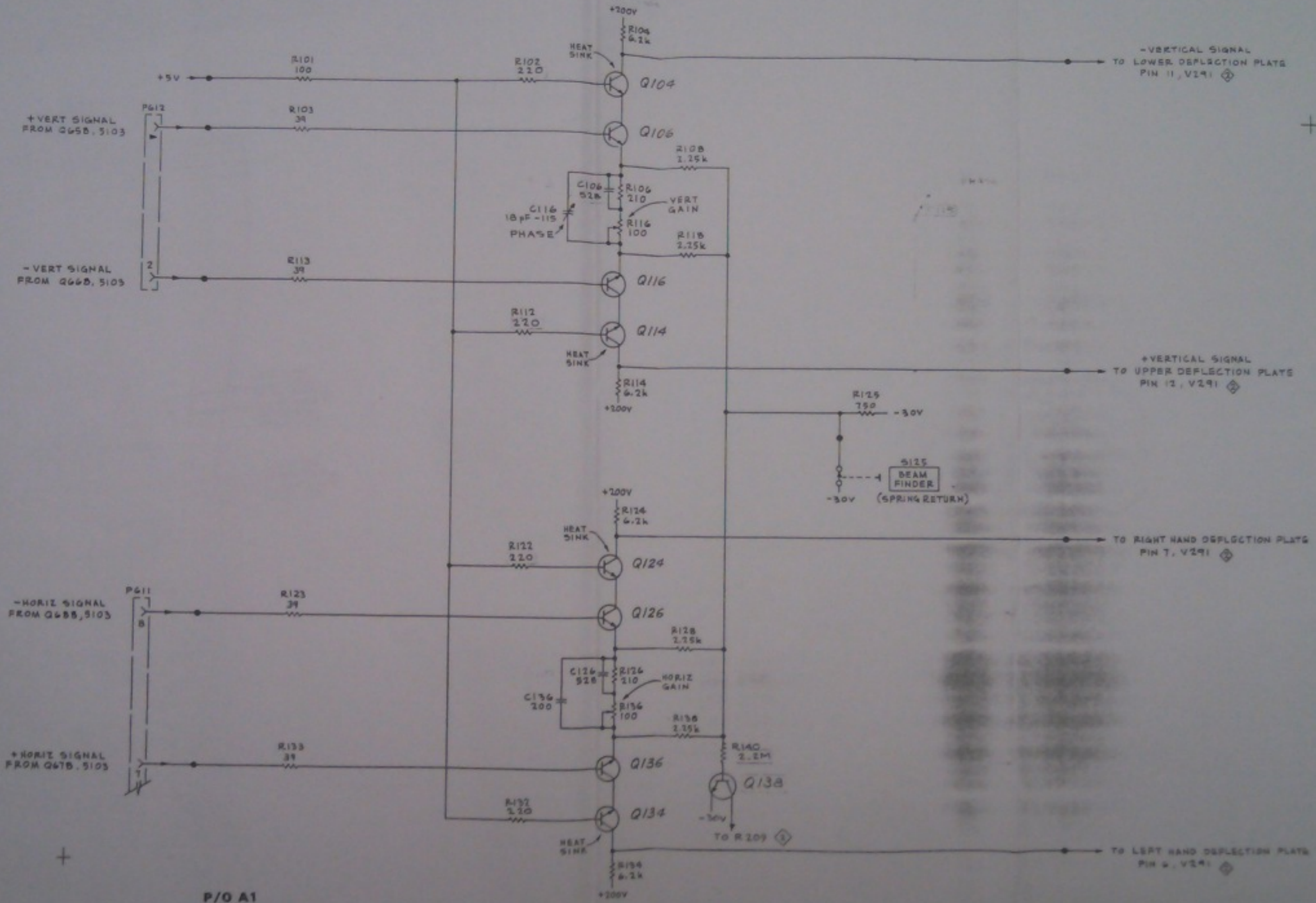
REV. B, AUG. 1974

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C106	B-3	C251	H-5	CR209	E-5	CR262	G-5	VR237	E-5
C115	A-2	C252	H-5	CR211	C-5	CR264	G-5	VR258	I-5
C116	C-3	C253	I-5	CR214	D-5	CR269	F-4	VR281	F-3
C126	E-3	C254	H-5	CR215	D-5			VR282	F-3
C136	E-3	C258	I-5	CR224	F-5				
C224	E-5	C259	J-4	CR239	F-4				
C227	E-5	C272	G-3	CR241	I-2				
C236	F-5	C273	G-4	CR247	I-2				
C241	G-3	C274	G-3	CR252	H-5				
C242	F-3	C279	H-4	CR253	H-5				
C248	H-3	C281	F-3	CR255	J-4				
C249	G-3			CR256	H-5				

CKT NO	GRID LOC
DS271	G-2
DS272	G-2
DS273	G-2
L259	I-4

CKT NO	GRID LOC	CKT NO	GRID LOC
Q104	B-2	Q252	J-5
Q106	B-3	Q262	G-5
Q114	C-2	Q264	G-5
Q116	C-3	Q278	G-4
Q124	D-2		
Q126	D-3		
Q134	E-2		
Q136	E-3		
Q214	D-5		
Q222	E-5		
Q226	F-5		
Q234	F-4		

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
R101	D-4	R122	D-3	R202	C-5	R222	E-5	R251	G-5	R273	G-2	R24	D-1	R206	E-5	R223	E-5	R251	G-5
R102	B-3	R123	D-4	R203	D-5	R223	E-5	R252	H-5	R274	F-4	R25	B-4	R207	C-5	R226	F-4	R252	H-5
R103	C-4	R124	D-2	R206	C-5	R227	E-5	R254	H-5	R275	J-1	R26	E-2	R208	C-5	R227	E-5	R254	H-5
R104	B-2	R125	B-4	R207	C-5	R231	F-4	R257	J-2	R276	H-4	R27	D-3	R209	D-5	R231	F-4	R257	J-2
R106	C-2	R126	E-2	R208	C-5	R232	F-5	R262	G-5	R278	F-5	R	E-3	R211	C-5	R232	F-5	R262	G-5
R108	B-3	R128	D-3	R211	C-5	R234	F-5	R263	G-5	R279	G-4	R	E-4	R213	D-5	R234	F-5	R263	G-5
R112	C-3	R132	E-3	R213	D-5	R236	F-4	R266	G-5	R282	F-3	R34	E-1	R215	D-5	R236	F-4	R266	G-5
R113	C-4	R133	D-4	R215	D-5	R239	F-4	R267	G-5	R285	E-4	R136	E-2	R216	D-5	R239	F-4	R267	G-5
R114	C-2	R134	E-2	R216	D-5	R242	G-4	R268	G-4	R286	E-2	R38	E-3	R217	D-5	R242	G-2	R268	G-4
R115	C-3	R135	E-3	R217	D-5	R243	G-2	R269	G-4	R287	E-3	R40	C-4	R218	D-5	R243	G-2	R269	G-4
R116	B-1	R136	E-2	R218	D-5	R245	H-2	R270	G-2			R42	C-5	R219	C-5	R245	H-2	R271	G-4
R118	C-3	R138	E-3	R219	C-5	R248	H-2	R271	G-4			R203	D-5	R222	E-5	R248	H-2	R272	H-3	T240	J-3



P/O A1

D10

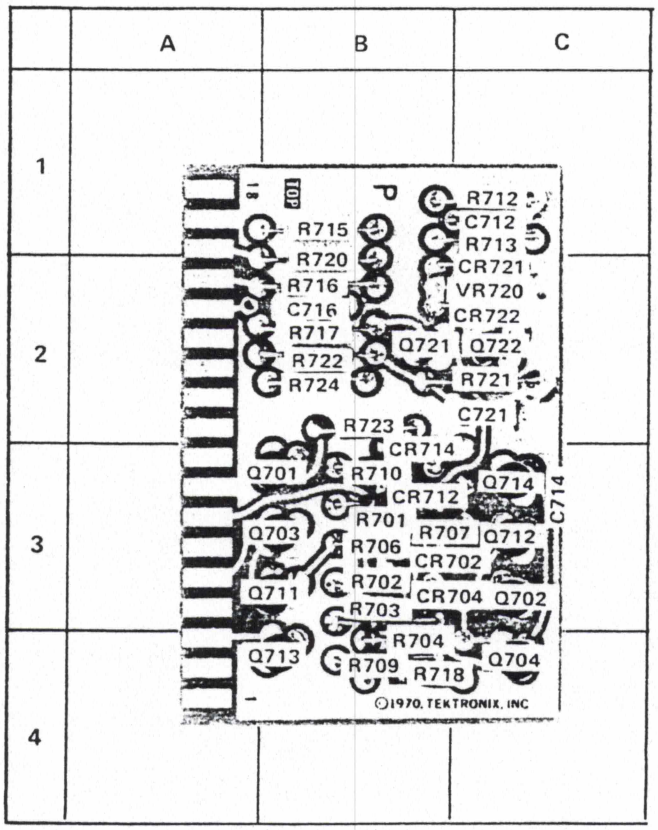
REV C MAY 1975

VERTICAL AND HORIZONTAL AMPLIFIERS

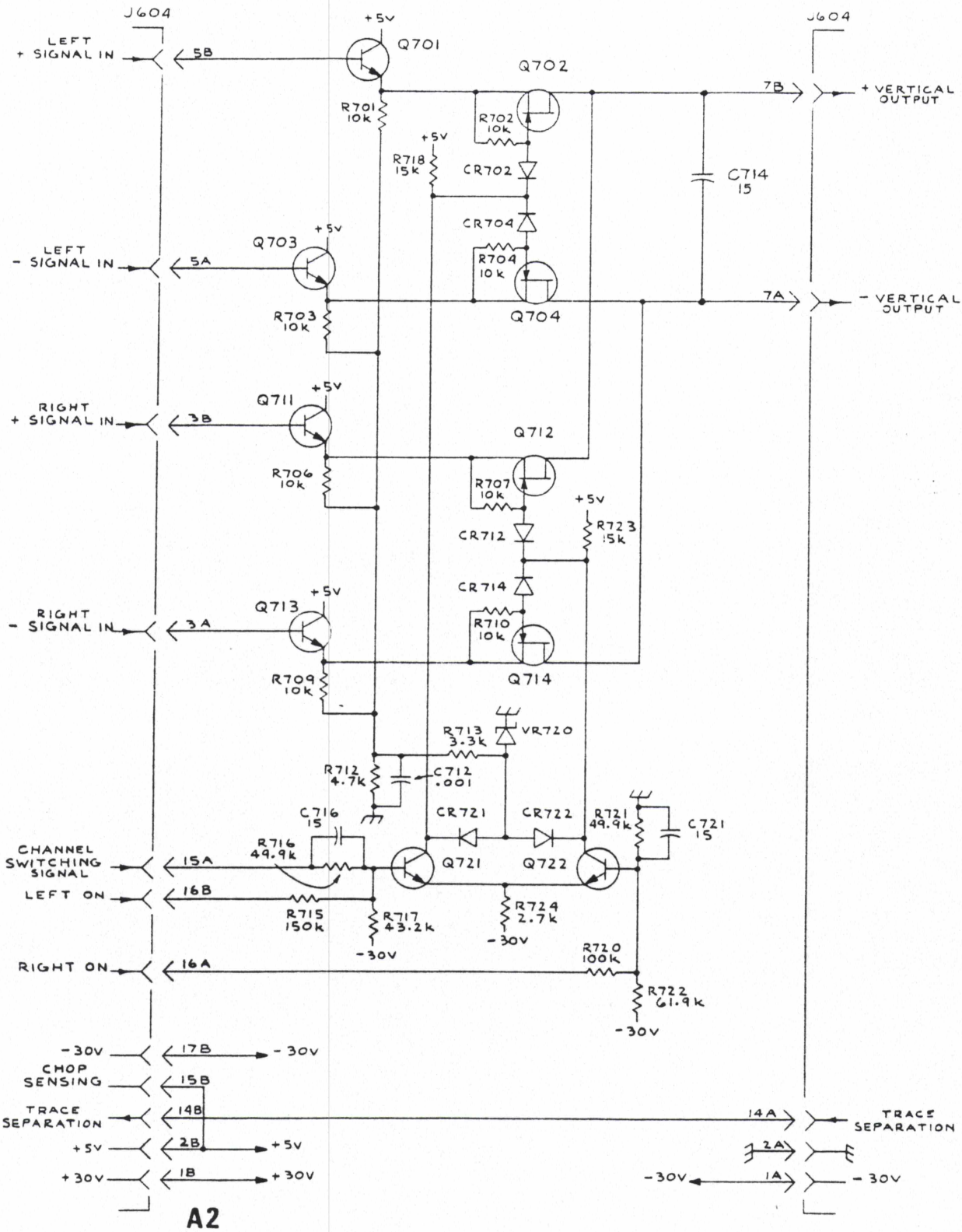
(REAR PANEL) LINE FUSE 1.6A SLOW
P201 S200 POWER PULL ON S201
110/230V AC P201
P801 TO POWER SUPPLY
INTENSITY R200 100k
+30V R202 56k
-30V TO S125
-30V
FROM INTERFACE CIRCUIT
SWEEP BLANKING R203 10k
CHOP BLANKING R206 6.8k
TRACE INTENSIFICATION R207 8.2k R208 47k
TO G'38
R209 220K CR209
+200V R234 22k CR234 Z230 100 VR237 45V C236 0.1 +30V
R231 4.7k R232 270k Q234
C227 0.68 R227 140k C224 .001
R111 1k Q222 R223 4.7k -30V
CR224 R226 100k Q226
-30V R213 62k R217 10k +30V R216 15k R218 18k
EXT INTENSITY INPUT J210 R211 10k Q214 R219 68k -30V
CR214 CR211 CR215 +5V R215 10k -30V
FROM POWER SUPPLY: +200V +40V +30V +5V GND -30V -40V
T240 R242 22k C241 .0068 R245 2M R243 1M C242 .01 -3450V
CR241 INT RANGE
+40V R251 5.6 C251 10MF -40V CR247
C259 0.22 L259 75uH CR255 VR258 9.1V C256 1MF -40V CR256
Q252 C252 4700 R252 100 CR253 C253 .01 TO HEAT SINK R254 3.3 C254 1MF -40V
R261 4.7k CR262 Q262 R263 15k Q264 CR264 R264 330k R267 33k -40V -30V
R268 22k C248 .0068 C249 .0068 -3400V
R257 100k
6.3V AC FROM T801, POWER SUPPLY P270
TRACE ROTATION (REAR PANEL) +30V R291 5k -30V L291
V291
+200V VR281 82V C281 0.1 +200V VR282 51V R282 16k GEOM R285 100k
R286 100k ASTIG R287 18k
LEFT HAND HORIZ SIG FROM Q134 ①
RIGHT HAND HORIZ SIG FROM Q124
-VERT SIG FROM Q104 ①
+VERT SIG FROM Q114 ①
R272B 150k C273 0.22 -30V R276 1M R275 100k HV ADJ -30V
R270 22K R279 100k C279 .001 R274 1M C274 .0027 (SEL) -40V DS271 DS272 DS273
+30V R278 5.6k Q278 R271 3.9M -40V R268 10k R269 100 CR269 +30V
R271C 15M R271D 4M R272A 1.2M C271 .001 R295 5M FOCUS
R273 100k
2 1 14

CRT CIRCUIT ②

AUXILIARY BOARD PARTS LOCATION GRID



CKT NO	GRID LOC	CKT NO	GRID LOC
C712	C-1	Q721	B-2
C714	C-3	Q722	C-2
C716	B-2		
C721	C-2	R701	B-3
		R702	B-3
CR702	C-3	R703	B-3
CR704	C-3	R704	B-4
CR712	B-3	R706	B-3
CR714	B-3	R707	B-3
CR721	C-2	R709	B-4
CR722	C-2	R710	B-3
		R712	C-1
VR720	C-2	R713	C-1
		R715	B-1
Q701	B-3	R716	B-2
Q702	C-3	R717	B-2
Q703	B-3	R718	B-4
Q704	C-4	R720	B-2
Q711	B-3	R721	C-2
Q712	C-3	R722	B-2
Q713	B-4	R723	B-2
Q714	C-3	R724	B-2


J604
LEFT + SIGNAL IN
5B
+5V
Q701
Q702
R701 10k
R702 10k
R718 15k
CR702
CR704
C714 15
7B
+ VERTICAL OUTPUT
LEFT - SIGNAL IN
5A
Q703
R704 10k
Q704
R703 10k
7A
- VERTICAL OUTPUT
RIGHT + SIGNAL IN
3B
Q711
Q712
R706 10k
R707 10k
R723 15k
CR712
CR714
RIGHT - SIGNAL IN
3A
Q713
R710 10k
Q714
R709 10k
R713 3.3k
VR720
R712 4.7k
C712 .001
C716 15
CR721
CR722
R721 49.9k
C721 15
CHANNEL SWITCHING SIGNAL
15A
R716 49.9k
Q721
Q722
LEFT ON
16B
R715 150k
R717 43.2k
-30V
R724 2.7k
-30V
R720 100k
RIGHT ON
16A
R722 61.9k
-30V
-30V
17B
- 30V
CHOP SENSING
15B
TRACE SEPARATION
14B
14A
TRACE SEPARATION
+5V
2B
+5V
2A
+30V
1B
+30V
-30V
1A
- 30V
A2

SECTION 7
MECHANICAL PARTS LIST

FIGURE 1 EXPLODED & STANDARD ACCESSORIES

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty 1 2 3 4 5	Description
1-1	670-1454-00			1	CIRCUIT BOARD ASSEMBLY--AUXILIARY A2
	----- -----			-	circuit board assembly includes:
	388-2003-00			1	CIRCUIT BOARD
-2	200-1218-00			1	BEZEL
-3	211-0188-00			2	SCREW, 4-40 x 0.70 inch
-4	354-0233-00	B010100	B072526X	2	RING, retaining, 0.10 ID x 0.203 inch OD
-5	337-1440-00			1	SHIELD, implosion
-6	386-1946-00			1	SUPPORT CRT, front
-7	348-0279-00			2	PAD cushioning, CRT
-8	348-0070-01			3	CUSHION, CRT, 0.69 x 2.03 inches long
-9	348-0145-00			2	GROMMET, plastic, u-shape, 1 inch
-10	334-1379-00			1	LABEL, CRT, 0.75 x 1.75 inches
-11	337-1419-00	B010100	B069999	1	SHIELD, CRT, front
	337-1419-05	B070000		1	SHIELD, CRT
-12	337-1420-00			1	SHIELD, CRT, rear
-13	352-0409-00			1	RING, clamp, CRT shield
	----- -----			-	mounting hardware: (not included w/ring)
-14	211-0632-00			1	SCREW, 6-32 x 2.25 inch, Fil HS
-15	343-0123-01			2	CLAMP, CRT retainer
-16	220-0444-00			1	NUT, square, 6-32 x 0.25 inch
-17	211-0507-00			2	SCREW, 6-32 x 0.312 inch, PHS
-18	407-0922-00			1	BRACKET, CRT clamp
-19	384-1064-00			1	SHAFT, extension, 10.185 inches long, w/knob
-20	119-0238-00	B010100	B090724	1	CURRENT LOOP
	119-0373-00	B090725		1	CURRENT LOOP
	----- -----			-	mounting hardware: (not includes w/current loop)
	210-0442-00			2	NUT, hex., 3-48 x 0.188 inch
	210-0004-00			2	WASHER, lock, internal, 0.12 ID x 0.26 inch OD
	210-0994-00			2	WASHER, flat, 0.125 ID x 0.25 inch OD
	210-0935-00			2	WASHER, fiber, 0.14 ID x 0.375 inch OD
-21	361-0059-01			1	SPACER, current loop
-22	210-0593-00			2	NUT, current loop, 3-48 x 0.25 inch
-23	358-0216-00			1	BUSHING, 0.257 ID x 0.412 inch OD
-24	366-0494-00			1	KNOB, charcoal--FOCUS
	----- -----			-	knob includes:
	213-0153-00			1	SETSCREW, 5-40 x 0.125 inch, HSS
-25	366-0494-00			1	KNOB, charcoal--INTENSITY
	----- -----			-	knob includes:
	213-0153-00			1	SETSCREW, 5-40 x 0.125 inch, HSS
-26	131-0955-00			1	CONNECTOR, receptacle, female, BNC, w/hardware
	----- -----			-	mounting hardware: (not includes w/connector)
-27	210-0255-00			1	LUG, solder, 0.375 inch, SE

FIGURE 1 EXPLODED & STANDARD ACCESSORIES (cont)

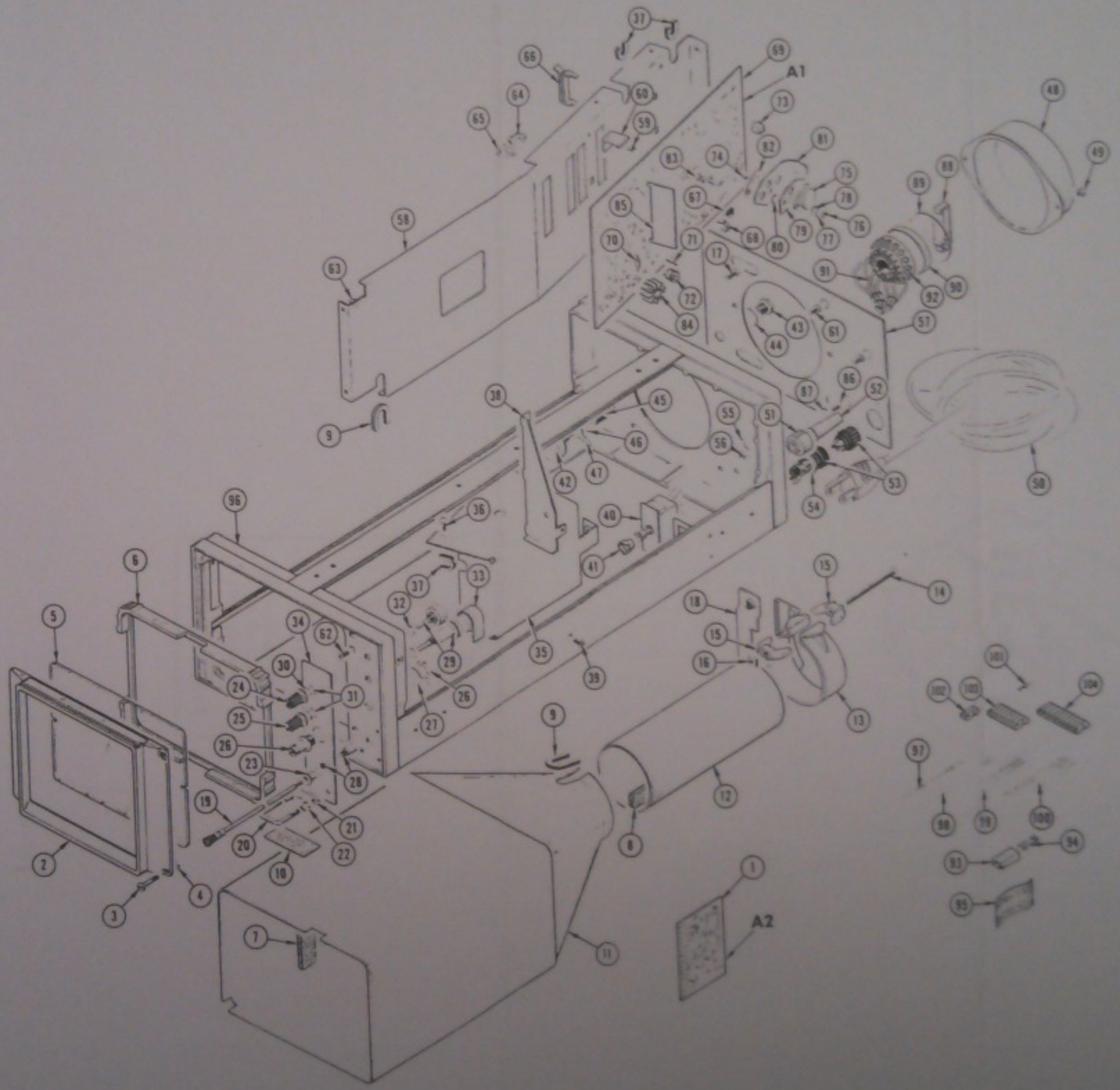
Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description
1-28	260-1238-00			1	SWITCH, pushbutton--BEAM FINDER, w/hardware
-29	- - - - - -			2	RESISTOR, variable
	- - - - - -			-	mounting hardware for each: (not included w/resistor)
-30	210-0583-00			1	NUT, hex., 0.25-32 x 0.312 inch
-31	210-0940-00			1	WASHER, flat, 0.25 ID x 0.375 inch OD
-32	210-0046-00			1	WASHER, lock, internal, 0.261 ID x 0.408 inch OD
-33	200-0608-00			1	COVER, variable resistor, plastic
-34	333-1409-00			1	PANEL, front
-35	337-1421-00			1	SHIELD, high voltage
	- - - - - -			-	mounting hardware: (not included w/shield)
-36	211-0504-00			3	SCREW, 6-32 x 0.25 inch, PHS
-37	348-0115-00			3	GROMMET, plastic, u-shape, 0.548 inch
-38	407-0896-00			1	BRACKET, chassis
	- - - - - -			-	mounting hardware: (not included w/bracket)
-39	211-0541-00			1	SCREW, 6-32 x 0.25 inch, 100° csk, FHS
-40	260-1222-00			1	SWITCH, push-pull--POWER
-41	376-0127-00			1	COUPLER, shaft, plastic
-42	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
-43	358-0029-00			1	BUSHING, 0.375-32 x 0.50 inch
-44	210-0978-00			1	WASHER, flat, 0.375 ID x 0.50 inch OD
-45	210-0421-00			1	NUT, hex., 0.375-32 x 0.50 x 0.438 inch long
-46	210-0012-00			2	WASHER, lock, internal, 0.375 ID x 0.50 inch OD
-47	210-0207-00			1	LUG, solder, 0.375 inch, SE
-48	200-1204-01			1	COVER, CRT
	- - - - - -			-	mounting hardware: (not included w/cover)
-49	210-0401-00			2	NUT, cap, hex., 6-32 x 0.312 inch
-50	161-0033-08			1	CABLE ASSEMBLY, power, w/terminal
-51	358-0366-00			1	BUSHING, strain relief, bottom
	358-0365-00			1	BUSHING, strain relief, top
-52	200-1004-00			1	CABLE NIPPLE, 1.30 inches long
-53	352-0076-00			1	HOLDER, fuse, w/hardware
	- - - - - -			-	mounting hardware: (not included w/holder)
-54	210-0873-00			1	WASHER, rubber, 0.50 ID x 0.688 inch OD
-55	210-0201-00			1	LUG, solder, SE #6
	- - - - - -			-	mounting hardware: (not included w/lug)
-56	210-0586-00			1	NUT, keps, 4-40 x 0.25 inch

FIGURE 1 EXPLODED & STANDARD ACCESSORIES (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description
-57	333-1429-00			1	PANEL, rear
-58	441-0991-00			1	CHASSIS
	- - - - - -			-	chassis includes:
-59	210-0659-01			4	EYELET
-60	344-0131-00			4	CLIP, circuit board
	- - - - - -			-	mounting hardware: (not included w/chassis)
-61	211-0504-00			2	SCREW, 6-32 x 0.25 inch, PHS
-62	211-0538-00			2	SCREW, 6-32 x 0.312 inch, 100° csk, FHS
-63	210-0457-00			2	NUT, keps, 6-32 x 0.312 inch
-64	- - - - - -			1	SWITCH, thermostatic
	- - - - - -			-	mounting hardware: Znot included w/switch)
-65	210-0586-00			2	NUT, keps, 4-40 x 0.25 inch
-66	344-0225-00			2	CLIP, cable, for 4 wire ribbon
-67	348-0067-00			1	GROMMET, plastic, 0.312 inch diameter
-68	343-0088-00			3	CLAMP, cable, push-on, small
-69	670-1433-00	B010100	B029999	1	CIRCUIT BOARD ASSEMBLY--DEF AMPLIFIER/HIGH VOLTAGE A1
	670-1433-01	B030000	B049999	1	CIRCUIT BOARD ASSEMBLY--DEF AMPLIFIER/HIGH VOLTAGE A1
	670-1433-02	B050000		1	CIRCUIT BOARD ASSEMBLY--DEF AMPLIFIER/HIGH VOLTAGE A1
	- - - - - -			-	circuit board assembly
	388-1982-00			1	CIRCUIT BOARD
-70	131-0566-00	B010100	B030000X	4	LINK, terminal connecting
	131-0566-00	XB050000		4	LINK, terminal connecting
-71	131-0589-00			2	TERMINAL, pin, 0.50 inch long
-72	136-0183-00	B010100	B049999	5	SOCKET, transistor, 3 pin
	136-0183-00	B050000		1	SOCKET, transistor, 3 pin
-73	136-0220-00	B010100	B049999	10	SOCKET, transistor, 3 pin, square
	136-0220-00	B050000		11	SOCKET, transistor, 3 pin, square
-74	136-0254-00			2	SOCKET, connector pin
	136-0252-04	XB050000	B070000X	12	SOCKET, connector pin
-75	- - - - - -			1	TRANSISTOR
	- - - - - -			-	mounting hardware: (not included w/transistor)
-76	210-0407-00			2	NUT, hex., 6-32 x 0.25 inch
-77	210-0055-00			2	WASHER, lock, split, 0.145 ID x 0.253 inch OD
-78	210-0801-00			2	WASHER, flat, 0.14 ID x 0.281 inch OD
-79	214-1610-00			1	HEATSINK
-80	210-1133-00			2	WASHER, fiber, 0.142 ID x 0.25 inch OD
-81	214-1536-00			1	HEATSINK, 1.75 inches long
-82	214-1610-00			1	HEATSINK, transistor
-83	211-0511-00			2	SCREW, 6-32 x 0.50 inch, PHS
-84	214-1291-00			4	HEATSINK, transistor
-85	337-1179-00			1	SHIELD, electrical
	- - - - - -			-	mounting hardware: (not included w/circuit board assembly)
-86	211-0510-00			1	SCREW, 6-32 x 0.375 inch, PHS
-87	210-0975-00			1	WASHER, plastic, 0.14 ID x 0.375 inch OD
-88	343-0254-00	B010100	B069999X	1	CLAMP, socket
-89	367-0117-00	B010100	B069999X	1	PULL, CRT socket
-90	200-0917-02	B010100	B069999X	1	COVER, CRT socket

FIGURE 1 EXPLODED & STANDARD ACCESSORIES (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
1-91	136-0450-00	B010100	B069999	1	WIRING HARNESS, CRT
	136-0492-01	B070000		1	WIRING HARNESS, CRT
	- - - - - -			-	wiring harness includes:
-92	136-0304-02	B010100	B069999	1	SOCKET, CRT, w/connectors
	136-0301-01	B070000		1	SOCKET, CRT, w/connectors
	195-0086-00	B070000		1	LEAD SET, CRT deflection
	200-0616-01	B070000		1	COVER, CRT socket
-93	200-1075-00			4	COVER, terminal
-94	131-0861-00			3	TERMINAL, quick disconnect
-95	195-0086-00	B010100	B069999X	1	LEAD SET, CRT deflection
-96	426-0740-00			1	FRAME ASSEMBLY
-97	175-0863-00			ft	WIRE, electrical, 2 wire ribbon, 49 inches long
-98	175-0862-00			ft	WIRE, electrical, 3 wire ribbon, 12 inches long
-99	175-0859-00			ft	WIRE, electrical, 6 wire ribbon, 12.50 inches long
-100	175-0855-00			ft	WIRE, electrical, 10 wire ribbon, 10 inches long
-101	131-0621-00			22	CONNECTOR, terminal
-102	352-0198-00			3	HOLDER, terminal connector, 2 wire (black)
-103	352-0204-00			1	HOLDER, terminal connector, 8 wire (black)
-104	352-0206-00			1	HOLDER, terminal connector, 10 wire (black)
	175-1453-00			1	CABLE ASSEMBLY ELECTRIC (not shown)
	----- -----			-	cable assembly includes:
	131-0861-00			2	TERMINAL, quick disconnect
	200-1075-00			2	COVER, terminal
	131-0707-00			2	CONNECTOR, terminal
	352-0161-00			1	HOLDER, terminal connector, 3 wire (black)


A1
A2

CARTON ASSEMBLY
(Part No. 065-0150-00)

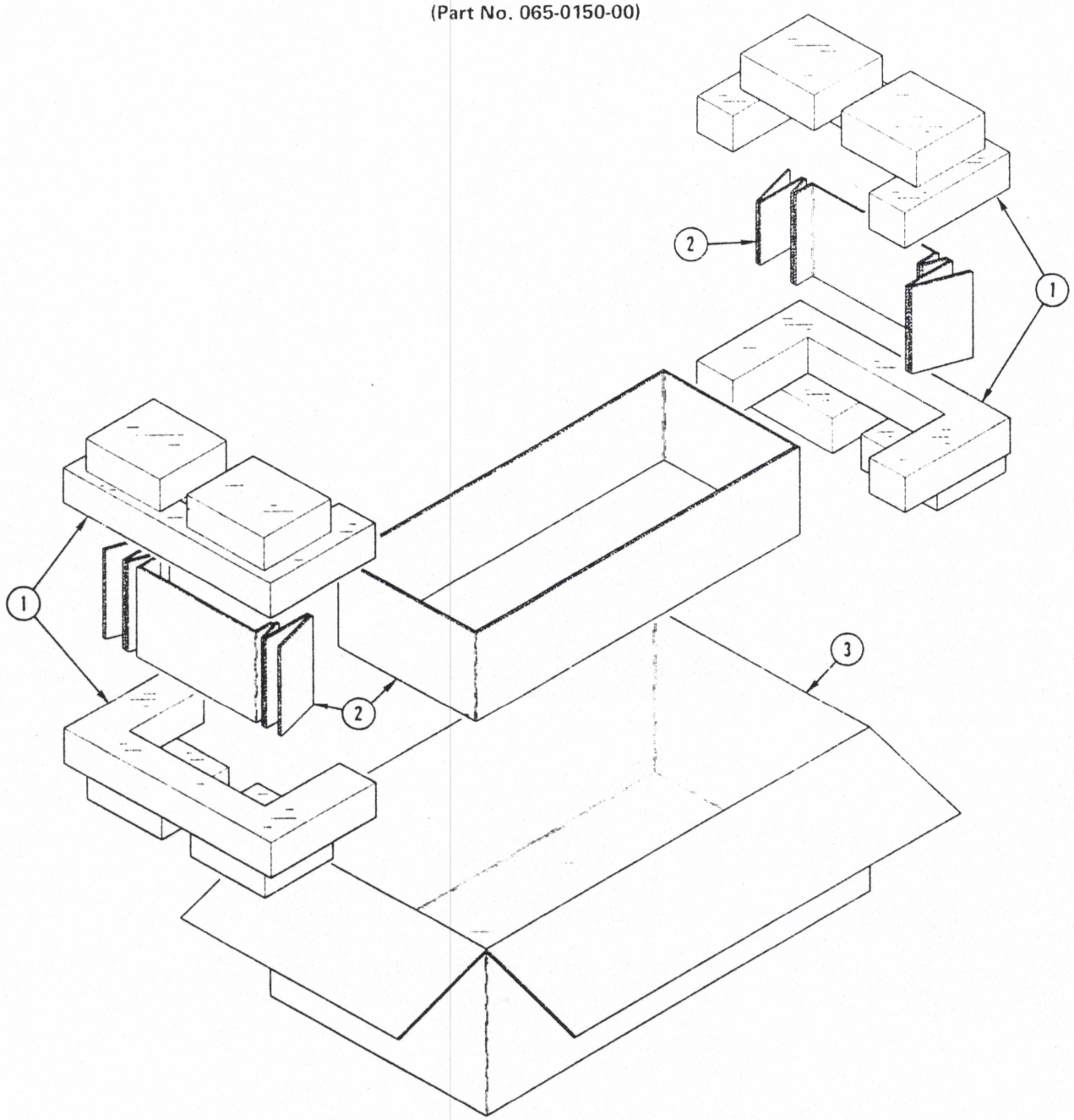


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty 1 2 3 4 5	Description
2-	065-0150-00			1	CARTON ASSEMBLY, for display &
	- - - - - -			-	power modules
	- - - - - -			-	carton assembly includes:
-1	004-0281-00			2	ETHAFRAME, top & bottom
-2	004-1097-00			1	PAD SET, 3 piece
-3	004-0791-00			1	CARTON

FIG. 2 REP; AGING

CALIBRATION TEST EQUIPMENT REPLACEMENT

Calibration Test Equipment Chart

This chart compares TM 500 product performance to that of older Tektronix equipment. Only those characteristics where significant specification differences occur, are listed. In some cases the new instrument may not be a total functional replacement. Additional support instrumentation may be needed or a change in calibration procedure may be necessary.

Comparison of Main Characteristics

DM 501 replaces 7D13		
PG 501 replaces 107	PG 501 - Risetime less than 3.5 nsec into 50 Ω.	107 - Risetime less than 3.0 nsec into 50 Ω.
108	PG 501 - 5 V output pulse; 3.5 nsec Risetime.	108 - 10 V output pulse; 1 nsec Risetime.
111	PG 501 - Risetime less than 3.5 nsec; 8 nsec Pretrigger pulse delay.	111 - Risetime 0.5 nsec; 30 to 250 nsec Pretrigger Pulse delay.
114	PG 501 - ±5 V output.	114 - ±10 V output. Short proof output.
115	PG 501 - Does not have Paired, Burst, Gated, Delayed & Undelayed pulse mode; ±5 V dc Offset; short proof output. Has ±5 V output.	115 - Paired, Burst, Gated, Delayed & Undelayed pulse mode; ±10 V output. Short proof output.
PG 502 replaces 107		
108	PG 502 - 5 V output	108 - 10 V output.
111	PG 502 - Risetime less than 1 nsec; 10 nsec Pretrigger pulse delay.	111 - Risetime 0.5 nsec; 30 to 250 nsec Pretrigger pulse delay.
114	PG 502 - ±5 V output.	114 - ±10 V output. Short proof output.
115	PG 502 - Does not have Paired, Burst, Gated, Delayed & Undelayed pulse mode; ±5 V output. Short proof output.	115 - Paired, Burst, Gated, Delayed & Undelayed pulse mode; ±10 V output. Short proof output.
2101	PG 502 - Does not have Paired, Delayed, Undelayed and output locked mode; ±5 V output.	2101 - Paired, Delayed, Undelayed and output locked on mode; 10 V output.
PG 506 replaces 106	PG 506 - Positive-going trigger output signal at least 1 V; High Amplitude, 60 V output.	106 - Positive and Negative-going trigger output signal, 50 nsec and 1 V; High Amplitude output, 100 V.
067-0502-01	PG 506 - Does not have chopped feature.	0502-01 - Comparator output can be alternately chopped to a reference voltage.
SG 503 replaces 190, 190A, 190B	SG 503 - Amplitude range 5 mV to 5.5 V p-p.	190B - Amplitude range 40 mV to 10 V p-p.
191	SG 503 - Frequency range 250 kHz to 250 MHz.	191 - Frequency range 350 kHz to 100 MHz.
067-0532-01	SG 503 - Frequency range 250 kHz to 250 MHz.	0532-01 - Frequency range 65 MHz to 500 MHz.
TG 501 replaces 180, 180A	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available only at 5,2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. Only one time-mark can be generated.	180A - Marker outputs, 5 sec to 1 μs. Sinewave available at 5, 10, and 50 MHz. Trigger pulses 1, 10, 100 Hz; 1,10, and 100 kHz. Multiple time-marks can be stacked.
181	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available only at 5, 2, and 1 ns.	181 - Marker outputs, 1, 10, 100, 1000, and 10,000, plus 10 MHz sinewave.
2901	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available only at 5, 2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. Only one time-mark can be generated.	2901 - Marker outputs, 5 sec to 0.1 μs. Sinewave available at 5, 10, and 50 ns. Separate trigger pulses, from 5 sec to 0.1 μs. Multiple time-marks can be stacked.

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