INSTRUCTION MANUAL

Serial Number _____

TYPE 611

STORAGE DISPLAY UNIT

Tektronix, Inc. ● P. O. Box 500 ● Beaverton, Oregon 97005 ● Phone 644-0161 ● Cables: Tektronix

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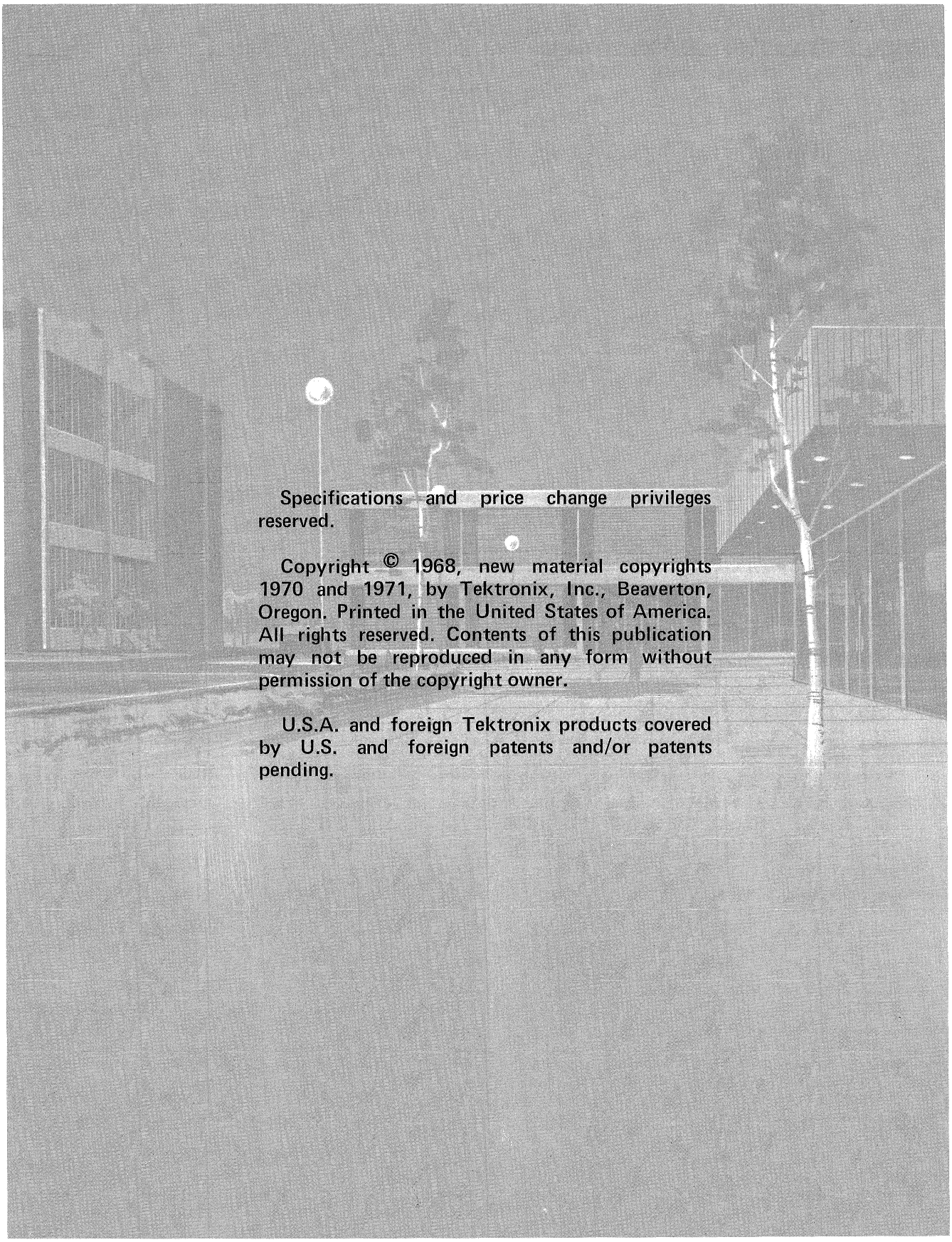

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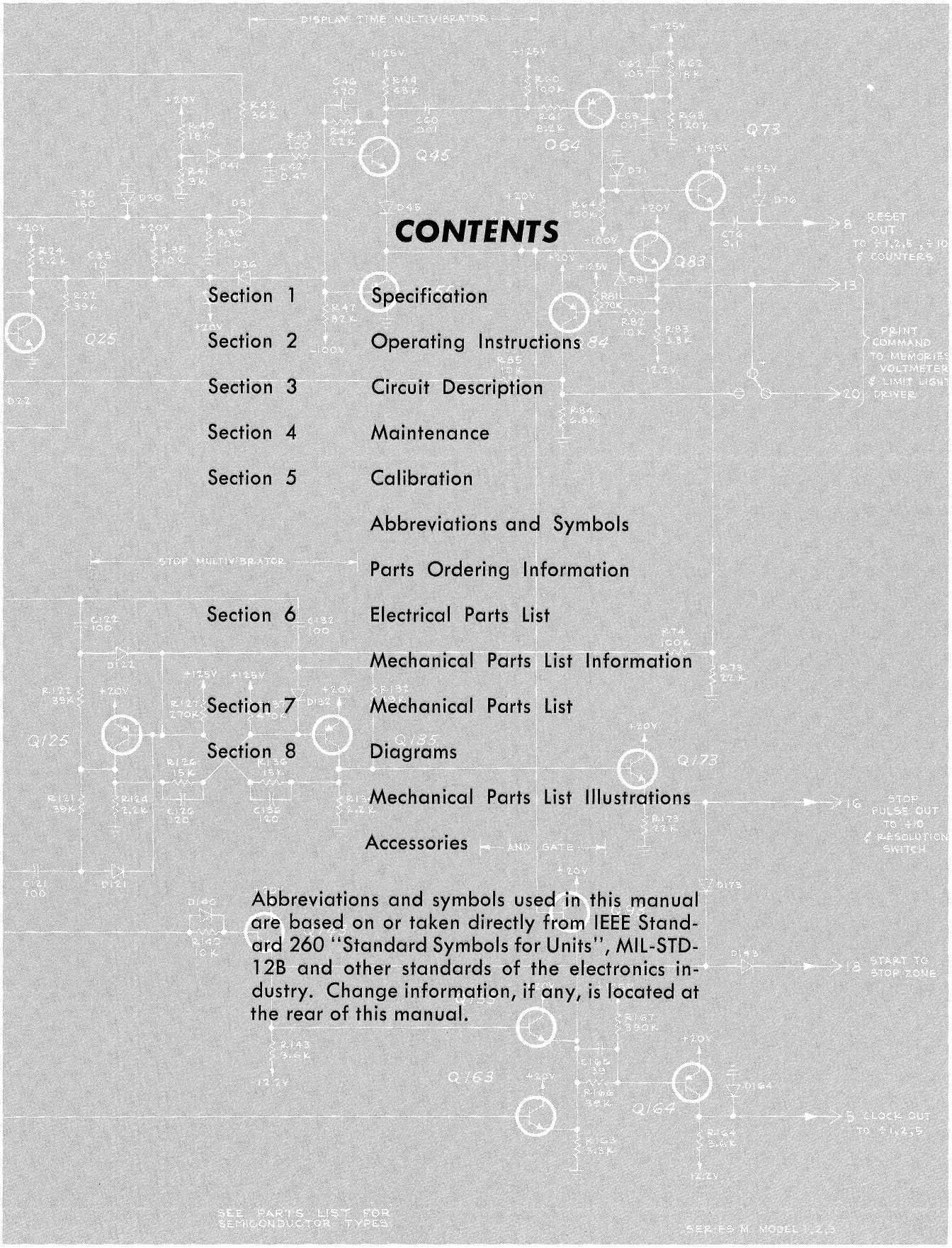


CONTENTS

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.

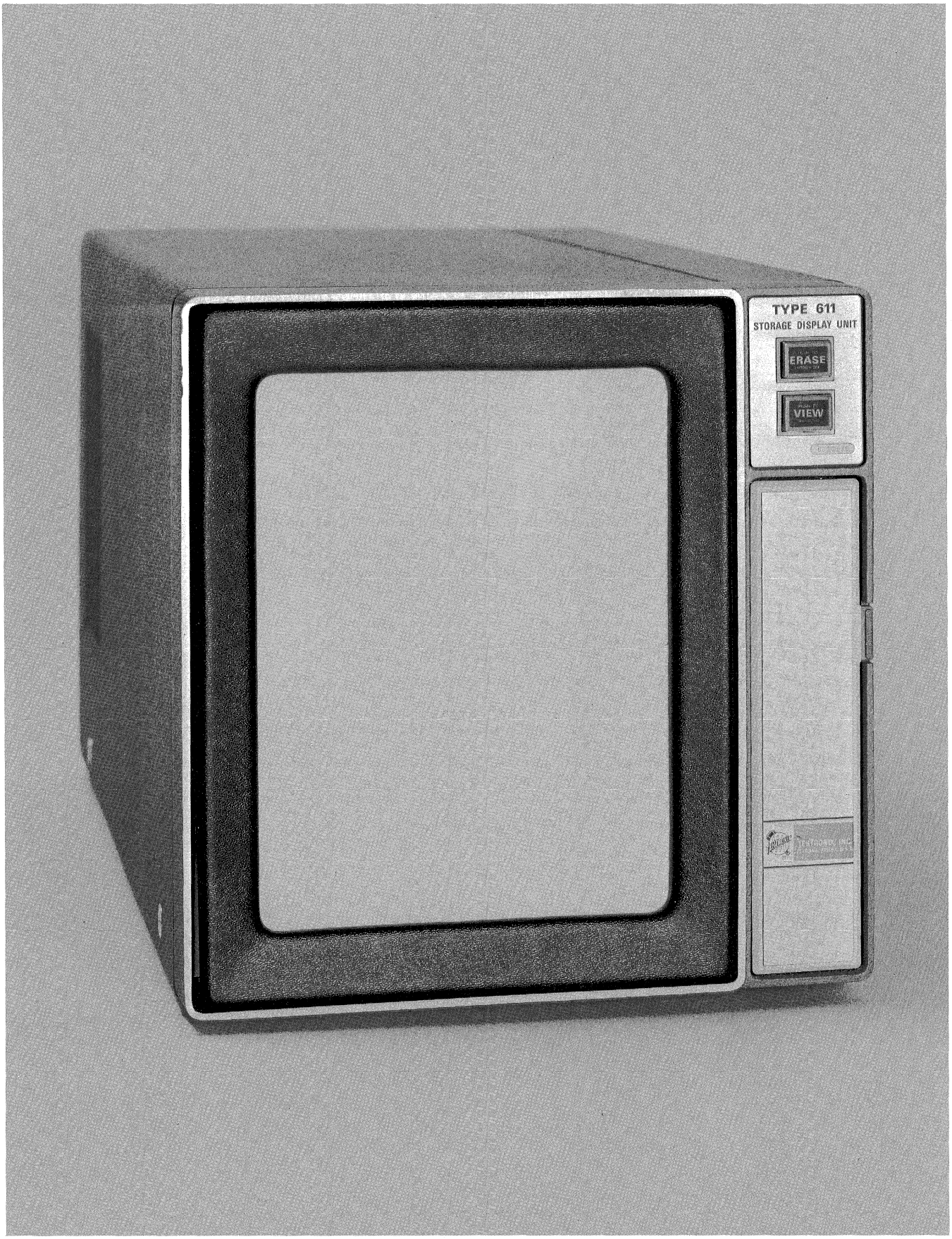


Fig. 1-1. Type 611 Storage Monitor

SECTION 1
SPECIFICATION

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

General Information

The Type 611 Storage Monitor is a data storage and display instrument. Its principal application is in terminal input-output stations of digital computer or other data transmission systems.

The Type 611 uses a Tektronix 11-inch storage cathode ray tube to present the data from the transmission system in the aspect ratio of a conventional typewritten page (3/4 scale). As an option, and without reducing the useful information writing area, the Type 611 may be purchased with the long dimension of the CRT oriented horizontally instead of vertically.

The Type 611, when adjusted for normal viewing, may be operated with its two front-panel pushbutton switches, VIEW and ERASE, or it may be operated from a remote station. Remote operation permits two additional modes, Write-Through and Non-Store.

The holding-mode of operation is incorporated in the Type 611 to prolong the life expectancy of the cathode ray tube phosphors. The instrument automatically assumes a holding-mode condition about 1 minute after the last writing function or after a view mode has been initiated by the front panel VIEW switch.

Specific Information

Each electrical, environmental or mechanical attribute or capability considered necessary to qualify the Type 611 for a particular application is listed in the following chart under the Characteristics column. Acceptable qualitative or quantitative limits for the given characteristics are listed in the Performance Requirement column. Items listed in the Supplemental Information column are provided to augment or explain the characteristics and performance information. Statements in the Supplemental Information column are not intended as requisite qualifications for the Type 611.

NOTE

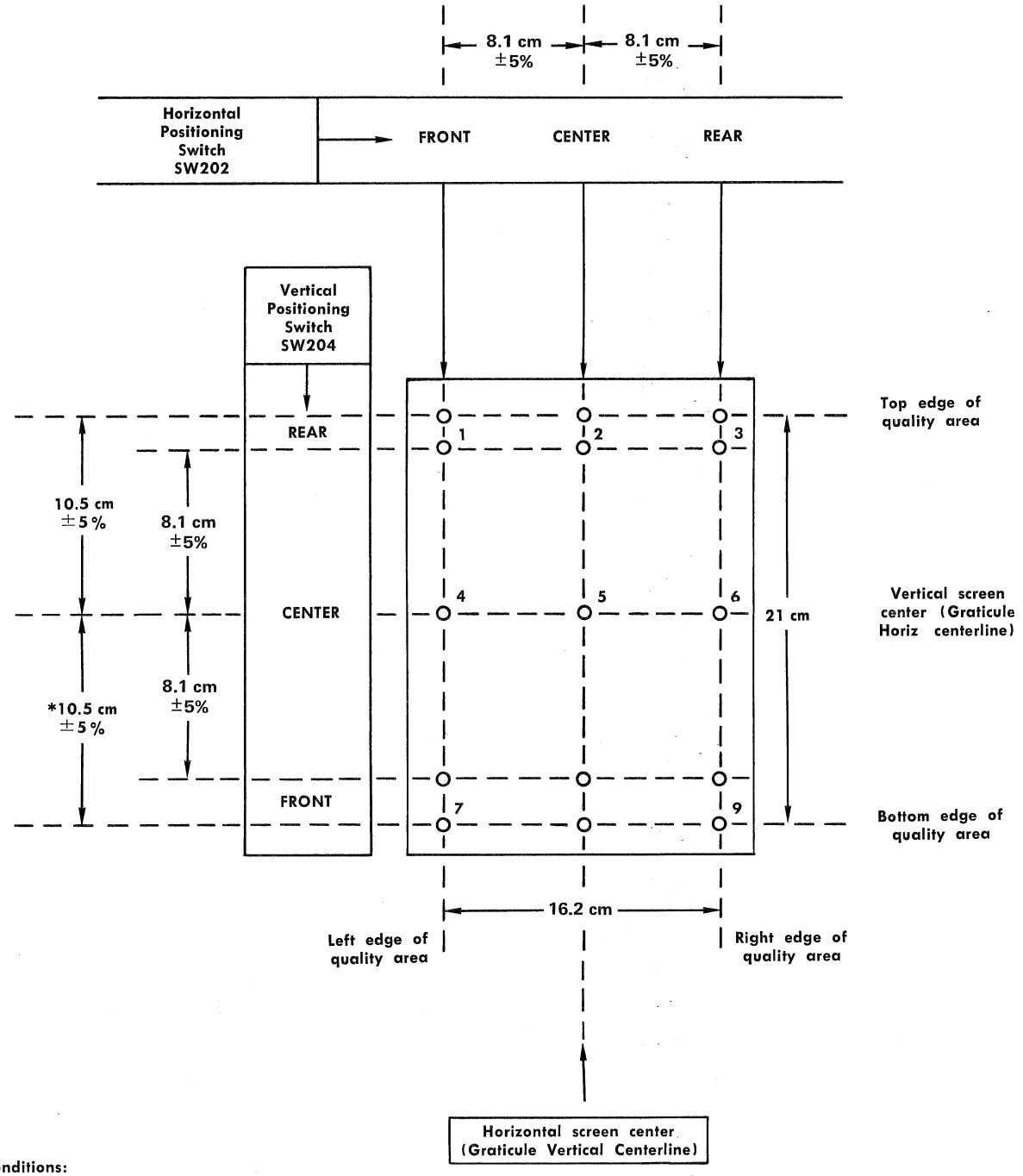
Operating PERFORMANCE REQUIREMENTS are valid provided the following conditions are met; the ambient temperature during instrument calibration is within the range of +20° C to +30° C, the deflection factors of both axes are calibrated for 1 V/full scale, signal source impedance are $\leq$75 Ω, the warmup period is $\geq$20 minutes and environmental conditions are within stated limits.

ELECTRICAL CHARACTERISTICS

TABLE 1-1

VERTICAL and HORIZONTAL DEFLECTION SYSTEM

Characteristic	Performance Requirement
Input Requirements	
Without Attenuator	
Vertical Deflection Factor (long dimension of CRT oriented vertically)	1 volt/16.2 cm (square format) or 1 volt/21 cm (rectangular format) within 2% of full scale deflection (referred to center screen)
Horizontal Deflection Factor (long dimension of CRT oriented vertically)	1 volt/16.2 cm (square or rectangular format) within 2% of full scale deflection (referred to center screen)
Deflection Polarity	(+) vertical input moves beam up (+) horizontal input moves beam to right
With Attenuator	
Vertical Deflection Factor (long dimension of CRT oriented vertically)	10 volt/16.2 cm (square format) or 10 volt/21 cm (rectangular format) Accuracy within 3% of attenuator bypassed accuracy
Horizontal Deflection Factor (long dimension of CRT oriented vertically)	10 volt/16.2 cm (square or rectangular format). Accuracy within 3% of attenuator bypassed accuracy
Deflection Polarity	(+) vertical input moves beam up (+) horizontal input moves beam to right
Deflection Factor at Maximum Attenuation	75 volt/full screen with proper attenuator resistors installed (see Table 2-2)
Maximum Input Voltage	±50 volts DC and peak AC
Input R and C	100 kΩ, within 10% shunted by 60 pF, within 12 pF
Initial Beam Position (inputs shorted)	Selected by internal switches (see Fig. 1-2)
Position Range (internal adjustment)	Equivalent to at least ±0.1 volt at input to Vertical or Horizontal amplifiers.
Position Stability	
At 20° C to 30° C	$\leq$0.16 mm/hour
At 10° C to 50° C	Within 1.6 mm/hour from the 25° C position.
Settling Time (to within 1 spot diameter of final position)	3.5 μs/cm + 5 μs



Conditions:

1. X and Y Inputs terminated in 50 Ω.
2. X and Y Amplifier gains properly adjusted.
3. Horizontal and Vertical Positioning adjustments properly set.

*8.1 cm with gain set for square format and 10.5 cm for rectangular format.

Fig. 1-2. Selectable positions for trace start.

TABLE 1-2

Z AXIS

Characteristic	Performance Requirement
Input Requirements	
Turn-On Level	≥+1 volt
Shut-Off Level	≤+0.5 volt
Turn-On Rate	≥10 V/ms required to automatically switch instrument from "hold" to view mode
Maximum Input Voltage	±50 volts DC and peak AC
Circuit Response	
Rise and Fall Times (output signal)	≤0.2 μs at TP440
Input R and C	100 kΩ, within 10% paralleled by 50 pF, within 10 pF
Z Axis Output	Adjustable from ≤5 volts to ≥80 volts at TP440

TABLE 1-3

DISPLAY

Characteristic	Performance Requirement
CRT	
Tube Type	Magnetic deflection
Phosphor	Storage
Quality Area	25% incrementally storable
Vertical	≥21 cm (≈8.250 inches)
Horizontal	≥16.2 cm (≈6.375 inches)
Line Straightness (Deviation from mean straight line)	±0.5% of line length
Stored Luminance	≥6 Foot Lamberts
Uniformity	2:1 or less
Contrast Ratio	≥6:1
Stored Resolution	4000 clearly legible characters with good spacing, based upon a 90 X 70 mil matrix
Vertical	Equivalent to 400 line pairs closely spaced line pairs exceed 25% incremental storage)
Horizontal	Equivalent to 300 line pairs (see Vertical)
Display	
Linearity	
Full Scale	Within 1% (spot will be within 1% of proper position for voltage applied)
Incremental	Deflection factor of any 2 cm area is with 10% of that of any other 2 cm area.

TABLE 1-3 (Cont)

Characteristic	Performance Requirement
Viewing Time	15 minutes or less recommended for specified resolution. Viewing time may be extended to one hour without permanent damage to the storage target.
Drop Out	In a 300 × 400 dot display, no more than 5 stored dots in any 10 × 10 dot group will fade out to less than three raised collector dots
Fade Up	In a 300 × 400 dot display, no more than 15 stored dots of any 10 × 10 group may blend to an adjacent dot
Hold Mode Time	Extends ×5 the time a display may be stored for later viewing.
Erase Time	≤0.5 seconds
View Mode Timer Interval	Stays in view mode 60 to 90 seconds after VIEW switch is pushed.
Dot Writing Time (stored)	≤5 μs

TABLE 1-4

REMOTE PROGRAM

Characteristic	Performance Requirement	
Logic Type	Positive Logic Form	
Input Requirements	Logical 0	Logical 1
Voltage	Ground closure or +0.5 V to −10 V	Open circuit (At least 1 MΩ) or +10 V to +50 V
Current	Terminal will source 5 mA or less	Input diode disconnected above +10 V
Mode Switching Response Time		
Hold to View	10 μs or less	
Store to Non-Store	20 μs or less	
Non-Store to Store	200 μs or less	
Store to Write-Through	20 ms or less	
Write-Through to Store	20 ms or less	
Pulse to Initiate Erase		
Width	At least 2 ms	
Rate of Fall	At least 10 V/ms	
Input Lines	See Fig. 2-5, Operating Instructions	
	Interface Connections	Switching Signal
Non-Store	J340, Pin 6	Level
View	Pin 20	Level
Write-Through	Pin 8	Level
Erase	Pin 18	Pulse

TABLE 1-4 (Cont)

Characteristic	Performance Requirement	
Output Line	J340, Pin 7	
	Logical 0	Logical 1
Erase Interval	During Erase Cycle: +0.3 V, ±0.2 V, sinking 250 μA or less	+10 V, ±1 V, sinking 5 mA or less
With Origin Shifter Attached	Output voltages slightly less than half.	
Output Impedance	2 kΩ, 10%	
Program Ground	J340, Pin 9 Ground return line for external switching circuits.	

TABLE 1-5

POWER SUPPLY

Characteristic	Performance Requirement
Line Voltage Range	
115 volts	Low 90 to 110 volts Medium 104 to 126 volts High 112 to 136 volts
230 volts	Low 180 to 220 volts Medium 208 to 252 volts High 224 to 272 volts
Maximum Power Consumption At 115 volts, 60 Hz	250 W, 2.5 A
Line Frequency	48 to 66 Hz

TABLE 1-6

ENVIRONMENTAL CHARACTERISTICS

NOTE

The following environmental test limits apply when tested in accordance with the recommended test-procedure. This instrument will meet the electrical performance requirements given in this section following environmental test. Complete details on environmental test procedures, including failure criteria, etc., may be obtained from Tektronix Inc. Contact your local Tektronix Field Office or representative.

Characteristic	Performance Requirement
Temperature	
Non-operating	−40° C to +65° C
Useful Operation	0° C to +50° C (at sea level)
Specified Operation	+10° C to +50° C (at sea level)
Altitude	
Non-operating	to 50,000 feet
Operating	to 15,000 feet (at 0° C to +30° C)
Transportation	Qualified under National Safe Transit Committee test procedure 1A, Category II (24 inch drop)

TABLE 1-7

MECHANICAL CHARACTERISTICS

Characteristic	Performance Requirement
Construction	
Chassis	Alluminum alloy
Front Panel	Alluminum alloy with anodized finish
Cabinet	Vinyl-painted aluminum
Circuit Boards	Glass-epoxy laminate
Overall Dimensions	
Height	11 7/8 inches
Width	11 5/8 inches
Length	22 3/8 inches

SECTION 2
OPERATING INSTRUCTIONS

Introduction

This section of the manual describes the function and operation of the instrument's controls and connectors and gives instrument preparation information and operating instructions.

For reference and guidance, a glossary of terms is included in Section 3.

Power Cord Conductor Identification

Conductor	Color	Alternate Color
Ungrounded (Line)	Brown	Black
Grounded (Neutral)	Blue	White
Grounding (Earthing)	Green-Yellow	Green-Yellow

Power Supply Requirements

This instrument may be operated with power from either a 115-volt or a 230-volt (nominal) power source. The power supply circuit will provide satisfactory voltage regulation with any source voltage within the voltage ranges of 90 to 136 volts and 180 to 272 volts and frequency range of 48 to 66 Hz. A Line Voltage Selector assembly, located at the rear of the instrument, facilitates selection of an operating range compatible with the line voltage (Fig. 2-1). The assembly contains two line fuses and two movable pin and socket type connectors. The two position connector is termed the Voltage Selector and the three position connector is called the Range Selector.

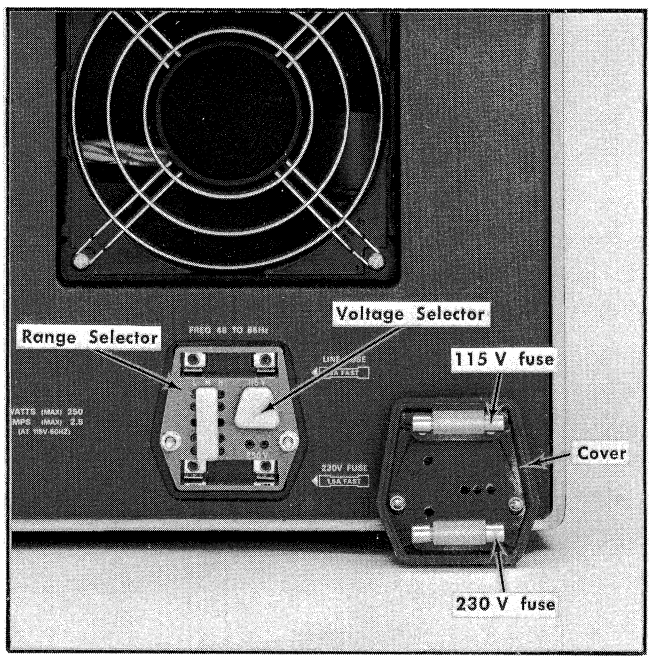


Fig. 2-1. Line Voltage Selector assembly with cover removed.

Table 2-1 lists the six selector combinations and their regulating ranges. Before connecting the instrument to a power source, measure the source voltage and position the Voltage and Range selectors accordingly.

TABLE 2-1

Voltage Selector position	Range Selector position	Will regulate source voltages from
115 V	LO	90 to 110 volts
115 V	M	104 to 126 volts
115 V	HI	112 to 136 volts
230 V	LO	180 to 220 volts
230 V	M	208 to 252 volts
230 V	HI	224 to 272 volts

To change the power transformer from one regulating range configuration to another use the following procedure:

1. Disconnect the instrument from the power source.

2. Loosen the two captive screws, then pull to remove the cover. Since the line fuses are attached to the cover, they will be pulled from their holders with the cover.

3. To change nominal line selections, pull the Voltage Selector until its pins are free of the sockets, invert the selector and reseat the pins in the desired sockets.

NOTE

115 volt to 230 volt plug adapters are not supplied with this instrument. If a suitable adapter is not avaliable, it may be necessary to change the line-cord plug.

4. To change regulating range selections, pull the Range Selector until its pins are free of the sockets, move it to the desired range position and seat the pins in the sockets.

5. Replace the assembly cover and the two line fuses. Press the cover firmly onto the assembly to seat the two fuses in their holders, then tighten the captive screws.

6. The indicating tabs on the selectors will be protruding through the covers to indicate the selected regulating range. Always check the position of these tabs before applying power to the instrument.

Temperature Considerations

To reduce operating temperatures, air is drawn in through the filter at the rear and blown forward through the instrument. For efficient air circulation and heat dissipation, provide at least three inches clearance at the rear, two inches at the sides and operate the instrument with the side covers installed. If the fan becomes inoperative or the air circulation is obstructed, the internal temperatures can exceed a safe operating level in a relatively short period of time. To prevent damage to the components from excessive temperatures, a thermal cutout switch is incorporated in the power supply circuitry. This switch is designed to interrupt power to the instrument when its ambient temperature exceeds approximately 150°F.

CAUTION

Since the thermal cutout switch will reset when its ambient temperature is reduced to some level below its actuating temperature, set the POWER switch to OFF before attempting to remedy the cause of the high temperature condition.

FUNCTIONS OF CONTROLS AND CONNECTORS

Front Panel Controls (Fig. 2-2A)

ERASE — This pushbutton switch provides the means of erasing any previously stored information on the CRT. The switch is illuminated when the POWER switch is set to ON.

VIEW — This pushbutton switch enables the operator to switch the instrument from a holding mode to a view mode during normal operation. The switch is illuminated when the instrument is in a holding mode.

Controls Behind Front Panel Access Door (Fig. 2-2A)

INTENSITY — Provides adjustment of the writing beam intensity for normal writing functions (see WRITE THRU INTENSITY).

WRITE THRU INTENSITY — Provides adjustment of the writing beam intensity during a write through function.

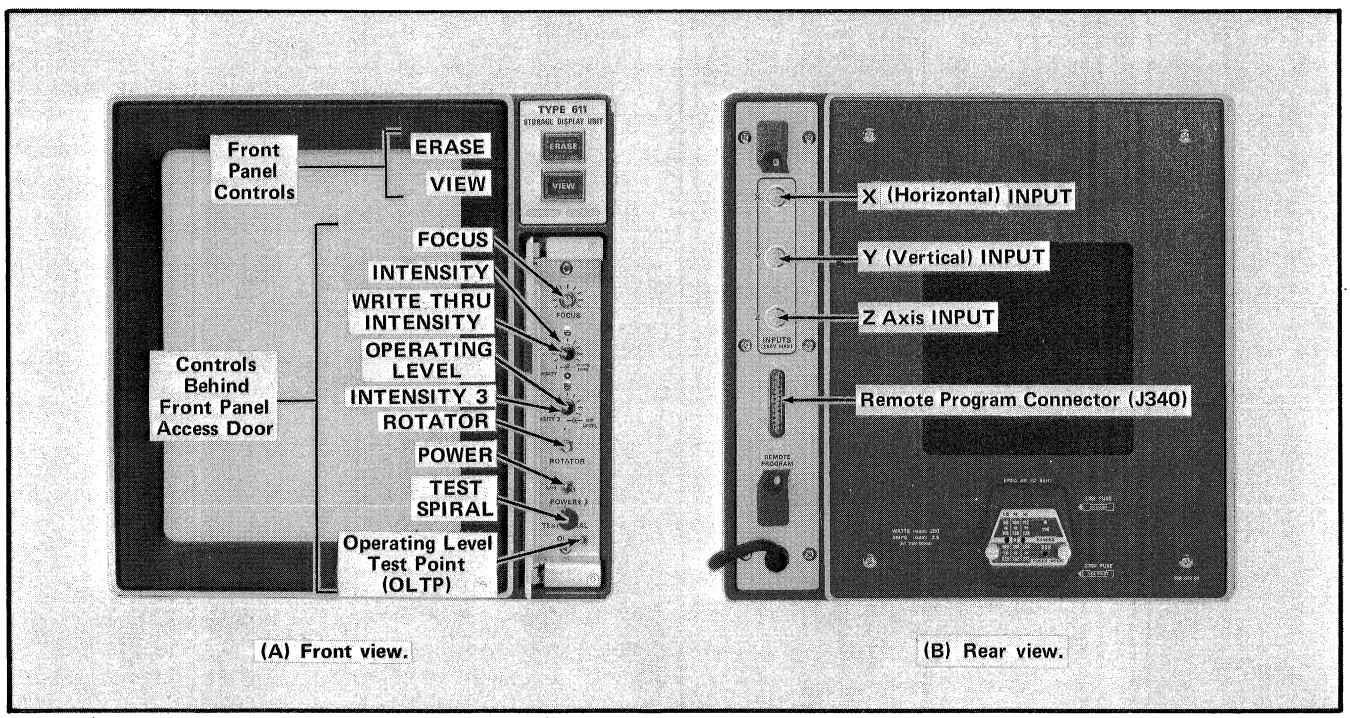


Fig. 2-2. Locations of external controls, connectors and test point.

FOCUS	Permits adjustment of the writing beam focus.
INTENSITY 3 (Applies only to instruments above SN B150000)	Provides adjustment of the writing beam intensity when using the Type 611 with a Tektronix Hard-copy unit such as the 4601.
OPERATING LEVEL	Provides adjustment of the target backplate potential. Do not change the setting of this control without monitoring the target backplate potential. The proper adjustment procedure is given in step 11 of the Calibration Section.
ROTATOR (Applies only to instruments above SN B180000)	Aligns a horizontal sweep to be parallel to the top or bottom of the Type 611.
POWER	This toggle switch is the power on-off switch for the instrument.
TEST SPIRAL	This three position push-pull switch provides a convenient means of changing the instrument circuitry from a normal operating configuration to either of two test mode configurations. The three circuit configurations are: NORMAL, when the switch is centered, STORE test, when the switch is pushed and held in for more than a second, and FOCUS test, when the switch is pulled out.
OLTP	Operating Level Test Point. DC voltmeter is connected here to monitor the back plate voltage when adjusting the OPERATING LEVEL control.

Rear Panel Controls and Connectors (Fig. 2-2B)

X CONNECTOR	This BNC connector is the signal input connector for the horizontal amplifier (signal input for horizontal deflection).
Y CONNECTOR	This BNC connector is the signal input connector for the vertical amplifier (signal input for vertical deflection).
Z CONNECTOR	This BNC connector is the signal input for the Z axis amplifier.
REMOTE PROGRAM CONNECTOR	This 25 contact socket serves as the access to the instrument for remote control functions: Write-through, Non-store, Erase and View; and as the output connector for the Erase Interval Pulse. The unused contacts of the socket may be used as optional input points of the X, Y and Z input signals. For additional information on use of each pin of the Remote Program connector, refer to Table 2-3.

Internal Controls (Fig. 2-3)

SW202	Three-position slide switch to select beam origin for the horizontal axis.
SW204	Three-position slide switch to select beam origin for the vertical axis.

NOTE

Fig. 1-2 in the Specification section of this manual shows the selectable beam origin positions for each switch.

Input Signal Requirements

To perform the functions of a storage monitor in a data display system, the Type 611 must be supplied X and Y

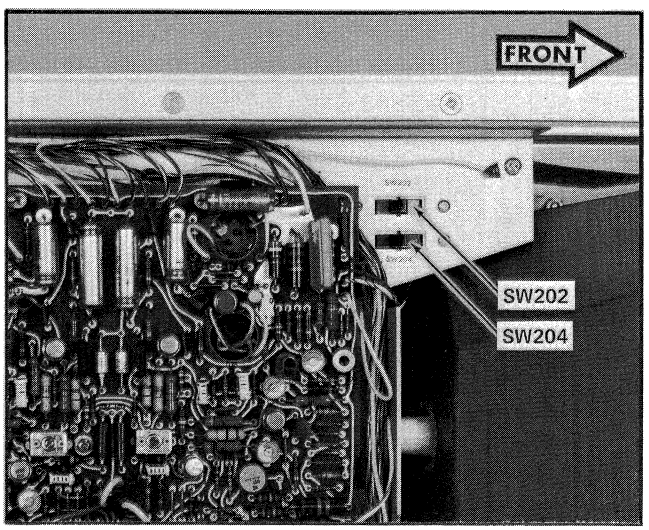


Fig. 2-3. Left side view showing internal slide switch locations.

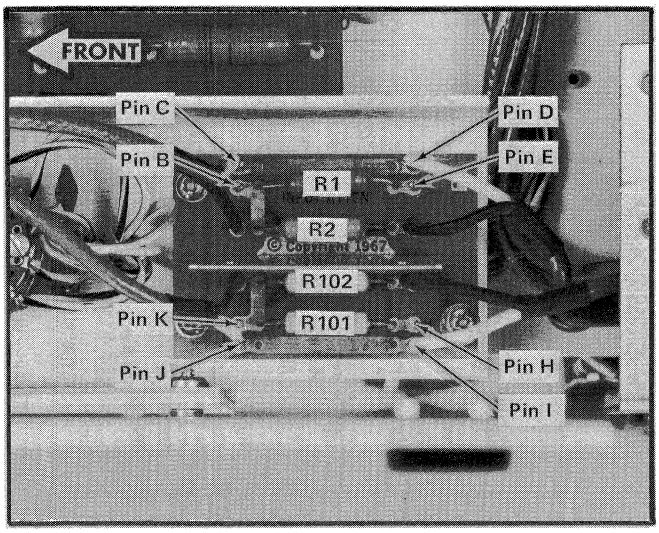


Fig. 2-4. Right side interior view with lower right cabinet frame section removed to show Attenuator board pin connections.

axis deflection signals and Z axis control signals through its rear panel BNC type connectors. Direct coupling of the X and Y signals to the amplifiers is accomplished by connecting the center conductors of the coaxial cables to pins C, D, I and J as shown in Fig. 2-4. To attenuate the horizontal input signal by a factor of 10, move the leads from C to B and D to E; to attenuate the vertical input signal, move the leads from I to H and J to K. Other attenuation factors may be obtained by changing the resistance values of R1, R2, R101 and R202 (refer to Table 2-2).

The X and Y axis deflection amplifiers are calibrated at the factory for a deflection factor of 1 volt/16.2 cm. To change the display format from square to rectangular, adjust the Y axis sensitivity for a deflection factor of 1 volt/21 cm, using the procedures given in the Calibration section. Positive input voltages cause right X axis deflection and upward Y axis deflection. The input impedance of the X and Y axis deflection amplifiers is approximately 100 kΩ paralled by 60 pF. For good positional stability characteristics, the signal source impedance must be low with respect to the input impedance.

The writing beam may be turned on by applying a voltage of at least + 1 volt to the Z axis input, and turned off with a voltage more negative than +0.5 volts. Practical turn-on voltage amplitudes are from +1 volt to +9 volts and practical turn-off voltages are from +0.25 volt to −10 volts. The timing and duration of the turn-on voltage applied to the Z axis must be sychronized with the deflection signals to allow for beam positioning time and writing time. The input impedance of the Z axis amplifier circuit is approximately 100 kΩ paralleled by 50 pF.

TABLE 2-2

Input Signal Attenuation Factors

Attenuation Factor	Resistance Required	
	R1 and R101	R2 and R102
1[1]	Short	None
2	49.9 kΩ	100 kΩ
5	80.6 kΩ	24.9 kΩ
10[2]	90.9 kΩ	11 kΩ
20	95.3 kΩ	5.23 kΩ
50	97.6 kΩ	2.05 kΩ
100	100 kΩ	1 kΩ
200	100 kΩ	499 Ω
500	100 kΩ	200 Ω
1000	100 kΩ	100 Ω

[1] **Factory wired for this attenuation factor.**

[2] **Resistors to obtain this attenuation factor both vertically and horizontally have been wired onto the Attenuation board. Refer to the paragraphs above for changing the attenuation factor.**

Remote Program Inputs

The functions and operating modes are as follows: Erase, View, Non-store and Write-through. These modes may be controlled from a remote station by applying appropriate ground closures through the rear-panel remote program connector J340 (see Fig. 2-5). Write-through requires, in addition to the ground closure, a Z-axis signal. Refer to Table 2-3 for an explanation of these and other wired pins as illustrated in Fig. 2-5.

TABLE 2-3

Remote Program Connector J340

Pin Number	Function and Operating Mode
1, 2 and 14	Optional connection for X axis signal input. Disconnect the coaxial cable from the X axis BNC connector. Connect the center conductor of the coaxial cable to pin 1 and the shield to pins 2 and 4.
3, 15 and 16	Optional connection for Y axis signal input. Disconnect the coaxial cable from the Y axis BNC connector. Connect the center conductor of the coaxial cable to pin 15 and the shield to pins 3 and 16.
4, 5 and 17	Optional connection for Z axis signal input. Disconnect the coaxial cable from the Z axis BNC connector. Connect the center conductor to pin 4 and the shield to pins 5 and 17.

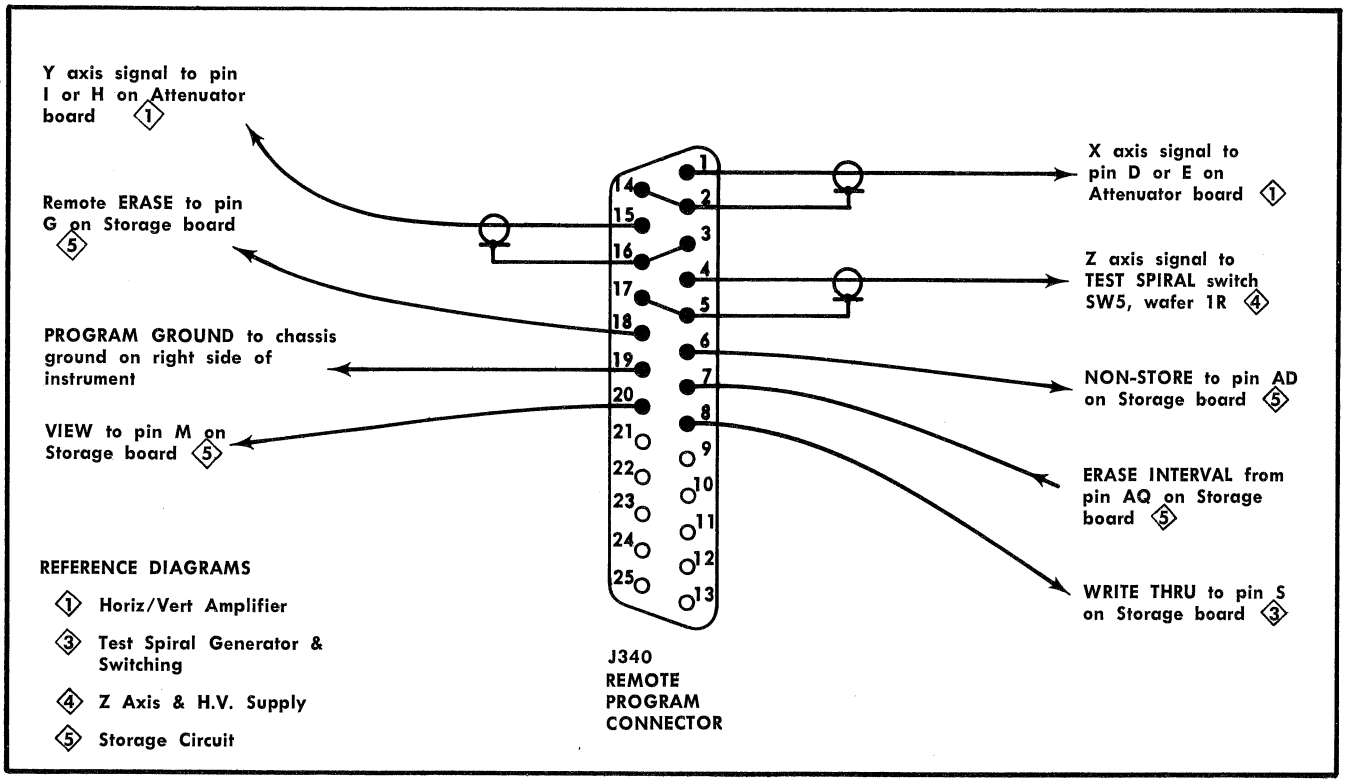


Fig. 2-5. Remote program connector on the Type 611 showing the pin connector wiring. Note that the X, Y, and Z signals may be applied to the instrument via the remote program connector J340 instead of the rear-panel BNC connectors (see Table 2-2).

TABLE 2-3 (cont)

Pin Number	Function and Operating Mode
6	NON-STORE is a function which is forced by grounding pin 6 to pin 19 (except when using the TEST SPIRAL switch).
7	ERASE INTERVAL is a signal output that goes from +10 V to +0.3 V during the interval of erasure.
8	WRITE THRU is accomplished by grounding pin 8 to pin 19 and exciting the Z axis.
18	ERASE FUNCTION is obtained by grounding pin 18 to pin 19.
19	PROGRAM GND is the ground reference for the remotely connected external functions.
20	VIEW MODE is a function that is forced to exist as long as pin 20 is grounded to pin 19.

The four J340 pins (6, 7, 18 and 20) used for remote control programming are at about +10 volts. When these pins are grounded to pin 19 (or connected to any voltage from 0 V to −10 V with respect to pin 19), their circuits require as much as 5 mA through the closure switch. Minimum closure rate should be 10 volts/ms.

If desired, the remote program connector J340 may be used to apply X, Y and Z signals to the instrument. Fig. 2-5 shows the pins that are normally reserved for this option. To maintain the input capacitance specification of the instrument when altering the wiring, use the internal coaxial cables by disconnecting the cables from the X, Y and Z BNC connectors and reconnecting these same cables to the appropriate pins on J340 as shown in Fig. 2-5.

Operating Precautions

To prolong the useful life of the cathode ray tube, observe the following precautions when operating the Type 611.

1. Adjust the INTENSITY control for the minimum writing gun beam-current level that will produce a clear, well-defined display. Excessive beam current may cause either a bright burn condition or, if intense enough, a more serious dark burn condition.

A bright burn condition is the appearance of a residual display image after erasure. Bright burn images can be erased by adjusting the OPERATING LEVEL control to establish a fade-positive condition. The time required for a fade-positive condition to effect a complete erasure is dependent on the severity of the burn. A severe burn may

require up to 12 hours for complete erasure. Operate the instrument in the fade-positive mode only as long as necessary, since in addition to the loss of useful operating time, extended fade-positive operation will decrease the life expectancy of the CRT.

A dark burn condition is the destruction of the cathode ray tube phosphor by the intensive beam current. This condition is evidenced by a spot or area that will not react to the writing gun. As with a conventional CRT, the only remedy for this condition is replacement of the cathode ray tube.

2. Erase the display when the information is no longer needed. If a display is left on the CRT for an extended period of time, it can cause a residual image that may appear as a negative image of the erased display or a positive image superimposed on the new display. Whether the image appears positive or negative will depend on the brightness level of the image phosphor as compared to the brightness level of the new display's back-ground phosphor. The residual image may be erased by establishing a fade-positive condition.

Instrument Turn-On and Test

This procedure is provided to demonstrate the function of the front panel controls and the basic operating modes of the Type 611.

Preliminary Instructions

1. Disconnect all external signal cables from the rear panel connectors.

2. Set the front panel controls as follows:

POWER	OFF
INTENSITY	CCW
OPERATING LEVEL	Do not change the setting of this control
FOCUS	Midrange
TEST SPIRAL	NORMAL

3. Set the rear panel VOLTAGE and RANGE selectors to the appropriate positions for the available power source and connect the power cord to the power source.

Operating Steps

1. Turn the POWER switch to ON. The ERASE switch should illuminate and as the instrument warms up, the display area of the CRT should assume the bright luminance of a fade positive condition.

2. Press and release the ERASE switch. The instrument should cycle through an erase function and assume a ready-to-write condition. The display should appear to be at a uniform luminance level, much lower than the brightness level of the fade positive condition.

3. Begin to slowly turn the INTENSITY control in a clockwise direction while observing the display for the indication of a bright spot. If a bright spot appears, immediately turn the control counterclockwise. If the control can be turned fully clockwise without a spot appearing, this test of the instrument's operating condition is normal. Set the INTENSITY control to midrange and proceed.

NOTE

Storage capability and resolution are affected by the interaction of the OPERATING LEVEL, INTENSITY and FOCUS control setting.

4. The OPERATING LEVEL control provides adjustment of the Storage Target Backplate potential. The procedure for this adjustment is given in the Calibration section of this manual.

5. Pull the TEST SPIRAL switch to its FOCUS position. A spiral waveform should appear on the display. Adjust the FOCUS and INTENSITY controls for an overall clear, well-defined display of the desired viewing brightness.

6. Push and hold the TEST SPIRAL switch to its spring loaded STORE position for about 3 seconds or until a stored spiral waveform appears on the display. The stored spiral should remain clearly visible for about 60 to 90 seconds, then appear to be almost erased as the VIEW switch is illuminated. An illuminated VIEW switch indicates that the instrument is in a holding mode of operation.

7. Press and release the illuminated VIEW switch. The stored spiral should again appear on the display and the VIEW switch should be extinguished. The instrument should remain in this condition for about 60 to 90 seconds and again assume a holding mode of operation.

8. Press and release the ERASE switch. The instrument should cycle through an erase function and assume a ready-to-write condition. This completes the Instrument Turn-On and Test procedure.

Instrument Operation

To prepare the Type 611 for normal operation, perform the Instrument Turn-on and Test procedure listed pre-

viously in this Section, then connect the X, Y and Z axis signal sources to the rear panel BNC type connectors. The functions write-through and non-store require the application of ground potentials through the rear panel access plug J340. It is assumed that a remote program device with Erase, View, Write-Thru and Non-Store switching facilities is connected to the Type 611 remote control access plug.

When the preparation procedure for normal operation is completed, the instrument will be in a ready-to-write state and a display may be produced and stored by the application of appropriate X, Y and Z axis signals. When a display is stored, it will remain at its normal viewing intensity for about 60 seconds after the last Z axis turn-on signal is applied and then become very faint, to the point that it may not be discernible from the background areas. When the change occurs and the display appears to be reduced in intensity, the instrument has automatically shifted to a holding mode of operation.

Holding Mode. When the instrument assumes a holding mode of operation, the VIEW switch is illuminated and the action of the storage circuits produces a display with an ON time of about 10%, producing the effect of decreased intensity. The purpose of the holding mode of operation is to permit extended retention of displayed information with a negligible reduction in CRT life expectancy. The instrument will remain in a holding mode of operation until it is either returned to a viewing mode of operation or is erased and returned to a ready-to-write state.

Viewing Mode. The instrument may be returned to a viewing mode of operation from a holding mode by three means: with the front panel VIEW switch, or a remote View switch, or by the application of a Z axis turn-on signal. If the front panel VIEW switch is used, the instrument will remain in the viewing mode for about 60 seconds then automatically revert to a holding mode. If a remote View switch is used, the instrument will remain in the viewing mode only while the remote View switch is closed (Ground Closure) and return to a holding mode as the switch is opened. If a Z axis turn-on signal is applied, e.g. the addition of information to a stored display while the instrument is in a holding mode, the instrument will shift to and remain in a viewing mode for about 60 seconds after the Z axis turn-on signal is applied, then automatically return to a holding mode.

Erase Mode. Erasure of stored displays may be accomplished with either the front panel ERASE switch or with a remote ERASE switch, whether the instrument is in a viewing mode or a holding mode of operation. An erase cycle usually requires about 0.5 seconds and at the completion of the cycle, the instrument is returned to a ready-to-write state.

Write-Through Operation. This mode is useful when it is desirable to know the writing beam's location under particular deflection conditions without storage of the beam's position. Write-through operation requires a Z axis turn-on signal in addition to the application of a ground potential to pin 8 of the remote access plug. When the instrument is configured for write-through operation, the writing beam's intensity is generally reduced making the beam's position less obvious and sometimes difficult to find particularly with a stored display. As an aid to locating the beam, under these conditions, use a Z axis signal of about 20 Hz to cause the beam to pulsate.

Non-Store Operation. The Type 611 may be configured to non-storage operation with the application of ground potential through the rear panel access plug (pin 6) by setting the remote Non-Store switch to ON. Non-storage operation is particularly useful as a means of extending the CRT life expenctancy when the operating conditions are such that the instrument must be continuously ready for use and data storage is infrequent. In a non-store configuration, the Type 611 may be used as a conventional CRT display unit for repetitive waveforms. In a non-store mode, deflection calibration is in error approximately the ratio of the store mode operating level divided by 4000 volts.

NOTES

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 a complete description of the circuitry used in the Type 611 Storage Monitor. The description includes a general discussion of the storage tube construction and operating principles, statements of purpose and relationships of the major circuits shown on the Block Diagram in Section 8, and a detailed explanation of the purpose or function of each component in the major circuits.

The accompanying illustrations in this section are intentionally general and often show only components significant to the circuit's functional description. For specific component values, typical electrical measurements and waveforms, refer to the complete circuit diagrams provided in Section 8.

Glossary of Storage Tube Terms

These terms are defined as they are used in this manual and are provided as an aid to the reader.

Amplifier, X-axis (long axis mounted vertically)	Used interchangeably with Horizontal Amplifier—the amplifier for signals intended to produce horizontal deflection.
Amplifier, Y-axis (long axis mounted vertically)	Used interchangeably with Vertical Amplifier—the amplifier for signals intended to produce vertical deflection.
Amplifier, Z-axis	The amplifier for signals intended to turn on and turn off the writing beam.
Background luminance	The luminance of the storage target after an erase cycle and before a writing function.
Backplate	A conductive surface, electrically coupled to and physically supporting the storage target.
Collimation lens	An electrostatic lens system used to adjust the trajectories of flood gun electrons.
Collimation electrode	An element used to make up the collimation lens system.
Contrast ratio	The ratio of stored luminance to background luminance.
Conventional mode	That mode of operating the storage tube where the display does not store, but performs with the usual phosphor luminance and decay. Accomplished by operating with the backplate voltage below the retention threshold.
Edge defocusing	Change in size and/or shape of the displayed spot as it approaches the edges of the target area.
Erase	To change electrode potentials in such a sequence and manner that all target phosphors are written, unwritten and then returned to their rest potential.
Erase cycle	The sequence of circuit and electrode-potential changes required to erase.
Fade positive level	The flood gun cathode-to-backplate voltage at which flood gun electrons land with enough energy to shift unwritten phosphors to a written state.
Fade up	Spontaneous shifting of phosphors from their unwritten to their written state. Generally occurs with phosphors adjacent to written phosphors.

Flood gun	Source of low energy electrons.
Fully written	The condition under which the entire storage target is in a written state.
Geometry	The degree to which a rectilinear display is accurately reproduced on the target.
Holding mode	A mode of operation where the flood gun duty cycle is about 10% ON, for the purpose of increasing CRT life expectancy.
Non-store level	Backplate voltage when the instrument is configured for conventional non-storage operation.
Operating level	The flood gun cathode-to-backplate potential (within the operating range) selected for optimum storage performance.
Operating range	The flood gun cathode-to-backplate voltage range within which storage can be achieved. The voltage range between writing threshold and upper writing limit.
Ready-to-write state	The stable electrostatic state of target phosphors at the completion of an erase cycle and before a writing function.
Rest potential	That flood gun cathode-to-backplate potential at which all target phosphors will shift from a written electrostatic state to an unwritten electrostatic state. During an erase cycle, the phosphors remain at this equilibrium potential as the backplate is slowly returned to the operating point.
Retention threshold	The lowest flood gun cathode-to-backplate potential at which previously stored information can be retained.
Store	To retain a display of an electrical event that occurs only once.
Stored luminance	The luminance of stored information at a given operating voltage.
Storage mode	The mode of operation that permits the storage target to retain written information.
Storage target	The phosphor surface having the ability to store information when bombarded by an electron beam.
Storage target backplate (also backplate or STB)	A conductive surface electrically couples to and usually physically supporting the storage target.
Stored resolution	A measure of the tube's capability for displaying discrete elements of stored information, defined as the number of resolvable dots per horizontal or vertical dimension.
Stored writing speed	The speed, centimeters per second or Ms/dot, at which the writing beam will register stored information when scanning the storage target, under stated conditions of operation.
Upper writing limit	The highest operating voltage at which a signal can be written and still maintain a given stored resolution under given conditions of operation.
View mode	The mode of operation where a stored display is visible at normal luminance.
Write	To bombard the phosphor screen with electrons and produce luminescence.
Writing gun	A high-energy electron gun giving a narrow focused beam which can be deflected and is used to write the information to be stored.

Writing threshold	The lowest operating voltage at which a signal can be written and completely stored under given conditions of operation.
Written state	The stable electrostatic state of the phosphors in any area of a storage target after writing and before erasure.

Storage Tube Description

The Tektronix T6110 is a high-resolution, direct viewing storage tube. Figure 3-1 is an illustration showing the elements significant to the tube's storage capability. The primary features that distinguish the T6110 from conventional non-storage oscilloscope CRTs include, in addition to size, the storage target, flood gun assembly, collimation lens system and magnetic deflection system. The other elements are similar in construction and purpose to the same elements in a conventional CRT.

The Storage Target is constructed as a continuous phosphor film surface deposited on a conductive backplate matrix, having the ability to store transient writing backplate bombardment (information) when operated within certain voltage ranges and electrostatic conditions. The phosphor film functions as the bistable target material and the backplate serves as a flood gun cathode to target voltage control element and as an electron collector.

The Flood Gun assembly with its six cathodes and accelerating anode is constructed in the form of a ring, and is mounted coaxially with and forward of the writing gun assembly. The purpose of the flood gun assembly is to provide low energy electrons to maintain the electrostatic state of both ready-to-write and written phosphors. When the instrument is in the view mode of operation, the flood gun cathodes are operated at about 0 volts and the accelerating anode at about +150 volts. The accelerating anode voltage is set independently with a voltage control circuit. During a holding mode of operation, 1 kHz signals from the Hold Multivbrator cause the anode voltage to be reduced to 20 V below the cathode voltage for about 90% of the time. Since flood gun emission during holding is restricted to about a 10% duty cycle at the 1 kHz rate, written phosphors are effectively reduced in intensity and the useful life expectancy of the CRT is greatly increased.

The Collimation Electrodes form an electrostatic lens system that uniformly distributes the flood gun electrons

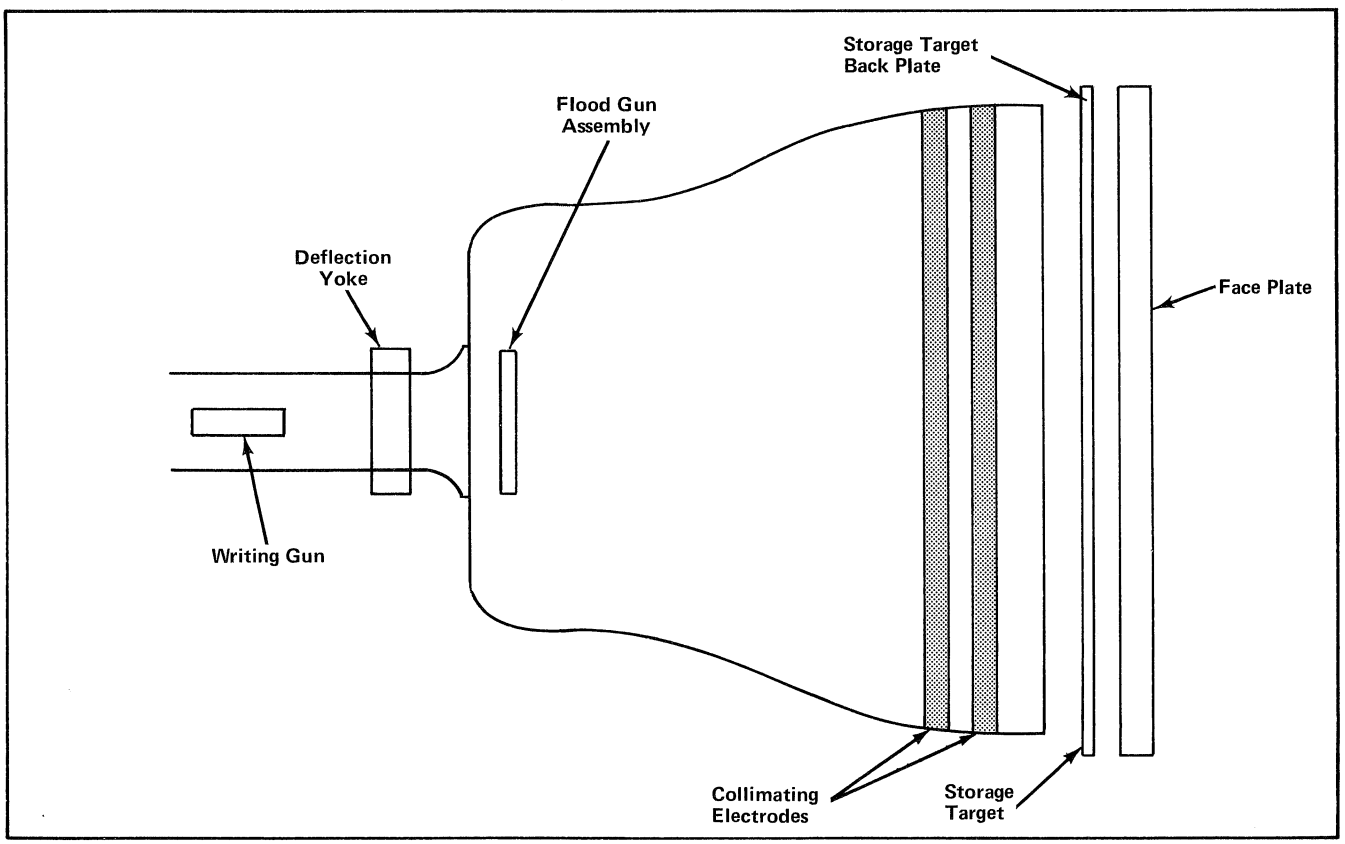


Fig. 3-1. Pictorial diagram of storage tube Type T6110.

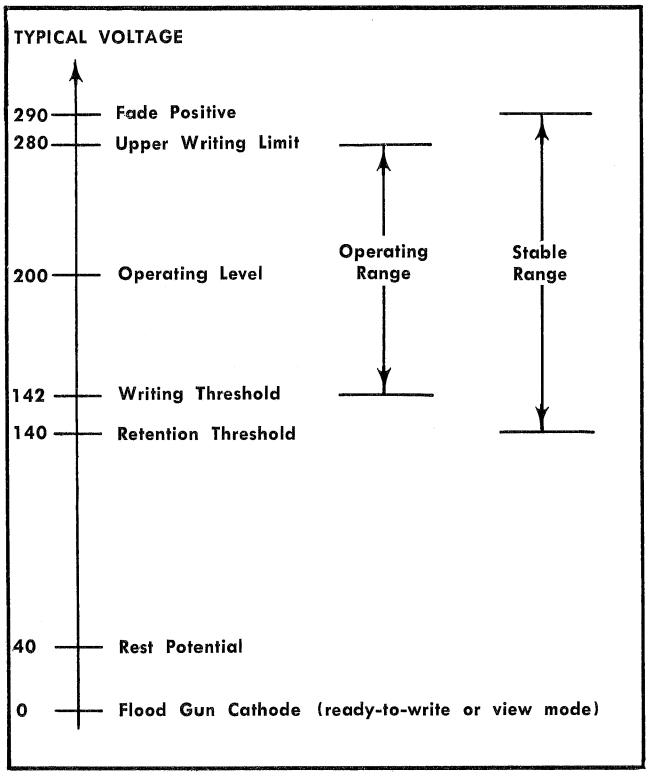


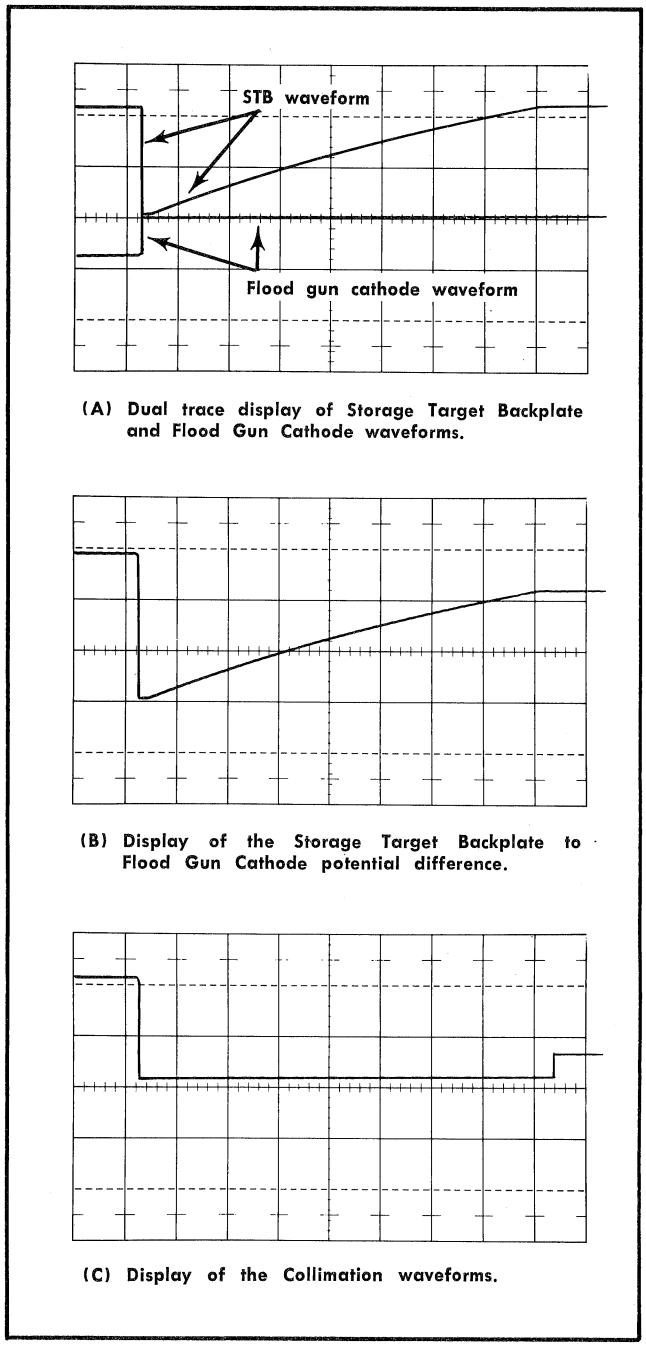
Fig. 3-2. Significant target backplate with respect to flood gun cathode potentials.

over the target area. The operating voltages of the collimating electrodes are controlled and adjusted with a voltage amplifier circuit. During an erase cycle, the voltage excursions of the collimating electrodes maintain the even distribution of flood gun electrons over the target area.

The Writing Beam is produced with a conventional electron gun assembly. The beam is gated on and off in a conventional manner with signals from the Z Axis amplifier circuit applied to the grid circuit. Since the writing gun cathode is operated at about −3800 volts and the STB at about +200 volts, writing beam electrons have sufficient energy to produce enough secondary emission to shift target phosphors from a ready-to-write electrostatic state to a written electrostatic state.

Fig. 3-2 is a graph of the significant flood gun cathode to target potentials. Storage can be achieved at any potential within the operating range, but the optimum potential must be arbitrarily selected and is dependent on the parameters of the individual CRT.

During an erase cycle, the fade positive potential difference between the Storage Target Backplate (STB) and the flood gun cathode is achieved by holding the STB at the



(A) Dual trace display of Storage Target Backplate and Flood Gun Cathode waveforms.

(B) Display of the Storage Target Backplate to Flood Gun Cathode potential difference.

(C) Display of the Collimation waveforms.

Fig. 3-3. Typical Erase cycle voltage waveforms.

operating level and making the Flood Gun Assembly (cathodes and anode) more negative by about 100 volts (see Fig. 3-3). The fade positive potential difference is maintained for 50 to 70 μs, then the Flood Gun Assembly is returned to its quiescent voltages and simultaneously the STB voltage is changed to approximately the flood gun cathode voltage. This change in potential difference shifts the target phosphors from a written (fade positive) state to an unwritten state. To insure that the phosphors remain in the stable unwritten electrostatic state until struck by the

writing beam, the STB is returned to the operating level at an RC rate that takes approximately 400 ms. During an erase cycle, the collimation electrode potentials are also changed; first, positive to maintain proper collimation during the fade positive condition; then, negative during the STB voltage change time and back to the quiescent levels at the end of the erase cycle.

BLOCK DIAGRAM DESCRIPTION

The Horizontal and Vertical Deflection amplifiers are similar in circuit configuration and function. The purpose of each is to convert voltage signals applied to their inputs into current drive signals through the magnetic deflection yoke.

The general circuit configuration of each amplifier is that of an operational amplifier with special signal compensating feedback circuits. Since the CRT faceplate is flat and the writing beam emanates essentially from a point on a line perpendicular to the center of the faceplate, a linear increment of beam deflection causes a non-linear increment of trace display. This requires a non-linear increment of correction, if the deflection factor is to remain constant over the flat faceplate of the CRT. The feedback circuits with the Geometry Correction circuits provide the non-linear compensation (both in-axis and cross-axis to the deflection signals) that is necessary to produce the constant deflection factor over the useful area of the CRT. Additionally, any excursion of the writing beam from the center of the CRT faceplate causes a change in focal length. Compensation for this intrinsic defocusing is accomplished with a Dynamic Focus circuit. The Dynamic Focus circuit is essentially a summing amplifier, and any signals that occur in the Geometry Correction circuits are applied as the input signals to this amplifier. The resultant summation is applied to the ground return of the CRT focusing circuit.

The Z AXIS amplifier converts signals applied to its input stage into suitable writing beam unblanking waveforms.

The TEST SPIRAL switch is a three position, push-pull switch; STORE (pushed in), NORMAL (centered) and FOCUS (pulled out). When the switch is set to NORMAL, the instrument is configured to accept external X, Y and Z axis signals. When the switch is pushed and held in STORE, all the rear panel input connectors are disconnected, interrupting any X, Y or Z axis or remote station signals, and the instrument automatically cycles through a single shot "self" storage test. When the TEST SPIRAL switch is pulled out to FOCUS, a continuous spiral display appears on the CRT.

The Test Spiral Generator is an RC phase shift type oscillator circuit whose purpose is to supply the deflection signals used for a Focus Test, Storage Test or a Write-through function.

The Erase Multivibrator circuit may be switched to initiate an erase function by either the front panel ERASE switch or a remote station Erase switch through J340 or the Test switch.

The Hold Multivibrator forces a flood gun duty cycle of about 10% when it is active. The Hold Multivibrator may be inhibited by signals from the Erase Multivibrator, the View Multivibrator and by the remote station View switch through J340.

The View Multivibrator provides a means of inhibiting the Hold Multivibrator for a period of approximately 60 to 90 seconds after either the front panel VIEW switch is pushed, or after a writing function.

DETAILED CIRCUIT DESCRIPTION

Horizontal Deflection Amplifier

The purpose of the Horizontal Deflection Amplifier is to convert voltage signals intended to produce horizontal deflection into current signals through the magnetic deflection yoke. The yoke currents (output signals) are sampled and applied as feedback signals to the input of the deflection amplifier. The overall gain factor of the Horizontal Deflection Amplifier is a function of its feedback and input resistances. The operating characteristics of the complete circuit are essentially those of an operational amplifier where the input signals are applied to the (+) input and the feedback signals are applied to the (−) input. Fig. 3-4 shows the equivalent operational amplifier representation of the Horizontal Deflection Amplifier. The component labeled R sampling in the illustration represents a resistor, R82, that is provided to develop signal voltages proportional to the yoke currents for application to the feedback circuit.

The block labeled Feedback Network includes the Horizontal Gain adjust R45, and an operational amplifier circuit that applied geometry correction to the feedback signals. The block labeled R input includes the Horizontal

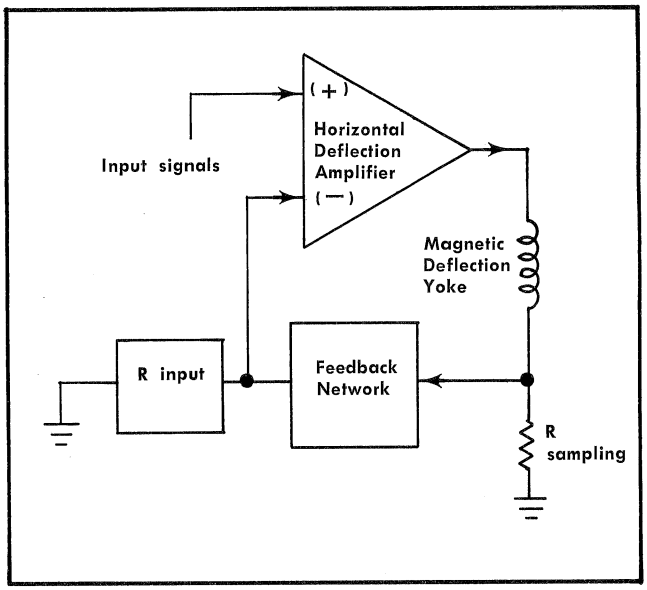


Fig. 3-4. Operational amplifier representation of the Horizontal Deflection Amplifier circuit.

Position control R44, the trace origin selection circuitry and the resistor R5, whose value in conjunction with R13 establishes the effective resistance that the feedback network drives. The triangular operational amplifier symbol represents the several stages of circuitry between the HORIZ INPUT connector and the magnetic deflection yoke that converts the voltage signals to current signals.

Fig. 3-5 is a block diagram of the Horizontal Deflection Amplifier circuitry showing the resultant voltage waveforms at significant points in the amplifier when a typical signal is applied to the HORIZ INPUT connector. The applied signal as it appears at the (+) input of U10 is stepped from 0 volts to about 1 volt for about 1 ms, then back to 0 volts. The resultant ±10 volt excursions at the output of U10 are characteristic of the waveforms that appear at this point when deflection signals of about 0.5 volt or greater amplitude are applied to the input. Only the duration of the voltage excursions increase with increases in deflection signal amplitudes. With square wave input signals less than about 0.5 volt the U10 output signals appear as conven-

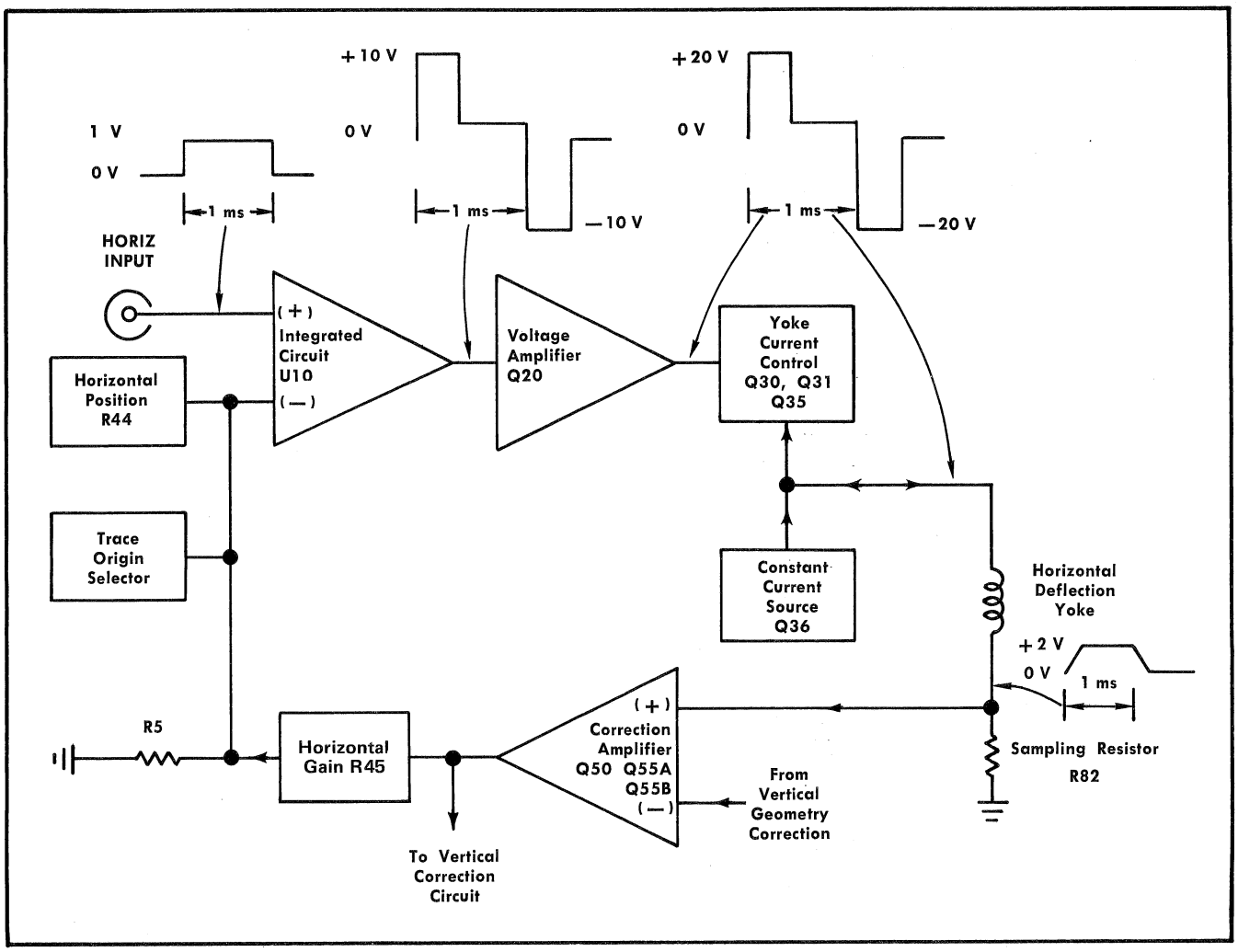


Fig. 3-5. Block diagram of the Horizontal Deflection Amplifier.

tional differentiated waveforms. Since the amplifier stage formed with Q20 is essentially a times two voltage amplifier, the voltage excursions of the waveform at its output are increased in amplitude to approximately ±20 volts. The yoke current control circuit formed with Q30, Q31, and Q35 is essentially a current amplifier and the voltage waveform at its output is the same as the voltage waveform at its input. The bias of Q36 establishes a constant current source from the −20 volt supply. This constant current is metered through the yoke by the Yoke Current Control circuit to produce left deflection. Since yoke current is also the current through R sampling (R82) and any voltage developed across R82 is applied to the (+) input of the Correction Amplifier circuit, the signal through the feedback loop is representative of the yoke current.

INPUT ATTENUATOR BOARD

The two optional Attenuator Board selections are: Attenuation by a factor of about 10 or direct coupling (Fig. 3-6). Square pin type connectors on the center wire and the shield of the signal conducting coaxial cables that the attenuator board facilitate changing the connections. The center wire is connected for direct coupling at the factory. The shield is connected to the junction of R6 and R7. R7 is connected between the center wire and the shield and its value (approximately 100 kΩ) establishes the characteristic input resistance of the horizontal deflection circuit. R6 provides ground loop suppression, since its 0.25 Ω appears large with respect to the resistance of the shield.

INPUT SIGNAL SELECTIONS

The signal source selections are: from the HORIZ INPUT connector to the (+) input of U10 when the TEST SPIRAL switch is set to NORMAL, from C323 of the Spiral Generator circuit to the (+) input of U10 when the TEST SPIRAL switch is set to either STORE or FOCUS, and from R335 of the Spiral Generator circuit to the (−) input of U10 when the instrument is programmed for a Write-through function (Fig. 3-6). Input signals that are applied to the (+) input of U10 are limited in voltage to peak-to-peak excursions of approximately ±3 volts by diodes D8 and D9, and are limited in current by resistor R8.

INPUT AMPLIFIER

The integrated circuit U10 and its associated components form the input amplifier stage of the Horizontal Deflection Amplifier (see Fig. 3-7). U10 is an operational amplifier with feedback from its output applied to its (−) input through R14. R13 serves as the circuits R input

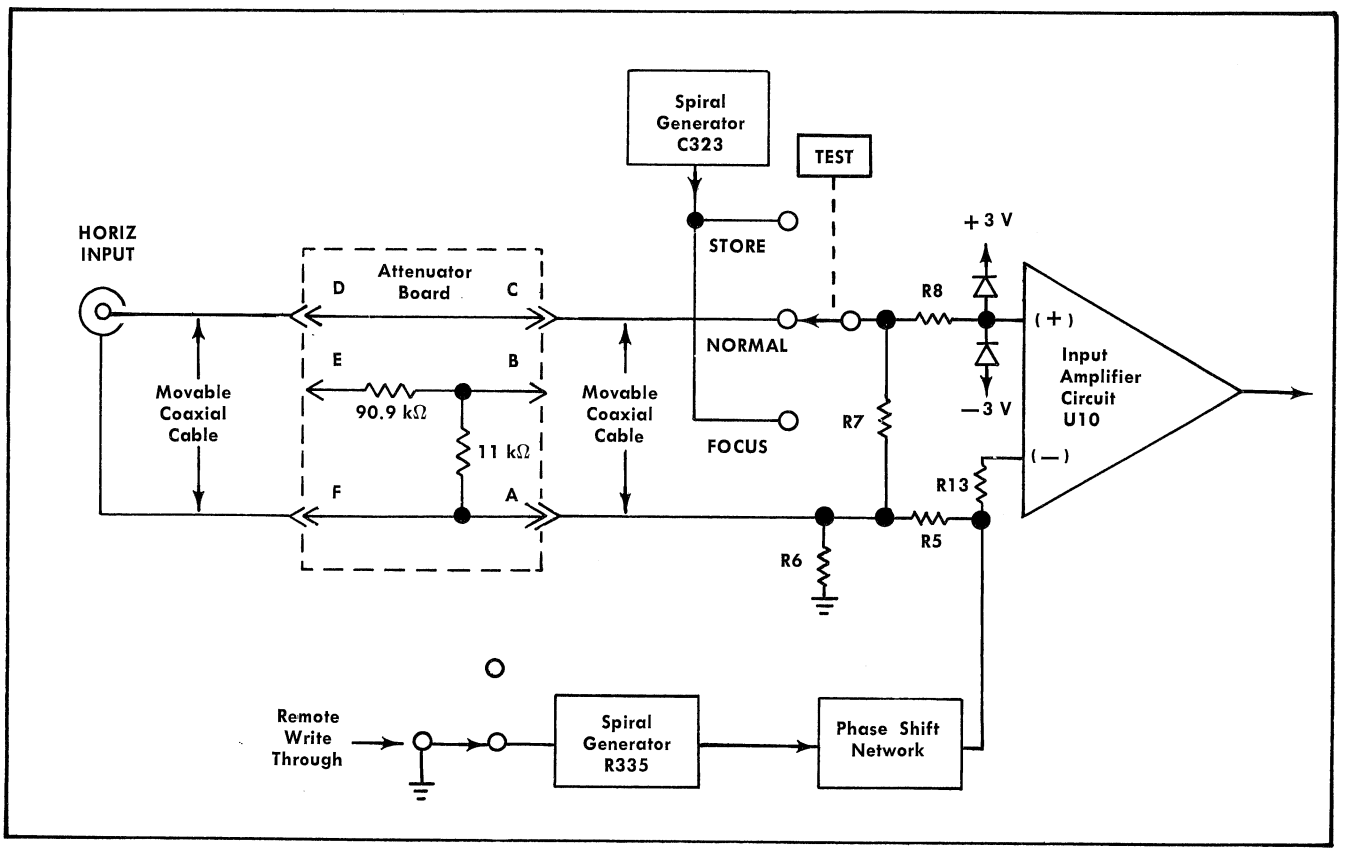


Fig. 3-6. Optional Horizontal Attenuator Board and input signal selections.

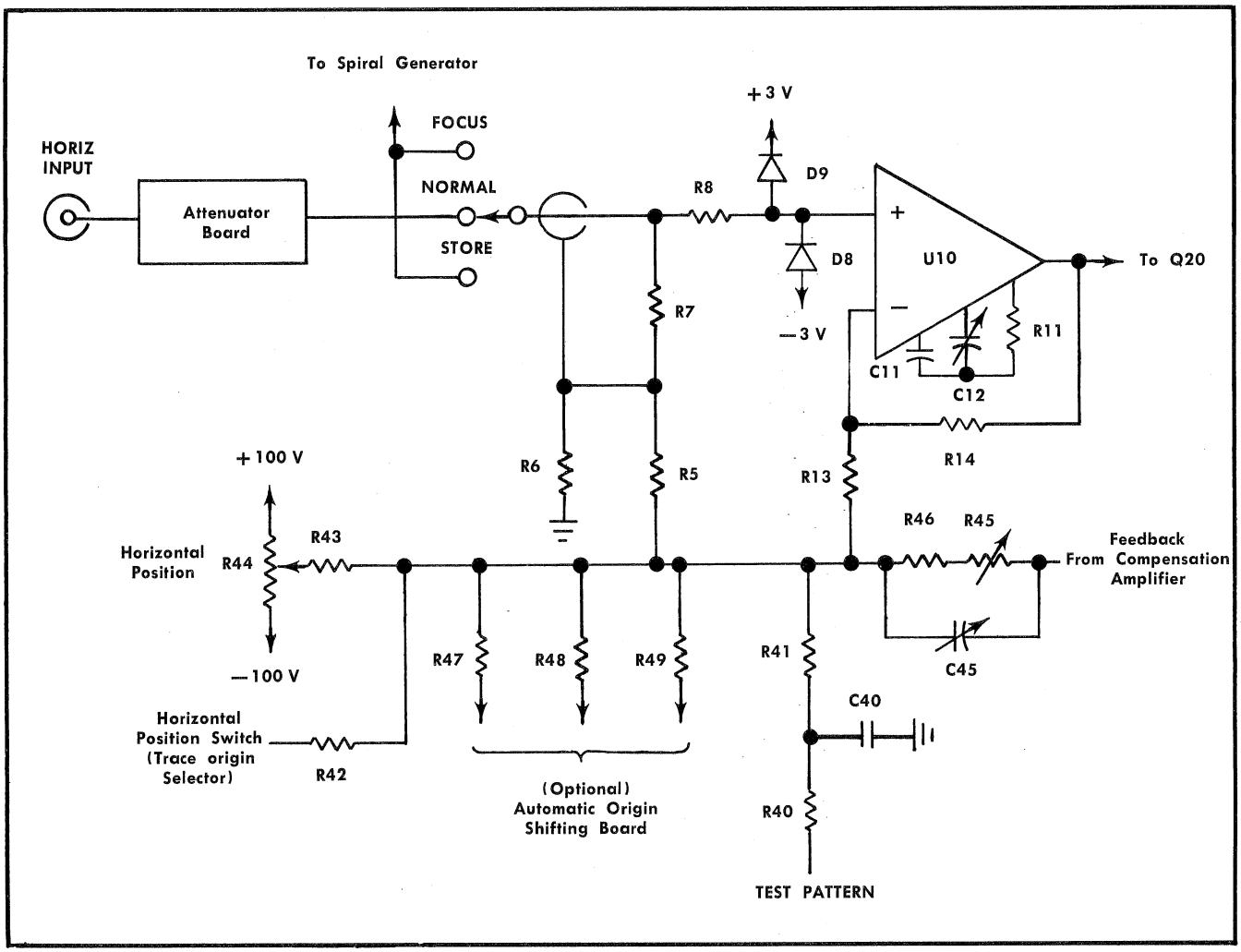


Fig. 3-7. Partial schematic of the Horizontal Input Amplifier circuit.

element and C11 and C12 with R11 form a frequency compensating network. The (−) input of U10 is also the feedback point for the signals from the output of the Horizontal Deflection Amplifier circuit. For the operational amplifier formed by the complete Horizontal Deflection Amplifier circuit, the R input element is essentially R5 and the R feedback element is composed primarily of the series resistance of R46 and Horizontal Gain adjust, R45. The variable capacitor C45 and the feedback amplifier Q50, Q55A, and Q55B, provide additional frequency compensation adjustment for the overall feedback loop.

The DC operating voltage at the junction of R5 and R13 determines the no-signal or horizontal trace origin on the CRT. In the Type 611, the position of trace origin is adjustable. The horizontal origin is a function of the setting of a three position switch SW202 and Horizontal Position control R44. An optional Origin Shifter can be used with the Type 611 and the purpose of R47, R48 and R49 is to make the input circuit compatible with the optional device.

When a write-through function is performed, the Test Pattern signals from the Spiral Generator are coupled to the (−) input through a phase shifting network formed by C40, R40 and R41.

VOLTAGE AMPLIFIER Q20

The stage formed by Q20 and its associated components is operated as a common base amplifier (Fig. 3-8). Amplified Deflection signals appear at the collector with the same phase as the applied signals. The emitter of Q20 is returned to −100 volts through R20, ensuring that the quiescent operating point of the stage remains relatively predictable. R19 limits the current to U10 in the event Q20 is removed from its socket while the instrument is turned on and, with R24, sets the gain of the stage.

YOKE CURRENT CONTROL

Q20, Q31, Q35 and Q36 with their associated components form a current amplifier circuit (Fig. 3-8). The

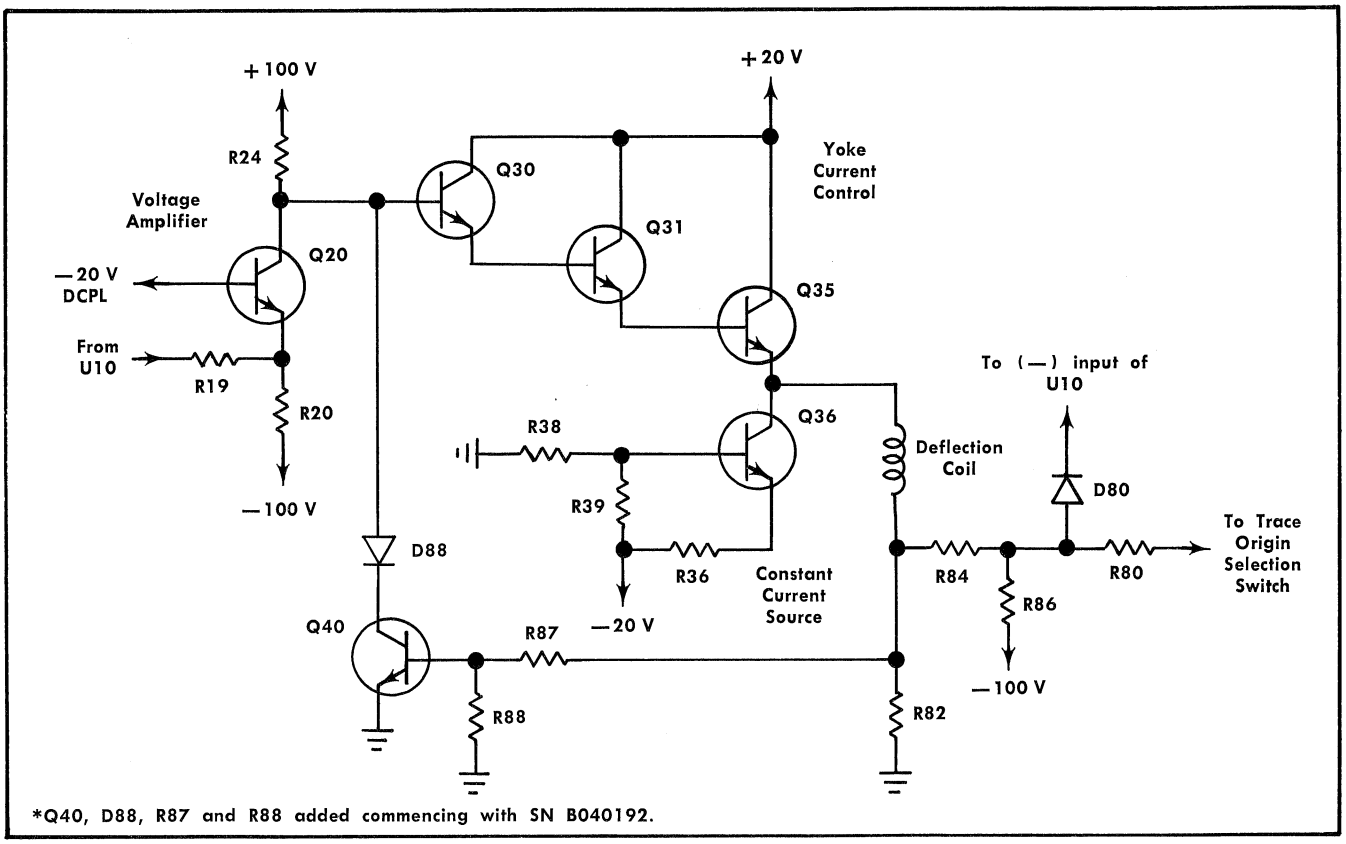


Fig. 3-8. Partial schematic showing the voltage amplifier Q20 and yoke current control circuits.

amount and direction of yoke current is determined by the applied voltage at the base of Q30. The current through Q36 is constant and may be directed through either Q35 or the yoke. When the Q35 current is very low most of Q36's current is directed through the yoke, beam deflection is to the extreme left. When the Q35 current equals the Q36 current, yoke current is zero and the beam is at horizontal center. When Q35's current is the Q36 current plus a mear-equal amount through the yoke, beam deflection is to the extreme right. Maximum Q36 current limits beam deflection to the left while the circuit formed by D80 with R80, R84 and R86 limits beam deflection to the right. Commencing with Serial Number B040192, the clamping circuit formed by Q40, D88 and their associated resistors, R87 and R88, was added to protect R82 during a condition of continuous overdrive in the positive direction.

GAIN CORRECTION AMPLIFIER

The Gain Correction Amplifier circuit is made up of Q50, Q55A, Q55B and their associated components. The circuit is an operational amplifier with the input signal across R82 applied to the (+) input and feedback signals applied to the (—) input. See Fig. 3-9. The base of Q55A is the (—) input and the base of Q55B is the (+) input. The collector of Q50 is the output of the circuit. The R feedback element is essentially a piece-wise linear approximation circuit formed by diodes D60 and D62 in combi-

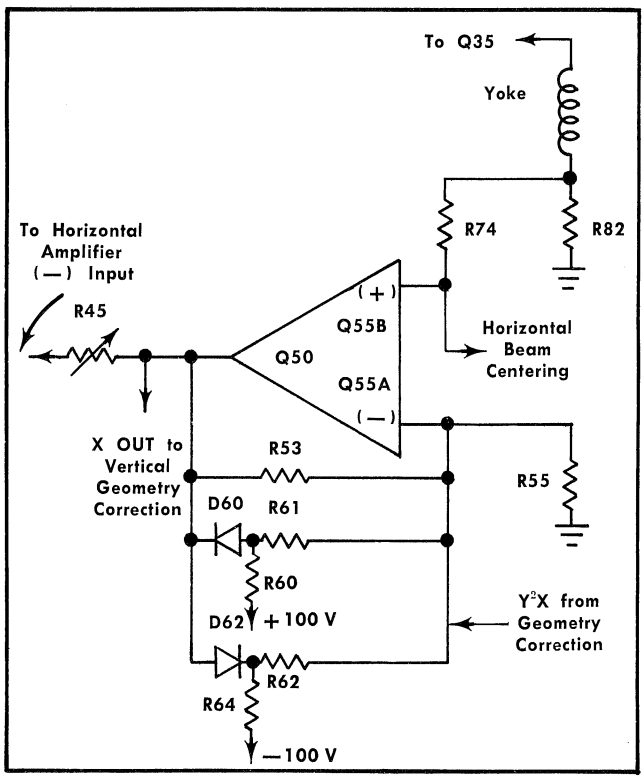


Fig. 3-9. Schematic representation of Horizontal Correction Amplifier.

nation with R53 and their associated resistance network. The feedback loop of the circuit is configured to provide automatic gain correction to the feedback signals to maintain a constant deflection factor over the center horizontal axis of the flat faceplate of the CRT. R55 is the R input element for the (—) input and R70 plus R74 form the R input element for the (+) input.

Input signals to the Gain Correction Amplifier (+) input are the horizontal deflection signals developed across the sampling resistor R82 and the beam centering voltage through R71. Geometry correction signals equal to the square of the vertical times the horizontal feedback signals are applied to the (—) input. The output of the Gain Correction Amplifier is coupled from the collector of Q50 to U10 through the Horizontal Gain control R45, and to the Geometry Correction circuit.

Vertical Deflection Amplifier

The Vertical Deflection Amplifier circuit is configured essentially the same as the Horizontal Deflection Amplifier. The circuit description of the Horizontal Deflection circuitry is applicable to the Vertical deflection circuitry when certain circuit differences are accounted for. In addition to component designations, there are differences in the two piece-wise linear approximation circuit layouts and in the values of some comparable components (e.g. R76 vs R176, R82 vs R182, etc.) to account for the vertical and horizontal axis dimensional differences.

GEOMETRY CORRECTION

The Geometry Correction circuit is designed as two identical amplifier circuits (Fig. 3-10). The two circuits process the feedback signals of both deflection amplifiers and reapply them as cross-axis compensation to the (—) inputs of both Gain Correction Amplifiers. This cross-axis compensation is provided to cancel the pin-cushion effect that is inherent with large flat-faced CRT's. As shown in Figure 3-10, one of the amplifier circuits applies the square of the horizontal feedback signal times the vertical feedback signal (X^2-Y) to the (—) input of the Vertical

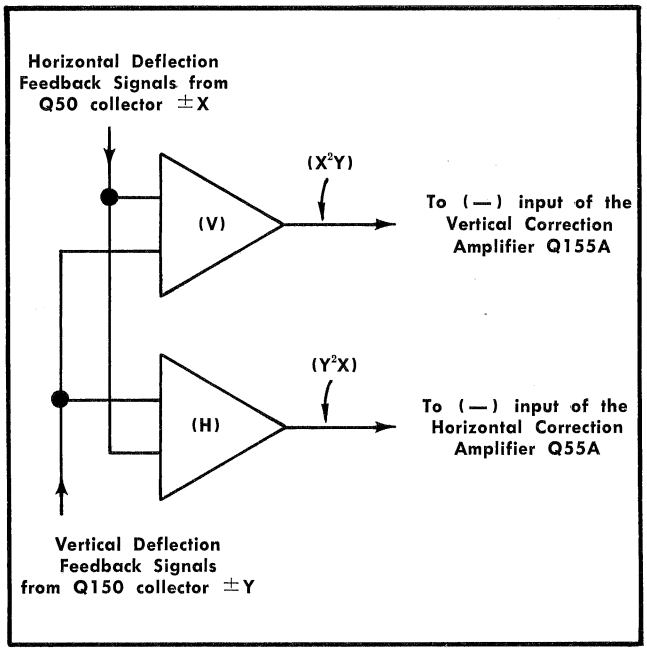


Fig. 3-10. Block diagram of the Geometry Correction Amplifier.

Correction Amplifier. The other amplifier circuit applies Y^2X to the (—) input of the Horizontal Correction Amplifier. Feedback signals from the Horizontal deflection circuit at the collector of Q50 are designated ±X, since they are proportional to signal voltages applied to the X input. By the same reasoning, feedback signals from the Vertical deflection circuit at the collector of Q50 are designated ±Y, since they are proportional to signal voltage applied to the Y input.

ABSOLUTE VALUE OF X

Q210, D210, D215 and their associated components form a circuit that changes ±X signals to equivalent amplitude +X signals only and couples them to the next stage (Fig. 3-11). The bias applied to Q210 is such that when X is zero or positive, the conduction state of Q210 is

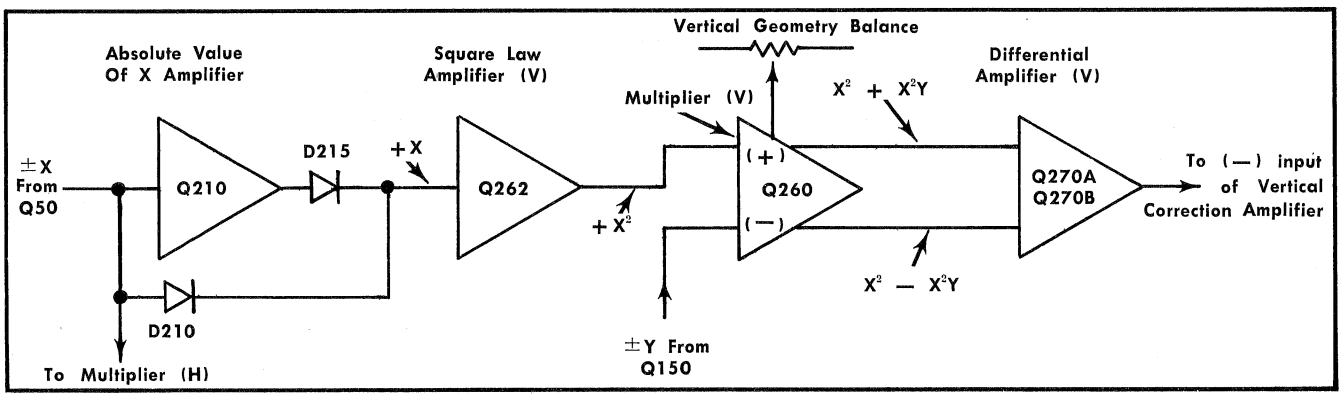


Fig. 3-11. Partial schematic showing the individual stages of the (V) Geometry Correction circuit.

at saturation and the +X signals are coupled by forward-biased D210 to the following amplifier stage. When the X signal is negative, D210 is reverse biased and the conduction of Q210 is reduced. Since the gain of the stage is one, the positive voltage developed at the collector of Q210 is equal in amplitude to the applied negative signal. The equivalent amplitude +X signal is coupled through D215.

SQUARE LAW AMPLIFIER (X)

Field effect transistor (FET) is biased into the square-law region of its characteristics curve, so that it operates as a square-law amplifier. Q262 is biased so its drain current is proportional to the square of its gate-to-source input voltage. Thus, when an input voltage equal to the absolute value of X is applied to Q262, its drain current output to the emitters of Q260 is proportional to X^2.

MULTIPLIER (X)

Dual transistor Q260 and its associated components form the multiplier circuit. The X^2 input signals from the Square Law Amplifier are applied to both emitters. Other inputs are from the Vertical Geometry Balance circuit to one base and ±Y inputs from the collector of Q150 to the other base. The differential outputs of this stage are equivalent to $(X^2 + X^2Y)$ and $(X^2 - X^2Y)$.

DIFFERENTIAL AMPLIFIER (X)

A Differential Amplifier stage comprises Q270A, Q270B and Q280 with their associated components. The combination of Q280 and R287 functions as a constant current source. The input signals from the multiplier circuit ($X^2 + X^2Y$ and $X^2 - X^2Y$) are coupled differentially to the bases of Q270A and Q270B. The X^2Y signal developed at the collector of Q270A is proportional to the inputs. This signal is coupled to the (–) input of the Vertical Correction Amplifier through R156. The Horizontal Geometry control, R238, is an adjustable resistance between the emitters of Q270A and Q270B which provides a means of adjusting the amplitude of the output signal.

ABSOLUTE VALUE OF Y

Q250, D250, D255 and their associated components change the ±Y signals from the collector of Q155 to equivalent amplitude +Y signals. This circuit functions in the same manner as the Absolute Value of X circuit.

SQUARE LAW AMPLIFIER (Y)

FET Q222 performs the same function as Q262 and changes the absolute value of Y signals applied to its input to signals proportional to Y^2 for application to the emitters of Q220.

The multiplier circuit formed by Q220 and its associated components functions the same as the Q260 multiplier circuit. The output signals of this circuit are $(Y^2 + XY^2)$ and $(Y^2 - XY^2)$.

DIFFERENTIAL AMPLIFIER (Y)

The Differential Amplifier (Y) circuit includes Q230A, Q230B, Q240 and their associated components. The functioning of this circuit is the same as the Differential Amplifier (X) circuit. The single-ended output Y^2X is applied to the (–) input of the Horizontal Correction Amplifier circuit.

DYNAMIC FOCUS

Q290 and its associated components form the Dynamic Focus Amplifier (Fig. 3-12). Its purpose is to provide automatic focus corrections to compensate for changing focal lengths as the writing beam is deflected over the faceplate of the CRT. The input signals to this circuit are the X^2 and Y^2 differential outputs of the two multiplier stages in the Geometry Correction circuit. The signals from the multiplier stages may be balanced as required for best focusing with the Focus Correction Symmetry adjustment, R288. The Corner Focus adjustment R292 is a feedback signal adjustment used to set the signal amplitude. The output of the Dynamic Focus Amplifier $(X^2 + Y^2)$ is coupled from the collector of Q290 to R470, the ground return for the DC Focus supply.

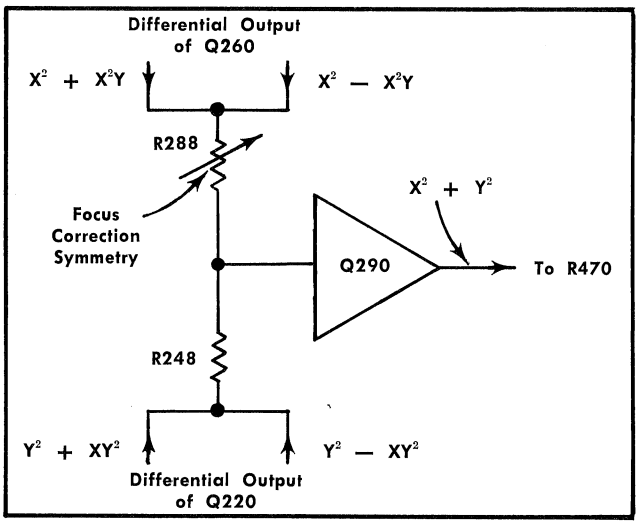


Fig. 3-12. Partial schematic showing the Dynamic Focus Amplifier.

Spiral Generator

Description applies to all serial numbers. The Spiral Generator is an RC type oscillator circuit including Q310, Q315 and their associated components (Fig. 3-13). The purpose of the Spiral Generator is to provide a repetitive damped sine-wave signal for the Horizontal and Vertical

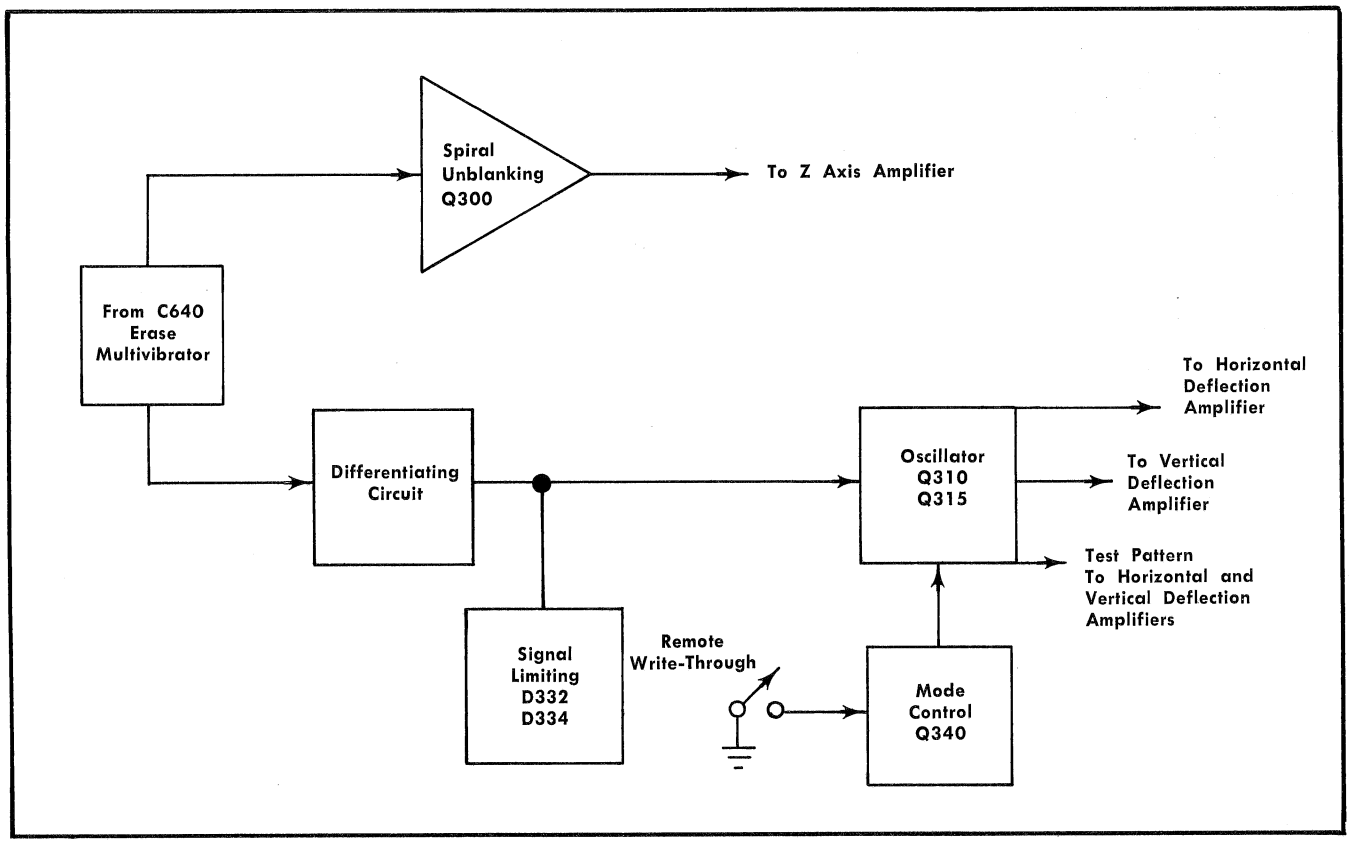


Fig. 3-13. Block diagram of the Spiral Generator circuit.

Deflection Amplifiers when the instrument is set up for FOCUS Test, STORAGE Test or continuous sine-wave in Write-through. The characteristics oscillating frequency of approximately 500 Hz is established by the phase-shifting feedback components C320, R320, C322, R322, C323, R323, C325 and R325 between the emitter of Q315 and the base of Q310. The conduction state of Q340 determines whether the Spiral Generator is biased to operate as a self-excited oscillator or as a ringing oscillator that requires a driving pulse.

When the instrument is operated in Write-through mode, the ground potential applied to the junction of R341 and R342 through J340 biases Q240 to an ON state and the Spiral Generator operates a self-excited phase-shift oscillator. In this mode of operation the output of the Spiral Generator is the 500 Hz sine-wave Test Pattern, coupled from C330 to a phase shifting network in the deflection amplifiers.

When the instrument operating mode is either FOCUS test or STORE test, Q340 is in a non-conduction state and the Spiral Generator operates as a damped oscillator. The drive pulses applied to the base of Q310 are the plus and minus voltage excursions that result when the waveform from C640 of the Erase Multivibrator is coupled to the differentiating circuit which includes R311, R312 and C312. The damped sinewave outputs of the Spiral Generator are coupled, 90° out of phase with each other, through the TEST SPIRAL switch to the deflection amplifiers. The writing beam is unblanked for about 6 ms, coincident with the negative portion of the erase generator pulse. One spiral display appears on the CRT for each Erase Multivibrator waveform applied to the Spiral Generator.

Voltage excursions at the emitter of Q315 are limited in amplitude by the circuitry formed by diodes D332, D334 and their associated components.

Description applies only to instruments above SN B150000. Q360, Q362 and Q364 serve to reduce Write Thru recovery time from approximately 20μs down to about 2 μs. This is accomplished by their action in damping and shunting to ground the oscillations that would normally appear at terminal T. In the Write Thru mode, the −20 volts that is applied through terminal BA to the WRITE THRU control is also applied to the base of Q362 and the gate of Q364. This turns Q362 and Q364 off and turns Q360 on. When the −20 volts is removed, Q362 and Q364 are turned on and Q360 is turned off. The voltage drops across the junctions of D361 and D362 assure that Q362 will be turned off by −20 volts.

Q352 serves as a Write Thru inhibit when the Intensity 3 mode is selected. Q352 is normally on. When Pin 9 of J340 supplies a ground reference to the cathode of D350 during the Intensity 3 mode operation, Q352 is turned off. This will hold Q340 in the off condition and prevent Write Thru from turning on. D345 serves to protect the emitter-base junction of Q340.

Spiral Unblanking

Q300 and associated components comprise the Spiral Unblanking Amplifier (Fig. 3-14). Output signals from C640 of the Erase Multivibrator are input signals to the Spiral Generator and also to this circuit. This results in a direct time relationship between the output signals of the Spiral Generator and The Spiral Unblanking circuits. When the input waveform at the junction of R301 and R302 is positive going, C302 and C304 are charged through D304. Since quiescent bias holds Q300 in a cutoff state, the conduction state of Q300 is not affected by the increased positive voltage at its base. When the input is a negative-going voltage excursion, D304 is reverse biased and C304 begins to discharge through R304. When the charge across C304 drops below about 20 volts, Q300 is turned on to saturation condition at the RC rate of C304 and R304. This generates the output unblanking signal. The turn-on rate of Q300 permits the output of the Spiral Generator to reach a maximum before the writing beam is unblanked. Q300 remains in conduction until the charge across C302 is dissipated enough to forward-bias D304 and charge C304 to its quiescent level. The approximate 6 ms duration of the Spiral Unblanking Amplifier output signal is sufficient to allow about 4 cycles of the damped sine-wave to be displayed, but still short enough to prevent the generation of a bright spot at the center of the CRT.

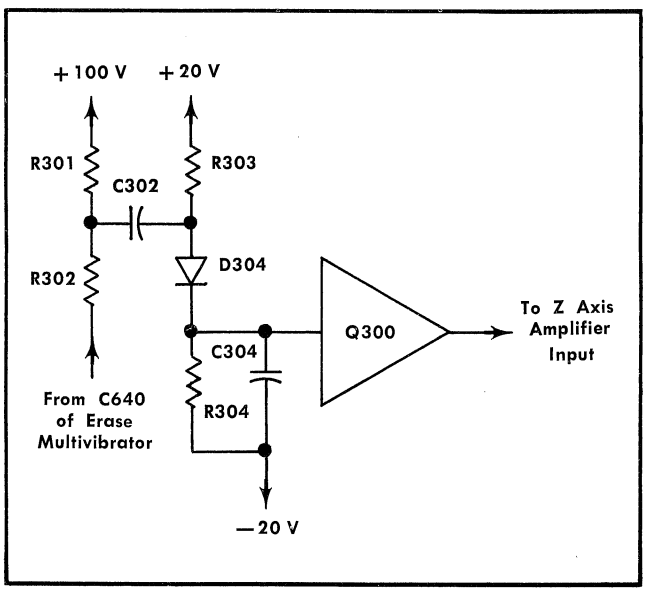


Fig. 3-14. Partial schematic of the Spiral Unblanking Amplifier.

Z Axis Amplifier

Description applies only to instruments above SN B150000. A block diagram of the Z Axis Amplifier circuit is shown in Fig. 3-15. The purpose of the circuit is to convert 1 volt signals applied to the input into writing beam unblanking signals. The input signals for normal operation or for write-through operation must be applied to the Z AXIS INPUT connector located on the rear panel of the instrument. When the TEST SPIRAL switch is set to either FOCUS or STORE, the input signals for the Z axis circuit are the output signals of the Spiral Unblanking amplifier.

The input impedance of the Z Axis Amplifier is approximately the 100 kΩ represented by R420 and R421. R422 limits the gate current of Q420, the source follower input stage. D422 limits the input signals to essentially positive-going signals. The circuit formed by D430, C430 and R430 shapes the positive-going input signals applied to the unblanking signal amplifier Q430. Unblanking signals developed in the collector circuit of Q430 are coupled to the base of Q435. The unblanking signals at the collector of Q435 are developed by the impedance of L439/R439 and applied to the base of emitter follower Q440.

The unblanking signals at the emitter of Q440 are limited by D444 and D445 to values between about 0 volts and +80 volts. The voltage at the cathode of D417 determines the amplitude of the unblanking signals within the clamped limits.

Description applies only to instruments below SN B150000. A block diagram of the Z Axis Amplifier circuit is shown in Fig. 3-15. The purpose of the circuit is to convert 1 volt signals applied to the input writing beam unblanking signals. The input signals for normal operation or for write-through operation must be applied to the Z AXIS INPUT connector located on the rear panel of the instrument. When the TEST SPIRAL switch is set to either FOCUS or STORE, the input signals for the Z axis circuit are the output signals of the Spiral Unblanking amplifier.

The input impedance of the Z Axis Amplifier is the approximate 100 kΩ of R421. R422 limits the gate current of Q420, the Source Follower input stage. D422 limits the input signals to essentially positive going signals. The circuit formed by D430, C430 and their associated components shape the positive-going input signals applied to Unblanking Signal Amplifier Q430. Unblanking signals developed in the collector circuit of Q430 are coupled to the base of Q435 and through R437 and C437 to the base of Q560, the Z axis signal input to the View Reset circuit.

The unblanking signals of the collector of Q435 are developed by the impedance of L439 and R439 and applied to the base of emitter follower Q440.

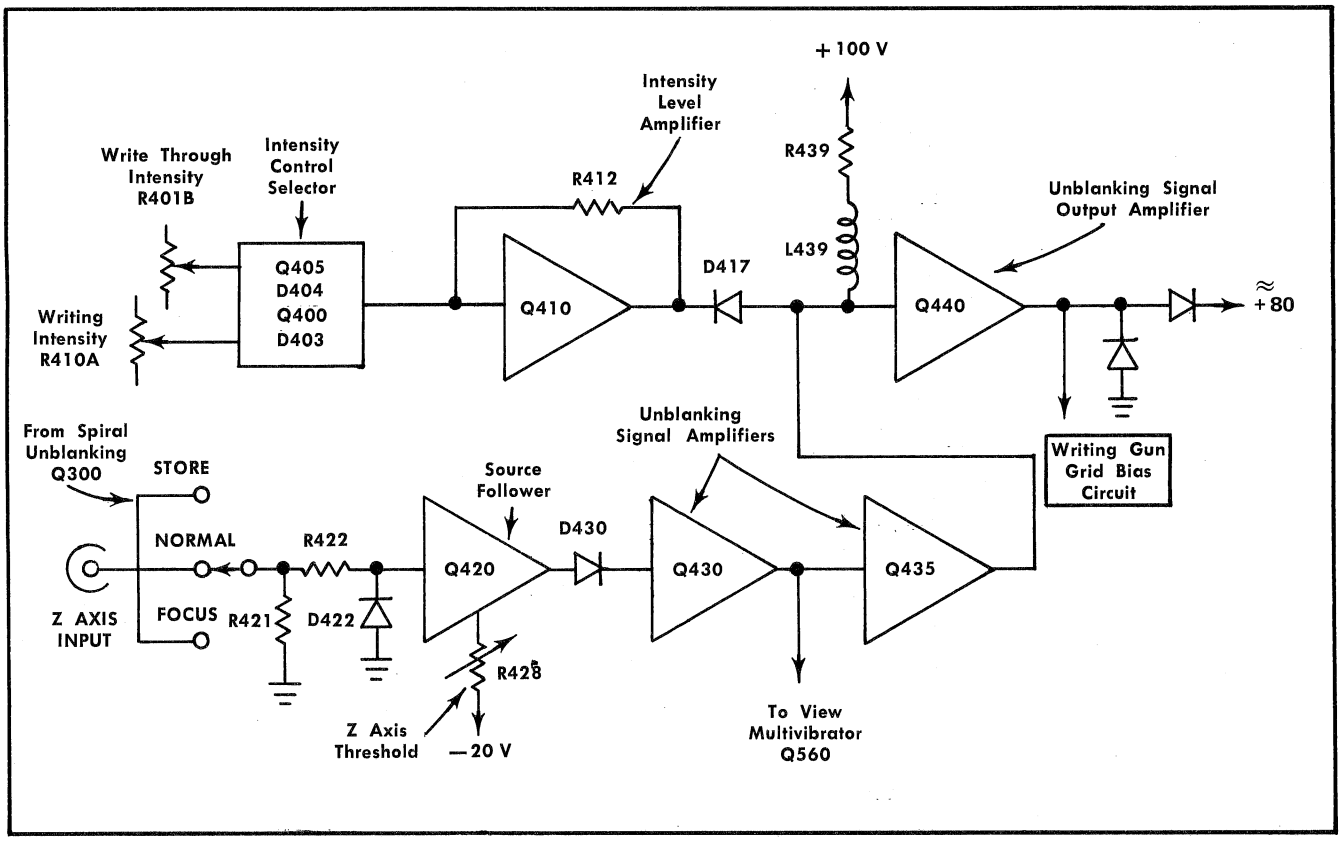


Fig. 3-15. Block diagram of the Z axis amplifier circuit.

The unblanking signals at the emitter of Q440 are limited by D444 and D445 to values between about 0 and 65 volts. The voltage at the cathode of D417 determines the amplitude of the unblanking signals within the clamped limits.

Intensity Control Selection

Description applies only to instruments above SN B150000. The Intensity Control Selection circuit functions as follows:

1. For Write Intensity, Q375 and Q385 are turned off to reverse bias D377 and D387. Q395 is turned on and the INTENSITY control R396 sets the bias on the base of Q410.

2. During Write Thru mode, the junction of R380/R381 is grounded through J340-8 to turn off Q380. This allows Q385 to turn on, applying about −20 volts to the WRITE THRU control R377 and biasing off Q395. D377 is forward biased and the bias at the base of Q410 is now set by the WRITE THRU control.

3. The Intensity 3 input to the base of Q370 will override both Write Intensity and Write Thru circuits. Grounding the junction of R370/R371 turns Q370 off and its collector voltage rises. This turns on Q390 to lock out the Write Thru circuit, and at the same time Q375 is turned on. When Q375 turns on, Q395 is biased off, and about −20 volts is applied to the INTENSITY 3 control. D387 is forward biased and the bias at the base of Q410 is set by the INTENSITY 3 control. Q410/Q415 configuration provides a stable thermal environment to prevent drift due to temperature changes. The output of the circuit is applied to the cathode of D417 to control the amplitude of the unblanking signal.

Description applies only to instruments below SN B150000. Q400, Q405, D403 and D404 form the Intensity Control Selection circuit (Fig. 3-16). The conduction status of Q400 controls the conduction status of other elements, and determines which intensity control voltage is applied to the input of the Intensity Level Amplifier. Except during Write-through operation, Q400 is biased to an ON state, and conduction through R402 is such that D403 is reverse biased. Q405 is held in a cutoff state by the voltage at the junction of R407 and R408. D404 is forward biased and the current into the base of Q410 is determined by the setting of the Intensity Control, R410A. When a remote Write-through signal is applied to the instrument through J340, Q400 is biased to a cutoff state and the conduction through R402 is reduced to an amount that allows Q405 to

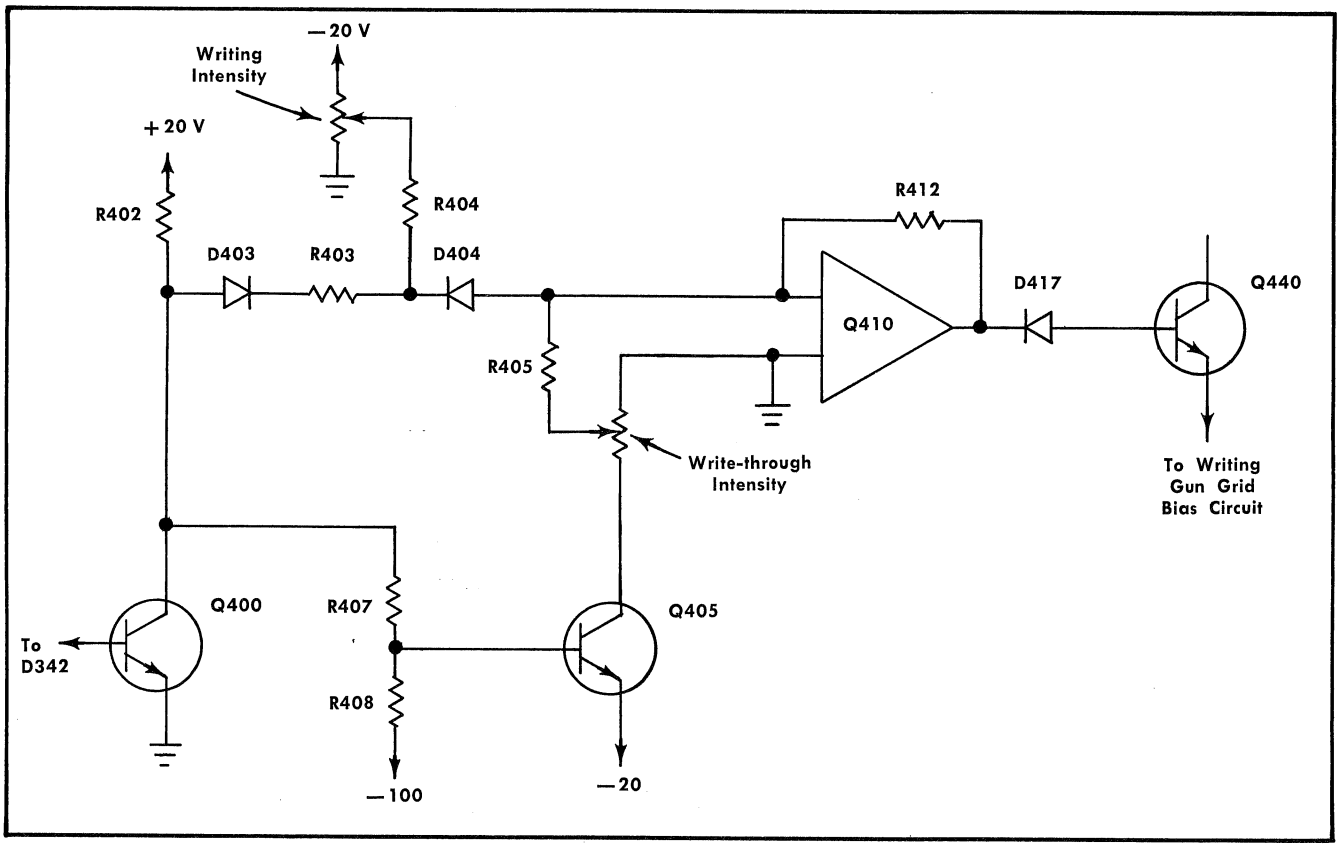


Fig. 3-16. Partial schematic of the Intensity Control circuit.

become forward biased. This applies —20 volts to the Write-through Intensity Control R410B. The reduced conduction through R402 also allows D403 to become forward biased, and the conduction through R403 reverse biases D404. Current into the base of Q410 is determined by the setting of the Write-through Intensity control, R410B.

Erase Multivibrator

The Erase Generator circuitry provides the means of returning all stored target phosphors to a ready-to-write condition. The circuitry includes the Erase switch circuit, and Erase Multivibrator and a one stage voltage amplifier (Fig. 3-17). The Erase Multivibrator is a monostable circuit when the TEST SPIRAL switch is set to either NORMAL or STORE. In a normal operating mode, switching signals may be initiated by either the front panel ERASE switch or by remote station Erase switch through pin 18 of J340. When the TEST SPIRAL Switch is set to STORE, the closing contacts of the TEST SPIRAL Switch is set to FOCUS (the instrument is set for non-storage operation), the Erase Multivibrator is astable, due to the +100 volts applied to D646, and its output is coupled to the Spiral Generator and the Spiral Unblanking amplifier.

When an erase function is initiated during normal operation, the Erase Multivibrator is switched to its transient state and the positive-going output signal at the collector of Q640 is coupled to the base of Q660 through an RC coupling circuit. The multivibrator output biases the Fade Positive voltage amplifier stage (Q660), to a saturation condition until coupling capacitor C656 is charged sufficiently through R655 and R660 to bias Q660 to its quiescent cutoff state.

The Erase Multivibrator remains in its transient state until the erase cycle is completed. During the charge time of C656, the Fade Positive amplifier output signal provides two significant functions: The flood gun assembly voltages are made negative by about 100 volts and capacitor C511 in the input circuit of the target voltage control amplifier is charged to about 100 volts. The change in flood gun assembly voltage increases the flood gun cathode-to-target potential sufficiently to cause a fade-positive condition. When the Fade Positive amplifier is cut off, the flood gun assembly is returned to its normal voltages and charged capacitor C511 in the target voltage control input circuit provides a positive going signal which is applied to the (—) input of the Storage Target Backplate amplifier. This causes the target voltage to be switched to about the flood gun cathode voltage (approximately ground). The target backplate voltage is then returned at an RC rate to its normal operating level. The Erase Multivibrator switches to its stable state, and the instrument is in a ready-to-write state.

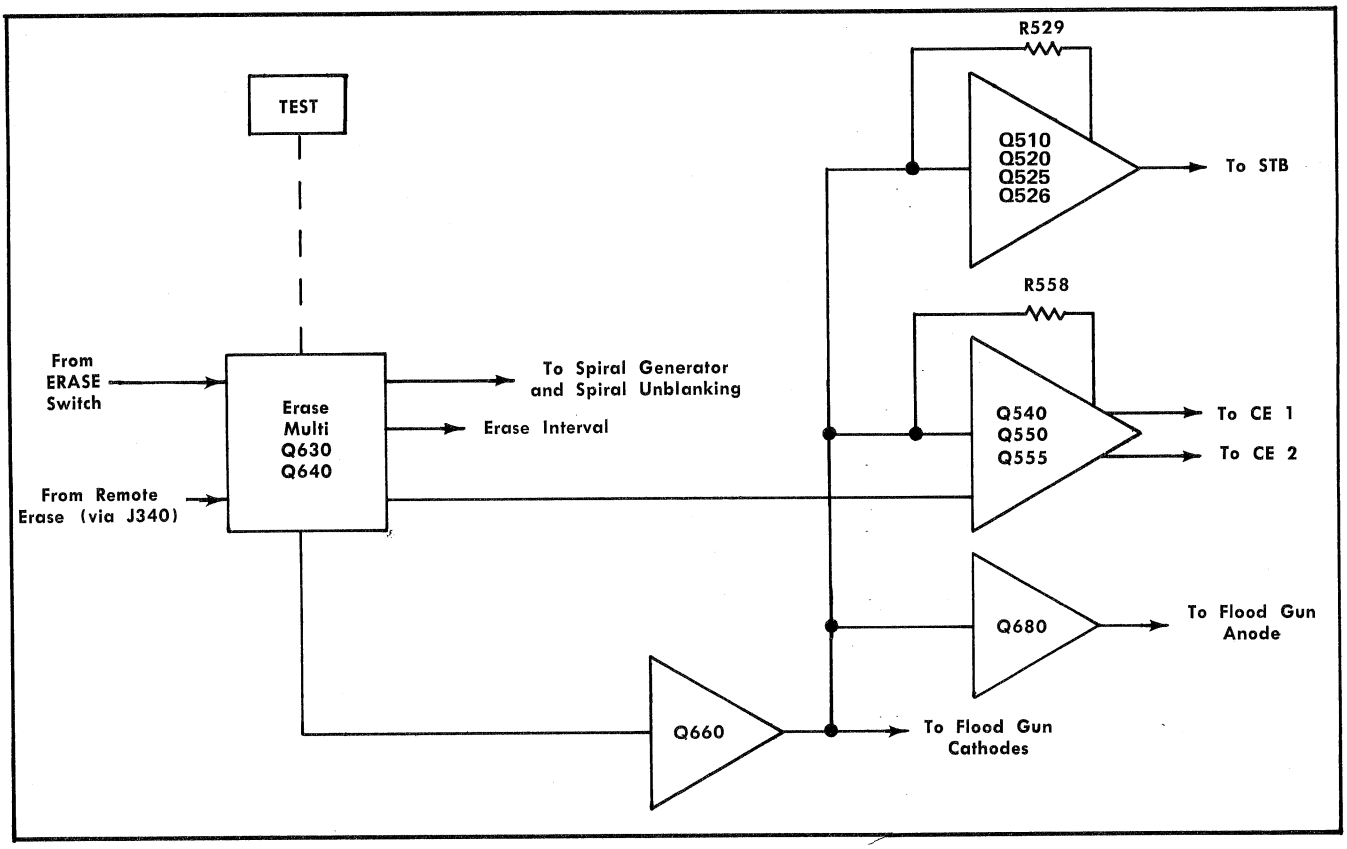


Fig. 3-17. Block diagram of the Erase Multivibrator and Storage Amplifiers.

The process of returning the backplate voltage to its operating point gives the dielectric between the backplate and target phosphors time to change its charge, permitting the phosphors to remain at their stable rest potential. During the erase cycle the collimating electrodes are first raised to a higher potential to maintain proper collimation during the fade positive condition, and then dropped to a lower potential while the target is returning to the ready-to-write state.

Collimation Amplifier

Description applies only to instruments above SN B150000. Q535 is normally on, with its base set at about 5.5 volts by the R533-R535 divider action. D539 is reverse biased. When the ground reference is applied to D530, Q535 is turned off, which will forward bias D539, causing the base of Q540 to go more negative. Q540, Q550 and Q555 comprise an operational amplifier which controls the collimation voltage amplitude at CE-2. The increase of negative voltage at the base of Q540 causes CE-2 to become more positive and allows Hardcopy operation. During the condition when Q535 is turned off, D533 protects the emitter-base junction.

Hold Multivibrator

The Hold Multivibrator includes Q590 and Q600 (Fig. 3-18). The Hold Multivibrator, when active, is an astable circuit with approximately a 1 kHz output coupled to the flood gun Anode Voltage control amplifier. The output waveform is such that the flood gun duty cycle is approximately 10%. The purpose of the holding function is to extend the CRT life expectancy by maintaining storage with a minimum of flood gun electrons.

The Hold Multivibrator may be inhibited by a signal through D582 from the View Multivibrator, by a signal through D628 from the Erase Multivibrator, or by biasing

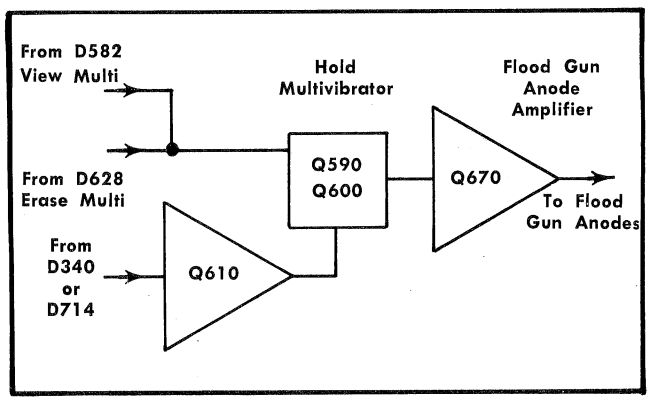


Fig. 3-18. Block diagram of the Hold Multivibrator.

Q610 to a cutoff state. Q610 is biased to cutoff by a signal through J340 (during a write-through function) or by a remote View signal through D614.

Flood Gun Anode Amplifier

Description applies only to instruments above SN B150000. In the emitter circuit of Q670, D678 has been added to prevent any distortion of the hold waveform due to the added filter components C678 and R678.

View Multivibrator

Description applies to all serial numbers. Q570 and Q580 form the monostable View Multivibrator (Fig. 3-19). In the stable state, Q570 is conducting and Q580 is in a cutoff state. When the circuit is switched to the transient state, it will return to the stable state after about 60 to 90 seconds. The output of the circuit is the negative going voltage pulse generated at the collector of Q580 when the circuit is switched to its transient state. The negative pulse forward biases D582 and inhibits the Hold Multivibrator.

Switching signals are applied to the gate of Q570 from either the VIEW switch circuit or the View Reset Multivibrator. C581 with R581 insure that a VIEW switch closure signal will be of long enough duration to effect switching of the View Multivibrator.

Description applies only to instruments above SN B150000. Q564 serves as a veiw multivibrator clamp and is in the normally off condition. When a ground reference is applied through D563, Q564 turns on, and holds Q560 in an off condition regardless of any Z axis signal that might appear on pin Z. This prevents noise from affecting the display during the Intensity 3 mode of operation.

View Reset Multivibrator

Q560 and Q565 with their associated components form the monostable View Reset Multivibrator (Fig. 3-19). The circuit functions as a complementary multivibrator with both transistors biased to cutoff in the stable state. When a Z axis signal is applied to the base of Q560, the circuit is switched to its transient state. This generates an output pulse that is coupled to the View Multivibrator through D569.

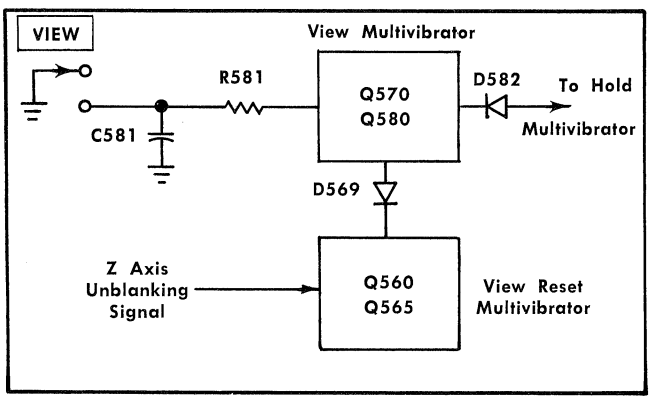


Fig. 3-19. Block diagram of the View Multivibrator.

Non-Store Amplifier

During normal operation, Non-Store Amplifier Q500 is biased to a cutoff state. When a non-store closure signal is applied to pin 6 of J340, D503 is reverse biased and Q500 is forward biased. The conduction of Q500 is applied to the Storage Target Backplate operational amplifier input (Q510), and the target-to-flood gun cathode potential is decreased below retention threshold potential.

STB Amplifier

Description applies only to instruments above SN B150000. The Storage Target Backplate (STB) amplifier consists of operational amplifier Q510, Q520, Q525 and Q526, and transformer T522. T522 couples pulse signals from terminal 4 of V490 to pins 13 and 25 of J340 through a shielded pair cable. The output of T522 is fed through pins BD and BJ, with pin BE being the shield connection. Pin BC provides the connection from V490 to T522. C522 is a noise filter.

CRT Circuit

The CRT Circuit provides the high-voltage and control circuits necessary for operation of the cathode-ray tube (CRT). Fig. 3-20 shows a detailed block diagram of the CRT Circuit. A schematic of this circuit is shown on diagram 4 at the rear of this manual.

Q465 and associated circuitry comprise the High-Voltage Oscillator. The circuit is operated as a class C oscillator and the conduction current of Q465 through the primary windings of high-voltage transformer T465 provides the drive for the secondary windings.

T465 has four output windings. One winding provides unrectified voltage for the writing gun filaments. The outputs of the other three windings are rectified to provide the operating voltages for the writing gun cathode, control grid, and focusing anode.

The half-wave rectifier circuit formed by D492 and C492 is referenced to ground and provides the approximate 3.8 kilovolts accelerating potential that is applied to the cathode. A fraction of this output voltage is returned to the (—) input of the High-Voltage Regulator circuit.

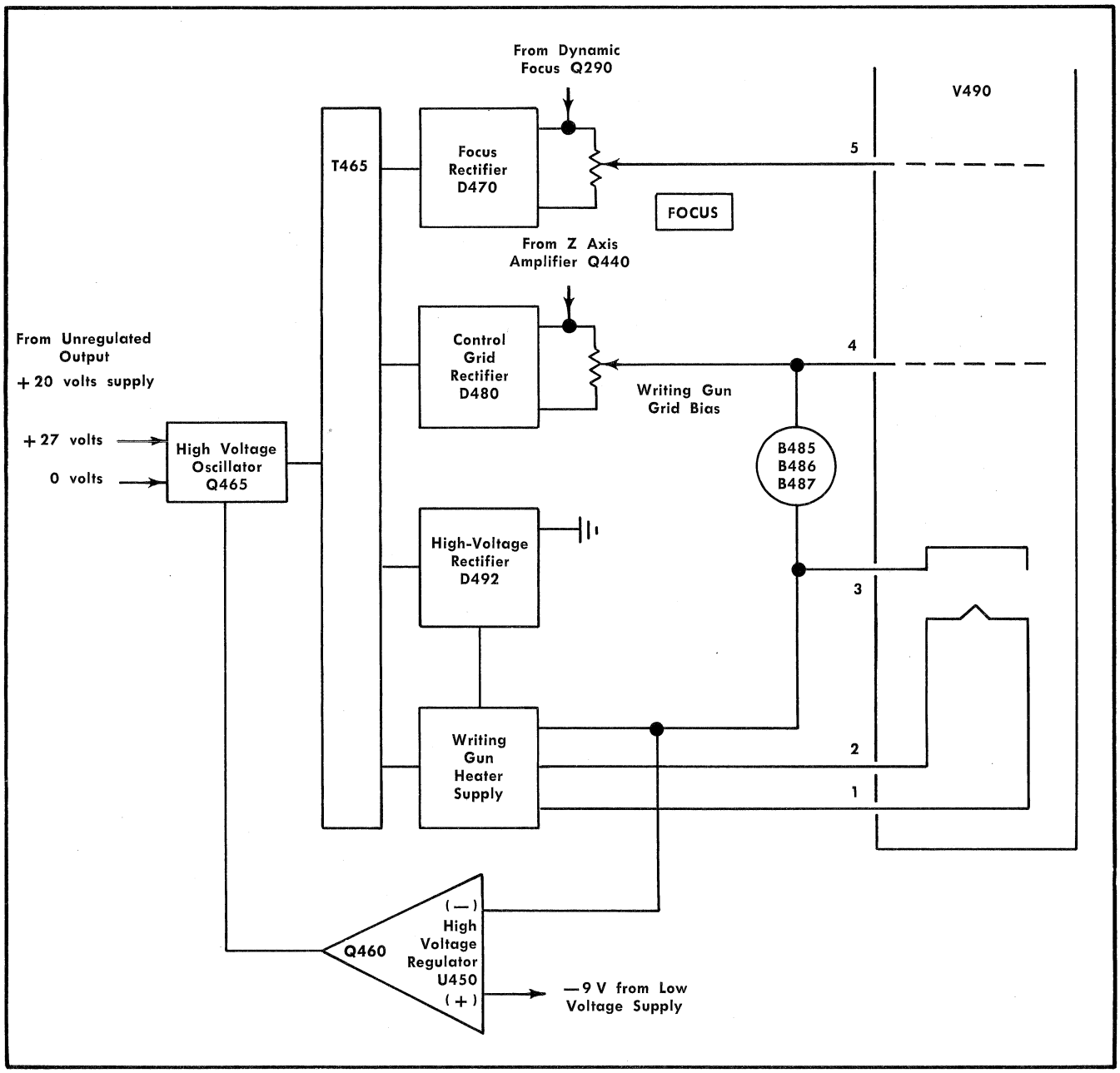


Fig. 3-20. Block diagram of the CRT circuit.

The half-wave rectifier circuit formed by D480 with C480 is connected to the emitter of Q440 in the Z Axis Amplifier output stage. The negative output level of this rectifier is adjustable and may be set with the Writing Gun Grid Bias adjustment, R486. The three neon bulbs, B485, B486 and B487 provide protection against excessive negative grid to cathode voltage, and the circuit formed by D490, R490 and R493 restricts grid current to a safe level, in the event the grid is driven positive with respect to the cathode.

D470 with C470 forms a half-wave rectifier referenced to the collector of Q290 in the Dynamic Focus Amplifier circuit. The adjustable negative output level of this rectifier circuit is applied to the focusing anode and may be adjusted with the front panel FOCUS control, R475.

The High Voltage Regulator includes integrated circuit U450 and its associated components. The circuit is in the form of an operational amplifier with a sample of the 3.8 kilovolt high-voltage supply applied to the (—) input and regulated —9 volts from the low-voltage supply applied to the (+) input. The sampled voltage level may be adjusted with the 3.8 kV Set control, R450. The output voltage of U450 is applied to an amplifier stage formed with Q460,

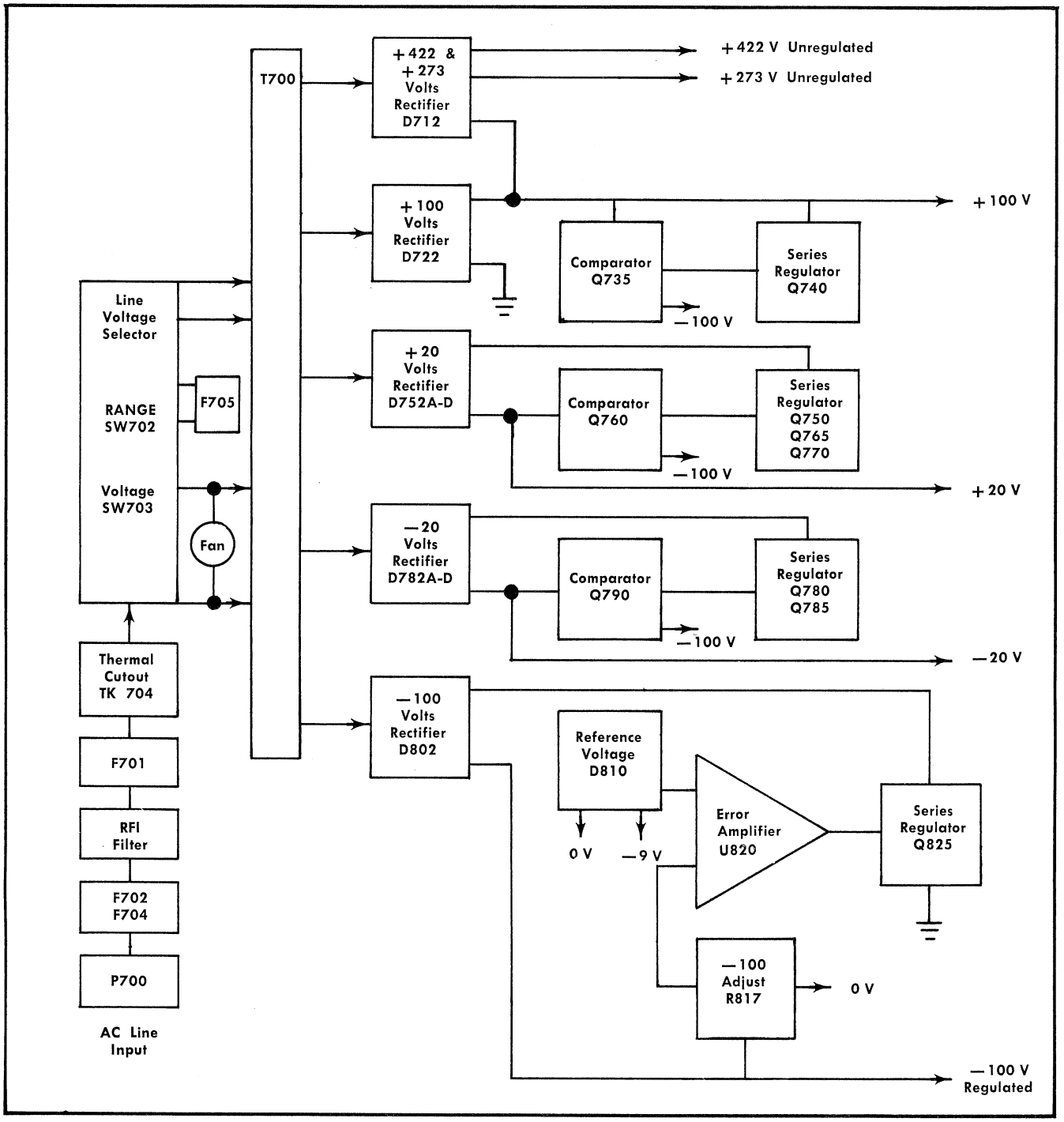


Fig. 3-21. Block diagram of the Power Supply circuit.

and the output of Q460 controls the bias applied to Q465 in the High-Voltage Oscillator circuit.

Low Voltage Power Supply

The Low-Voltage Power Supply circuit provides the operating power for this instrument from four regulated supplies and two unregulated supplies. Electronic regulation is used to provide stable, low-ripple output voltages from the regulated supplies. All of the regulator circuits operate alike. A sensing circuit compares a fraction of the output voltage against a fixed reference voltage. Any difference between the output voltage and the reference produces an error signal which is amplified and applied to the series regulator transistors, causing the regulators to correct for the error and return the output to the proper value. Fig. 3-21 is a block diagram of the Power Supply circuit. A complete schematic of the Low-Voltage Power Supply is shown on diagram 5 at the rear of this manual.

Power Transformer Primary

To provide optimum voltage regluation and correct DC voltage levels with any applied line voltage within the ranges of 90 to 136 VAC and 180 to 272 VAC, the primary is constructed with two identical windings, each with three taps to permit selection of different turns ratios. The desired transformer turns ratio is selected by positioning the Voltage and Range Selectors (located in the Line Voltage Selector Assembly). The two windings are connected in parallel when the Voltage Selector is set to 115 V and in series when the selector is set to 230 V. The position of the Range Selector (LO, M, HI) determines which taps on the two windings are selected.

When line voltage is applied to the instrument, the current path through the primary circuit is through the two 10A fuses, F702 and F704, the line filter, POWER switch, thermal cutout, fuse F701 or fuses F701 and F705, and through both primary windings. When the instrument is connected for 115 volts only fuses F701, F702, and F704 are used. With 230 volts fuse F705 is added to the circuitry.

Thermal cutout switch TK704 is provided to protect the instrument from excessive heating. When its ambient temperature exceeds approximately 150°F, the thermal cutout switch will open the transformer primary circuit. Since the switch will close and restore line voltage to the primary when its ambient temperature drops below its opening temperature, always set the POWER switch to OFF before attempting to remedy an overheated instrument condition.

The fan must be operative to adequately circulate the cooling air when power is applied to the instrument. Since the fan motor is connected across one of the primary windings, power is applied to the fan motor when it is applied to the primary windings and the fan rotation speed is not affected by changes to the transformer's turns ratio.

−100 VOLT SUPPLY

Modular diode assembly (MDA) D802 is connected as a full-wave diode bridge rectifier circuit and its output develops approximately 120 volts DC across C802. Since the +side of C802 is returned to chassis ground through the Series Regulator Q825, the − side of C802 is the −100 volts output. Error Amplifier U820 is connected as an operational amplifier that functions as a voltage comparator circuit with its output applied to the Series Regulator. The two inputs to the Error Amplifier are from the Reference Voltage circuit Zener diode D810, and from the −100 volts dividing and adjustment circuit.

−20 VOLT SUPPLY

Diodes D782A through D are connected as a full-wave rectifier circuit with the output voltage developed across C782. The Comparator circuit formed with D790 is referenced to the −100 volts supply and its output is applied to the Series Regulator circuit Q780 and Q785.

+20 VOLT SUPPLY

Diodes D752A through D are connected as a full-wave rectifier circuit with the output voltage developed across C752. Q760 and its associated components comprise comparator circuit referenced to the −100 volt supply Q765 with R772 is a load current sensing circuit. Q754 and Q770 make up the Series Regulator circuit. The unregulated output across C752 is provided as the supply for the High Voltage Oscillator circuit.

+100 VOLT SUPPLY

MDA D722 is a full-wave diode bridge rectifier circuit and its output voltage is developed across C722. The negative side of C722 is connected to chassis ground and the positive side is the ground return for the unregulated supplies. The comparator circuit formed by Q735 with its associated components is referenced to the −100 volt supply. The comparator output signals are emitter-coupled to the series regualtor through Q730 and Q720. Q740 is the series regulator and the regulated +100 volt output is coupled from its emitter.

UNREGULATED SUPPLIES

MDA D712 provides full-wave rectification for both unregulated supplies. All four diodes are used in the configuration of a conventional diode bridge circuit to rectify the full secondary voltage between pins 18 and 20. The output voltage of the diode bridge rectifier is developed across C714A and is added to the unregulated output of the +100 Volt Supply to produce the +422 Volt Supply. Two of the diodes with their respective halves of the secondary form half-wave rectifiers that conduct on alternate half cycle. The effective full-wave rectification of one-half the secondary voltage is developed across C714B and is also added to the unregulated output of the +100 Volt Supply to produce the +273 Volt supply.

SECTION 4
MAINTENANCE

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

Introduction

This section of the manual contains preventative maintenance, corrective maintanence and troubleshooting information for the Type 611.

PREVENTIVE MAINTENANCE

Preventative maintenance consists of cleaning, inspecting lubricating and recalibrating the instrument. Since preventive maintenance may reveal and correct minor circuit misadjustments or defects, preventive maintenance should be performed regularly to assure continued optimum performance. Preventive maintenance is recommended after each 500 hours of operating, or at least every six months if used intermittently.

Cleaning

The exterior of the instrument may be cleaned as often as operating conditions require. It may be cleaned with a soft cloth or small paint brush dampened in a mild detergent and water solution. Abrasive cleaners should not be used.

Cleaning of the interior should be followed with instrument recalibration. Dust in the interior can prevent efficent heat dissipation and may provide an electrical conduction path under high humidity conditions. Low-velocity air should be used to blow off the accumulated dust. Any remaining residue or grease may be removed with a mild detergent and water solution. Cotton-tipped applicators are useful for cleaning the ceramic terminal strips and circuit boards.

The air filter may be cleaned by soaking it in a detergent and hot water solution, then rinsing it in clear water. When the filter is dry, coat it with an air filter adhesive (available from air conditioner suppliers or by ordering Tektronix Part No. 006-0580-00).

CAUTION

Avoid the use of chemical cleaning agents which might damage the plastic used in this instrument. Avoid chemicals which contain benzene, toluene, xylene, acetone or similar solvents.

Lubrication

The reliability of potentiometers and other moving parts can be maintained if they are kept properly lubricated. Use a cleaning-type lubricant (e.g., Tektronix Part No. 006-0442-00) on shaft bushings and switch contacts. Lubricate switch detents with a heavier grease (e.g., Tektronix Part No. 006-0219-00). Potentiometers which are not permanently sealed should be lubricated with a lubricant which will not affect electrical characteristics (e.g., Tektronix Part No. 006-0172-00). Do not over-lubricate. A lubrication kit containing the necessary lubricants and instructions is available from Tektronix, Inc. Order Tektronix Part No. 003-0342-01.

Visual Inspection

Inspect for such defects as broken connectors, broken or damaged ceramic strips, improperly seated transistors or nuvistors, damaged circuit boards and heat-damaged parts.

The corrective procedure for most visible defects is obvious; however, particular care must be taken if heat-damaged components are found. Overheating usually indicates other trouble in the instrument; therefore, it is important that the cause of overheating be corrected to prevent recurrence of the damage.

Transistors

Periodic removal of transistors for testing is not recommended. The best operational check of a transistor is its performance in the instrument.

Recalibration

Complete calibration instruction are given in Section 5.

TROUBLESHOOTING

This information is provided as an aid to troubleshooting and should facilitate locating defective components or other circuit malfunctions. The most effective aid to efficient troubleshooting is an understanding of circuit operation. A complete circuit description is given in Section 3.

Troubleshooting Aids

Diagrams. Schematic diagrams are given on foldout pages in Section 8. The circuit numbers and electrical values of all components, as well as significant voltages and waveforms, are shown on the diagrams.

Component numbers. Each main circuit is assigned a series of component numbers. Table 4-1 lists the main circuits with their component number series.

Wiring Color Code. All insulated wire used in the Type 611 is color coded to facilitate circuit tracing and voltage measurement. A decoupled supply or a signal carrying lead will have either one or two colored stripes. The volt-

TABLE 4-1

Component Numbers

Component Numbers on Diagrams	Diagram Number	Circuit
1-299	1	Horiz/Vert Amplifiers and Geometry Correction
301-399	2	Test Spiral Generator and Switching
401-499	3	Z Axis & H V Supply
501-699	4	Storage Circuit
701-899	5	Power Supply

age supply leads will have three stripes. Using the EIA resistor color code, the three stripes on a voltage supply lead indicate the approximate supply voltage. The widest strip indicates the first significant number and the background indicates either positive or negative voltage. Table 4-2 lists the supply voltages and wire color codes used in the Type 611.

TABLE 4-2

Color codes of voltage supply leads

Supply	Background color	First Stripe	Second Stripe	Third Stripe
—100	Tan	Brown	Black	Brown
+100	White	Brown	Black	Brown
+20	White	Red	Black	
—20	Tan	Red	Black	
+430	White	Yellow	Orange	Black
+280	White	Red	Grey	Black

Resistor Color-Code. In addition to the brown composition resistors, some metal-film resistors, wire-wound resistors and special temperature coefficient resistors are used in the Type 611. The values of wire-wound and temperature coefficient resistors are printed on the body of the components. The resistances values of composition resistors and metal-film resistors are color-coded on the components with EIA color-code (some metal-film resistors may have the value printed on the body). The color-code is read starting with the stripe nearest the end of the resistor. Composition resistors have four stripes which consist of two significant figures, a multiplier and a tolerance value. (Fig. 4-1). Metal-film resistors have five stripes consisting of three significant figures, a multiplier and a tolerance value.

Capacitor Marking. The capacitance values of common disc capacitors and small electrolytics are marked in microfarads on the side of the component body. The white ceramic capacitors used in the Type 611 are color coded in picofarads using a modified EIA code.

Diode Color Code. The cathode end of each glass-encased diode is indicated by a stripe, a series of stripes or a dot. For most silicon or germanium diodes with a series of stripes, the color-code also indicates the Type of diode and identifies the Tektronix Part Number using the resistor color-code system (e.g., a diode color-coded blue-brown-gray-green indicates diode type 6185 with Tektronix Part Number 152-0185-00). The cathode and anode end of the metal-encased diode can be identified by the diode symbol marked on the body.

Transistor Lead Identification. Figure 4-2 shows the lead configuration of the transistor types used in the Type 611.

Troubleshooting Aids

The following equipment is useful for troubleshooting the Type 611.

1. Transistor Tester

Description: Tektronix Type 575 Transistor-Curve Tracer or equivalent.

Purpose: To test the semiconductors used in this instrument.

2. Multimeter

Description: VTVM, 10 megohm input impedance and a 0 to 500 volts range; ohmmeter, 0 to 50 megohms. Accuracy, within 3%. Test prods must be insulated to prevent accidental shorting.

Purpose: To check voltages and for general troubleshooting.

NOTE

A 20,000 ohms/volt VOM can be used to check the voltages in this instrument if allowances are made for the circuit loading of the VOM at high-impedance points.

3. Test Oscilloscope

Description: DC to 10 MHz frequency response, 50 millivolts to 50 volts/division deflection factor. A 10× probe should be used to reduce circuit loading.

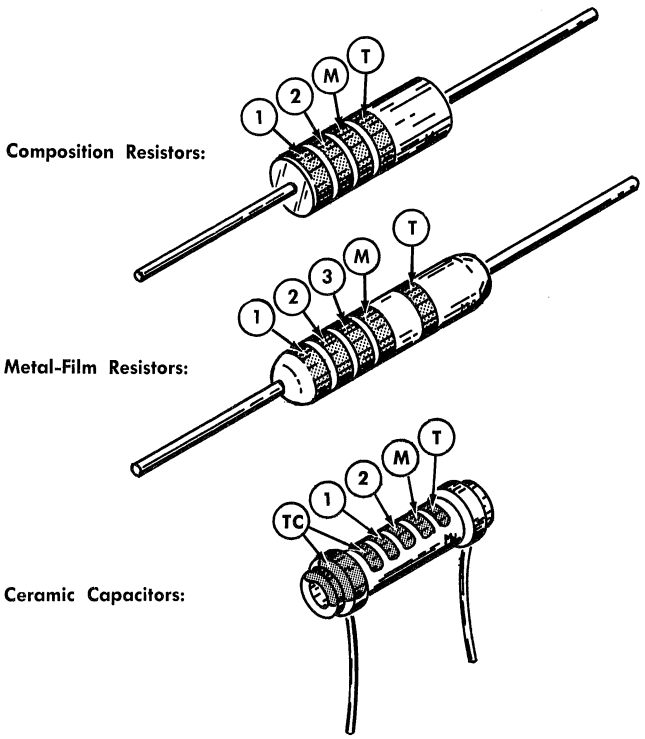
Purpose: To view circuit waveforms.

Troubleshooting Techniques

Verify that the malfunction is actually a fault of the Type 611 and not a malfunction of associated instruments or connecting equipment. Operate the front panel controls to be sure the trouble is not a result of incorrect settings, and to observe the effects of the controls on the symptoms. The trouble symptoms often identify the circuit in which the malfunction is located.

When the trouble is isolated to a circuit, attempt to locate the defective component by inspecting for heat-damaged or broken components, checking for abnormal voltages and waveforms, or by checking individual components as follows.

A. TRANSISTORS. The best check of transistor operation is actual performance under operating conditions. If a transistor is suspected of being defective, it can best be checked by substituting a new component or one which has been checked previously. However, be sure that circuit conditions are not such that a replacement transistor might also be damaged. If substitute transistors are not available, use



(1) (2) and (3) —1st, 2nd and 3rd significant figures;
(M) —multiplier; (T) —tolerance;
(TC) —temperature coefficient.

Resistor and Capacitor Color Code

Color	Significant Figures	Multiplier		Tolerance	
		Resistors	Capacitors	Resistors	Capacitors
Silver	---	10^{-2}	---	±10%	---
Gold	---	10^{-1}	---	±5%	---
Black	0	1	1	---	±20% or 2 pF*
Brown	1	10	10	±1%	±1% or 0.1 pF*
Red	2	10^{2}	10^{2}	±2%	±2%
Orange	3	10^{3}	10^{3}	±3%	±3%
Yellow	4	10^{4}	10^{4}	±4%	+100% —0%
Green	5	10^{5}	10^{5}	±0.5%	±5% or 0.5 pF*
Blue	6	10^{6}	10^{6}	---	---
Violet	7	---	---	---	---
Gray	8	---	10^{-2}	---	+80% —20% or 0.25 pF*
White	9	---	10^{-1}	---	±10% or 1 pF*
(none)	---	---	---	±20%	±10% or 1 pF*

*For capacitance of 10 pF or less.

NOTE: (T) and/or (TC) color code for capacitors depends upon manufacturer and capacitor type. May not be present in some cases.

Fig. 4-1. Color-code for resistors and ceramic capacitors.

a dynamic tester (such as Tektronix Type 570 or 575). Static-type testers are not recommended, since they do not check operation under simulated operating conditions.

CAUTION

The POWER switch must be turned off before removing or replacing transistors.

B. DIODES. A diode can be checked for an open or shorted condition by measuring the resistance between terminals. With an ohmmeter scale having an internal source of between 800 millivolts and 3 volts, the resistance should be very high in one direction and very low when the meter leads are reversed.

CAUTION

Do not use an ohmmeter scale that has a high internal current. High currents may damage the diode. Use a dynamic tester such as a Tektronix Type 575 Transistor-Curve Tracer.

C. RESISTORS. Check the resistors with an ohmmeter. See the Electrical Parts List for the tolerance of the resistors used in this instrument. Resistors normally do not need to be replaced unless the measured value varies widely from the specified value.

D. INDUCTORS. Check for open inductors by checking continuity with an ohmmeter. Shorted or partially shorted inductors can usually be found by checking the waveform response when high-frequency signals are passed through the circuit. Partial shorting often reduces high-frequency response (roll-off).

E. CAPACITORS. A leaky or shorted capacitor can best be detected by checking resistance with an ohmmeter on the highest scale. Do not exceed the voltage rating of the capacitor. The resistance reading should be high after initial charge of the capacitor. An open capacitor can best be detected with a capacitance meter or by checking whether the capacitor passes AC signals.

If any defective parts are located, follow the replacement procedures given in this section. Be sure to check the performance of any circuit that has been repaired or that has had any electrical components replaced.

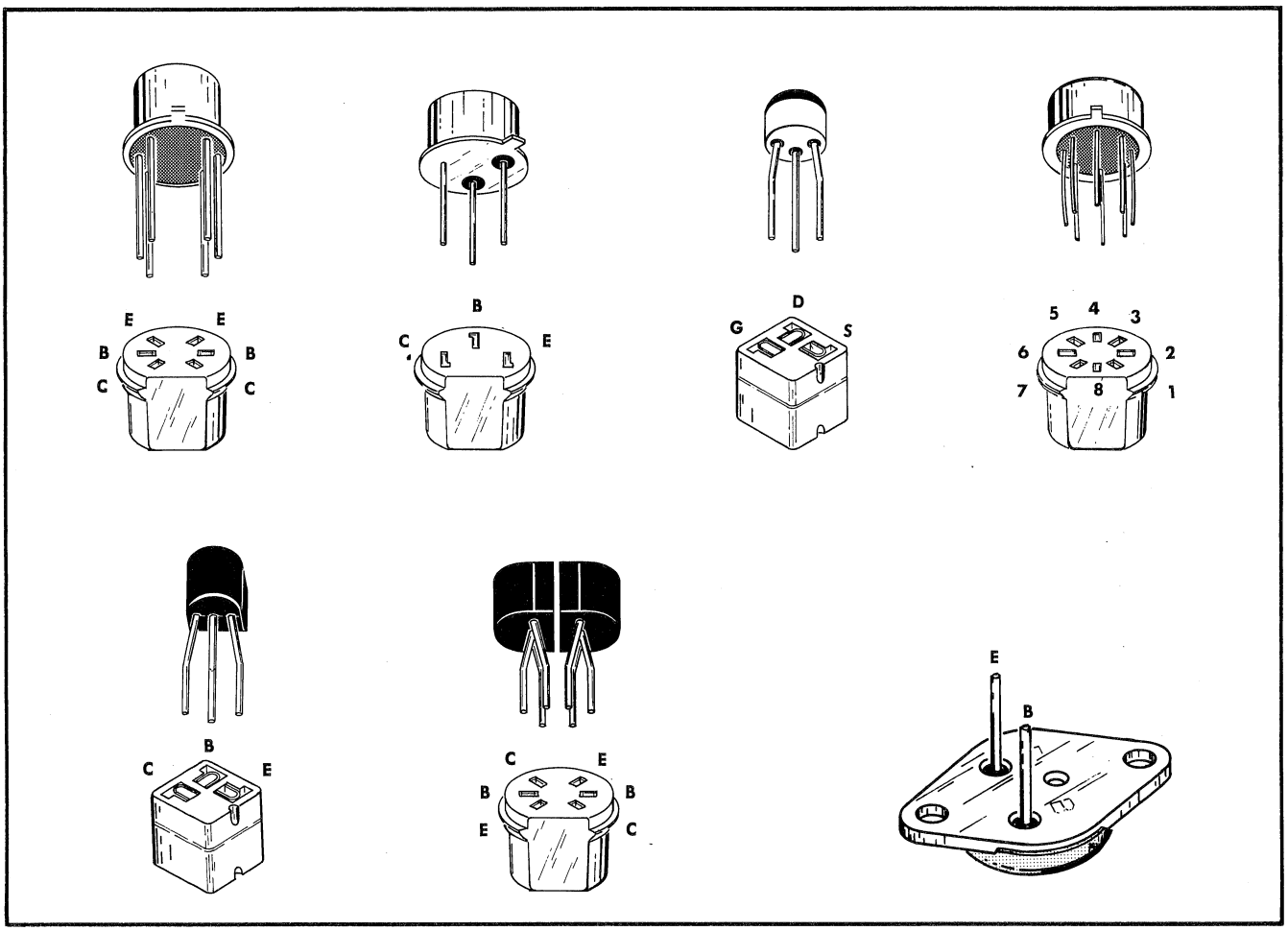


Fig. 4-2. Electrode configuration for transistors in this instrument (as viewed from bottom).

CORRECTIVE MAINTENANCE

General

Corrective maintenance consists of component replacement and instrument repair. Special techniques required to replace components in this instrument are given here.

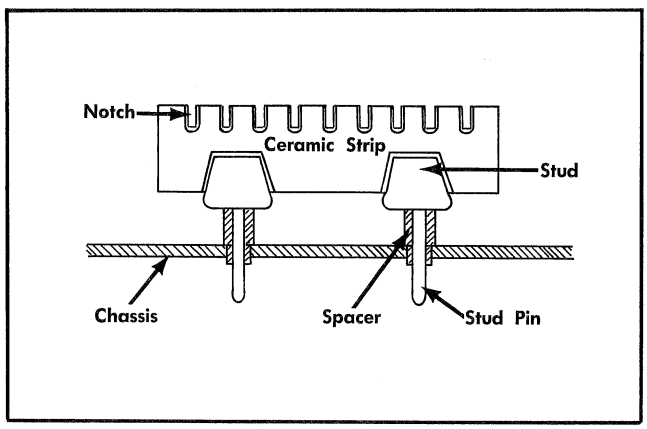


Fig. 4-3. Ceramic terminal strip assembly.

Obtaining Replacement Parts

Standard Parts. All electrical and mechanical part replacements for the Type 611 can be obtained through your local Tektronix Field Office or representative. However, many of the standard electronic components can be obtained locally in less time than is required to order them from Tektronix, Inc. Before purchasing or ordering replacement parts, check the parts lists for value, tolerance, rating and description.

NOTE

When selecting replacement parts, it is important to remember that the physical size and shape of a component may affect its performance in the instrument, particularly at high frequencies. All replacement parts should be direct replacements unless it is known that a different component will not adversely affect instrument performance.

Special Parts. In addition to the standard electronic components, some special parts are used in the Type 611. These parts are manufactured or selected by Tektronix, Inc. to meet specific performance requirements, or are manufac-

tured for Tektronix, Inc. in accordance with our specifications. These special parts are indicated in the parts list by an asterisk preceding the part number. Most of the mechanical parts used in this instrument have been manufactured by Tektronix, Inc. Order all special parts directly from your local Tektronix Field Office or representative.

Ordering Parts. When ordering replacement parts from Tektronix, Inc., include the following information:

1. Instrument Type.
2. Instrument Serial Number.
3. A description of the part (if electrical, include circuit number).
4. Tektronix Part Number.

Soldering Techniques

WARNING

Disconnect the instrument from the power source before soldering.

Circuit Boards. Use ordinary 60/40 solder and a 35- to 40-watt pencil type soldering iron on the circuit boards. The tip of the iron should be clean and properly tinned for best heat transfer to the solder joint. A higher wattage soldering iron may separate the wiring from the base material.

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

1. Grip the component lead with long-nose pliers. Touch the soldering iron to the lead at the solder connection. Do not lay the iron directly on the board at it may damage the board.

2. When the solder begins to melt, pull the lead out gently. This should leave a clean hole in the board. If not, the hole can be cleaned by reheating the solder and placing a sharp object such as a toothpick into the hole to clean it out. A vacuum-type desoldering tool can also be used for this purpose.

3. Bend the leads of the new component to fit the holes in the board. If the component is replaced while the board is mounted in the instrument, cut the leads so they will just protrude through the board. Insert the leads into the holes in the board so the component is firmly seated against the board (or as positioned originally). If it does not seat properly, heat the solder and gently press the component into place.

4. Touch the iron to the connection and apply a small amount of solder to make a firm solder joint; do not apply too much solder. To protect heat-sensitive components, hold the lead between the component body and the solder joint with a pair of long-nose pliers or other heat sink.

5. Clip the excess lead that protrudes through the board.

6. Clean the area around the solder connection with a flux-remover solvent. Be careful not to remove information printed on the board.

Ceramic Terminal Strips. Solder used on the ceramic terminal strips should contain about 3% silver. Use a 40- to 75-watt soldering iron with a 1/8-inch wide wedge-shaped tip. Ordinary solder can be used occasionally without damage to the ceramic terminal strips. However, if ordinary solder is used repeatedly or if excessive heat is applied, the solder-to-ceramic bond may be broken. Silver-bearing solder should be available from local electronic distributors, or it may be purchased in one pound rolls through your Tektronix Field Office. Order by Tektronix Part No. 251-0514-00.

Observe the following precautions when soldering to ceramic terminal strips.

1. Use a hot iron for a short time. Apply only enough heat to make the solder flow freely.
2. Maintain a clean, properly tinned tip.
3. Avoid putting pressure on the ceramic terminal strip.
4. Do not attempt to fill the terminal-strip notch with solder; use only enough solder to cover the wires adequately.
5. Clean the flux from the terminal strip with a flux-remover solvent.

Metal Terminals. When soldering metal terminals (e.g., swich terminals, potentiometers, etc.), ordinary 60/40 solder can be used. Use a soldering iron with a 40- to 75-watt rating and a 1/8-inch wide wedge-shaped tip.

Observe the following precautions when soldering metal terminals.

1. Apply only enough heat to make the solder flow freely.
2. Apply only enough solder to form a solid connection. Excess solder may impair the function of the part.
3. If a wire extends beyond the solder joint, clip off the excess.
4. Clean the flux from the solder joint with a flux-remover solvent.

Component Replacement

WARNING

Disconnect the instrument from the power source before replacing components.

Ceramic Terminal Strip Replacement. Replacement strips (including studs) and spacers are supplied under separate part numbers. However, the old spacers may be re-used if they are not damaged. The applicable Tektronix Part Numbers for the ceramic strips and spacers used in this instrument are given in the Mechanical Parts List. Fig. 4-3 shows a complete ceramic terminal strip assembly.

To replace a ceramic terminal strip, use the following procedure:

Removal:

1. Unsolder all components and connections on the strip. To aid in replacing the strip, it may be advisable to mark each lead or draw a sketch to show location of the components and connections.
2. Pry or pull the damaged strip from the chassis. Be careful not to damage the chassis.

3. If the spacers come out with the strip, remove them from the stud pins for use on the new strip (spacers should be replaced if they are damaged).

Replacement:

1. Place the spacers in the chassis holes.

2. Carefully press the studs of the strip into the spacers until they are completely seated. If necessary, use a soft mallet and tap lightly, directly over the stud, to seat the strip completely.

3. If the stud extends through the spacers, cut off the excess.

4. Replace all components and connectors. Observe the soldering precautions given under Soldering Techniques in this section.

Circuit Board Replacement. If a circuit board is damaged beyond repair, either the entire assembly including all soldered-on components, or the board only, can be replaced. Part numbers are given in the Mechanical Parts List for either the completely wired or the unwired board. Most of the components mounted on the circuit boards can be replaced without removing the boards from the instrument. Observe the soldering precautions given under Soldering Techniques in this section. However, if the bottom side of the board must be reached or if the board must be moved to gain access to other areas of the instrument, only the mounting screws need to be removed. The interconnecting wires on most of the boards are long enough to allow the board to be moved out of the way or turned over without disconnecting the pin connectors.

Transistor Replacement. Transistors should not be replaced unless actually defective. If removed from their sockets during routine maintenance, return them to their original sockets. Unnecessary replacement of transistors may affect the calibration of this instrument. When transistors are replaced, check the operation of the instrument.

CAUTION

POWER switch must be turned off before removing or replacing transistors.

Air Filter Replacement

The air filter may be removend with the rear panel dust cover in place by pulling it through the ventilation opening (see Fig. 4-4). The filter may be replaced by inserting its edges through the ventilation opening and pushing it into place.

Fan Assembly Replacement

The fan assembly with its protective grille may be removed from its snap-in mounting using the following procedure:

1. Remove the air filter to expose the fan and clear the ventilation opening through which the fan will be removed (see Fig. 4-5).

2. Remove the left dust cover to expose the top of the instrument and raise the swing-up chassis (see Fig. 4-6).

3. From the interior of the instrument, depress the holding clip on one side by inserting a small screwdriver or other tool between the fan assembly and the clip (see Fig. 4-7). While the clip is depressed, pull the fan toward the rear with the other hand until it is clear of the holding fingers (about ½ inch). At this stage, the fan assembly should be tilted from the centerline since the fingers on the opposite clip will still be engaged.

4. Depress the opposite holding clip while pulling the fan assembly to the rear. When the fan assembly is free of the holding fingers of both clips, it may be pulled free of the snap-in mounting through the ventilation opening to the length of the power lead (see Fig. 4-8).

5. To disconnect the fan assembly completely from the instrument, unsolder the two power leads.

To install a new fan assembly in the Type 611, use the following procedure:

1. Install the protective grille from the old fan assembly on the rear of the new assembly with four holding screws. The rear of the new assembly can be determined by observing the air flow directional arrow on the fan label. The fan assembly should be installed to draw air in through the air filter at the rear of the instrument.

2. Solder the two power leads to the pins on the fan assembly.

3. Insert the fan assembly into the snap-in mounting through the ventilation opening. Very little pressure is required to properly seat the fan assembly in the holding clips, provided the alignment is correct. To assure proper alignment, observe that the upper and lower ends of the holding clips are curved inward to form flanges and that the sides of the fan assembly are grooved to accept the flanges when alignment is correct.

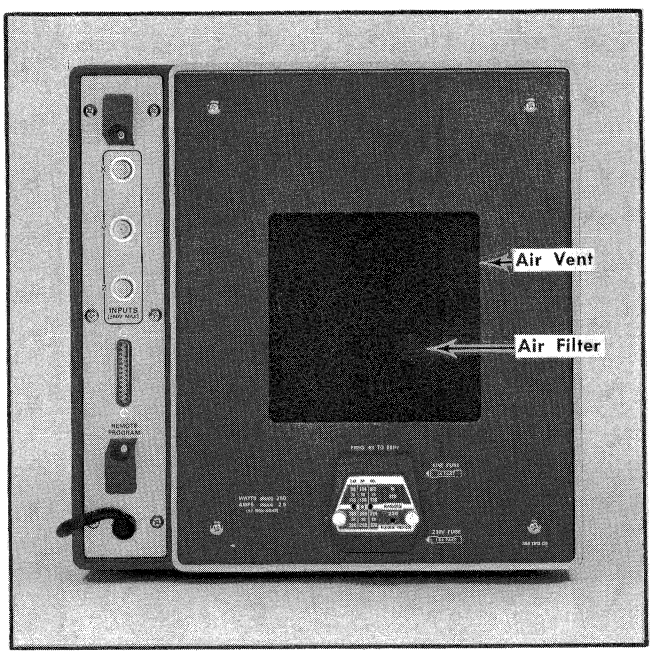


Fig. 4-4. Type 611, Rear panel with air filter installed.

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Cathode-Ray Tube Replacement

WARNING

The CRT may implode if it is scratched or struck severely enough. Wear protective clothing and a face shield when replacing the CRT.

To remove the Cathode Ray Tube, use the following procedure:

1. Disconnect the signal cable and power cord from the instrument.

2. Remove the side covers.

3. With the instrument in the normal position, raise the swing-up chassis.

4. Pull the fan assembly from its snap-in mounting; do not disconnect its power leads.

5. Disconnect the CRT base socket by pulling the socket straight back (see Fig. 4-8).

6. Disconnect the storage socket from the CRT (see Fig. 4-6). Loosen the yoke "O" ring retaining clamp (see Fig. 4-6) to relieve the strain on the neck of the CRT for the steps that follow.

7. Remove the bezel by pulling forward on it while flexing its upper and lower edges to disengage the front casting fingers from the holes in the bezel. An alternative method of disengaging the front casting fingers from the holes in the bezel is to pry the upper and lower bezel edges away from the casting with a thin bladed instrument.

8. Remove the four nuts and spacers from the studs located in the corners of the front casting (see Fig. 4-9).

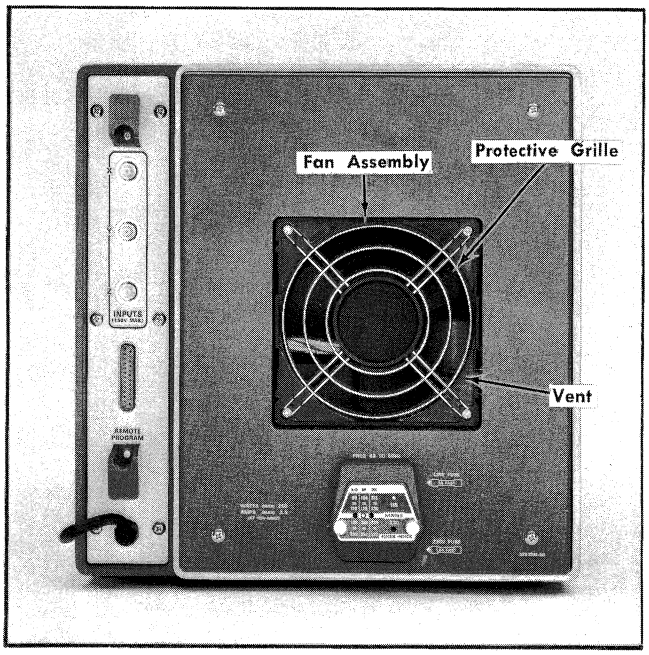


Fig. 4-5. Filter removed from the air vent.

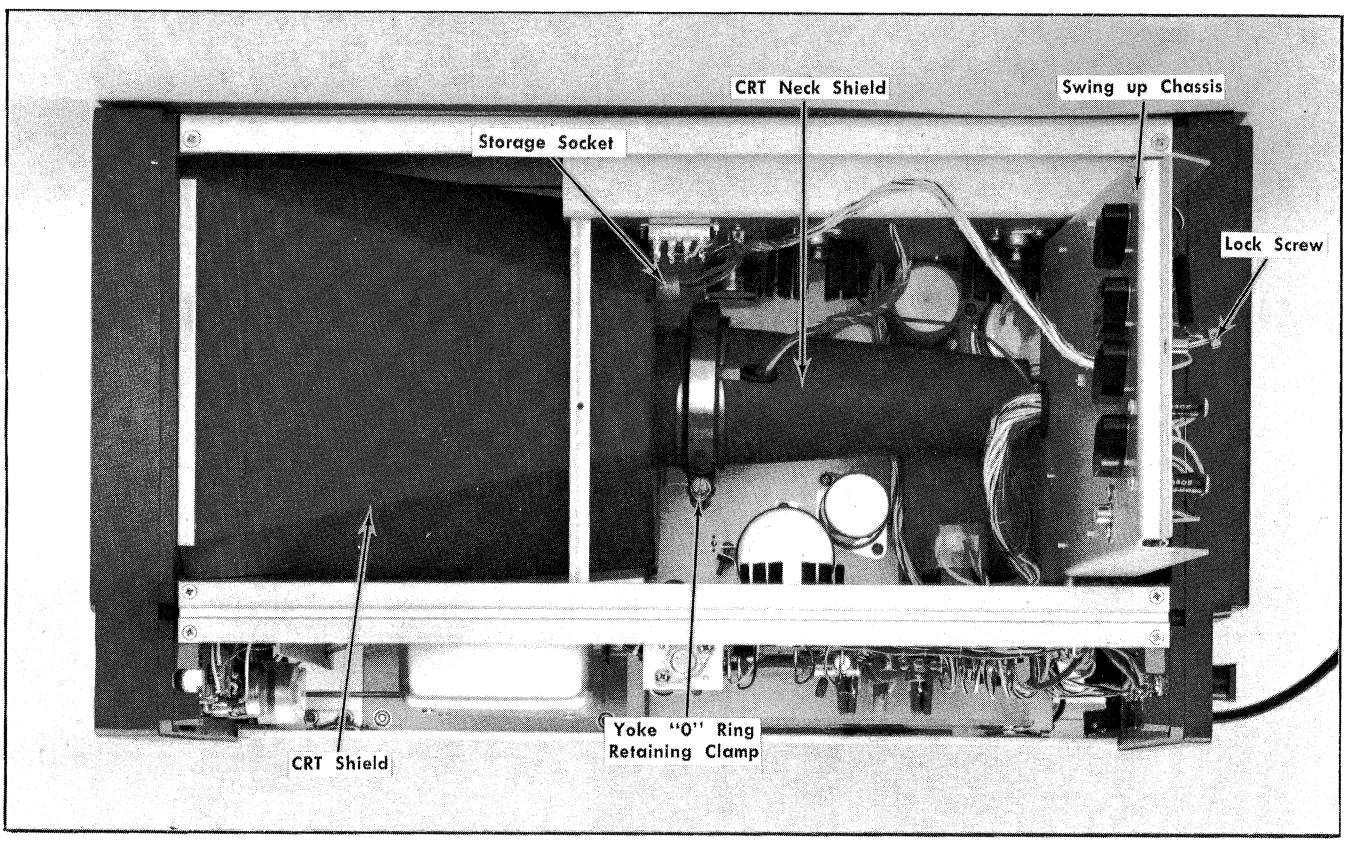


Fig. 4-6. Type 611 with swing up chassis raised.

9. Leave the metal holding bracket, rubber gasket and plastic implosion shield in place on the CRT and begin pulling the CRT straight forward through the front casting. As soon as the CRT is far enough forward, put one hand into the CRT compartment to support the tube neck.

10. With the CRT out of the instrument, remove the metal bracket, rubber gasket and plastic implosion shield.

11. Protect the CRT from damage while it is out of the instrument by placing it face down on a soft mat or preferably by placing it in a CRT shipping carton.

To install a CRT in the Type 611, use the following procedure:

1. Place the plastic implosion shield on the CRT faceplate and hold it in place with the rubber gasket. The rubber gasket must be correctly installed to prevent its front holding lip from rolling back and causing binding when an attempt is made to install the metal bracket.

2. Place the metal bracket face down on the work bench. Insert the CRT faceplate with implosion shield and rubber gasket installed into the metal gasket. If binding occurs, inspect the rubber gasket to insure the holding lip is not rolled back from the edge of the implosion shield. With some installations, a thin-bladed instrument may be useful for holding the rubber gasket in place as the CRT is inserted into the metal bracket.

3. Insert the storage plug through the desired access hole in the CRT shield. (As shown in Fig. 4-10, two holes are provided in the CRT front shield to allow the CRT to be installed either 'upright' or 'inverted' and still make connections to the storage plug. The CRT operates properly when

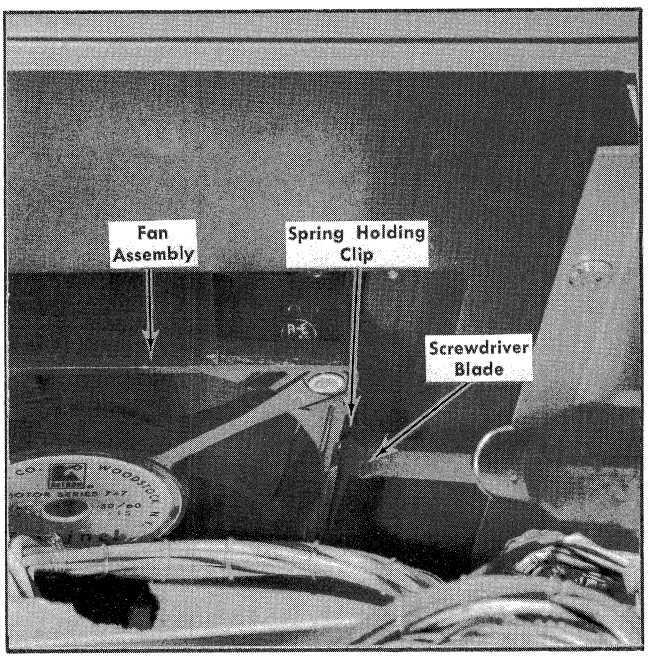


Fig. 4-7. Interior view, showing screwdriver inserted between Fan Assembly and holding clip.

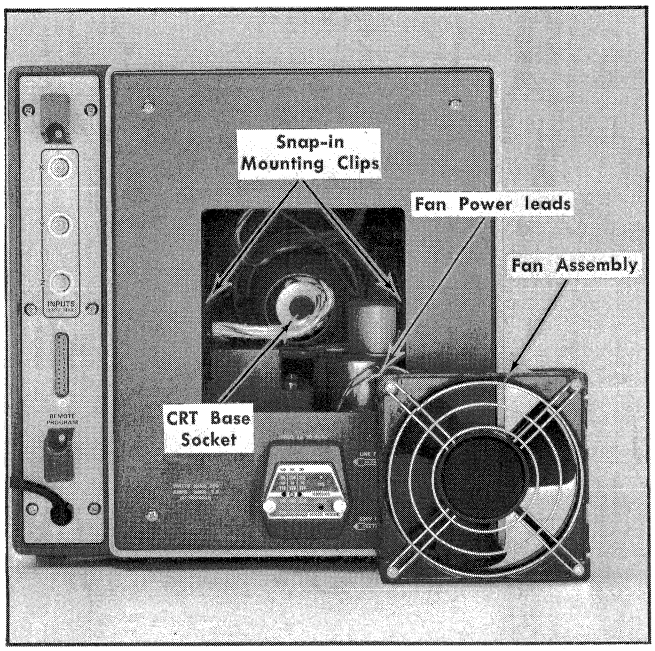


Fig. 4-8. Fan Assembly removed from the fan snap-in mounting.

installed either way.) Lower the swing-up chassis to its normal position. Insert the CRT neck first partially into the CRT compartment. Connect the storage plug to the CRT storage connector.

4. Support the CRT neck with one hand and guide it into the plastic liner of the yoke. Push the CRT into the instrument. While doing this, raise the swing-up chassis and remove the slack in the cable that goes to the storage plug. This will prevent the cable from getting squeezed between the CRT and shield. Push the CRT all the way into its compartment so the instrument holding studs are protruding far enough through the front metal bracket to permit installation of the four spacers and nuts.

5. Install the four spacers and nuts but do not tighten the nuts at this time. Remove the yoke "O" ring retaining clamp (see Fig. 4-6). Slide the yoke and neck shield to the rear so the yoke is located just to the rear of the flange on the front CRT shield. (Moving the yoke out of the way of the front CRT shield allows the front mounting nuts to be tightened without placing undue stress on the CRT neck in the event that the neck is thrown off center while tightening the nuts.)

6. Raise the front of the CRT slightly to center the front bracket on the studs. Tighten the nuts. Check that the plastic yoke liner is located inside the yoke and is properly positioned; i.e., the yoke liner is not twisted and the tabs of the yoke liner are properly seated against the front and rear rims of the yoke coil form. Slide the yoke forward until the yoke is flush against the flared portion of the CRT. Check that the yoke "O" ring is positioned over the yoke and is located flush against the flange on the front CRT shield.

NOTE

If the yoke cannot be positioned forward within the flange of the front CRT shield without binding,

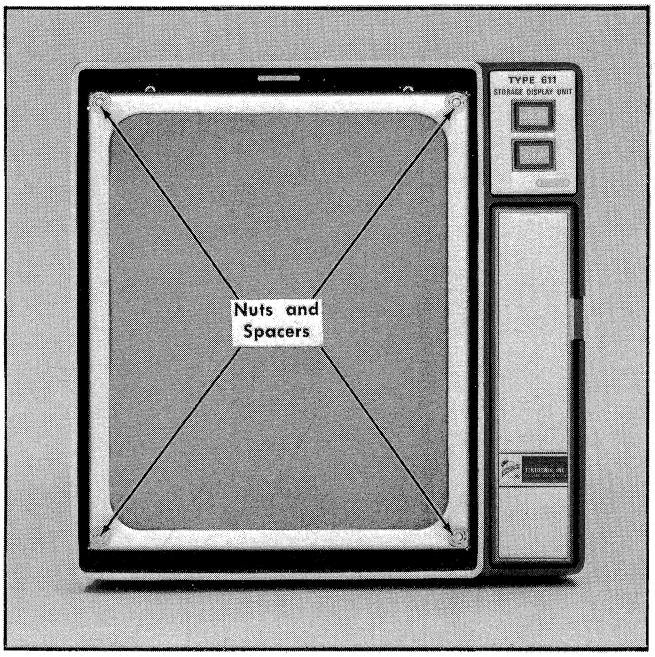


Fig. 4-9. Front panel with Bezel removed.

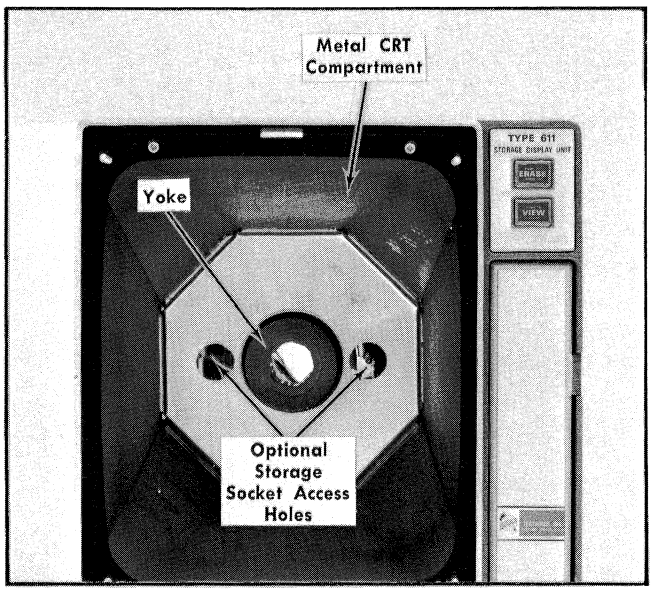


Fig. 4-10. Front view of Type 611 with CRT removed.

then the CRT front mounting nuts must be loosened, the CRT bracket must be shifted slightly, and then the nuts must be selectively tightened to cause the CRT neck to be properly centered with respect to to the front CRT shield flange. With the CRT neck centered as described, the yoke should slide freely into the shield for a flush fit against the flared portion of the CRT.

7. Install the "O" ring retaining clamp over the yoke "O" ring, over the front CRT shield flange and the neck shield flange. Tighten the "O" ring retaining clamp. As the clamp is tightened, the neck shield will be pulled forward snugly against the yoke "O" ring.

8. Connect the base socket to the CRT base.

9. Replace the fan assembly in its snap-in mounting.

10. Replace the bezel. Be sure the casting fingers are in the bezel holes.

11. After the installation of a CRT, it may be necessary to calibrate the instrument and reposition the yoke. These procedures are given in Section 5 of this manual.

NOTE

The CRT shield and CRT neck shield are fabricated from a metal that protects the CRT yoke and electron trajectories from external magnetic interference. Since a sharp blow may cause the shield to lose some of its protective properties, handle it carefully. If the shield is damaged and a loss of shielding occurs, contact your local Tektronix, Inc. Field Office or representative for assistance.

Power Transformer Replacement

Be sure to use only the correct replacement for a power transformer. Tag the leads with the terminal numbers as they are unsoldered from the transformer to aid in connecting the new transformer. After replacing the power transformer, check the power supply (to ground) resistance given in Table 4-3, then check the calibration of the entire instrument.

TABLE 4-3

Power Supply Resistance Checks
(power cord disconnected)

Supply	Approximate Resistance	Test Point
—100 volts	[1]4 kΩ	AC
—20 volts	32 Ω	AZ
+20 volts	[1]63 Ω	AM
+100 volts	2.5 kΩ	X
+250 volts	40 kΩ	S
+430 volts	50 kΩ	Q

[1]Positive lead connected to ground.

NOTES

SECTION 5
CALIBRATION

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

Introduction

This calibration procedure may be used to check circuit performance with respect to the applicable Performance Requirements listed in Section 1. The procedure also describes how to adjust the variable components for best instrument performance. To assure continued optimum performance, check the functioning of the instrument circuits every 1000 operating hours or every six months if used infrequently.

The index to the calibration steps may be used by an experienced calibrator as an abridged calibration procedure or as a performance check. In addition, the index may be reproduced and used as a calibration record for the Type 611.

TEST EQUIPMENT REQUIRED

The listed items of test equipment and accessories, or their equivalents, are required for a complete calibration of the Type 611. The specifications listed with an item are provided as a guide for the selection of substitute equipment.

All test equipment required for this calibration procedure can be obtained from Tektronix, Inc. Order by part number through your local Tektronix Field Office or representative.

1. Test oscilloscope. DC to at least 20 MHz. Minimum vertical deflection factor, 0.005 volt/division. Must be capable of supplying a sawtooth approximately 90 volts peak to peak and a gate output approximately 20 volts peak to peak. Tektronix Type 547 with a Type 1A1 Dual-Trace Plug-In unit was used in this procedure.

2. Test Display Generator. Must be capable of generating a raster of approximately 16 to 24 line pairs and a 300 by 400 dot raster. The raster output amplitude should be approximately 1 volt. The unblanking Z axis output must be adjustable from 0.5 V to 1 V. Tektronix Calibration Fixture 067-0561-01 recommended.

3. Variable autotransformer. Must be capable of supplying at least 250 watts over a voltage range of 90 to 136 volts (180 to 272 volts for 230-volt nominal line). If the autotransformer does not have an AC (RMS) voltmeter to indicate output voltage, monitor output with an AC (RMS) voltmeter. For example. General Radio W10MT3W Metered Variac Autotransformer for 115-volt nominal line.

4. Precision DC voltmeter. Accuracy, within ±0.5%; meter resolution, 50 microvolts; range, zero to five kilovolts. For example, Fluke Model 825A Differential DC Voltmeter. Use a Fluke Model 80E-5 Voltage Divider with voltmeter to measure voltages above 500 volts.

5. Pulse Generator. Variable pulse amplitude, selectable polarity, variable pulse width (approximately 1 to 100 μs); risetime, $\leq$10 ns. Tektronix Type 114 Pulse Generator recommended.

6. Time-mark generator. Marker outputs, 1 microsecond and 5 microseconds; marker accuracy, within 0.1%; amplitude, 1 volt minimum peak into 50 ohm. Trigger output, 0.1 millisecond positive-going pulse, 0.4 volt minimum amplitude into 50 ohms. Tektronix Type 184 Time-Mark Generator recommended.

7. Standard Amplitude calibrator. Amplitude accuracy, within 0.25%; signal amplitude, 1 volt; output signal, 1 kHz square wave, positive-going. Tektronix Calibration Fixture 067-0502-01 recommended.

8. Sweep attenuator. Must be capable of attenuating a sweep sawtooth to one volt amplitude. Tektronix Calibration Fixture 067-0569-00, or equivalent.

9. 10X attenuator probes (two). Tektronix P6008 Probe with 12-inch ground lead recommended. Tektronix Part No. 010-0129-00.

10. 1X probe. Tektronix P6011 Probe with 12-inch ground lead recommended. Tektronix Part No. 010-6101-01.

11. Coaxial cables (four). Impedance, 50 ohms; length, 42 inches; connectors, BNC. Tektronix Part No. 012-0057-01.

12. Patch cord. BNC to banana plug-jack; length, 18 inches. Tektronix Part No. 012-0091-00.

13. Terminations (two). Impedance, 50 ohms; accuracy, ±2%; connectors, BNC. Tektronix Part No. 011-0049-01.

14. 5X attenuator, Impedance, 50 ohms; accuracy, ±2%; connectors, BNC. Tektronix Part No. 011-0060-02.

15. 10X attenuator. Impedance, 50 ohms; accuracy, ±2%; connectors, BNC. Tektronix Part No. 011-0059-02.

16. ,Test graticule. 1 cm divisions, Tektronix Part No. 067-0573-00.

17. Magnifier. Power, 9X to 12X; field of view, at least 0.325 inch.

18. Tools:

a. Screwdriver, 3-inch shaft; 3/32-inch wide bit for slotted screws. Tektronix Part No. 003-0192-00.

b. Screwdriver, 1/4-inch bit with 4-inch shank; length overall, 7 7/8 inches. For slotted screw in CRT clamp. Tektronix Part No. 003-0515-00.

c. Alignment tool, 1 1/2-inch shaft, 5 inches total length, plastic shaft and handle, metal screwdriver tip. Tektronix Part No. 003-0000-00.

INDEX

This index to the Type 611 Calibration procedure may be used as a calibration guide for the experienced calibrator or it may be reproduced and used as a calibration record.

Type 611, Serial No. _____

Calibration Date _____

Calibrator _____

10A. Check or Adjust Trace Alignment (For instruments above SN B180000) Page 5-11

Align vertical trace with vertical centerline of test graticule.

10B. Check or Adjust Yoke Alignment (For instruments below SN B180000) Page 5-11

Align vertical trace with vertical centerline of test graticule.

11. Check or Adjust OPERATING LEVEL (R531) Page 5-13

OLTP voltage is the same as that originally specified for the CRT initial setting storage level.

12. Check or Adjust CE-2 (R540) and CE-1 (R554) Page 5-13

Voltage at pins CE-2 and CE-1 are the same as the levels originally specified for the CRT collimation electrodes CE-2 and CE-1.

13. Check or Adjust Erase Collimation (R538) Page 5-14

Lower excursion of CE-2 waveform is at the same level as originally specified for the CRT negative pulse height from ground on CE-2.

14. Check or Adjust Fade Negative Amplitude Control (R510) Page 5-15

Pin STB waveform has dead time of approximately 10 ms.

15. Check or Adjust Storage Target Backplate Recovery Time (R511) Page 5-15

Recovery time of waveform at pin STB coincides with end negative-going excursion obtained at pin CE-2.

16. Check Erase Interval (R632) Page 5-16

Erase signal negative-going excursion time should be 450 ms, ±50 ms.

17. Check or Adjust Horizontal Position (R44) Page 5-17

Adjusted to obtain minimum DC level at junction of C216 and R216.

18. Check or Adjust Vertical Position (R144) Page 5-18

Adjusted to obtain minimum DC level at junction of C256 and R256.

19. Check or Adjust Beam Centering (R72, R172) Page 5-18

Beam spot coincides with the center of the test graticule.

20. Check or Adjust Horizontal Gain (R45) Page 5-19

Deflection factor, 1 volt/16.2 cm.

21. Check or Adjust Vertical Gain (R145) Page 5-19

Deflection factor, 1 volt/21 cm for a rectangular display format or 1 volt/16.2 cm for a square format.

22. Check or Adjust Vertical Line Straightness (R227 and R238) Page 5-20

The deviation of the line being observed should not exceed 1% peak to peak (2.1 mm).

23. Check or Adjust Horizontal Line Straightness (R267 and R278) Page 5-21

The deviation of the line being observed should not exceed 1% peak to peak (1.63 mm).

24. Check or Adjust Focus Correction Symmetry (R288) Page 5-21

Equal focus quality of dots in all four corners.

25. Check or Adjust Corner Focus (R292) Page 5-21

Equal focus quality of dots in the corners with respect to dots located in other areas of the screen.

26. Check Dot Writing Time and Dot Resolution Page 5-22

Fade Up (bridging): In a 300 X 400 dot display, no more than 15 stored dots of any 10 X 10 dot group may blend to an adjacent dot.

Drop Out: In a 300 X 400 dot display, no more than 5 stored dots in any 10 X 10 dot group will fade out to less than three raised collector dots.

27. Check Linearity — Page 5-23

Full scale linearity: Within 1% along the center screen axis. Incremental linearity: No more than 10% difference between any two cm.

28. Check VIEW Mode — Page 5-24

Display stays in view for 60 to 90 seconds.

29A. Check or Adjust WRITE THRU (R377) and INTENSITY 3 (R387) For instruments above SN B150000 — Page 5-24

WRITE THRU must vary display of lines when TDG Write Through-Off switch is set to Write Through.

When pin BH is grounded, pin CE-2 voltage should rise to about 200 volts and INTENSITY 3 should control display intensity.

29B. Check or Adjust WRITE THRU INTENSITY (R410B) For instruments below SN B150000 — Page 5-24

Small circle display should not store when positioned any where on the screen within the test graticule area.

30. Check or Adjust Horizontal Amplifier Settling Time (C12, C45, C53 and C62) — Page 5-25

Settling time is $\leqslant 3.5\ \mu s/cm + 5\mu s$.

31. Check or Adjust Vertical Amplifier Settling Time (C112, C132, C145 and C153) — Page 5-28

Settling time is $\leqslant 3.5\ \mu s/cm + 5\ \mu s$.

32. Check or Adjust Horizontal Deflection Amplifier for No Oscillations (Readjust C12 and C53) — Page 5-30

No oscillations.

33. Check or Adjust Vertical Deflection Amplifier for No Oscillations (Readjust C112 and C132) — Page 5-31

No oscillations.

CALIBRATION PROCEDURE

General

In the following calibration procedure, a test equipment setup is shown for each major setup change. Near each setup picture is a complete list of control settings. To aid in locating individual controls which have been changed, the names of the changed controls are printed in bold type.

NOTE

When performing a complete recalibration, best performance will be obtained if each adjustment is made to the exact setting, even if the CHECK is within the allowable tolerance.

If only a partial recalibration of the instrument is being performed, start with the nearest setup picture and use the complete list of control settings to set the controls on the Type 611 and associated test equipment.

The following procedure uses the equipment listed under Equipment Required. If substitute equipment is used, control settings or setup must be altered to meet the requirements of the equipment used.

Preliminary Procedure

1. Remove the covers from the Type 611.

2. Check that the X and Y connectors are direct coupled (no attenuation) to the amplifiers as shown in Fig. 2-4.

3. Set the Type 611 Voltage Selector to 115 V and Range Selector to M.

4. Connect the autotransformer to a suitable power source.

5. Connect the Type 611 power cord to the autotransformer output.

6. Set the autotransformer for a 115-volt output.

7. Check that the INTENSITY control is set fully counterclockwise, then pulse the Type 611 POWER switch to ON. Allow at least one minute warmup at 25°C, ±5°C, for checking the instrument to the given accuracy.

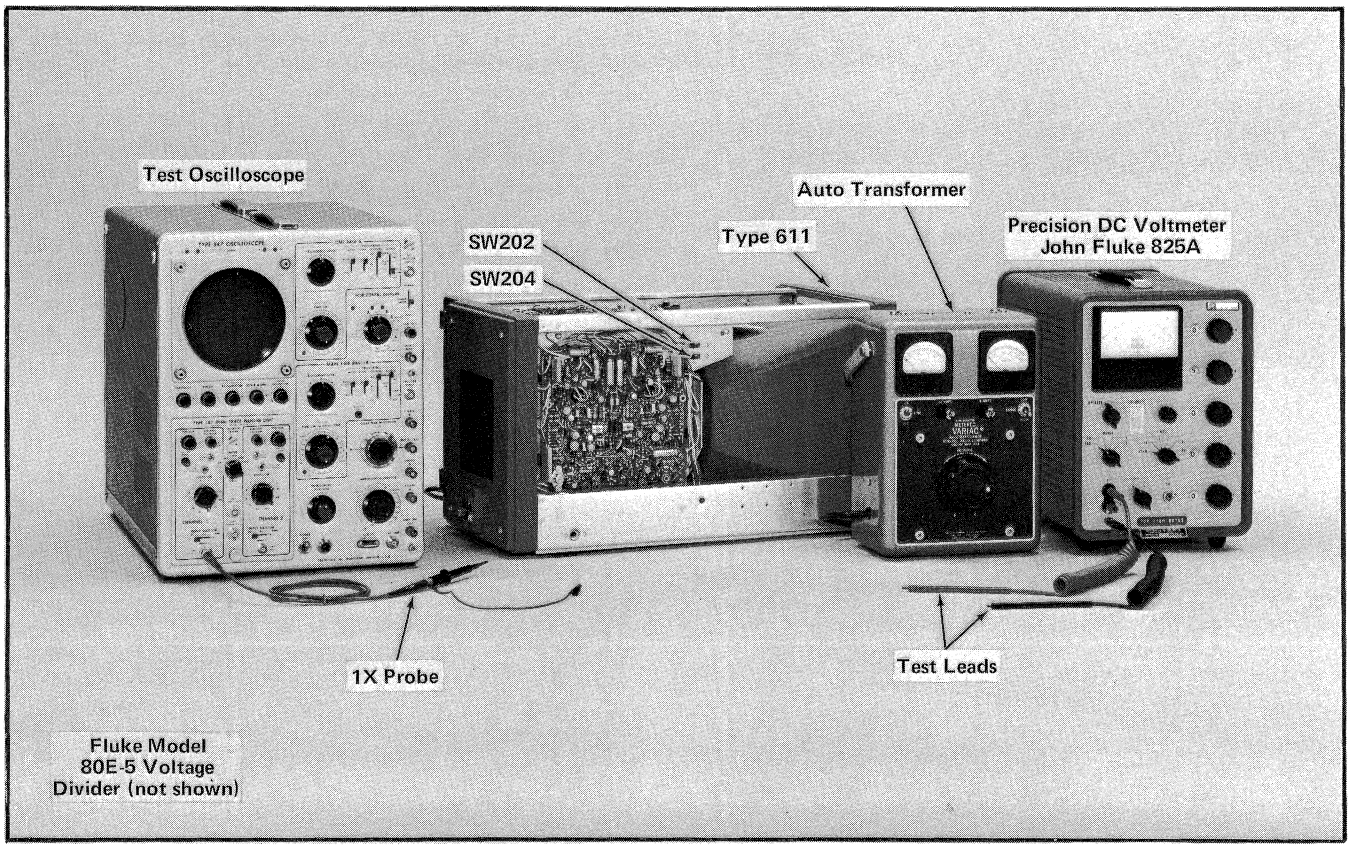


Fig. 5-1. Equipment required for Power Supply calibration steps. Locations of SW202 and SW204 are shown.

POWER SUPPLIES

Control Settings

Type 611

INTENSITY	full ccw
WRITE-THRU INTENSITY	as is
FOCUS	as is
OPERATING LEVEL	as is
TEST SPRIAL	NORMAL
Internal Controls	
SW202 (Fig. 5-1)	centered
SW204 (Fig. 5-1)	centered
All other controls	as is

Test Oscilloscope

Intensity	normal brightness
Focus	well defined trace
Astigmatism	well defined trace
Horizontal Display	A
Time Base A	
Triggering Level	0
Triggering Mode	Auto
Triggering Slope	+
Triggering Coupling	AC
Triggering Source	Line
Time/Cm	5 ms
Vertical Amplifier	
Mode	Ch 1
Volts/Cm (Ch 1)	.005
Input Selector (Ch 1)	AC
CRT Cathode Selector	External CRT Cathode

NOTE

Just prior to each power supply voltage or ripple check, press the VIEW button.

1. Check or Adjust −100 Volt Supply (R817)

a. Test equipment setup is shown in Fig. 5-1.

b. Lay the Type 611 on its right side.

c. Connect the precision DC voltmeter between the −100 volt supply output and ground (Fig. 5-2).

d. CHECK—The output voltage should be between −99.5 and −100.5 volts.

e. ADJUST—R817 (Fig. 5-2) for a voltmeter reading of −100 volts ±0.5%.

f. INTERACTION—Operation of all circuits within the Type 611 may be affected by the −100 volt supply.

2. Check Low-Voltage Power Supplies

a. Connect the precision DC voltmeter successively between the output of each low-voltage power supply and ground. See Fig. 5-2 for test-point locations.

b. CHECK—Each supply is within the accuracy tolerance listed in column 2 of Table 5-1 (No tolerance is given for the +273 V and +420 V supplies.)

c. Connect the 1X probe from the test oscilloscope Channel 1 input to each power supply test point in succession. To check regulation, monitor the supply with the precision DC voltmeter.

d. CHECK—Each supply voltage remains within the regulation tolerance (except +273 V and +420 V supplies) and peak-to-peak ripple voltage amplitude (column 3 and 4 of Table 5-1) as the autotransformer output voltage is varied from 104 VAC through 126 VAC.

TABLE 5-1

Supply	Accuracy	Regulation	Twice Line Freq. Ripple
−100 V	±0.5% (−99.5 to −100.5 V)	0.1% of actual voltage reading	4 mV
+100 V	±2.5% (+97.5 to +102.5 V)	0.1% of actual voltage reading	4 mV
−20 V	±2.5% (−19.5 to −20.5 V)	1% of actual voltage reading	5 mV
+20 V	±2.5% (+19.5 to +20.5 V)	1% of actual voltage reading	5 mV
+273 V unregulated			20 V
+420 V unregulated			20 V

e. Disconnect the probe and precision voltmeter. Set the Type 611 upright.

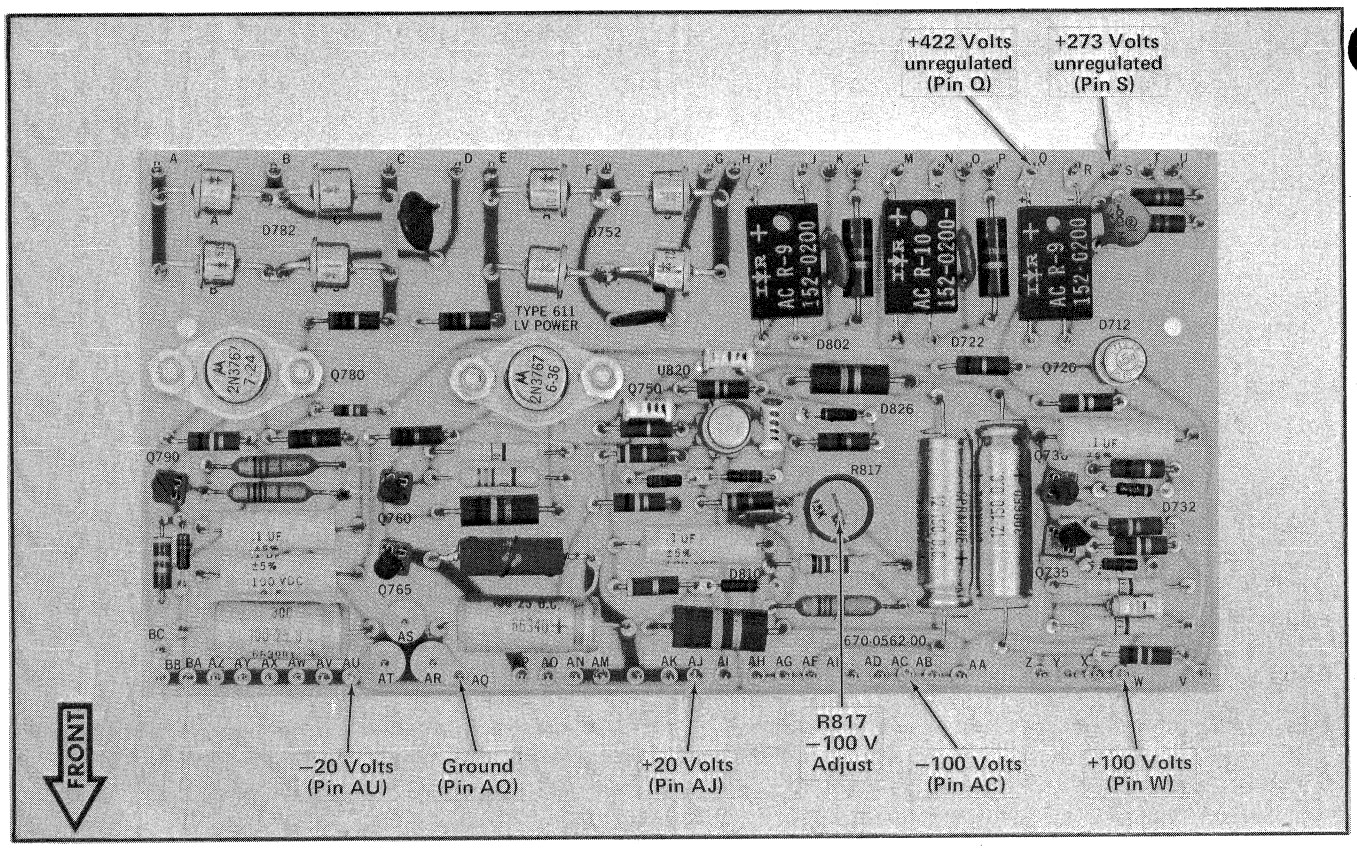


Fig. 5-2. Locations of the low-voltage power supply test points and R817, −100 V adjustment.

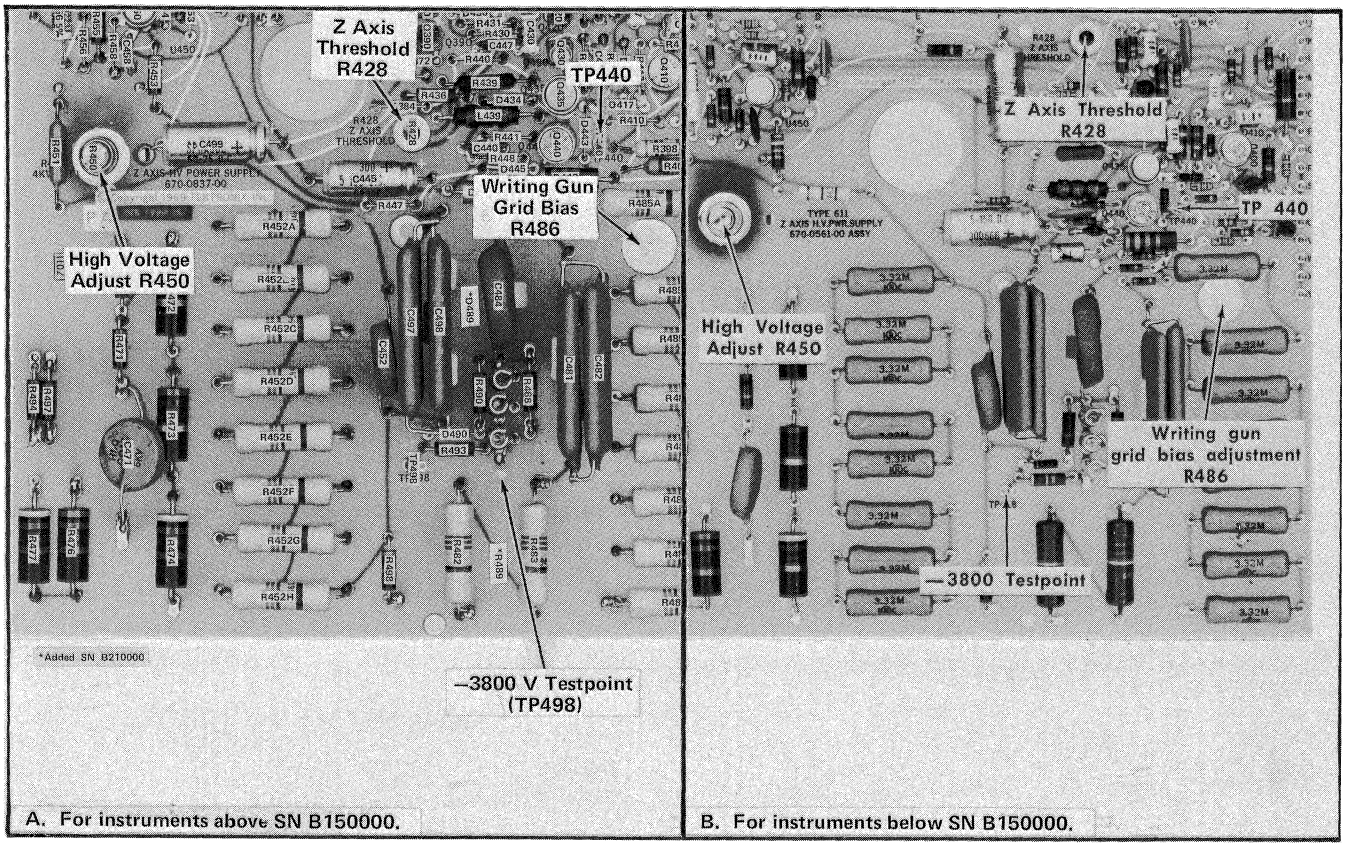


Fig. 5-3. Locations of adjustments and test points on the Z Axis and H. V. Power Supply board for steps 3, 4, 6, 8 and 9.

3. Check or Adjust High Voltage Supply (R450)

a. Connect the precision DC voltmeter (use the precision 5 kV divider) between the –3800 V test point (Fig. 5-3) and chassis ground.

b. CHECK—The high voltage output should be between –3724 and –3876 volts.

c. ADJUST—High Voltage control R450 (Fig. 5-3) for a meter reading of –3800 volts ±2%.

d. INTERACTION—May affect operation of all circuits within the Type 611.

4. Check High Voltage Regulation

a. With the precision DC voltmeter connected for the previous step, vary the autotransformer output from 104 VAC to 126 VAC.

b. CHECK—High voltage must remain within ±1% of the voltage measured in step 3.

c. Disconnect the precision voltmeter.

NOTE

The Type 611 may now be connected directly to the power source for the remainder of the calibration procedure, providing the Line Selector and Range Selector switches are set to the proper positions for the source line voltage.

5. Check or Adjust Flood Gun Anode Voltage (R667)

a. With power applied to the Type 611, push the VIEW switch to assure a visible display of background luminance on the CRT.

b. CHECK—Background luminance is at a suitable level for operation.

c. Connect a precision DC voltmeter between the emitter of Q670 (Fig. 5-4) and ground.

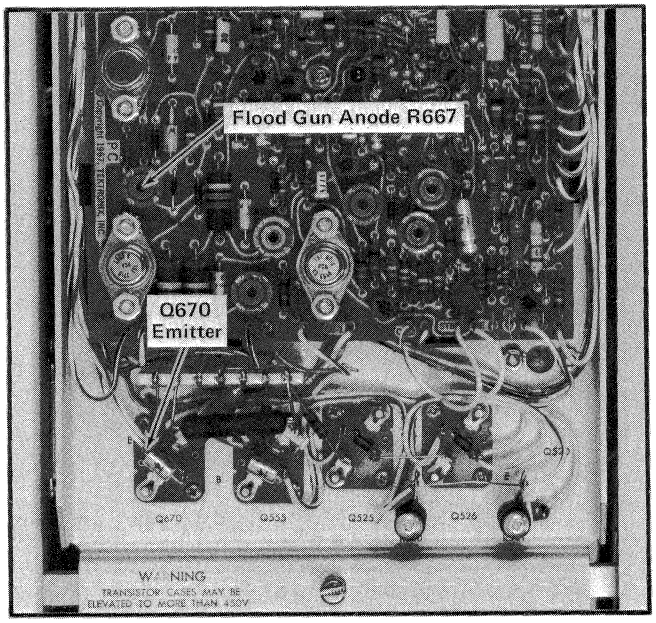


Fig. 5-4. Locations of step 5 adjustment on Storage board and test point on Storage chassis.

d. ADJUST—R667 (Fig. 5-4) until the voltage is the same as originally specified for the CRT flood gun anode voltage. If the CRT original voltage is not known, set R667 to obtain a voltmeter reading of +150 volts.

Z AXIS

Control Settings

Type 611

INTENSITY	**midrange**
WRITE-THRU INTENSITY	as previously adjusted
FOCUS	as previously adjusted
OPERATING LEVEL	as previously adjusted
TEST SPIRAL	NORMAL
Internal Controls	
SW202	**front**
SW204	**front**
All other controls	as previously adjusted

Test Oscilloscope

Intensity	normal brightness
Focus	well defined trace
Astigmatism	well defined trace
Horizontal Display	A
Time Base A	
Triggering Level	0
Triggering Mode	**Trig**
Triggering Slope	+
Triggering Coupling	AC
Triggering Source	**Int Norm**
Time/Cm	**10 μs**
Vertical Amplifier	
Mode	Ch 1
Volts/Cm (Ch 1)	**1**
Input Selector (Ch 1)	**DC**
CRT Cathode Selector	External CRT Cathode

Test Display Generator (TDG)

Mode	
Cont-Ready-Single	Cont
Raster-Single-Dot	Raster
Density	
Selector	125:100
Variable/Cal	Cal
Dots-Lines	Dots
Horiz-Vert	Horiz
Time/Dot	9
Amplitude	.75
Time/Line	3
DC Offset	Off
Output Signal Source	Int
Remote Program Test	
Non Store-Store-Erase	Non Store
View	View
Write Through	Off

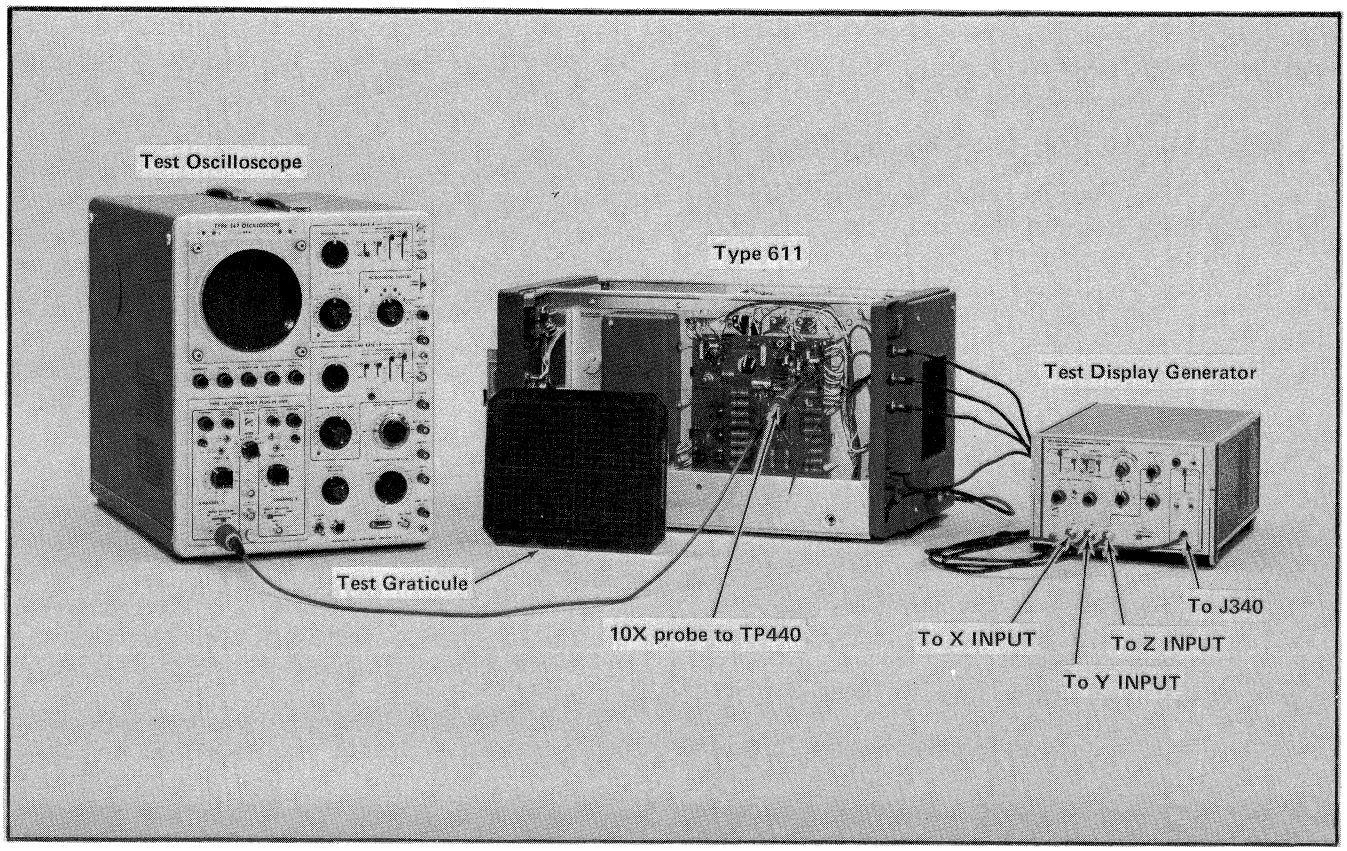


Fig. 5-5. Equipment required for Z Axis Amplifier calibration steps.

6. Check or Adjust Z Axis Turn-On Threshold (R428)

a. Test equipment setup is shown in Fig. 5-5.

b. Using coaxial cables, connect the X, Y and Z outputs of the Test Display Generator (TDG) to the X, Y and Z INPUTS of the Type 611. Connect the TDG remote program test connector to Type 611 remote program connector J340.

c. CHECK—Set the TDG Amplitude switch to .5 Volt. The Type 611 dot-raster display should disappear. Return the Amplitude switch to .75 Volt. The display should reappear.

d. Connect a 10X probe from the oscilloscope Channel 1 input to TP440 on the Z Axis and H.V. Power Supply board (Fig. 5-3).

e. Observe the Z Axis Amplifier output displayed on the test oscilloscope CRT while rotating the Z Axis Threshold control, R428 (Fig. 5-3), through its range. Note the R428 setting where the positive-going rectangular waveform (Fig. 5-6) first appears as the control is rotated in a counterclockwise direction from full clockwise.

f. ADJUST—R428 to the setting where the positive-going rectangular waveform first appears.

g. Set the TDG Amplitude switch to .5 Volt.

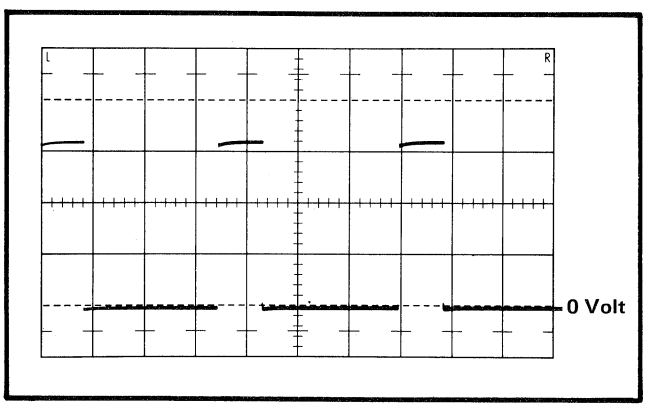


Fig. 5-6. Example of Z Axis Amplifier output waveform obtained at TP440. Vertical deflection factor, 10 V/cm; sweep rate, 10 μs/cm.

h. CHECK—The displays on the Type 611 and test oscilloscope should disappear.

7. Check INTENSITY Control Range (R410A)

a. Set the TDG Amplitude switch to 1 Volt and the test oscilloscope Volts/Cm switch to 2.

b. Rotate the INTENSITY control throughout its range and observe the display on the test oscilloscope CRT.

c. CHECK—The waveform amplitude displayed on the test oscilloscope should vary from 5 volts or less to 80 volts or more as the INTENSITY control is rotated clockwise from full counterclockwise.

d. Set the INTENSITY control fully counterclockwise.

e. Disconnect the 10X probe from the Type 611.

8. Check or Adjust Writing Gun Grid Bias (R486) ◐

a. Check that INTENSITY control is set fully counterclockwise and then set the TDG Raster-Single Dot switch to Single Dot.

b. Set the Type 611 switches SW202 and SW204 to their centered positions.

c. CHECK—The writing beam spot should not be visible. (If it is visible, it will be located near the center of the Type 611 CRT faceplate.)

d. ADJUST—R486 (Fig. 5-3) to a setting that will cause the writing beam spot to disappear. This will ensure that the beam can be turned off with the INTENSITY control. To check that R486 is set correctly, turn the INTENSITY control about 1-2/3 divisions (about 50°) clockwise. The spot should be visible.

e. Return the INTENSITY control to fully counterclockwise.

9. Check Z Axis Amplifier Risetime and Falltime

a. Set the test oscilloscope A Time/Cm switch to .1 μs and the Channel 1 Volts/Cm switch to 1.

b. Reconnect the 10X probe to TP440 on the Z Axis and H.V. Power Supply board.

c. Set the TDG Raster-Single Dot switch to Raster and then rotate the Type 611 INTENSITY control fully clockwise.

d. Adjust the test oscilloscope Triggering Level control to display the full rising portion of the waveform. Use the Channel 1 Variable Volts/Cm control to set the waveform amplitude so that a risetime measurement can be made (see Fig. 5-7A).

NOTE

Each major division of the graticules illustrated in this manual represents one centimeter.

e. CHECK—10% to 90% risetime is ≤0.2 μs.

f. Set the INTENSITY control fully counterclockwise.

g. Change the test oscilloscope Triggering Slope control to – (minus) and set the Channel 1 Volts/Cm switch to .05.

h. Set the test oscilloscope Triggering Level control to display the falling portion of the waveform. Use the Channel 1 Variable Volts/Cm control to set the waveform amplitude so that a falltime measurement can be made (see Fig. 5-7B).

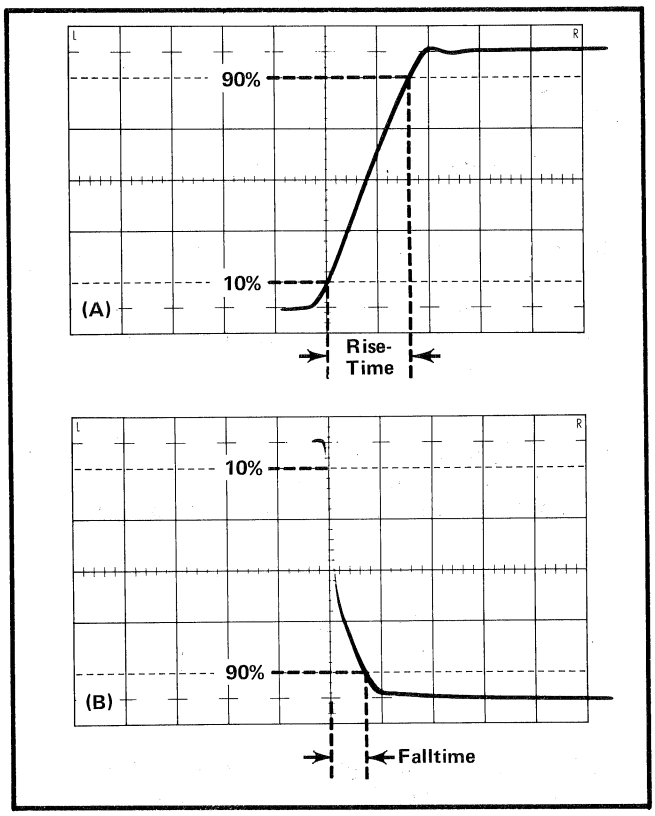


Fig. 5-7. Measuring the risetime and falltime of the Z Axis Amplifier output waveform. Sweep rate is 0.1 μs/cm.

Ⓓ

i. CHECK—90% to 10% falltime is ≤0.2 μs.

j. Disconnect the 10X probe from TP440.

DISPLAY ALIGNMENT

(For instruments above SN B180000)

10A. Check or Adjust Trace Alignment

a. Set SW204 to its front position.

b. Set the TDG controls as follows:

Density	
Selector	25
Dots-Lines	Lines
Horiz-Vert	Vert
DC Offset	On

c. Remove the Display Unit CRT bezel and install the test graticule. The bezel can be removed by flexing its upper and lower edges to disengage the front casting fingers from the holes in the bezel, or pry the upper and lower edges away from the casting with a thin-bladed tool. If the test graticule fits loosely in the metal bracket, it can be held in position with a few pieces of cellophane tape.

d. Adjust the INTENSITY 1 and FOCUS controls as necessary to obtain a well defined trace on the CRT.

e. Use the TDG Offset X and Y controls to position one of the vertical traces to coincide with the center vertical graticule line.

f. CHECK—Trace should be parallel with the center vertical graticule line.

g. ADJUST—ROTATOR, R492A and B, to align the trace with the center vertical graticule line.

YOKE ALIGNMENT

(For instruments below SN B180000)

10B. Check or Adjust Yoke Alignment

a. Set SW204 to its front position.

b. Set the TDG controls as follows:

Density	
Selector	25
Dots-Lines	Lines
Horiz-Vert	Vert
DC Offset	On

c. Remove the Type 611 CRT bezel and install the test graticule. The bezel can be removed by flexing its upper and lower edges to disengage the front casting fingers from the holes in the bezel. An alternative method of removing the bezel is to pry the upper and lower edges away from the casting with a thin bladed tool. If the test graticule fits loosely in the metal bracket, it can be held in position with a few pieces of cellophane tape.

d. Adjust the INTENSITY and FOCUS controls as necessary to obtain a well defined trace on the CRT.

e. Use the TDG Offset X and Y controls to position one of the vertical traces to coincide with the center vertical graticule line.

f. CHECK—Trace should be parallel with the center vertical graticule line.

g. ADJUST—Raise the Storage chassis, loosen the CRT shield clamp and rotate the rear CRT shield to align the trace with the center vertical graticule line.

h. Tighten the CRT clamp and secure the Storage chassis.

STORAGE

Storage circuit control settings for optimum stored resolution are dependent on the parameters of the individual CRTs. The controls are set for the requirement of the installed CRT in the factory. These requirements are recorded on a card located in front of the Storage chassis.

Replacement CRTs are also supplied with a card containing a list of voltages that will produce optimum stored resolution. As a CRT ages, its voltage requirements for optimum stored resolution performance tend to change. When the performance becomes marginal, an adjustment of the OPERATING LEVEL control generally returns the tube to optimum performance.

If the CRT operates properly, disconnect the TDG and proceed to step 16.

If there is severe performance deterioration, whether due to a change in the tube's requirements or other cause such as a component replacement, use the procedure that follows. As a preliminary procedure, preset R538, R554, R540, R510 and R511 (Fig. 5-4) to midrange and then proceed to step 11.

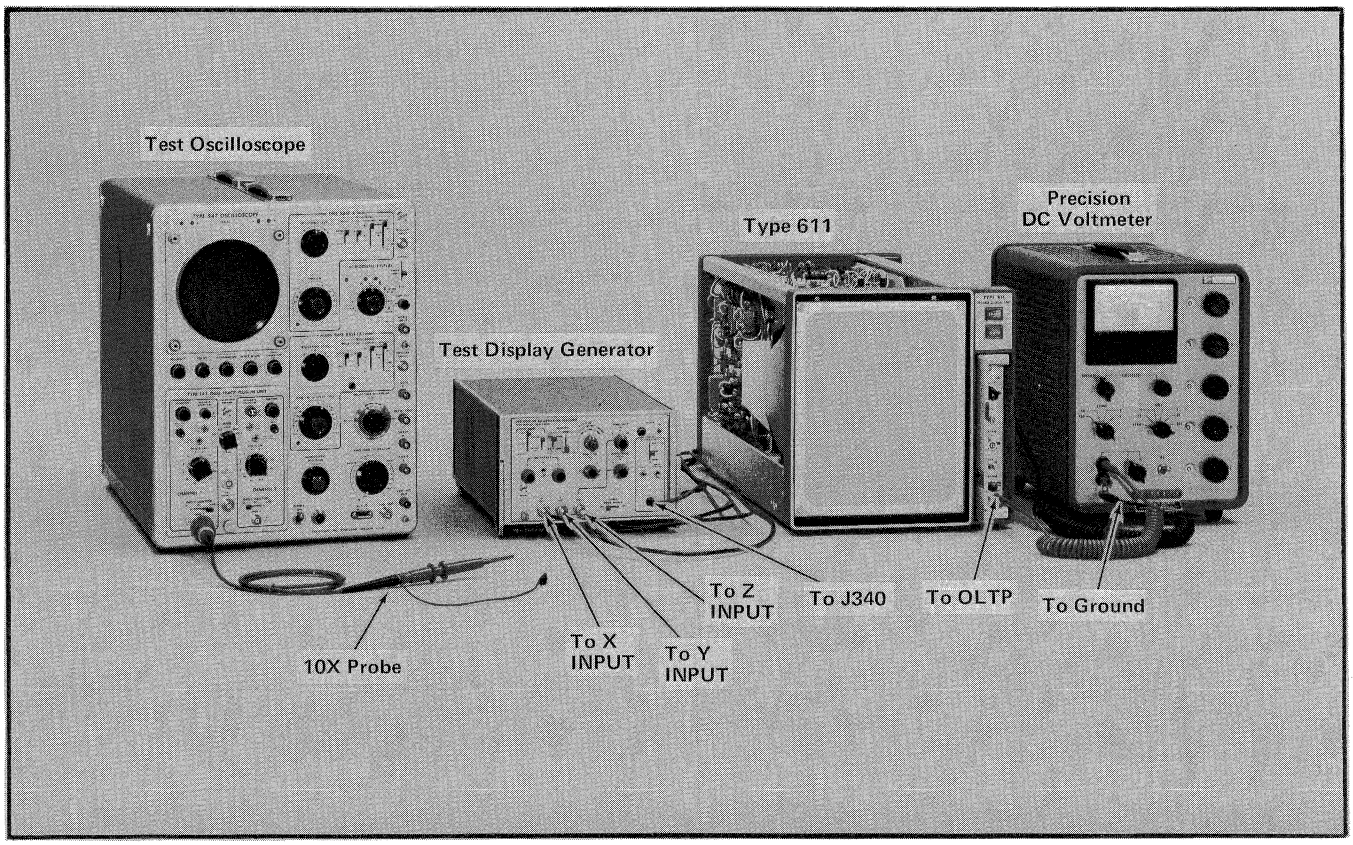


Fig. 5-8. Equipment required for Storage calibration steps. Location of step 11 test point is shown.

Control Settings

Type 611

INTENSITY	**midrange**
WRITE-THRU INTENSITY	as previously adjusted
FOCUS	as previously adjusted
OPERATING LEVEL	as previously adjusted
TEST SPIRAL	NORMAL
Internal Controls	
SW202	centered
SW204	**centered**
All other controls	as previously adjusted

Test Oscilloscope

Intensity	normal brightness
Focus	well defined trace
Astigmatism	well defined trace
Horizontal Display	A
Time Base A	
Triggering Level	**About 20° in + region**
Triggering Mode	Auto
Triggering Slope	+
Triggering Coupling	AC
Triggering Source	**Int Plug In**
Time/Cm	**50 ms**
Vertical Amplifier	
Mode	Ch 1
Volts/Cm (Ch 1)	**2**
Input Selector (Ch 1)	**Gnd**
CRT Cathode Selector	External CRT Cathode

Test Display Generator

Mode	
Cont-Ready-Single	**Ready**
Raster-Single Dot	Raster
Density	
Selector	**100**
Variable/Cal	Cal
Dots/Lines	Lines
Horiz/Vert	**Horiz**
Time/Dot	9 μs
Amplitude	1
Time/Line	**10**
DC Offset	**Off**
Output Signal Source	Int
Remote Program Test	
Non Store-Store-Erase	**Store**
View	View
Write Through	Off

11. Check or Adjust OPERATING LEVEL (R531)

a. Test setup is shown in Fig. 5-8.

b. Momentarily press the ERASE button to clear the screen.

c. Connect a precision DC voltmeter between the front panel OLTP (Operating Level Test Point) and chassis ground (Fig. 5-8). Use a voltmeter range of at least +300 V.

NOTE

A precision DC voltmeter (non-loading type) is used because a DC voltmeter with 10 MΩ or greater input impedance should be used for measuring the CRT voltages.

d. CHECK—Voltage reading should be same as originally specified for CRT backplate voltage at operating point.

e. ADJUST—The OPERATING LEVEL control so that the meter reading at OLTP is the same as that originally specified for the backplate voltage at operating point for the CRT in your instrument.

If this information is not available, or if your CRT has aged to the point where it not longer applies, determine and use the mean voltage bewteen the approximate fade-positive and fade-negative levels. To determine these two operating levels, start with the OPERATING LEVEL control set at about mid-range and proceed as follows:

Adjust the OPERATING LEVEL control clockwise in a series of small increments, storing a new test spiral display at each succeeding step. At the point where the screen starts to fade positive at the edges, note and record the meter reading. This is the approximate fade-positive level. Then, again starting from the midrange position of the control, make a similar series of adjustments and observations in the counterclockwise direction. At the point where the outer portion of the spiral barely becomes stored (a dimly stored display), again read and record the meter indication. This is the approximate fade-negative point. A good approximation of the proper backplate voltage at operating point can be determined by adding the fade positive and fade negative meter readings and dividing their sum by two. Typical voltage at the OLTP jack is usually about +190 volts.

To further refine the setting of the OPERATING LEVEL control, complete the remaining Storage calibration steps and repeat the procedure given in the previous paragraph, substituting stored symbols or a 300 X 400 dot matrix for the stored spiral.

f. Disconnect the precision DC voltmeter.

12. Check or Adjust CE-2 (R540) and CE-1 (R554)

a. Momemtarily press the ERASE button to remove the previously stored display.

b. CHECK—Observe the entire screen for uniform luminance.

c. Connect a precision DC voltmeter between pin CE-2 on the Storage board (Fig. 5-9) and chassis ground.

d. ADJUST—CE-2 (R540, Fig. 5-9) to obtain the same voltage reading as that specified for the CRT collimation electrode CE-2 in the instrument.

e. Disconnect the voltmeter test lead from pin CE-2 and reconnect it to pin CE-1 (Fig. 5-9).

f. ADJUST—CE-1 (R554, Fig 5-9) to obtain the same voltage reading as that specified for the CRT collimation electrode CE-1 in the instrument.

If the original CRT collimation electrode voltages are not known, R554 can be preset to midrange while the setting for R540 is determined as follows:

If the CE-2 voltage is too low (R540 set fully ccw), the display may appear as several superimposed luminescent rectangular areas that are smaller than the CRT screen. If the CE-2 voltage is too high (R540 set fully cw), the edges of the viewing area will be dimmer than the center. To find the optimum setting, set R540 fully counterclockwise. Then, rotate R540 slowly clockwise until the edges of all the superimposed areas are located just outside of the screen. In addition, the luminance of the edge areas should be the same as the luminance of the center area. Note the voltage reading at pin CE-2 and connect the voltmeter between CE-1 and chassis ground. Adjust R554 to obtain a voltage reading about one volt lower than the voltage noted for CE-2. As a guide, a typical voltage for CE-2 is +109 volts and for CE-1 is +108 volts.

g. Disconnect the precision DC voltmeter from the Type 611.

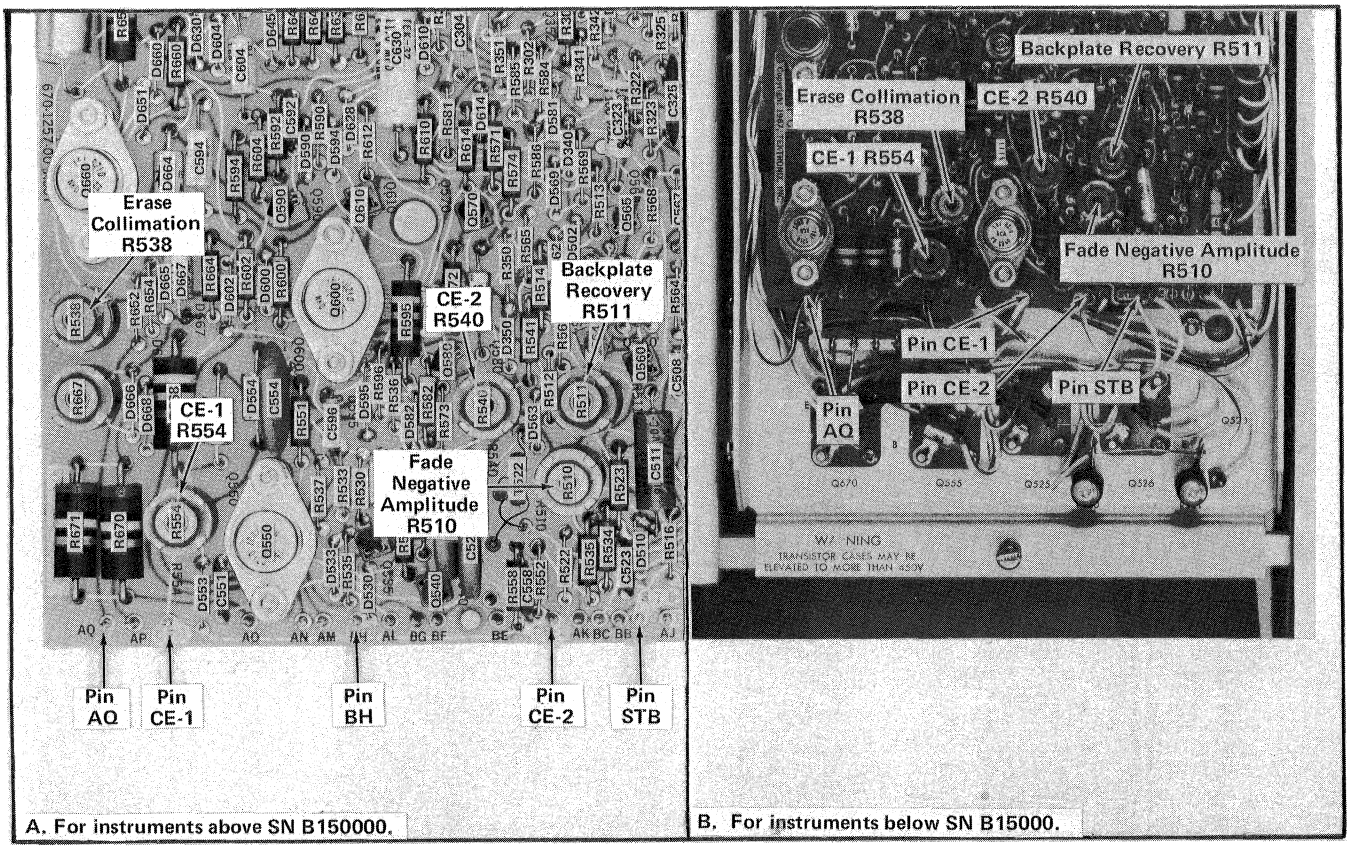


Fig. 5-9. Locations of the Storage board adjustments and test points for steps 12 through 16 and step 29A for instruments above SN B150000.

13. Check or Adjust Erase Collimation (R538)

a. Connect a 10X probe from the test oscilloscope Channel 1 input to pin CE-2 on the Storage board (Fig. 5-9) and position the test oscilloscope trace to the bottom horizontal graticule line.

b. Set the Channel 1 Input Selector switch to DC. The test oscilloscope trace should shift to the quiescent voltage level set with R540 in the previous step.

c. Set the test oscilloscope Triggering Mode switch to Trig.

d. Press the ERASE button repeatedly and observe the CE-2 erase cycle waveform (Fig. 5-10).

e. CHECK—The negative-going excursion of the erase pulse should be at the same voltage level as that specified for the CRT "negative pulse height from ground on CE-2" in the instrument.

f. ADJUST—R538 (Fig. 5-9) for a CE-2 waveform with its lower excursion at the same level as specified for the CRT.

If this voltage level is not known, adjust R538 so the negative pulse height from ground is at the +40-volt level as shown in Fig. 5-10.

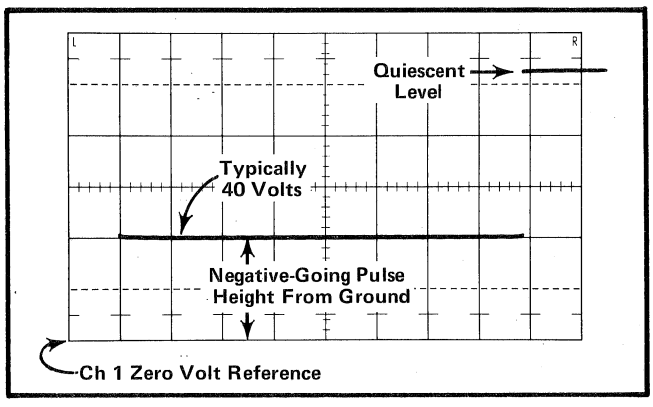


Fig. 5-10. Erase cycle waveform obtained at pin CE-2 on the Storage board when the ERASE button is pressed. Vertical deflection factor is 20 V/cm and sweep rate is 50 ms/cm.

14. Check or Adjust Fade Negative Amplitude Control (R510)

a. Change the test oscilloscope controls as follows:

A Triggering Mode	Auto
Vertical Amplifier	
Mode	Chop
Volts/Cm (both)	10
Input Selector (both)	GND
CRT Cathode Selector	Chopped Blanking

b. Connect another 10X probe from the test oscilloscope Channel 2 input to pin STB on the Storage board (Fig. 5-9).

c. Position the test oscilloscope Channel 1 trace to the bottom horizontal graticule line and the Channel 2 trace to the center horizontal graticule line.

d. Set the test oscilloscope controls as follows:

A Triggering Mode	Trig
Input Selector (both)	DC

e. Repeatedly press the ERASE button and, if necessary, use the test oscilloscope Horizontal Position control to position the dual-trace display to a similar location as that shown in Fig. 5-11A.

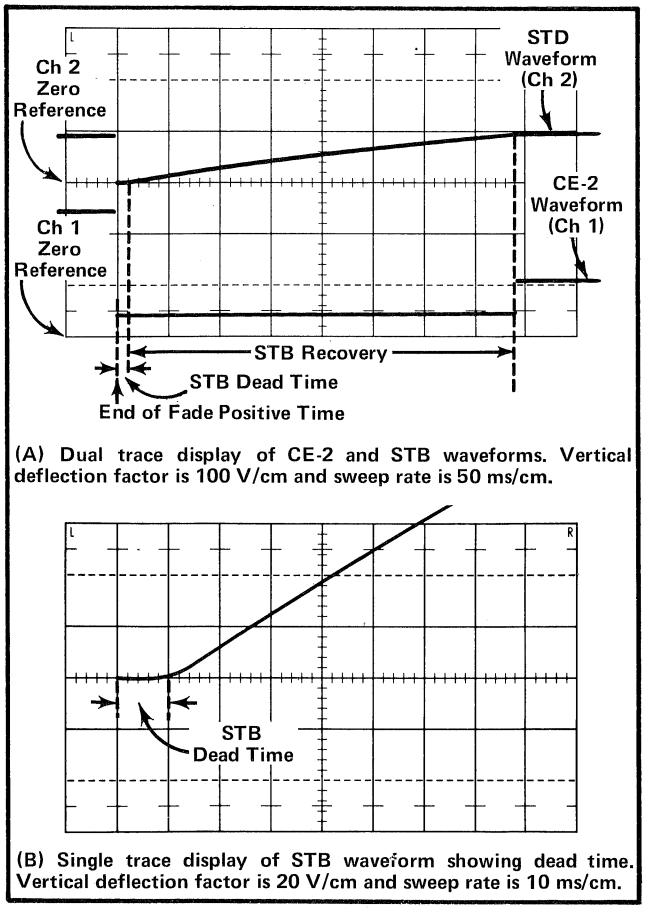
f. CHECK—The Storage Target Backplate (STB) waveform displayed by Channel 2 should remain at about zero volt for approximately 10 ms between the end of the fade positive time and the start of the recovery time. This 10-ms period is referred to as the STB dead time (Figs. 5-11A and 5-11B).

For ease of STB dead time measurement as shown in Fig. 5-11B, change the test oscilloscope controls as follows:

A Triggering Level	20° in minus region
A Triggering Slope	–
A Triggering Source	Int Norm
A Time/Cm	10 ms
Mode	Ch 2
Volts/Cm (Ch 2)	1

While repeatedly pushing the ERASE button, set the test oscilloscope Triggering Level and Horizontal Position controls to obtain a display positioned to the same location as shown in Fig. 5-11B. Check for a dead time of approximately 10 ms.

g. ADJUST—R510 (Fig. 5-9) for approximately 10 ms STB dead time at the zero volts level.



(A) Dual trace display of CE-2 and STB waveforms. Vertical deflection factor is 100 V/cm and sweep rate is 50 ms/cm.

(B) Single trace display of STB waveform showing dead time. Vertical deflection factor is 20 V/cm and sweep rate is 10 ms/cm.

Fig. 5-11. Examples of erase cycle waveforms obtained when performing step 14.

15. Check or Adjust Storage Target Backplate Recovery Time (R511)

a. Change the following test oscilloscope control settings:

A Triggering Level	10° in positive region
A Triggering Mode	Auto
A Triggering Slope	+
A Triggering Source	Int Plug In
A Time/Cm	2 ms
Mode	Chop
Volts/Cm (Ch 2)	5
Input Selector (both)	GND

b. Position the Channel 1 trace one cm above graticule center and the Channel 2 trace to the bottom horizontal graticule line.

c. Set the test oscilloscope controls as follows:

A Triggering Mode	Trig
A Time/Cm	.1 s
Input Selector (both)	DC

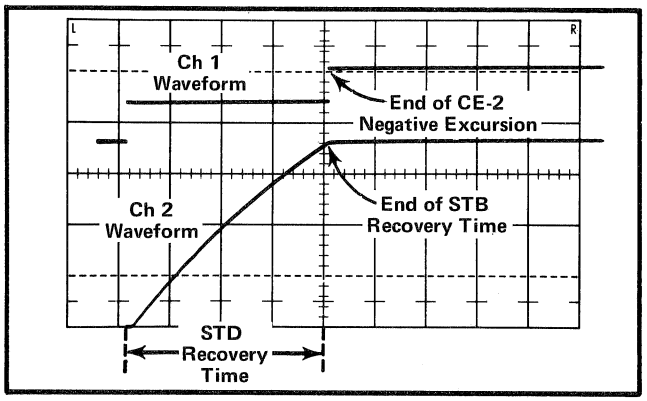


Fig. 5-12. Dual trace display of STB and CE-2 waveforms. Vertical deflection factor of Ch 1, 100 V/cm; Ch 2, 50 V/cm. Sweep rate is 0.1 sec/cm.

d. While repeatedly pushing the ERASE button, use the test oscilloscope Horizontal Position control to position the Channel 1 waveform to the location shown in Fig. 5-12.

e. CHECK—The end of the Channel 2 STB recovery time should coincide with the end of the Channel 1 CE-2 negative-going excursion as shown in Fig. 5-12.

f. ADJUST—R511 (Fig. 5-9) so that the end of the STB recovery time coincides with the end of the CE-2 negative-going excursion.

g. INTERACTION—Repeat steps 14 through 15f, as necessary, to obtain proper STB waveform as described.

h. Remove the Channel 2 10X probe from the Storage board.

16. Check Erase Interval

a. Connect the Channel 1 10X probe to pin AQ on the Storage board (Fig. 5-9).

b. Set the test oscilloscope controls as follows:

A Triggering Level	10° in minus region
A Triggering Mode	Auto
A Triggering Slope	–
A Triggering Source	Int Norm
Mode	Ch 1
Volts/Cm (Ch 1)	.5
Input Selector (Ch 1)	GND

c. Position the trace one cm below graticule center.

d. Set the test oscilloscope controls as follows:

A Triggering Mode	Trig
Input Selector (Ch 1)	DC

e. While repeatedly pressing the ERASE button, position the waveform to the location shown in Fig. 5-13.

f. CHECK—The negative-going excursion time of the erase signal should be 450 ms ±50 ms (Fig. 5-13).

g. Disconnect the Channel 1 10X probe from the Storage board.

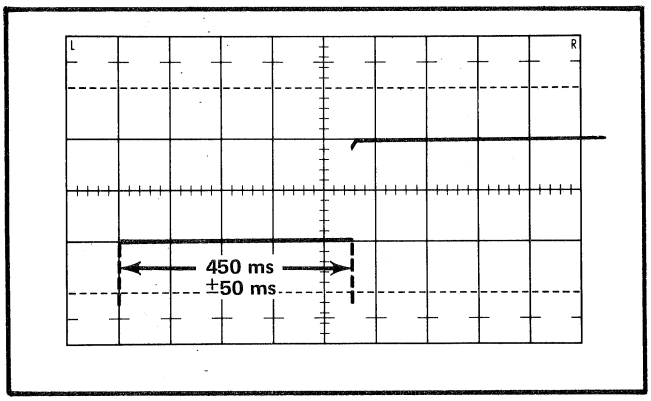


Fig. 5-13. Checking the negative-going excursion time of the erase signal at pin AQ on the Storage board.

HORIZONTAL AND VERTICAL AMPLIFIERS

In this procedure the gain controls will be adjusted for a horizontal deflection factor of 1 volt/16.2 cm and a vertical deflection factor of 1 volt/21 cm to meet the calibration requirements of other circuits. If a square rather than rectangular display format is desired, readjust the vertical deflection to 1 volt/16.2 cm after the completion of the calibration procedure.

Control Settings

Type 611

INTENSITY	**fully ccw**
WRITE-THRU INTENSITY	as previously adjusted
FOCUS	as previously adjusted
OPERATING LEVEL	as previously adjusted
TEST SPIRAL	NORMAL
Internal Controls	
SW202	centered
SW204	centered
All other controls	as previously adjusted

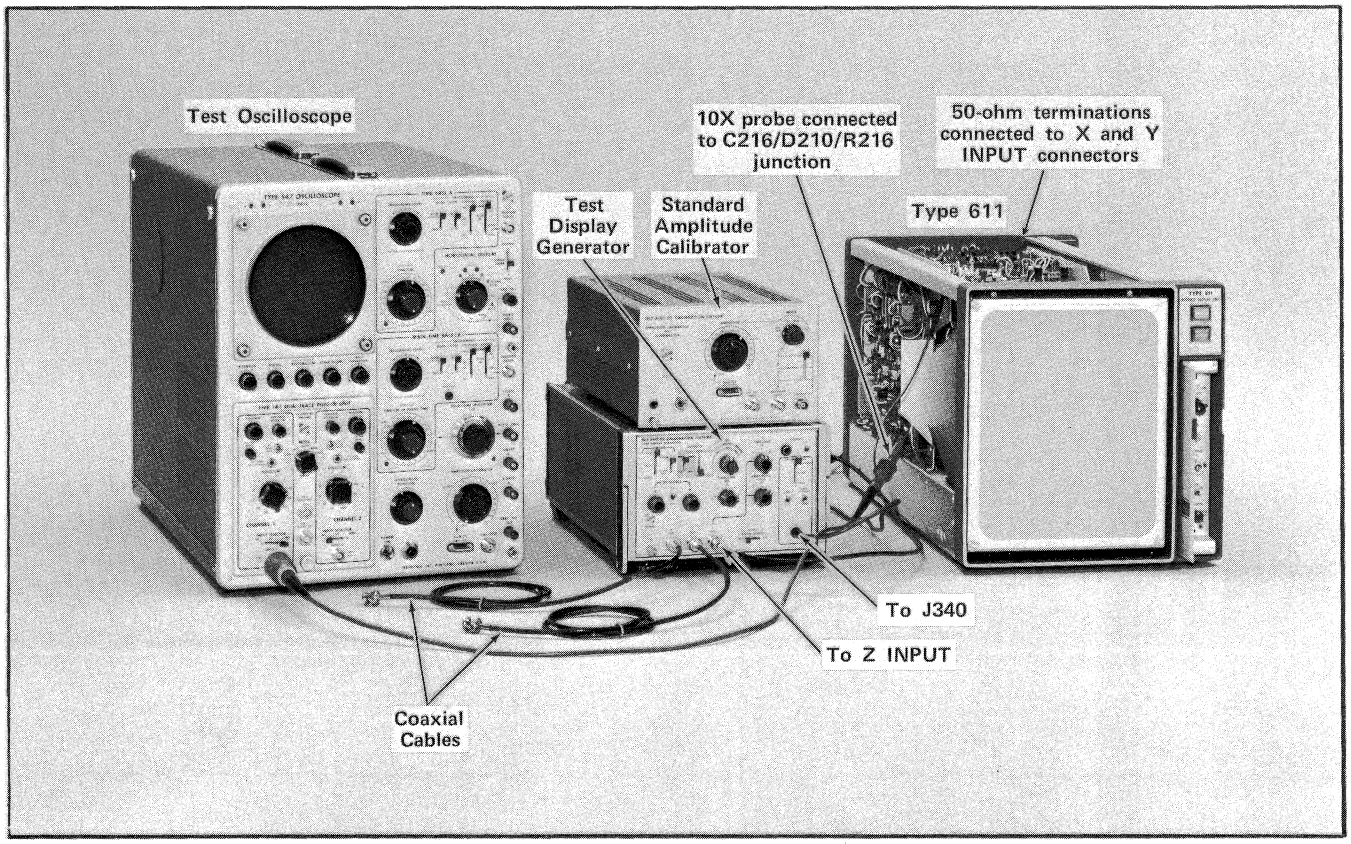


Fig. 5-14. Equipment required for Horizontal Gain, Vertical Gain and Beam Centering calibration steps.

Test Display Generator

Mode	
Cont-Ready-Single	**Cont**
Raster-Single Dot	Raster
Density	
Selector	100
Variable/Cal	Cal
Dots-Lines	Lines
Horiz-Vert	Horiz
Time/Dot	9
Amplitude	1
Time/Line	10
DC Offset	Off
Output Signal Source	Int
Remote Program Test	
Non Store-Store-Erase	**Non Store**
View	View
Write Through	Off

Test Oscilloscope

Intensity	normal brightness
Focus	well defined trace
Astigmatism	well defined trace
Horizontal Display	A
Time Base A	
Triggering Level	**fully cw**
Triggering Mode	**Auto**
Triggering Slope	+
Triggering Coupling	AC
Triggering Source	Int Norm
Time/Cm	**.2 ms**
Vertical Amplifier	
Mode	Ch 1
Volts/Cm (Ch 1)	**.05**
Input Selector (Ch 1)	**GND**
CRT Cathode Selector	**External CRT Cathode**

Standard Amplitude Calibrator

Amplitude	1 Volt
Mode	Squarewave

17. Check or Adjust Horizontal Position (R44) ❶

a. Test setup is shown in Fig. 5-14.

b. Disconnect the TDG coaxial cable from the Type 611 X and Y INPUT connectors. Connect 50-ohm terminations to the X and Y INPUT connectors to ensure a no-deflection signal condition for the Type 611 amplifiers.

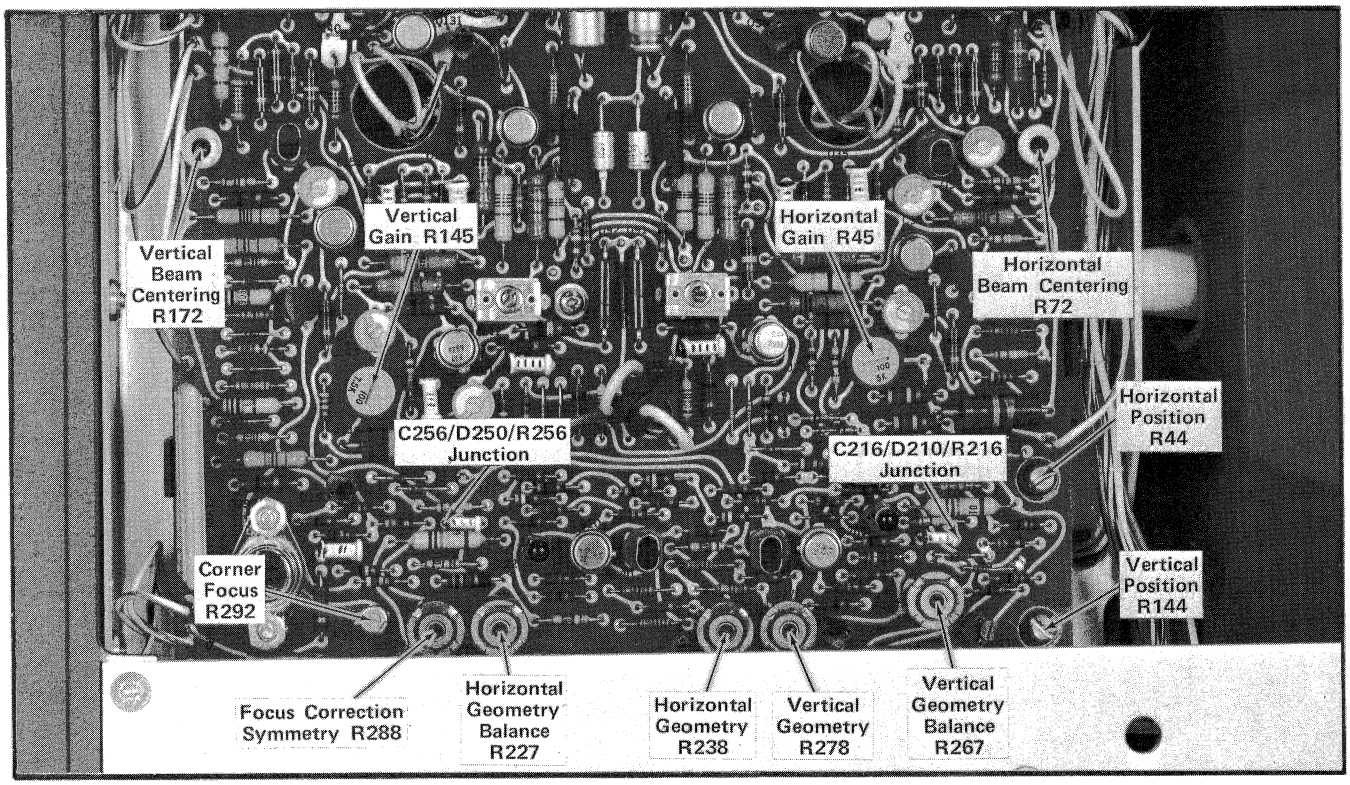


Fig. 5-15. Locations of test points and adjustments for steps 16 through 24.

c. Connect a 10X probe from the test oscilloscope Channel 1 input to the output of Q210 at the junction of C216, CR210 and R216 (Fig. 5-15) on the X-Y Amplifier board.

d. Use the test oscilloscope Vertical Position control to position the trace one cm above the bottom graticule line.

e. Set the test oscilloscope Input Selector switch to DC.

f. CHECK—The free-running display should be at minimum DC level (about one cm above ground) and should have minimum AC component amplitude (about 2 mm) as indicated on the test oscilloscope and obtained at the completion of part g of this step.

g. ADJUST—Horizontal Position control R44 (Fig. 5-15) for minimum DC level and minimum AC component amplitude.

NOTE

This is a preliminary adjustment. Final adjustment is described in step 32e.

18. Check or Adjust Vertical Position (R144)

a. Move the Channel 1 10X probe to the output of Q250 at the junction of C256, CR250 and R256 (Fig. 5-15) on the X-Y Amplifier board.

b. CHECK—The free-running display should be at minimum DC level (about one cm or less above ground) and should have minimum AC component amplitude (about 2 mm or less) as indicated on the test oscilloscope and obtained at the completion of part c of this step.

c. ADJUST—Vertical Position R144 (Fig. 5-15) for minimum DC level and minimum AC component amplitude.

NOTE

This is a preliminary adjustment. Final adjustment described in step 32e.

d. Disconnect the Channel 1 10X probe from the X-Y Amplifier board.

19. Check or Adjust Beam Centering (R72, R172)

a. Slowly turn the INTENSITY control clockwise until the writing beam spot is dimly visible.

b. CHECK—The beam spot should be within 1 mm of graticule center.

c. ADJUST—Horizontal Beam Centering control R72 and Vertical Beam Centering control R172 (Fig. 5-15) to align the spot with the center of the graticule.

NOTE

This is a preliminary adjustment. Final adjustment is described in step 25.

20. Check or Adjust Horizontal Gain (R45)

a. Set the controls as follows:

Type 611

INTENSITY	fully ccw
SW202	front position

b. Disconnect the TDG remote program test connector from the Type 611 remote program connector J340. Using a coaxial cable, connect the Z output of the TDG to the Z INPUTs on the Type 611.

c. Momentarily press the ERASE button to remove the background luminance.

d. Disconnect the 50-ohm termination from the X INPUT connector.

e. Connect a 1-volt squarewave signal from the Standard Amplitude Calibrator output connector through a coaxial cable to the Type 611 X INPUT connector.

f. Rotate the INTENSITY control clockwise until a two-dot display is dimly visible.

g. Readjust R44 to align the left-hand dot with the left border line of the graticule (Fig. 5-16). Readjust R144 to align the dots with the horizontal centerline.

h. CHECK—The two dots should be approximately 16.2 cm apart at the horizontal centerline of the graticule.

i. ADJUST—Horizontal Gain control R45 (Fig. 5-15) for a dot separation of 16.2 cm. Use R44 and R144 as positioning controls to align the dots with the graticule lines.

NOTE

To minimize parallax when using the test graticule, use image of the pupil of your eye reflected from the faceplate for determining the exact beam location.

21. Check or Adjust Vertical Gain (R145)

a. Remove the 50-ohm termination from the Y INPUT connector and move the Standard Amplitude Calibrator output from the X to the Y INPUT connector. Install the 50-ohm termination on the X INPUT connector.

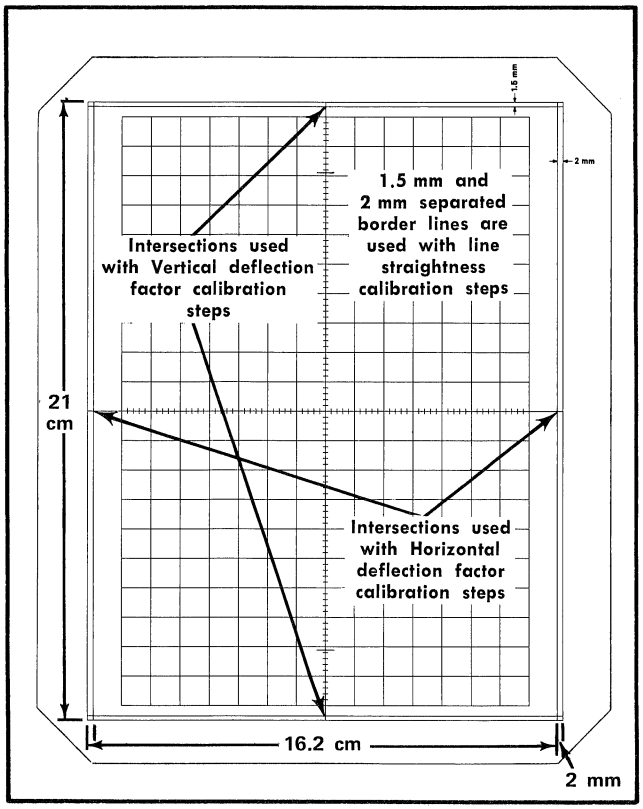


Fig. 5-16. Test graticule.

b. Return SW202 to its center position and move SW204 to its front position. Momentarily press the ERASE button to remove the previously stored display.

c. Readjust R144 to align the lower dot with the bottom border line of the graticule (Fig. 5-16). Readjust R44 to align the dots with the vertical centerline.

d. CHECK—The display should appear as two dots approximately 21 cm apart near the vertical centerline of the graticule.

e. ADJUST—Vertical Gain control R145 (Fig. 5-15) for a dot separation of 21 cm. Use R44 and R144 as positioning controls to align the dots with the graticule lines.

f. Turn off and disconnect the Standard Amplitude Calibrator from the Y INPUT connector. Connect the TDG remote program test connector to the Type 611 remote program connector J340.

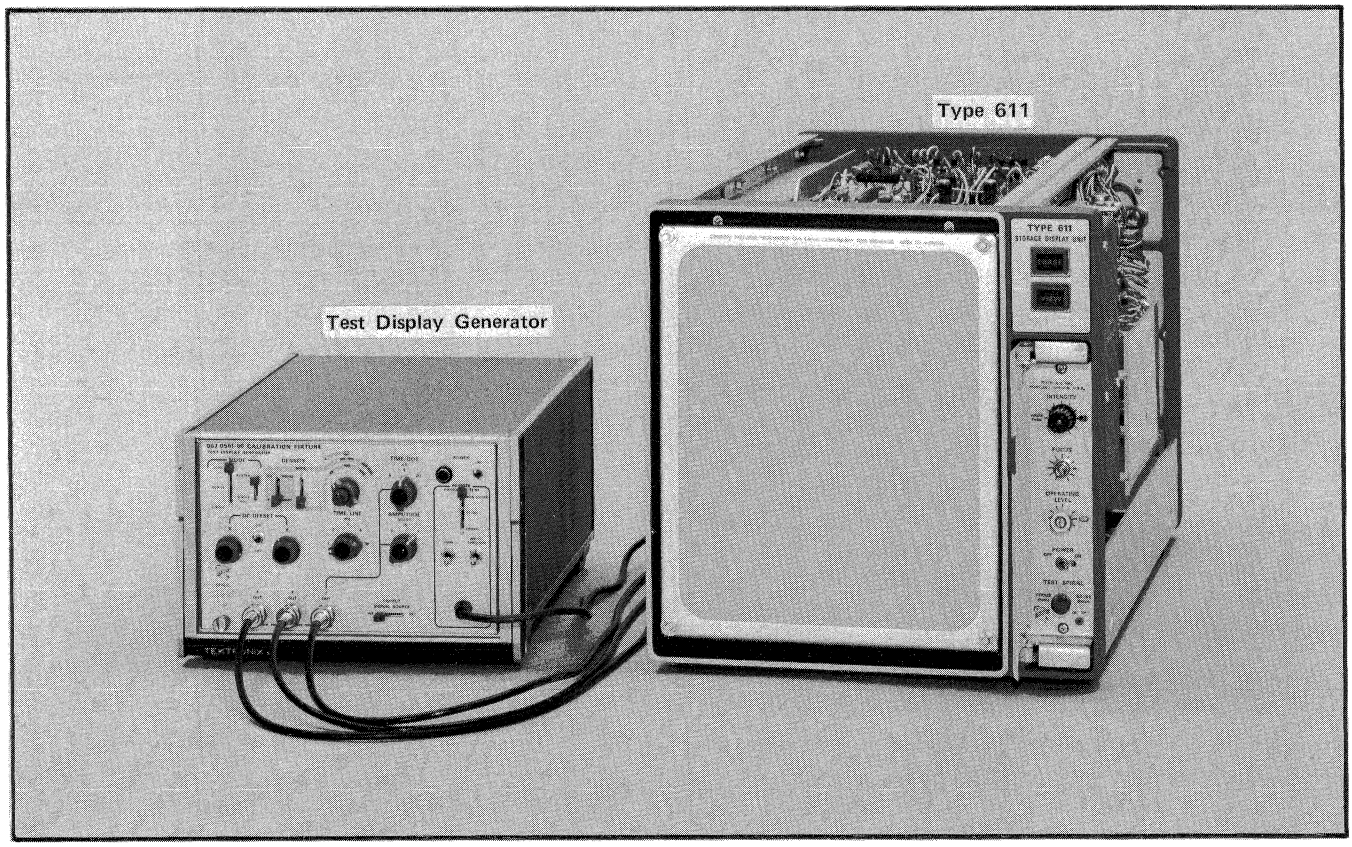


Fig. 5-17. Equipment setup for Line Straightness and Dynamic Focus calibration steps.

LINE STRAIGHTNESS

This calibration procedure for the Geometry Correction Circuit controls must be preceded by steps 16 through 20.

Control Settings

Type 611

INTENSITY	as previously adjusted
WRITE-THRU INTENSITY	as previously adjusted
FOCUS	as previously adjusted
OPERATING LEVEL	as previously adjusted
TEST SPIRAL	NORMAL
Internal Controls	
SW202	**front**
SW204	front
All other controls	as previously adjusted

Test Display Generator

Mode	
Cont-Ready-Single	Cont
Raster-Single Dot	Raster
Density	
Selector	**25**
Variable/Cal	Cal
Dots-Lines	Lines
Horiz-Vert	**Vert**
Time/Dot	9
Amplitude	1
Time/Line	**.1 ms**
DC Offset	**ON**
Output Signal Source	Int
Remote Program Test	
Non Store-Store-Erase	**Non Store**
View	**OFF**
Write Through	OFF

22. Check and Adjust Vertical Line Straightness (R227 and R238) ❶

a. Test setup is shown in Fig. 5-17.

b. Disconnect the 50-ohm termination from the X INPUT connector. Connect the TDG X and Y outputs to the respective Type 611 X and Y INPUTS using coaxial cables.

c. Check that the TDG Z output and the remote program test connector are connected to the Type 611.

NOTE

When performing steps 22 through 25, use the TDG DC Offset controls to position the display to locations described in the procedure.

d. Set the INTENSITY control and, if necessary, the FOCUS control so the displayed lines are visible and well defined.

e. Position the display so that most or all of the left vertical line is located within the 2 mm spaced lines on the left graticule border (Fig. 5-16).

f. CHECK—The deviation of the line being observed should not exceed 1% peak to peak (2.1 mm) from top to bottom of the test graticule.

NOTE

If the center vertical display line does not coincide with the center vertical graticule line, readjust the yoke. Use step 10 as a guide.

g. Position the display so that most or all of the right vertical line is located within the 2 mm spaced lines on the right graticule border.

h. CHECK—The deviation of the line being observed should not exceed 1% peak to peak (2.1 mm) from top to bottom of graticule.

i. ADJUST—Horizontal Geometry Balance control R227 and Horizontal Geometry control R238 (Fig. 5-15) for optimum vertical line straightness within the required tolerance of 2.1 mm.

23. Check or Adjust Horizontal Line Straightness (R267 and R278) ◐

a. Change the TDG Horiz/Vert switch to Horiz.

b. Position the display so that most or all of the top horizontal line is located within the 1.5 mm spaced lines on the upper border of the test graticule (Fig. 5-16).

c. CHECK—The deviation of the line being observed should not exceed 1% peak to peak (1.63 mm) from left to right side of the test graticule.

d. Position the display so that most or all of the bottom horizontal line is located within the 1.5 mm spaced lines on the lower border of the graticule.

e. CHECK—The deviation of the line being observed should not exceed 1% peak to peak (1.63 mm) from left to right side of the test graticule.

f. ADJUST—Vertical Geometry Balance control R267 and Vertical Geometry control R278 (Fig. 5-15) for optimum horizontal line straightness within the required tolerance of 1.63 mm.

DYNAMIC FOCUS

24. Check or Adjust Focus Correction Symmetry (R288) ◐

a. Change the TDG Dots/Lines switch to Dots.

b. CHECK—Inspect the displayed dots over about a 4-cm square area in each corner. Check for uniform focus quality in all corner areas of the CRT display area.

c. ADJUST—Focus Correction Symmetry control R288 (Fig. 5-15) for equal focus quality of the dots in all corners.

25. Check or Adjust Corner Focus (R292) ◐

a. CHECK—Equal focusing quality of the dots in the corners as compared to the dots located in other areas of the screen.

b. ADJUST—Corner Focus control R292 (Fig. 5-15) for equal focus quality of the dots in the corners as compared to the dots located in other areas of the screen. Readjust the FOCUS control as necessary.

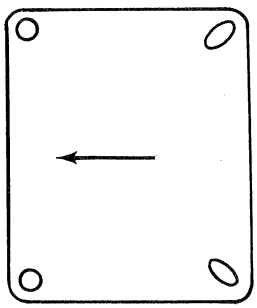
Elliptical dots oriented radially to screen center are focused slightly positive of optimum; round dots are optimum and elliptical dots oriented tangentially are slightly negative of optimum (Fig. 5-18). In those CRTs where focusing problems occur, proceed as follows:

To produce the same dot shape in all corners, determine which side of the dot array needs to be made more positive in terms of focus voltage. See Fig. 5-18 for some examples. Use position controls (R44, R144) to move the raster in that direction by an increment of about 1/8 inch. Use the beam centering controls (R72, R172) to recenter the raster. Readjust R292, R288 and the FOCUS control for best overall focus of the display. If the improvement is not

EXAMPLE A:

Stored dots in the upper right and lower right corners are radial ellipses, while dots in both left corners are round. Therefore, focus correction for the entire left edge of the raster must be made more positive.

R44 is adjusted to move the raster about 1/8 inch to the left. R72 is adjusted to recenter the raster. R292, R288 and the FOCUS control are adjusted to obtain best overall focus of the display.

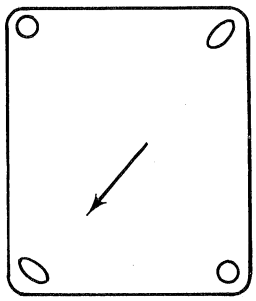


Example A

EXAMPLE B:

Dots are radial ellipses in the upper right corner, round in the upper left and lower right corners and tangential ellipses in the lower left corner. Therefore focus correction for the lower left corner must be improved.

R44 is used to move the raster 1/8 inch to the left. R144 is adjusted to move the raster 1/8 inch toward the lower edge of the screen. R72 and R172 are adjusted to recenter the raster. R292, R288 and the FOCUS control are adjusted for best overall focus of the display.



Example B

Fig. 5-18. Examples for focus correction. Arrows indicate direction of raster movement when using the positioning controls, R44 and R144.

sufficient, move the raster an additional increment in the same direction.

If the preceeding procedure was performed to improve the overall focus of the display, it will be necessary to repeat steps 22 and 23.

DOT WRITING TIME, DOT RESOLUTION & LINEARITY

26. Check Dot Writing Time and Dot Resolution

a. Set the TDG controls as follows:

Cont-Ready-Single	Ready
Density Selector	300:400
Time/Line	3
Time/Dot	5
Non Store-Store-Erase	Store

b. Remove the test graticule.

c. Depress the TDG Cont-Ready-Single switch to write the entire screen. Check that the display is properly centered and stored. If not, erase the display. Use the TDG DC Offset and the Type 611 INTENSITY and FOCUS controls to obtain the proper display.

d. CHECK—The stored dots throughout the graticule area should be checked for any indication of bridging (Fig. 5-18) or drop out (missing dots). Use a 9X to 12X magnifier to inspect any questionable 10-dot by 10-dot area.

A guide for proper operation is as follows: Fade up (bridging)—No more than 15 stored dots or any 10 X 10 group may bridge excessively to an adjacent dot. Excessive bridging occurs when the width of the luminescent area that joins two written dots is equal to or greater than 3.5 mils (0.0035 inch). To estimate this distance, use the 6.7-mil distance between raised collector dots as a gauge. Thus, 3.5 mils is equivalent to slightly more than one-half the distance between the collector dots. The raised collector dots are the black dots on the screen that are visible when viewed through the magnifying lens (Fig. 5-19). Drop out—No more than 5 stored dots in any 10 X 10 dot group will fade out to less than three raised collector dots.

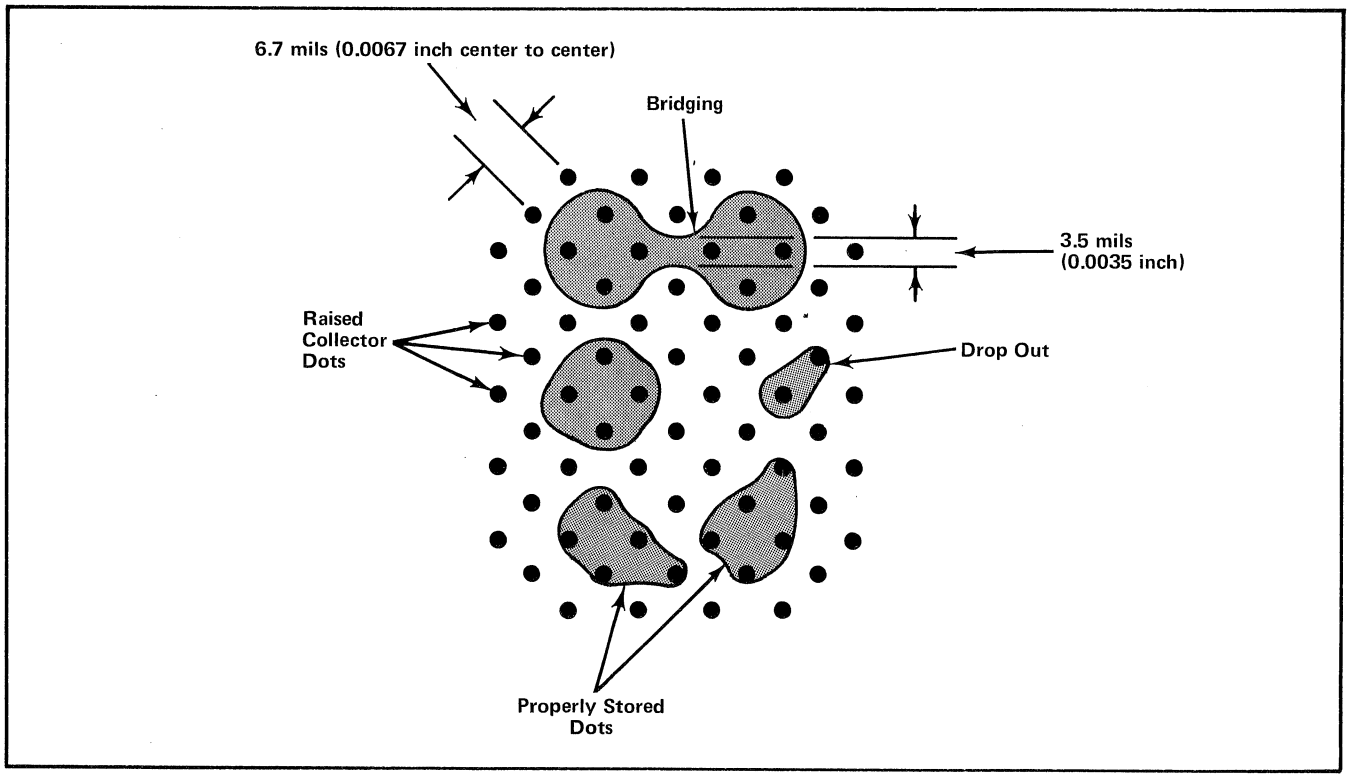


Fig. 5-19. Illustration showing a magnified portion of the display.

If dot resolution has deteriorated in the upper left quarter of the screen due to greater usage and is good in the lower right quarter because of lesser usage, the CRT can be turned 180°. This change is desirable if it is not expedient to replace the CRT at this time. Refer to the Maintenance section for information concerning CRT removal and installation. Use only the applicable information. For example, the plastic implosion shield with its rubber gasket need not be removed from the CRT faceplate. Then, repeat steps 10 through 26 in the Calibration procedure.

27. Check Linearity

a. Set the TDG controls as follows:

Cont-Ready-Single	Cont
Dots-Lines	Lines
Density Selector	25

b. Reinstall the test graticule.

c. Use the TDG DC Offset and Variable Density controls to obtain 21 horizontal lines. Set the Non Store-Store-Erase switch momentarily to Erase to remove a previously stored display in this procedure. The distance between the bottom and top horizontal lines should be exactly 20 cm; i.e., the first line should coincide with the bottom graticule line located 10 cm below the horizontal centerline and the 21st line should coincide with the top graticule line located 10 cm above the horizontal centerline.

d. CHECK—All the lines within the graticule area 20 cm should coincide with their corresponding 1-cm graticule line within 1% (2 mm) when viewed along the vertical center axis.

Also, check the display at 2-cm increments to locate the lines that are closest together in a 2-cm space and the lines that are the greatest distance apart in a 2-cm space. The difference between the two distances should not exceed 10% (2 mm).

e. Set the TDG Horiz-Vert switch to Vert.

f. Use the TDG DC Offset and Variable Density controls to obtain 17 vertical lines. Position the first vertical line to coincide with the 0-cm graticule line located 8 cm to the left of vertical center and position the 17th line to coincide with the 16-cm graticule line located 8 cm to the right of vertical center.

g. CHECK—Using part d of this step as guide, check full scale linearity (1%) and incremental linearity (10%) of the vertical lines.

28. Check VIEW Mode

a. Set the TDG Cont-Ready-Single switch to Ready and momentarily press the Type 611 ERASE button. Wait until the VIEW button becomes illuminated.

b. Momentarily set the TDG Cont-Ready-Single switch to the Single position.

c. CHECK—The Type 611 VIEW button light should go out and the vertical lines should be displayed. In 60 to 90 seconds the VIEW button should again become illuminated and the display should go to the hold mode.

d. Press the Type 611 VIEW button.

e. CHECK—The VIEW button light should go out and the vertical lines should be displayed. In 60 to 90 seconds the VIEW button should light and the display should go to the hold mode.

f. Set the TDG View-Off switch to View and press the Non Store-Store-Erase switch to Erase.

29A. Check or Adjust WRITE THRU (R377) and INTENSITY 3 (R387) For instruments above SN B150000 ❶

a. Set the controls as follows:

Type 611

INTENSITY	fully ccw
SW202	Centered
SW204	Centered

Test Dsiplay Generator

Cont-Ready-Single	Cont
Raster-Single Dot	Single Dot
View-Off	View
Write Through-Off	Write Through

b. Momentarily press the ERASE button.

c. Reduce the ambient light or use a viewing hood when performing parts d and e of this step.

d. CHECK—A very dim small circle should be displayed near the center of the screen. The exact location is determined by the setting of the TDG DC Offset control. The displayed circle should be sufficiently dim so it will not be stored when positioned anywhere within the 14 cm by 20 cm graticule area. Use the TDG X and Y DC Offset controls to position the display.

e. ADJUST—Front panel WRITE THRU control until the circle is visible, but sufficiently dim so that it cannot be stored when positioned anywhere within the 14 cm by 20 cm area of the test graticule.

f. Set the Raster-Single Dot switch to Raster.

g. Connect a precision DC voltmeter between Pin CE-2 on the Storage Board and chassis ground, see Fig. 5-9A. Note the DC voltmeter reading.

h. Connect a jumper wire between pin BH on the Storage Board and chassis ground, see Fig. 5-9A.

i. CHECK—Voltage reading should now be approximately 200 volts. The exact voltage reading will be influenced by the OPERATING LEVEL voltage and Collimation voltage.

j. Rotate the front-panel INTENSITY 3 control.

k. CHECK—INTENSITY 3 control varies the display intensity.

l. ADJUST—Front-panel INTENSITY 3 control until the display of lines is at the desired intensity.

m. Disconnect the DC voltmeter, the jumper wire, and the Test Display Generator.

29B. Check or Adjust WRITE THRU INTENSITY (R410B) For instruments below SN B150000 ❶

a. Set the controls as follows:

Type 611

INTENSITY	fully ccw
SW202	Centered
SW204	Centered

Test Display Generator

Cont-Ready-Single	Cont
Raster-Single Dot	Single Dot
View-Off	View
Write Through-Off	Write Through

Ⓓ

b. Momentarily press the ERASE button.

c. Reduce the ambient light or use a viewing hood when performing parts d and e of this step.

d. CHECK—A very dim small circle should be displayed near the center of the screen. The exact location is determined by the setting of the TDG DC Offset control. The displayed circle should be sufficiently dim so it will not be stored when positioned anywhere within the 14 cm by 20 cm graticule area. Use the TDG X and Y DC Offset controls to position the display.

e. ADJUST—Front panel WRITE THRU INTENSITY control until the circle is visible, but sufficiently dim so that it cannot be stored when positioned anywhere within the 14 cm by 20 cm area of the test graticule.

f. Disconnect the Test Display Generator.

SETTLING TIME

In this calibration procedure the high frequency compensation capacitors in the Horizontal and Vertical Deflection Amplifier circuits are adjusted for optimum response to a square-wave input signal. The applied square-wave input signal is adjustable in amplitude and polarity, to permit adjustment and checking of the trace deflection time at various distances from the center of the display area, and in four directions. A time-mark reference is provided by applying the output of a Time-Mark Generator to the Z Axis Amplifier.

The adjustment procedure is essentially the same for both amplifier circuits. The procedure involves finding the faceplate area with slowest deflection time (area of slowest settling time) and adjusting the high frequency compensating capacitors for the fastest settling time and optimum response. The worst-case area for a given display amplitude is found by moving the display along the axis in one direction, reversing the input signal polarity and moving the display in the other direction.

A sawtooth waveform is applied to the input of the deflection amplifier not being checked or compensated to produce a sweep. Since this sweep is unblanked, it will produce a bright spot at the start of the sweep that must be positioned out of the viewing area. For this procedure, the end of the sweep is also positioned out of the viewing area. The sawtooth amplitude range is sufficient to position the end of the sweep off the faceplate, but the positioning range of the Type 611 must be increased to move the start of the sweep out of the viewing area.

Control Settings

Type 611

INTENSITY	fully ccw
WRITE-THRU INTENSITY	as previously adjusted
FOCUS	as previously adjusted
OPERATING LEVEL	as previously adjusted
TEST SPIRAL	NORMAL
Internal Controls	
SW202	**front**
SW204	**front**
All other controls	as previously adjusted

Test Oscilloscope

Intensity	normal brightness
Focus	well defined trace
Astigmatism	well defined trace
Horizontal Display	A
Time Base A	
Triggering Level	fully cw
Triggering Mode	**Trig**
Triggering Slope	+
Triggering Coupling	AC
Triggering Source	**Ext**
Time/Cm	**20 μs**
Vertical Amplifier	
Mode	Ch 1
Volts/Cm (Ch 1)	.05
Input Selector (Ch 1)	DC
CRT Cathode Selector	External CRT Cathode

Type 184

Marker Selector	1 μs and 5 μs
Trigger Selector	.1 ms

Type 114

Period	External Trigger
Variable/Cal	Cal
Width	10 μs
Variable/Cal	midrange
Amplitude	+3 to 10 V
Variable	midrange

Sweep Attenuator (067-0569-00)

Amplitude	midrange

30. Check or Adjust Horizontal Amplifier Settling Time (C12, C45, C53 and C62) ❶

a. Test setup is shown in Fig. 5-20.

b. Connect a coaxial cable from the Type 184 Marker Output connector to the Type 611 Z INPUT connector.

Ⓓ

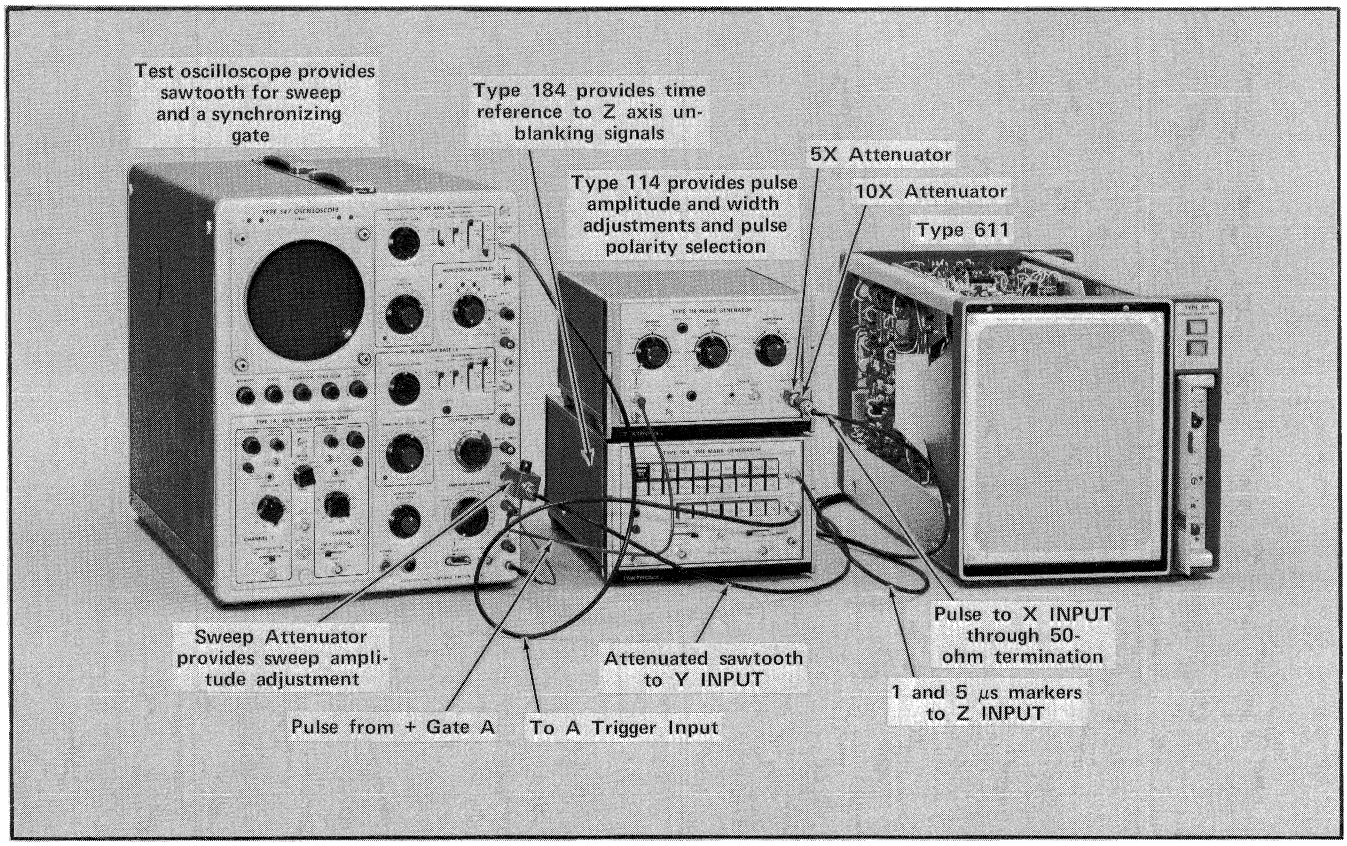


Fig. 5-20. Equipment setup for Deflection Amplifier settling time calibration steps.

Connect another coaxial cable from the Trigger Output connector to the test oscilloscope Trigger Input connector.

c. Connect the Sweep A banana plug of the Sweep Attenuator to the test oscilloscope Sweep A connector. Connect the Sweep Attenuator Gnd lead to the test oscilloscope ground connector. Connect a coaxial cable from the Sweep Attenuator Output connector to the Type 611 Y INPUT connector.

d. Connect the signal from the Type 114 Output connector through a 5X attenuator, a 10X attenuator, a coaxial cable and a 50-ohm termination to the Type 611 X INPUT connector. Connect all items in the given order.

e. Connect a patch cord from the test oscilloscope + Gate A connector to the Type 114 External Trigger Input connector.

f. Slowly turn the INTENSITY control clockwise until the spot appears on the faceplate. The spot is located at the start of the sweep. Move this spot down and out of the viewing area with the Vertical Position control, R144.

g. Turn the INTENSITY control further clockwise to view the display at normal brightness. Set the Type 114 Variable Width and Variable Amplitude controls, and the Sweep Attenuator Amplitude control to obtain a display similar to the one shown in Fig. 5-22. Use the Type 611 Horizontal Positon (R44), Horizontal Trace origin Selector switch SW202 and Vertical Position (R144) controls to position the last portion of the pulse trace as shown in Fig. 5-22. The 1 μs and 5 μs markers unblank the beam to produce the series of visible dots that make up the display and enable the settling time measurements to be made.

h. Set the Type 114 Variable Amplitude control and, if necessary, the Amplitude switch to +1 and 3 V to obtain a 1-cm pulse amplitude. Set the Variable Width control so that a 5 μs dot is positioned at a point where the settling time is just starting (Fig. 5-23).

i. Count the number of microseconds settling time by counting the time-marker dots in the settling area of the display (Fig. 5-23). End of settling time is when the beam is located within one spot diameter of its final position.

j. CHECK—Settling time should not exceed 8.5 μs/cm. Settling time performance requirement is ≤3.5 μs/cm plus 5 μs.

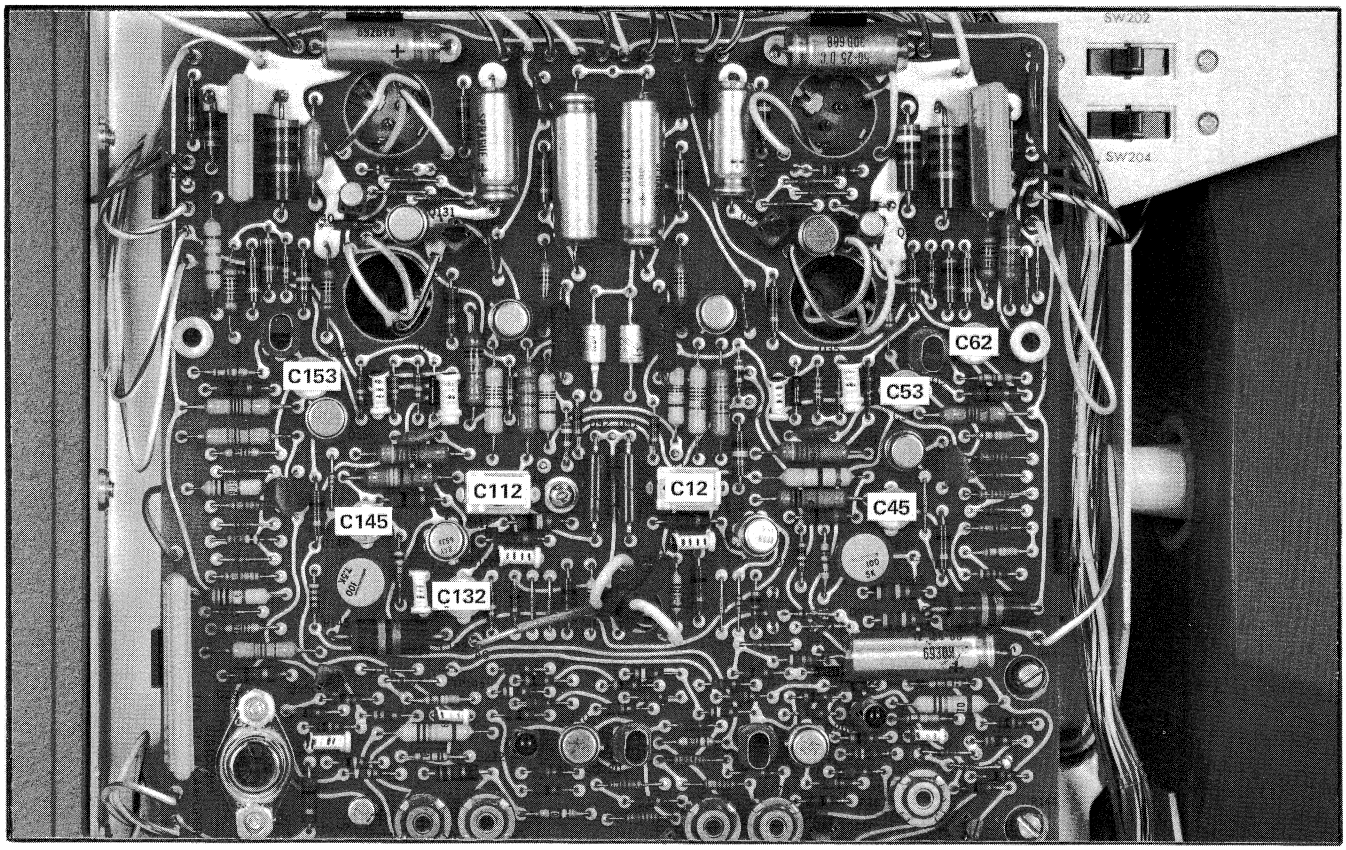


Fig. 5-21. Location of settling time calibration adjustments on the X-Y Amplifier board.

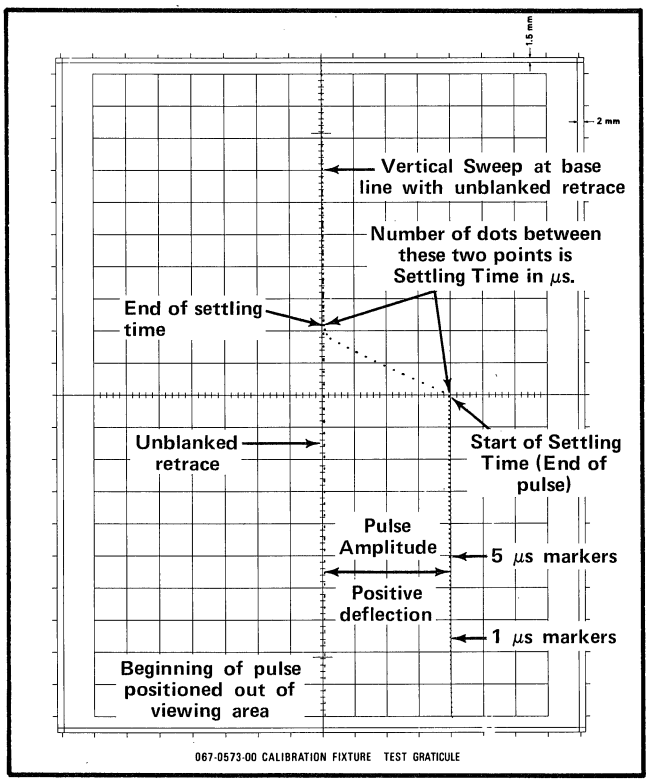


Fig. 5-22. Appearance of initial settling time display with various points identified.

k. Position the one-cm pulse slowly to various areas of the graticule. Use R44, R144, SW202 and the Type 114 Width controls to position the display. Repeat part k of this step. Momentarily press the ERASE button to remove previously stored information.

l. Change the Type 114 Amplitude switch to the −1 to 3 V position and repeat parts j and k of this step. If the performance requirement is met, proceed to part p of this step; if not, go to part m.

m. Set the Type 114 Amplitude switch to −3 to 10 V and adjust the Variable Amplitude control to obtain a pulse amplitude of 3 cm. Position the display, using the controls described in part k of this step, to an area where the longest settling time is found. Usually this area is located in the lower right portion of the graticule.

n. ADJUST—C12, C45, C53 and C62 (Fig. 5-21) for minimum settling time using the 3 cm pulse amplitude. Settling time should be equal to or less than 15.5 μs. All the adjustments primarily affect the ending portion of the settling time display. C12 and C45 have the most noticeable effect. C12, if misadjusted, can cause a jittery display.

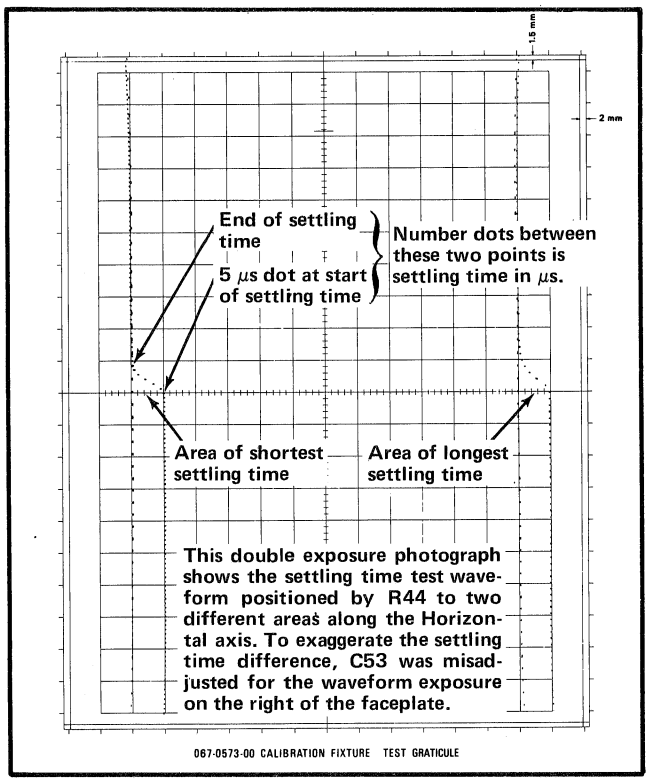


Fig. 5-23. Double exposure photograph of the settling time calibration waveform showing an exaggerated difference in settling time between two areas.

o. Change the Type 114 Amplitude control to produce a pulse amplitude of 4 cm.

p. CHECK—Find the graticule area of longest settling time and check for a settling time of ≤19 μs/4 cm.

q. Remove the 5X attenuator from the Type 114 Output connector to obtain more pulse amplitude. Change the Type 114 Width and Variable controls, and the Sweep Amplitude control as necessary, to produce a 16 cm pulse amplitude display.

r. CHECK—Locate the area of longest settling time and check for a settling time ≤61 μs/16 cm.

s. ADJUST—If the settling time performance requirement is not met for either the 4-cm or 16-cm pulse amplitude checks, repeat the adjustment given in part n of this step.

t. Reinsert the 5X attenuator at the Type 114 Output connector.

31. Check or Adjust Vertical Amplifier Settling Time (C112, C132, C145 and C153)

a. Test setup is the same as for the previous step except as follows: Set the INTENSITY control fully counterclockwise. Interchange the coaxial cables at the Type 611 X and Y INPUT connectors. Be sure to move the 50-ohm termination to the Y INPUT connector.

b. Set the controls as follows:

Type 114

Width	10 μs
Amplitude	+1 to 3 V

Type 611

SW202	front
SW204	centered
R44 and R144	midrange

c. Set the INTENSITY control for normal display brightness. If the spot at sweep start is on the screen, position the spot off the faceplate using R44.

d. Set the Type 114 Variable Amplitude control to produce a pulse amplitude of 1 cm. Set the Variable Width control so that a 5 μs dot is positioned at a point where the settling time is just starting.

NOTE

Use R144 and SW204 for positioning the display.

e. CHECK—Settling time should not exceed 8.5 μs/cm. Settling time performance requirement is ≤3.5 μs/cm plus 5 μs.

f. Position the one-cm pulse to various areas of the graticule. Repeat part e of this step. Momentarily press the ERASE button to remove previously stored information.

g. Change the Type 114 Amplitude switch to −1 to 3 V position and repeat part f of this step. If the performance requirement is met, proceed to part j of this step; if not, go to part h.

h. Set the Type 114 Amplitude switch to +3 to 10 V and adjust the Variable Amplitude control to obtain a 3-cm pulse amplitude display. Position the display, using the

controls described in part d of this step, to an area where longest settling time is found. This area is usually found in the lower left portion of the graticule.

i. ADJUST—C112, C132, C145 and C153 (Fig. 5-21) for fastest settling time and optimum response using a 3 cm pulse amplitude. Settling time should be equal to or less than 15.5 μs. All the adjustments primarily affect the ending portion of the settling time display. C112 and C132 have the most noticable effect. C112, if misadjusted can cause a jittery display.

j. Change the Type 114 Variable Amplitude control to produce a pulse amplitude of 4 cm.

k. CHECK—Find the graticule area of longest settling time and check for a settling time of ≤19 μs/cm.

l. Remove the 5X attenuator from the Type 114 Output connector. Change the Type 114 Variable Width and Amplitude controls, and the Sweep Attenuator control as necessary, to obtain a 20 cm pulse amplitude display.

m. CHECK—Locate the area where the longest settling time can be found. Check for a settling time of ≤75 μs/21 cm.

n. ADJUST—If the settling time performance requirement is not met for either the 4-cm or 20-cm pulse amplitude checks, repeat the adjustments given in part i of this step.

o. Disconnect and turn off the Type 114 and Type 184.

p. Turn the INTENSITY control fully counterclockwise.

q. Disconnect the Sweep Attenuator from the test oscilloscope and Type 611.

OSCILLATION

The Horizontal and Vertical Deflection Amplifiers are subject to unwanted oscillations if certain capacitive feedback conditions exist. The unwanted oscillations are typically between 1 and 10 MHz and may be eliminated by readjusting the capacitors listed in the following procedure.

Control Settings

Type 611

INTENSITY	fully ccw
WRITE-THRU INTENSITY	as previously adjusted
FOCUS	as previously adjusted
OPERATING LEVEL	as previously adjusted
TEST SPIRAL	NORMAL
Internal Controls	
SW202	**centered**
SW204	**centered**
All other controls	as previously adjusted

Test Oscilloscope

Intensity	normal brightness
Focus	well defined trace
Astigmatism	well defined trace
Horizontal Display	A
Time Base A	
Triggering Level	**0**
Triggering Mode	Trig
Triggering Slope	+
Triggering Coupling	AC
Triggering Source	**Int Norm**
Time/Cm	**1 μs**
Vertical Amplifier	
Mode	Ch 1
Volts/Cm (Ch 1)	**.01**
Input Selector (Ch 1)	**AC**
CRT Cathode Selector	External CRT Cathode

Test Display Generator

Mode	
Cont-Ready-Single	Cont
Raster-Single Dot	Single Dot
Density	
Selector	25
Variable/Cal	Cal
Dots-Lines	**Lines**
Horiz-Vert	Horiz
Time/Dot	**9**
Amplitude	1
Time/Line	**.1**
DC Offset	**Off**
Output Signal Source	Int
Remote Program Test	
Non Store-Store-Erase	**Non Store**
View	**Off**
Write Through	**Off**

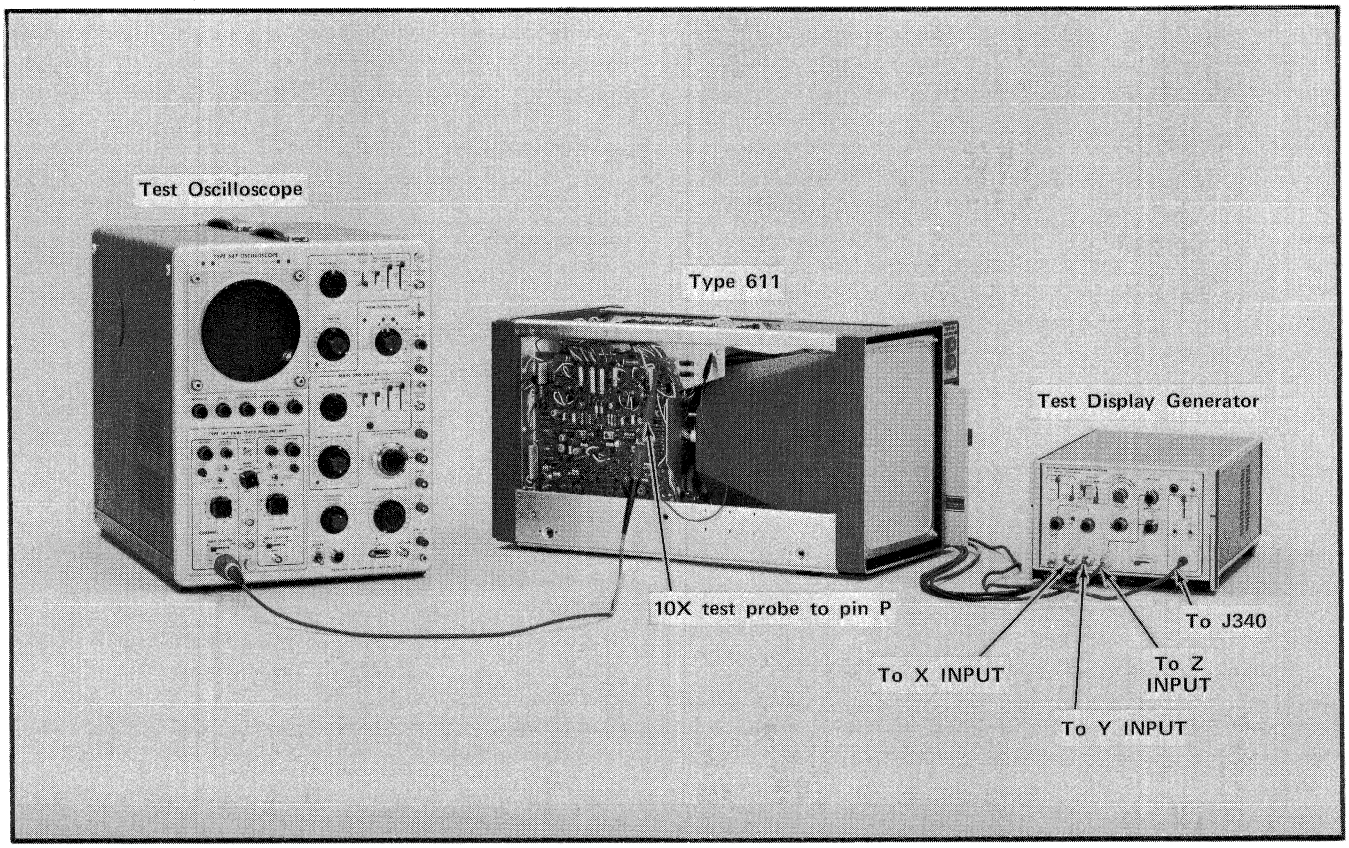


Fig. 5-24. Test setup for Deflection Amplifier Oscillations check.

32. Check or Adjust Horizontal Deflection Amplifier for No Oscillations (Readjust C12 and C53)

a. Test setup is shown in Fig. 5-24.

b. Connect 50 ohm terminations to the X and Y connectors.

c. Connect a coaxial cable from the TDG Z Out connector to the Type 611 Z INPUT connector. Connect the TDG remote program test connector to Type 611 remote program connector J340.

d. Turn the INTENSITY control clockwise until a dim writing beam spot appears on the CRT faceplate.

e. Readjust R44 and R144 to relocate the spot to coincide with graticule center.

f. Remove the 50 ohm terminations from the Type 611 X and Y INPUT connectors. Connect a coaxial cable from the TDG X Out connector to the Type 611 X INPUT connector. Connect another cable from the TDG Y Out connector to the Type 611 Y INPUT connector.

g. Connect the Channel 1 10X probe to pin P on the X-Y Amplifier circuit board (Fig. 5-25).

h. Set SW202 and SW204 to their front positions. Set the TDG DC Offset switch to On.

i. While observing the test oscilloscope and Type 611 displays, position the spot to various extremes of the graticule using the TDG DC Offset controls.

j. CHECK—That no oscillations occur with the spot positioned anywhere on the CRT.

NOTE

If oscillations occur, a stable sine-wave display will appear at some frequency between 1 and 10 MHz. Change the test oscilloscope Time/Cm switch, as necessary, to display the waveform.

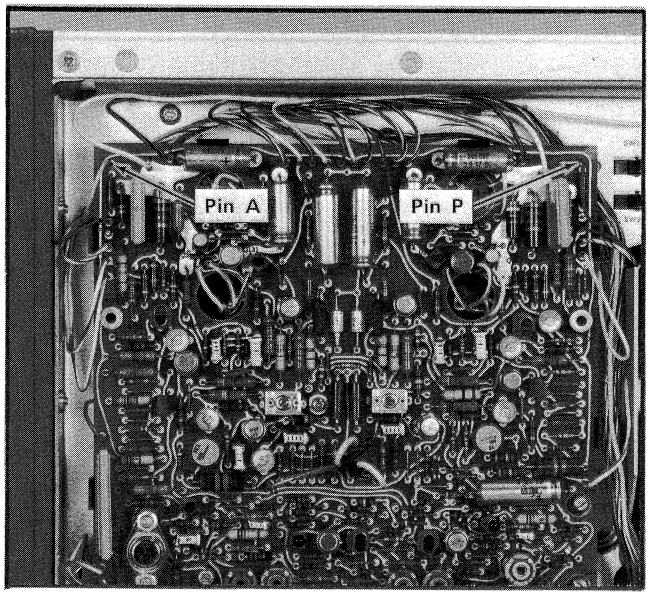


Fig. 5-25. Test point locations on the X-Y Amplifier board for steps 31 and 32.

k. ADJUST—If oscillations are present, repeat step 30 adjustments for a compromise between the shortest settling time and no oscillations.

NOTE

Usually clockwise rotation of C12 and slight readjustment of C45 will cause the oscillations to stop without seriously affecting the settling time.

33. Check or Adjust Vertical Deflection Amplifier for No Oscillations (Readjust C112 and C132)

a. Connect the Channel 1 10X probe to pin A on the X-Y Amplifier circuit board.

b. While observing the test oscilloscope and Type 611 displays, position the spot to various extremes of the graticule using the TDG DC Offset controls.

c. CHECK—That no 1 to 10 MHz oscillations occur with the spot positioned anywhere on the CRT.

d. ADJUST—If oscillations are present, repeat step 31 adjustments for a compromise between shortest settling time and no oscillations.

NOTE

Usually clockwise rotation of C112 and slight readjustment of C132 will cause the oscillations to stop without seriously affecting the settling time.

e. Set SW202 and SW204 to their centered positions.

f. Disconnect the probe from pin A and turn off the test oscilloscope.

This completes the calibration procedure for the Type 611. If a square display format is desired, use step 21 as a guide and adjust Vertical Gain control R145 for 16.2 cm separation of the two dots.

Disconnect all test equipment. Reconnect the X and Y input attenuator as originally wired. Replace the side and bottom covers on the Type 611. Remove the test graticule and re-install the CRT bezel.

NOTES

REPLACEABLE ELECTRICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

ABBREVIATIONS

ACTR	ACTUATOR	PLSTC	PLASTIC
ASSY	ASSEMBLY	QTZ	QUARTZ
CAP	CAPACITOR	RECP	RECEPTACLE
CER	CERAMIC	RES	RESISTOR
CKT	CIRCUIT	RF	RADIO FREQUENCY
COMP	COMPOSITION	SEL	SELECTED
CONN	CONNECTOR	SEMICOND	SEMICONDUCTOR
ELCTLT	ELECTROLYTIC	SENS	SENSITIVE
ELEC	ELECTRICAL	VAR	VARIABLE
INCAND	INCANDESCENT	WW	WIREWOUND
LED	LIGHT EMITTING DIODE	XFMR	TRANSFORMER
NONWIR	NON WIREWOUND	XTAL	CRYSTAL

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
01002	GENERAL ELECTRIC COMPANY, INDUSTRIAL AND POWER CAPACITOR PRODUCTS DEPARTMENT	JOHN STREET	HUDSON FALLS, NY 12839
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
02735	RCA CORPORATION, SOLID STATE DIVISION	ROUTE 202	SOMERVILLE, NY 08876
04222	AVX CERAMICS, DIVISION OF AVX CORP.	P O BOX 867, 19TH AVE. SOUTH	MURTLE BEACH, SC 29577
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD,PO BOX 20923	PHOENIX, AZ 85036
07910	TELEDYNE SEMICONDUCTOR	12515 CHADRON AVE.	HAWTHORNE, CA 90250
08806	GENERAL ELECTRIC CO., MINIATURE LAMP PRODUCTS DEPARTMENT	NELA PARK	CLEVELAND, OH 44112
09353	C AND K COMPONENTS, INC.	103 MORSE STREET	WATERTOWN, MA 02172
10582	CTS OF ASHEVILLE, INC.	MILLS GAP ROAD	SKYLAND, NC 28776
11236	CTS OF BERNE, INC.	406 PARR RD.	BERNE, IN 46711
11237	CTS KEENE, INC.	3230 RIVERSIDE AVE.	PASO ROBLES, CA 93446
12697	CLAROSTAT MFG. CO., INC.	LOWER WASHINGTON STREET	DOVER, NH 03820
12969	UNITRODE CORPORATION	580 PLEASANT STREET	WATERTOWN, MA 02172
15818	TELEDYNE SEMICONDUCTOR	1300 TERRA BELLA AVE.	MOUNTAIN VIEW, CA 94043
32997	BOURNS, INC., TRIMPOT PRODUCTS DIV.	1200 COLUMBIA AVE.	RIVERSIDE, CA 92507
34263	CTS OF BROWNSVILLE, INC.	1100 ROOSEVELT ST.	BROWNSVILLE, TX 78520
44655	OHMITE MFG. CO.	3601 W. HOWARD ST.	SKOKIE, IL 60076
53944	ELT INC., GLOW LITE DIVISION	BOX 698	PAULS VALLEY, OK 73075
56289	SPRAGUE ELECTRIC CO.		NORTH ADAMS, MA 01247
71400	BUSSMAN MFG., DIVISION OF MCGRAW-EDISON CO.	2536 W. UNIVERSITY ST.	ST. LOUIS, MO 63107
71468	ITT CANNON ELECTRIC	666 E. DYER RD.	SANTA ANA, CA 92702
71590	CENTRALAB ELECTRONICS, DIV. OF GLOBE-UNION, INC.	P O BOX 858	FORT DODGE, IA 50501
72136	ELECTRO MOTIVE CORPORATION, SUB OF INTERNATIONAL ELECTRONICS CORPORATION	SOUTH PARK AND JOHN STREETS	WILLIMANTIC, CT 06226
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
73138	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.	2500 HARBOR BLVD.	FULLERTON, CA 92634
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
76493	BELL INDUSTRIES, INC., MILLER, J. W., DIV.	19070 REYES AVE., P O BOX 5825	COMPTON, CA 90224
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
80294	BOURNS, INC., INSTRUMENT DIV.	6135 MAGNOLIA AVE.	RIVERSIDE, CA 92506
81483	INTERNATIONAL RECTIFIER CORP.	9220 SUNSET BLVD.	LOS ANGELES, CA 90069
82389	SWITCHCRAFT, INC.	5555 N. ELSTON AVE.	CHICAGO, IL 60630
83003	VARO, INC.	P O BOX 411, 2203 WALNUT STREET	GARLAND, TX 75040
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NE 68601
91836	KINGS ELECTRONICS CO., INC.	40 MARBLEDALE ROAD	TUCKAHOE, NY 10707
93410	ESSEX INTERNATIONAL, INC., CONTROLS DIV. LEXINGTON PLANT	P. O. BOX 1007	MANSFIELD, OH 44903
96182	MASTER SPECIALTIES CO.	1640 MONROVIA	COSTA MESA, CA 92627

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
B485	150-0035-00			LAMP,GLOW:90V,0.3MA	53944	A1B-3
B486	150-0035-00			LAMP,GLOW:90V,0.3MA	53944	A1B-3
B487	150-0035-00			LAMP,GLOW:90V,0.3MA	53944	A1B-3
B580A	150-0085-00			LAMP,GLOW:FLG BASE	08806	A1G
B580B	150-0085-00			LAMP,GLOW:FLG BASE	08806	A1G
B622A	150-0085-00			LAMP,GLOW:FLG BASE	08806	A1G
B622B	150-0085-00			LAMP,GLOW:FLG BASE	08806	A1G
C9	290-0200-00			CAP.,FXD,ELCTLT:12UF,+50-10%,150V	56289	30D2858
C10	281-0547-00	XB200000		CAP.,FXD,CER DI:2.7PF,10%,500V	72982	301-000C0J0279C
C11	281-0579-00	B010100	B149999	CAP.,FXD,CER DI:21PF,5%,500V	72982	301-050C0G0210J
C11	281-0603-00	B150000		CAP.,FXD,CER DI:39PF,5%,500V	72982	308-000C0G0390J
C12	281-0118-00			CAP.,VAR,MICA D:8-90PF,750V	72136	T50417-6
C22	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8141N037Z5U0105Z
C30	290-0209-00			CAP.,FXD,ELCTLT:50UF,+75-10%,25V	56289	30D688
C31	283-0065-00			CAP.,FXD,CER DI:0.001UF,5%,100F,100V	72982	805-518-Z5D0102J
C36	290-0209-00			CAP.,FXD,ELCTLT:50UF,+75-10%,25V	56289	30D688
C40	283-0065-00			CAP.,FXD,CER DI:0.001UF,5%,100F,100V	72982	805-518-Z5D0102J
C42	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C45	281-0092-00			CAP.,VAR,CER DI:9-35PF,200V	72982	538-011 D9-35
C50	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C52	281-0517-00			CAP.,FXD,CER DI:39PF,+/-3.9PF,500V	72982	308-000C0G0390K
C53	281-0092-00			CAP.,VAR,CER DI:9-35PF,200V	72982	538-011 D9-35
C54	281-0558-00			CAP.,FXD,CER DI:18PF,10%,500V	72982	301-000C0G0180K
C62	281-0092-00			CAP.,VAR,CER DI:9-35PF,200V	72982	538-011 D9-35
C90	290-0200-00			CAP.,FXD,ELCTLT:12UF,+50-10%,150V	56289	30D2858
C93	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8141N037Z5U0105Z
C94	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8141N037Z5U0105Z
C95	290-0200-00			CAP.,FXD,ELCTLT:12UF,150V	56289	30D2858
C110	281-0547-00	XB200000		CAP.,FXD,CER DI:2.7PF,10%,500V	72982	301-000C0J0279C
C111	281-0579-00	B010100	B149999	CAP.,FXD,CER DI:21PF,5%,500V	72982	301-050C0G0210J
C111	281-0603-00	B150000		CAP.,FXD,CER DI:39PF,5%,500V	72982	308-000C0G0390J
C112	281-0118-00			CAP.,VAR,MICA D:8-90PF,750V	72136	T50417-6
C122	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8141N037Z5U0105Z
C130	290-0209-00			CAP.,FXD,ELCTLT:50UF,+75-10%,25V	56289	30D688
C131	283-0065-00			CAP.,FXD,CER DI:0.001UF,5%,100F,100V	72982	805-518-Z5D0102J
C132	281-0092-00			CAP.,VAR,CER DI:9-35PF,200V	72982	538-011 D9-35
C136	290-0209-00			CAP.,FXD,ELCTLT:50UF,+75-10%,25V	56289	30D688
C140	281-0543-00			CAP.,FXD,CER DI:270PF,10%,500V	72982	301055X5P271K
C142	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C145	281-0092-00			CAP.,VAR,CER DI:9-35PF,200V	72982	538-011 D9-35
C150	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C152	281-0517-00			CAP.,FXD,CER DI:39PF,+/-3.9PF,500V	72982	308-000C0G0390K
C153	281-0092-00			CAP.,VAR,CER DI:9-35PF,200V	72982	538-011 D9-35
C154	281-0509-00			CAP.,FXD,CER DI:15PF,+/-1.5PF,500V	72982	301-000C0G0150K
C200	290-0159-00			CAP.,FXD,ELCTLT:2UF,+50-10%,150V	56289	30D205F150BB9
C204	290-0159-00			CAP.,FXD,ELCTLT:2UF,+50-10%,150V	56289	30D205F150BB9
C216	281-0611-00			CAP.,FXD,CER DI:2.7PF,+/-0.25PF,200V	72982	374-001C0J0279C
C256	281-0611-00			CAP.,FXD,CER DI:2.7PF,+/-0.25PF,200V	72982	374-001C0J0279C
C293	281-0580-00			CAP.,FXD,CER DI:470PF,10%,500V	04222	7001-1374
C302	290-0244-00	B010100	B149999	CAP.,FXD,ELCTLT:0.47UF,5%,35V	56289	162D474X5035BC2
C302	285-0905-00	B150000		CAP.,FXD,PLSTC:0.33UF,5%,50V	56289	LP66A1A334J002
C304	290-0244-00			CAP.,FXD,ELCTLT:0.47UF,5%,35V	56289	162D474X5035BC2

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C312	283-0067-00	B010100	B149999	CAP.,FXD,CER DI:0.001UF,10%,200V	72982	835-515B102K
C312	283-0000-00	B150000		CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C320	290-0269-00			CAP.,FXD,ELCTLT:0.22UF,5%,35V	56289	162D224X5035BC2
C322	285-0684-00			CAP.,FXD,PLSTC:0.056UF,5%,100V	56289	61F22AC563
C323	285-0683-00			CAP.,FXD,PLSTC:0.022UF,5%,100V	56289	410P22351
C325	283-0029-00			CAP.,FXD,CER DI:0.005UF,5%,500V	72982	821-000B502J
C327	290-0125-00			CAP.,FXD,ELCTLT:5UF,+75-10%,6V	56289	30D505G006AA4
C330	283-0026-00			CAP.,FXD,CER DI:0.2UF,+80-20%,25V	56289	274C3
C339	283-0092-00			CAP.,FXD,CER DI:0.03UF,+80-20%,200V	72982	845-534E303Z
C408	281-0602-00	XB150000		CAP.,FXD,CER DI:68PF,5%,500V	72982	308-000P2G0680J
C409	283-0059-00	B010100	B149999X	CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8141N037Z5U0105Z
C410	283-0128-00	XB210000		CAP.,FXD,CER DI:100PF,5%,500V	72982	871-536T2H101J
C413	281-0602-00	B010100	B149999X	CAP.,FXD,CER DI:68PF,5%,500V	72982	308-000P2G0680J
C417	281-0543-00	B010100	B149999	CAP.,FXD,CER DI:270PF,10%,500V	72982	301055X5P271K
C417	281-0536-00	B150000		CAP.,FXD,CER DI:1000PF,10%,500V	72982	301055X5P102K
C422	281-0536-00			CAP.,FXD,CER DI:1000PF,10%,500V	72982	301055X5P102K
C430	281-0536-00			CAP.,FXD,CER DI:1000PF,10%,500V	72982	301055X5P102K
C434	281-0536-00	B010100	B149999	CAP.,FXD,CER DI:1000PF,10%,500V	72982	301055X5P102K
C434	281-0523-00	B150000		CAP.,FXD,CER DI:100PF,+/-20PF,500V	72982	301-000U2M0101M
C437	283-0079-00			CAP.,FXD,CER DI:0.01UF,20%,250V	72982	8151B202Y5S0103M
C440	283-0079-00			CAP.,FXD,CER DI:0.01UF,20%,250V	72982	8151B202Y5S0103M
C445	290-0149-00			CAP.,FXD,ELCTLT:5UF,+75-10%,15OV	56289	30D505G150DD4
C447	283-0079-00			CAP.,FXD,CER DI:0.01UF,20%,250V	72982	8151B202Y5S0103M
C452	283-0033-00			CAP.,FXD,CER DI:0.001UF,+100-0%,6000V	72982	3906BW200E102P
C456	285-0683-00	B010100	B189999	CAP.,FXD,PLSTC:0.022UF,5%,100V	56289	410P22351
C456	285-0629-00	B190000		CAP.,FXD,PLSTC:0.047UF,20%,100V	56289	410P47301
C458	283-0001-00			CAP.,FXD,CER DI:0.005UF,+100-0%,500V	72982	831-559E502P
C459	281-0523-00			CAP.,FXD,CER DI:100PF,+/-20PF,500V	72982	301-000U2M0101M
C465	290-0117-00			CAP.,FXD,ELCTLT:50UF,+75-10%,50V	56289	30D506G050DD9
C466	290-0719-00	XB226525		CAP.,FXD,ELCTLT:47UF,20%,25V	56289	196D476X0025TE3
C468	285-0623-00	B010100	B189999	CAP.,FXD,PLSTC:0.47UF,20%,100V	56289	410P47401
C468	285-0893-00	B190000		CAP.,FXD,PLSTC:1UF,10%,200V	56289	LP66A1C105K006
C470	283-0161-00			CAP.,FXD,CER DI:0.0068UF,+80-30%,6000V	56289	7Y5047
C471	283-0033-00			CAP.,FXD,CER DI:0.001UF,6000V	72982	3906BW200E102P
C480	283-0161-00			CAP.,FXD,CER DI:0.0068UF,+80-30%,6000V	56289	7Y5047
C481	283-0162-00			CAP.,FXD,CER DI:0.01UF,+80-30%,5000V	56289	112C403
C482	283-0162-00			CAP.,FXD,CER DI:0.01UF,+80-30%,5000V	56289	112C403
C484	283-0036-00	B010100	B209999	CAP.,FXD,CER DI:2500PF,+100-0%,6000V	71590	DA111-001B
C484	283-0033-00	B210000		CAP.,FXD,CER DI:0.001UF,+100-0%,6000V	72982	3906BW200E102P
C492	283-0161-00			CAP.,FXD,CER DI:0.0068UF,+80-30%,6000V	56289	7Y5047
C496	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8141N037Z5U0105Z
C497	283-0162-00			CAP.,FXD,CER DI:0.01UF,+80-30%,5000V	56289	112C403
C498	283-0162-00			CAP.,FXD,CER DI:0.01UF,+80-30%,5000V	56289	112C403
C499	290-0209-00			CAP.,FXD,ELCTLT:50UF,+75-10%,25V	56289	30D688
C508	283-0067-00	B010100	B149999	CAP.,FXD,CER DI:0.001UF,10%,200V	72982	835-515B102K
C508	283-0000-00	B150000		CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C511	290-0271-00			CAP.,FXD,ELCTLT:9UF,+20-15%,125V	56289	109D905C2125F2
C522	283-0008-00	XB150000		CAP.,FXD,CER DI:0.1UF,20%,500V	56289	275C8
C523	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C529	283-0001-00	XB150000	B159999	CAP.,FXD,CER DI:0.005UF,+100-0%,500V	72982	831-559E502P
C529	283-0078-00	B160000		CAP.,FXD,CER DI:0.001UF,20%,500V	56289	20C114A8
C551	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C552	283-0008-00	XB150000		CAP.,FXD,CER DI:0.1UF,20%,500V	56289	275C8

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C554	283-0008-00	XB150000		CAP.,FXD,CER DI:0.1UF,20%,500V	56289	275C8
C556	281-0550-00			CAP.,FXD,CER DI:120PF,10%,500V	04222	7001-1373
C558	283-0001-00	XB150000		CAP.,FXD,CER DI:0.005UF,+100-0%,500V	72982	831-559E502P
C567	290-0177-00			CAP.,FXD,ELCTLT:1UF,20%,50V	56289	162D105X0050CD2
C572	281-0523-00			CAP.,FXD,CER DI:100PF,+/-20PF,500V	72982	301-000U2M0101M
C581	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C586	290-0340-00			CAP.,FXD,ELCTLT:10UF,10%,50V	56289	109D106X9050C2
C592	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8141N037Z5U0105Z
C594	285-0598-00			CAP.,FXD,PLSTC:0.01UF,5%,100V	01002	61F10AC103
C596	281-0523-00			CAP.,FXD,CER DI:100PF,+/-20PF,500V	72982	301-000U2M0101M
C604	285-0598-00			CAP.,FXD,PLSTC:0.01UF,5%,100V	01002	61F10AC103
C621	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C626	283-0003-00	B010100	B149999	CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C626	283-0002-00	B150000		CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C628	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C630[1]	290-0404-00			CAP.,FXD,ELCTLT:11UF,10%,35V	56289	151D503
C640	283-0134-00			CAP.,FXD,CER DI:0.47UF,+80-20%,50V	72982	8141N078E474Z
C655	283-0005-00			CAP.,FXD,CER DI:0.01UF,+100-0%,250V	72982	8131N300Z5U0103P
C656	290-0200-00			CAP.,FXD,ELCTLT:12UF,+50-10%,150V	56289	30D2858
C677	283-0008-00	XB150000	B203339	CAP.,FXD,CER DI:0.1UF,20%,500V	56289	275C8
C677	283-0002-00	B203340	B214010	CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C677	283-0008-00	B214011		CAP.,FXD,CER DI:0.1UF,500V	56289	275C8
C678	283-0002-00	XB150000	B203339	CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C678	283-0008-00	B203340	B214010	CAP.,FXD,CER DI:0.1UF,20%,500V	56289	275C8
C678	283-0002-00	B214011		CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C680	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8141N037Z5U0105Z
C685	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8141N037Z5U0105Z
C710	283-0078-00			CAP.,FXD,CER DI:0.001UF,20%,500V	56289	20C114A8
C714A C714B	290-0156-00			CAP.,FXD,ELCTLT:80UF/400V,125UF/250V	56289	D3343-DFP
C720	283-0078-00			CAP.,FXD,CER DI:0.001UF,20%,500V	56289	20C114A8
C722	290-0173-00			CAP.,FXD,ELCTLT:200UF,+75-10%,250V	56289	D38790-DFP
C732	285-0703-00			CAP.,FXD,PLSTC:0.1UF,5%,100V	56289	410P10451
C745	281-0546-00			CAP.,FXD,CER DI:330PF,10%,500V	04222	7001-1380
C746	290-0200-00			CAP.,FXD,ELCTLT:12UF,+50-10%,150V	56289	30D2858
C750	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C752	290-0338-00			CAP.,FXD,ELCTLT:9000UF,+75-10%,50V	56289	36D902G050BC2A
C761	285-0703-00			CAP.,FXD,PLSTC:0.1UF,5%,100V	56289	410P10451
C775	290-0215-00			CAP.,FXD,ELCTLT:100UF,+75-10%,25V	56289	30D107G025DD9
C780	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C782	290-0339-00			CAP.,FXD,ELCTLT:6000UF,+75-10%,50V	56289	36D602G050BB2A
C791	285-0703-00			CAP.,FXD,PLSTC:0.1UF,5%,100V	56289	410P10451
C795	290-0215-00			CAP.,FXD,ELCTLT:100UF,+75-10%,25V	56289	30D107G025DD9
C800	283-0078-00			CAP.,FXD,CER DI:0.001UF,20%,500V	56289	20C114A8
C802	290-0179-00			CAP.,FXD,ELCTLT:125UF,+75-10%,250V	56289	D37022-DFP
C810	285-0703-00			CAP.,FXD,PLSTC:0.1UF,5%,100V	56289	410P10451
C814	283-0114-00			CAP.,FXD,CER DI:0.0015UF,5%,200V	72982	805-509B152J
C818	290-0200-00			CAP.,FXD,ELCTLT:12UF,+50-10%,150V	56289	30D2858
C820	281-0525-00			CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364
C822	281-0525-00			CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364
C824	281-0513-00			CAP.,FXD,CER DI:27PF,+/-5.4PF,500V	72982	301-000P2G0270M
D8	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152

[1] Non-polarized.

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D9	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D10	152-0061-00	XB040000		SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
D30	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D35	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D50	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D55	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D56	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D60	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D62	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D80	152-0165-00	B010100	B227345	SEMICOND DEVICE:SILICON,200V,10 PA AT 3V	80009	152-0165-00
D80	152-0323-00	B227346		SEMICOND DEVICE:SILICON,35V,0.1A	80009	152-0323-00
D88	152-0141-02	XB040000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D91	152-0120-00			SEMICOND DEVICE:ZENER,1W,10V,5%	80009	152-0120-00
D92	152-0120-00			SEMICOND DEVICE:ZENER,1W,10V,5%	80009	152-0120-00
D97	152-0278-00			SEMICOND DEVICE:ZENER,0.4W,3V,5%	07910	1N4372A
D98	152-0278-00			SEMICOND DEVICE:ZENER,0.4W,3V,5%	07910	1N4372A
D99	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D108	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D109	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D130	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D135	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D150	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D160	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D162	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D166	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D167	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D180	152-0165-00	B010100	B227345	SEMICOND DEVICE:SILICON,200V,10 PA AT 3V	80009	152-0165-00
D180	152-0323-00	B227346		SEMICOND DEVICE:SILICON,35V,0.1A	80009	152-0323-00
D188	152-0141-02	XB040000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D210	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D215	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D250	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D255	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D304	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D314	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D332	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D334	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D340	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D342	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D345	152-0141-02	XB150000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D350	152-0141-02	XB150000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D361	152-0141-02	XB150000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D362	152-0141-02	XB150000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D372	152-0141-02	XB150000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D375	152-0141-02	XB150000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D377	152-0141-02	XB150000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D379	152-0141-02	XB150000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D382	152-0141-02	XB150000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D387	152-0141-02	XB150000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D389	152-0141-02	XB150000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D394	152-0141-02	XB150000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D396	152-0141-02	XB150000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D403	152-0141-02	B010100	B149999X	SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152

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D404	152-0141-02	B010100	B149999X	SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D408	152-0141-02	B010100	B149999X	SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D417	152-0233-00			SEMICOND DEVICE:SILICON,85V,100MA	80009	152-0233-00
D422	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D430	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D434	152-0233-00	XB150000		SEMICOND DEVICE:SILICON,85V,100MA	80009	152-0233-00
D436	152-0141-02	XB150000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D443	152-0233-00			SEMICOND DEVICE:SILICON,85V,100MA	80009	152-0233-00
D444	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
D445	152-0180-00			SEMICOND DEVICE:SILICON,10V,5A	12969	UTR1112
D453	152-0165-00	B010100	B227345	SEMICOND DEVICE:SILICON,200V,10 PA AT 3V	80009	152-0165-00
D453	152-0323-00	B227346		SEMICOND DEVICE:SILICON,35V,0.1A	80009	152-0323-00
D454	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D460	152-0282-00			SEMICOND DEVICE:ZENER,0.4W,30V,5%	04713	1N972B
D463	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D470	152-0218-00	B010100	B099999	SEMICOND DEVICE:SILICON,10KV,20MA	83003	7715-10XVPN
D470	152-0408-00	B100000		SEMICOND DEVICE:SILICON,10KV,5MA	83003	H345
D480	152-0218-00	B010100	B099999	SEMICOND DEVICE:SILICON,10KV,20MA	83003	7715-10XVPN
D480	152-0408-00	B100000		SEMICOND DEVICE:SILICON,10KV,5MA	83003	H345
D489	152-0242-00	XB210000		SEMICOND DEVICE:SILICON,225V,200MA	12969	NDP341
D490	152-0242-00			SEMICOND DEVICE:SILICON,225V,200MA	12969	NDP341
D492	152-0218-00	B010100	B099999	SEMICOND DEVICE:SILICON,10KV,20MA	83003	7715-10XVPN
D492	152-0408-00	B100000		SEMICOND DEVICE:SILICON,10KV,5MA	83003	H345
D501	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D502	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D503	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D505	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D510	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D520	152-0040-00			SEMICOND DEVICE:SILICON,600V,1A	80009	152-0040-00
D523	152-0040-00			SEMICOND DEVICE:SILICON,600V,1A	80009	152-0040-00
D530	152-0141-02	XB150000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D533	152-0141-02	XB150000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D539	152-0141-02	XB150000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D551	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
D552	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
D553	152-0061-00	B010100	B149999	SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
D553	152-0141-02	B150000	B159999	SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D553	152-0061-00	B160000		SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
D554	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
D562	152-0141-02	XB150000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D563	152-0141-02	XB150000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D564	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D565	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D569	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D581	152-0141-02	XB030000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D582	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D590	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D594	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D595	152-0304-00			SEMICOND DEVICE:ZENER,0.4W,20V,5%	04713	1N968B
D600	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D602	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
D604	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D610	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152

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D614	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D620	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D622	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D628	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D630	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D632	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D638	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D640	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D644	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D645	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
D646	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D648	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D651	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D655	152-0141-02	B010100	B049999	SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D655	152-0061-00	B050000	B149999	SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
D655	152-0141-02	B150000	B159999	SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D655	152-0061-00	B160000		SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
D660	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
D664	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
D665	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
D666	152-0264-00			SEMICOND DEVICE:ZENER,3W,56V,5%	12969	UZ756
D667	152-0100-00			SEMICOND DEVICE:ZENER,1W,120V,5%	81483	1N3046B
D668	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
D673	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
D678	152-0233-00	XB150000	B214010	SEMICOND DEVICE:SILICON,85V,100MA	80009	152-0233-00
D678	152-0242-00	B214011		SEMICOND DEVICE:SILICON,225V,200MA	12969	NDP341
D712	152-0200-00			SEMICOND DEVICE:SILICON,400V,1500MA	80009	152-0200-00
D722	152-0200-00			SEMICOND DEVICE:SILICON,400V,1500MA	80009	152-0200-00
D732	152-0357-00			SEMICOND DEVICE:ZENER,0.4W,82V,5%	04713	1N983B
D738	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D752A-D	152-0198-00	B010100	B159999	SEMICOND DEVICE:SILICON,200V,3A	04713	1N4721
D752A-D	152-0198-01	B160000		SEMICOND DEVICE:SILICON,200V,3A	80009	152-0198-01
D782A-D	152-0198-00	B010100	B159999	SEMICOND DEVICE:SILICON,200V,3A	04713	1N4721
D782A-D	152-0198-01	B160000		SEMICOND DEVICE:SILICON,200V,3A	80009	152-0198-01
D793	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D802	152-0200-00			SEMICOND DEVICE:SILICON,400V,1500MA	80009	152-0200-00
D810	152-0124-00			SEMICOND DEVICE:ZENER,0.5W,9V,5%	80009	152-0124-00
D813	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D814	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
D826	152-0280-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	80009	152-0280-00
F701	159-0015-00			FUSE,CARTRIDGE:3AG,3A,250V,FAST-BLOW	71400	AGC 3
F702	159-0057-00	B010100	B199999X	FUSE,CARTRIDGE:3AG,10A,250V,SLOW-BLOW	71400	MDA 10
F704	159-0057-00	B010100	B199999X	FUSE,CARTRIDGE:3AG,10A,250V,SLOW-BLOW	71400	MDA 10
F705	159-0016-00			FUSE,CARTRIDGE:3AG,1.5A,250V,FAST-BLOW	71400	AGC 1 1/2
F782	159-0015-01	XB160000		FUSE,CARTRIDGE:3AG,3A,250V,FAST-BLOW	71400	GJV3
FL701	119-0028-03	B010100	B199999	FUSE,RI:2X 3A,250VAC,450 HZ	80009	119-0028-03
FL701	119-0028-04	B200000		FUSE,RI:2X 3A,250VAC,400 HZ	80009	119-0028-04
J1	131-0274-00			CONNECTOR,RCPT,:BNC	91836	KC79-67
J101	131-0274-00			CONNECTOR,RCPT,:BNC	91836	KC79-67
J340	131-0569-00			CONNECTOR,RCPT,:25 PIN,FEMALE	71468	DB25S
J420	131-0274-00			CONNECTOR,RCPT,:BNC	91836	KC79-67
L78 L178	108-0451-00	B010100	B179999	COIL ASSY:CRT DEFLECTION	80009	108-0451-00

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L78 | L178	108-0609-00	B180000		COIL ASSY:CRT DEFLECTION	80009	108-0609-00
L439	108-0213-00			COIL,RF:2.5MH	76493	8862-2.5
P490	136-0274-01	B010100	B149999	SOCKET ASSY,CRT:	80009	136-0274-01
P490	136-0368-00	B150000		SOCKET ASSY,CRT:	80009	136-0368-00
P491	136-0275-00			SOCKET ASSY:STORAGE	80009	136-0275-00
Q20	151-0096-00			TRANSISTOR:SILICON,NPN	80009	151-0096-00
Q30	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q31	151-0136-00			TRANSISTOR:SILICON,NPN	02735	35495
Q35	151-0239-00			TRANSISTOR:SILICON,NPN	80009	151-0239-00
Q36	151-0148-00			TRANSISTOR:SILICON,NPN	02735	39539
Q40	151-0250-00	XB040000		TRANSISTOR:SILICON,NPN	80009	151-0250-00
Q50	151-0096-00			TRANSISTOR:SILICON,NPN	80009	151-0096-00
Q55A	151-0188-00			TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q55B	151-0188-00			TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q120	151-0096-00			TRANSISTOR:SILICON,NPN	80009	151-0096-00
Q130	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q131	151-0136-00			TRANSISTOR:SILICON,NPN	02735	35495
Q135	151-0239-00			TRANSISTOR:SILICON,NPN	80009	151-0239-00
Q136	151-0148-00			TRANSISTOR:SILICON,NPN	02735	39539
Q140	151-0250-00	XB040000		TRANSISTOR:SILICON,NPN	80009	151-0250-00
Q150	151-0096-00			TRANSISTOR:SILICON,NPN	80009	151-0096-00
Q155A	151-0188-00			TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q155B	151-0188-00			TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q210	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q220	151-0236-00			TRANSISTOR:SILICON,NPN	15818	SA2700
Q222	151-1026-00			TRANSISTOR:FET,N-CHAN,SI	80009	151-1026-00
Q230A	151-0188-00			TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q230B	151-0188-00			TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q240	151-0188-00			TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q250	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q260	151-0236-00			TRANSISTOR:SILICON,NPN	15818	SA2700
Q262	151-1026-00			TRANSISTOR:FET,N-CHAN,SI	80009	151-1026-00
Q270A	151-0188-00			TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q270B	151-0188-00			TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q280	151-0188-00			TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q290	151-0210-00			TRANSISTOR:SILICON,NPN	80009	151-0210-00
Q300	151-0188-00			TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q310	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q315	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q340	151-0188-00			TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q352	151-0190-00	XB150000		TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q360	151-1005-00	XB150000		TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1005-00
Q362	151-0190-00	XB150000		TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q364	151-1005-00	XB150000		TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1005-00
Q370	151-0192-00	XB150000		TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q375	151-0190-02	XB150000		TRANSISTOR:SILICON,NPN	80009	151-0190-02
Q380	151-0192-00	XB150000		TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q385	151-0190-02	XB150000		TRANSISTOR:SILICON,NPN	80009	151-0190-02
Q390	151-0192-00	XB150000		TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q395	151-0190-02	XB150000		TRANSISTOR:SILICON,NPN	80009	151-0190-02

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Q400	151-0190-00	B010100	B149999X	TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q405	151-0190-00	B010100	B149999X	TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q410	151-0169-00			TRANSISTOR:SILICON,NPN	80009	151-0169-00
Q415	151-0280-00	XB150000		TRANSISTOR:SILICON,PNP	80009	151-0280-00
Q420	151-1005-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1005-00
Q430	151-0108-00			TRANSISTOR:SILICON,NPN	80009	151-0108-00
Q435	151-0124-00			TRANSISTOR:SILICON,NPN,SEL FROM 2N3501	80009	151-0124-00
Q440	151-0169-00			TRANSISTOR:SILICON,NPN	80009	151-0169-00
Q460	151-0227-00			TRANSISTOR:SILICON,PNP	04713	2N3741
Q465	151-0140-00			TRANSISTOR:SILICON,NPN	80009	151-0140-00
Q500	151-0188-00			TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q510	151-0188-00			TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q520	151-0240-00			TRANSISTOR:SILICON,NPN	02735	2N4063
Q525	151-0210-00			TRANSISTOR:SILICON,NPN	80009	151-0210-00
Q526	151-0210-00			TRANSISTOR:SILICON,NPN	80009	151-0210-00
Q535	151-0188-00	XB150000		TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q540	151-0188-00			TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q550	151-0210-00			TRANSISTOR:SILICON,NPN	80009	151-0210-00
Q555	151-0241-00			TRANSISTOR:SILICON,NPN	80009	151-0241-00
Q560	151-0188-00			TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q564	151-0188-00	XB150000		TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q565	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q570	151-1005-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1005-00
Q580	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q590	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q600	151-0210-00			TRANSISTOR:SILICON,NPN	80009	151-0210-00
Q610	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q630	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q640	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q660	151-0210-00			TRANSISTOR:SILICON,NPN	80009	151-0210-00
Q670	151-0241-00			TRANSISTOR:SILICON,NPN	80009	151-0241-00
Q720	151-0150-00			TRANSISTOR:SILICON,NPN	80009	151-0150-00
Q730	151-0188-00			TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q735	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q740	151-0149-00			TRANSISTOR:SILICON,NPN	80009	151-0149-00
Q750	151-0226-00			TRANSISTOR:SILICON,NPN	04713	2N3767
Q760	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q765	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q770	151-0140-00			TRANSISTOR:SILICON,NPN	80009	151-0140-00
Q780	151-0226-00			TRANSISTOR:SILICON,NPN	04713	2N3767
Q785	151-0140-00			TRANSISTOR:SILICON,NPN	80009	151-0140-00
Q790	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q825	151-0149-00			TRANSISTOR:SILICON,NPN	80009	151-0149-00
R1	323-0381-00			RES.,FXD,FILM:90.9K OHM,1%,0.50W	75042	CECT0-9092F
R2	323-0293-00			RES.,FXD,FILM:11K OHM,1%,0.50W	75042	CECT0-1102F
R5	323-0164-09			RES.,FXD,FILM:499 OHM,1%,0.50W	75042	CECT9-4990F
R6	308-0090-00			RES.,FXD,WW:0.25 OHM,10%,1W	80009	308-0090-00
R7	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	91637	MFF1816G10002F
R8	301-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.50W	01121	EB1025
R9	315-0472-00	B010100	B039999	RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R9	315-0473-00	B040000	B209999	RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R9	315-0563-00	B210000		RES.,FXD,CMPSN:56K OHM,5%,0.25W	01121	CB5635
R10	315-0102-00	XB040000		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025

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R11	301-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.50W	01121	EB1525
R13	301-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.50W	01121	EB1025
R14	301-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.5W	01121	EB1045
R19	323-0270-00			RES.,FXD,FILM:6.34K OHM,1%,0.50W	91637	MFF1226G63400F
R20	323-0314-00			RES.,FXD,FILM:18.2K OHM,1%,0.50W	75042	CECT0-1822F
R22	301-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.50W	01121	EB1015
R24	322-0385-00			RES.,FXD,FILM:100K OHM,1%,0.25W	75042	CEBT0-1003F
R31	315-0430-00			RES.,FXD,CMPSN:43 OHM,5%,0.25W	01121	CB4305
R36	307-0004-00			RES.,FXD,CMPSN:3.9 OHM,5%,1W	01121	GB39GS
R38	305-0361-00			RES.,FXD,CMPSN:360 OHM,5%,2W	01121	HB3615
R39	301-0390-00			RES.,FXD,CMPSN:39 OHM,5%,0.50W	01121	EB3905
R40	315-0304-00			RES.,FXD,CMPSN:300K OHM,5%,0.25W	01121	CB3045
R41	315-0304-00			RES.,FXD,CMPSN:300K OHM,5%,0.25W	01121	CB3045
R42	323-0384-09			RES.,FXD,FILM:97.6K OHM,1%,0.50W	75042	CECT9-9762F
R43	323-0434-00	B010100	B069999	RES.,FXD,FILM:324K OHM,1%,0.50W	91637	MFF1226G32402F
R43	323-0414-09	B070000		RES.,FXD,FILM:200K OHM,1%,0.50W	75042	CECT9-2003F
R44	311-0218-00			RES.,VAR,WW:50K OHM,5%,2W	12697	CM26978
R45	311-0601-00			RES.,VAR,WW:5K OHM,5%,1W	75042	100-0000-502
R46	321-1299-09			RES.,FXD,FILM:12.9K OHM,1%,0.125W	91637	MFF1816C12901F
R47	322-0481-00			RES.,FXD,FILM:1M OHM,1%,0.25W	75042	CEBT0-1004F
R48	315-0205-00			RES.,FXD,CMPSN:2M OHM,5%,0.25W	01121	CB2055
R49	316-0395-00			RES.,FXD,CMPSN:3.9M OHM,10%,0.25W	01121	CB3951
R50	301-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.50W	01121	EB1015
R51	305-0123-00			RES.,FXD,CMPSN:12K OHM,5%,2W	01121	HB1235
R52	315-0624-00			RES.,FXD,CMPSN:620K OHM,5%,0.25W	01121	CB6245
R53	321-0278-09			RES.,FXD,FILM:7.68K OHM,1%,0.125W	91637	MFF1816C76800F
R54	315-0334-00			RES.,FXD,CMPSN:330K OHM,5%,0.25W	01121	CB3345
R55	322-0193-09			RES.,FXD,FILM:1000 OHM,1%,0.25W	75042	CEBT9-1001F
R56	315-0433-00			RES.,FXD,CMPSN:43K OHM,5%,0.25W	01121	CB4335
R57	301-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.50W	01121	EB1015
R58	321-0412-00			RES.,FXD,FILM:191K OHM,1%,0.125W	91637	MFF1816G19102F
R59	323-0385-00			RES.,FXD,FILM:100K OHM,1%,0.50W	75042	CECT0-1003F
R60	321-0452-00			RES.,FXD,FILM:499K OHM,1%,0.125W	91637	MFF1816G49902F
R61	321-0361-00			RES.,FXD,FILM:56.2K OHM,1%,0.125W	91637	MFF1816G56201F
R62	321-0361-00			RES.,FXD,FILM:56.2K OHM,1%,0.125W	91637	MFF1816G56201F
R64	321-0452-00			RES.,FXD,FILM:499K OHM,1%,0.125W	91637	MFF1816G49902F
R70	302-0102-00			RES.,FXD,CMPSN:1K OHM,10%,0.50W	01121	EB1021
R71	323-0423-08			RES.,FXD,FILM:249K OHM,1%,0.50W	75042	CECT2-2493F
R72	311-0831-00	B010100	B199999	RES.,VAR,NONWIR:TRMR,100K OHM,0.5W	01121	SV1041
R72	311-1272-00	B200000		RES.,VAR,NONWIR:100K OHM,10%,0.50W	32997	3329P-L58-104
R74	322-0193-08			RES.,FXD,FILM:1000 OHM,1%,0.25W	75042	CEBT2-1001F
R76	301-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.5W	01121	EB1825
R78	301-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.50W	01121	EB2425
R80	315-0624-00			RES.,FXD,CMPSN:620K OHM,5%,0.25W	01121	CB6245
R82	310-0662-00			RES.,FXD,WW:8.9 OHM,1%,4W	80009	310-0662-00
R84	301-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.50W	01121	EB3025
R86	301-0204-00			RES.,FXD,CMPSN:200K OHM,5%,0.50W	01121	EB2045
R87	315-0103-00	XB040000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R88	315-0182-00	XB040000	B179999	RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R88	315-0272-00	B180000		RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R90	301-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.50W	01121	EB1015
R91	308-0385-00			RES.,FXD,WW:200 OHM,5%,3W	91637	CW2B-200R0J
R92	308-0385-00			RES.,FXD,WW:200 OHM,5%,3W	91637	CW2B-200R0J

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R95	301-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.50W	01121	EB1015
R97	301-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.50W	01121	EB4745
R98	301-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.50W	01121	EB4745
R101	323-0381-00			RES.,FXD,FILM:90.9K OHM,1%,0.50W	75042	CECT0-9092F
R102	323-0293-00			RES.,FXD,FILM:11K OHM,1%,0.50W	75042	CECT0-1102F
R105	323-0164-09			RES.,FXD,FILM:499 OHM,1%,0.50W	75042	CECT9-4990F
R106	308-0090-00			RES.,FXD,WW:0.25 OHM,10%,1W	80009	308-0090-00
R107	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	91637	MFF1816G10002F
R108	301-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.50W	01121	EB1025
R111	301-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.50W	01121	EB1525
R113	301-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.50W	01121	EB1025
R114	301-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.5W	01121	EB1045
R119	323-0270-00			RES.,FXD,FILM:6.34K OHM,1%,0.50W	91637	MFF1226G63400F
R120	323-0314-00			RES.,FXD,FILM:18.2K OHM,1%,0.50W	75042	CECT0-1822F
R122	301-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.50W	01121	EB1015
R124	322-0385-00			RES.,FXD,FILM:100K OHM,1%,0.25W	75042	CEBT0-1003F
R131	315-0430-00			RES.,FXD,CMPSN:43 OHM,5%,0.25W	01121	CB4305
R132	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R133	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R136	308-0240-00			RES.,FXD,WW;2 OHM,5%,3W	44655	242EX2R000JQ18
R138	305-0361-00			RES.,FXD,CMPSN:360 OHM,5%,2W	01121	HB3615
R139	301-0430-00			RES.,FXD,CMPSN:43 OHM,5%,0.50W	01121	EB4305
R140	315-0624-00			RES.,FXD,CMPSN:620K OHM,5%,0.25W	01121	CB6245
R142	323-0384-09			RES.,FXD,FILM:97.6K OHM,1%,0.50W	75042	CECT9-9762F
R143	323-0434-00	B010100	B069999	RES.,FXD,FILM:324K OHM,1%,0.50W	91637	MFF1226G32402F
R143	323-0414-09	B070000		RES.,FXD,FILM:200K OHM,1%,0.50W	75042	CECT9-2003F
R144	311-0218-00			RES.,VAR,WW:50K OHM,5%,2W	12697	CM26978
R145	311-0835-00			RES.,VAR,WW:7.5K OHM,5%,1W	75042	100-0000-752
R146	321-0285-09			RES.,FXD,FILM:9.09K OHM,1%,0.125W	91637	MFF1816C90900F
R147	322-0481-00			RES.,FXD,FILM:1M OHM,1%,0.25W	75042	CEBT0-1004F
R148	315-0205-00			RES.,FXD,CMPSN:2M OHM,5%,0.25W	01121	CB2055
R149	316-0395-00			RES.,FXD,CMPSN:3.9M OHM,10%,0.25W	01121	CB3951
R150	301-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.50W	01121	EB1015
R151	305-0123-00			RES.,FXD,CMPSN:12K OHM,5%,2W	01121	HB1235
R152	315-0624-00			RES.,FXD,CMPSN:620K OHM,5%,0.25W	01121	CB6245
R153	321-0285-09			RES.,FXD,FILM:9.09K OHM,1%,0.125W	91637	MFF1816C90900F
R154	315-0334-00			RES.,FXD,CMPSN:330K OHM,5%,0.25W	01121	CB3345
R155	322-0193-09			RES.,FXD,FILM:1000 OHM,1%,0.25W	75042	CEBT9-1001F
R156	315-0433-00			RES.,FXD,CMPSN:43K OHM,5%,0.25W	01121	CB4335
R157	301-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.50W	01121	EB1015
R158	321-0412-00			RES.,FXD,FILM:191K OHM,1%,0.125W	91637	MFF1816G19102F
R159	323-0385-00			RES.,FXD,FILM:100K OHM,1%,0.50W	75042	CECT0-1003F
R160	322-0643-00			RES.,FXD,FILM:600K OHM,1%,0.25W	75042	CEBT0-6003F
R161	321-0379-00			RES.,FXD,FILM:86.6K OHM,1%,0.125W	91637	MFF1816G86601F
R162	321-0379-00			RES.,FXD,FILM:86.6K OHM,1%,0.125W	91637	MFF1816G86601F
R164	322-0643-00			RES.,FXD,FILM:600K OHM,1%,0.25W	75042	CEBT0-6003F
R165	321-0350-08			RES.,FXD,FILM:43.2K OHM,1%,0.125W	91637	MFF1816D43201F
R166	323-0457-00			RES.,FXD,FILM:562K OHM,1%,0.50W	75042	CECT0-5623F
R167	321-0350-08			RES.,FXD,FILM:43.2K OHM,1%,0.125W	91637	MFF1816D43201F
R168	323-0457-00			RES.,FXD,FILM:562K OHM,1%,0.50W	75042	CECT0-5623F
R170	302-0102-00			RES.,FXD,CMPSN:1K OHM,10%,0.50W	01121	EB1021
R171	323-0423-08			RES.,FXD,FILM:249K OHM,1%,0.50W	75042	CECT2-2493F
R172	311-0831-00	B010100	B199999	RES.,VAR,NONWIR:TRMR,100K OHM,0.5W	01121	SV1041

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R172	311-1272-00	B200000		RES.,VAR,NONWIR:100K OHM,10%,0.50W	32997	3329P-L58-104
R174	322-0193-08			RES.,FXD,FILM:1000 OHM,1%,0.25W	75042	CEBT2-1001F
R176	301-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.50W	01121	EB1025
R178	302-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.50W	01121	EB1031
R180	315-0624-00			RES.,FXD,CMPSN:620K OHM,5%,0.25W	01121	CB6245
R182	310-0661-00			RES.,FXD,WW:4.5 OHM,1%,4W	80009	310-0661-00
R184	301-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.50W	01121	EB3025
R186	301-0204-00			RES.,FXD,CMPSN:200K OHM,5%,0.50W	01121	EB2045
R187	315-0103-00	XB040000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R188	315-0182-00	XB040000	B179999	RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R188	315-0272-00	B180000		RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R200	301-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.50W	01121	EB1015
R204	301-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.50W	01121	EB1015
R210	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R211	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R212	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R215	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R216	321-0452-00			RES.,FXD,FILM:499K OHM,1%,0.125W	91637	MFF1816G49902F
R218	323-0486-00			RES.,FXD,FILM:1.13M OHM,1%,0.50W	75042	CECT0-1134F
R220	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R221	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R222	321-0403-00			RES.,FXD,FILM:154K OHM,1%,0.125W	91637	MFF1816G15402F
R223	315-0162-00			RES.,FXD,CMPSN:1.6K OHM,5%,0.25W	01121	CB1625
R225	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R226	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R227	311-0510-00	B010100	B199999	RES.,VAR,NONWIR:10K OHM,20%,0.25W	01121	FR103M
R227	311-1228-00	B200000		RES.,VAR,NONWIR:10K OHM,20%,0.50W	32997	3386F-T04-103
R229	315-0162-00			RES.,FXD,CMPSN:1.6K OHM,5%,0.25W	01121	CB1625
R231	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R232	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R234	321-0269-00			RES.,FXD,FILM:6.19K OHM,1%,0.125W	91637	MFF1816G61900F
R236	321-0218-00			RES.,FXD,FILM:1.82K OHM,1%,0.125W	91637	MFF1816G18200F
R238	311-0463-00	B010100	B199999	RES.,VAR,NONWIR:5K OHM,20%,0.25W	01121	FR502M
R238	311-1227-00	B200000		RES.,VAR,NONWIR:5K OHM,20%,0.50W	32997	3386F-T04-502
R239	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R241	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R242	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R244	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
R246	321-0218-00			RES.,FXD,FILM:1.82K OHM,1%,0.125W	91637	MFF1816G18200F
R247	324-0296-00			RES.,FXD,FILM:11.8K OHM,1%,1W	91637	MFF1-14G11801F
R248	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R250	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R251	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R252	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R255	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R256	321-0452-00			RES.,FXD,FILM:499K OHM,1%,0.125W	91637	MFF1816G49902F
R258	323-0486-00			RES.,FXD,FILM:1.13M OHM,1%,0.50W	75042	CECT0-1134F
R260	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R261	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R262	321-0403-00			RES.,FXD,FILM:154K OHM,1%,0.125W	91637	MFF1816G15402F
R263	315-0162-00			RES.,FXD,CMPSN:1.6K OHM,5%,0.25W	01121	CB1625
R265	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R266	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135

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R267	311-0510-00	B010100	B199999	RES.,VAR,NONWIR:10K OHM,20%,0.25W	01121	FR103M
R267	311-1228-00	B200000		RES.,VAR,NONWIR:10K OHM,20%,0.50W	32997	3386F-T04-103
R269	315-0162-00			RES.,FXD,CMPSN:1.6K OHM,5%,0.25W	01121	CB1625
R271	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R272	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R274	321-0269-00			RES.,FXD,FILM:6.19K OHM,1%,0.125W	91637	MFF1816G61900F
R276	321-0218-00			RES.,FXD,FILM:1.82K OHM,1%,0.125W	91637	MFF1816G18200F
R278	311-0463-00	B010100	B199999	RES.,VAR,NONWIR:5K OHM,20%,0.25W	01121	FR502M
R278	311-1227-00	B200000		RES.,VAR,NONWIR:5K OHM,20%,0.50W	32997	3386F-T04-502
R279	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R281	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R282	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R284	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
R286	321-0218-00			RES.,FXD,FILM:1.82K OHM,1%,0.125W	91637	MFF1816G18200F
R287	324-0296-00			RES.,FXD,FILM:11.8K OHM,1%,1W	91637	MFF1-14G11801F
R288	311-0463-00	B010100	B199999	RES.,VAR,NONWIR:5K OHM,20%,0.25W	01121	FR502M
R288	311-1227-00	B200000		RES.,VAR,NONWIR:5K OHM,20%,0.50W	32997	3386F-T04-502
R290	301-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.50W	01121	EB3325
R292	311-0613-00			RES.,VAR,NONWIR:100K OHM,10%,0.50W	73138	82-27-0
R293	315-0204-00			RES.,FXD,CMPSN:200K OHM,5%,0.25W	01121	CB2045
R294	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R296	310-0634-00			RES.,FXD,WW:47K OHM,1%,8W	80009	310-0634-00
R301	301-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.50W	01121	EB3335
R302	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R303	321-0309-00			RES.,FXD,FILM:16.2K OHM,1%,0.125W	91637	MFF1816G16201F
R304	321-0315-00			RES.,FXD,FILM:18.7K OHM,1%,0.125W	91637	MFF1816G18701F
R306	301-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.50W	01121	EB8225
R307	301-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.50W	01121	EB2025
R308	301-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.50W	01121	EB2025
R309	301-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.50W	01121	EB1835
R311	301-0514-00			RES.,FXD,CMPSN:510K OHM,5%,0.50W	01121	EB5145
R312	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R314	315-0394-00			RES.,FXD,CMPSN:390K OHM,5%,0.25W	01121	CB3945
R316	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R318	301-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.50W	01121	EB3025
R320	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R321	315-0124-00			RES.,FXD,CMPSN:120K OHM,5%,0.25W	01121	CB1245
R322	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R323	315-0133-00			RES.,FXD,CMPSN:13K OHM,5%,0.25W	01121	CB1335
R325	321-0357-00			RES.,FXD,FILM:51.1K OHM,1%,0.125W	91637	MFF1816G51101F
R327	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R328	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R331	315-0244-00			RES.,FXD,CMPSN:240K OHM,5%,0.25W	01121	CB2445
R332	315-0205-00			RES.,FXD,CMPSN:2M OHM,5%,0.25W	01121	CB2055
R333	315-0244-00			RES.,FXD,CMPSN:240K OHM,5%,0.25W	01121	CB2445
R334	315-0205-00			RES.,FXD,CMPSN:2M OHM,5%,0.25W	01121	CB2055
R335	321-0408-00			RES.,FXD,FILM:174K OHM,1%,0.125W	91637	MFF1816G17402F
R336	321-0322-00			RES.,FXD,FILM:22.1K OHM,1%,0.125W	91637	MFF1816G22101F
R337	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R339	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R341	315-0913-00			RES.,FXD,CMPSN:91K OHM,5%,0.25W	01121	CB9135
R342	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R344	315-0204-00			RES.,FXD,CMPSN:200K OHM,5%,0.25W	01121	CB2045

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R345	315-0104-00	XB150000		RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R346	321-0301-00			RES.,FXD,FILM:13.3K OHM,1%,0.125W	91637	MFF1816G13301F
R350	315-0333-00	XB150000		RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R351	315-0103-00	XB150000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R352	315-0104-00	XB150000		RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R354	315-0822-00	XB150000		RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R355	315-0822-00	XB150000		RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R360	315-0824-00	XB150000		RES.,FXD,CMPSN:820K OHM,5%,0.25W	01121	CB8245
R364	315-0104-00	XB150000		RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R370	315-0123-00	XB150000		RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R371	315-0303-00	XB150000		RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R372	315-0104-00	XB150000		RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R374	315-0513-00	XB150000		RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R375	315-0203-00	XB150000		RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R377[1]	311-0985-00	XB150000		RES.,VAR,NONWIR:1K OHM X 2K OHM,10%,4W	10582	AW2880
R380	315-0123-00	XB150000		RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R381	315-0303-00	XB150000		RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R382	315-0104-00	XB150000		RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R384	315-0104-00	XB150000		RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R387[2]	311-1106-00	XB150000		RES.,VAR,NONWIR:PNL,2 X 25K OHM,4W	10582	AW-3212
R389	315-0204-00	XB150000		RES.,FXD,CMPSN:200K OHM,5%,0.25W	01121	CB2045
R391	315-0202-00	XB150000		RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R393	315-0393-00	XB150000		RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R394	315-0754-00	XB150000		RES.,FXD,CMPSN:750K OHM,5%,0.25W	01121	CB7545
R396[1]	311-0985-00	XB150000		RES.,VAR,NONWIR:1K OHM X 2K OHM,10%,4W	10582	AW2880
R398	323-0244-00	XB150000		RES.,FXD,FILM:3.4K OHM,1%,0.50W	75042	CECT0-3401F
R400	315-0104-00	B010100	B149999X	RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R402	303-0102-00	B010100	B149999X	RES.,FXD,CMPSN:1K OHM,5%,1W	01121	GB1025
R403	315-0751-00	B010100	B149999X	RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R404	301-0202-00	B010100	B039999	RES.,FXD,CMPSN:2K OHM,5%,0.50W	01121	EB2025
R404	315-0362-00	B040000	B149999X	RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	01121	CB3625
R405	315-0752-00	B010100	B039999	RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R405	315-0123-00	B040000	B149999X	RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R406	323-0318-00	XB150000		RES.,FXD,FILM:20K OHM,1%,0.50W	75042	CECT0-2002F
R407	315-0124-00	B010100	B149999X	RES.,FXD,CMPSN:120K OHM,5%,0.25W	01121	CB1245
R408	315-0474-00	B010100	B149999	RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R408	315-0510-00	B150000		RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R409	315-0104-00	XB040000	B149999	RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R409	322-0385-00	B150000		RES.,FXD,FILM:100K OHM,1%,0.25W	75042	CEBT0-1003F
R410A R410B	311-0832-00	B010100	B149999	RES.,VAR,WW:1K OHM,20%,2W :50K OHM	01121	JJC-94320A
R410	315-0122-00	B150000		RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R412	301-0562-00	B010100	B039999	RES.,FXD,CMPSN:5.6K OHM,5%,0.50W	01121	EB5625
R412	301-0203-00	B040000	B149999X	RES.,FXD,CMPSN:20K OHM,5%,0.50W	01121	EB2035
R413	315-0510-00	B010100	B149999X	RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R415	308-0307-00			RES.,FXD,WW:5K OHM,1%,3W	91637	RS2B-B50000F
R417	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R420	315-0101-00	B010100	B149999	RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R420	315-0100-00	B150000		RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R421	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R422	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R424	301-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.50W	01121	EB1015
R426	315-0432-00	B010100	B199999	RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325

[1]R377 and R396 furnished as a unit.
[2]Furnished as a unit with R531.

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R426	315-0392-00	B200000		RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R428	311-0840-00	B010100	B199999	RES.,VAR,NONWIR:20K OHM,10%,0.50W	01121	SV2031
R428	311-1269-00	B200000	B209999	RES.,VAR,NONWIR:20K OHM,10%,0.50W	32997	3329P-L58-203
R428	311-0614-00	B210000		RES.,VAR,NONWIR:30K OHM,10%,0.20W	73138	82-28-0
R430	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R431	315-0204-00			RES.,FXD,CMPSN:200K OHM,5%,0.25W	01121	CB2045
R433	301-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.50W	01121	EB1025
R434	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R435	301-0242-00	B010100	B149999	RES.,FXD,CMPSN:2.4K OHM,5%,0.50W	01121	EB2425
R435	315-0271-00	B150000		RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R436	301-0332-00	XB150000		RES.,FXD,CMPSN:3.3K OHM,5%,0.50W	01121	EB3325
R437	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R439	308-0360-00			RES.,FXD,WW:13.3K OHM,1%,3W	91637	RS2B-B13301F
R440	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R441	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R443	303-0333-00			RES.,FXD,CMPSN:33K OHM,5%,1W	01121	GB3335
R447	315-0333-00	B010100	B039999	RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R447	315-0822-00	B040000		RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R448	315-0683-00	B010100	B039999	RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
R448	315-0913-00	B040000		RES.,FXD,CMPSN:91K OHM,5%,0.25W	01121	CB9135
R450	311-0547-00	B010100	B149999	RES.,VAR,WW:TRMR,10K OHM,4W	11237	AW1930
R450	311-1078-00	B150000		RES.,VAR,NONWIR:PNL,10K OHM,2W	11236	550-BB30653
R451	323-0362-00			RES.,FXD,FILM:57.6K OHM,1%,0.50W	75042	CECT0-5762F
R452A-H	324-0531-00			RES.,FXD,FILM:3.32M OHM,1%,1W	91637	MFF1-14G33203F
R453	301-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.50W	01121	EB3935
R454	301-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.50W	01121	EB1025
R455	301-0205-00			RES.,FXD,CMPSN:2M OHM,5%,0.50W	01121	EB2055
R456	315-0181-00			RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
R458	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R460	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R461	301-0823-00	B010100	B209999	RES.,FXD,CMPSN:82K OHM,5%,0.50W	01121	EB8235
R461	301-0154-00	B210000		RES.,FXD,CMPSN:150K OHM,5%,0.50W	01121	EB1545
R463	315-0184-00			RES.,FXD,CMPSN:180K OHM,5%,0.25W	01121	CB1845
R464	315-0471-00	B010100	B189999	RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R464	303-0301-00	B190000		RES.,FXD,CMPSN:300 OHM,5%,1W	01121	GB3015
R465	315-0101-03	XB226525		RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R470	301-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.50W	01121	EB3335
R471	301-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.50W	01121	EB1015
R472	306-0825-00			RES.,FXD,CMPSN:8.2M OHM,10%,2W	01121	HB8251
R473	306-0825-00			RES.,FXD,CMPSN:8.2M OHM,10%,2W	01121	HB8251
R474	305-0475-00			RES.,FXD,CMPSN:4.7M OHM,5%,2W	01121	HB4755
R475	311-0121-00	B010100	B010114	RES.,VAR,NONWIR:5M OHM,20%,0.50W	34263	CTS45
R475	311-0121-01	B010115		RES.,VAR,NONWIR:5M OHM,20%,0.50W	71590	BA811-4367HV2
R476	305-0685-00			RES.,FXD,CMPSN:6.8M OHM,5%,2W	01121	HB6855
R477	305-0475-00			RES.,FXD,CMPSN:4.7M OHM,5%,2W	01121	HB4755
R480	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R481	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R482	324-0522-00	B010100	B209999	RES.,FXD,FILM:2.67M OHM,1%,1W	91637	FMM1-14G26703F
R482	324-0443-00	B210000		RES.,FXD,FILM:402K OHM,1%,1W	91637	MFF1-14G40202F
R483	324-0522-00	B010100	B209999	RES.,FXD,FILM:2.67M OHM,1%,1W	91637	MFF1-14G26703F
R483	324-0467-00	B210000		RES.,FXD,FILM:715K OHM,1%,1W	91637	MFF1-14G71502F
R484	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R485A-H	324-0531-00			RES.,FXD,FILM:3.32M OHM,1%,1W	91637	MFF1-14G33203F

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R486	311-0260-00			RES.,VAR,NONWIR:PNL,2M OHM,0.50W	71590	BA811-4817#2
R488	301-0514-00			RES.,FXD,CMPSN:510K OHM,5%,0.50W	01121	EB5145
R489	324-0467-00	XB210000		RES.,FXD,FILM:715K OHM,1%,1W	91637	MFF1-14G71502F
R490	301-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.50W	01121	EB2225
R491	301-0182-00	XB180000		RES.,FXD,CMPSN:1.8K OHM,5%,0.5W	01121	EB1825
R492A,B	311-1066-00	XB180000		RES.,VAR,NONWIR:PNL,2X2K OHM,1.3W	11236	2-551-BB30654
R493	301-0473-00	B010100	B039999	RES.,FXD,CMPSN:47K OHM,5%,0.50W	01121	EB4735
R493	315-0562-00	B040000	B149999	RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R493	301-0562-00	B150000		RES.,FXD,CMPSN:5.6K OHM,5%,0.50W	01121	EB5625
R494	307-0025-00	B010100	B129999	RES.,FXD,CMPSN:3.3 OHM,10%,0.50W	01121	EB33G1
R494	307-0093-00	B130000		RES.,FXD,CMPSN:1.2 OHM,5%,0.50W	01121	EB12G5
R495	323-0097-00			RES.,FXD,FILM:100 OHM,1%,0.50W	75042	CECT0-1000F
R496	323-0097-00			RES.,FXD,FILM:100 OHM,1%,0.50W	75042	CECT0-1000F
R497	307-0025-00	B010100	B129999	RES.,FXD,CMPSN:3.3 OHM,10%,0.50W	01121	EB33G1
R497	307-0051-00	B130000		RES.,FXD,CMPSN:2.7 OHM,5%,0.50W	01121	EB27G5
R498	301-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.50W	01121	EB3035
R499	301-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.50W	01121	EB1005
R501	301-0913-00			RES.,FXD,CMPSN:91K OHM,5%,0.50W	01121	EB9135
R502	301-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.50W	01121	EB8225
R503	301-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.5W	01121	EB1045
R505	315-0204-00			RES.,FXD,CMPSN:200K OHM,5%,0.25W	01121	CB2045
R506	315-0243-00	B010100	B149999	RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
R506	301-0243-00	B150000		RES.,FXD,CMPSN:24K OHM,5%,0.50W	01121	EB2435
R507	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R508	323-0350-00			RES.,FXD,FILM:43.2K OHM,1%,0.50W	75042	CECT0-4322F
R509	323-0385-00			RES.,FXD,FILM:100K OHM,1%,0.50W	75042	CECT0-1003F
R510	311-0624-00	B010100	B199999	RES.,VAR,NONWIR:200K OHM,20%,0.125W	01121	FR2040T
R510	311-1251-00	B200000		RES.,VAR,NONWIR:200K OHM,20%,0.50W	32997	3386F-T06-204
R511	311-0624-00	B010100	B199999	RES.,VAR,NONWIR:200K OHM,20%,0.125W	01121	FR2040T
R511	311-1251-00	B200000		RES.,VAR,NONWIR:200K OHM,20%,0.50W	32997	3386F-T06-204
R512	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R513	315-0624-00			RES.,FXD,CMPSN:620K OHM,5%,0.25W	01121	CB6245
R514	301-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.50W	01121	EB1035
R516	301-0163-00	B010100	B149999	RES.,FXD,CMPSN:16K OHM,5%,0.50W	01121	EB1635
R516	315-0163-00	B150000		RES.,FXD,CMPSN:16K OHM,5%,0.25W	01121	CB1635
R518	301-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.50W	01121	EB1015
R520	308-0008-00			RES.,FXD,WW:10K OHM,5%,5W	91637	HL602Z8-80000J
R521	308-0008-00			RES.,FXD,WW:10K OHM,5%,5W	91637	HL602Z8-80000J
R522	315-0101-00	XB150000		RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R523	301-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.50W	01121	EB1015
R525	301-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.50W	01121	EB1015
R527	304-0564-00			RES.,FXD,CMPSN:560K OHM,10%,1W	01121	GB5641
R528	302-0563-00	B010100	B149999	RES.,FXD,CMPSN:56K OHM,10%,0.50W	01121	EB5631
R528	301-0563-00	B150000		RES.,FXD,CMPSN:56K OHM,5%,0.50W	01121	EB5635
R529	323-0452-00			RES.,FXD,FILM:499K OHM,1%,0.50W	75042	CECT0-4993F
R530	315-0243-00	XB150000		RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
R531	311-0218-00	B010100	B149999	RES.,VAR,WW:PNL,50K OHM,2W	12697	CM26978
R531[1]	311-1106-00	B150000		RES.,VAR,NONWIR:PNL,2 X 25K OHM,4W	10582	AW-3212
R532	323-0304-00	B010100	B149999	RES.,FXD,FILM:14.3K OHM,1%,0.50W	75042	CECT0-1432F
R532	323-0275-00	B150000		RES.,FXD,FILM:7.15K OHM,1%,0.50W	75042	CECT0-7151F
R533	315-0153-00	XB150000		RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R534	301-0754-00			RES.,FXD,CMPSN:750K OHM,5%,0.50W	01121	EB7545
R535	301-0124-00	B010100	B149999	RES.,FXD,CMPSN:120K OHM,5%,0.50W	01121	EB1245

[1]Furnished as a unit with R387.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R535	315-0472-00	B150000		RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R536	315-0563-00	B010100	B219999	RES.,FXD,CMPSN:56K OHM,5%,0.25W	01121	CB5635
R536	315-0473-00	B220000		RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R537	315-0184-00	XB150000		RES.,FXD,CMPSN:180K OHM,5%,0.25W	01121	CB1845
R538	311-0511-00	B010100	B089999	RES.,VAR,NONWIR:PNL,10K OHM,0.50W	12697	381CM33047
R538	311-0676-00	B090000	B199999	RES.,VAR,NONWIR:500K OHM,20%,0.25W	01121	FR504R
R538	311-1253-00	B200000	B219999	RES.,VAR,NONWIR:500K OHM,20%,0.50W	32997	3386F-T05-504
R538	311-1235-00	B220000		RES.,VAR,NONWIR:100K OHM,20%,0.50W	32997	3386F-T04-104
R539	315-0203-00	XB150000		RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R540	311-0465-00	B010100	B199999	RES.,VAR,NONWIR:100K OHM,20%,0.25W	01121	FR104M
R540	311-1235-00	B200000		RES.,VAR,NONWIR:100K OHM,20%,0.50W	32997	3386F-T04-104
R541	301-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.50W	01121	EB1235
R543	301-0164-00			RES.,FXD,CMPSN:160K OHM,5%,0.50W	01121	EB1645
R544	301-0124-00	XB150000		RES.,FXD,CMPSN:120K OHM,5%,0.50W	01121	EB1245
R545	301-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.50W	01121	EB2035
R547	301-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.50W	01121	EB1015
R550	308-0464-00			RES.,FXD,WW:56K OHM,5%,8W	91637	RS7-B56001J
R551	301-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.50W	01121	EB1015
R552	315-0101-00	XB150000		RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R554	311-0463-00	B010100	B199999	RES.,VAR,NONWIR:5K OHM,20%,0.25W	01121	FR502M
R554	311-1227-00	B200000		RES.,VAR,NONWIR:5K OHM,20%,0.50W	32997	3386F-T04-502
R556	301-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.50W	01121	EB1015
R558	301-0244-00			RES.,FXD,CMPSN:240 OHM,5%,0.50W	01121	EB2445
R560	315-0753-00	XB150000		RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R561	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R562	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R563	315-0123-00	XB150000		RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R564	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R565	315-0822-00	XB150000		RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R567	301-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.5W	01121	EB1045
R568	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R569	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R571	301-0103-00	B010100	B199999	RES.,FXD,CMPSN:10K OHM,5%,0.50W	01121	EB1035
R571	301-0333-00	B200000		RES.,FXD,CMPSN:33K OHM,5%,0.50W	01121	EB3335
R572	301-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.50W	01121	EB2035
R573	321-0385-00	B010100	B149999	RES.,FXD,FILM:100K OHM,1%,0.125W	91637	MFF1816G10002F
R573	315-0104-00	B150000		RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R574	301-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.50W	01121	EB1035
R580A	316-0224-00			RES.,FXD,CMPSN:220K OHM,10%,0.25W	01121	CB2241
R580B	316-0224-00			RES.,FXD,CMPSN:220K OHM,10%,0.25W	01121	CB2241
R581	315-0152-00	B010100	B029999	RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R581	315-0103-00	B030000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R582	301-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.50W	01121	EB4725
R584	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
R585	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R586	316-0336-00			RES.,FXD,CMPSN:33M OHM,10%,0.25W	01121	CB3361
R590	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R592	301-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.50W	01121	EB1035
R594	301-0153-00	B010100	B219999	RES.,FXD,CMPSN:15K OHM,5%,0.50W	01121	EB1535
R594	301-0162-00	B220000		RES.,FXD,CMPSN:1.6K OHM,5%,0.50W	01121	EB1625
R595	303-0243-00			RES.,FXD,CMPSN:24K OHM,5%,1W	01121	GB2435
R596	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R600	301-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.50W	01121	EB3025

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R602	301-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.50W	01121	EB3935
R604	301-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.50W	01121	EB4745
R610	301-0104-00	B010100	B219999	RES.,FXD,CMPSN:100K OHM,5%,0.5W	01121	EB1045
R610	301-0433-00	B220000		RES.,FXD,CMPSN:43K OHM,5%,0.50W	01121	EB4335
R612	315-0303-00	B010100	B299999	RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R612	315-0133-00	B220000		RES.,FXD,CMPSN:13K OHM,5%,0.25W	01121	CB1335
R614	301-0123-00	B010100	B299999	RES.,FXD,CMPSN:12K OHM,5%,0.50W	01121	EB1235
R614	301-0562-00	B220000		RES.,FXD,CMPSN:5.6K OHM,5%,0.50W	01121	EB5625
R620	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R621	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R622A	316-0224-00			RES.,FXD,CMPSN:220K OHM,10%,0.25W	01121	CB2241
R622B	316-0224-00			RES.,FXD,CMPSN:220K OHM,10%,0.25W	01121	CB2241
R623	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R624	301-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.50W	01121	EB4735
R625	301-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.50W	01121	EB4735
R626	301-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.50W	01121	EB1025
R630	303-0102-00			RES.,FXD,CMPSN:1K OHM,5%,1W	01121	GB1025
R632	301-0124-00			RES.,FXD,CMPSN:120K OHM,5%,0.50W	01121	EB1245
R634	321-0417-00			RES.,FXD,FILM:215K OHM,1%,0.125W	91637	MFF1816G21502F
R640	301-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.50W	01121	EB5135
R644	301-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.50W	01121	EB1535
R646	301-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.50W	01121	EB6235
R648	301-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.50W	01121	EB2025
R651	303-0183-00			RES.,FXD,CMPSN:18K OHM,5%,1W	01121	GB1835
R652	315-0162-00			RES.,FXD,CMPSN:1.6K OHM,5%,0.25W	01121	CB1625
R654	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R655	305-0163-00	B010100	B219999	RES.,FXD,CMPSN:16K OHM,5%,2W	01121	HB1635
R655	305-0203-00	B220000		RES.,FXD,CMPSN:20K OHM,(NOM VALUE),SEL	01121	HB2035
R660	301-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.50W	01121	EB1025
R664	301-0514-00			RES.,FXD,CMPSN:510K OHM,5%,0.50W	01121	EB5145
R667	311-0541-00	B010100	B199999	RES.,VAR,NONWIR:20K OHM,20%	01121	FR203M
R667	311-1230-00	B200000		RES.,VAR,NONWIR:20K OHM,20%,0.50W	32997	3386F-T04-203
R668	305-0243-00			RES.,FXD,CMPSN:24K OHM,5%,2W	01121	HB2435
R670	306-0154-00			RES.,FXD,CMPSN:150K OHM,10%,2W	01121	HB1541
R671	306-0154-00			RES.,FXD,CMPSN:150K OHM,10%,2W	01121	HB1541
R673	301-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.50W	01121	EB2215
R675	308-0071-00			RES.,FXD,WW:500 OHM,1%,5W	91637	RS5-B500R0F
R677	301-0103-00	XB150000		RES.,FXD,CMPSN:10K OHM,5%,0.50W	01121	EB1035
R678	301-0104-00	XB150000		RES.,FXD,CMPSN:100K OHM,5%,0.5W	01121	EB1045
R680	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R685	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R710	307-0057-00			RES.,FXD,CMPSN:5.1 OHM,5%,0.50W	01121	EB51G5
R711	307-0057-00			RES.,FXD,CMPSN:5.1 OHM,5%,0.50W	01121	EB51G5
R720	307-0007-00			RES.,FXD,CMPSN:2.7 OHM,10%,2W	01121	GB27G1
R724	302-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.50W	01121	EB1011
R726	302-0104-00			RES.,FXD,CMPSN:100K OHM,10%,0.50W	01121	EB1041
R730	302-0154-00			RES.,FXD,CMPSN:150K OHM,10%,0.50W	01121	EB1541
R732	302-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.50W	01121	EB1011
R735	301-0754-00			RES.,FXD,CMPSN:750K OHM,5%,0.50W	01121	EB7545
R738	302-0104-00			RES.,FXD,CMPSN:100K OHM,10%,0.50W	01121	EB1041
R740	301-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.50W	01121	EB1015
R741	304-0560-00	XB210000		RES.,FXD,CMPSN:56 OHM,10%,1W	01121	GB5601
R745	323-0356-09			RES.,FXD,FILM:49.9K OHM,1%,0.50W	75042	CECT9-4992F

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R746	323-0356-09			RES.,FXD,FILM:49.9K OHM,1%,0.50W	75042	CECT9-4992F
R754	302-0100-00			RES.,FXD,CMPSN:10 OHM,10%,0.50W	01121	EB1001
R756	302-0104-00			RES.,FXD,CMPSN:100K OHM,10%,0.50W	01121	EB1041
R760	303-0203-00			RES.,FXD,CMPSN:20K OHM,5%,1W	01121	GB2035
R761	301-0200-00			RES.,FXD,CMPSN:20 OHM,5%,0.50W	01121	EB2005
R772	308-0465-00			RES.,FXD,WW:0.225 OHM,10%,2W	80009	308-0465-00
R775	323-0287-00			RES.,FXD,FILM:9.53K OHM,1%,0.50W	75042	CECT0-9531F
R776	323-0356-00	B010100	B121789	RES.,FXD,FILM:49.9K OHM,1%,0.50W	75042	CECT0-4992F
R776	323-0356-09	B121790		RES.,FXD,FILM:49.9K OHM,1%,0.50W	75042	CECT9-4992F
R784	302-0100-00			RES.,FXD,CMPSN:10 OHM,10%,0.50W	01121	EB1001
R786	302-0104-00			RES.,FXD,CMPSN:100K OHM,10%,0.50W	01121	EB1041
R790	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235
R791	301-0200-00			RES.,FXD,CMPSN:20 OHM,5%,0.50W	01121	EB2005
R793	301-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.50W	01121	EB2735
R795	323-0289-00			RES.,FXD,FILM:10K OHM,1%,0.50W	75042	CECT0-1002F
R796	323-0347-09			RES.,FXD,FILM:40.2K OHM,1%,0.50W	75042	CECT9-4022F
R800	307-0007-00			RES.,FXD,CMPSN:2.7 OHM,10%,2W	01121	GB27G1
R810	302-0471-00			RES.,FXD,CMPSN:470 OHM,10%,0.50W	01121	EB4711
R811	306-0123-00			RES.,FXD,CMPSN:12K OHM,10%,2W	01121	HB1231
R812	302-0392-00			RES.,FXD,CMPSN:3.9K OHM,10%,0.50W	01121	EB3921
R814	301-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.50W	01121	EB4325
R816	323-0251-09			RES.,FXD,FILM:4.02K OHM,1%,0.50W	75042	CECT9-4021F
R817	311-0532-00			RES.,VAR,WW:TRMR,1.5K OHM,1W	80294	3345P-1-152
R818	323-0352-09			RES.,FXD,FILM:45.3K OHM,1%,0.50W	75042	CECT9-4532F
R820	302-0824-00			RES.,FXD,CMPSN:820K OHM,10%,0.50W	01121	EB8241
R822	302-0152-00			RES.,FXD,CMPSN:1.5K OHM,10%,0.50W	01121	EB1521
R825	301-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.50W	01121	EB5105
R826	304-0223-00			RES.,FXD,CMPSN:22K OHM,10%,1W	01121	GB2231
SW5	260-0974-00	B010100	B089999	SWITCH,ROTARY:3 SECT,3 POSN,30 DEG	80009	260-0974-00
SW5	260-1014-00	B090000		SWITCH,ROTARY:3 SECT,3 POSN,60 DEG	80009	260-1014-00
SW202	260-0450-00			SWITCH,SLIDE:3 POS,DOUBLE POLE	82389	11D-1007
SW204	260-0450-00			SWITCH,SLIDE:3 POS,DOUBLE POLE	82389	11D-1007
SW580	260-0919-00			SWITCH,PUSH:DPDT,5A,115VAC	96182	90EA1C2F10J1ALLN
SW622	260-0919-00			SWITCH,PUSH:DPDT,5A,115VAC	96182	90EA1C2F10J1ALLN
SW701	260-0834-00			SWITCH,TOGGLE:DPDT,5A,125VAC,0.25-40 THD	09353	U21-SHZQE
SW702[1]						
SW703[1]						
TK704	260-0071-00			SW,THERMOSTATIC:155 DEG F	93410	430-353
T465	120-0515-00	B010100	B209999	XFMR:H.V. POWER	80009	120-0515-00
T465	120-0802-00	B210000		XFMR:H.V. POWER	80009	120-0802-00
T522	120-0691-00	XB150000		XFMR:TOROID,2 WINDINGS	80009	120-0691-00
T700	120-0514-00			XFMR:L.V. POWER	80009	120-0514-00
TP45	214-0579-00			TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
TP75	214-0579-00			TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
TP145	214-0579-00			TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
TP175	214-0579-00			TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
TP440	214-0579-00			TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
TP498	214-0579-00			TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
U10	156-0015-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0015-00
U110	156-0015-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0015-00
U450	156-0015-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0015-00
U820	156-0015-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0015-00

[1]See Mechanical Parts List. Line Voltage Selector Body.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
V490	154-0518-00	B010100	B129999	ELECTRON TUBE:CRT	80009	154-0518-00
V490	154-0624-00	B130000	B199999	ELECTRON TUBE:CRT	80009	154-0624-00
V490[1]	154-0624-11	B200000	B227329	ELECTRON TUBE:CRT	80009	154-0624-11
V490[1]	154-0624-12	B227330		ELECTRON TUBE:CRT	80009	154-0624-12
V490[2]	154-0624-11	B200000	B226519	ELECTRON TUBE:CRT	80009	154-0624-11
V490[2]	154-0624-12	B226520		ELECTRON TUBE:CRT	80009	154-0624-12

[1]611 only
[2]611-2 only

REPLACEABLE MECHANICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations.

INDENTATION SYSTEM

This mechanical parts list is indented to indicate item relationships. Following is an example of the indentation system used in the description column.

1 2 3 4 5 Name & Description

Assembly and/or Component
Attaching parts for Assembly and/or Component
- - - * - - -
Detail Part of Assembly and/or Component
Attaching parts for Detail Part
- - - * - - -
Parts of Detail Part
Attaching parts for Parts of Detail Part
- - - * - - -

Attaching Parts always appear in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation. The separation symbol - - - * - - - indicates the end of attaching parts.

Attaching parts must be purchased separately, unless otherwise specified.

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

ABBREVIATIONS

"	INCH
#	NUMBER SIZE
ACTR	ACTUATOR
ADPTR	ADAPTER
ALIGN	ALIGNMENT
AL	ALUMINUM
ASSEM	ASSEMBLED
ASSY	ASSEMBLY
ATTEN	ATTENUATOR
AWG	AMERICAN WIRE GAGE
BD	BOARD
BRKT	BRACKET
BRS	BRASS
BRZ	BRONZE
BSHG	BUSHING
CAB	CABINET
CAP	CAPACITOR
CER	CERAMIC
CHAS	CHASSIS
CKT	CIRCUIT
COMP	COMPOSITION
CONN	CONNECTOR
COV	COVER
CPLG	COUPLING
CRT	CATHODE RAY TUBE
DEG	DEGREE
DWR	DRAWER
ELCTRN	ELECTRON
ELEC	ELECTRICAL
ELCTLT	ELECTROLYTIC
ELEM	ELEMENT
EPL	ELECTRICAL PARTS LIST
EQPT	EQUIPMENT
EXT	EXTERNAL
FIL	FILLISTER HEAD
FLEX	FLEXIBLE
FLH	FLAT HEAD
FLTR	FILTER
FR	FRAME or FRONT
FSTNR	FASTENER
FT	FOOT
FXD	FIXED
GSKT	GASKET
HDL	HANDLE
HEX	HEXAGON
HEX HD	HEXAGONAL HEAD
HEX SOC	HEXAGONAL SOCKET
HLCPS	HELICAL COMPRESSION
HLEXT	HELICAL EXTENSION
HV	HIGH VOLTAGE
IC	INTEGRATED CIRCUIT
ID	INSIDE DIAMETER
IDENT	IDENTIFICATION
IMPLR	IMPELLER
IN	INCH
INCAND	INCANDESCENT
INSUL	INSULATOR
INTL	INTERNAL
LPHLDR	LAMPHOLDER
MACH	MACHINE
MECH	MECHANICAL
MTG	MOUNTING
NIP	NIPPLE
NON WIRE	NOT WIRE WOUND
OBD	ORDER BY DESCRIPTION
OD	OUTSIDE DIAMETER
OVH	OVAL HEAD
PH BRZ	PHOSPHOR BRONZE
PL	PLAIN or PLATE
PLSTC	PLASTIC
PN	PART NUMBER
PNH	PAN HEAD
PWR	POWER
RCPT	RECEPTACLE
RES	RESISTOR
RGD	RIGID
RLF	RELIEF
RTNR	RETAINER
SCH	SOCKET HEAD
SCOPE	OSCILLOSCOPE
SCR	SCREW
SE	SINGLE END
SECT	SECTION
SEMICOND	SEMICONDUCTOR
SHLD	SHIELD
SHLDR	SHOULDERED
SKT	SOCKET
SL	SLIDE
SLFLKG	SELF-LOCKING
SLVG	SLEEVING
SPR	SPRING
SQ	SQUARE
SST	STAINLESS STEEL
STL	STEEL
SW	SWITCH
T	TUBE
TERM	TERMINAL
THD	THREAD
THK	THICK
TNSN	TENSION
TPG	TAPPING
TRH	TRUSS HEAD
V	VOLTAGE
VAR	VARIABLE
W/	WITH
WSHR	WASHER
XFMR	TRANSFORMER
XSTR	TRANSISTOR

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
000BK	STAUFFER SUPPLY	105 SE TAYLOR	PORTLAND, OR 97214
00287	C.E.M. COMPANY, INC.	24 SCHOOL	DANIELSON, CT 06239
00779	AMP, INC.	P O BOX 3608	HARRISBURG, PA 17105
00866	GOE ENGINEERING COMPANY, INC.	P O BOX 3485, 250 S 9TH AVE.	CITY OF INDUSTRY, CA 91746
02735	RCA CORPORATION, SOLID STATE DIVISION	ROUTE 202	SOMERVILLE, NY 08876
09353	C AND K COMPONENTS, INC.	103 MORSE STREET	WATERTOWN, MA 02172
11897	PLASTIGLIDE MFG. CORPORATION	P O BOX 867, 1757 STANFORD ST.	SANTA MONICA, CA 90406
12327	FREEWAY CORPORATION	9301 ALLEN DRIVE	CLEVELAND, OH 44125
12697	CLAROSTAT MFG. CO., INC.	LOWER WASHINGTON STREET	DOVER, NH 03820
22753	U. I. D. ELECTRONICS CORP.	4105 PEMBROKE RD.	HOLLYWOOD, FL 33021
28520	HEYMAN MFG. CO.	147 N. MICHIGAN AVE.	KENILWORTH, NJ 07033
46384	PENN ENGINEERING AND MFG. CORP.	P O BOX 311	DOYLESTOWN, PA 18901
66295	WITTEK MFG. CO.	4305 W. 24TH PLACE	CHICAGO, IL 60623
70276	ALLEN MFG. CO.	P. O. DRAWER 570	HARTFORD, CT 06101
70485	ATLANTIC INDIA RUBBER WORKS, INC.	571 W. POLK ST.	CHICAGO, IL 60607
71279	CAMBRIDGE THERMIONIC CORP.	445 CONCORD AVE.	CAMBRIDGE, MA 02138
71468	ITT CANNON ELECTRIC	666 E. DYER RD.	SANTA ANA, CA 92702
71785	TRW, CINCH CONNECTORS	1501 MORSE AVENUE	ELK GROVE VILLAGE, IL 60007
72962	ESNA, DIV. OF AMERACE CORPORATION	2330 VAUXHALL ROAD	UNION, NJ 07083
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
74445	HOLO-KROME CO.	31 BROOK ST. WEST	HARTFORD, CT 06110
74921	ITEN FIBRE CO., THE	4001 BENEFIT AVE., P O BOX 9	ASHTABULA, OH 44004
75915	LITTELFUSE, INC.	800 E. NORTHWEST HWY	DES PLAINES, IL 60016
77250	PHEOLL MANUFACTURING CO., DIVISION OF ALLIED PRODUCTS CORP.	5700 W. ROOSEVELT RD.	CHICAGO, IL 60650
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
78471	TILLEY MFG. CO.	900 INDUSTRIAL RD.	SAN CARLOS, CA 94070
79807	WROUGHT WASHER MFG. CO.	2100 S. O BAY ST.	MILWAUKEE, WI 53207
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
82389	SWITCHCRAFT, INC.	5555 N. ELSTON AVE.	CHICAGO, IL 60630
82877	ROTRON, INC.	7-9 HASBROUCK LANE	WOODSTOCK, NY 12498
83330	SMITH, HERMAN H., INC.	812 SNEDIKER AVE.	BROOKLYN, NY 11207
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
83584	DRIV-LOK INC.	1140 PARK AVENUE	SYCAMORE, IL 60178
83907	ACCURATE RUBBER PRODUCTS CO.	123 N. RACINE	CHICAGO, IL 60607
86928	SEASTROM MFG. COMPANY, INC.	701 SONORA AVENUE	GLENDALE, CA 91201
87473	INSULECTRO, A DIVISION OF QUINTEC INDST.	343 CORAL CIRCLE	EL SEGUNDO, CA 90245
88245	LITTON SYSTEMS, INC., USECO DIV.	13536 SATICOY ST.	VAN NUYS, CA 91409
89663	REESE, J. RAMSEY, INC.	71 MURRAY STREET	NEW YORK, NY 10007
91506	AUGAT, INC.	33 PERRY AVE.	ATTLEBORO, MA 02703
91836	KINGS ELECTRONICS CO., INC.	40 MARBLEDALE ROAD	TUCKAHOE, NY 10707
93907	CAMCAR SCREW AND MFG. CO.	600 18TH AVE.	ROCKFORD, IL 61101
94222	SOUTHCO, INC.		LESTER, PA 19113
95987	WECKESSER CO., INC.	4444 WEST IRVING PARK RD.	CHICAGO, IL 60641
96182	MASTER SPECIALTIES CO.	1640 MONROVIA	COSTA MESA, CA 92627
98278	MALCO A MICRODOT COMPANY, INC. CONNECTOR AND CABLE DIVISION	220 PASADENA AVE.	SOUTH PASADENA, CA 91030
98291	SEALECTRO CORP.	225 HOYT	MAMARONECK, NY 10544
98627	UNIVERSAL OIL PRODUCTS CO., MORPLEX DIV.	1300 MORPLEX DRIVE	LACROSSE, WI 54601
98978	INTERNATIONAL ELECTRONIC RESEARCH CORP.	135 W. MAGNOLIA BLVD.	BURBANK, CA 91502

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-1	334-1180-00			1		MARKER,IDENT:ERASE	80009	334-1180-00
-2	260-0919-00			1		SWITCH,PUSH:DPDT,5A,115VAC	96182	90EA1C2F10J1AL1N
-3	334-1181-00			1		MARKER,IDENT:VIEW	80009	334-1181-00
-4	260-0919-00			1		SWITCH,PUSH:DPDT,5A,115VAC	96182	90EA1C2F10J1AL1N
-5	366-0254-00	B010100	B149999X	1		KNOB:CHARCOAL	80009	366-0254-00
	213-0020-00			1		. SETSCREW:6-32 X 0.125 INCH,HEX.SKT STL	70276	OBD
-6	----- -----			1		RESISTOR,VARIABLE:		
						(ATTACHING PARTS)		
-7	210-0207-00			1		TERMINAL,LUG:0.375 INCH DIAMETER	12697	01136902
	210-0012-00			1		WASHER,LOCK:INTL,0.375 ID X 0.50" OD STL	78189	1220-02-00-0541C
	210-0978-00			1		WASHER,FLAT:0.375 ID X 0.50 INCH OD,STL	78471	OBD
	210-0590-00			1		NUT,PLAIN,HEX.:0.375 X 0.438 INCH,STL	73743	2X28269-402
						- - - * - - -		
-8	200-0269-00	B010100	B010114	1		SHIELD,RESISTOR:	80009	200-0269-00
	200-0745-00	B010115		1		COVER,VAR RES:0.938 DIA,POLYPROPYLENE	80009	200-0745-00
-9	----- -----			1		RESISTOR,VARIABLE:		
						(ATTACHING PARTS)		
	210-0012-00			1		WASHER,LOCK:INTL,0.375 ID X 0.50" OD STL	78189	1220-02-00-0541C
	210-0978-00			1		WASHER,FLAT:0.375 ID X 0.50 INCH OD,STL	78471	OBD
-10	210-0590-00			1		NUT,PLAIN,HEX.:0.375 X 0.438 INCH,STL	73743	2X28269-402
						- - - * - - -		
-11	----- -----			1		RESISTOR,VARIABLE:		
						(ATTACHING PARTS)		
	210-0840-00			1		WASHER,FLAT:0.39 ID X 0.562 INCH OD,STL	89663	644R
	210-0444-00			1		NUT,SLEEVE:5-40 X 0.250 X 0.94 I THK,BRS	80009	210-0444-00
						- - - * - - -		
-12	260-0834-00			1		SWITCH,TOGGLE:DPDT,5A,125VAC,0.25-40 THD	09353	U21-SHZQE
						(ATTACHING PARTS)		
-13	210-0940-00			1		WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
						- - - * - - -		
-14	366-0162-00			1		PUSH BUTTON:RED	80009	366-0162-00
	213-0076-00			1		. SETSCREW:2-56 X 0.125 INCH,HEX.SKT STL	74445	OBD
-15	376-0029-00	B010100	B079999X	1		CPLG,SHAFT,RGD:0.128 ID X 0.312 OD X 0.5"L	80009	376-0029-00
	213-0075-00			2		. SETSCREW:4-40 X 0.094 INCH,HEX SKT STL	000BK	OBD
	348-0031-00			1		GROMMET,PLASTIC:0.156 INCH DIA	80009	348-0031-00
	384-0681-00	B010100	B079999	1		EXTENSION SHAFT:14.17 INCH LONG,OFFSET	80009	384-0681-00
	384-0681-01	B080000	B203534X	1		EXTENSION SHAFT:14.468 INCH LONG,OFFSET	80009	384-0681-01
	376-0029-00	B010100	B060439X	1		. CPLG,SHAFT,RGD:0.128 ID X 0.312 OD X 0.5"L	80009	376-0029-00
	213-0075-00	B010100	B060439X	2		. . SETSCREW:4-40 X 0.094 INCH,HEX SKT STL	000BK	OBD
						(ATTACHING PARTS FOR SHAFT)		
	213-0048-00	B010100	B079999X	1		SETSCREW:4-40 X 0.125 INCH,HEX SKT STL	74445	OBD
						- - - * - - -		
-16	214-1084-02	B080000		1		LEVER,MNL CONT:	80009	214-1084-02
-17	407-0410-00	B010100	B149999	1		BRACKET,CMPNT:	80009	407-0410-00
	407-0410-01	B150000	B179999	1		BRACKET,CMPNT:	80009	407-0410-01
	407-0410-02	B180000		1		BRACKET,CMPNT:	80009	407-0410-02
						(ATTACHING PARTS)		
-18	211-0507-00			2		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
						- - - * - - -		
-19	214-0989-00			2		SPRING,FLAT:0.312 X 1.75 INCH LONG	80009	214-0989-00
						(ATTACHING PARTS FOR EACH)		
-20	211-0538-00			1		SCREW,MACHINE:6-32 X 0.312"100 DEG,FLH STL	83385	OBD
-21	210-0457-00			1		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		
-22	131-0255-00			1		JACK,TIP:	98291	016-8010-00-0-20
-23	333-1030-00			1		PANEL,FRONT:	80009	333-1030-00
-24	386-1321-00			1		SUBPANEL,FRONT:	80009	386-1321-00
						(ATTACHING PARTS)		
-25	211-0538-00			4		SCREW,MACHINE:6-32 X 0.312"100 DEG,FLH STL	83385	OBD
						- - - * - - -		
	200-0864-00			1		DOOR,ACCESS:	80009	200-0864-00
-26	333-1031-00			1		. PANEL,FRONT:ACCESS DOOR	80009	333-1031-00
-27	200-0800-00			1		. DOOR,ACCESS:	80009	200-0800-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-28	367-0088-00			1		. PULL,ACCESSOR:	80009	367-0088-00
						(ATTACHING PARTS)		
	214-1030-00			2		PIN,GRVD,HDLS:	83584	OBD
						- - - * - - -		
-29	331-0203-00	B010100	B199999	1		MASK,CRT:	80009	331-0203-00
	331-0203-03	B200000		1		MASK,CRT:	80009	331-0203-03
-30	407-0409-00	B010100	B199999	1		BRACKET,SUPPORT:CRT	80009	407-0409-00
	426-0834-00	B200000	B209999	1		FR,IMPLOSION SH:	80009	426-0834-00
	426-0834-01	B210000		1		FR,IMPLOSION SH:	80009	426-0834-01
						(ATTACHING PARTS)		
	361-0168-00			4		SPACER,SLEEVE:0.198 ID X 0.250 OD X 0.986"L	80009	361-0168-00
-31	210-0410-00			4		NUT,PLAIN,HEX.:10-32 X 0.312 INCH,BRS	73743	2X20003-402
						- - - * - - -		
-32	426-0397-01			1		FRAME PNL,CAB.:FRONT	80009	426-0397-01
-33	337-0976-01			1		SHLD,ELECTRON T:FRONT	80009	337-0976-01
						(ATTACHING PARTS)		
-34	211-0512-00			4		SCREW,MACHINE:6-32 X 0.50" 100 DEG,FLH STL	83385	OBD
-35	214-0972-00			2		NUT,STRIP:6.750 INCH L	80009	214-0972-00
-36	212-0023-00			1		SCREW,MACHINE:8-32 X 0.375 INCH,PNH STL	83385	OBD
-37	210-0458-00			1		NUT,PLAIN,EXT W:8-32 X 0.344 INCH,STL	83385	OBD
						- - - * - - -		
-38	407-0422-00			1		BRACKET,ANGLE:CRT SHIELD	80009	407-0421-00
						(ATTACHING PARTS)		
	212-0023-00			2		SCREW,MACHINE:8-32 X 0.375 INCH,PNH STL	83385	OBD
	210-0804-00			2		WASHER,FLAT:0.17 ID X 0.375 INCH OD,STL	12327	OBD
						- - - * - - - -		
-39	252-0564-00	B010100	B101229	FT		PLASTIC EXTR:1.563 FT LONG	80009	252-0564-00
	255-0334-00	B101230		FT		PLASTIC CHANNEL:	11897	122-37-2500
-40	119-0153-00	B010100	B179999	1		COIL,TUBE DEFL:	80009	119-0153-00
	119-0232-00	B180000		1		COIL,TUBE,DEFL:	80009	119-0232-00
-41	131-0371-00			6		. CONTACT,ELEC:FOR NO.26 AWG WIRE	98278	122-0182-019
-42	162-0579-00			FT		. INS SLV,ELEC:0.25 ID,SPL WRAP	87473	OBD
-43	354-0320-00			1		RING,YOKE SPRT:	80009	354-0320-00
-44	348-0132-00			1		LINER,YOKE:	80009	348-0132-00
-45	348-0005-00			1		GROMMET,RUBBER:0.50 INCH DIA	70485	230
-46	337-0979-01			1		SHLD,ELECTRON T:REAR	80009	337-0979-01
						(ATTACHING PARTS)		
-47	343-0152-00			1		CLAMP,LOOP:	66295	OBD
						- - - * - - -		
	344-0233-00	XB200000	B209999X	4		CLIP,ELECTRICAL:CRT	80009	344-0233-00
	136-0274-00	B010100	B149999	1		SKT,PL-IN ELEK:	80009	136-0274-00
	136-0368-00	B150000		1		SKT,PL-IN ELEK:	80009	136-0368-00
-48	136-0278-00			1		. SOCKET,PLUG-IN:WITH PINS	80009	136-0278-00
	204-0322-00			1		. . BODY,CRT SOCKET:	80009	204-0322-00
	214-0464-00			7		. . CONTACT,ELEC:CRT	80009	214-0464-00
-49	200-0801-00			1		. COVER,SOCKET,PL:ELECTRON TUBE,PLASTIC	80009	200-0801-00
	136-0275-00	B010100	B149999	1		SKT,PL-IN ELEK:	80009	136-0275-00
	136-0275-01	B150000		1		SKT,PL-IN ELEK:	80009	136-0275-01
	131-0371-00			4		. CONTACT,ELEC:FOR NO.26 AWG WIRE	98278	122-0182-019
-50	136-0271-00			1		. SOCKET,PLUG-IN:7 PIN	71785	111-01-10-012
-51	200-0811-00			1		. COVER,SKT TERM.:	80009	200-0811-00
	----- -----			1		TUBE,CRT:		
-52	337-0977-00	B010100	B199999X	1		. SHLD,IMPLOSION:	80009	337-0977-00
-53	354-0316-00	B010100	B199999	1		. MOUNT,RESILIENT:CRT	80009	354-0316-00
	354-0316-01	B200000		1		. RING,CRT MTG:NEOPRENE	80009	354-0316-01
	337-1482-00	XB200000		1		SHLD,IMPLOSION:	80009	337-1482-00
						(ATTACHING PARTS)		
	211-0065-00			4		SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	77250	OBD
	407-0997-00			2		BRACKET,ANGLE:IMP SHIELD RET,9 INCH LONG	80009	407-0997-00
						- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-	----- -----	XB1800000		1		RESISTOR,VARIABLE:ROTATOR		
						(ATTACHING PARTS)		
	210-0583-00			1		NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20224-402
	210-0940-00			1		WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
	210-0046-00			1		WASHER,LOCK:INTL,0.26 ID X 0.40" OD,STL	78189	1214-05-00-0541C
						- - - * - - -		
	131-0809-00	XB180000		1		TERMINAL,STUD:PNL MT,4-40 TAP 1 END	71279	570-1510-01-0519
						(ATTACHING PARTS)		
	211-0007-00			1		SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
	210-0004-00			1		WASHER,LOCK:INTL,0.12 ID X 0.26"OD,STL	78189	1204-00-00-0541C
						- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-1	441-0761-00			1		CHAS,ELEC EQPT:HIGH VOLTAGE,Z AXIS AMPL	80009	441-0761-00
-2	343-0088-00			2		CLAMP,LOOP:0.062 INCH DIA	80009	343-0088-00
-3	343-0089-00			9		CLAMP,LOOP:LARGE	80009	343-0089-00
-4	348-0056-00			3		GROMMET,PLASTIC:0.375 INCH DIA	80009	348-0056-00
-5	358-0215-00			1		GROMMET,PLASTIC:U SHAPED	80009	358-0215-00
-6	214-0210-00			1		SLDR SPOOL ASSY:W/SILVER SOLDER	80009	214-0210-00
	214-0209-00			1		. SPOOL,SOLDER:	80009	214-0209-00
						(ATTACHING PARTS)		
	361-0007-00			1		SPACER,SLEEVE:0.250 INCH DIA,PLASTIC	80009	361-0007-00
						- - - * - - -		
-7	210-0201-00			2		TERMINAL,LUG:SE #4	78189	2104-04-00-2520N
						(ATTACHING PARTS)		
	213-0044-00			2		SCR,TPG,THD FOR:5-32 X 0.188 INCH,PNH STL	83385	OBD
						- - - * - - -		
-8	210-0204-00			1		TERMINAL,LUG:0.146 INCH DIA DE,45 DEG BEND	78189	2157-06-01-2520N
						(ATTACHING PARTS)		
-9	213-0044-00			1		SCR,TPG,THD FOR:5-32 X 0.188 INCH,PNH STL	83385	OBD
						- - - * - - -		
-10	129-0137-00			1		POST,ELEC-MECH:0.312 HEX X 1.75 INCH L,AL	80009	129-0137-00
-11	129-0144-00	B010100	B111569	4		SPACER,POST:0.312 OD X 1.875 INCH L,NYL	80009	129-0144-00
	385-0120-00	B111570		4		INS,STANDOFF:0.25 DIA X 1.89 INCH LONG,NYL	80009	385-0120-00
						(ATTACHING PARTS)		
-12	211-0507-00			4		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
						- - - * - - -		
-13	385-0060-00			2		SPACER,POST:1.750 INCH LONG,W/6-32 THD	80009	385-0060-00
-14	129-0154-00			2		SPACER,POST:0.25 OD X 1.50 INCH LONG,AL	80009	129-0154-00
						(ATTACHING PARTS)		
	211-0507-00			2		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
						- - - * - - -		
	162-0021-00			FT		INSUL SLVG,ELEC:0.5 ID VINYL,0.250 FEET LONG	80009	162-0021-00
-15	346-0052-00			1		STRAP,RETAINING:TRANSFORMER	80009	346-0052-00
						(ATTACHING PARTS)		
	211-0507-00			2		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
						- - - * - - -		
-16	337-0978-00	B010100	B169999	1		SHIELD,ELEC:HV BOX	80009	337-0978-00
	337-1293-00	B170000		1		SHIELD,ELEC:HV OSCILLATOR	80009	337-1293-00
						(ATTACHING PARTS)		
-17	211-0507-00			3		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
						- - - * - - -		
-18	407-0425-00			1		BRACKET,ANGLE:TRANSISTOR	80009	407-0425-00
						(ATTACHING PARTS)		
-19	211-0507-00			2		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
-20	210-0457-00			2		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		
-21	136-0270-00			3		SOCKET,PLUG-IN:XSTR,2 PIN	22753	03-100-0003
						(ATTACHING PARTS FOR EACH)		
	213-0088-00			2		SCR,TPG,THD CTG:4-24 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-22	131-0235-00			1		TERMINAL,STUD:0.213 DIA X 0.455 INCH L	88245	420977-9
						(ATTACHING PARTS)		
	358-0136-00			1		INSULATOR,BSHG:	88245	420971
						- - - * - - -		
-23	----- -----			3		TRANSISTOR:		
						(ATTACHING PARTS)		
-24	213-0104-00			6		SCR,TPG,THD FOR:6-20 X 0.375 INCH,TRH STL	83385	OBD
-25	386-0143-00			3		INSULATOR,PLATE:0.002 INCH MICA,FOR TO-2	02735	DF31A
						- - - * - - -		
-26	407-0405-00			1		BRACKET,ANGLE:TRANSISTOR	80009	407-0405-00
						(ATTACHING PARTS)		
-27	211-0511-00			4		SCREW,MACHINE:6-32 X 0.50 INCH,PNH STL	83385	OBD
-28	210-0457-00			4		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-29	136-0135-00			1		SOCKET,PLUG-IN:2 PIN	91506	8038-1G8
						(ATTACHING PARTS)		
	213-0113-00			2		SCR,TPG,THD FOR:2-32 X 0.312 INCH,PNH STL	93907	OBD
						- - - * - - -		
-30	136-0135-00			1		SOCKET,PLUG-IN:2 PIN	91506	8038-1G8
						(ATTACHING PARTS)		
	211-0062-00			2		SCREW,MACHINE:2-56 X 0.312 INCH,RDH STL	83385	OBD
						- - - * - - -		
-31	----- -----			1		TRANSISTOR:		
						(ATTACHING PARTS)		
-32	211-0611-00			2		SCREW,MACHINE:6-32 X 0.625 INCH,PNH,BRS	83385	OBD
	386-0786-00			1		INSULATOR,PLATE:XSTR,MICA	80009	386-0786-00
						- - - * - - -		
-33	----- -----			1		TRANSISTOR:		
						(ATTACHING PARTS)		
	211-0510-00			2		SCREW,MACHINE:6-32 X 0.375 INCH,PNH STL	83385	OBD
	386-0786-00			1		INSULATOR,PLATE:XSTR,MICA	80009	386-0786-00
						- - - * - - -		
-34	136-0135-00			1		SOCKET,PLUG-IN:2 PIN	91506	8038-1G8
						(ATTACHING PARTS)		
	211-0112-00			2		SCREW,MACHINE:4-40 X 0.375"100DEG,FLH STL	83385	OBD
	210-0001-00			2		WASHER,LOCK:INTL,0.092 ID X 0.18"OD,STL	78189	1202-00-00-0541C
-35	210-0405-00			2		NUT,PLAIN,HEX.:2-56 X 0.188 INCH,BRS	73743	2X12157-402
						- - - * - - -		
-36	214-0559-00			1		HEAT SINK,XSTR:	98978	OBD
-37	----- -----			1		TRANSISTOR:		
						(ATTACHING PARTS)		
-38	211-0511-00			2		SCREW,MACHINE:6-32 X 0.50 INCH,PNH STL	83385	OBD
						- - - * - - -		
-39	129-0006-00			1		TERMINAL,STUD:INSULATED	00866	1700P
						(ATTACHING PARTS)		
-40	210-0457-00			1		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		
-41	200-0269-00	B010100	B019999	1		SHIELD,RESISTOR:	80009	200-0269-00
	200-0745-00	B020000		1		COVER,VAR RES:0.938 DIA,POLYPROPYLENE	80009	200-0745-00
-42	----- -----			1		RESISTOR,VARIABLE:		
						(ATTACHING PARTS)		
-43	210-0012-00			1		WASHER,LOCK:INTL,0.375 ID X 0.50" OD STL	78189	1220-02-00-0541C
	210-0978-00			1		WASHER,FLAT:0.375 ID X 0.50 INCH OD,STL	78471	OBD
-44	210-0590-00			1		NUT,PLAIN,HEX.:0.375 X 0.438 INCH,STL	73743	2X28269-402
						- - - * - - -		
-45	344-0132-00			8		CLIP,ELECTRICAL:MOLDED PLSTC	80009	344-0132-00
						(ATTACHING PARTS)		
-46	213-0088-00			8		SCR,TPG,THD CTG:4-24 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-47	252-0564-00	B010100	B101229	FT		PLASTIC EXTR:1.563 FT LONG	80009	252-0564-00
	255-0334-00	B101230		FT		PLASTIC CHANNEL:	11897	122-37-2500
-48	385-0012-00	B010100	B079999	1		INS,STANDOFF:0.312 OD X 0.562" L,NYLON	80009	385-0012-00
	384-0519-00	B080000		1		POST,ELEC-MECH:HEX,0.25 X 0.562 INCH	80009	384-0519-00
						(ATTACHING PARTS)		
-49	211-0097-00	B010100	B079999	1		SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
	211-0504-00	B080000		1		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-50	337-0981-00			1		INSULATOR,PLATE:4.2 W X 8.125INCH LONG	80009	337-0981-00
						(ATTACHING PARTS)		
-51	211-0538-00			4		SCREW,MACHINE:6-32 X 0.312"100 DEG,FLH STL	83385	OBD
						- - - * - - -		
-52	407-0406-00			1		BRACKET,CMPNT:	80009	407-0406-00
						(ATTACHING PARTS)		
-53	211-0507-00			2		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
	210-0870-00	XB040000		2		WASHER,FLAT:0.14 ID X 0.312 INCH OD STL	12327	OBD
						- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-54	260-0974-00	B010100	B079999	1		SWITCH,ROTARY:3 SECT,3 POSN,30 DEG	80009	260-0974-00
	260-1014-00	B080000		1		SWITCH,ROTARY:3 SECT,3 POSN,60 DEG	80009	260-1014-00
						(ATTACHING PARTS)		
	210-0012-00	B010100	B010121X	1		WASHER,LOCK:INTL,0.375 ID X 0.50" OD STL	78189	1220-02-00-0541C
	210-0027-00	B010100	B010121X	1		WASHER,LOCK:INTL,0.375 ID X 0.50" OD STL		
	210-0978-00			1		WASHER,FLAT:0.375 ID X 0.50 INCH OD,STL	78471	OBD
-55	210-0590-00			1		NUT,PLAIN,HEX.:0.375 X 0.438 INCH,STL	73743	2X28269-402
						- - - * - - -		
-56	214-1024-01	B010100	B079999	1		ARM,LEVER:	80009	214-1024-01
	214-1084-01	B080000	B203534	1		LEVER,MNL CONT:	80009	214-1084-01
	213-0004-00			1		. SETSCREW:6-32 X 0.188 INCH,HEX SKT STL	74445	OBD
						(ATTACHING PARTS)		
	213-0022-00	B010100	B079999X	1		SETSCREW:4-40 X 0.188 INCH,HEX SKT STL	74445	OBD
						- - - * - - -		
-57	214-0802-00	B010100	B079999X	1		CLEVIS,ROD END:	80009	214-0802-00
						(ATTACHING PARTS)		
	214-0797-00	B010100	B079999X	1		PIN,SPRING:	00287	031-250MDP
	213-0048-00	B010100	B079999X	1		SETSCREW:4-40 X 0.125 INCH,HEX SKT STL	74445	OBD
						- - - * - - -		
	214-0110-00	XB080000	B203534X	1		PIN,HOLLOW:	72962	52-012-062-0250
-58	343-0005-00			1		CLAMP,LOOP:0.438 INCH	95987	7-16-6B
						(ATTACHING PARTS)		
-59	211-0510-00			1		SCREW,MACHINE:6-32 X 0.375 INCH,PNH STL	83385	OBD
	210-0863-00			1		WSHR,LOOP CLAMP:FOR 0.50" WIDE CLAMP,STL	95987	C191
-60	210-0457-00			1		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		
-61	343-0006-00			1		CLAMP,LOOP:0.50 INCH DIAMETER,PLSTC	95987	1-2-6B
						(ATTACHING PARTS)		
-62	211-0510-00			1		SCREW,MACHINE:6-32 X 0.375 INCH,PNH STL	83385	OBD
	210-0863-00			1		WSHR,LOOP CLAMP:FOR 0.50" WIDE CLAMP,STL	95987	C191
	210-0457-00			1		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		
-63	210-0201-00	XB010121		1		TERMINAL,LUG:SE #4	78189	2104-04-00-2520N
						(ATTACHING PARTS)		
	213-0044-00	XB010121		1		SCR,TPG,THD FOR:5-32 X 0.188 INCH,PNH STL	83385	OBD
						- - - * - - -		
-64	348-0031-00			1		GROMMET,PLASTIC:0.156 INCH DIA	80009	348-0031-00
-65	348-0056-00			1		GROMMET,PLASTIC:0.375 INCH DIA	80009	348-0056-00
-66	348-0063-00			1		GROMMET,PLASTIC:0.50 INCH DIA	80009	348-0063-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
3-1	441-0760-00			1		CHAS,ELEC EQPT:DEFL AMPLIFIER	80009	441-0760-00
-2	348-0055-00			1		GROMMET,PLASTIC:0.25 INCH DIA	80009	348-0055-00
-3	348-0063-00			1		GROMMET,PLASTIC:0.50 INCH DIA	80009	348-0063-00
-4	348-0056-00			4		GROMMET,PLASTIC:0.375 INCH DIA	80009	348-0056-00
-5	385-0012-00			1		INS,STANDOFF:0.312 OD X 0.562" L,NYLON	80009	385-0012-00
						(ATTACHING PARTS)		
-6	211-0097-00			1		SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
						- - - * - - -		
-7	----- -----			2		RESISTOR,VARIABLE:		
						(ATTACHING PARTS)		
-8	210-0978-00			2		WASHER,FLAT:0.375 ID X 0.50 INCH OD,STL	78471	OBD
-9	210-0590-00			2		NUT,PLAIN,HEX.:0.375 X 0.438 INCH,STL	73743	2X28269-402
						- - - * - - -		
-10	260-0450-00			2		SWITCH,SLIDE:3 POS,DOUBLE POLE	82389	11D-1007
						(ATTACHING PARTS)		
	211-0008-00			4		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-11	210-0406-00			4		NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
						- - - * - - -		
-12	210-0201-00			1		TERMINAL,LUG:SE #4	78189	2104-04-00-2520N
						(ATTACHING PARTS)		
	213-0044-00			1		SCR,TPG,THD FOR:5-32 X 0.188 INCH,PNH STL	83385	OBD
						- - - * - - -		
-13	136-0270-00			4		SOCKET,PLUG-IN:XSTR,2 PIN	22753	03-100-0003
						(ATTACHING PARTS)		
-14	213-0088-00			8		SCR,TPG,THD CTG:4-24 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-15	136-0135-00			2		SOCKET,PLUG-IN:2 PIN	91506	8038-1G8
						(ATTACHING PARTS)		
-16	211-0112-00			4		SCREW,MACHINE:4-40 X 0.375"100DEG,FLH STL	83385	OBD
	210-0001-00			4		WASHER,LOCK:INTL,0.092 ID X 0.18"OD,STL	78189	1202-00-00-0541C
-17	210-0405-00			4		NUT,PLAIN,HEX.:2-56 X 0.188 INCH,BRS	73743	2X12157-402
						- - - * - - -		
-18	----- -----			2		TRANSISTOR:		
						(ATTACHING PARTS)		
-19	213-0104-00			4		SCR,TPG,THD FOR:6-20 X 0.375 INCH,TRH STL	83385	OBD
-20	386-0143-00			2		INSULATOR,PLATE:0.002 INCH MICA,FOR TO-2	02735	DF31A
						- - - * - - -		
-21	214-0559-00			2		HEAT SINK,XSTR:	98978	OBD
-22	----- -----			2		TRANSISTOR:		
						(ATTACHING PARTS)		
-23	211-0511-00			4		SCREW,MACHINE:6-32 X 0.50 INCH,PNH STL	83385	OBD
						- - - * - - -		
-24	344-0132-00			8		CLIP,ELECTRICAL:MOLDED PLSTC	80009	344-0132-00
						(ATTACHING PARTS)		
-25	213-0088-00			8		SCR,TPG,THD CTG:4-24 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-26	344-0131-00			8		CLIP,SPG TENS:CIRCUIT CARD MOUNTING	80009	344-0131-00
						(ATTACHING PARTS)		
-27	213-0088-00			8		SCR,TPG,THD CTG:4-24 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-28	348-0051-00			1		GROMMET,RUBBER:0.938 INCH DIA	83907	1107
-29	----- -----			1		TRANSISTOR:		
						(ATTACHING PARTS)		
-30	211-0012-00			2		SCREW,MACHINE:4-40 X 0.375 INCH,PNH STL	83385	OBD
-31	386-1094-00			1		INSULATOR,PLATE:	02735	DF63A
	210-0849-00			2		WSHR,SHOULDERED:0.11 ID X 0.188"OD,FIBER	83330	2151
	210-0994-00			2		WASHER,FLAT:0.125 ID X 0.25" OD,STL	86928	5714-147-20N
-32	210-0586-00			2		NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	211-041800-00
						- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
3-33	----- -----			1		RESISTOR:		
						(ATTACHING PARTS)		
-34	211-0544-00			1		SCREW,MACHINE:6-32 X 0.750,TRH STL	83385	OBD
-35	210-0478-00			1		INSERT,SCR THD:0.66" L,W/HEX FLG ONE END	80009	210-0478-00
	210-0202-00			1		TERMINAL,LUG:SE #6	78189	2104-06-00-2520N
-36	211-0507-00			1		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
						- - - * - - -		
-37	----- -----			1		RESISTOR:		
						(ATTACHING PARTS)		
-38	211-0544-00			1		SCREW,MACHINE:6-32 X 0.750,TRH STL	83385	OBD
-39	210-0478-00			1		INSERT,SCR THD:0.66" L,W/HEX FLG ONE END	80009	210-0478-00
-40	211-0507-00			1		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
						- - - * - - -		
-41	129-0143-00			1		INSULATOR,STDF:0.312 OD X 0.406" L,NYLON	80009	129-0143-00
						(ATTACHING PARTS)		
-42	211-0097-00	B010100	B203349	1		SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
	211-0008-00	B203350		1		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-43	----- -----			4		TRANSISTOR:		
						(ATTACHING PARTS)		
-44	213-0104-00			4		SCR,TPG,THD FOR:6-20 X 0.375 INCH,TRH STL	83385	OBD
-45	386-0143-00			4		INSULATOR,PLATE:0.002 INCH MICA,FOR TO-2	02735	DF31A
						- - - * - - -		
-46	200-0669-00			4		COV,TRANSISTOR:INSULATING	80009	200-0669-00
						(ATTACHING PARTS)		
-47	213-0183-00			4		SCR,TPG,THD FOR:6-32 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-48	441-0758-00			1		CHAS,ELEC EQPT:STORAGE	80009	441-0758-00
-49	214-0329-00			1		. THUMBSCREW:6-32 X 0.656 INCH,W/STANDOFF	94222	51-18-406-24
						(ATTACHING PARTS)		
-50	212-0008-00			1		SCREW,MACHINE:8-32 X 0.500 INCH,PNH STL	83385	OBD
	348-0067-00			2		GROMMET,PLASTIC:0.312 INCH DIA	80009	348-0067-00
-51	361-0170-00			1		SPACER,SLEEVE:0.250 OD X 0.932 INCH LONG,AL	80009	361-0170-00
-52	361-0169-00			1		SPACER,SLEEVE:0.25 OD X 0.680 INCH LONG,AL	80009	361-0169-00
	212-0020-00			1		SCREW,MACHINE:8-32 X 1.0 INCH,PNH STL	93907	OBD
						- - - * - - -		
-53	129-0138-00			1		SPACER,POST:0.375 SQ X 7.268 INCH LONG,AL	80009	129-0138-00
						(ATTACHING PARTS)		
-54	211-0507-00			2		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
-55	210-0202-00			1		TERMINAL,LUG:SE #6	78189	2104-06-00-2520N
						- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
4-1	441-0759-00			1		CHAS,ELEC EQPT:LV POWER SPLY	80009	441-0759-00
-2	344-0132-00			7		CLIP,ELECTRICAL:MOLDED PLSTC	80009	344-0132-00
						(ATTACHING PARTS)		
-3	213-0088-00			7		SCR,TPG,THD CTG:4-24 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-4	348-0063-00			2		GROMMET,PLASTIC:0.50 INCH DIA	80009	348-0063-00
-5	358-0166-00			1		GROMMET,PLASTIC:BLACK	80009	358-0166-00
-6	348-0056-00			1		GROMMET,PLASTIC:0.375 INCH DIA	80009	348-0056-00
	210-0204-00			2		TERMINAL,LUG:0.146 INCH DIA DE,45 DEG BEND	78189	2157-06-01-2520N
-7	210-0202-00			3		TERMINAL,LUG:SE #6	78189	2104-06-00-2520N
						(ATTACHING PARTS)		
-8	213-0088-00			1		SCR,TPG,THD CTG:4-24 X 0.25 INCH,PNH STL	83385	OBD
-9	210-0407-00			2		NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
						- - - * - - -		
-10	343-0088-00			1		CLAMP,LOOP:0.062 INCH DIA	80009	343-0088-00
-11	200-0260-00			1		SHLD,CAPACITOR:1.402 OD X 2.09 INCH LONG	80009	200-0260-00
-12	200-0293-00			1		SHLD,CAPACITOR:2.563 INCHES LONG	80009	200-0293-00
-13	----- -----			1		CAPACITOR:		
						(ATTACHING PARTS)		
-14	211-0534-00			2		SCR,ASSEM,WSHR:6-32 X 0.312 INCH,PNH STL	83385	OBD
-15	386-0254-00			1		RETAINER,CAP.:	98627	OBD
	210-0457-00			2		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		
-16	----- -----			1		CAPACITOR:		
						(ATTACHING PARTS)		
-17	211-0534-00			2		SCR,ASSEM,WSHR:6-32 X 0.312 INCH,PNH STL	83385	OBD
-18	386-0155-00			1		PANEL,REAR:	80009	386-0155-00
	210-0457-00			2		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		
-19	----- -----			1		SWITCH,THERMAL CUTOUT:		
						(ATTACHING PARTS)		
-20	213-0044-00			2		SCR,TPG,THD FOR:5-32 X 0.188 INCH,PNH STL	83385	OBD
						- - - * - - -		
-21	----- -----			1		CAPACITOR:		
						(ATTACHING PARTS)		
-22	211-0588-00			2		SCREW,MACHINE:6-32 X 0.75 INCH,HEX.HD STL	83385	OBD
-23	432-0048-00	B010100	B227319	1		BASE,CAP.MTG:	80009	432-0048-00
	432-0048-03	B227320		1		BASE,CAP.MTG:2.375 H,PLASTIC	80009	432-0048-03
-24	386-0254-00			1		RETAINER,CAP.:	98627	OBD
-25	210-0457-00			2		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		
-26	385-0012-00			1		INS,STANDOFF:0.312 OD X 0.562" L,NYLON	80009	385-0012-00
						(ATTACHING PARTS)		
-27	211-0097-00			1		SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
						- - - * - - -		
-28	----- -----			2		CAPACITOR:		
						(ATTACHING PARTS)		
-29	343-0151-00			2		CLAMP,LOOP:	80009	343-0151-00
-30	211-0507-00			6		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
-31	210-0803-00			6		WASHER,FLAT:0.15 ID X 0.375 INCH OD,STL	12327	OBD
	210-0457-00	B010100	B159999	6		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
	210-0457-00	B160000		5		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
-32	385-0080-00	XB160000		1		POST,ELEC-MECH:	80009	385-0080-00
						- - - * - - -		
-33	129-0006-00	XB160000		1		TERMINAL,STUD:INSULATED	00866	1700P
-34	210-0206-00			6		TERMINAL,LUG:SE #10	86928	A373-147-1
-35	----- -----			1		TRANSFORMER:		
-36	212-0516-00			4		. SCREW,MACHINE:10-32 X 2 INCH,HEX HD STL	77250	OBD
-37	210-0813-00			4		. WSHR,SHOULDERED:# 10 FIBER	74921	OBD
						(ATTACHING PARTS FOR TRANS)		
-38	220-0410-00			4		NUT,EXTENDED WA:10-32 X 0.375 INCH,STL	83385	OBD
						- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
4-39	352-0025-00			1		FUSEHOLDER:	75915	357002
						(ATTACHING PARTS)		
-40	211-0507-00			2		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
						- - - * - - -		
-41	426-0401-01			1		FRAME PNL,CAB.:BACK	80009	426-0401-01
						(ATTACHING PARTS)		
	212-0023-00			7		SCREW,MACHINE:8-32 X 0.375 INCH,PNH STL	83385	OBD
	212-0040-00			1		SCREW,MACHINE:8-32 X 0.375 100 DEG,FLH STL	83385	OBD
						- - - * - - -		
-42	351-0046-00			2		CLIP,SPG TENS:FAN	82877	OBD
						(ATTACHING PARTS FOR EACH)		
-43	211-0559-00			2		SCREW,MACHINE:6-32 X 0.375"100 DEG,FLH STL	83385	OBD
						- - - * - - -		
-44	119-0147-00			1		FAN,AXIAL:115V,50-60HZ,14W	82877	028021
-45	214-0762-00			1		GRILLE,METAL:ZINC PLATED STL	82877	20132-2
						(ATTACHING PARTS)		
-46	211-0511-00			4		SCREW,MACHINE:6-32 X 0.50 INCH,PNH STL	83385	OBD
-47	210-0457-00			4		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		
-48	378-0037-01			1		FIL ELEM,AIR CO:5.50 X 6.125 INCH,FOAM	80009	378-0037-01
-49	----- -----			1		LINE FILTER:		
						(ATTACHING PARTS)		
-50	211-0507-00			2		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
						- - - * - - -		
-51	333-1037-01			1		PANEL,FRONT:	80009	333-1037-01
						(ATTACHING PARTS)		
-52	211-0542-00			6		SCREW,MACHINE:6-32 X 0.312 INCH,TRH STL	83385	OBD
						- - - * - - -		
-53	358-0323-00			1		BSHG,STRAIN RLF:90 DEG,0.515 DIA HOLE	28520	SR15-1
-54	161-0033-00	B010100	B209999	1		CABLE ASSY,PWR,:POWER	80009	161-0033-00
	161-0033-07	B210000		1		CABLE ASSY,PWR,:3 WIRE,92 INCH LONG	80009	161-0033-07
-55	407-0322-00			2		BRACKET,PWR CA:	80009	407-0322-00
						(ATTACHING PARTS)		
-56	211-0012-00			2		SCREW,MACHINE:4-40 X 0.375 INCH,PNH STL	83385	OBD
-57	210-0586-00			2		NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	211-041800-00
						- - - * - - -		
-58	131-0569-00			1		CONNECTOR,RCPT,:25 PIN,FEMALE	71468	DB25S
						(ATTACHING PARTS)		
-59	211-0101-00			2		SCREW,MACHINE:4-40 X 0.25" 100 DEG,FLH STL	83385	OBD
	210-0004-00			2		WASHER,LOCK:INTL,0.12 ID X 0.26"OD,STL	78189	1204-00-00-0541C
-60	210-0406-00			2		NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
						- - - * - - -		
-61	131-0274-00			3		CONNECTOR,RCPT,:BNC	91836	KC79-67
-62	386-1312-00			1		PANEL,REAR:	80009	386-1312-00
						(ATTACHING PARTS)		
-63	211-0537-00			4		SCREW,MACHINE:6-32 X 0.375 INCH,TRH STL	83385	OBD
						- - - * - - -		
-64	204-0279-00			1		BODY ASSY,LINE:115/230 VOLTS	80009	204-0279-00
						(ATTACHING PARTS)		
	210-0006-00			2		WASHER,LOCK:INTL,0.146 IDX 0.288 OD,STL	78189	1206-00-00-0541C
-65	210-0407-00			2		NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
						- - - * - - -		
-66	200-0762-00			1		COV ASSY,LINE V:WITH FUSEHOLDER,115/230V	80009	200-0762-00
-67	352-0102-00			2		. FUSEHOLDER:0.262"ID TUBE FOR CRTG FUSE	80009	352-0102-00
						(ATTACHING PARTS)		
-68	213-0141-00			8		. SCR,TPG,THD FOR:4-40 X 0.25 INCH,PNH	93907	OBD
						- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
5-1	670-0559-00	B010100	B039999	1		CKT BOARD ASSY:DEFLECTION AMPLIFIER	80009	670-0559-00
	670-0559-01	B040000	B179999	1		CKT BOARD ASSY:DEFLECTION AMPLIFIER	80009	670-0559-01
	670-0559-02	B180000	B199999	1		CKT BOARD ASSY:DEFLECTION AMPLIFIER	80009	670-0559-02
	670-0559-03	B200000		1		CKT BOARD ASSY:DEFLECTION AMPLIFIER	80009	670-0559-03
	136-0218-00	XB040000	B109999X	2		. SOCKET,PLUG-IN:3 PIN	71785	133-23-11-036
	354-0285-00	XB040000	B109999X	2		. RET.,SEMICOND:	80009	354-0285-00
	407-0577-00	XB040000	B109999X	1		. BRACKET,ANGLE:	80009	407-0577-00
-2	131-0633-00			48		. CONTACT,ELEC:0.385 INCH LONG	80009	131-0633-00
-3	214-0579-00			4		. TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
-4	214-0973-00			4		. HEAT SINK,ELEC:0.28 X 0.18 OVAL X 0.187"H	80009	214-0973-00
-5	136-0183-00	B010100	B227149	6		. SOCKET,PLUG-IN:3 PIN,ROUND	80009	136-0183-00
-6	136-0220-00	B010100	B109999	8		. SOCKET,PLUG-IN:3 PIN,SQUARE	71785	133-23-11-034
	136-0220-00	B110000	B227149X	10		. SOCKET,PLUG-IN:3 PIN,SQUARE	71785	133-23-11-034
-7	136-0235-00	B010100	B227149X	6		. SOCKET,PLUG-IN:6 CONTACT,ROUND	71785	133-96-12-062
-8	136-0237-00	B010100	B227149X	2		. SOCKET,PLUG-IN:8 CONTACT,ROUND	71785	133-98-12-062
-9	136-0234-00			2		. SOCKET,PIN TERM:0.088 OD X 0.247 INCH L	00779	380598-1
-10	----- -----			1		. TRANSISTOR:		
						(ATTACHING PARTS)		
-11	211-0511-00	B010100	B129999	2		. SCREW,MACHINE:6-32 X 0.50 INCH,PNH STL	83385	OBD
	220-0435-00	B010100	B129999	2		. NUT,PRESSMOUNT:6-32 X 0.250 HEX X 0.189"L	46384	S0-632-6CC
	355-0108-00	B130000	B199999	2		. TERMINAL,STUD:0.156 HEX X 0.50 INCH L,BRS	80009	355-0108-00
	355-0159-00	B200000		2		. TERMINAL,STUD:0.156 HEX X 0.58 INCH L,BRS	80009	355-0159-00
-12	210-0457-00	B010100	B129999	2		. NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
	210-0586-00	B130000		2		. NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	211-041800-00
						(ATTACHING PARTS FOR CKT BD ASSY)		
	211-0116-00			1		SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
						- - - * - - -		
-13	670-0560-00	B010100	B149999	1		CKT BOARD ASSY:STORAGE	80009	670-0560-00
	670-1257-00	B150000	B172469	1		CKT BOARD ASSY:STORAGE	80009	670-1257-00
	670-1257-01	B172470	B190000	1		CKT BOARD ASSY:STORAGE	80009	670-1257-01
	670-1257-02	B200000	B219999	1		CKT BOARD ASSY:STORAGE	80009	670-1257-02
	670-1257-03	B220000		1		CKT BOARD ASSY:STORAGE	80009	670-1257-03
	361-0007-00	XB150000		1		. SPACER,SLEEVE:0.250 INCH DIA,PLASTIC	80009	361-0007-00
	426-0121-00	XB150000		1		. MT,XMFR,TOROID:	80009	426-0121-00
-14	131-0633-00	XB150000		55		. CONTACT,ELEC:0.385 INCH LONG	80009	131-0633-00
-15	344-0119-00			3		. CLIP,ELECTRICAL:SEMICOND DEVICE	80009	344-0119-00
-16	136-0220-00	B010100	B149999	15		. SOCKET,PLUG-IN:3 PIN,SQUARE	71785	133-23-11-034
	136-0220-00	B150000	B227149X	21		. SOCKET,PLUG-IN:3 PIN,SQUARE	71785	133-23-11-034
-17	136-0234-00	B010100	B227149X	6		. SOCKET,PIN TERM:0.088 OD X 0.247 INCH L	00779	380598-1
-18	----- -----			3		. TRANSISTOR:		
						(ATTACHING PARTS)		
-19	211-0511-00	B010100	B129999	6		. SCREW,MACHINE:6-32 X 0.50 INCH,PNH STL	83385	OBD
	220-0435-00	B010100	B129999	6		. NUT,PRESSMOUNT:6-32 X 0.250 HEX X 0.189"L	46384	S0-632-6CC
	355-0108-00	B130000	B199999	6		. TERMINAL,STUD:0.156 HEX X 0.50 INCH L,BRS	80009	355-0108-00
	355-0159-00	B200000		6		. TERMINAL,STUD:0.156 HEX X 0.58 INCH L,BRS	80009	355-0159-00
-20	210-0457-00	B010100	B129999	6		. NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
	210-0586-00	B130000		12		. NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	211-041800-00
						- - - * - - -		
-21	----- -----			2		. RESISTOR,VARIABLE:		
						(ATTACHING PARTS)		
	210-0840-00			2		. WASHER,FLAT:0.39 ID X 0.562 INCH OD,STL	89663	644R
-22	210-0413-00			2		. NUT,PLAIN,HEX.:0.375-32 X 0.50 INCH,STL	73743	3145-402
						(ATTACHING PARTS FOR CKT BD ASSY)		
	211-0116-00			1		SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
						- - - * - - -		
-23	670-0561-00	B010100	B039999	1		CKT BOARD ASSY:HIGH VOLTAGE AND Z AXIS	80009	670-0561-00
	670-0561-00	B040000	B149999	1		CKT BOARD ASSY:HIGH VOLTAGE AND Z AXIS	80009	670-0561-00
	670-0837-01	B150000	B169999	1		CKT BOARD ASSY:HIGH VOLTAGE AND Z AXIS	80009	670-0837-01
	670-0837-02	B170000	B189999	1		CKT BOARD ASSY:HIGH VOLTAGE AND Z AXIS	80009	670-0837-02
	670-0837-03	B190000	B199999	1		CKT BOARD ASSY:HIGH VOLTAGE AND Z AXIS	80009	670-0837-03
	670-0837-05	B200000	B209999	1		CKT BOARD ASSY:HIGH VOLTAGE AND Z AXIS	80009	670-0837-05
	670-0837-07	B210000	B226524	1		CKT BOARD ASSY:HIGH VOLTAGE AND Z AXIS	80009	670-0837-07
	670-0837-10	B226525		1		CKT BOARD ASSY:HIGH VOLTAGE AND Z AXIS	80009	670-0837-10

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
5-	136-0274-00	XB101080	B149999	1		. SKT,PL-IN ELEK:	80009	136-0274-00
	136-0368-00	B150000		1		. SKT,PL-IN ELEK:	80009	136-0368-00
	136-0278-00			1		. . SOCKET,PLUG-IN:WITH PINS	80009	136-0278-00
	204-0322-00			1		. . . BODY,CRT SOCKET:	80009	204-0322-00
	214-0464-00			7		. . . CONTACT,ELEC:CRT	80009	214-0464-00
	200-0801-00			1		. . COVER,SOCKET,PL:ELECTRON TUBE,PLASTIC	80009	200-0801-00
-24	131-0633-00	XB150000		29		. CONTACT,ELEC:0.385 INCH LONG	80009	131-0633-00
-25	214-0579-00			2		. TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
-26	136-0183-00	B010100	B149999	3		. SOCKET,PLUG-IN:3 PIN,ROUND	80009	136-0183-00
	136-0183-00	B150000	B227149X	4		. SOCKET,PLUG-IN:3 PIN,ROUND	80009	136-0183-00
-27	136-0220-00	B010100	B149999	4		. SOCKET,PLUG-IN:3 PIN,SQUARE	71785	133-23-11-034
	136-0220-00	B150000	B227149X	8		. SOCKET,PLUG-IN:3 PIN,SQUARE	71785	133-23-11-034
-28	136-0237-00	B010100	B227149X	1		. SOCKET,PLUG-IN:8 CONTACT,ROUND	71785	133-98-12-062
-29	352-0066-00			2		. RETAINER,CAP.:	80009	352-0066-00
						(ATTACHING PARTS)		
-30	361-0007-00			4		. SPACER,SLEEVE:0.250 INCH DIA,PLASTIC	80009	361-0007-00
						- - - * - - -		
-31	352-0086-00	B010100	B209999X	1		. HOLDER,TOROID:0.50 INCH DIA	80009	352-0086-00
-32	343-0043-00			3		. CLAMP,LOOP:#20,NEON BULBS	80009	343-0043-00
-33	----- -----			1		. RESISTOR,VARIABLE:		
						(ATTACHING PARTS)		
-34	210-0840-00			1		. WASHER,FLAT:0.39 ID X 0.562 INCH OD,STL	89663	644R
-35	210-0413-00			1		. NUT,PLAIN,HEX.:0.375-32 X 0.50 INCH,STL	73743	3145-402
						(ATTACHING PARTS FOR CKT BD ASSY)		
	211-0116-00	B010100	B079999	1		SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
	211-0601-00	B080000		1		SCR,ASSEM WSHR:6-32 X 0.312 INCH,PNH BRS	80009	211-0601-00
	210-0228-00	XB080000		1		TERMINAL,LUG:0.176 ID X 0.312"OD,SE	78189	2103-08-00-2520N
						- - - * - - -		
-36	670-0562-00			1		CKT BOARD ASSY:LOW VOLTAGE	80009	670-0562-00
-37	131-0633-00			55		. CONTACT,ELEC:0.385 INCH LONG	80009	131-0633-00
-38	136-0183-00	B010100	B227149X	1		. SOCKET,PLUG-IN:3 PIN,ROUND	80009	136-0183-00
-39	136-0220-00	B010100	B227149X	5		. SOCKET,PLUG-IN:3 PIN,SQUARE	71785	133-23-11-034
-40	136-0237-00	B010100	B227149X	1		. SOCKET,PLUG-IN:8 CONTACT,ROUND	71785	133-98-12-062
-41	136-0234-00	B010100	B227149X	4		. SOCKET,PIN TERM:0.088 OD X 0.247 INCH L	00779	380598-1
-42	----- -----			2		. TRANSISTOR:		
						(ATTACHING PARTS)		
-43	211-0511-00	B010100	B129999	4		. SCREW,MACHINE:6-32 X 0.50 INCH,PNH STL	83385	OBD
-44	220-0435-00	B010100	B129999	4		. NUT,PRESSMOUNT:6-32 X 0.250 HEX X 0.189"L	46384	SO-632-6CC
	355-0108-00	B130000	B199999	4		. TERMINAL,STUD:0.156 HEX X 0.50 INCH L,BRS	80009	355-0108-00
	355-0159-00	B200000		4		. TERMINAL,STUD:0.156 HEX X 0.58 INCH L,BRS	80009	355-0159-00
-45	210-0457-00	B010100	B129999	4		. NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
	210-0586-00	B130000		8		. NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	211-041800-00
						(ATTACHING PARTS FOR CKT BD ASSY)		
	211-0116-00			1		SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
						- - - * - - -		
-46	670-0563-00			1		CKT BOARD ASSY:X-Y INPUT ATTENUATOR	80009	670-0563-00
-47	131-0633-00			12		. CONTACT,ELEC:0.385 INCH LONG	80009	131-0633-00
-48	337-0763-00			1		. SHIELD,ELEC:	80009	337-0763-00
						(ATTACHING PARTS FOR CKT BD ASSY)		
	211-0116-00			3		SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
						- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
6-1	124-0089-00	B010100	B149999	1		TERMINAL BOARD:7 NOTCH,CERAMIC,CLIP MTD	80009	124-0089-00
	124-0090-00	B150000	B209999	1		TERMINAL BOARD:9 NOTCH,CERAMIC,CLIP MTD	80009	124-0090-00
	124-0095-00	B210000		1		TERMINAL BOARD:5 NOTCH,CERAMIC,CLIP MTD	80009	124-0095-00
	355-0046-00	B010100	B209999	2		. MOUNT,TERM. BD:0.577 INCH H	80009	355-0046-00
	355-0158-00	B210000		2		. STUD,TERM BD:	80009	355-0158-00
						(ATTACHING PARTS)		
	361-0007-00	B010100	B209999	4		. SPACER,SLEEVE:0.250 INCH DIA,PLASTIC	80009	361-0007-00
	361-0039-00	B210000		4		. SPACER,SLEEVE:	80009	361-0039-00
						- - - * - - -		
-2	124-0091-00	B010100	B209999	3		TERMINAL BOARD:11 NOTCH,CERAMIC,CLIP MTD	80009	124-0091-00
	124-0106-00	B210000		3		TERMINAL BOARD:11 NOTCH,CERAMIC,CLIP MTD	80009	124-0106-00
	355-0082-00	B010100	B209999	2		. MOUNT,TERM BD:	80009	355-0082-00
	355-0158-00	B210000		2		. STUD,TERM BD:	80009	355-0158-00
						(ATTACHING PARTS)		
	361-0009-00	B010100	B209999	2		SPACER,SLEEVE:0.11 ID X 0.25 OD X 0.41 H	80009	361-0009-00
	361-0392-00	B210000		2		SPACER,SLEEVE:0.12 ID X 0.25 OD X 0.718	80009	361-0392-00
						- - - * - - -		
-3	179-1235-00	B010100	B149999	1		WIRING HARNESS,:STORAGE 1	80009	179-1235-00
	179-1235-01	B150000	B179999	1		WIRING HARNESS,:STORAGE 2	80009	179-1235-01
	179-1572-00	B180000		1		WIRING HARNESS,:STORAGE	80009	179-1572-00
	131-0371-00			38		. CONTACT,ELEC:FOR NO.26 AWG WIRE	98278	122-0182-019
-4	179-1236-00	B010100	B149999	1		WIRING HARNESS,:STORAGE 2	80009	179-1236-00
	179-1236-01	B150000		1		WIRING HARNESS,:STORAGE 2	80009	179-1236-01
	131-0371-00			8		. CONTACT,ELEC:FOR NO.26 AWG WIRE	98278	122-0182-019
-5	179-1237-00	B010100	B199999	1		WIRING HARNESS,:LINE VOLTAGE SELECTOR	80009	179-1237-00
	179-1237-01	B200000		1		WIRING HARNESS:LINE VOLTAGE SELECTOR	80009	179-1237-01
-6	179-1239-00	B010100	B159999	1		WIRING HARNESS,:POWER	80009	179-1239-00
	179-1239-01	B160000		1		WIRING HARNESS,:POWER	80009	179-1239-01
	131-0371-00			57		. CONTACT,ELEC:FOR NO.26 AWG WIRE	98278	122-0182-019
-7	179-1230-00	B010100	B019999X	1		WIRING HARNESS,:HV NO 1	80009	179-1230-00
-8	179-1229-00	B010100	B019999X	1		WIRING HARNESS,:HV NO 2	80009	179-1229-00
-9	179-1234-00	B010100	B149999	1		WIRING HARNESS,:COAX	80009	179-1234-00
	179-1234-01	B150000	B179999	1		WIRING HARNESS,:COAX	80009	179-1234-01
	179-1234-02	B180000		1		WIRING HARNESS,:STORAGE	80009	179-1234-02
	131-0371-00			13		. CONTACT,ELEC:FOR NO.26 AWG WIRE	98278	122-0182-019
-10	179-1238-00			1		WIRING HARNESS,:VERT/HORIZ AMPLIFIER	80009	179-1238-00
	131-0371-00			24		. CONTACT,ELEC:FOR NO.26 AWG WIRE	98278	122-0182-019
	179-1231-00			1		WIRING HARNESS,:POT	80009	179-1231-00
	131-0371-00			7		. CONTACT,ELEC:FOR NO.26 AWG WIRE	98278	122-0182-019
						- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
7-1	390-0021-00			1		COVER,SCOPE:LEFT SIDE	80009	390-0021-00
-2	355-0125-00			2		. STUD,TURNLOCK:	94222	OBD
-3	210-1058-00			2		. WASHER,FLAT:0.125 ID X 0.438 INCH OD	80009	210-1058-00
-4	426-0394-00			1		FRAME SECT,CAB.:TOP CORNER	80009	426-0394-00
						(ATTACHING PARTS)		
-5	212-0040-00			7		SCREW,MACHINE:8-32 X 0.375 100 DEG,FLH STL	83385	OBD
	210-0458-00			3		NUT,PLAIN,EXT W:8-32 X 0.344 INCH,STL	83385	OBD
						- - - * - - -		
-6	426-0396-00			1		FRAME SECT,CAB.:LOWER LEFT	80009	426-0396-00
						(ATTACHING PARTS)		
-7	212-0040-00			6		SCREW,MACHINE:8-32 X 0.375 100 DEG,FLH STL	83385	OBD
-8	212-0043-00			3		SCREW,MACHINE:8-32 X 0.500 INCH,FLH STL	83385	OBD
						- - - * - - -		
-9	348-0137-00			4		FOOT,CABINET:1.25 INCH LONG	80009	348-0137-00
						(ATTACHING PARTS)		
-10	211-0513-00			2		SCREW,MACHINE:6-32 X 0.625 INCH,PNH STL	83385	OBD
-11	210-0457-00			2		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		
-12	390-0023-00	B010100	B119999	1		COVER,SCOPE:BOTTOM	80009	390-0023-00
	390-0023-01	B120000		1		COVER,SCOPE:BOTTOM	80009	390-0023-01
	214-0361-00	B010100	B119999	4		. CLAMP,RIM CLENC:	80009	214-0361-00
-13	214-0400-00			1		. . PIN,STR,HEADED:	80009	214-0400-00
-14	358-0218-00			1		. . BUSHING,PLASTIC:	80009	358-0218-00
-15	387-0871-00			1		. . STOP,CLP,RIM CL:	80009	387-0871-00
-16	387-0804-00			1		. . CLAMP,RIM CLENC:	80009	387-0804-00
-17	220-0486-00			1		. . NUT,SHEET SPR:	80009	220-0486-00
	214-0816-00	B120000		4		. LATCH ASSEMBLY:	80009	214-0816-00
	214-0603-01			1		. . PIN,SECURING:0.27 INCH LONG	80009	214-0603-01
	214-0604-00			1		. . WASH.,SPG TNSN:0.26 ID X 0.47 INCH OD	80009	214-0604-00
	386-0227-00			1		. . PL,LATCH INDEX:	80009	386-0227-00
	386-1151-00			1		. . PLATE,LATCH LKG:	80009	386-1151-00
-18	426-0393-00			1		FRAME SECT,CAB.:TOP CENTER	80009	426-0393-00
						(ATTACHING PARTS)		
-19	211-0559-00			4		SCREW,MACHINE:6-32 X 0.375"100 DEG,FLH STL	83385	OBD
-20	211-0510-00			4		SCREW,MACHINE:6-32 X 0.375 INCH,PNH STL	83385	OBD
	210-0457-00			4		NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
						- - - * - - -		
-21	426-0395-00			1		FRAME SECT,CAB.:RIGHT LOWER	80009	426-0395-00
						(ATTACHING PARTS)		
-22	212-0040-00			4		SCREW,MACHINE:8-32 X 0.375 100 DEG,FLH STL	83385	OBD
-23	212-0043-00			5		SCREW,MACHINE:8-32 X 0.500 INCH,FLH STL	83385	OBD
						- - - * - - -		
-24	390-0022-00			1		COVER,SCOPE:RIGHT SIDE	80009	390-0022-00
-25	355-0125-00			2		. STUD,TURNLOCK:	94222	OBD
-26	210-1058-00			2		. WASHER,FLAT:0.125 ID X 0.438 INCH OD	80009	210-1058-00

SECTION 8

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols and Reference Designators

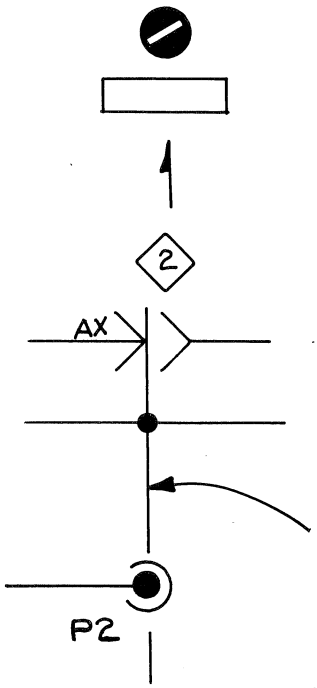
Electrical components shown on the diagrams are in the following units unless noted otherwise:

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 comply with USA Standard Y32.2-1970.

Logic symbology complies with ANSI Y32.14-1973 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:



Screwdriver adjustment

Front panel control or connector

Clockwise control rotation in direction of arrow

Refer to indicated diagram

Connection to circuit board made with pin connector at indicated pin

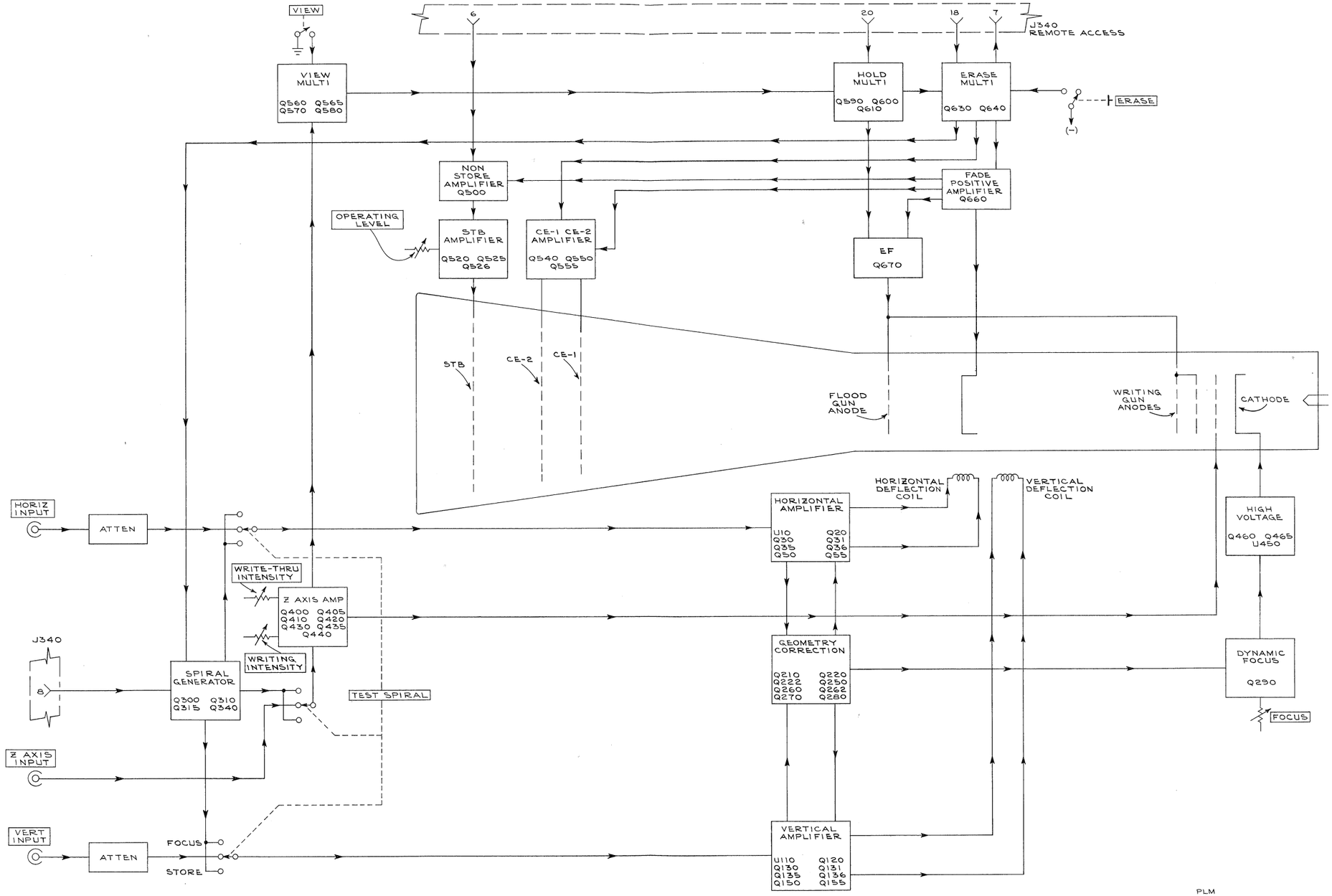
Connector soldered to circuit board

Blue line encloses components located on circuit board

Indicates coaxial connector

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



PLM
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TYPE 611 DISPLAY DEVICE

BLOCK DIAGRAM

REV. B, JAN. 1976

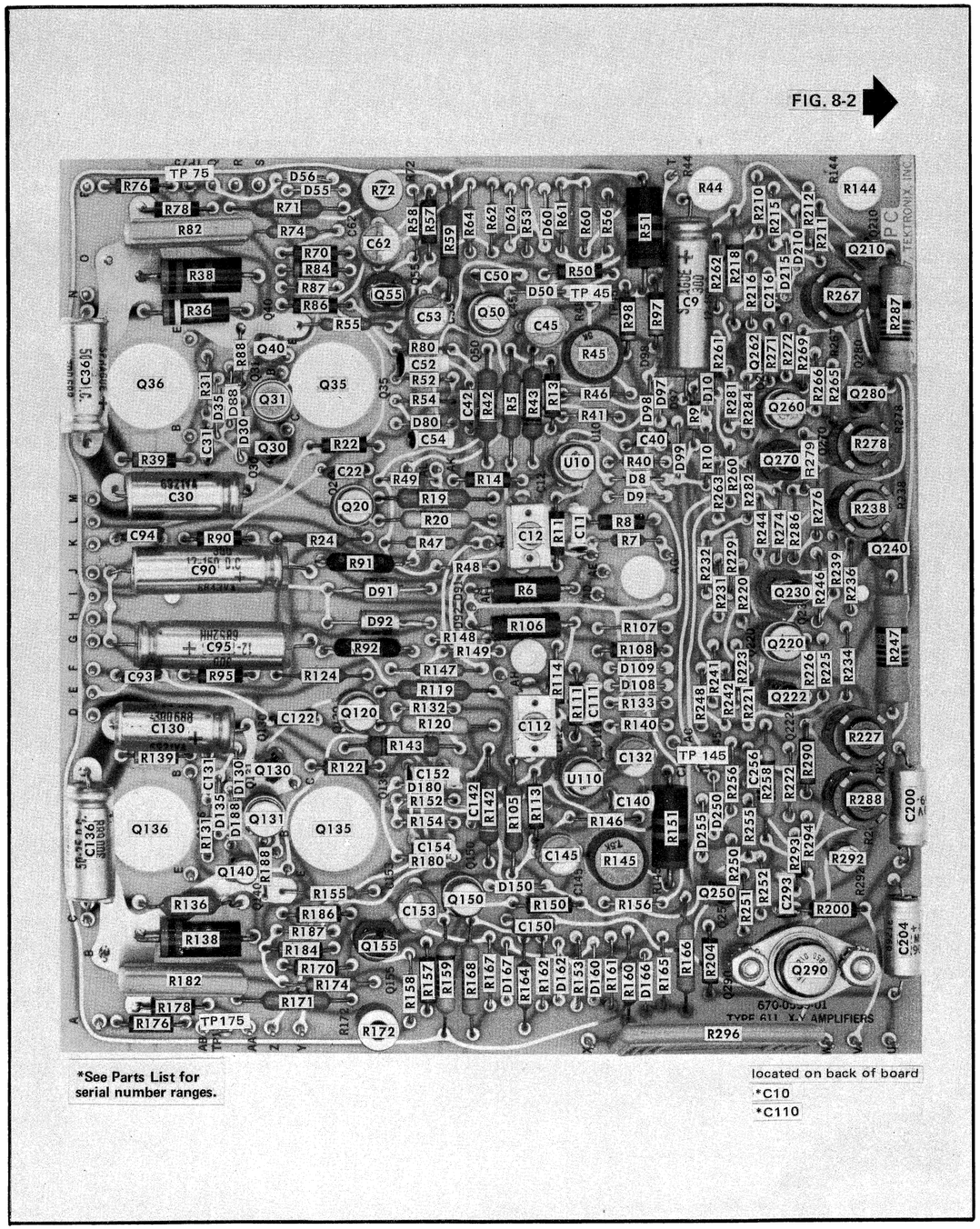


Fig. 8-1. Horizontal and Vertical Amplifier circuit board, component locations for instruments SN B111518 and up.

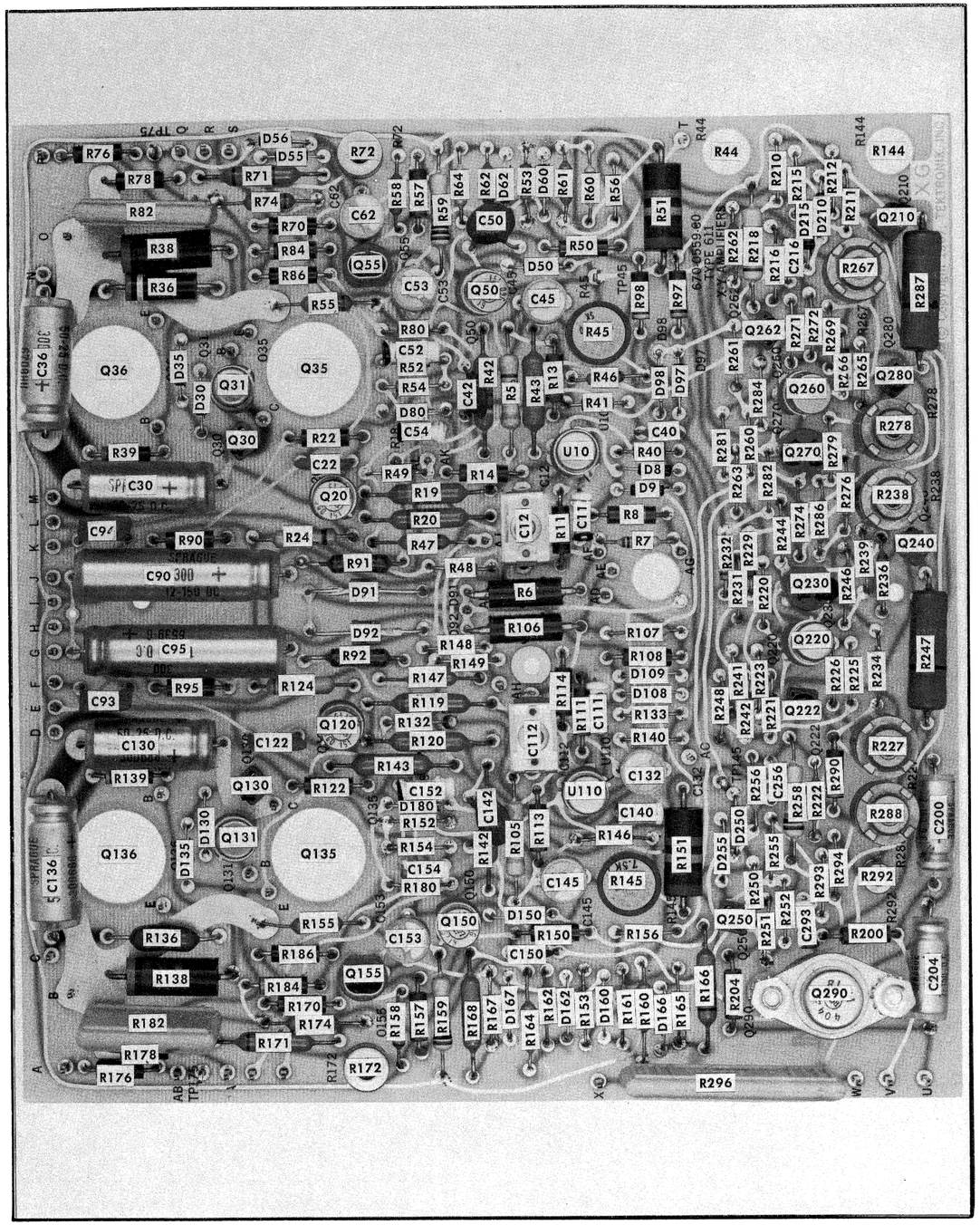
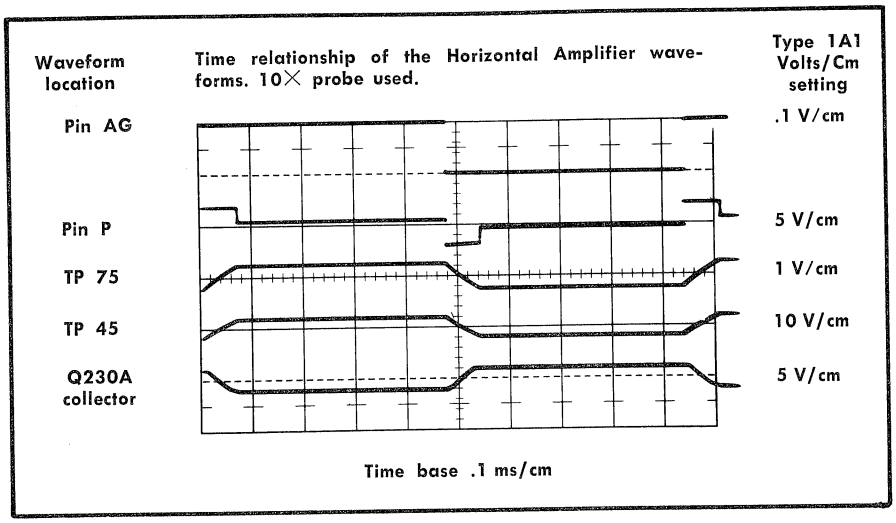


Fig. 8-2. Horizontal and Vertical Amplifier circuit board, component locations for instruments SN B010100 to B101517.

REV. E, SEPT. 1974



VOLTAGE AND WAVEFORM CONDITIONS

The circuit voltages shown in blue on the schematic diagrams were measured with a 20,000 Ω/V DC VOM. All readings are in volts with respect to chassis ground unless otherwise specified.

The waveforms shown in blue on the schematic diagrams are actual waveform photographs taken with a Tektronix Oscilloscope Camera System and Projected Graticule. The waveforms were obtained using a 10× Probe, Type 1A1 Plug-In and Type 547 Oscilloscope. The Type 611 was operated in a View Mode for all waveform photographs except the Spiral Generator circuit and the Hold Multivibrator waveforms.

Where practical, the input signal to a circuit was also coupled to the oscilloscope Trigger Input with a 10× probe to show the time relation between waveforms. A 1 volt Calibrator signal from the Type 547 was applied as the input signal for the Horizontal Deflection Amplifier, Vertical Deflection Amplifier and the Z Axis Amplifier. The Geometry Correction circuit waveforms were taken with the 1 volt Calibrator signal applied to the HORIZ INPUT. The ERASE switch was pushed to generate the input signal for the Storage circuit waveforms (except Hold Multivibrator). The input signal for the Spiral Generator circuit was the output of the Erase Multivibrator (SPIRAL TEST switch set to FOCUS).

The waveform photographs were taken with the Type 1A1 Input Selector set to DC to show the voltage levels and polarity of the waveforms. Each waveform photograph is labeled with the scale of the graticule lines and the 0 volts reference line.

Unless otherwise noted on the schematic page or on the individual waveform photograph, the Type 611 controls were set as follows:

WRITING INTENSITY	For normal viewing
WRITE-THRU INTENSITY	midrange
FOCUS	Focused display
OPERATING LEVEL	For optimum storage performance
TEST SPIRAL	NORMAL
SW202	Forward
SW404	Forward

All other internal controls as previously adjusted during the Calibration procedure.

TIME RELATION OF HORIZONTAL AMPLIFIER WAVEFORMS.

HORIZ INPUT J1 — PARTIAL ATTEN BOARD — R1 90.9K, R2 11K — FROM C323 ③ — STORE (PUSH) — FOCUS (PULL)

R7 100K AF — R6 0.25 — R5 499 — R8 1K — D8 — -3.5V — R9 56K — C9 12μF — D10 — R10 1K — +100V — D9 — +3V

U10 — C10 2.7μF — R11 1.5K — C11 3.9 — C12 8-90 — -10V

R19 6.34K — R20 18.2K — -100V — R87 10K — R88 2.7K — TO R82

Q20 — Q30 — Q31 — Q40 -21V — C22 1μF — R22 100 — -20V (DEC#1) — R24 100K — -2.5V SW202 FORWARD — C30 50μF — +20V — D30 — D35 — D88 — C31 .001 — R31 43

Q35 — Q36 — (HEAT SINK) — R38 360 — R39 39 — R36 3.9 — C36 50μF — -20V (DEC#2)

1V/CM -0V .2mS/CM — 20V/CM -0V .2mS/CM — .2mS/CM

R40 300K — R41 300K — C40 .001 — R43 200K — R44 50K — +100V (DEC) — -100V (DEC) — HORIZ POSITION

R47 1M — R48 2M — R49 3.9M — FROM R147 — FROM R148 — FROM R149 — HORIZ GAIN R45 5K — R46 12.9K — R14 100K — R13 1K — TP45 — TO Q210 ⑤

-17V SW202 FORWARD
0V SW202 CENTERED
+15V SW202 REAR

R42 97.6K — TO R80 — C42 .01 — R200 100 — C200 2μF — +100V

SW5 ③ TEST SPIRAL

SW202 HORIZ POSITION — SW204 VERT POSITION

SN B010100-B149999 PIN AA WAS T PIN Z WAS R

PARTIAL Z AXIS BOARD ④ — AA — Z

FROM R335 ③ 0V TEST PATTERN — AC — 2R — 3R

VERT POSITION — +100V (DEC) — R144 50K — -100V (DEC) — R143 200K — N

R142 97.6K — TO R180 — C142 .01 — C145 9-35 — TO Q250 ⑤ — C204 2μF — R204 100 20V/CM — -100V — TP145

-17V SW204 FORWARD
0V SW204 CENTERED
+16V SW204 REAR

Q140 — R188 2.7K — R187 10K — FROM R182 — D188 — 20V/CM -0V .2mS/CM

R140 620K — C140 270 — R146 9.09K — R145 7.5K — VERT GAIN — TO R47 — R147 1M — TO R48 — R148 2M — TO R49 — R149 3.9M — AJ — AH — AK

R114 100K — +10V — U110 — C110 2.7μF — R111 1.5K — C111 21 — C112 8-90 — -10V — -3.5V — D108 — +20V — D109 — +3V

R105 499 — R113 1K — R106 0.25 — R107 100K — R108 1K — AE — AD — AL — AI

R119 6.34K — -21V — R120 18.2K — -100V

Q130 — Q120 — Q131 — Q135 — Q136 — (HEAT SINK) — C130 50μF — C122 1μF — C131 .001 — R131 43 — D130 — D135 — R122 100 — R124 100K — -20V — +100V — +20V

R138 360 — R139 43 — R136 2 — C136 50μF — -20V — C132 9-35 — R132 51K — R133 1K

FROM R335 ③ 0V TEST PATTERN — AC — 2R — 3R

VERT POSITION — +100V (DEC) — R144 50K — -100V (DEC) — R143 200K — N

R142 97.6K — TO R180 — C142 .01 — C145 9-35 — TO Q250 ⑤ — C204 2μF — R204 100 20V/CM — -100V — TP145

-17V SW204 FORWARD
0V SW204 CENTERED
+16V SW204 REAR

Q140 — R188 2.7K — R187 10K — FROM R182 — D188 — .2mS/CM

R140 620K — C140 270 — R146 9.09K — R145 7.5K — VERT GAIN — TO R47 — R147 1M — TO R48 — R148 2M — TO R49 — R149 3.9M — AJ — AH — AK

R114 100K — +10V — U110 — C110 2.7μF — R111 1.5K — C111 21 — C112 8-90 — -10V — -3.5V — D108 — +20V — D109 — +3V

R105 499 — R113 1K — R106 0.25 — R107 100K — R108 1K — AE — AD — AL — AI

R119 6.34K — -21V — R120 18.2K — -100V

Q130 — Q120 — Q131 — Q135 — Q136 — (HEAT SINK) — C130 50μF — C122 1μF — C131 .001 — R131 43 — D130 — D135 — R122 100 — R124 100K — -20V — +100V — +20V

R138 360 — R139 43 — R136 2 — C136 50μF — -20V — C132 9-35 — R132 51K — R133 1K

-1.5V SW204 FORWARD

FROM R335 ③ 0V TEST PATTERN — AC — 2R — 3R

VERT INPUT J101 — PARTIAL ATTEN BOARD — R101 90.9K — R102 11K — FROM R321 ③ — STORE (PUSH) — FOCUS (PULL)

1V/CM -0V .2mS/CM

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

PARTIAL X-Y BOARD

D80 — 20V/CM -0V .2mS/CM — HORIZONTAL DEFLECTION COIL — P — R — Q — R76 1.8K — R78 2.4K — LT8 2mH — R82 8.9

+100V (DEC) — R60 499K — R61 56.2K — FROM R42 — R80 620K — R84 3K — R86 200K — -100V (DEC) — FROM R87 — TP75 — SEPARATE HORIZONTAL GND ✳

D60 — D62 — R62 56.2K — C62 9-35 — R64 499K — D56 — D55 — +100V (DEC)

+100V (DEC) — R51 12K — C52 39 — R52 620K — C53 9-35 — R53 7.68K — C54 18 — R54 330K — -100V (DEC) — R55 1K — -20V (DEC#1) — FROM Q230A ② — R57 100 — -20V (DEC#1) — D50

Q55A — Q55B — R59 100K — +100V (DEC) — R74 1K — R71 249K — R72 100K — -100V (DEC) — HORIZ BEAM CENTERING

Q50 — C50 .01 — R50 100 — -20V (DEC#1) — R58 191K — -100V (DEC) — 5V/CM -0V .2mS/CM — -2.5V SW202 FORWARD
0V SW202 CENTERED
+2.5V SW202 REAR

TO COMMON GROUND ON POWER SUPPLY BOARD — Q

-2.2V SW204 FORWARD
0V SW204 CENTERED
+2.2V SW204 REAR

+100V (DEC) — R160 600K — R161 86.6K — R162 86.6K — R164 600K — R165 43.2K — R166 562K — R167 43.2K — R168 562K — D160 — D162 — D166 — D167 — 5V/CM -0V .2mS/CM

R151 12K — C152 39 — R152 620K — C153 9-35 — R153 9.09K — C154 15 — R154 330K — FROM Q270A ② — Q155A — Q155B — R159 100K — R155 1K — R157 100 — -20V — D150 — VERT BEAM CENTERING — R170 1K — R171 249K — R172 100K — -100V (DEC)

Q150 — C150 .01 — R150 100 — -20V — R158 191K — -100V (DEC) — 20V/CM -0V .2mS/CM — R174 1K — R182 4.5 — TO R187 — TP175 — B — SEPARATE VERTICAL GND ✳ — AB — AA — L178 1mH — R178 10K — A — VERTICAL DEFLECTION COIL

FROM R142 — R180 620K — R186 200K — -100V (DEC) — D180 — R184 3K — R176 1K

REFERENCE DIAGRAMS
② GEOMETRY CORRECTION & DYNAMIC FOCUS
③ TEST SPIRAL GEN & SWITCHING
④ Z AXIS & H.V. SUPPLY
⑦ FOR POWER DISTRIBUTION

SEE PARTS LIST FOR SEMICONDUCTOR TYPES

0671

TYPE 611 DISPLAY DEVICE — ⓕ — HORIZONTAL/VERTICAL AMPLIFIER ◇1

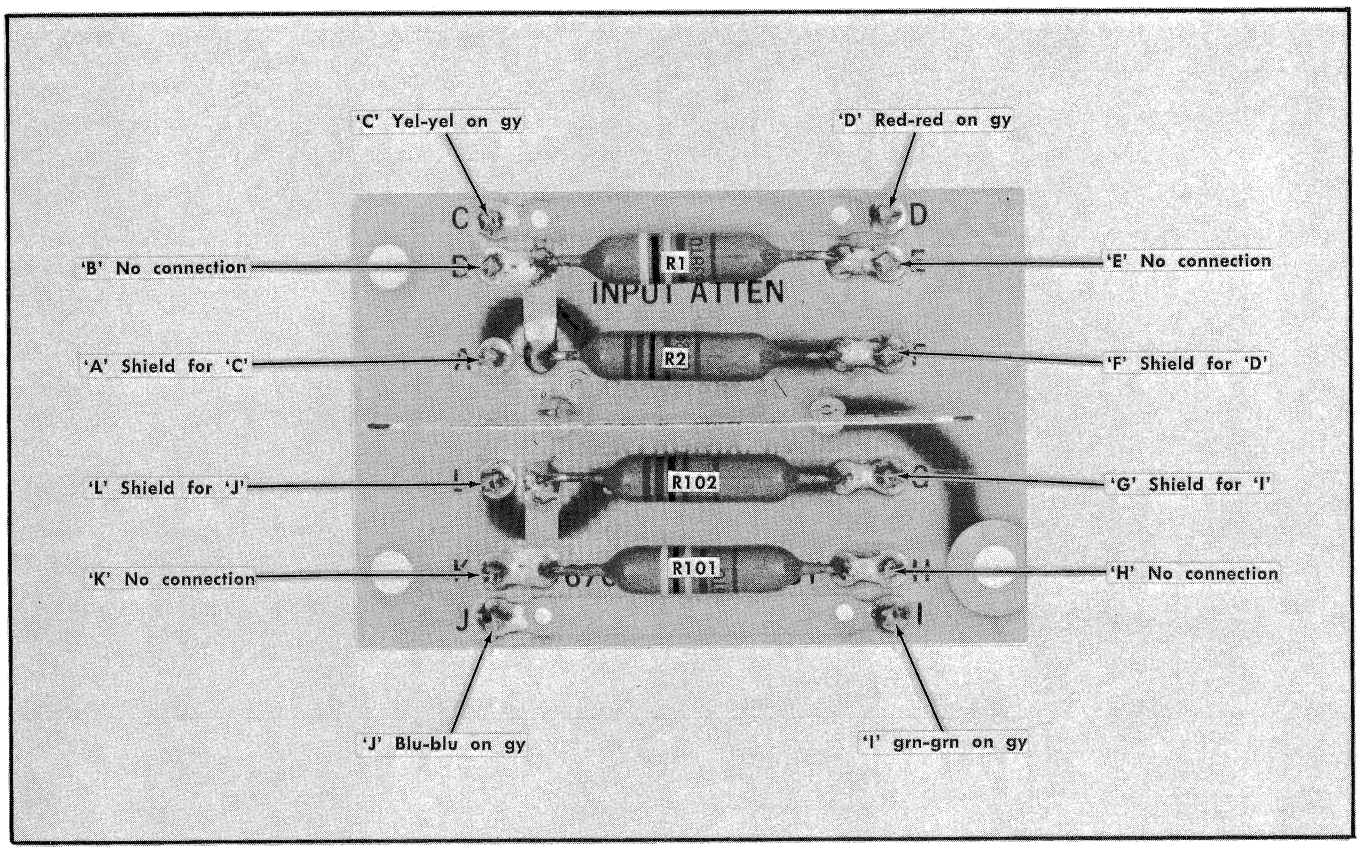


Fig. 8-3. Input Attenuation circuit board.

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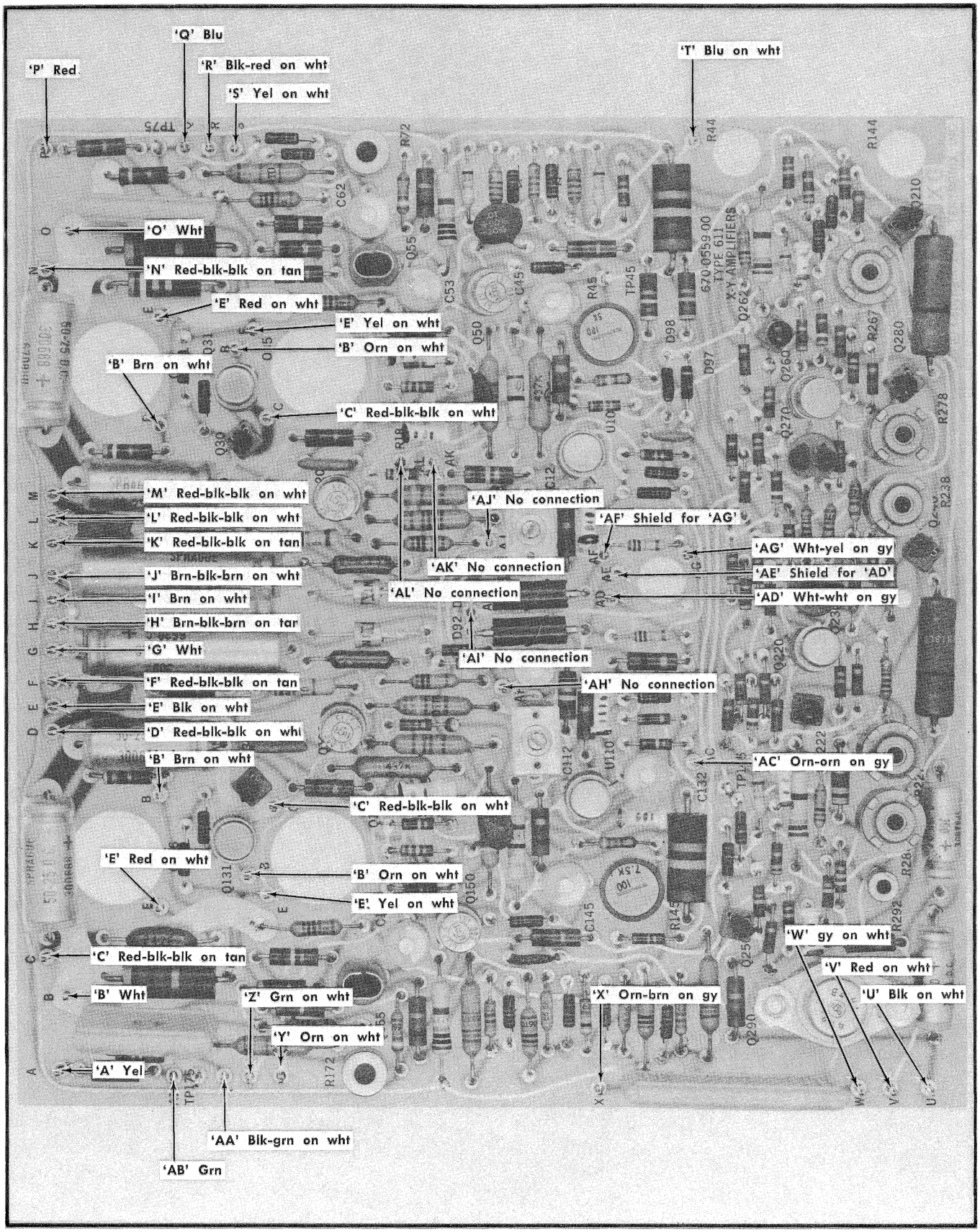
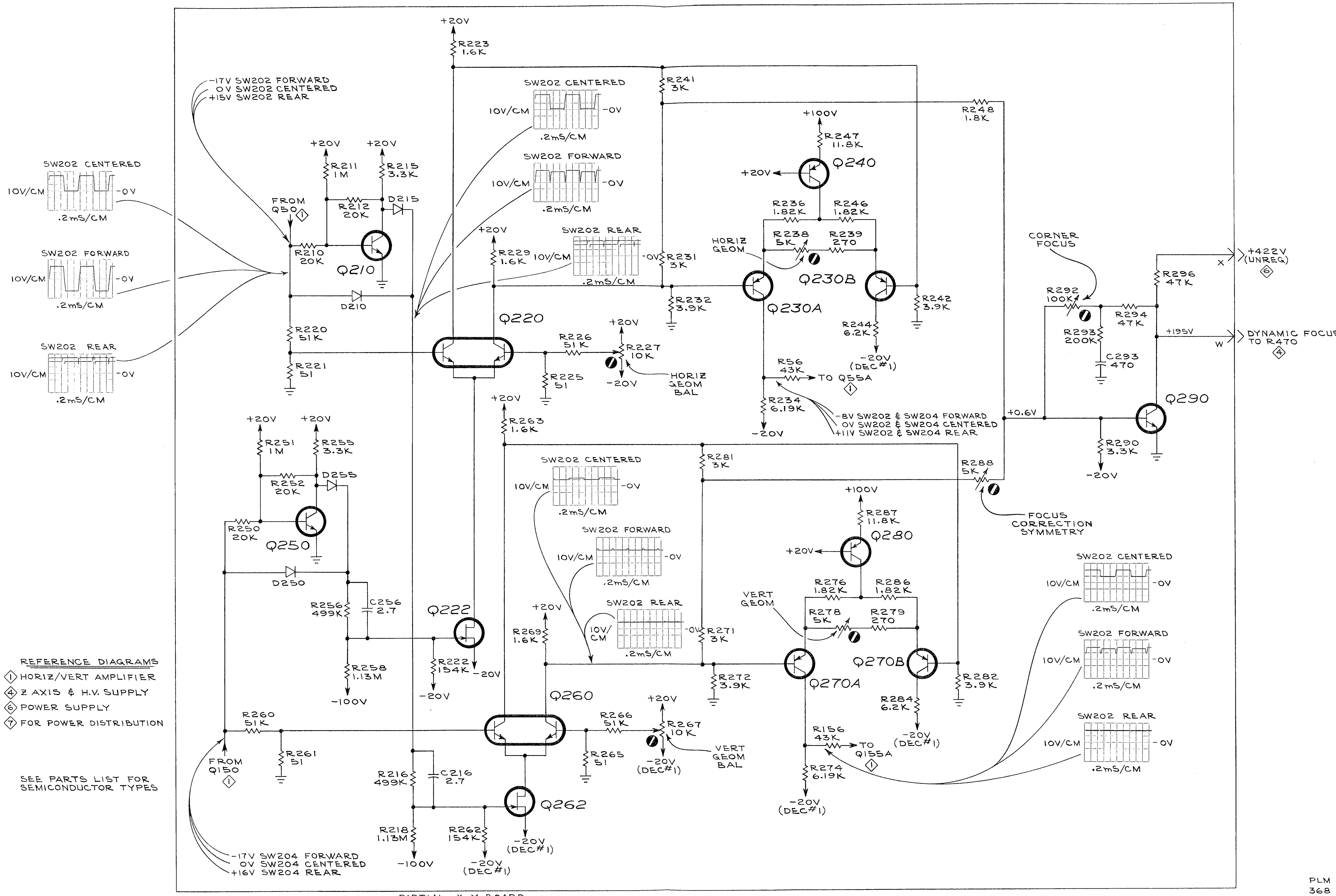


Fig. 8-4. Horizontal and Vertical Amplifier circuit board, color codes of connecting leads.



-17V SW202 FORWARD
OV SW202 CENTERED
+15V SW202 REAR
SW202 CENTERED
SW202 FORWARD
SW202 REAR
10V/CM
.2mS/CM
-0V
FROM Q50 ⟨1⟩
R210 20K
R211 1M
R212 20K
R215 3.3K
D215
D210
Q210
R220 51K
R221 51
+20V
R223 1.6K
R229 1.6K
Q220
R226 51K
R227 10K
R225 51
HORIZ GEOM BAL
-20V
R241 3K
R231 3K
R232 3.9K
R248 1.8K
+100V
R247 11.8K
Q240
R236 1.82K
R246 1.82K
R238 5K
R239 270
HORIZ GEOM
Q230A
Q230B
R242 3.9K
R244 6.2K
-20V (DEC#1)
R56 43K
TO Q55A ⟨1⟩
R234 6.19K
-8V SW202 & SW204 FORWARD
OV SW202 & SW204 CENTERED
+11V SW202 & SW204 REAR
CORNER FOCUS
R292 100K
R293 200K
C293 470
R294 47K
R296 47K
+422V (UNREG) ⟨6⟩
+195V
DYNAMIC FOCUS TO R470 ⟨4⟩
+0.6V
Q290
R290 3.3K
R251 1M
R255 3.3K
R252 20K
D255
R250 20K
Q250
D250
R256 499K
C256 2.7
R258 1.13M
-100V
Q222
R222 154K
R263 1.6K
R281 3K
R288 5K
FOCUS CORRECTION SYMMETRY
R287 11.8K
Q280
R276 1.82K
R286 1.82K
VERT GEOM
R278 5K
R279 270
R269 1.6K
R271 3K
R272 3.9K
Q270A
Q270B
R282 3.9K
R284 6.2K
Q260
R260 51K
R261 51
R266 51K
R267 10K
R265 51
VERT GEOM BAL
R156 43K
TO Q155A ⟨1⟩
R274 6.19K
FROM Q150 ⟨1⟩
R216 499K
C216 2.7
Q262
R218 1.13M
R262 154K
-17V SW204 FORWARD
OV SW204 CENTERED
+16V SW204 REAR
REFERENCE DIAGRAMS
⟨1⟩ HORIZ/VERT AMPLIFIER
⟨4⟩ Z AXIS & H.V. SUPPLY
⟨6⟩ POWER SUPPLY
⟨7⟩ FOR POWER DISTRIBUTION
SEE PARTS LIST FOR SEMICONDUCTOR TYPES
PARTIAL X-Y BOARD

PLM
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TIME RELATION OF SPIRAL GENERATOR WAVEFORMS.

+100V
+20V
R301 33K
C302 0.33
R303 16.2K
R302 2K
D304
Q300
R304 18.7K
C304 0.47
-20V
R306 8.2K
-20V
+20V
R309 18K
R308 2K
R307 2K

2V/CM
-0V
10mS/CM
L
K

FROM Z AXIS INPUT J420 ④
Z AXIS OUTPUT TO PIN R ④

R325 51.1K
C325 .005
+100V
+20V
R314 390K
R316 100
Q315
D314
+20V
C320 0.22
Q310
C322 .056
C323 .022
R322 4.7K
R323 13K
R320 2K
X
Y

ERASE MULTI DRIVE FROM C640 ⑤
R311 510K
C312 .001
R312 100K

10V/CM
-0V
10mS/CM

1V/CM
-0V
10mS/CM

① HORIZONTAL AMPLIFIER INPUT
HORIZONTAL AMPLIFIER OUTPUT ①

R327 5.1K
R328 5.1K
C327 5μF
R318 3K
-20V
C330 0.2
+20V
R332 2M
R331 240K
R333 240K
D332
D334
R334 2M
-20V

10V/CM
-0V
10mS/CM
V
R321 120K

① VERTICAL AMPLIFIER INPUT
VERTICAL AMPLIFIER OUTPUT ①

1V/CM
-0V
10mS/CM
W
T
U

TEST PATTERN
TO PIN AC ①

Q360
R360 820K
Q364
R335 174K
R336 22.1K
Q362
R364 100K
D361
D362
-20V
BA
FROM WRITE THRU R577 ④

*SW5 TEST SPIRAL ① ④ ⑤
STORE (PUSH)
FOCUS (PULL)

TO PIN E ⑤
TO PIN AG ⑤
+100V
TO PIN C ⑤
TO PIN H ⑤

+100V (DEC) (THRU PIN V) ①
TO SW202 & SW204 ①
-100V (DEC) (THRU PIN U) ①
TO PIN R ④

PARTIAL STORAGE BOARD ⑤

1 X INPUT
X GND 14
2 X GND
Y INPUT 15
3 Y GND
Y GND 16
4 Z INPUT
Z GND 17
5 Z GND
REMOTE ⑤ ERASE 18
6 NON-STORE ⑤
PROGRAM GND 19
7 ERASE INTERVAL
⑤ VIEW 20
8 WRITE THRU
21
9
22
100
23
110
24
25 120
0 BJ ⑤
130 BD ⑤
BE ⑤
J340
REMOTE PROGRAM CONNECTOR

TO R612 & R614 ⑤
+100V
D340
R341 91K
S
R342 8.2K
D342
+100V
R344 200K
Q340
R346 13.3K
R345 100K
R
FROM PIN L ④
TO D530, D561, D563 ⑤
+20V
R350 33K
R354 8.2K
D350
D345
BH
BG
R351 10K
Q352
R352 100K
-20V
TO PIN H ④
AC
TO PIN Y ④
R337 100K
C339 .03
R339 10K
-100V
ADDED SN B170000

REFERENCE DIAGRAMS
① HORIZONTAL/VERTICAL AMPLIFIER
④ Z AXIS & HV SUPPLY
⑤ STORAGE CIRCUIT
⑦ FOR POWER DISTRIBUTION

SEE PARTS LIST FOR SEMICONDUCTOR TYPES
* SPRING RETURN FROM STORE POSITION

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

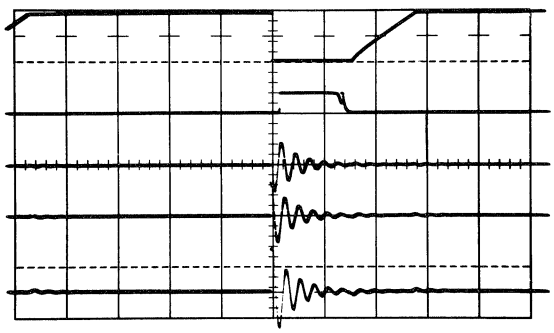
0171

TYPE 611 DISPLAY DEVICE

B1

TEST SPIRAL GENERATOR & SWITCHING ③
SN B150000-UP

& SWITCHING

Waveform location	Time relationship of Spiral Generator waveforms. 10× probe used.	Type 1A1 Volts/Cm setting
Junction of R302 & R311		2 V/cm
Pin L		.5 V/cm
Pin X		.1 V/cm
Pin V		.1 V/cm
Pin T		.2 V/cm

Time base 5 ms/cm

TIME RELATION OF SPIRAL GENERATOR WAVEFORMS.

+100V +20V
R301 33K
C302 0.33
R303 16.2K
D304
R302 2K
Q300
R304 18.7K
C304 0.47
-20V
R306 8.2K
-20V
+20V
R309 18K
R308 2K
R307 2K

2V/CM -0V
10mS/CM
L
K
FROM Z AXIS INPUT J420 (4)
Z AXIS OUTPUT TO R420 (4)

R325 51.1K
C325 .005
+20V
+100V
R316 100
R314 390K
Q315
D314
C320 0.22
+20V
Q310
R320 2K
C322 .056
C323 .022
R322 4.7K
R323 13K
X
Y
HORIZONTAL AMPLIFIER INPUT (1)
HORIZONTAL AMPLIFIER OUTPUT (1)

ERASE MULTI DRIVE FROM C640 (5)
R311 510K
C312 .001
R312 100K

10V/CM -0V
10mS/CM

1V/CM -0V
10mS/CM

R327 5.1K
R328 5.1K
C327 5μF
R318 3K
-20V
C330 0.2
+20V
R332 2M
D332
R331 240K
D334
R333 240K
-20V
R334 2M
R335 174K
R336 22.1K
R337 100K
C339 .03
R339 10K
-100V

10V/CM -0V
10mS/CM
R321 120K
V
W
VERTICAL AMPLIFIER INPUT (1)
VERTICAL AMPLIFIER OUTPUT (1)

TEST PATTERN
T
U
TO R40 & R140 (1)
1V/CM -0V
10mS/CM

SW5 TEST SPIRAL
STORE (PUSH)
FOCUS (PULL)
(1) (4) (5)

TO R612 & R614 (5)
+100V
D340
R341 91K
S
R342 8.2K
D342
+100V
R344 200K
R
FROM Q400 (4)
Q340
R346 13.3K

TO PIN E (5)
TO PIN AG (5)
+100V
TO PIN C (5)
TO PIN H (5)

+100V (DEC) (THRU PIN V) (1)
TO SW202 & SW204 (1)
-100V (DEC) (THRU PIN U) (1)
TO PIN R (4)

PARTIAL STORAGE BOARD (5)

J340 REMOTE PROGRAM CONNECTOR
10
014 20
015 30
016 40
017 50
(5) ERASE 018 60 → NON-STORE (5)
PROGRAM GND 019 70 → ERASE INTERVAL
(5) VIEW 020 80 → WRITE THRU
021 90
022 100
023 110
024 120
025 130

REFERENCE DIAGRAMS
(1) HORIZONTAL/VERTICAL AMPLIFIER
(4) Z AXIS & HV SUPPLY
(5) STORAGE CIRCUIT
(7) FOR POWER DISTRIBUTION

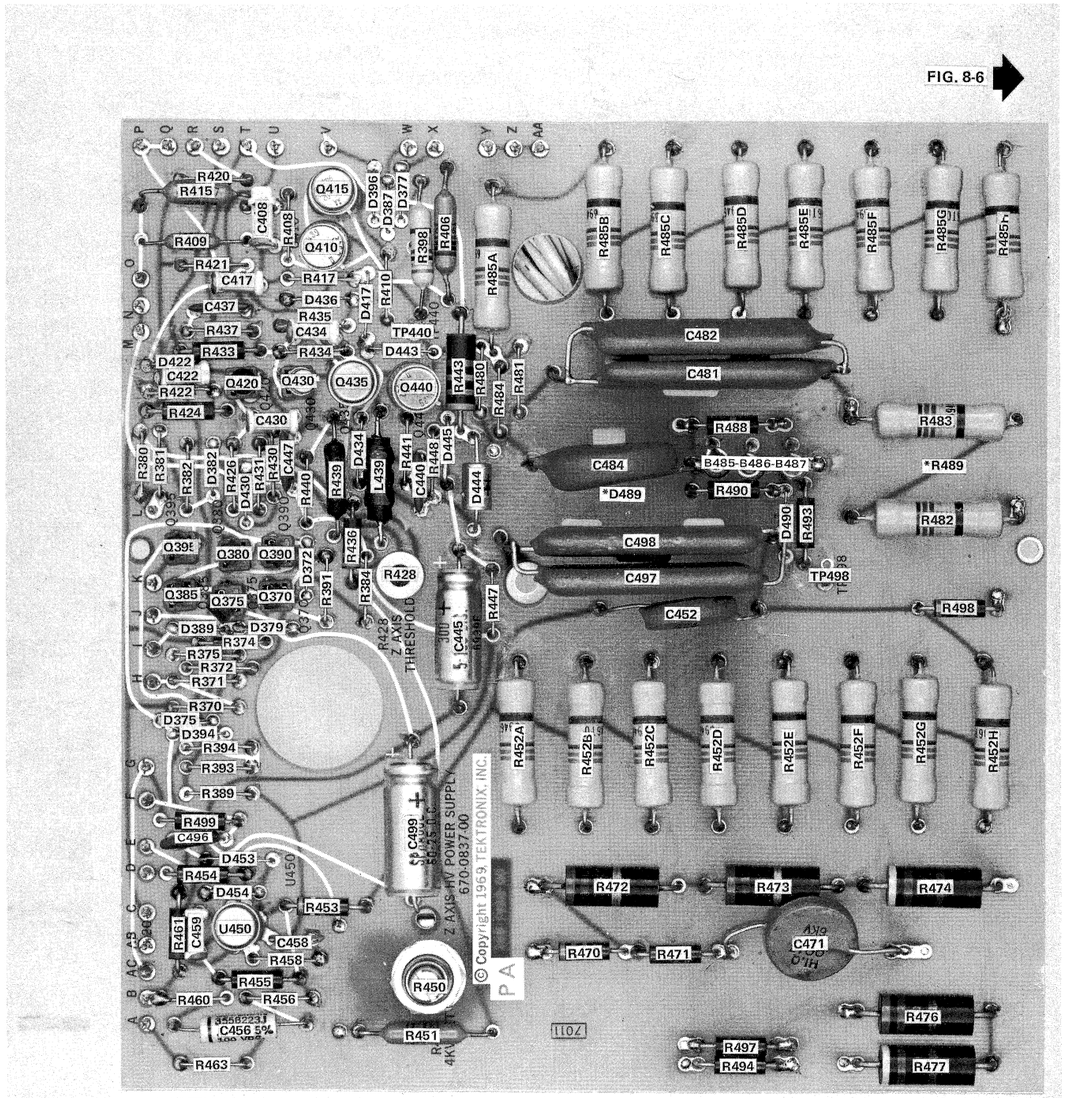
SEE PARTS LIST FOR SEMICONDUCTOR TYPES

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

1170

TEST SPIRAL GENERATOR & SWITCHING (3)

SN B010100 - B149999



*Added SN B210000

REV. C, SEPT. 1974

Fig. 8-5. Z Axis and H.V. Power Supply circuit board, component location. For instruments above SN B150000.

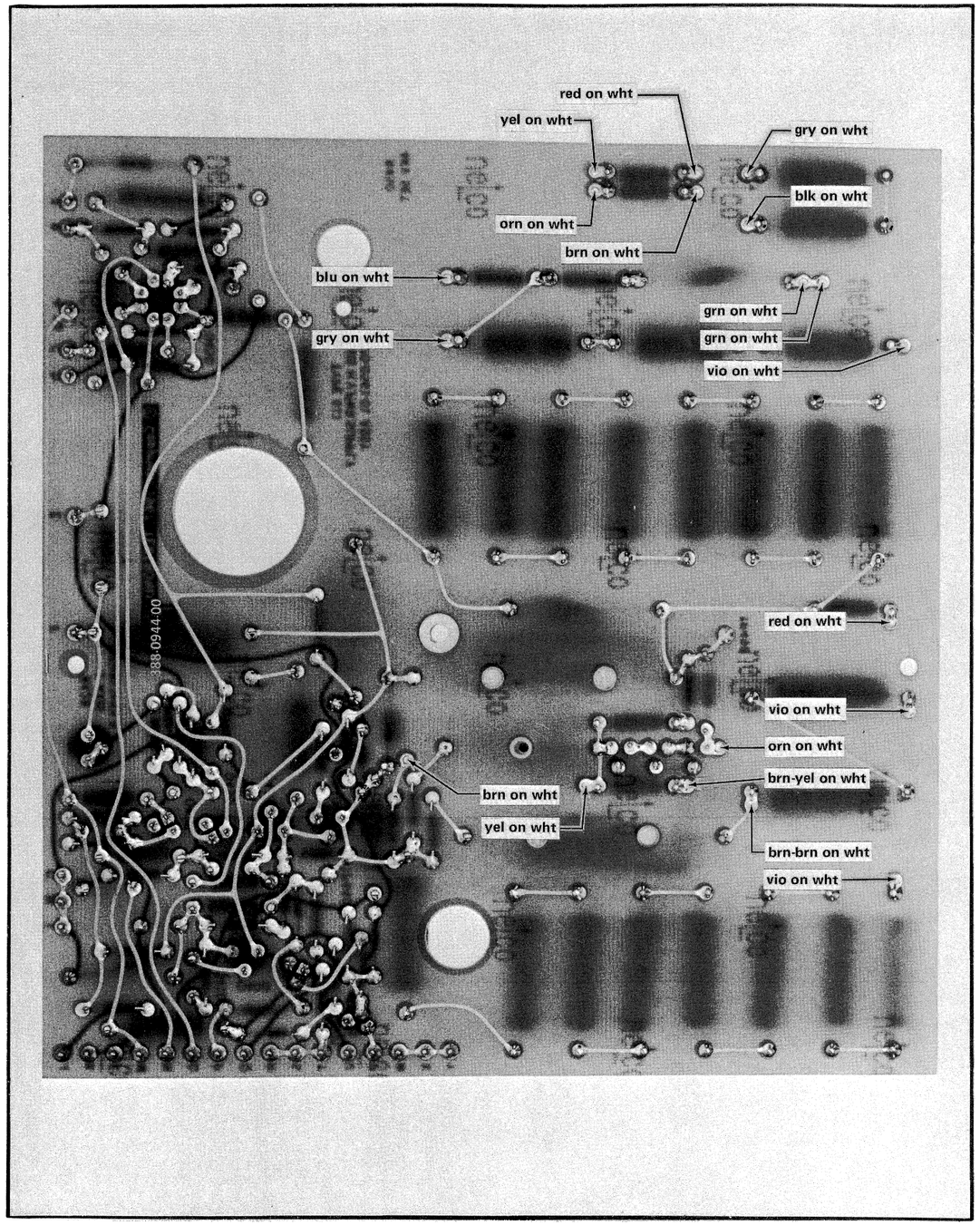


Fig. 8-6. Back of Z Axis and High Voltage circuit Board showing location and color codes of wire. Applies for all serial numbers.

Ⓑ

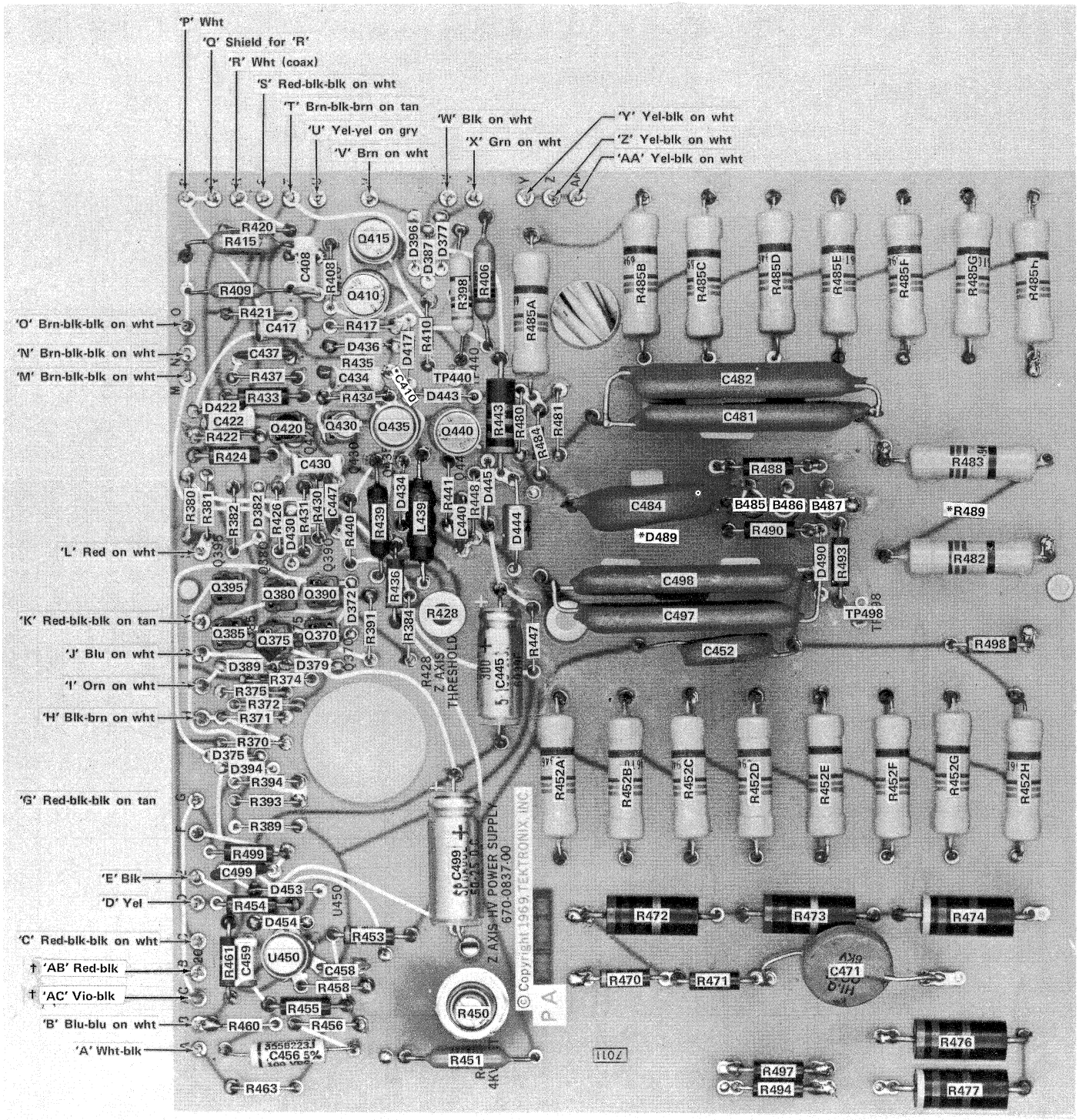
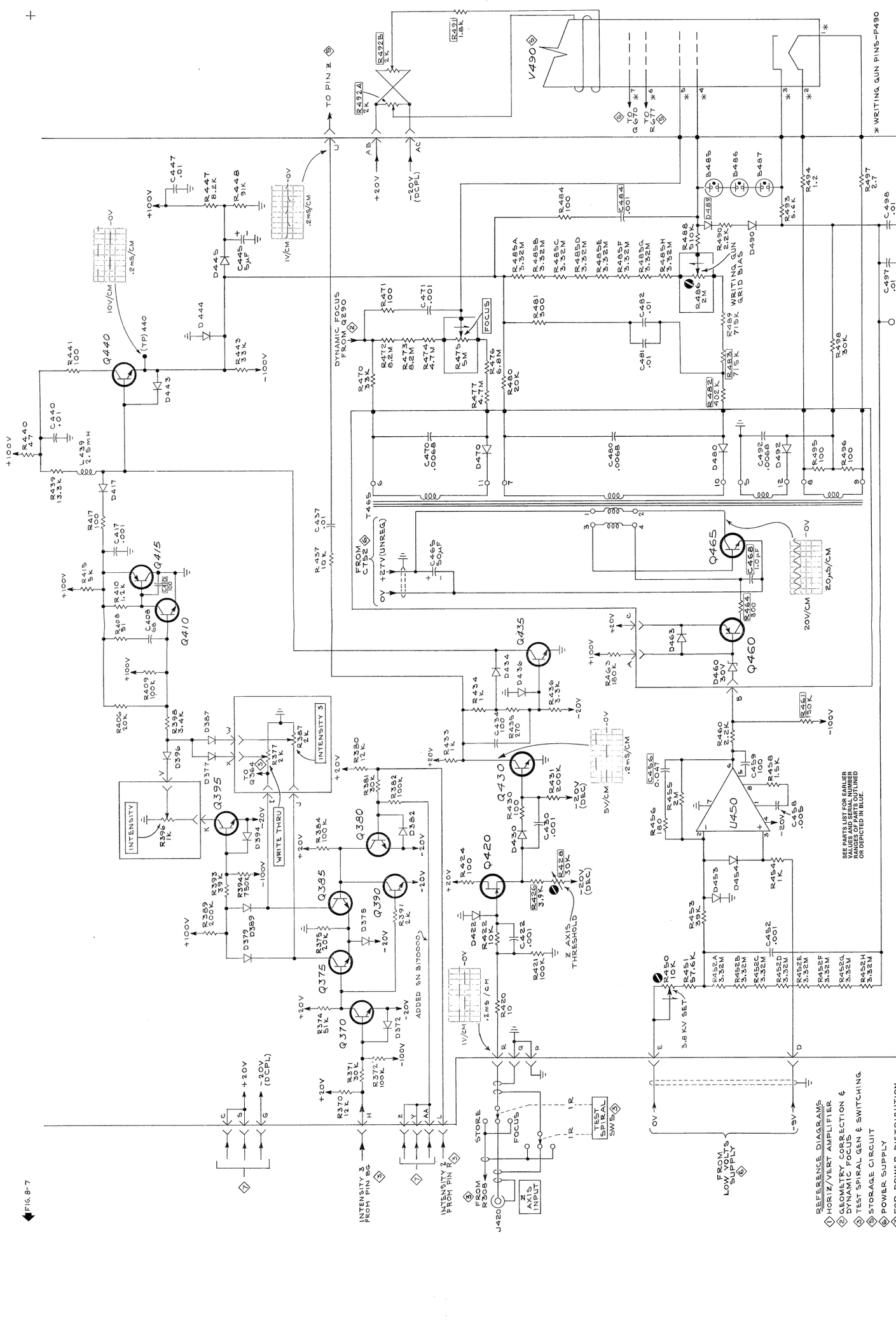


Fig. 8-7. Z Axis and H.V. Power Supply circuit board, color codes of connecting leads. For instruments above SN B150000.


Z AXIS & H.V. SUPPLY 4
SN B150000-UP
PLM 572
* WRITING GUN PINS-P490
TO PIN Z
V490
WRITING GUN GRID BIAS
DYNAMIC FOCUS FROM Q290
FOCUS
FROM C152 +27V(UNREG)
Q465
Q460
Q435
Q430
Q420
Q410
Q415
Q440
Q395
Q380
Q385
Q390
Q375
Q370
U450
20μs/CM
20V/CM
5V/CM
.2ms/CM
1V/CM
10V/CM
INTENSITY
WRITE THRU
INTENSITY 3
TO Q364
ADDED SN B170000
Z AXIS THRESHOLD
3.8 KV SET
STORE
FOCUS
TEST SPIRAL SW5
Z AXIS INPUT
FROM R308
J420
INTENSITY 3 FROM PIN BG
INTENSITY 2 FROM PIN R
FROM LOW VOLTS
Z AXIS H.V. POWER SUPPLY BOARD
REV G JAN, 1975
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES NOT LISTED OR DEPICTED IN BLUE.
REFERENCE DIAGRAMS
1 HORIZ/VERT AMPLIFIER
2 GEOMETRY CORRECTION & DYNAMIC FOCUS
3 TEST SPIRAL GEN & SWITCHING
4 STORAGE CIRCUIT
5 POWER SUPPLY
6 FOR POWER DISTRIBUTION
7 SEE PARTS LIST FOR SEMICONDUCTOR TYPES
TYPE 611 DISPLAY DEVICE
FIG. 8-7

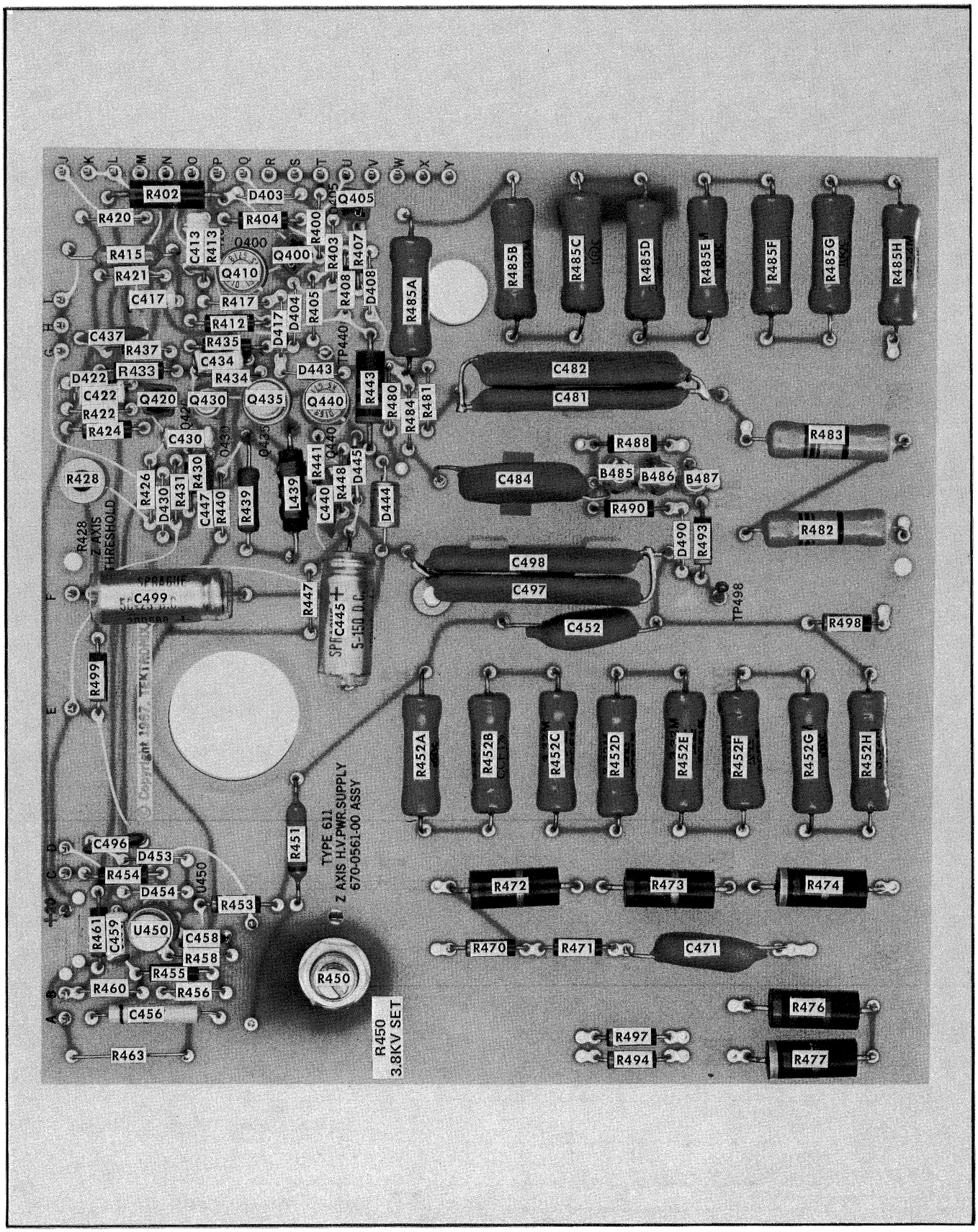


Fig. 8-8. Z Axis and H.V. Power Supply circuit board, component location. For instruments below SN B150000.

®

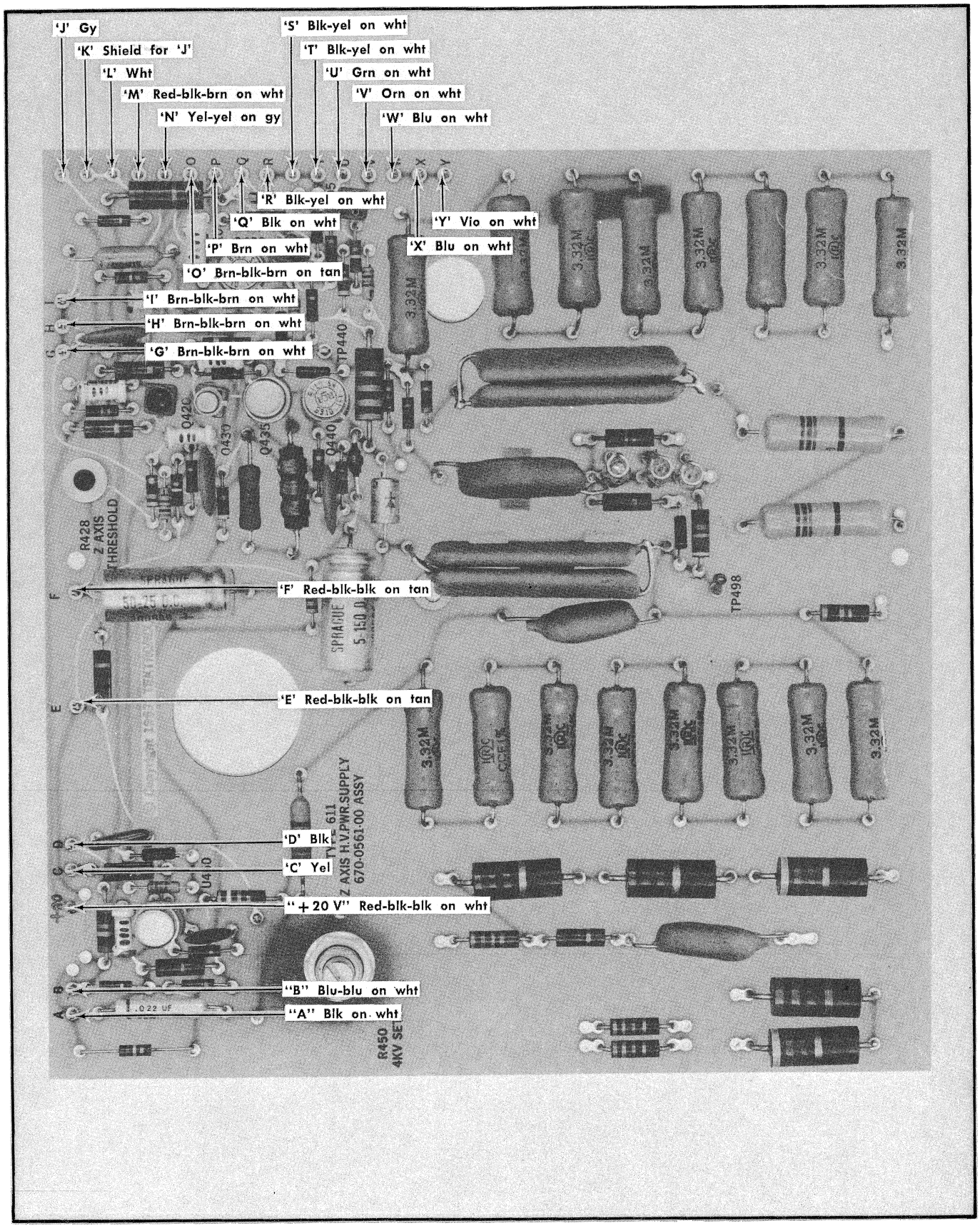
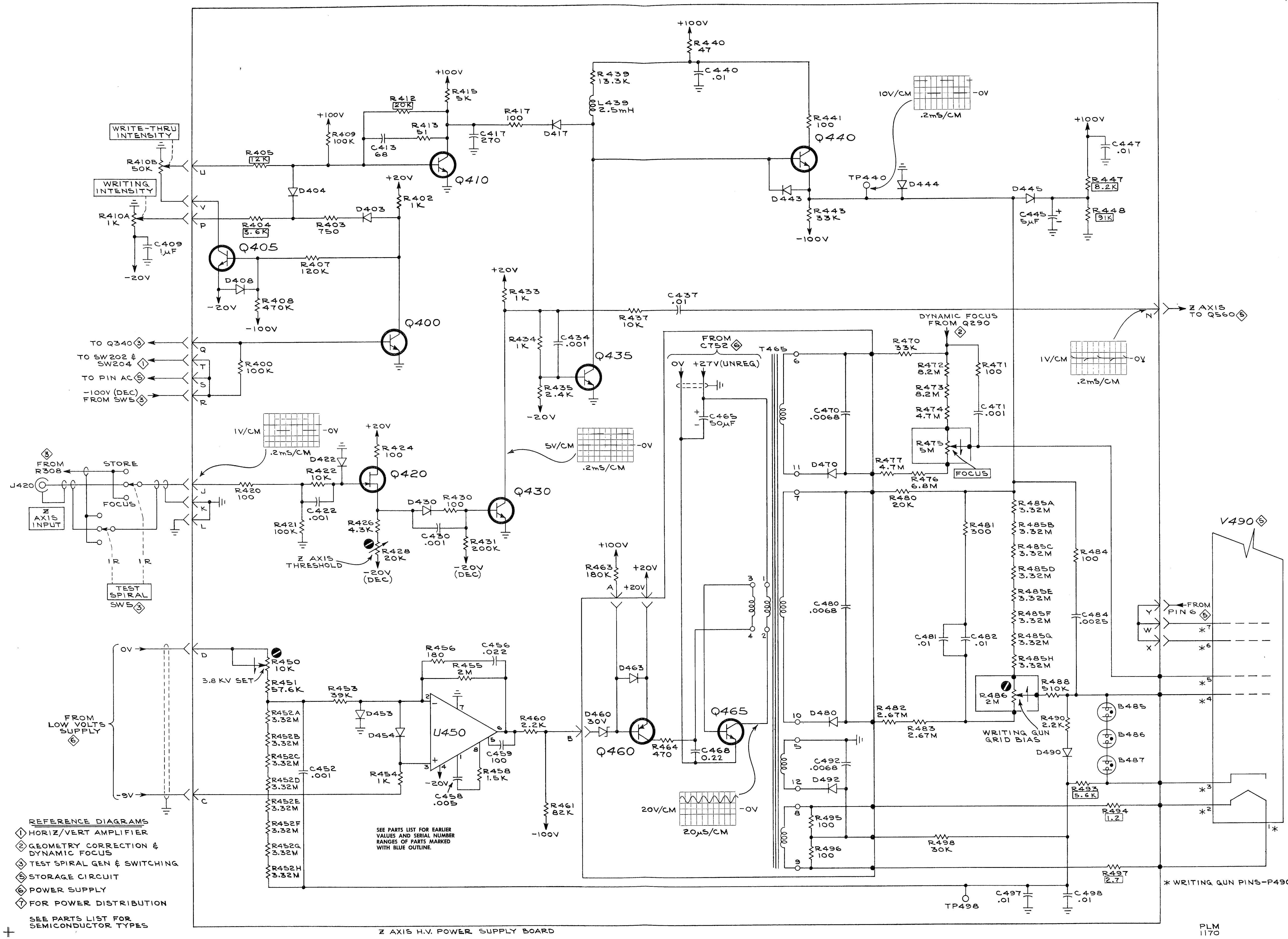


Fig. 8-9. Z Axis and H.V. Power Supply circuit board, color codes of connecting leads. For instruments below SN B150000.


WRITE-THRU INTENSITY
R410B 50K
WRITING INTENSITY
R410A 1K
C409 1µF
-20V
R405 12K
R409 100K
+100V
R412 20K
R413 51
C413 68
R415 5K
+100V
Q410
D404
+20V
R402 1K
D403
R404 3.6K
R403 750
Q405
R407 120K
D408
R408 470K
-20V
-100V
Q400
TO Q340 ③
TO SW202 & SW204 ①
TO PIN AC ⑤
-100V (DEC) FROM SW5 ③
R400 100K
R417 100
D417
C417 270
R439 13.3K
L439 2.5mH
+100V
R440 47
C440 .01
R441 100
Q440
D443
R443 33K
-100V
10V/CM
.2mS/CM
-0V
TP440
D444
+100V
C447 .01
R447 8.2K
D445
C445 5µF
R448 91K
+20V
R433 1K
C437 .01
R437 10K
Z AXIS TO Q560 ⑤
R434 1K
C434 .001
Q435
R435 2.4K
-20V
DYNAMIC FOCUS FROM Q290 ②
R470 33K
R472 8.2M
R473 8.2M
R474 4.7M
R471 100
C471 .001
R475 5M
FOCUS
1V/CM
.2mS/CM
-0V
FROM C752 ⑥
0V
+27V (UNREG)
T465
C465 50µF
C470 .0068
D470
R477 4.7M
R476 6.8M
R480 20K
1V/CM
.2mS/CM
-0V
+20V
R424 100
D422
R422 10K
Q420
STORE
FROM R308
J420
Z AXIS INPUT
FOCUS
R420 100
C422 .001
R421 100K
R426 4.3K
R428 20K
Z AXIS THRESHOLD
-20V (DEC)
D430
R430 100
C430 .001
R431 200K
-20V (DEC)
Q430
5V/CM
.2mS/CM
-0V
TEST SPIRAL SW5 ③
R481 300
R485A 3.32M
R485B 3.32M
R485C 3.32M
R485D 3.32M
R485E 3.32M
R485F 3.32M
R485G 3.32M
R485H 3.32M
R484 100
C484 .0025
V490 ⑤
+100V
R463 180K
+20V
C480 .0068
C481 .01
C482 .01
FROM PIN 6 ⑤
0V
R450 10K
3.8 KV SET
R451 57.6K
R456 180
C456 .022
R455 2M
R453 39K
D453
D454
U450
R460 2.2K
C459 100
R458 1.5K
R454 1K
-20V
C458 .005
R461 82K
-100V
R452A 3.32M
R452B 3.32M
R452C 3.32M
R452D 3.32M
R452E 3.32M
R452F 3.32M
R452G 3.32M
R452H 3.32M
C452 .001
FROM LOW VOLTS SUPPLY ⑥
-9V
D463
D460 30V
Q460
R464 470
Q465
C468 0.22
20V/CM
20µS/CM
-0V
D480
R482 2.67M
R483 2.67M
R486 2M
R488 510K
WRITING GUN GRID BIAS
R490 2.2K
D490
B485
B486
B487
C492 .0068
D492
R493 5.6K
R494 1.2
R495 100
R496 100
R498 30K
R497 2.7
TP498
C497 .01
C498 .01
* WRITING GUN PINS-P490
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.
Z AXIS H.V. POWER SUPPLY BOARD

REFERENCE DIAGRAMS
① HORIZ/VERT AMPLIFIER
② GEOMETRY CORRECTION & DYNAMIC FOCUS
③ TEST SPIRAL GEN & SWITCHING
⑤ STORAGE CIRCUIT
⑥ POWER SUPPLY
⑦ FOR POWER DISTRIBUTION

SEE PARTS LIST FOR SEMICONDUCTOR TYPES

PLM 1170

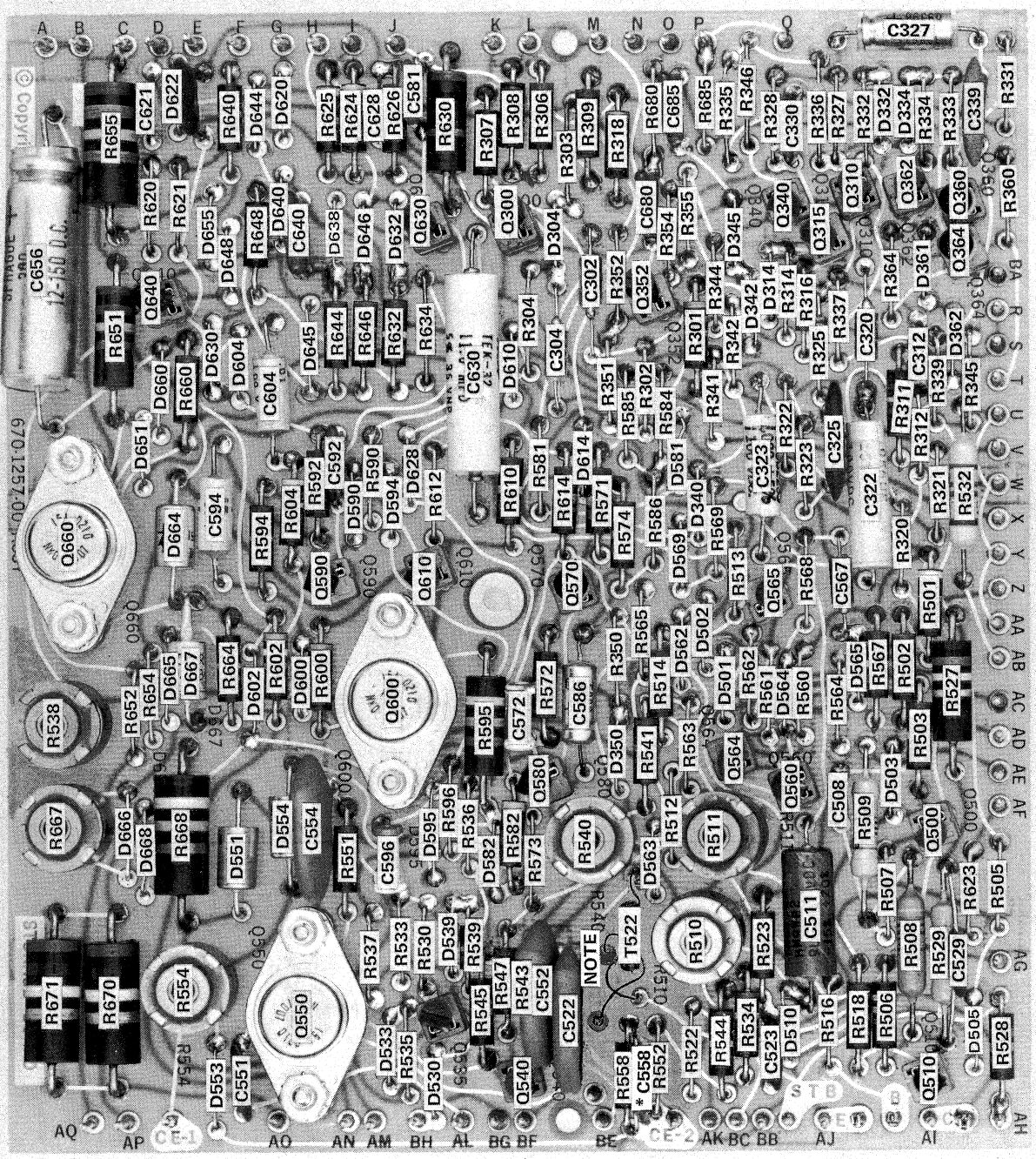


Fig. 8-10. Storage circuit board, component location. For instruments above SN B150000.

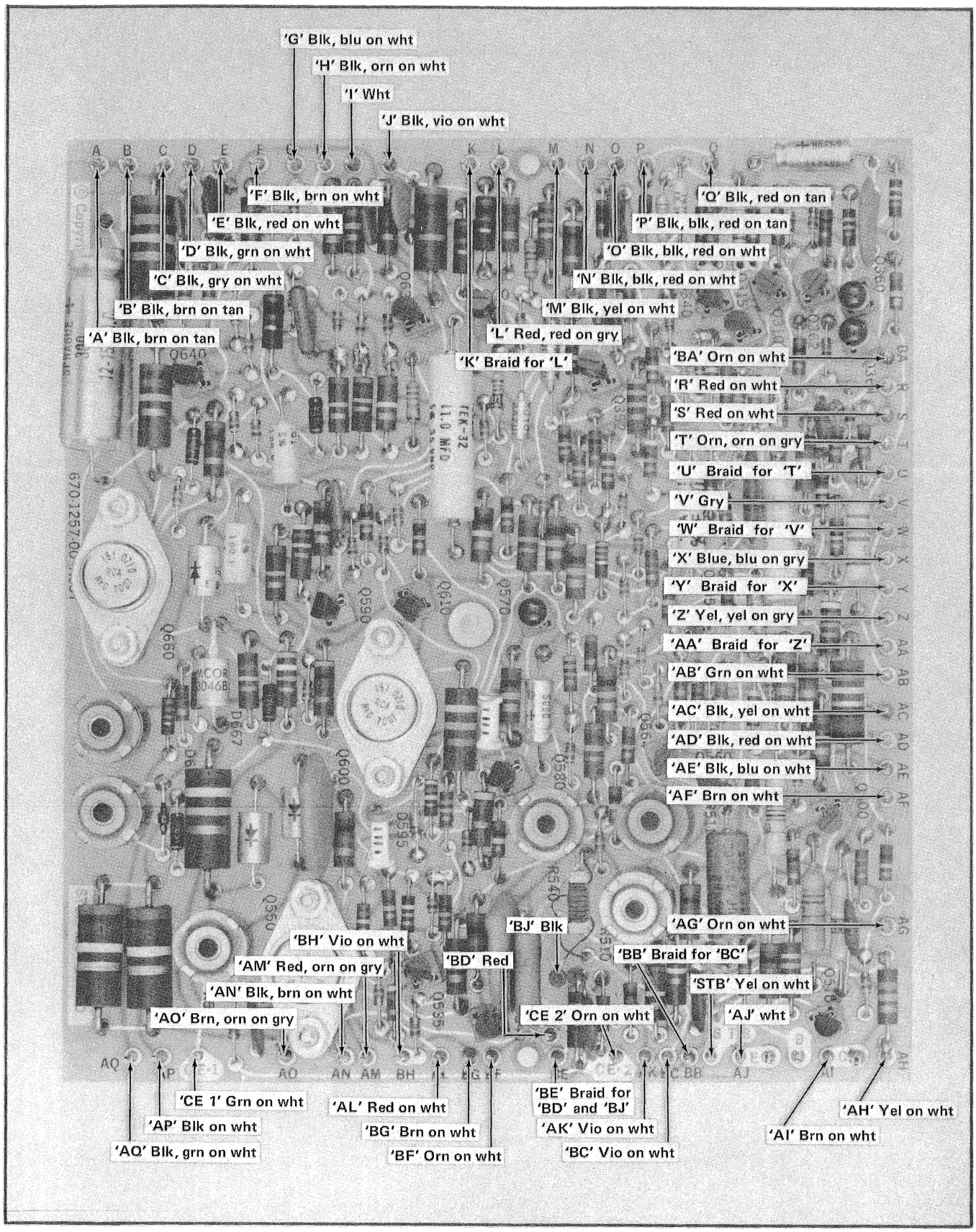


Fig. 8-11. Storage circuit board, color codes of connecting leads.For instruments above SN B150000.

FIG. 8-11

NON-STORE FROM PIN 6, J340 (3)

(4) PARTIAL Z AXIS BOARD

(1) -100V (DEC)

STORE

FOCUS

SW5 (3) TEST SPIRAL

SW580 VIEW (SPRING RETURN)

SW622 ERASE (SPRING RETURN)

FROM PIN BH (3)

Z AXIS FROM PIN U (4)

VIEW FROM PIN 20 J340 (3)

REMOTE ERASE FROM PIN 18 J340 (3)

FROM D340 (3)

TO R811 (3)

TO OPERATING LEVEL TEST POINT JACK

TO (4) P490 PIN 7

TO (4) P490 PIN 6

FROM POWER SUPPLY

ERASE INTERVAL TO PIN 7, J340 (3)

CE-1

CE-2

CE 1

J340

V490 (4)

STORAGE TARGET BACKPLATE

STORAGE BOARD

INTEGRAL UNIT OF SW580

B580 A&B

B622 A&B 220k 220k R622 A&B 115 VAC

VIEW MULTI — EFF BELOW SN B150000

HOLD MULTI

ERASE MULTI

OV VIEW +20V HOLD

FADE NEGATIVE AMPLITUDE

BACKPLATE RECOVERY

HOLD MODE

ERASE COLLIMATION

FLOOD GUN ANODE

100V/CM .1S/CM

10V/CM .1S/CM

50V/CM 1S/CM

0.2 MS/CM

** INDICATES FLOOD GUN PINS – P491

REFERENCE DIAGRAMS

(1) HORIZ/VERT AMPLIFIER

(3) TEST SPIRAL GEN & SWITCHING

(4) Z AXIS & H.V. SUPPLY

(7) FOR POWER DISTRIBUTION

SEE PARTS LIST FOR SEMICONDUCTOR TYPES

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN BLUE.

REV. D, DEC. 1975

971

TYPE 611 DISPLAY DEVICE

STORAGE CIRCUIT (5)

SN B150000-UP

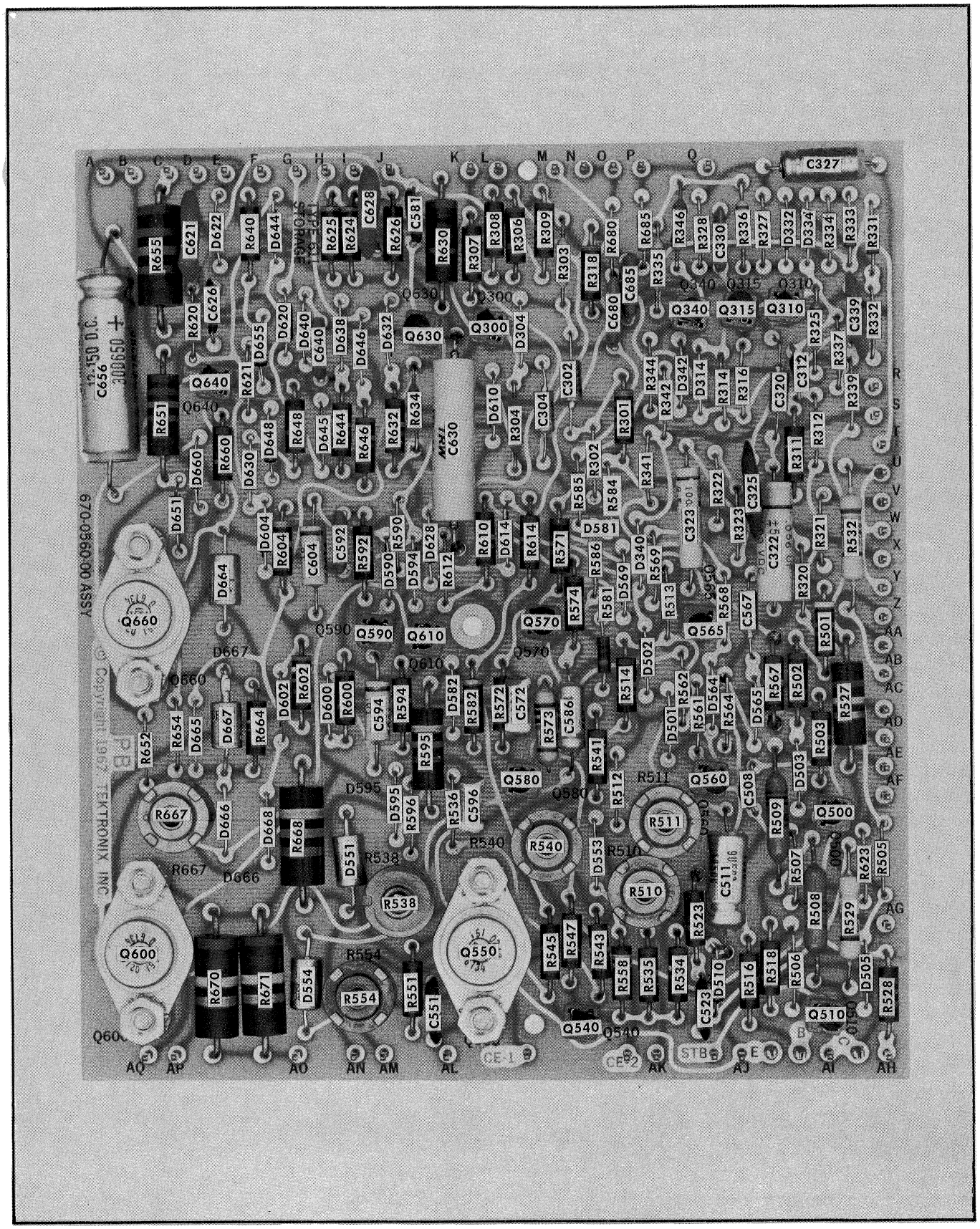


Fig. 8-12. Storage circuit board, component location. For instruments below SN B150000.

Ⓑ

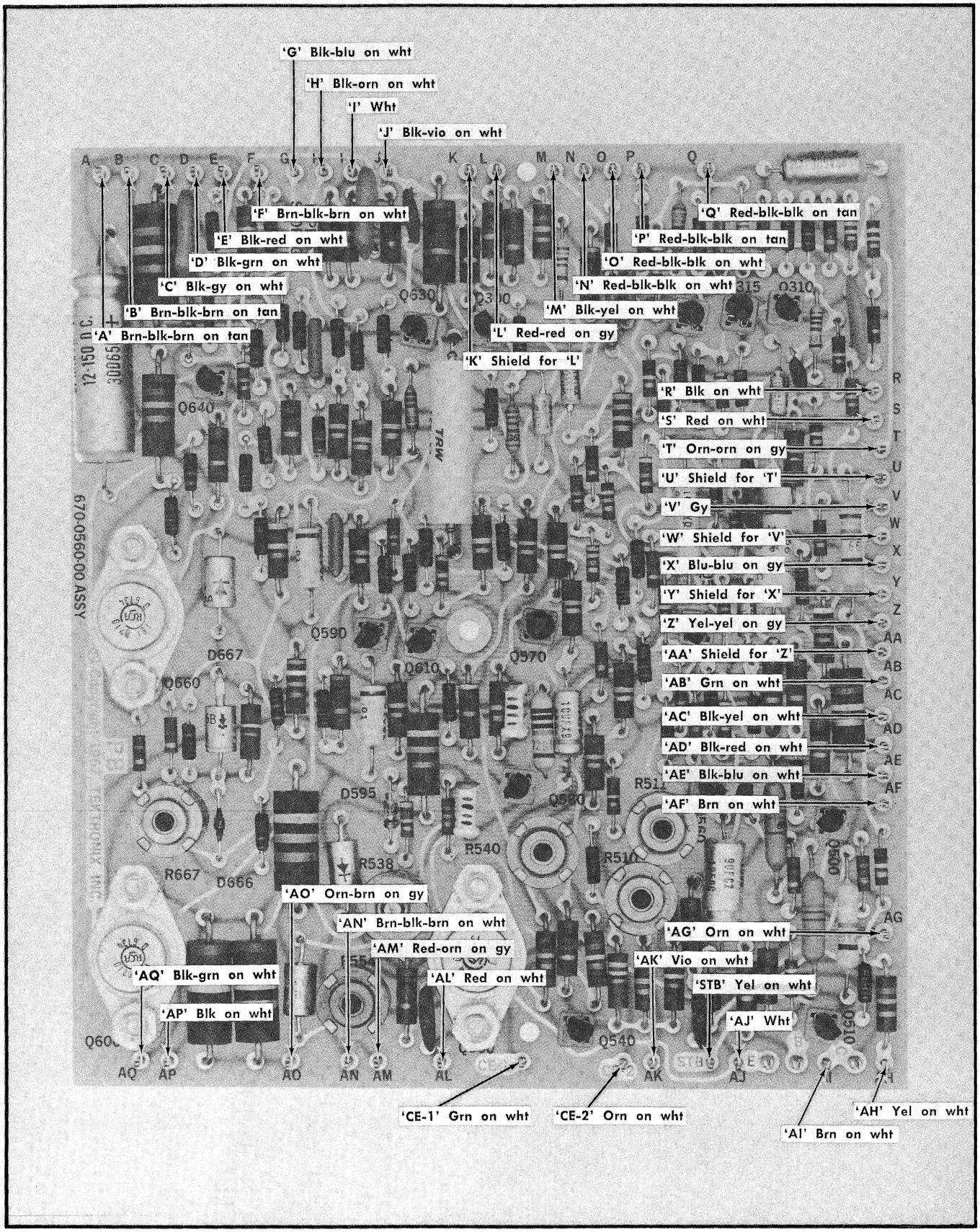
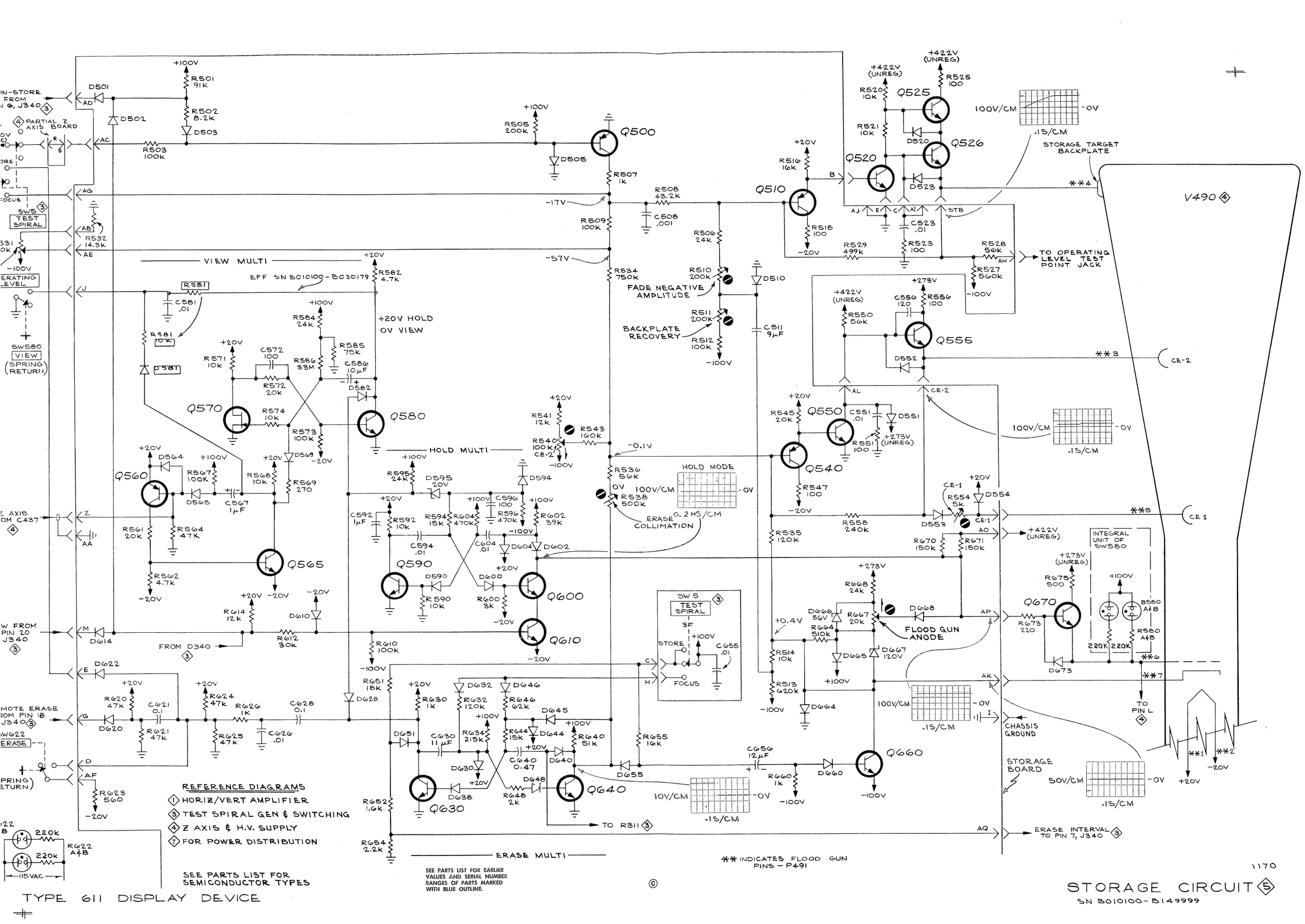


Fig. 8-13. Storage circuit board, color codes of connecting leads. For instruments below SN B150000.


+100V
R501 91k
D501
D502
R502 8.2k
D503
R503 100k
AD
AC
AG
AB
AE
J
R532 14.3k
VIEW MULTI
EFF SN B010100 - B030179
R582 4.7k
+20V
R581
C581 .01
R581 10k
D581
+20V HOLD
0V VIEW
R584 24k
R585 75k
C586 10µF
R586 33M
R571 10k
C572 100
R572 20k
Q570
R574 10k
R573 100k
Q580
D582
D564
R567 100k
D565
C567 1µF
R566 10k
D569
R569 270
-20V
Q560
R561 20k
R564 47K
R562 4.7k
Q565
R614 12k
D610
R612 30k
D614
FROM D340
R610 100k
-100V
D628
D622
R620 47k
C621 0.1
D620
R621 47k
R624 47k
R626 1K
C628 0.1
R625 47k
C626 .01
R623 560
AF
D
C
H
R595 24k
D595
20V
D594
R592 10k
C592 1µF
C594 .01
R594 15k
R604 470k
C590 100
R596 470k
R602 39k
C604 .01
D604
D602
Q590
D590
R590 10k
D600
R600 3k
Q600
Q610
R651 18k
D651
R630 1k
D632
R632 120k
D646
R646 62k
D645
C630 11µF
R634 215k
R644 15k
D644
C640 0.47
R640 51k
D640
D630
D638
R648 2k
Q630
Q640
R652 1.6k
R654 2.2k
D655
R655 16k
C656 12µF
R660 1k
D660
Q660
TO R311
ERASE MULTI
+100V
R505 200k
Q500
D505
R507 1k
-17V
R508 43.2k
C508 .001
R509 100k
-57V
R584 750k
R506 24k
R510 200k
FADE NEGATIVE AMPLITUDE
R511 200k
BACKPLATE RECOVERY
R512 100k
D510
C511 9µF
-100V
R541 12k
R543 100k
R540 100k CE-2
-0.1V
R536 56k
0V
R538 500k
100V/CM
.2 MS/CM
ERASE COLLIMATION
HOLD MULTI
HOLD MODE
-0V
+20V
R516 16k
Q510
R518 100
-20V
B
+422V (UNREG)
R520 10k
Q520
R521 10k
Q525
D520
Q526
R525 100
D523
100V/CM
.1S/CM
STORAGE TARGET BACKPLATE
**4
V490 4
AJ
E
C
AI
STB
C523 .01
R523 100
R529 499k
R528 56k
AH
R527 560k
TO OPERATING LEVEL TEST POINT JACK
+278V
C556 120
R556 100
R550 56k
Q555
D552
**3
CE-2
AL
R545 20k
Q550
C551 .01
D551
R551 100
+273V (UNREG)
100V/CM
.1S/CM
R547 100
R535 120k
R558 240k
D553
CE-1
R554 5k
D554
**5
CE 1
AO
R670 150k
R671 150k
+422V (UNREG)
INTEGRAL UNIT OF SW580
+273V (UNREG)
R675 500
Q670
R673 220
B580 A&B
220k
220k
R580 A&B
**6
**7
D673
TO PIN L 4
R668 24k
D668
D666 56V
R667 20k
FLOOD GUN ANODE
R664 510k
D665
D667 120V
D664
R514 10k
R513 620k
+0.4V
AP
AK
100V/CM
.1S/CM
CHASSIS GROUND
STORAGE BOARD
50V/CM
.1S/CM
**1
**2
-20V
AQ
ERASE INTERVAL TO PIN 7, J340 3
SW 5 3
TEST SPIRAL
3F
STORE
FOCUS
C655 .01
ON-STORE FROM J340 3
4 PARTIAL Z AXIS BOARD
SW5 TEST SPIRAL 3
-100V
OPERATING LEVEL
SW580 VIEW (SPRING RETURN)
Z AXIS FROM C437 4
W FROM PIN 20 J340 3
MOTE ERASE FROM PIN 18 J340 3
W622 ERASE
SPRING ETURN)
W22 B
220k
220k
R622 A&B
115VAC
REFERENCE DIAGRAMS
1 HORIZ/VERT AMPLIFIER
3 TEST SPIRAL GEN & SWITCHING
4 Z AXIS & H.V. SUPPLY
7 FOR POWER DISTRIBUTION
SEE PARTS LIST FOR SEMICONDUCTOR TYPES
TYPE 611 DISPLAY DEVICE
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.
** INDICATES FLOOD GUN PINS - P491
STORAGE CIRCUIT 5
1170
STORAGE CIRCUIT 5
SN B010100 - B149999

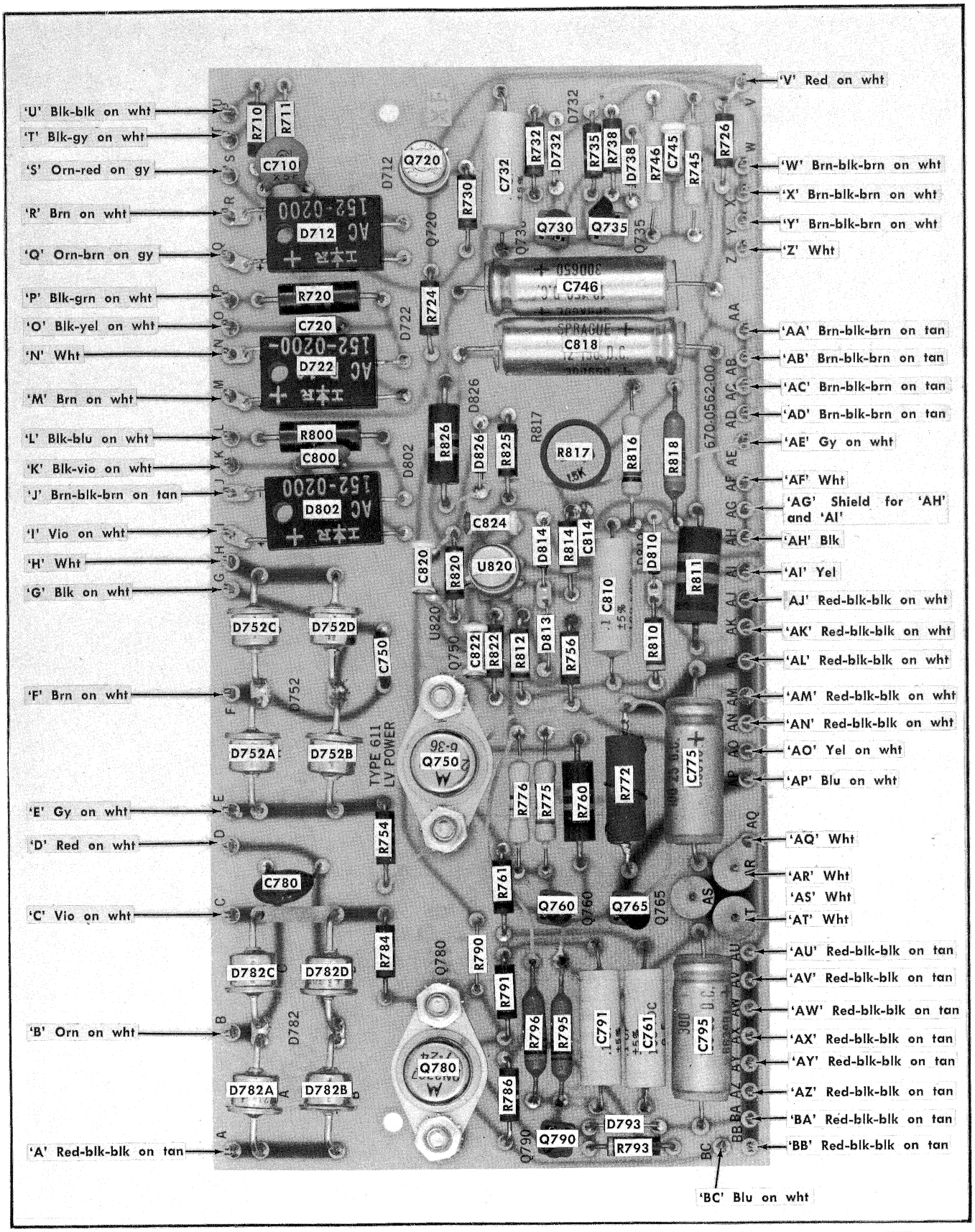
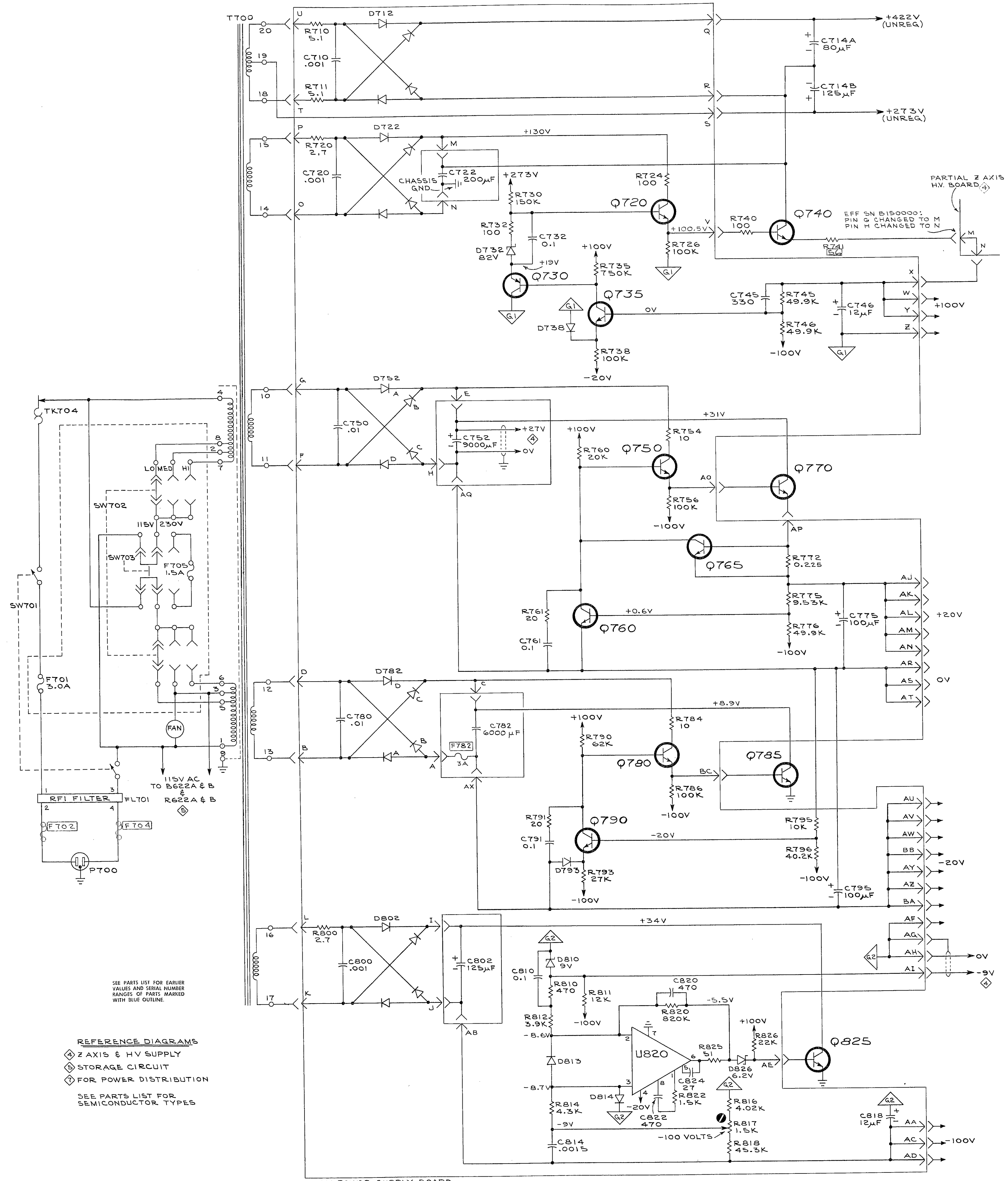


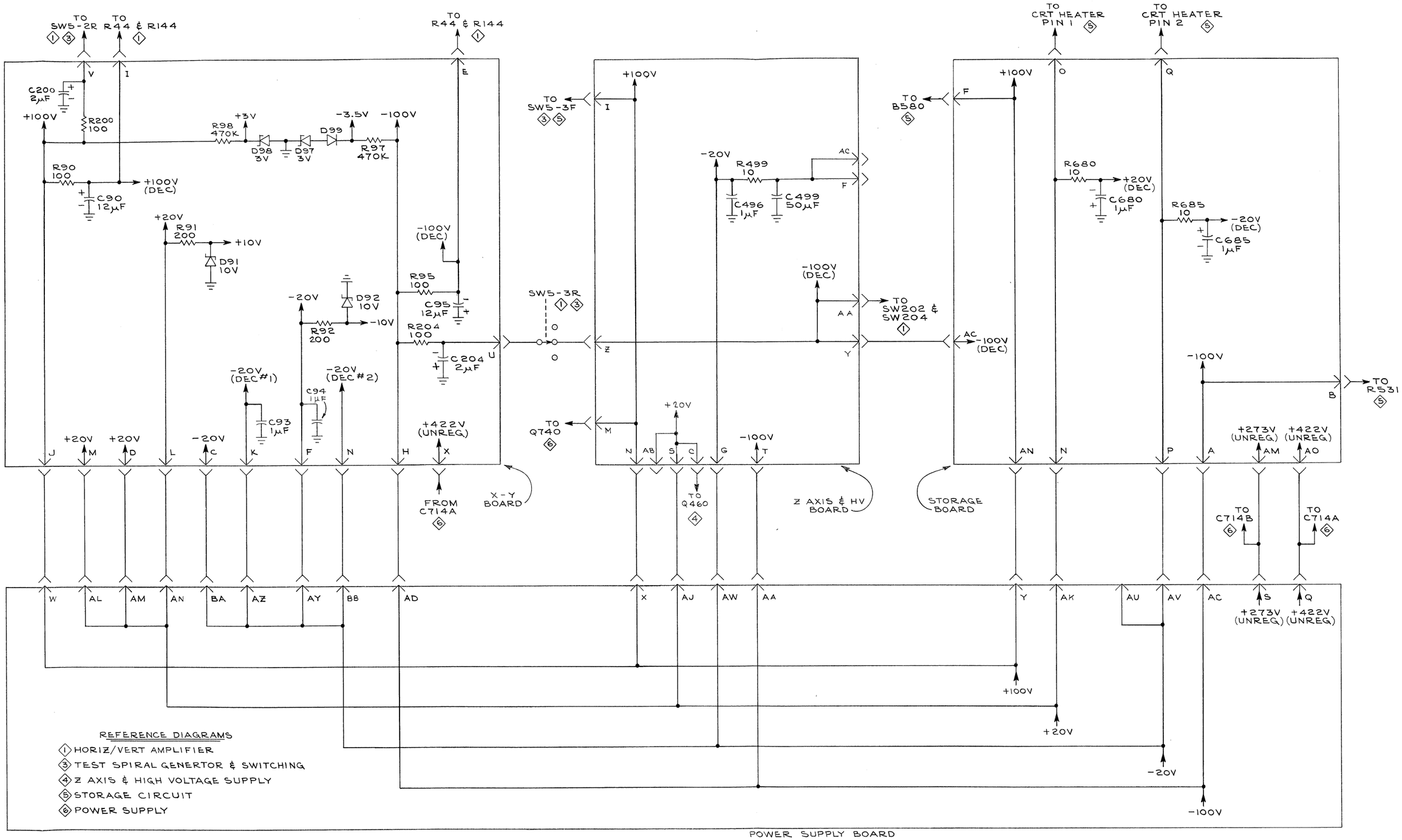
Fig. 8-14. Low Voltage Regulator board.



SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

REFERENCE DIAGRAMS
(4) Z AXIS & HV SUPPLY
(5) STORAGE CIRCUIT
(7) FOR POWER DISTRIBUTION

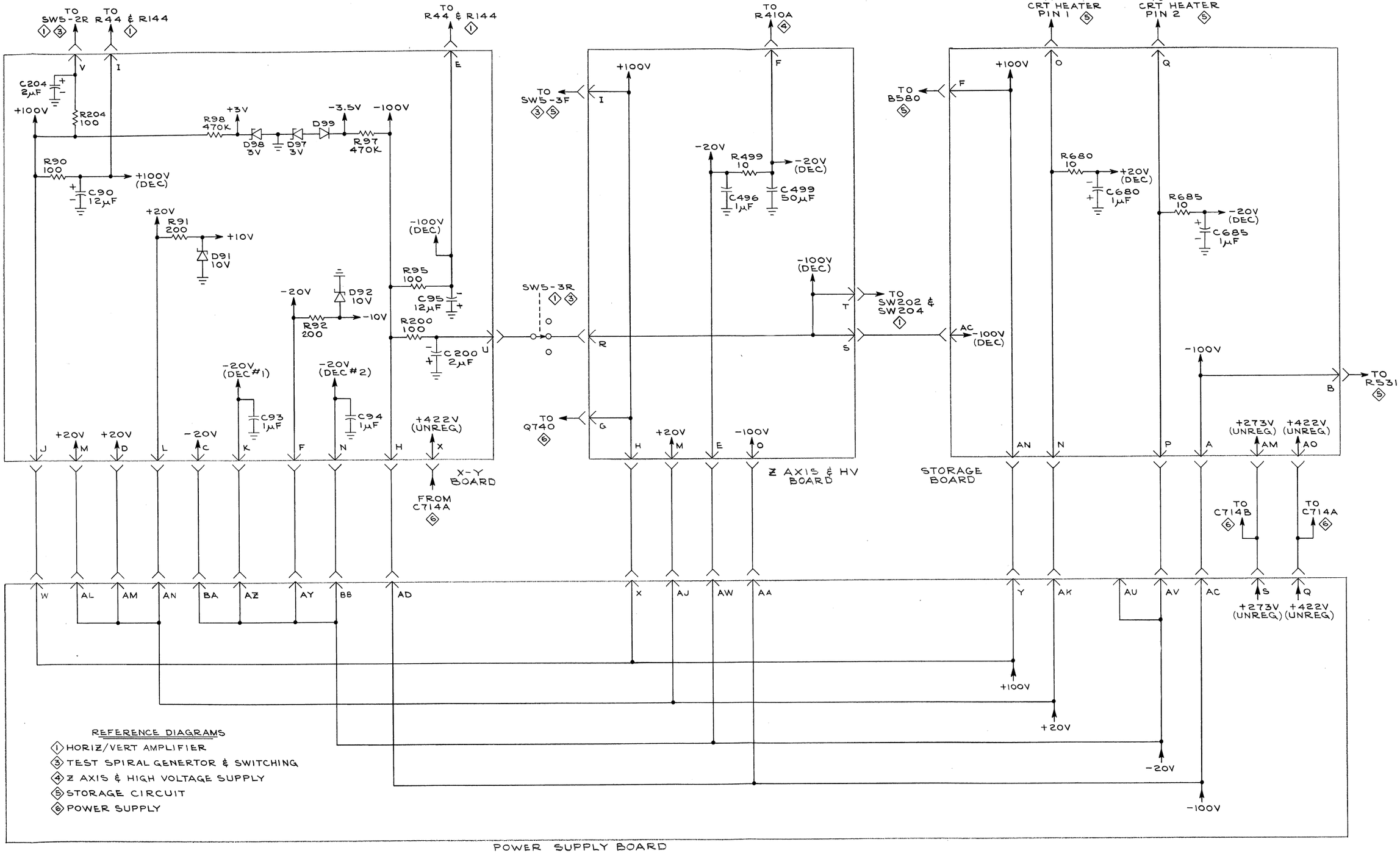
SEE PARTS LIST FOR SEMICONDUCTOR TYPES



TYPE 611 DISPLAY DEVICE

1170

POWER DISTRIBUTION 7
SN B150000-UP



REFERENCE DIAGRAMS

① HORIZ/VERT AMPLIFIER
③ TEST SPIRAL GENERTOR & SWITCHING
④ Z AXIS & HIGH VOLTAGE SUPPLY
⑤ STORAGE CIRCUIT
⑥ POWER SUPPLY

POWER SUPPLY BOARD

FIG. 1 FRONT

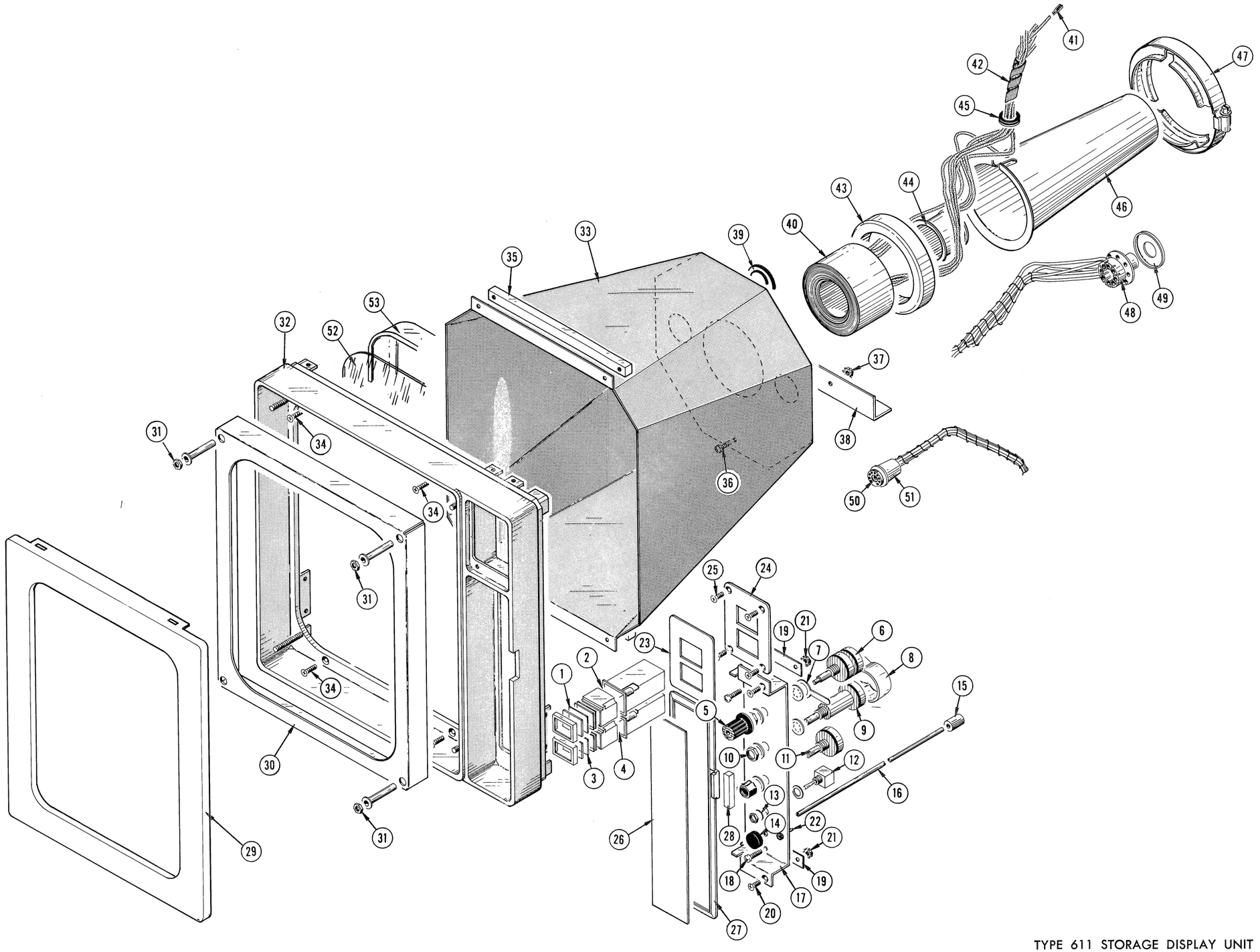


FIG. 1

TYPE 611 STORAGE DISPLAY UNIT

FIG. 2 HIGH VOLTAGE CHASSIS

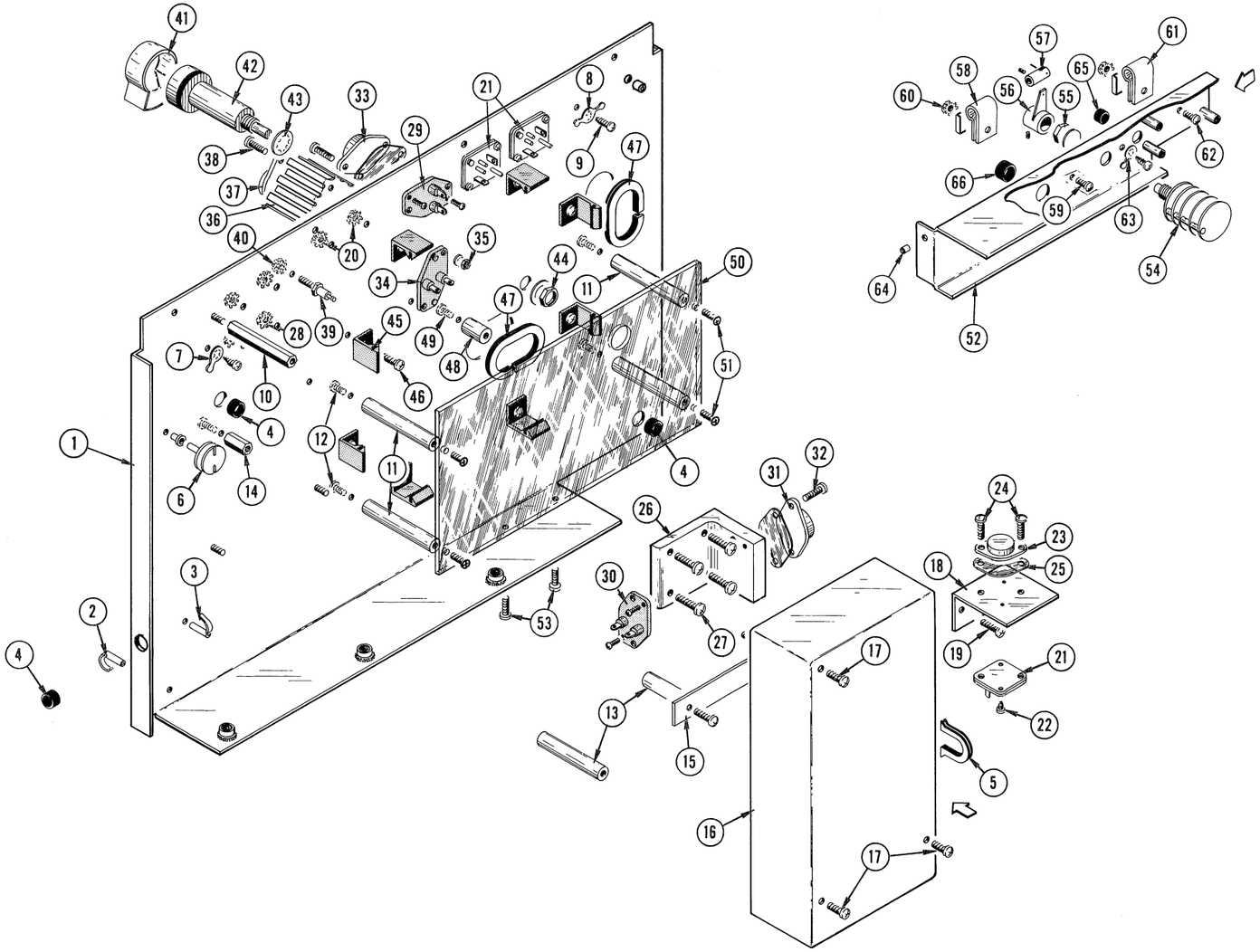


FIG. 2

B

TYPE 611 STORAGE DISPLAY UNIT

FIG. 3 VERTICAL/HORIZONTAL AMPLIFIER & STORAGE CHASSIS

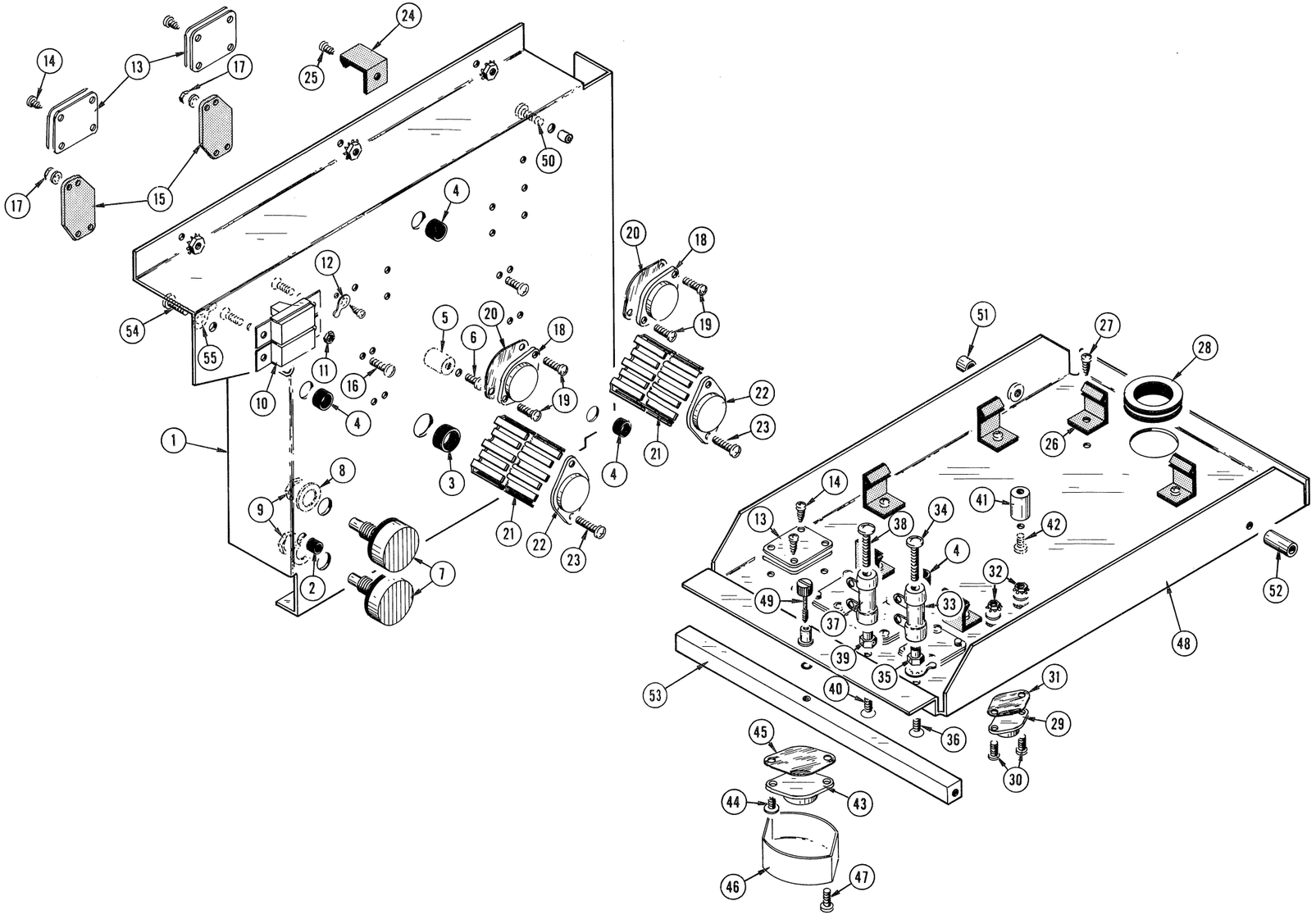
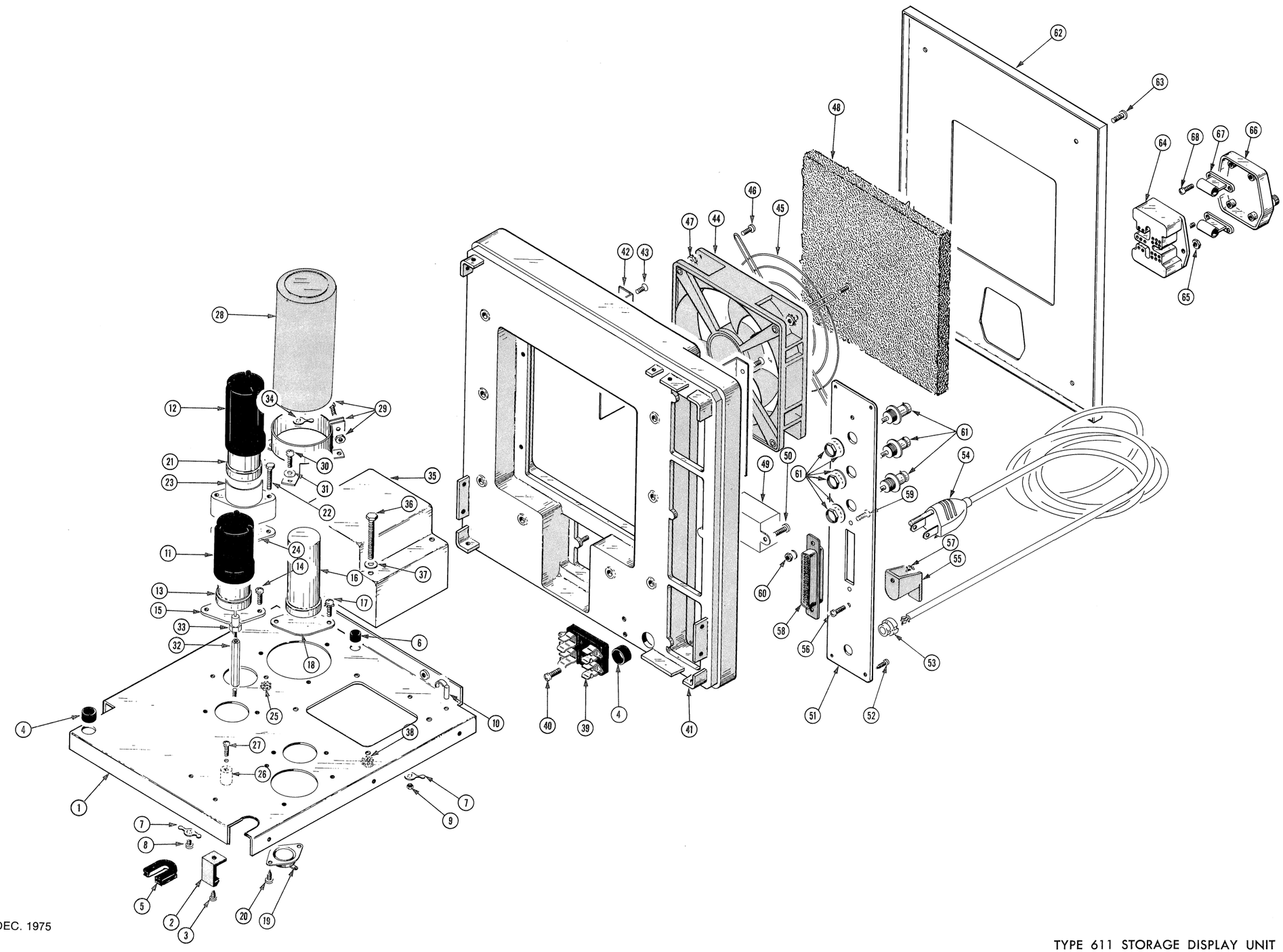


FIG. 4 LOW VOLTAGE CHASSIS & REAR



REV. C DEC. 1975

TYPE 611 STORAGE DISPLAY UNIT

FIG. 4

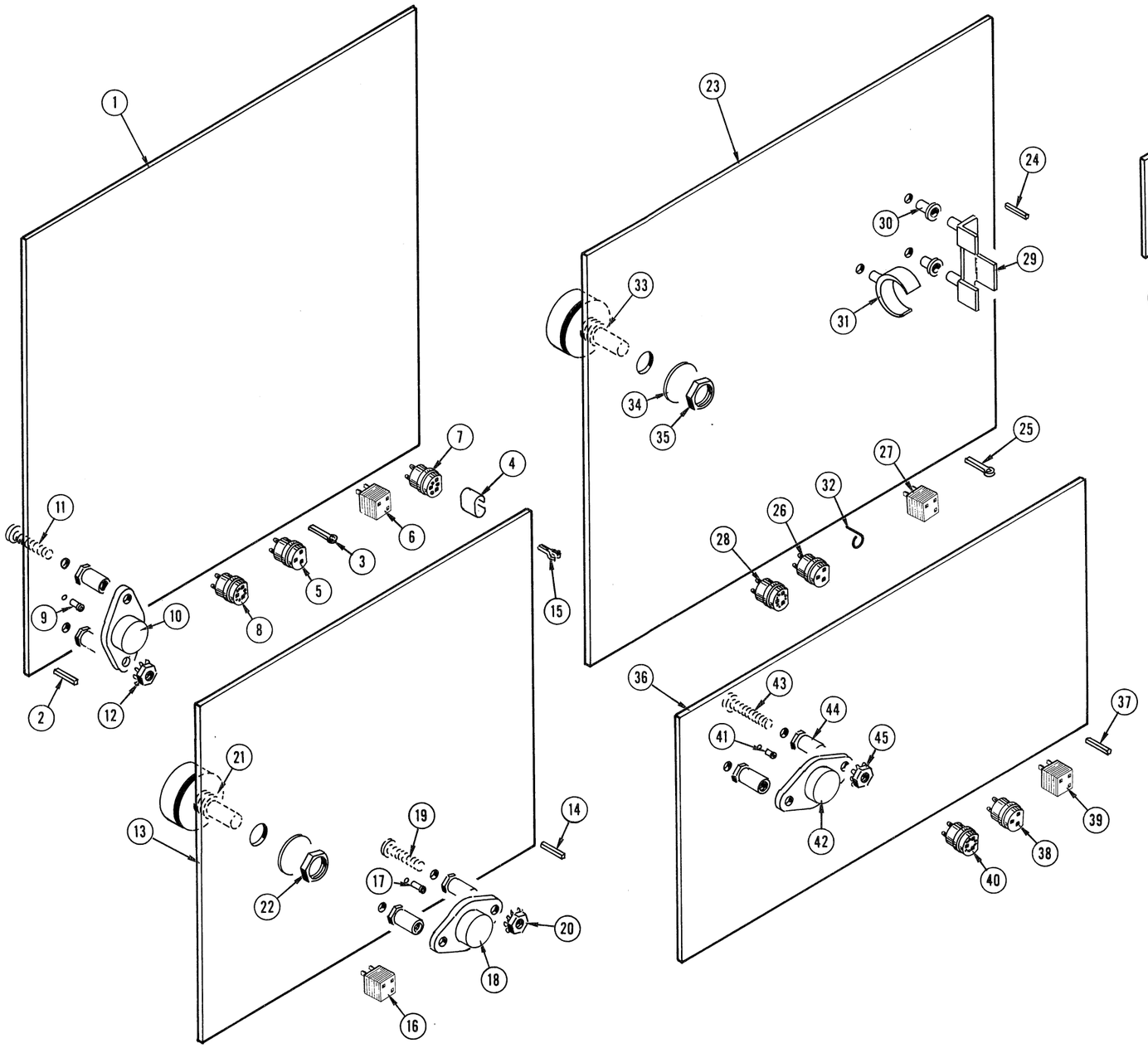

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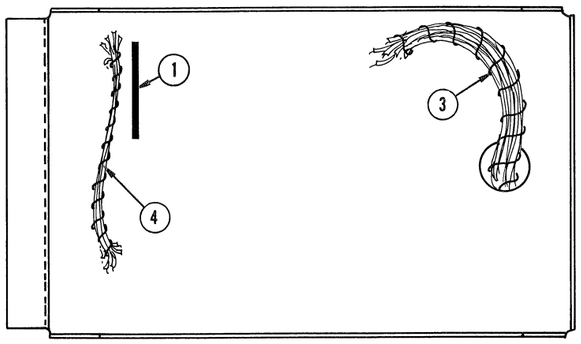
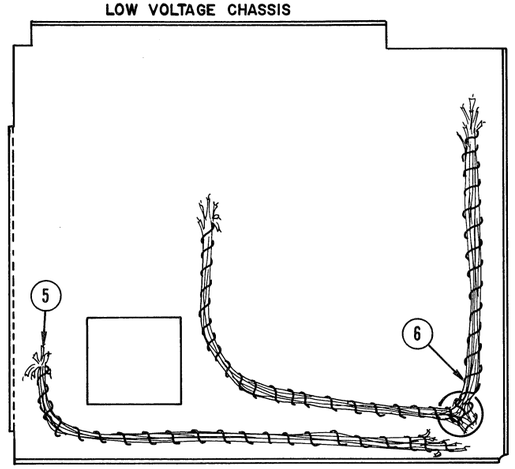
FIG. 6 CERAMIC STRIPS & CABLE HARNESSES

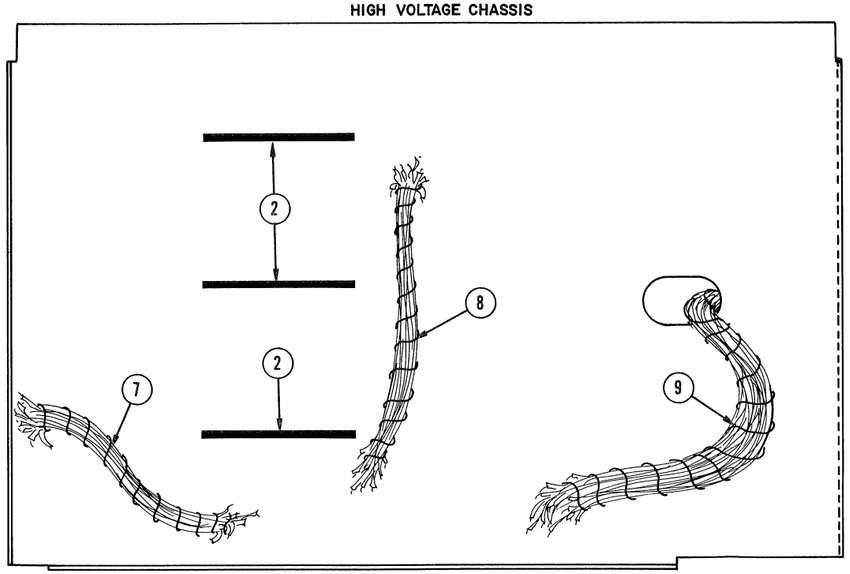
STORAGE CHASSIS



LOW VOLTAGE CHASSIS



HIGH VOLTAGE CHASSIS



VERTICAL / HORZONTAL AMPLIFIER CHASSIS

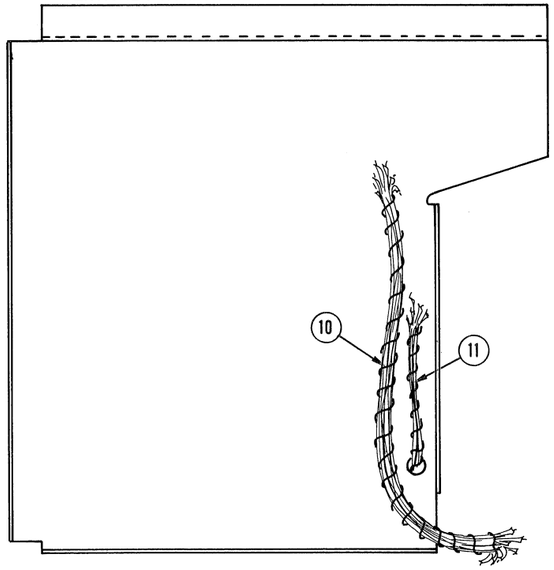


FIG. 6

FIG. 7 CABINET & FRAME

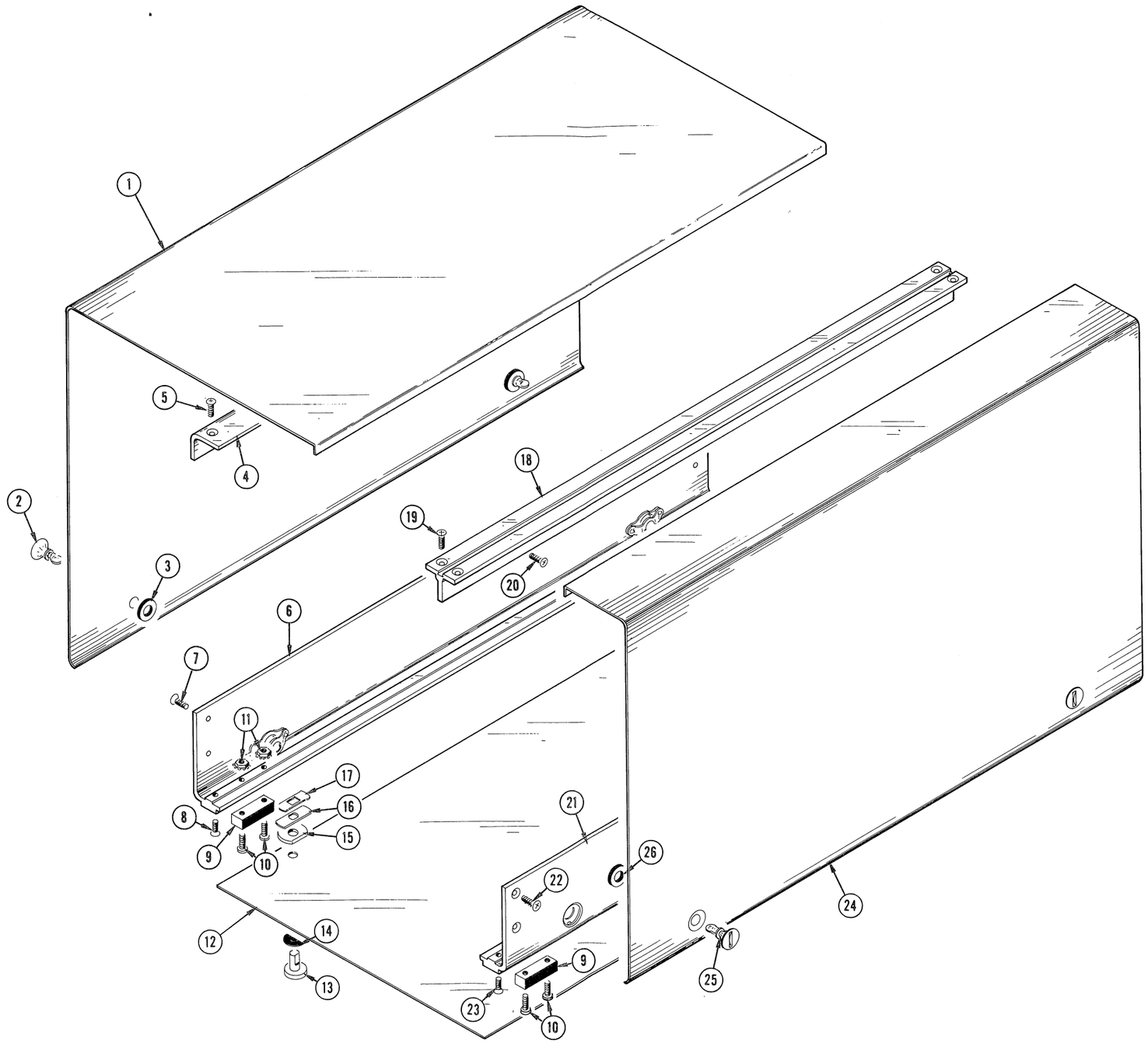


FIG. 8 STANDARD ACCESSORIES

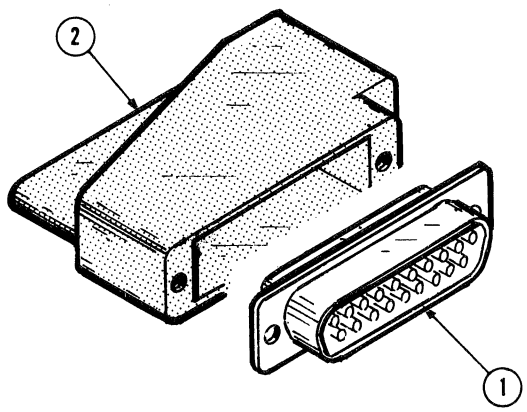


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
8-1	131-0570-00			1		CONNECTOR,RCPT,:25 PIN,MALE	71468	DB25P
-2	200-0821-00			1		COVER,ELEC CONN:FOR 25 PIN RTANG TYPE	71468	DB 51213-1
	070-0752-02			1		MANUAL,TECH:INSTRUCTION	80009	070-0752-02

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committed to technical excellence

MANUAL CHANGE INFORMATION

PRODUCT 611
070-0752-02

CHANGE REFERENCE M32091
DATE 8-10-77

CHANGE:	DESCRIPTION

EFF SN B226525

ELECTRICAL PARTS LIST AND SCHEMATIC CHANGES

ADD:

C466	290-0719-00	CAP.,FXD,ELCTLT:47UF,20%,25V
R465	315-0101-03	RES.,FXD,CMPSN:100 OHM,5%,0.25W

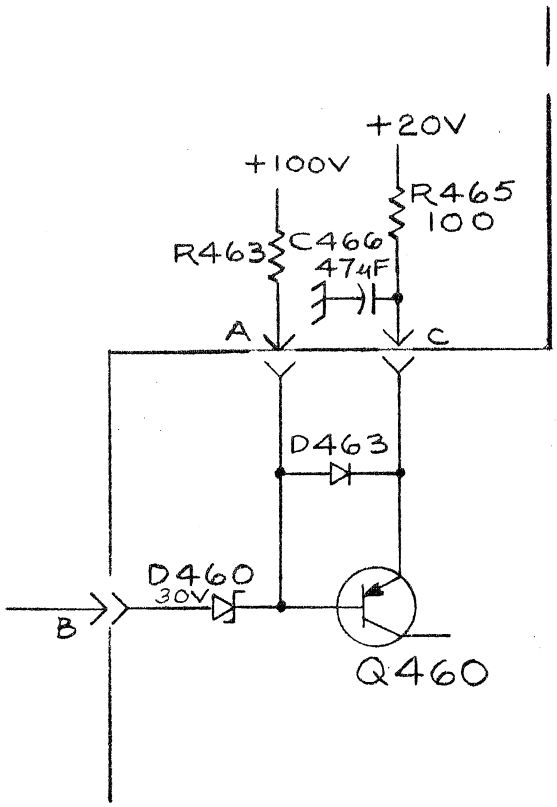
MECHANICAL PARTS LIST CHANGES

Page 7-13

CHANGE TO:

Fig. 5-23	670-0837-10	1	CKT BOARD ASSY:HIGH VOLTAGE AND Z AXIS

DIAGRAM ◇4◇ Z AXIS & H. V. SUPPLY - Partial



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MANUAL CHANGE INFORMATION

PRODUCT 611
070-0752-02

CHANGE REFERENCE M32578
DATE 3-13-78

CHANGE:	DESCRIPTION

EFF SN B227346

ELECTRICAL PARTS LIST AND SCHEMATIC CHANGES

CHANGE TO:

D80	152-0323-00	SEMICOND DEVICE:SILICON,35V,0.1A,SE365
D180	152-0323-00	SEMICOND DEVICE:SILICON,35V,0.1A,SE365
D453	152-0323-00	SEMICOND DEVICE:SILICON,35V,0.1A,SE365

D80 and D180 are shown on diagram 1 HORIZ/VERT AMP.

D453 is shown on diagram 4 Z AXIS & H. V. SUPPLY.