INSTRUCTION MANUAL

TYPE 576 CURVE-TRACER

MANUFACTURERS OF CATHODE-RAY OSCILLOSCOPES

INSTRUCTION MANUAL

Serial Number ____________

TYPE 576 CURVE-TRACER

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

Fig. 1-1. Type 576 Curve Tracer.

SECTION 1
SPECIFICATION

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

The Type 576 Curve Tracer is a dynamic semiconductor tester which allows display and measurement of characteristic curves of a variety of two and three terminal devices including bipolar transistors, field effect transistors, MOSFETs, silicon controlled rectifiers and unijunction transistors. A variety of possible measurements is available using either grounded emitter or grounded base configurations. The instrument has available either an AC or a DC collector supply voltage ranging from 0 to ±1500 volts. The step generator produces either current or voltage steps, which may be applied to either the base terminal or the emitter terminal of the device under test. Step generator outputs range from 5 nA to 2 A in the current mode, and from 5 mV to 40 V in the voltage mode. The steps may also be produced as short duration pulses. Calibrated step offset allows offsetting the step generator output either positive or negative. The vertical display amplifier measures either collector current or leakage current with a maximum deflection factor of 1 nA/division when making a leakage measurement. The horizontal display amplifier allows measurement of both collector and base voltage.

The following electrical and environmental characteristics are valid for instruments operated at an ambient temperature of from +10°C to +40°C after an initial warmup period of 5 minutes, when previously calibrated at a temperature of +25°C ±5°C. Section 5, Performance Check and Calibration Procedure, gives a procedure for checking and adjusting the Type 576 with respect to the following specification.

The Type 576 MOD 301W is a standard Type 576 without the Readout Assembly. All the information contained in this manual pertaining to the Readout Assembly and its operation should be disregarded when used in conjunction with a modified instrument.

TABLE 1-1
ELECTRICAL CHARACTERISTICS

Collector Supply

Characteristic	Performance			
Sweep Modes	Normal mode: AC (at line frequency); positive-or negative-going full wave rectified AC. DC mode: positive or negative DC.			
DC Mode Ripple	No-load: 2% or less of voltage, or 0.1% or less of full range voltage.			
Voltages Accuracy	Peak open circuit voltages on all ranges within +35% and −5%.			
Ranges	15 V	75 V	350 V	1500 V
Maximum Peak Current (Normal Mode)[1]	10 A	2 A	0.5 A	0.1 A
Peak Current (Step Generator in Pulsed Steps Mode)	At least 20 A	At least 4 A	At least 1 A	At least 0.2 A
Minimum Series Resistance	0.3 Ω	6.5 Ω	140 Ω	3 kΩ
Maximum Series Resistance	65 kΩ	1.4 MΩ	6.5 MΩ	6.5 MΩ
Series Resistance Available	0.3 Ω, 1.4 Ω, 6.5 Ω, 30 Ω, 140 Ω, 650 Ω, 3 kΩ, 14 kΩ, 65 kΩ, 300 kΩ, 1.4 MΩ and 6.5 MΩ, all within 5% or 0.1 Ω.			
Peak Power Watts Settings	0.1 W, 0.5 W, 2.2 W, 10 W, 50 W and 220 W. Derived from nominal peak open circuit collector voltages and nominal series resistance values at nominal line voltage.			
Safety Interlock	When MAX PEAK VOLTS switch is set to either 75, 350 or 1500, a protective box must be in place over test terminals and its lid closed be-			

[1]Collector Supply Maximum Continuous Peak Current Operating Time vs Duty Cycle and Ambient Temperature. With the PEAK POWER WATTS at 50 only, the following limitations apply: Maximum continuous operating time at rated current (100% duty cycle) into a short circuit is 20 minutes at 25°C ambient, or 10 minutes at 40°C ambient. Alternatively dury cycle may be limited to 50% at 25°C ambient or 25% at 40°C ambient. (A normal family of curves for a transistor will produce a duty cycle effect to 50% or less even if operated continuously.) Over dissipation of the collector supply will temporarily shut it off and turn on the yellow COLLECTOR SUPPLY VOLTAGE DISABLED light. No damage will result.

	fore voltage can be applied. Amber light on indicates interlock is open; Red light on indicates voltage is being applied to test terminals.
Looping Compensation	Cancels stray capacitance between collector test terminal and ground in Standard Test Fixture and all Standard Test Fixture Accessories.
	Step Generator
Accuracy (Current or Voltage Steps, Including Offset)	
Incremental Accuracy	Within 5% between any two steps, without .1X STEP MULT button pressed; within 10% with .1X STEP MULT button pressed.
Absolute Accuracy	Within 2% of total output, including any amount of offset, or 1% of AMPLITUDE switch setting, whichever is greater.
Step (Current or Voltage) Amplitudes	One times or 0.1 times (with .1X STEP MULT button pressed) the AMPLITUDE switch setting.
OFFSET MULT Control Range	Continuously variable from 0 to 10 times AMPLITUDE switch setting, either aiding or opposing the step generator polarity.
Current Mode	
AMPLITUDE Switch Range	200 mA to 50 nA, in 1-2-5 sequence.
Maximum Current (Steps and Aiding Offset)[2]	20 times AMPLITUDE switch setting, except 10 times switch setting when switch is set to 200 mA, and 15 times switch setting when the switch is set to 100 mA.
Maximum Voltage (Steps and Aiding Offset)	At least 10 V.
Maximum Opposing Offset Current	Whichever is less: 10 times AMPLITUDE switch setting, or between 10 mA and 20 mA.
Maximum Opposing Voltage	Between 1 V and 3 V.
Ripple Plus Noise	0.5% or less of AMPLITUDE switch setting or 4 nA, peak to peak.
Voltage Mode	
AMPLITUDE Switch Range	50 mV to 2 V, in 1-2-5 sequence.
Maximum Voltage (Steps and Aiding Offset)	20 times AMPLITUDE switch setting.
Maximum Current (Steps and Aiding Offset)	At least 2 A at 10 V or less, derating linearly to 10 mA at 40 V.
Short Circuit Current Limiting (Steps and Aiding Offset)	20 mA, 100 mA, 500 mA, +100%-0%; 2 A +50%-0%; as selected by CURRENT LIMIT switch.
Maximum Opposing Offset Voltage	10 times AMPLITUDE switch setting.
Maximum Opposing Current	Limited between 10 mA and 20 mA
Ripple Plus Noise	0.5% or less of AMPLITUDE switch setting, or 2 mV, peak to peak.
Step Rates	(Front panel RATE button labels in parentheses.) 1 times (.5X), 2 times (NORM) and 4 times (2X) line frequency. Steps occur at zero collector voltage when .5X or NORM RATE buttons are pressed, and also at peak voltage when 2X RATE button is pressed. Steps occur at collector voltage peak and at normal rate when .5X and 2X RATE buttons are pressed together.
Pulsed Steps	Pulsed steps 80 μs or 300 μs wide within +20%, −5% produced whenever one of the PULSED STEPS buttons is pressed. Pulsed steps can be produced only at normal and .5 times normal rates. Collector Supply mode automatically becomes DC when either the 300 μs or 80 μs PULSED STEPS button is pressed unless POLARITY switch is set to AC. If the 300 μs and 80 μs PULSED STEPS buttons are pressed together, 300 μs pulsed steps are produced, but collector supply mode does not change.

[2]Continuous DC Output vs Time, Temperature and Duty Cycle. 2A continuous DC output can be achieved for an unlimited period up to 30°C ambient. Between 30°C and 40°C ambient, 2A continuous DC operation should be limited to 15 minutes or limited to a 50% duty cycle or less. A family of steps (such as 10 steps at 200 mA per step) will automatically reduce the duty cycle to 50% even if generated continuously. Exceeding the rating will temporarily shut off power to the entire instrument but no damage will result.

Steps and Offset Polarity	Corresponds with collector supply polarity (positive going when POLARITY switch is set to AC) when the POLARITY INVERT button is released. Is opposite collector supply polarity (negative-going in AC) when either the POLARITY INVERT button is pressed or the Lead Selector switch is set to BASE GROUNDED. If Lead Selector switch is set to BASE GROUNDED, POLARITY INVERT button has no effect on steps and offset polarity.
Step Families	Repetitive families of characteristic curves generated with REP STEP FAMILY button pressed. Single family of characteristic curves generated each time SINGLE STEP FAMILY button is pressed.
Number of Steps	Ranges from 1 to 10 as selected by the NUMBER OF STEPS switch. For zero steps, press SINGLE STEP FAMILY button.

Display Amplifiers

Display Accuracies (%of Highest On-Screen Value)	Display magnified (DISPLAY OFFSET Selector switch set to either VERT X10 or HORIZ X10) and offset between			Display Unmagnified
	100 and 40 divisions	35 and 15 divisions	10 and 0 divisions	
Normal and DC Collector Supply Modes				
Vertical Collector Current	2%	3%	4%	3%
External Vertical (Through Interface)	2%	3%	4%	3%
Horizontal Collector Volts	2%	3%	4%	3%
Horizontal Base Volts	2%	3%	4%	3%
External Horizontal (Through Interface)	2%	3%	4%	3%
Leakage Collector Supply Mode				
Vertical Emitter Current (VERTICAL Switch set between 10 nA and 2 mA)	2% ±1 nA	3% ±1 nA	4% ±1 nA	3% ±1 nA
Vertical Emitter Current (VERTICAL Switch set to 5 nA, 2 nA or 1 nA)	Not Applicable			5% ±1nA
Horizontal Collector or Base Volts VERTICAL switch set to:				
1 µA or more	2%	3%	4%	3%
100 nA, 10 nA or 1 nA	Not Applicable			3% plus 0.025 V for each vertical division of deflection on the CRT
500 nA, 50 nA or 5 nA	Not Applicable			3% plus 0.125 V for each vertical division of deflection on the CRT
200 nA, 20 nA or 2 nA	Not Applicable			3% plus 0.050 V for each vertical division of deflection of the CRT
Step Generator Display				

Vertical Step Generator	3%	4%	5%	4%
Horizontal Step Generator	3%	4%	5%	4%

Deflection Factors Vertical Collector Current	1 μA/division to 2 A/division in 1-2-5 sequence.
Emitter Current	1 nA/division to 2 mA/division in 1-2-5 sequence.
Step Generator	1 step/division.
Horizontal Collector Volts	50 mV/division to 200 V/division in 1-2-5 sequence
Base Volts	50 mV/division to 2 V/division in 1 2 5 sequence.
Input Impedance	At least 100 MΩ with HORIZONTAL switch set to 50 mV, 100 mV and 200 mV BASE; 1 MΩ within 2% with switch set to .5 V, 1 V and 2 V.
Step Generator	1 step/division

Maximum Displayed Noise	1% or less, or MAX PEAK VOLTS Switch			
	15	75	350	1500
Vertical COLLECTOR	1 μA	1 μA	2 μA	5 μA
EMITTER	1 nA	1 nA	2 nA	5 nA
Horizontal COLLECTOR	5 mV	5 mV	20 mV	200 mV
BASE	5 mV	5 mV	5 mV	5 mV

Calibration Check	With DISPLAY OFFSET Selector switch set to NORM (OFF), spot is deflected 10 divisions both vertically and horizontally within 1.5% whenever the CAL button is pressed. With DISPLAY OFFSET Selector switch set to X10 MAGNIFIER (either axis) the calibration spot is within 0.5% of zero spot (previously set to CRT graticule center) when CAL button is pressed.
Vertical and Horizontal Position Controls	Coarse positioning in 5 division increments within 0.1 division; continuous fine positioning over at least 5 divisions for each coarse position.
Display Offset	Vertical or Horizontal offset of display centerline value up to 10 divisions in 21 half division steps.

Display Positioning Accuracy Using POLARITY Switch	Spot positioning with change in POLARITY switch setting (using AC position as reference), within 0.1 division of:	
	Vertically	Horizontally
AC	Centered	Centered
+(NPN)	−5 divisions	−5 divisions
−(PNP)	+5 divisions	+5 divisions

CRT and Readout

CRT Type	Electrostatic deflection.
Screen Size	Calibrated area of 10 divisions by 10 divisions; 12 usable divisions horizontally (1 division equals 1 cm).
Typical Accelerating Potential	4000 V
Readouts	Automatic digitally lighted display. Readout is automatically blanked if readings would be outside the available ranges or would give erroneous display.
PER VERT DIV	1 nA to 20 A calculated from VERTICAL switch setting, DISPLAY OFFSET Selector switch setting and MODE switch setting (or X10 Vertical Interface Input).
PER HORIZ DIV	5 mV to 200 V calculated from HORIZONTAL switch setting and DISPLAY OFFSET Selector switch setting
PER STEPS	5 nA to 2A and 5 mV to 20 V calculated from AMPLITUDE switch setting and .1X STEP MULT button position (or X10 Step Interface Input).

β or g_m PER DIV	1 µ to 500 k calculated from VERTICAL switch setting, DISPLAY OFFSET Selector switch setting, AMPLITUDE switch setting, .1X STEP MULT button position, X10 Vertical Interface Input and X10 Step Interface Input.

Power Requirements

Power Connection	This instrument is designed for operation from power source with its neutral at or near ground (earth) potential. It is not intended for operation from two phases of multi-phase system, or across legs of single-phase, three wire system. It is provided with a three-wire power cord with three-terminal polarized plug for connection to the power source. Third wire is directly connected to instrument frame, and is intended to ground the instrument to protect operating personnel, as recommended by national and international safety codes.	
Line Voltage Ranges	115 VAC	230 VAC
Low	90 V to 110 V	180 V to 220 V
Medium	104 V to 126 V	208 V to 252 V
High	112 V to 136 V	224 V to 272 V
Line Frequency Range	48 to 66 Hz	
Maximum Power Consumption at 115 VAC, 60 Hz	305 W, 3.2 A	

Table 1-2
ENVIRONMENTAL CHARACTERISTICS

Characteristic	Information
Temperature	
Nonoperating	−40°C to +65°C
Useful Operation	0°C to +50°C
Specified Operation	+10°C to +40°C
Altitude	
Nonoperating	To 50,000 feet
Operating	To 10,000 feet
Vibration	
Operating	15 minutes along each axis at 0.015 inch with frequency varied from 10-50-10 c/s in 1-minute cycles. Three minutes at any resonant point or at 50 c/s.
Shock	
Nonoperating	30 g's, 1/2 sine, 11 ms duration, 1 shock per axis. Total of 6 shocks
Transportation	12 inch package drop. Qualified under the National Safe Transit Committee test procedure 1A.

TABLE 1-3
MECHANICAL CHARACTERISTICS

Characteristic	Description
Dimensions	
Height	≈15 inches
Width	≈11 3/4 inches
Depth	≈23 1/4 inches
Weight	≈69 lbs.
Finish	
Front Panel (Type 576 and Standard Test Fixture)	Anodized Aluminum
Cabinet	Blue vinyl painted aluminum
Trim and Rear Panel	Satin finished chrome

SECTION 2
OPERATING INSTRUCTIONS

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

General

This section of the instruction manual provides information necessary for operating the Type 576 and for using it to test various semiconductor devices. Included are setup procedures, a description of the Type 576 controls and connectors, a discussion of the theory of the instrument, a first time operation procedure, and general operating information. Also included is a section describing the use of the Type 576 for measuring the characteristics of various semiconductor devices.

INITIAL CONSIDERATIONS

Cooling

The Type 576 maintains a safe operating temperature when operated in an ambient temperature of 0° C (122° F). Adequate clearance on all sides of the instrument should be provided to assure free air flow and dissipation of heat away from the instrument. A thermal cutout in the instrument provides thermal protection by disconnecting the power to the instrument if the internal temperature exceeds a safe operating level. Power is automatically restored when the temperature returns to a safe level. It should be noted that the instrument will turn off under certain conditions of high collector supply current output or high step generator current output even though the instrument is being operated in an ambient temperature which is within the specified range. See footnotes in the Specification section for further information.

Operating Voltage and Frequency

The Type 576 can be operated from either a 115-volt or a 230-volt line voltage source. The LINE VOLTAGE SELECTOR assembly, located on the rear panel, allows conversion of the instrument so that it may be operated from one line voltage or the other. In addition, this assembly changes the connections of the power transformer primary to allow selection of one of three regulating ranges (see Table 2-1). The assembly also includes the two line fuses. When the instrument is converted from 115-volt to 230-volt operation or vice versa, the assembly selects the proper fuse to provide the correct protection for the instrument.

The Type 576 may be operated from either a 50 Hz or a 60 Hz line frequency. In order to synchronize the step generator with the collector supply, the 60 Hz-50 Hz switch, located on the Type 576 rear panel below the LINE VOLTAGE SELECTOR assembly, must be set to the position which corresponds to the line frequency being used.

Use the following procedure to convert this instrument between line voltages, regulating ranges or line frequencies:

1. Disconnect the instrument from the power source.

TABLE 2-1

Regulating Ranges

Range Selector Switch Position	Regulating Range: 115 Volts Nominal	Regulating Range: 230 Volts Nominal
LO (switch bar in left holes)	90 to 110 volts	180 to 220 volts
M (switch bar in middle holes)	104 to 126 volts	208 to 252 volts
HI (switch bar in right holes)	112 to 136 volts	224 to 272 volts

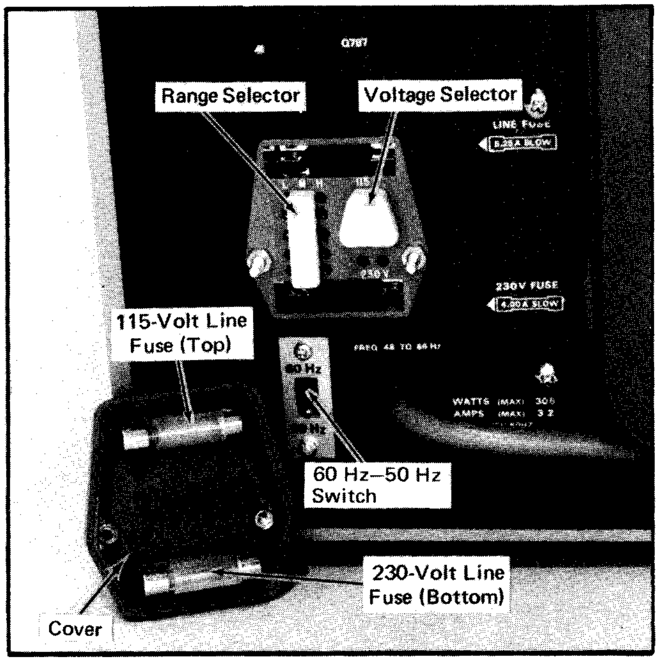


Fig. 2-1. Line Voltage Selector assembly and 60 Hz-50 Hz switch on the rear panel (shown with cover removed).

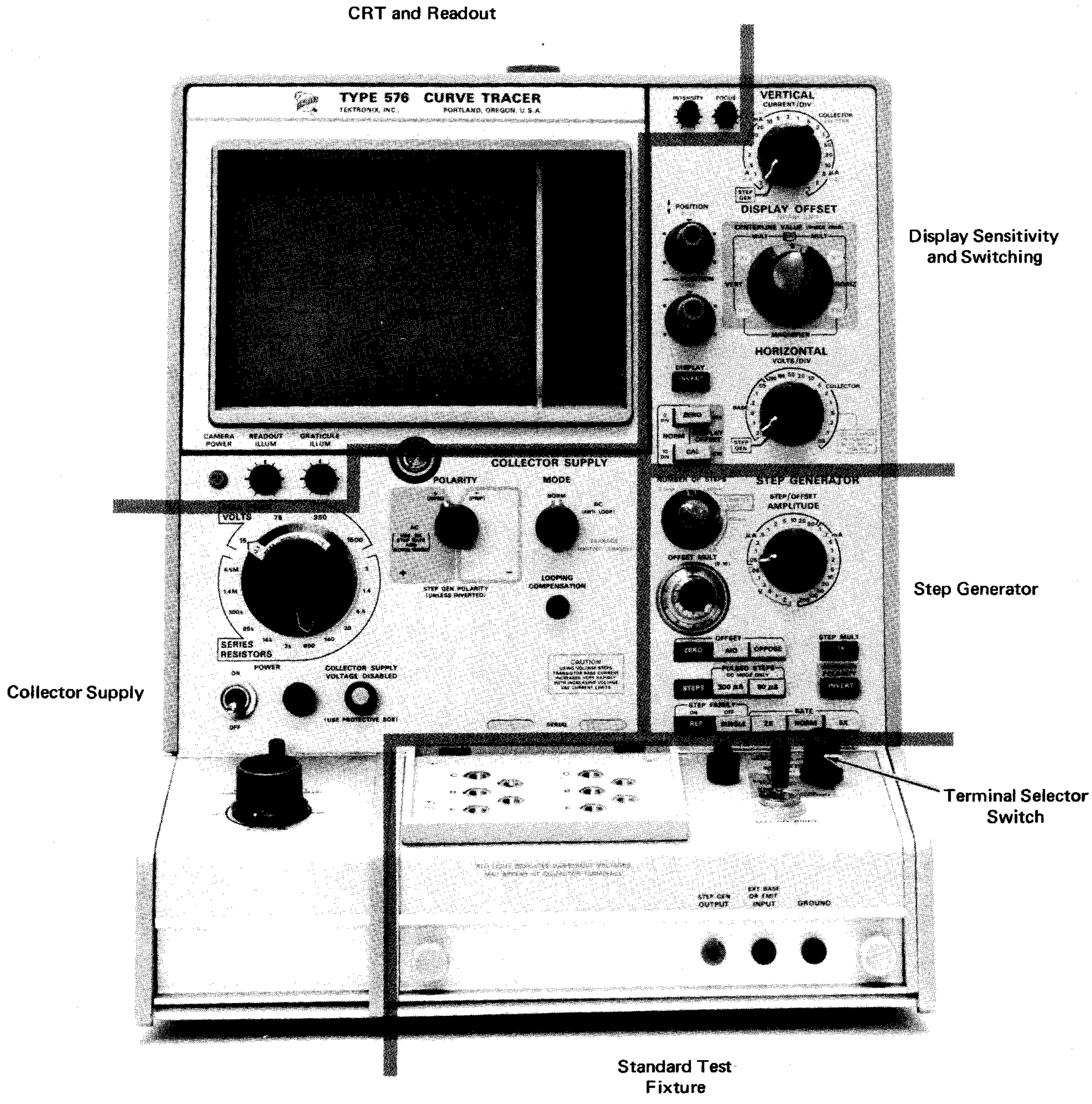


Fig. 2-2. Front-panel controls, connectors and readout.

2. Loosen the two captive screws which hold the cover onto the voltage selector assembly, then pull to remove the cover.

3. To convert from 115-volt to 230-volt line voltage or vice versa, pull out the Voltage Selector switch bar (see Fig. 2-1); turn it 180° and plug it back into the remaining holes. Change the line-cord power plug to match the power-source receptacle or use a 115-to-230-volt adapter.

4. To change regulating ranges, pull out the Range Selector switch bar (see Fig. 2-1) slide it to the desired position and plug it back in. Select a range which is centered about the average line voltage to which the instrument is to be connected (see Table 2-1).

5. Re-install the cover and tighten the two captive screws.

6. To convert from operation with 60 Hz line frequency to operation with 50 Hz line frequency (or vice versa), slide the 60 Hz-50 Hz switch (see Fig. 2-1) to the position which coincides with the line frequency being used.

7. Before applying power to the instrument, check that the indicating tabs on the switch bars are protruding through the correct holes in the voltage selector assembly cover for the desired line voltage and regulating range.

CAUTION

The Type 576 should not be operated with the Voltage Selector switch or the Range Selector switch in the wrong position for the line voltage applied. Operation of the instrument with either of these switches in the wrong position will cause incorrect operation and may damage the instrument.

CONTROLS, CONNECTORS AND READOUT

All controls and connectors required for normal operation of the Type 576 are located on the front and rear panels of the instrument and on the front panel of the standard test fixture (see Figs. 2-2 and 2-3). In addition, readout of some of the instrument functions has been provided on the front panel. Familiarity with the function and use of each of these controls, connectors and the readout is necessary for effective operation of the instrument. The functions are described in the following table.

Fig. 2-3. Rear-panel controls.

CRT and Readout

Controls

INTENSITY Control	Controls brightness of display.
FOCUS Control	Provides adjustment for optimum display definition.
READOUT	Controls brightness of readout.
ILLUM Control	
SCALE ILLUM Control	Controls graticule illumination.
Connector	
CAMERA POWER Connector	Provides +15 volts for operation of camera.
Readouts	
PER VERT DIV Readout	Readout indicates deflection factor of vertical display as viewed on CRT.
PER HORIZ DIV Readout	Readout indicates deflection factor of horizontal display as viewed on CRT.
PER STEP Readout	Readout indicates amplitude per step of Step Generator output.
β OR g_m PER DIV Readout	Readout indicates beta or transconductance per division of CRT display.

Display Sensitivity and Positioning

VERTICAL CURRENT/DIV Switch	Selects vertical deflection factor of display. COLLECTOR—Normal operation of instrument. Vertical display represents collector current. Use black units to determine vertical deflection factor.

EMITTER—Operation of instrument with MODE switch set to LEAKAGE (EMITTER CURRENT). Vertical display represents emitter current. Use orange units to determine vertical deflection factor.
STEP GEN—Steps indicating Step Generator output are displayed vertically. AMPLITUDE switch setting per division determines vertical deflection factor.

DISPLAY OFFSET Selector Switch — Allows selection of display offset or display offset and magnification.
NORM (OFF)—Display offset is not operable.
HORIZ X1—Allows horizontal display to be offset using calibrated CENTERLINE VALUE switch.
VERT X1—Allows vertical display to be offset using calibrated CENTERLINE VALUE switch.
HORIZ X10—Horizontal display magnified by 10 times. Allows horizontal display to be offset using calibrated CENTERLINE VALUE switch.
VERT X10—Vertical display magnified by 10 times. Allows vertical display to be offset using calibrated CENTERLINE VALUE switch.

CENTERLINE VALUE Switch — (Clear plastic flange with numbers on it) Provides calibrated offset of display.
X1 (VERT or HORIZ)—Number on CENTERLINE VALUE switch appearing in blue window represents number of divisions centerline of display is offset either vertically or horizontally from zero offset line.
X10 (VERT or HORIZ)—Number on CENTERLINE VALUE switch appearing in blue window multiplied by 10 represents number of divisions centerline of display is offset either vertically or horizontally from zero offset line.

HORIZONTAL VOLTS/DIV Switch — Selects the horizontal deflection factor of display.
COLLECTOR—Horizontal display represents collector voltage to ground.
BASE—Horizontal display represents base voltage to ground.
STEP GEN—Steps indicating Step Generator output are displayed horizontally. AMPLITUDE switch setting per division determines horizontal deflection factor.

ZERO Button — Provides a zero reference for the display.
NORM—When DISPLAY OFFSET selector switch is set to NORM (OFF), ZERO button provides point on CRT of zero vertical and horizontal deflection for adjusting position controls.
DISPLAY OFFSET—When DISPLAY OFFSET Selector switch is in one of four display offset positions, ZERO button provides reference point on CRT which must be positioned to vertical centerline (horizontal offset) or to horizontal centerline (vertical offset) to insure that the CENTERLINE VALUE switch setting applies to centerline. (Should always be checked with DISPLAY OFFSET Selector switch is set to MAGNIFIER.)

CAL Button — Provides signal which should cause 10 divisions of vertical and horizontal deflection for checking calibration of vertical and horizontal amplifiers.
NORM—When DISPLAY OFFSET selector switch is set to NORM (OFF), CAL button provides point on CRT of 10 divisions of vertical and horizontal deflection.
DISPLAY OFFSET—When DISPLAY OFFSET Selector switch is in one of four display offset positions, CAL button provides signal which should cause reference point on CRT to appear on vertical centerline (horizontal offset) or on horizontal centerline (vertical offset), assuming zero reference point was properly adjusted. (Check should be performed with DISPLAY OFFSET Selector switch set to MAGNIFIER.)

DISPLAY INVERT Button — Inverts display vertically and horizontally about center of CRT.

POSITION Switch (Horizontal) — Provides coarse positioning of horizontal display.

FINE POSITION Control (Horizontal) — Provides fine positioning of horizontal display.

POSITION Switch (Vertical) — Provides fine positioning of vertical display.

FINE POSITION Control (Vertical) — Provides fine positioning of vertical display.

Collector Supply

Controls

MAX PEAK VOLTS Switch — Selects range of VARIABLE COLLECTOR SUPPLY control. Switch is located below PEAK POWER WATTS switch and range is indicated by white arrow. When switch is set to 75, 350 and 1500, protective box must be used with Standard Test Fixtures (see section on interlock system).

PEAK POWER WATTS Switch — Selects nominal peak power output of Collector Supply, by selecting resistance in series with Collector Supply output. PEAK POWER WATTS is indicated by number on transparent switch flange appearing above white MAX PEAK VOLTS indicator. SERIES RESISTORS are indicated by black indicator. PEAK POWER WATTS switch must be pulled out to set nominal peak power output. When PEAK POWER WATTS switch is set, series resistance is automatically changed to maintain desired nominal peak power output when MAX PEAK VOLTS switch setting is changed.

VARIABLE COLLECTOR SUPPLY Control — Allows varying of collector supply voltage within range set by MAX PEAK VOLTS switch.

POLARITY Switch — Selects polarity of Collector Supply voltage and Step Generator output.

- –(PNP)—Collector Supply voltage and Step Generator output are negative-going.
- +(NPN)—Collector Supply voltage and Step Generator output are positive-going.
- AC—Collector Supply voltage is both positive- and negative-going (sine wave); Step Generator output is positive-going. When switch is set to AC position, use .5X step rate and normal mode of operation.

MODE Switch — Selects mode of operation of Collector Supply.

- NORM—Normal Collector Supply output is obtained.
- DC (ANTILOOP)—Collector Supply output is DC voltage equal to peak value set by VARIABLE COLLECTOR SUPPLY control.
- LEAKAGE (EMITTER CURRENT)—Vertical sensitivity is increased 1000 times. Vertical amplifier measures emitter current. Collector Supply mode set for DC voltage output.

LOOPING COMPENSATION Control — Allows adjustment of looping compensation. Allows compensation of internal and adapter stray capacitance. Does not compensate for device capacitance.

COLLECTOR SUPPLY RESET Button — Resets Collector Supply if it has been disabled by internal circuit breaker. Collector Supply is turned off whenever maximum current rating of transformer primary of 1.2 Amperes is exceeded.

POWER ON-OFF Switch — Controls input power to instrument.

Lights

POWER Light — Lights when power is on.

COLLECTOR SUPPLY VOLTAGE DISABLED Light — Indicates Collector Supply voltage has been disabled. Lights when Collector Supply may present a potentially dangerous voltage at its output. In such a case, use of protective box is required to enable Collector Supply. Also lights when high current generated by Collector Supply or Step Generator causes instrument to overheat.

Step Generator

Controls

NUMBER OF STEPS Switch — Selects number of steps per family of Step Generator output.

CURRENT LIMIT Switch — Provides current limit of the Step Generator output when voltage steps are being produced.

STEP/OFFSET AMPLITUDE Switch — Selects amplitude per step of steps and offset of Step Generator output. Amplitudes within black arc represent current steps; within yellow arc, voltage steps. Note caution on front-panel when using voltage steps.

OFFSET Buttons — Allows offsetting of Step Generator output using OFFSET MULT control.

- ZERO—No offset available.
- AID—Allows zero step of Step Generator output to be offset as many as 10 steps above its zero offset level.

OPPOSE—Allows zero step of Step Generator output to be offset as many as 10 steps below its zero offset level.

OFFSET MULT Control — Provides calibrated offset of step Generator output to ±10 times AMPLITUDE setting when either OFFSET AID or OFFSET OPPOSE button is pressed.

STEPS Button — Provides steps of normal duration (step lasts for entire period of rate cycle).

PULSED STEPS Buttons — Allows Step Generator output to be applied to Device Under Test for only a portion of normal step duration. Pulsed steps occur at peak of Collector Supply output.

300 μs—Selects pulsed steps with duration of 300 μs. Collector Supply is automatically switched to DC mode.

80 μs—Selects pulsed steps with duration of 80 μs. Collector Supply is automatically switched to DC mode.

300 μs and 80 μs—When buttons are pressed together, selects pulsed steps with duration of 300 μs; however, Collector Supply is not automatically switched to DC mode.

STEP FAMILY Buttons — Allows steps to be generated in repetitive families or one family at a time.

ON REP—Provides repetitive Step Generator output.

OFF SINGLE—Provides one family of steps whenever button is pressed. Once button has been pressed, Step Generator is turned off until pressed again or until ON REP button is pressed.

RATE Buttons — Selects rate at which steps are generated.

NORM—Provides normal Step Generator rate of 1X normal Collector Supply rate (120 steps per second for 60 Hz line frequency).

2X—Provides rate of two times normal rate.

.5X—Provides rate of one half normal rate.

2X and .5X—When buttons are pressed together, provides normal rate but with step transitions occuring at peak of Collector Supply sweep.

2X and .5X—Provides normal rate but with step transitions occurring at peak of Collector Supply sweep.

STEP/OFFSET POLARITY INVERT Button — Allows change of polarity of Step Generator output (from polarity set by POLARITY switch).

STEP MULT .1X Button — Provides 0.1 times multiplication of step amplitude, but does not effect offset.

Standard Test Fixture

Controls

Terminal Selector Switch — Selects way in which Step Generator is applied to Device Under Test. In all positions Collector Supply output is connected to Collector terminal.

EMITTER GROUNDED—Emitter of Device Under Test is connected to ground.

STEP GEN—Step Generator is applied to base terminal of Device Under Test. Normal operating position.

OPEN (OR EXT)—Base terminal of Device Under Test open. External signal applied to EXT BASE OR EMIT INPUT connector, will be applied to base terminal.

SHORT—Base terminal of Device Under Test is shorted to emitter terminal.

BASE GROUNDED—Base terminal of Device Under Test is connected to ground. Step Generator polarity is inverted.

OPEN (OR EXT)—Emitter terminal of Device Under Test is open. External signal applied to EXT BASE OR EMIT INPUT connector, will be applied to emitter terminal.

STEP GEN—Inverted Step Generator output is applied to emitter of Device Under Test.

LEFT-OFF-RIGHT Switch — Selects which device (choice of 2) is to be tested, left or right.

Interlock Switch — Enables Collector Supply when Protective Box is in place and lid is closed.

Connectors

Adapter Connectors — Allows connection of various test adapters to Standard Test Fixture. Connectors will accept standard size

	banana plugs if some other means of connecting Device Under Test to Standard Test Fixture is desired. C, B and E stand for collector, base and emitter, respectively. Unlabeled terminals allow Kelvin sensing of voltage for high current devices.
STEP GEN OUT Connector	Step Generator output signal appears at this connector.
EXT BASE OR EMIT INPUT Connector	Allows input of externally generated signal to either base terminal or emitter terminal of Device Under Test as determined by Terminal Selector Switch.
GROUND Connector	Provides external access to ground reference.
Light	
Caution Light	Red light on, indicates Collector Supply is enabled and dangerous voltage may appear at collector terminals.

Rear Panel

Controls	
Line Voltage Selector Switches	Switch assembly selects operating voltage and line voltage range. Also includes line fuses. Voltage Selector—Selects operating voltage (115 V or 230 V). Range Selector—Selects line voltage range (low, medium, high).
60 Hz-50 Hz Switch	Allows conversion of instrument for operation with either 60 Hz or 50 Hz line frequency.

FRONT PANEL COLORS

The various colors on the front-panel of the Type 576 and Standard Test Fixture indicate relationships between controls and control functions. Table 2-2 shows the relationship which each color indicates.

Table 2-2

Colors and Controls

Color	Relationship
Green	Indicates controls which affect the Step Generator polarity.
Blue	Indicates controls and statements associated with display offset.
Orange	Indicates relationship of LEAKAGE (EMITTER CURRENT) mode with the VERTICAL and HORIZONTAL switches.
Yellow	Indicates controls and statements associated with the voltage mode of operation of the Step Generator.
Black (Buttons)	Indicates function controlled by a single button, which is released for most common applications.
Dark Grey (Buttons)	Indicates function controlled by several buttons, and the dark grey button is pressed for most common applications.

PRECAUTIONS

A number of the Type 576 front-panel controls could, through improper use, cause damage to the device under test. Fig. 2-4 indicates the area of the Type 576 front panel where these controls are located. Care should be exercised when using controls located in this area.

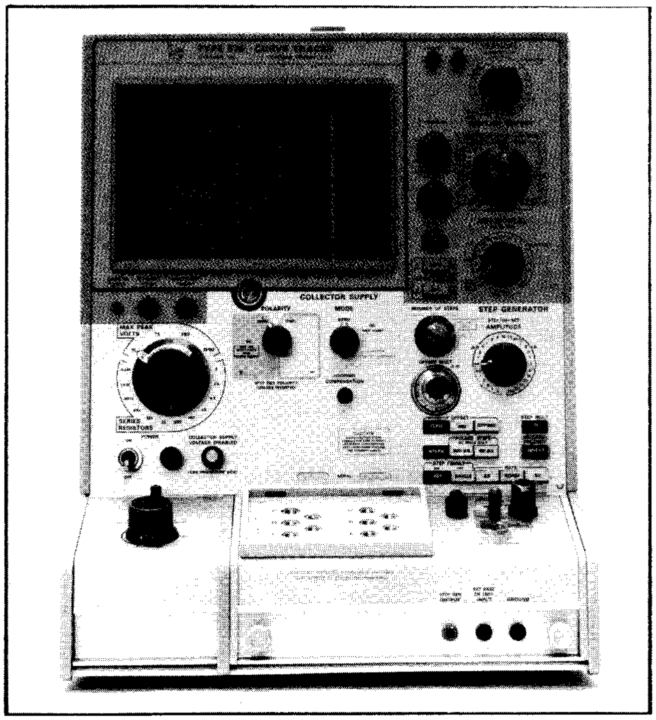


Fig. 2-4. Controls located in light area of Type 576 front-panel could cause damage to a device under test if used improperly.

GENERAL DESCRIPTION OF INSTRUMENT OPERATION

The Type 576 is a semiconductor tester which displays and allows measurement of both static and dynamic semiconductor characteristics obtained under simulated operating conditions. The Collector Supply and the Step Generator produces voltages and currents which are applied to the device under test. The display amplifiers measure the effects of these applied conditions on the device under test.

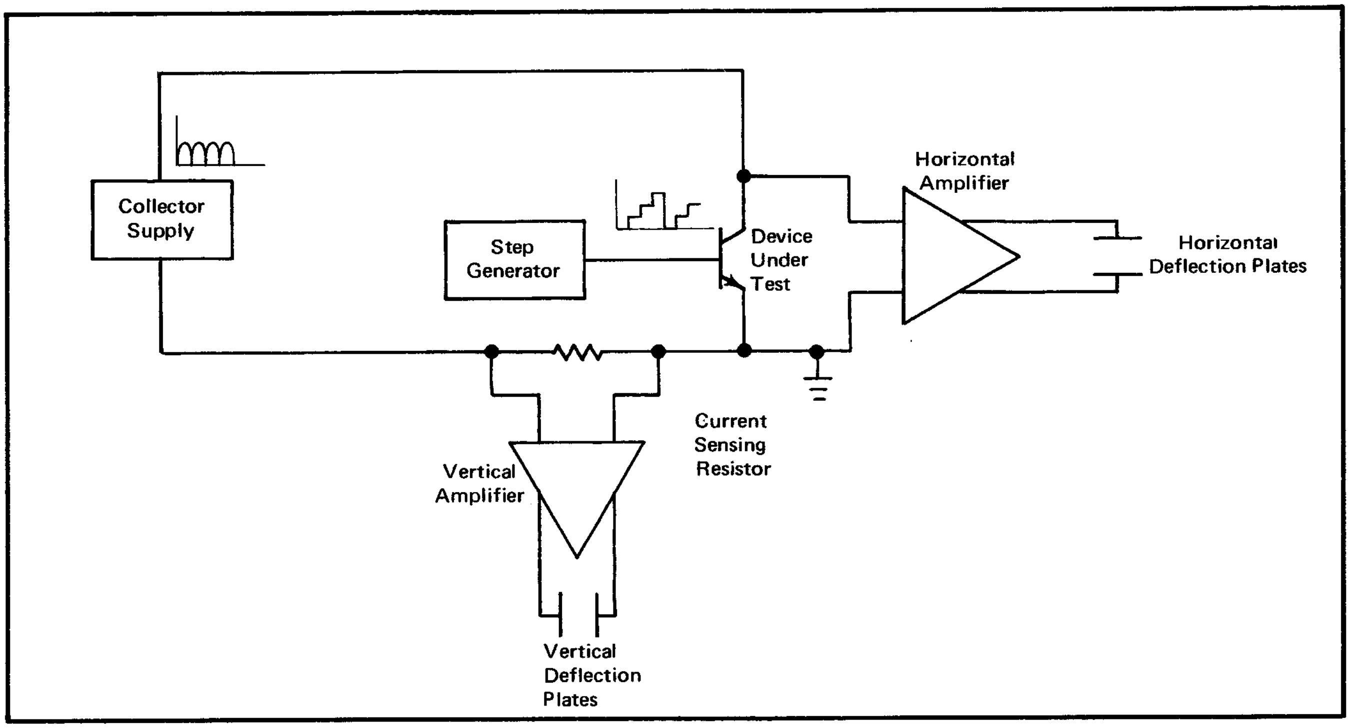


Fig. 2-5. Basic Block diagram showing typical connections of Collector Supply, Step Generator and Display Amplifiers to the device under test.

The result is families of characteristics curves traced on a CRT.

The Collector Supply circuit normally produces a full-wave rectified sine wave which may be either positive- or negative going. The amplitude of the signal can be varied from 0 to 1500 volts as determined by the MAX PEAK VOLTS switch and the VARIABLE COLLECTOR SUPPLY control. This Collector Supply output is applied to the collector (or equivalent) terminal of the device under test.

The Step Generator produces ascending steps of current or voltage at a normal rate of one step per cycle of the Collector Supply. The amount of current or voltage per step is controlled by the AMPLITUDE switch and the total number of steps is controlled by the NUMBER OF STEPS switch. This Step Generator output may be applied to either the base or the emitter (or equivalent) terminals of the device under test.

The display amplifiers are connected to the device under test. These amplifiers measure the effects of the Collector Supply and of the Step Generator on the device under test, amplify the measurements and apply the resulting voltages to the deflection plates of the CRT. The sensitivities of these amplifiers are controlled by the VERTICAL CURRENT/DIV switch and the HORIZONTAL VOLTS/DIV switch.

Fig. 2-5 is a block diagram showing the connection of these circuits to the device under test for a typical measurement.

FIRST TIME OPERATION

When the Type 576 is received, it is calibrated and should be performing within the specification shown in Section 1. The following procedure allows the operator to become familiar with the front panel controls and their functions as well as how they may be used to display transistor or diode characteristics. This procedure may also be used as a general check of the instrument's performance. For a check of the instrument's operation with respect to the specification given in Section 1, the Performance Check and Calibration Procedure in Section 5 must be used.

1. Apply power to the Type 576.

2. Allow the instrument to warm up for a few minutes. Instrument should operate within specified tolerances 5 minutes after it has been turned on.

3. Set the Type 576 and Standard Test Fixture front-panel controls as follows:

READOUT ILLUM	Fully counterclockwise
GRATICULE ILLUM	Fully counterclockwise
INTENSITY	Fully counterclockwise
FOCUS	Centered
VERTICAL	1 mA

®

DISPLAY OFFSET Selector	NORM (OFF)
CENTERLINE VALUE	0
HORIZONTAL	1 V COLLECTOR
Vertical POSITION	Centered
Vertical FINE POSITION	Centered
Horizontal POSITION	Centered
Horizontal FINE POSITION	Centered
ZERO	Released
CAL	Released
DISPLAY INVERT	Released
MAX PEAK VOLTS	15
PEAK POWER WATTS	0.1
VARIABLE COLLEC-TOR SUPPLY	Fully Counterclockwise
POLARITY	AC
MODE	NORM
LOOPING COMPENSATION	As is
NUMBER OF STEPS	1
CURRENT LIMIT	20 mA
AMPLITUDE	0.5 μA
OFFSET	ZERO
STEPS	Pressed
PULSED STEPS	Released
STEP FAMILY	REP ON
RATE	NORM
POLARITY INVERT	Released
STEP MULT .1X	Released
Terminal Selector	BASE TERM STEP GEN
LEFT-OFF-RIGHT	OFF

CRT and Readout Controls

4. Turn the GRATICULE ILLUM control throughout its range. Note that the graticule lines become illuminated as the control is turned clockwise. Set the control for desired illumination.

5. Turn the READOUT ILLUM control throughout its range. Note that the fiber-optic readouts and the readout titles become illuminated as the control is turned clockwise. Set the control for the desired readout illumination. The readout should read for these initial control settings; 1 mA per vertical division, 1 V per horizontal division, 50 nA per step and 20 k β or gm per division.

6. Turn the INTENSITY control clockwise until a spot appears at the center of the CRT graticule. To avoid burning the CRT phosphor, adjust the INTENSITY control until the spot is easily visible, but not overly bright.

7. Turn the FOCUS control throughout its range. Adjust the FOCUS control for a sharp, well-defined spot.

Positioning Controls

8. Turn the vertical FINE POSITION control throughout its range. Note that the control has a range of at least ±2.5 divisions about the center horizontal line. Set the control so that the spot is centered vertically on the CRT graticule.

9. Repeat step 8 using the horizontal FINE POSITION control.

10. Turn the vertical coarse POSITION switch. Note that the spot moves 5 divisions vertically each time the switch is moved one position. (The extreme positions of the switch represent 10 divisions of deflection, which in this case causes the spot to be off the CRT graticule.) Set the POSITION switch to the center position.

10. Turn the vertical coarse POSITION switch. Note that the spot moves 5 divisions vertically each time the switch is moved one position. (The most extreme positions of the switch represent 10 divisions of deflection, which in this case causes the spot to be off the CRT graticule.) Set the POSITION switch to the center position.

11. Repeat step 10 using the horizontal coarse POSITION switch.

12. Set the POLARITY switch to −(PNP). Note that the spot moves to the upper right corner of the CRT graticule.

13. Set the POLARITY switch to +(NPN). Note that the spot moves to the lower left corner of the CRT graticule.

Vertical and Horizontal Sensitivity

14. Install the diode adapter (Tektronix Part No.

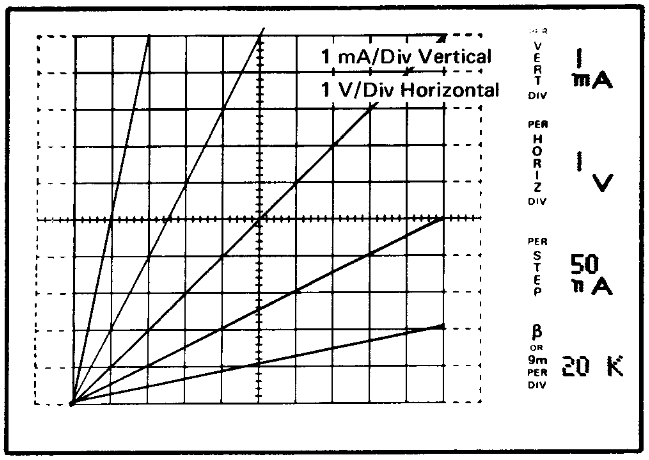


Fig. 2-6. Display of I vs. V for a 1 kΩ resistor using various settings of the VERTICAL and HORIZONTAL switches.

013-0072-00) into the right-hand set of accessory connectors located on the Standard Test Fixture.

15. Install a 1 kΩ, 1/2 watt resistor in the diode adapter.

16. Set the LEFT-OFF-RIGHT switch to RIGHT and turn the VARIABLE COLLECTOR SUPPLY control until a trace appears diagonally across the CRT.

17. Turn the VERTICAL switch clockwise and note that as the vertical deflection factor decreases the slope of the line decreases (see Fig. 2-6). Turn the VERTICAL switch counterclockwise from the 1 mA position and note that the slope increases. Also note that the PER VERT DIV readout changes in accordance with the position of the VERTICAL switch. Reset the VERTICAL switch to 1 mA.

18. Repeat step 17 using the HORIZONTAL switch within the COLLECTOR range of the switch. The change in slope of the trace will be the inverse of what it was for the VERTICAL switch. Reset the HORIZONTAL switch to 1 V COLLECTOR.

19. Press the ZERO button. Note that the diagonal trace reduces to a spot in the lower left corner of the CRT graticule. This spot denotes the point of zero deflection of the vertical and horizontal amplifiers. Release the ZERO button.

20. Press the CAL button. Note that the diagonal trace reduces to a spot in the upper right corner of the CRT graticule. The position of this spot indicates 10 divisions of deflection both vertically and horizontally. Release the CAL button.

21. Press the DISPLAY INVERT button and turn the VARIABLE COLLECTOR SUPPLY control counterclockwise. Note that the display has been inverted and is now originating from the upper right corner of the CRT graticule. Release the DISPLAY INVERT button.

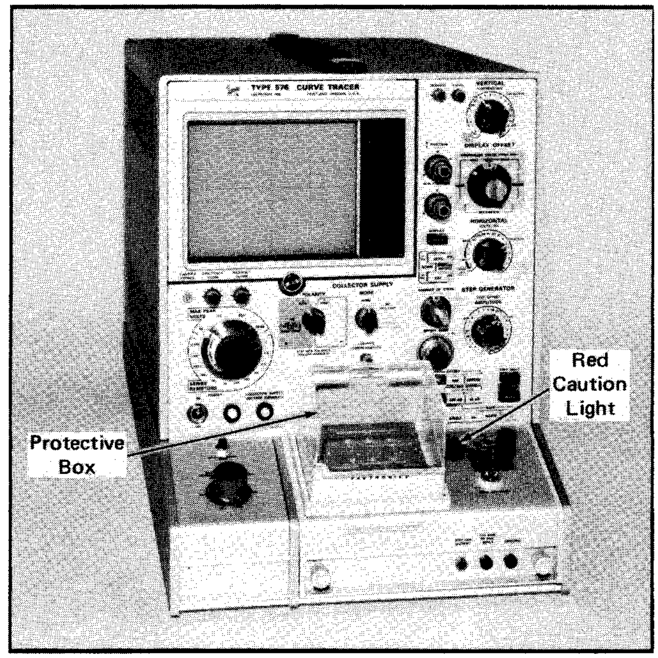


Fig. 2-7. Type 576 Standard Test Fixture with protective box installed for safe operation.

Collector Supply

22. Turn the MAX PEAK VOLTS switch throughout its range. Note that when the switch is in the 75, 350 and 1500 positions, the yellow light comes on.

23. While the yellow light is on, turn the VARIABLE COLLECTOR SUPPLY control fully clockwise. Note that the diagonal line obtained in step 16 does not appear. When the yellow light is on, the Collector Supply is disabled.

24. Set the following Type 576 controls:

MAX PEAK VOLTS	75
VARIABLE COLLECTOR SUPPLY	Fully counterclockwise
LEFT-OFF-RIGHT	OFF

25. Install the protective box on the Standard Test Fixture as shown in Fig. 2-7.

26. Close the lid of the protective box and set the LEFT-OFF-RIGHT switch to RIGHT. Note that the yellow light turns off and the red light turns on.

WARNING

The red light indicates that dangerous voltages may appear at the collector terminals of the Standard Test Fixture.

27. Turn the VARIABLE COLLECTOR SUPPLY control clockwise. Note that the diagonal trace appears indicating that the Collector Supply has been enabled.

28. Set the following Type 576 controls to:

MAX PEAK VOLTS	15
VARIABLE COLLECTOR SUPPLY	Fully Counterclockwise

(The protective box may be removed if desired.)

29. Turn the VARIABLE COLLECTOR SUPPLY control until the diagonal trace reaches the center of the CRT graticule. Pull out on the PEAK POWER WATTS switch and set it to 220. Note that the diagonal trace lengthens as the switch is turned through its range. Also note that the SERIES RESISTORS decrease as the maximum peak power is increased.

30. Allow the MAX PEAK VOLTS switch and the PEAK POWER WATTS switch to become interlocked and switch to 75. Note that the maximum peak power value remains at 220 and that the SERIES RESISTORS values change.

31. Set the following Type 576 controls to:

MAX PEAK VOLTS	15
PEAK POWER WATTS	0.1
LEFT-OFF-RIGHT	OFF

32. Remove the resistor from the diode adapter and replace it with a silicon diode. Align the diode so that its cathode is connected to the emitter terminal.

33. Set the LEFT-OFF-RIGHT switch to RIGHT and turn the VARIABLE COLLECTOR SUPPLY control clockwise. Note the display of the forward voltage characteristic of the diode. (see Fig. 2-8).

34. Set the COLLECTOR SUPPLY POLARITY switch to −(PNP). Note the display of the reverse voltage characteristic of the diode (see Fig. 2-8).

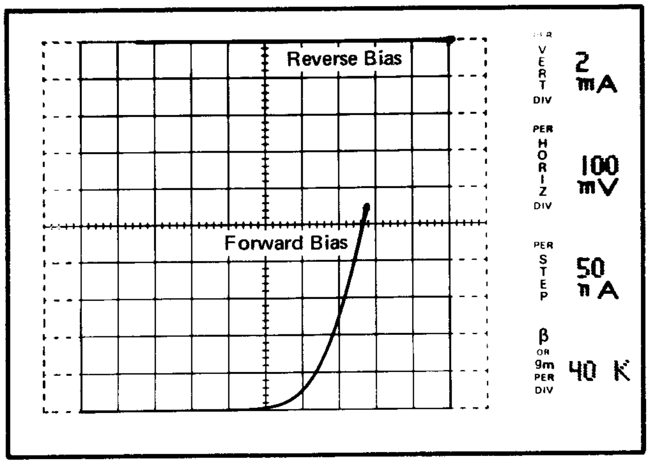


Fig. 2-8. Display of forward and reverse bias characteristics of a signal diode.

35. Set the following Type 576 controls to:

POLARITY	+ (NPN)
MODE	DC

Note that the display of the forward voltage diode characteristic has become a spot. The spot indicates the current conducted by the diode and the voltage across it.

36. Turn the VARIABLE COLLECTOR SUPPLY control counterclockwise. Note that the spot traces out the diode characteristic.

37. Set the following Type 576 controls to:

VERTICAL	1 µA
HORIZONTAL	2 V COLLECTOR
Vertical POSITION	Display Centered
VARIABLE COLLECTOR SUPPLY	Fully Clockwise
MODE	NORM
LEFT-OFF-RIGHT	LEFT

38. Adjust the LOOPING COMPENSATION control for minimum trace width (see Fig. 2-9).

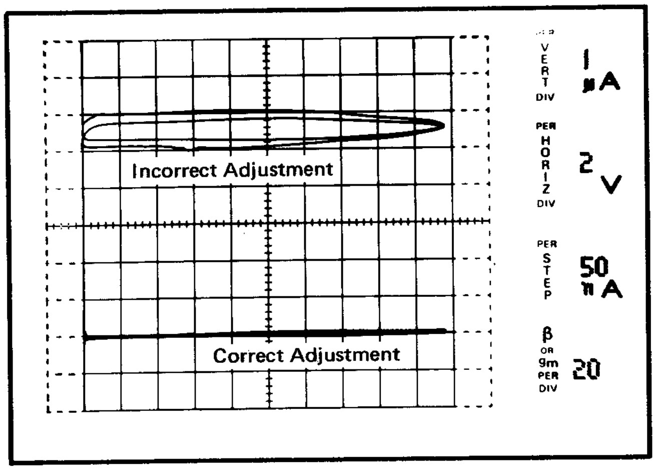


Fig. 2-9. Adjustment of LOOPING COMPENSATION control.

39. Set the following Type 576 controls to:

VERTICAL	5 mA
Vertical POSITION	Switch centered
VARIABLE COLLECTOR SUPPLY	Fully Counterclockwise
MODE	AC
LEFT-OFF-RIGHT	OFF

40. Remove the diode from the diode adapter and replace it with a 8 volt Zener diode. Align the diode so that its cathode is connected to the emitter terminal.

41. Set the LEFT-OFF-RIGHT switch to RIGHT and turn the VARIABLE COLLECTOR SUPPLY control clockwise. Note that the display shows both the forward and reverse characteristics of the Zener diode (see Fig. 2-10).

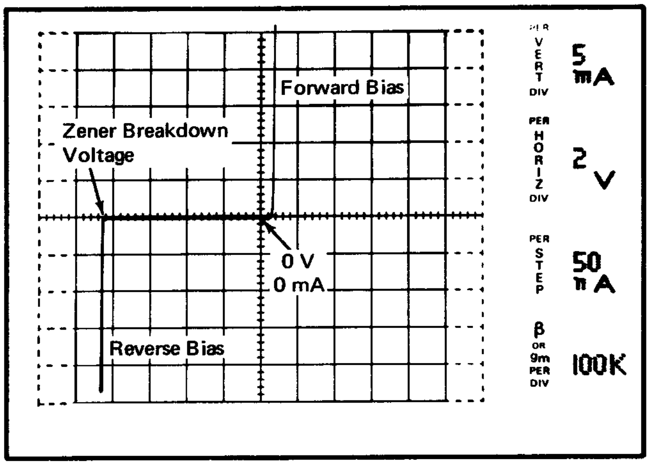


Fig. 2-10. Display of Zener diode I vs. V characteristic with POLARITY switch set to AC.

Display Offset and Magnifier

42. Set the following Type 576 controls to:

HORIZONTAL	2 V COLLECTOR
POLARITY	–(PNP)

Note the display of the reverse voltage characteristic of the Zener diode.

43. Position the display to the center of the CRT graticule with the vertical POSITION switch (see Fig. 2-11A).

44. Set the DISPLAY OFFSET Selector switch to HORIZ X10. Press the ZERO button and, using the horizontal FINE POSITION control, adjust the spot so that it is on the center vertical line of the CRT graticule. This spot position represents the zero offset position. Release the ZERO button and set the DISPLAY OFFSET Selector switch to HORIZ X1.

45. Turn the CENTERLINE VALUE switch from the 0 position clockwise, until the Zener breakdown portion of the display is within ±0.5 divisions of the center vertical line (see Fig. 2-11B). Note the number on the CENTERLINE VALUE switch which appears in the blue window below the word DIV. This number multiplied by the PER HORIZ DIV readout value gives the approximate value of the breakdown voltage of this Zener diode. For the diode in the example shown in Fig. 2-11, the approximate Zener breakdown voltage is 4 divisions times 2 V/division = 8 volts.

46. Set the DISPLAY OFFSET Selector switch to HORIZ X10. Note that PER HORIZ DIV readout value has changed to indicate the 10 times multiplication. By expanding the scale, a measurement can be made of that part of the characteristic which was not quite offset to the center vertical line of the CRT graticule (see Fig. 2-11C). This value when added to the approximate value (or subratcted if the approximate value was greater than the actual value) produces a more exact measurement of the breakdown voltage. In the example shown in Fig. 2-11, 400 mV should be

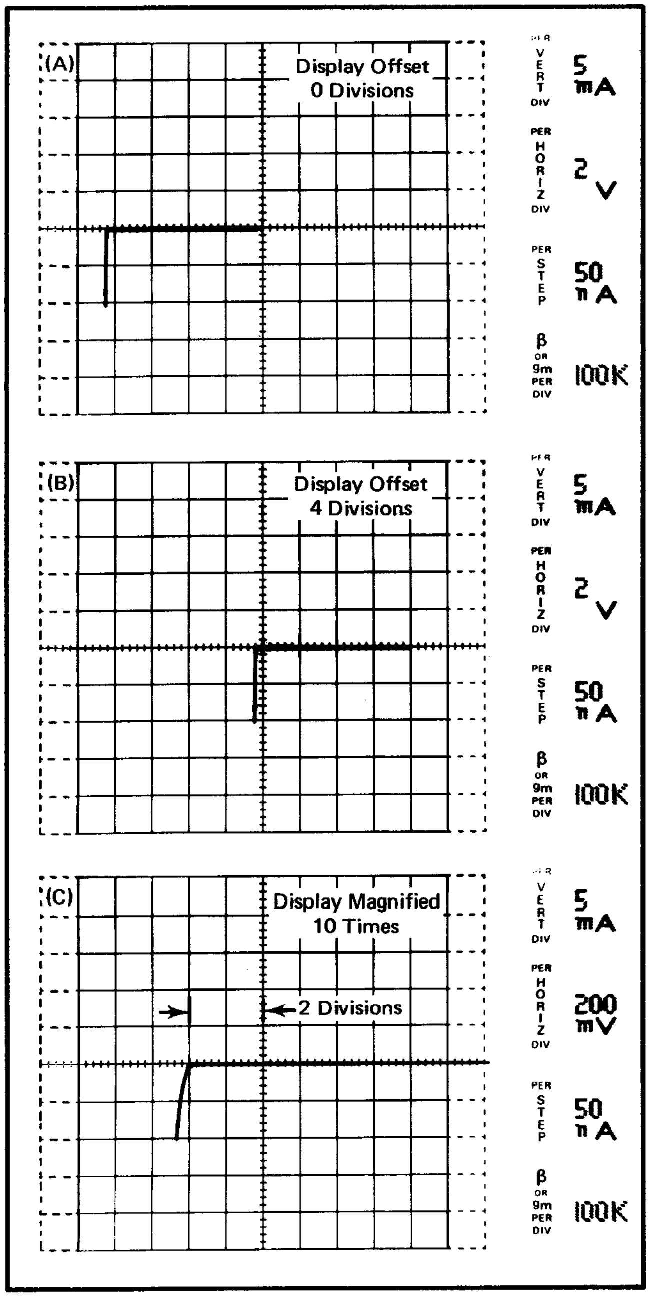


Fig. 2-11. Displays of measurement of Zener breakdown voltage using the DISPLAY OFFSET Selector and CENTERLINE VALUE switches, (A) DISPLAY OFFSET Selector switch set to HORIZ X1 and CENTERLINE VALUE switch set to 0; (B) CENTERLINE VALUE switch set to 4; (C) DISPLAY OFFSET Selector switch set to HORIZ X10.

added to the approximate estimate, yielding a value of 8.4 for the Zener voltage of the diode. The same process can also be carried out using vertical display offset and magnification.

Step Generator

47. Set the following Type 576 controls to:

DISPLAY OFFSET Selector	NORM (OFF)
CENTERLINE VALUE	0
Vertical POSITION	Switch centered
POLARITY	+(NPN)
VARIABLE COLLECTOR SUPPLY	Fully Counterclockwise
LEFT-OFF-RIGHT	OFF

48. Remove the diode adapter and replace it with the universal transistor adapter (Tektronix Part No. 013-0098-00).

49. Place an NPN silicon transistor into the right transistor test socket of the universal transistor adapter.

50. Set the LEFT-OFF-RIGHT switch to RIGHT and turn the VARIABLE COLLECTOR SUPPLY clockwise until the peak collector-emitter voltage is about 10 volts.

51. Turn the AMPLITUDE switch until a step appears on the CRT. Note that the greater the step amplitude, the greater the collector current (see Fig. 2-12). Set the AMPLITUDE for the minimum step amplitude which produces a noticeable step in the display.

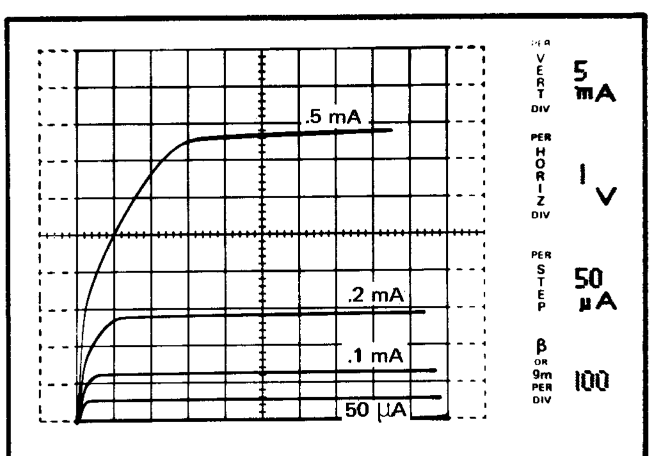


Fig. 2-12. Collector current vs. Collector-Emitter voltage for various settings of the AMPLITUDE switch.

52. Turn the NUMBER OF STEPS switch clockwise. Be sure the PEAK POWER WATTS switch is set within the power dissipation rating of the transistor being used. Note the display of collector current vs. collector-emitter voltage for ten different values of base current (see Fig. 2-13A).

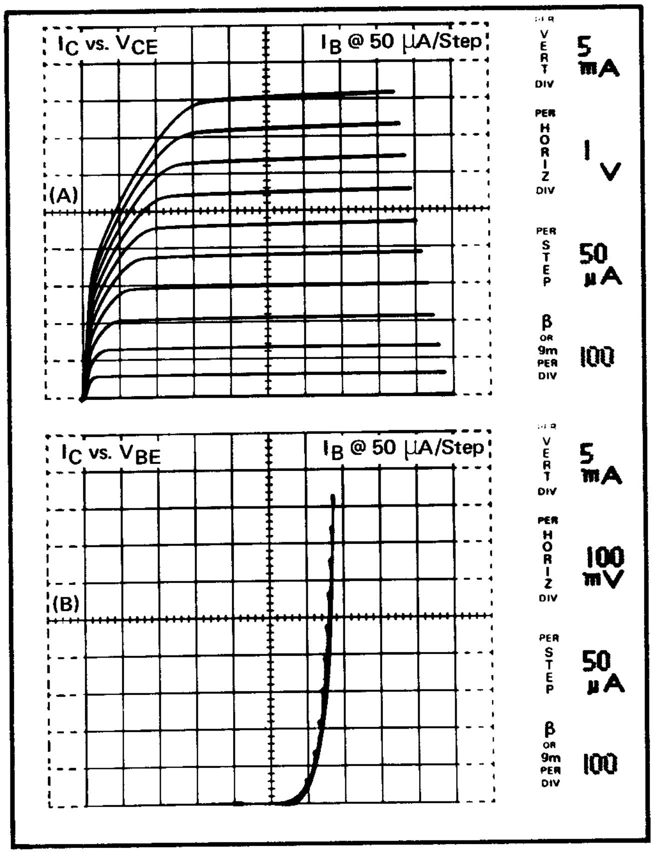


Fig. 2-13. (A) I_C vs. V_{CE} for 10 steps of base current at 50 µA per step; (B) I_C vs. V_{BE} for 10 steps of lease current at 50 µA per step.

53. Set the HORIZONTAL switch to .1 V BASE. Note the display of the collector current vs. base-emitter voltage for ten different values of base current (see Fig. 2-13B).

54. Set the VERTICAL switch to STEP GEN and the HORIZONTAL switch to 1 V COLLECTOR. Note the display of the base current, one step per vertical division, vs. the collector-emitter voltage (see Fig. 2-14A).

55. Set the HORIZONTAL switch to .1 V Base. Note the display of base current, one step per vertical division, vs. base-emitter voltage (see Fig. 2-14B).

56. Set the VERTICAL switch to 5 mA and the HORIZONTAL switch to STEP GEN. Note the display of collector current vs. base-current, one step per horizontal division (see Fig. 2-15).

57. Set the following Type 576 controls to:

HORIZONTAL	1 V COLLECTOR
RATE	.5X

Note that the step rate is slower than the normal rate.

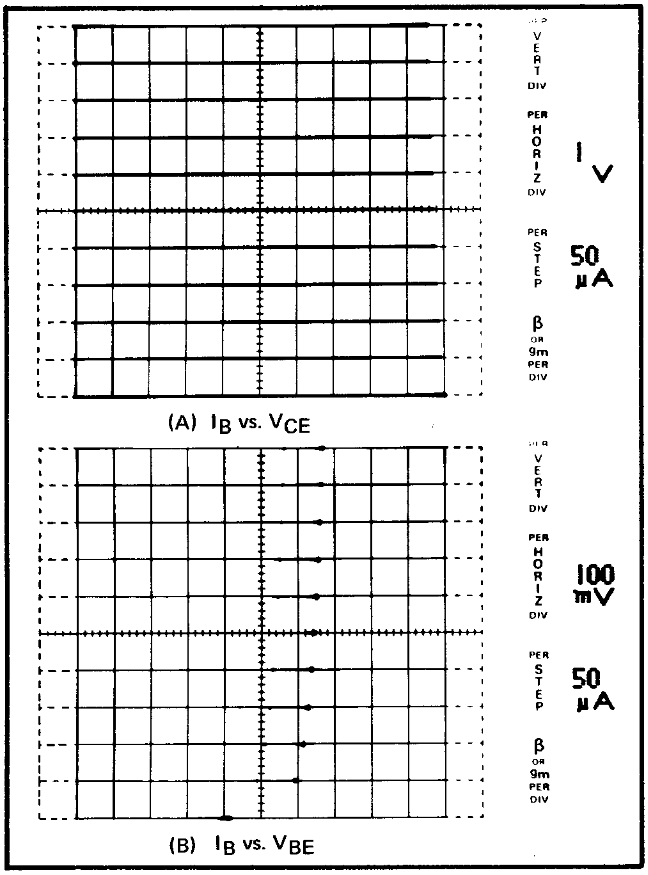


Fig. 2-14. (A) I_B vs. V_{CE}, I_b @ 50 µA per division; (B) I_B vs. V_{BE}, I_B @ 50 µA per division.

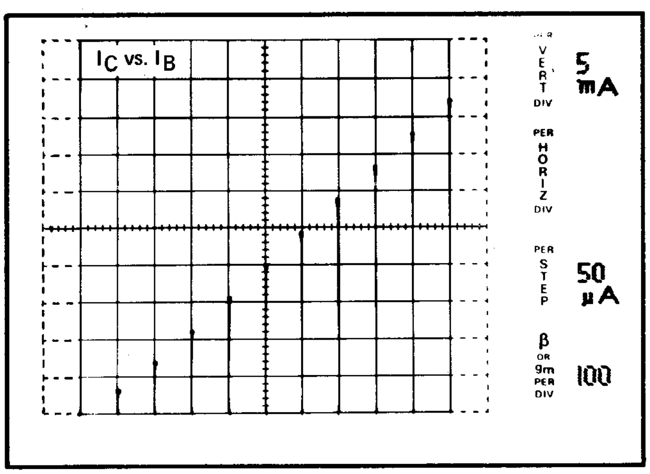


Fig. 2-15. I_C vs. I_B, I_B @ 50 µA per division.

58. Press the NORM RATE button and then the 2X RATE button. Note that the step rate is faster than the normal rate.

59. Press both the 2X RATE and .5X RATE buttons. Note that the step rate is normal, but that the steps occur at the peak of each collector sweep, rather than at the beginning of each collector sweep, as when the NORM RATE button is pushed.

60. Press the SINGLE STEP FAMILY button. Press it again. Note that each time the SINGLE button is pressed, a single family of characteristic curves is displayed and then the Step Generator turns off.

61. Set the following Type 576 controls to:

STEP FAMILY	REP ON
RATE	NORM
PULSED STEPS	300 µs

Note that the collector supply is in the DC mode and that each step is in the form of a pulse. (See Fig. 2-16A.) (Readjustment of the INTENSITY control may be necessary.)

62. Press the 80 µs button. Note that the duration of each pulsed step is reduced.

63. Press both the 300 µs and the 80 µs buttons. Note that the Collector Supply is in the normal mode and the steps are occurring at the peak of the collector sweep, with a duration as observed in step 61 (see Fig. 2-16B).

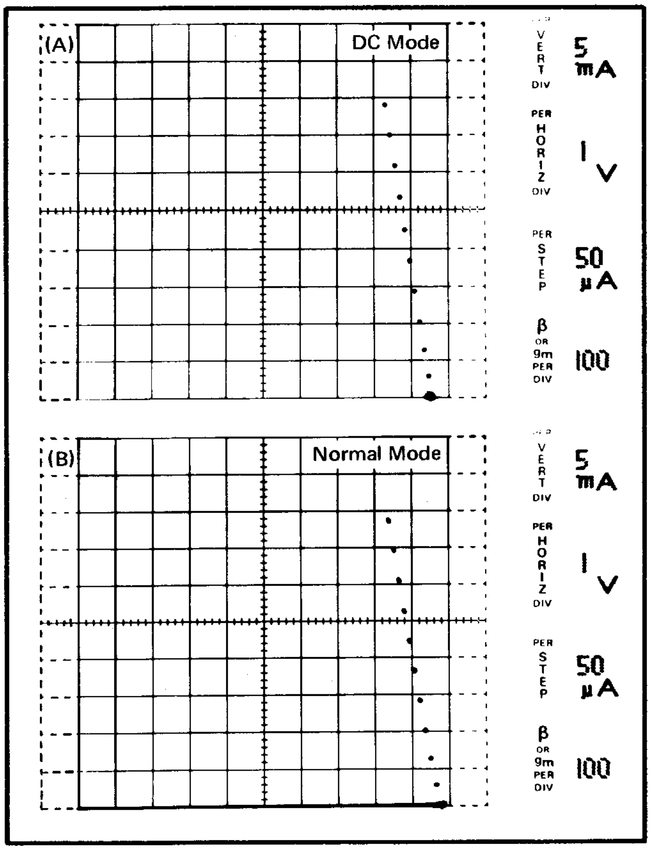


Fig. 2-16. 300 µs PULSED STEPS, (A) DC mode; (B) Normal mode.

64. Set the Type 576 LEFT-OFF-RIGHT switch to OFF and remove the universal transistor adapter from the Standard Test Fixture. (Leave the transistor in the adapter). Install the universal FET adapter (Tektronix Part No. 013-0099-00) on the Standard Test Fixture and place an N-channel junction FET into the right test socket of the adapter.

65. Set the following Type 576 controls to:

INTENSITY	Visible Display
VERTICAL	1 mA
VARIABLE COLLECTOR SUPPLY	Fully Counterclockwise
AMPLITUDE	.05 V
STEPS	Pressed

66. Set the LEFT-OFF-RIGHT switch to RIGHT and turn the VARIABLE COLLECTOR SUPPLY control slowly clockwise. Note the display of drain current vs. drain-source voltage with voltage steps of 0.05 V/step

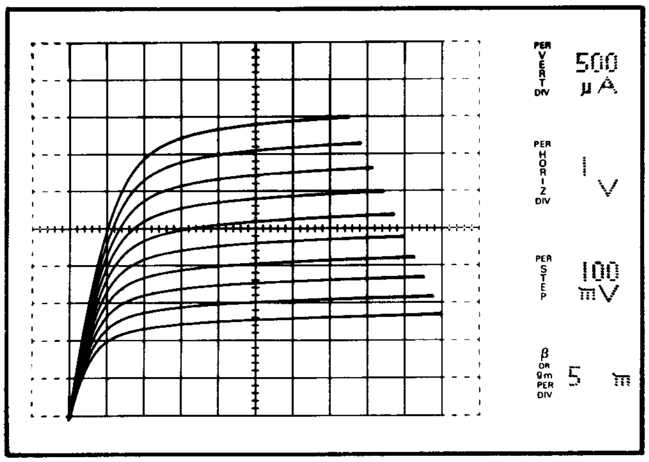


Fig. 2-17. Display of FET common-source characteristic curves: I_D vs. V_{DS} for 10 steps of gate voltage at 0.05 volts/step.

applied to the gate (see Fig. 2-17). Since the steps applied to the gate are positive-going, the curves displayed represent enhancement mode operation of the FET. (Press the SINGLE STEP FAMILY button to locate the curve obtained with zero volts on the gate.)

67. Press the POLARITY INVERT button and note the display of the depletion mode of operation of the FET (see Fig. 2-17). (Press SINGLE STEP FAMILY button for zero bias curve.)

68. Set the Type 576 LEFT-OFF-RIGHT switch to OFF. Remove the universal FET test adapter and replace it with the universal transistor test adapter (with the transistor still in it.)

69. Set the following Type 576 controls to:

VERTICAL	5 mA
AMPLITUDE	Current Steps
NUMBER OF STEPS	5
POLARITY INVERT	Released

Set the AMPLITUDE switch and the VARIABLE COLLECTOR SUPPLY control for a family of curves similar to Fig. 2-18A.

70. Note the β or g_m per division readout. By measuring the vertical divisions between two curves of the displayed family, the β of the device in that region can be determined. For example, there is approximately 0.9 division between the fourth and fifth steps shown in Fig. 2-18A. The β of the device when operated in this region is, therefore, approximately 0.9 (200) or 180. To make a more accurate measurement of β, the difference in both collector and base current between the fourth and fifth steps should be less.

71. Press the OFFSET AID button and set the OFFSET MULT control to 4. Note that the offset current has been added to the Step Generator output so that the zero step is now at the level of the fourth step displayed.

72. Press the STEP MULT .1X button. Note that the current per step is now 1/10 of the value set by the AMPLITUDE switch. Check the PER STEP readout for the new amplitude per step. (See Fig. 2-18B.)

73. Set the DISPLAY OFFSET Selector switch to VERT X1 and turn the CENTERLINE VALUE switch clockwise until the first step is within ±0.5 division of the center horizontal line.

74. Set the DISPLAY OFFSET Selector switch to VERT X10. Note that though the β per division is still 200 as it was in step 70, the change in collector and base current (ΔI_C and ΔI_B) is less between the fourth and the fifth step. This allows for a more accurate measurement of β at the level of the fourth step (see Fig. 2-18C). The β of the device at the fourth step now measures at about 0.8 (200) = 160.

75. Set the following Type 576 controls to:

VERTICAL	1 mA
DISPLAY OFFSET Selector	NORM (OFF)
AMPLITUDE	.05 V
NUMBER OF STEPS	1
OFFSET MULT	0
STEP MULT	Released

76. Turn the OFFSET MULT control until a step just begins to appear on the CRT. Note the multiplier value on the OFFSET MULT control. This number times the AMPLITUDE switch setting is the base-to-emitter turn on voltage of the transistor.

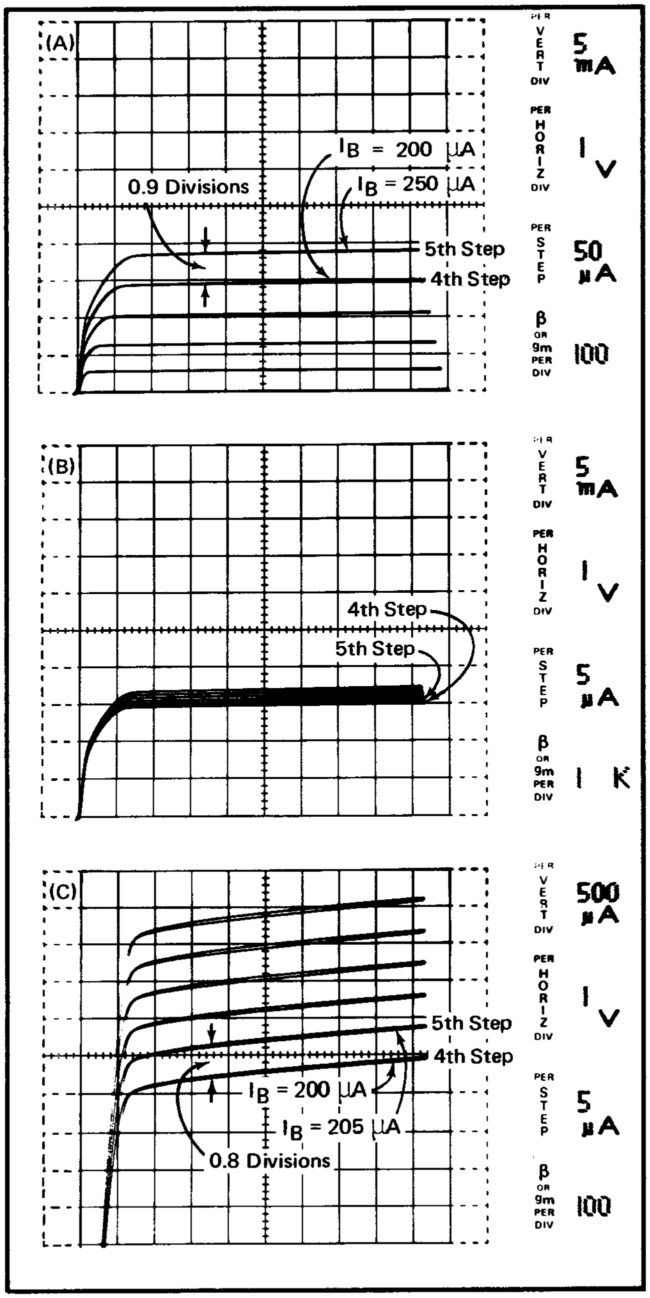


Fig. 2-18. Measurement of β of transistor, (A) Coarse measurement; (B) Offsetting of display and .1X multiplication of step amplitude; (C) 10X magnification of vertical display.

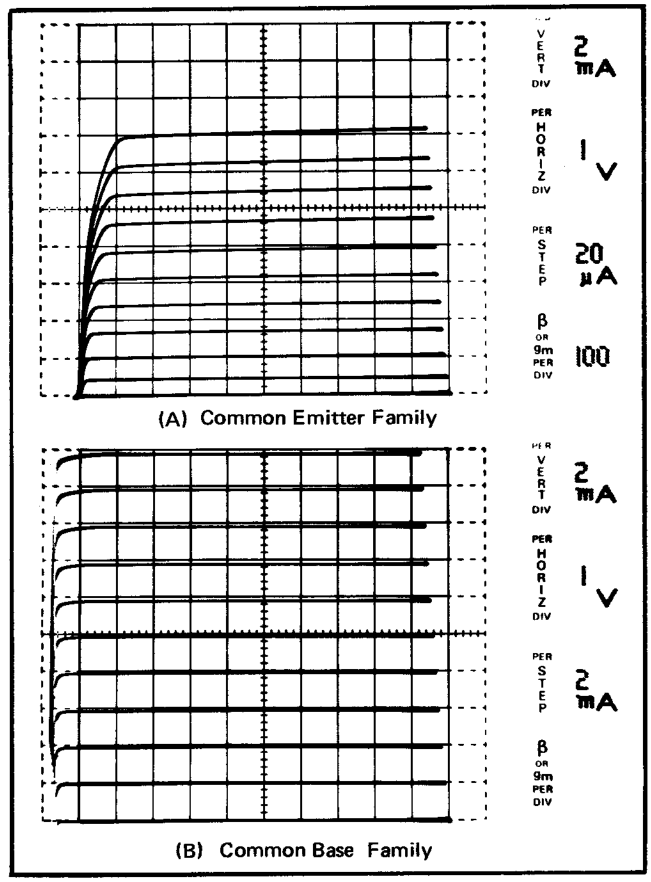


Fig. 2-19. (A) Terminal Selector switch set to BASE TERM STEP GEN (NORM); (B) Terminal Selector switch set to EMITTER TERM STEP GEN.

Standard Test Fixture

77. Set the following Type 576 controls to:

AMPLITUDE	20 µA
OFFSET	ZERO

78. Note the display of the characteristic curves with the emitter grounded and the current steps applied to the base (see Fig. 2-19A).

79. Set the LEFT-OFF-RIGHT switch to OFF and the STEP FAMILY button to OFF. Take a patch cord with banana plugs on each end and connect it between the STEP GEN OUTPUT connector and the EXT BASE OR EMIT INPUT connector.

80. Set the following Type 576 controls to:

STEP FAMILY	ON
LEFT-OFF-RIGHT	RIGHT
Terminal Selector	BASE TERM OPEN (OR EXT)

Note a display similar to that seen in step 78.

81. Set the following Type 576 controls to:

VERTICAL	1 nA EMITTER
MODE	LEAKAGE
VARIABLE COLLECTOR SUPPLY	Fully Counterclockwise
STEP FAMILY	OFF

Remove the patch cord.

82. Turn the VARIABLE COLLECTOR SUPPLY control clockwise and note the display of emitter leakage current with the base terminal open.

83. Set the Terminal Selector switch to SHORT and note the display of emitter leakage current with the base terminal shorted to ground.

84. Set the following Type 576 controls to:

VERTICAL	5 mA
AMPLITUDE	5 mA
Terminal Selector	EMITTER TERM STEP GEN
STEP FAMILY	ON

Turn the VARIABLE COLLECTOR SUPPLY control clockwise and note the display of collector current vs. collector-emitter voltage with current steps applied to the emitter of the transistor (see Fig. 2-19B).

85. Set the following Type 576 controls to:

STEP FAMILY	OFF
Terminal Selector	EMITTER TERM OPEN (OR EXT)

Reconnect the patch cord between the STEP GEN OUTPUT connector and the EXT BASE OR EMIT INPUT connector.

86. Set the STEP FAMILY button to ON and note a display similar to that seen in step 84.

This completes the first-time operation.

GENERAL OPERATING INFORMATION

CRT

The CRT in the Type 576 has a permanently etched internal graticule. The graticule is 10 divisions by 12 divisions, each division being 1 cm. Illumination of the graticule is controlled by the GRATICULE ILLUM control. Protective shields for the CRT and the fiber-optic readout display are fitted to the bezel. The bezel covers the CRT and the fiber-optic readout display. To remove, loosen the securing screw and pull out on the bottom of the bezel.

A blue filter has been provided to improve the contrast of the display when the ambient light is intense. This filter may be installed (or removed) by removing the bezel and sliding the filter from between the CRT protective shield and the bezel frame.

Readout

The readout located to the right of the CRT is made up of the fiber-optic displays and their titles. The fiber-optic displays show numbers and units (5 mA, 2 V, etc.) the values of which are a function of front-panel control settings. The titles are words printed on the fiber-optic display shield attached to the bezel. These words indicate the characteristics of the CRT display to which each fiber-optic display is related (PER VERT DIV, PER STEP, etc.). Illumination of the titles and the fiber-optic diplays is controlled by the READOUT ILLUM control. It should be noted that as the illumination of the readout is reduced, the fiber-optic display of β or g_m per division turns off before the other fiber-optic displays.

Intensity

The intensity of the display on the CRT is controlled by the INTENSITY control. This control should be adjusted so that the display is easily visible but not overly bright. It will probably require readjustment for different displays. Particular care should be exercised when a spot is being displayed. A high intensity spot may burn the CRT phosphor causing permanent damage to the CRT.

Focus

The focus of the CRT display is controlled by the FOCUS control. This control should be adjusted for optimum display definition.

Positioning

The position of the display on the CRT graticule, both vertically and horizontally, is controlled by four sets of controls: the vertical and horizontal POSITION controls, the POLARITY switch, the DISPLAY OFFSET controls and the DISPLAY INVERT, ZERO and CAL buttons.

The position controls provide coarse and fine positioning of the display both vertically and horizontally. Each coarse POSITION switch provides 5-division increments of display positioning. Each FINE POSITION control has a continuous range of greater than 5 divisions. The position controls should not be used to position the zero reference off the CRT. The DISPLAY OFFSET controls may be used for this purpose. If the display is magnified either vertically or horizontally using the DISPLAY OFFSET Selector switch, the ranges of the position controls are increased 10 times.

The POLARITY switch positions the zero signal point of a display (located by pressing the ZERO button) to a position convenient for making measurements on an NPN device, a PNP device or when making an AC measurement.

The DISPLAY OFFSET controls provide calibrated offset (or positioning) of the display either vertically or horizontally. These controls may be used either to make a measurement or to position particular portions of a display, which has been magnified, on the CRT graticule. The DISPLAY OFFSET Selector switch determines whether the display will be offset vertically or horizontally and the CENTERLINE VALUE switch provides the offset. Under unmagnified conditions, 10 divisions of offset are available. When the DISPLAY OFFSET Selector switch is set to one of its MAGNIFIER positions, 100 divisions of offset are available.

When making a measurement using the DISPLAY OFFSET controls, the CRT graticule becomes a window. When the CENTERLINE VALUE switch is set to 0, the vertical centerline (horizontal offset) or the horizontal centerline (vertical offset) of the window is at the zero signal portion of the display. As the CENTERLINE VALUE switch is turned counterclockwise, the window moves either vertically or horizontally along the display. For each position of the CENTERLINE VALUE switch, the number on the switch appearing in the blue window represents the number of divisions the vertical centerline or the horizontal centerline has been offset from the zero offset line. If the display has been magnified, the number in the blue window must be multiplied by 10.

The ZERO button provides a convenient means of positioning the zero reference point on the CRT graticule. Under normal operating conditions (DISPLAY OFFSET Selector switch set to NORM) when the ZERO button is pressed, a zero reference spot appears on the CRT graticule. This spot indicates the point on the CRT where zero signal is being measured by the vertical and horizontal display amplifiers. With the button pressed, the positioning controls may be used to position the spot to a point on the CRT graticule which makes measurements convenient. If the DISPLAY OFFSET Selector switch is set to VERT or HORIZ, the zero reference point indicates the horizontal or vertical graticule line, respectively, to which the CENTERLINE VALUE switch setting applies. To assure the accuracy of the CENTERLINE VALUE switch settings, the zero reference spot should be adjusted (using the positioning controls) to the appropriate centerline for the offset being used. For maximum accuracy of measurement, the position of this zero reference point should be adjusted with the DISPLAY OFFSET Selector switch in one of its MAGNIFIER positions.

The CAL button provides a means of checking the calibration of the display amplifiers. Under normal operating conditions (DISPLAY OFFSET Selector switch set to NORM) when the CAL button is pressed, a calibration reference spot appears on the CRT. This spot represents a signal applied to both the vertical and the horizontal display amplifiers which should cause 10 divisions deflection on the CRT graticule both vertically and horizontally. If the position of this spot is compared with the position of the spot obtained when the ZERO button is pressed, the accuracy of calibration of the display amplifiers can be determined. When the DISPLAY OFFSET Selector switch is set to either VERT or HORIZ, the calibration reference spot should appear on the vertical centerline (horizontal offset) or the horizontal centerline (vertical offset), assuming the zero reference point is properly adjusted. This calibration check should be made with the DISPLAY OFFSET Selector switch in either HORIZ X10 or VERT X10. Any departure of the calibration reference spot from the centerline, when this check is made, represents an error of 1% per division in the display offset.

The DISPLAY INVERT button provides a means of inverting the display on the CRT. When the DISPLAY INVERT button is pushed, the inputs to the display amplifiers are reversed, causing the display on the CRT to be inverted both vertically and horizontally about the center of the graticule.

If the position controls are centered, the zero and calibration references spots should appear in particular positions on the graticule depending on the positions of the POLARITY switch and the DISPLAY OFFSET Selector switch. Fig. 2-20 shows these positions of the spot for the various settings of the two switches. To determine the spot positions when the INVERT button is pressed, assume the graticule shown is inverted both vertically and horizontally.

Vertical Measurement and Deflection Factor

In the vertical dimension, the display on the CRT measures either collector current (I_C), emitter current (I_E) or the output of the Step Generator. The MODE switch and the VERTICAL switch determine which of these measurements are made.

The Vertical deflection factor of the display on the CRT is controlled by the VERTICAL switch, the DISPLAY OFFSET Selector switch and the MODE switch. The PER VERT DIV readout to the right of the CRT indicates the vertical deflection factor due to the combined effects of these three controls.

Under normal operating conditions, with the MODE switch set to NORM and the DISPLAY OFFSET Selector switch set to NORM (OFF), collector current is measured vertically and the VERTICAL switch determines the vertical sensitivity of the display.

When measuring collector current, the VERTICAL switch provides deflection factors (unmagnified) ranging from 1 μA/division to 2 A/division. The vertical deflection factor is indicated either by the PER VERT DIV readout or by the position of the VERTICAL switch, using the letters printed in black to determine units. The readout and the switch position should coincide.

When the MODE switch is set to LEAKAGE (EMITTER CURRENT) the CRT display measures emitter current vertically. In this case the vertical sensitivity of the display is increased by 1000 times for each position of the VERTICAL switch. The vertical deflection factor is indicated either by the PER VERT DIV readout or by the position of the VERTICAL switch, using the letters printed in orange to determine units. When the MODE switch is set to LEAKAGE the output of the Collector Supply is DC voltage, like that obtained when the MODE switch is set to DC (ANTI LOOP), rather than a voltage sweep. Also in the leakage mode a slight error (up to 1.25 V) is added to the horizontal display. The following Horizontal Measurement and Deflection Factor section shows how to determine the degree of this error.

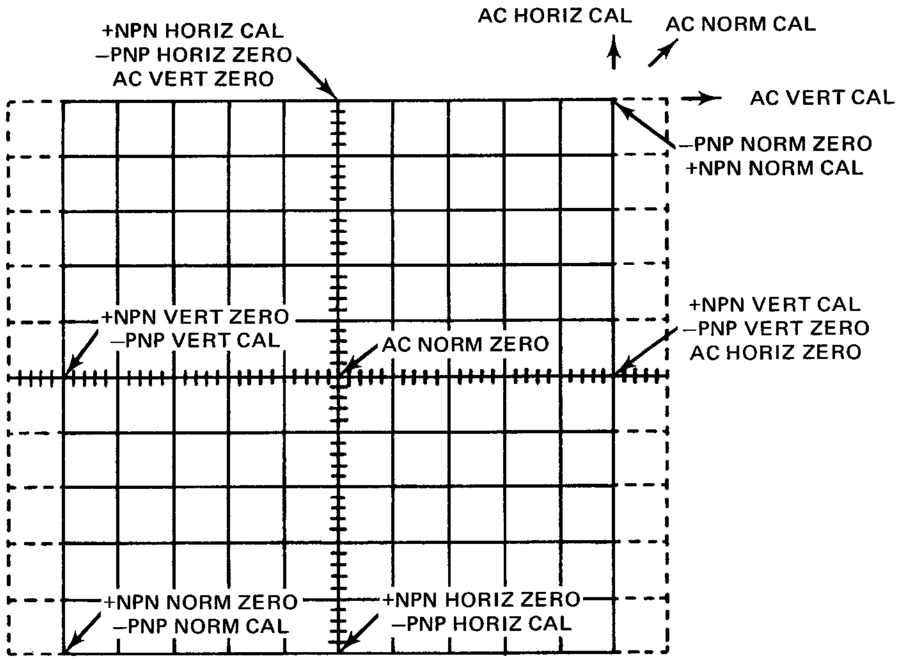


Fig. 2-20. Positions of spot on CRT graticule when ZERO or CAL buttons are pressed, for various positions of the POLARITY switch and the DISPLAY OFFSET Selection switch, assuming the position controls are centered.

When the VERTICAL switch is set to STEP GEN, steps indicating the Step Generator output are displayed vertically. The vertical display shows one step per division and the amplitude of each step, as shown by the PER STEP readout, determines the vertical deflection factor. It should be noted that if the HORIZONTAL switch is set to STEP GEN, the Step Generator output signal is not available for display vertically. In this case, setting the VERTICAL switch to STEP GEN causes zero vertical signal to be displayed.

The vertical sensitivity can be increased by 10 times for any of the previously mentioned measurements by setting the DISPLAY OFFSET Selector switch to VERT X10. The magnified vertical deflection factor can be determined either from the PER VERT DIV readout[1] or by dividing the setting of the VERTICAL switch by 10.

Horizontal Measurement and Deflection Factor

In the horizontal dimension, the display on the CRT measures either collector to emitter voltage (V_{CE}), collector to base voltage (V_{CB}), base to emitter voltage (V_{BE}), emitter to base voltage (V_{EB}) or the Step Generator output. The HORIZONTAL switch, the Terminal Selector switch and the parameter being measured vertically determine what is measured horizontally.

[1] **The PER VERT DIV readout does not indicate deflection factors less than 1 nA/division.**

The horizontal deflection factor of the display on the CRT is controlled by the HORIZONTAL switch and the DISPLAY OFFSET Selector switch. The PER HORIZ DIV readout to the right of the CRT indicates the horizontal deflection factor due to the combined effects of these two controls.

Under normal operating conditions with collector current being measured vertically, the Terminal Selector switch set to EMITTER GROUNDED and the DISPLAY OFFSET Selector switch set to NORM (OFF), the display will measure V_{CE} or V_{BE} horizontally. To measure V_{CE}, the HORIZONTAL switch must be set within the COLLECTOR range which has deflection factors between 50 mV/division and 200 V/division. To measure V_{BE}, the HORIZONTAL switch must be set within BASE range which has deflection factors between 50 mV/division and 2 V/division. In both cases, the horizontal deflection factors are indicated by both the PER HORIZ DIV readout and the position of the HORIZONTAL switch. The two values should coincide.

When the Terminal Selector switch is set to BASE GROUNDED the horizontal display measures collector to base voltage (V_{CB}) with the HORIZONTAL switch in the COLLECTOR range, or emitter to base voltage (V_{EB}) with the HORIZONTAL switch in the BASE range. It should be noted that V_{EB} in this case does not indicate a measurement of the emitter-base voltage under a reverse biased condition. It is a measurement of the forward biased base-emitter voltage with the horizontal sensing leads reversed.

When emitter current is being measured by the vertical display, the only significant measurements made by the horizontal display are V_{CE} and V_{CB}. To make these measurements, the HORIZONTAL switch is set within the COLLECTOR range and the Terminal Selector switch is set to EMITTER GROUNDED or BASE GROUNDED.

With the VERTICAL switch set between 500 nA/division and 1 nA/division, an error occurs in the horizontal measurement. Table 2-3 indicates the degree of this error in voltage per division of vertical deflection for all the settings of the VERTICAL switch within this given range. Using this table and the following procedure, the actual V_{CE} or V_{CB} can be caluclated.

TABLE 2-3

Error in Horizontal Voltage Measurement Per Division of Vertical Deflection

VERTICAL Switch Setting[1]	Voltage Error Per Vertical Division
50 nA, 5 nA	125 mV
20 nA, 2 nA	50 mV
100 nA, 10 nA, 1 nA	25 mV

[1]**EMITTER current, DISPLAY OFFSET Selector switch set to NORM (OFF).**

1. Measure the vertical deflection of the display in divisions (see Fig. 2-21).

2. Measure the horizontal deflection of the display in volts.

3. Using Table 2-3, find the error factor for the setting of the VERTICAL switch and multiply it by the value determined in step 1.

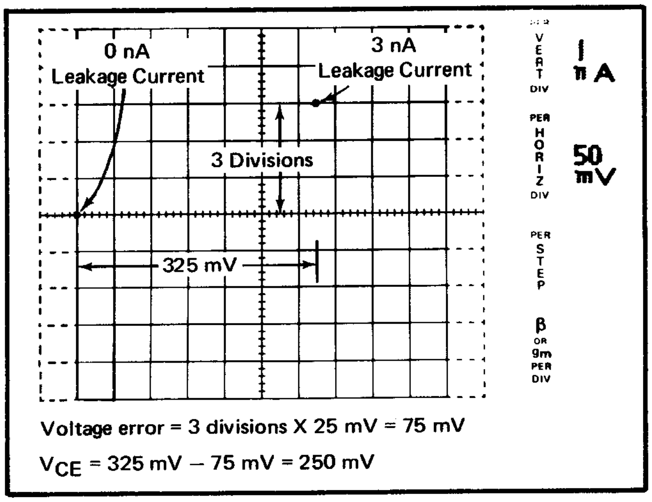


Fig. 2-21. Sample calculation of error in collector to emitter voltage incurred when measuring leakage of a transistor.

4. Subtract the voltage determined in step 3 from the voltage determined in step 2 to give the actual V_{CE} or V_{CB}.

When the HORIZONTAL switch is set to STEP GEN, steps indicating the Step Generator output are displayed horizontally. The horizontal display shows one step per division and the amplitude of each step, as shown by the PER STEP readout determines the horizontal deflection factor.

The horizontal deflection factor can be increased by 10 times for any of the previously mentioned measurements by setting the DISPLAY OFFSET Selector switch to HORIZ X10[2]. The magnified horizontal deflection can be determined either from the PER HORIZ DIV readout or by dividing the setting of the HORIZONTAL switch by 10.

Measurements

Table 2-4 shows the measurements which are being made vertically and horizontally by the display for the various positions of the VERTICAL switch, the HORIZONTAL switch and the Terminal Selector switch. Those switch position combinations not covered by the table are not considered useful.

Display Offset and Magnifier

The DISPLAY OFFSET Selector switch and the CENTERLINE VALUE switch provides a calibrated display offset of from 0 to 10 divisions (0 to 100 divisions when the display is magnified) and a 10 times display magnifier. The display offset and the display magnifier, when in operation, effect the display either vertically or horizontally, but never the whole display. Use of the calibrate display offset is discussed in the Positioning section. Use of the magnifier is discussed in both the Vertical and Horizontal Measurement and Deflection Factor sections.

Collector Supply

The Collector Supply provides operating voltage for the device under test. It is a variable voltage in the form of either a sine wave, or a full-wave rectified sine wave (see Fig. 2-22). This voltage is applied to the collector terminals of the Standard Test Fixture.

The MAX PEAK VOLTS switch and the VARIABLE COLLECTOR SUPPLY control determine the peak voltage output of the Collector Supply, which may be varied from 0 volts to 1500 volts. The MAX PEAK VOLTS switch provides four peak voltage ranges: 15 volts, 75 volts, 350 volts and 1500 volts. The VARIABLE COLLECTOR SUPPLY allows continuous voltage variation of the peak voltage within each peak voltage range.

The PEAK POWER WATTS switch, which interlocks with the MAX PEAK VOLTS switch, determines the maximum power output of the Collector Supply. Power output

[2]**The Horizontal display is not calibrated when the VERTICAL switch is set between 100 nA and 1 nA EMITTER.**

TABLE 2-4

Measurements Made by the Type 576 Display

Switch Settings			Measured by Display	
VERTICAL	HORIZONTAL	Terminal Selector	Vertically	Horizontally
COLLECTOR	COLLECTOR	EMITTER GROUNDED	I_C	V_{CE}
COLLECTOR	BASE	EMITTER GROUNDED	I_C	V_{BE}
COLLECTOR	STEP GEN	EMITTER GROUNDED	I_C	I_B or V_{BE}
COLLECTOR	COLLECTOR	BASE GROUNDED	I_C	V_{CB}
COLLECTOR	BASE	BASE GROUNDED	I_C	V_{EB}[2]
COLLECTOR	STEP GEN	BASE GROUNDED	I_C	I_B or V_{EB}[2]
EMITTER	COLLECTOR	EMITTER GROUNDED	I_E	V_{CE}[1]
EMITTER	COLLECTOR	BASE GROUNDED	I_B	V_{CB}[1]
STEP GEN	COLLECTOR	EMITTER GROUNDED	I_B or V_{BE}	V_{CE}
STEP GEN	BASE	EMITTER GROUNDED	I_B or V_{BE}	V_{BE}
STEP GEN	COLLECTOR	BASE GROUNDED	I_B or V_{BE}	V_{CB}
STEP GEN	BASE	BASE GROUNDED	I_B or V_{EB}[2]	V_{EB}[2]

[1]**Error in voltage must be calculated. See Horizontal Measurement in Deflection Factor section.**

[2]**V_{EB} indicates a measurement of forward voltage base-emitter, with the horizontal voltage sensing leads reversed.**

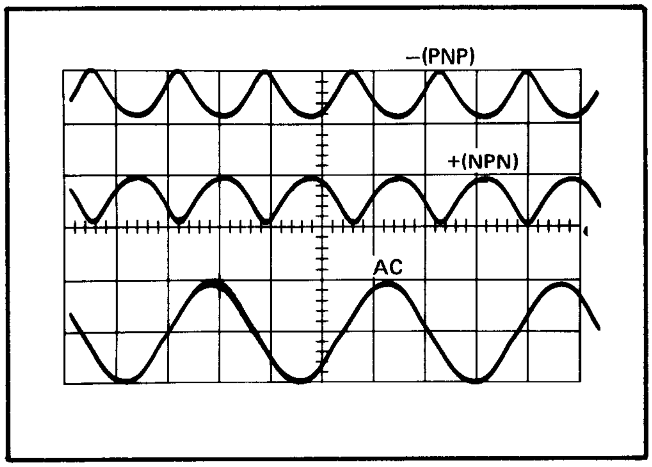


Fig. 2-22. Output of Collector Supply for three settings of POLARITY switch.

is controlled by placing a resistor, selected from the SERIES RESISTORS, in series with the Collector Supply output. The series resistance limits the amount of current which can be conducted by the Collector Supply. In setting the peak power output using the PEAK POWER WATTS switch, the proper series resistor is automatically selected. If the peak voltage range is changed while the MAX PEAK VOLTS and the PEAK POWER WATTS switches are interlocked, a new series resistor is chosen which will provide the same peak power output.

The Collector Supply POLARITY switch determines the polarity of the Collector Supply output and the Step Generator output. It also provides an initial display position on the CRT graticule as discussed in the section on positioning. When the POLARITY switch is set to +(NPN) the Collector Supply output is a positive-going full wave rectified sine wave and the Step Generator output is positive-going. When the switch is set to −(PNP) the Collector Supply output is a negative-going full wave rectified sine wave and the Step Generator output is also negative-going. The AC position of the POLARITY switch provides a Collector Supply output which is an unrectified sine wave, and the Step Generator output is positive-going. A negative-going Step Generator output can be obtained in this case by pressing the STEP/OFFSET POLARITY INVERT button. As noted on the front panel, when the AC position is being used, the MODE switch should be set to NORM and the Step Generator rate to .5X.

The MODE switch determines whether the Collector Supply output voltage will be a voltage sweep or a DC voltage. When the MODE switch is set to NORM the output is a repetitive voltage sweep varying from 0 volts to the peak voltage set by the MAX PEAK VOLTS switch and the VARIABLE COLLECTOR SUPPLY control. When the MODE switch is set to DC (ANTILOOP) or LEAKAGE (EMITTER CURRENT) the Collector Supply output is a DC voltage equal to the peak voltage set by the MAX PEAK VOLTS switch and the VARIABLE COLLECTOR SUPPLY control. This DC voltage may be either positive or negative. The DC mode is very useful when the normal display is exhibiting excessive looping.

Occasionally some of the characteristic curves displayed on the CRT consist of loops rather than well defined lines (see Fig. 2-23). This effect is known as looping and is most noticeable at very low or very high values or current. Looping is generally caused by stray capacitance within the Type 576, and device capacitance. It may also be caused by heating of the device under test. The LOOPING COMPENSATION control provides complete compensation for non heat-related looping due to the Type 576 and any standard device adapter which may be used. In general it does not compensate for any added capacitance introduced by the device under test. (Control has some effect in reducing stray capacitance in small diodes, and voltage-driven three terminal devices.) If uncompensated looping is hindering measurements, the MODE switch should be set to DC (ANTILOOP). If the collector sweep mode of operation (MODE switch set to NORM) is desired, an imaginary line lying inside the loop and equidistant from each side of the loop is the best approximation of the actual characteristic curve (see Fig. 2-23). Looping due to heating may be reduced by using the pulsed steps operation of the Type 576.

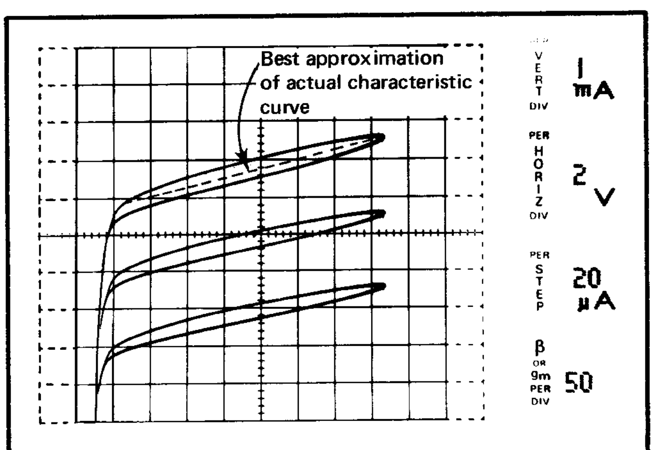


Fig. 2-23. Example of a display exhibiting looping.

Interlock System

Whenever the MAX PEAK VOLTS switch is in the 75, 350 or 1500 positions, the yellow COLLECTOR SUPPLY VOLTAGE DISABLED light comes on. This light indicates that the Collector Supply is disabled. In order to enable the Collector Supply under these circumstances, the Type 576 uses an interlock system. When the yellow light is on, the protective box must be installed over the accessories connectors (see Fig. 2-7). When the protective box is in place and the lid closed, the yellow light turns off and the red light turns on. The red light indicates that the Collector Supply is enabled and that a dangerous voltage may appear at the Collector terminals. For further information about the interlock system, see the Circuit Description.

Step Generator

The Step Generator provides current or voltage which may be applied to the base or the emitter of the device under test. The output of the Step Generator is families of ascending steps of current or voltage (see Fig. 2-24). When these steps together with the Collector Supply output are applied to the device under test, families of characteristic curves of the device are displayed on the CRT.

The NUMBER OF STEPS switch determines the number of steps per family and has a range of from 1 step to 10 steps. The AMPLITUDE switch determines the amplitude of each step and provides both current steps and voltage steps. The range of step amplitudes available are from 50 nA/step to 200 mA/step for current steps and from 5 mV/step to 2 V/step for voltage steps. The STEP MULT .1X button, when pressed, divides the step amplitude by 10. When voltage steps are being applied to the base of a transistor, the base current increases very rapidly with increasing base voltage (note Caution on front-panel). To avoid damage to the transistor when using voltage steps, current limiting is provided through the CURRENT LIMIT switch.

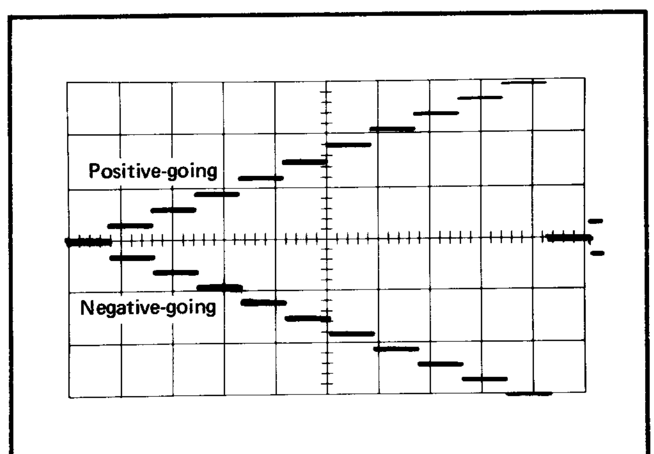


Fig. 2-24. Step Generator output in both polarities

The rate of generation of steps by the Step Generator is determined by the RATE buttons. When the NORM RATE button is pressed, steps are generated at a rate of 120 steps/second (assuming a 60 Hz line frequency), or one step per cycle of the Collector Supply, POLARITY switch set to +(NPN) or −(PNP). In this case each step occurs at the beginning of a Collector Supply cycle. When the .5X RATE button is pressed, the Step Generator rate is 60 steps/

second, or one step per 2 cycles of the Collector supply. Again, each step occurs at the beginning of a Collector Supply cycle. (This rate should be used when the POLARITY switch is set to AC.) Pressing the 2X RATE button produces a Step Generator rate of 240 steps/second, 2 steps per cycle of the Collector Supply. In this case steps occur at both the beginning and the peak of a Collector Supply cycle. If the 2X RATE and .5X RATE buttons are pressed together, the Step Generator rate is the normal rate of 120 steps/second except that the steps occur at the peak of each Collector Supply cycle rather than at the beginning as in normal rate operation.

The STEP FAMILY buttons determine whether step families are generated repetitively or one family at a time. Pressing the REP STEP FAMILY button turns the Step Generator on and provides repetitive families of steps. When the SINGLE STEP FAMILY button is pushed, one step family is generated and the Step Generator turns off. To get another step family, the SINGLE button must be pressed again.

The OFFSET buttons and the OFFSET MULT control allow current or voltage to be either added or subtracted from the Step Generator output. This causes the level at which the steps begin, to be shifted either in the direction of the ascending steps (aiding) offset, or in the opposite direction of the steps (opposing) offset. When the ZERO OFFSET button is pushed, the step family is generated at its normal level where the zero step level is either 0 mA or 0 V and the OFFSET MULT control is inhibited. When the AID OFFSET button is pressed, current or voltage may be added to the Step Generator output using the STEP MULT control. The amount of current or voltage added to the Step Generator output when the AID button is pressed is equal to the setting of the STEP MULT control times the setting of the AMPLITUDE switch. The STEP MULT control has a continuous range of 0 to 10 times the setting of the AMPLITUDE switch. Pressing the OPPOSE OFFSET button allows either current or voltage to be subrtracted from the Step Generator output, the amount subtracted determined by the STEP MULT control. Table 2-5 shows the polarity of the offset current or voltage for the two polarities of the Step Generator output.

Opposing offset is most useful when generating voltage steps to test field effect transistors. When current steps are being generated, the maximum opposing voltage is limited to approximately 2 volts. This voltage limiting protects the base-emitter junction of a bi-polar transistor from reverse breakdown.

The STEP/OFFSET POLARITY INVERT button allows the Step Generator output (both steps and offset) to be inverted from the polarity at which it was set by the POLARITY switch. It has no effect when the Terminal Selector switch is set to BASE GROUNDED. Caution should be exercised when using this button to cause reverse current to flow between the base and emitter terminals. Voltage limiting occurs, when current steps are being generated, only when the OPPOSE OFFSET button is pressed.

TABLE 2-5

Polarity of Offset for Polarity of Step Generator Output

Step Generator Polarity	OFFSET Buttons	Offset	
		Current	Voltage
Positive going	AID	Positive	Positive
Positive going	OPPOSE	Negative	Negative
Negative going	AID	Negative	Negative
Negative going	OPPOSE	Positive	Positive

When one of the PULSED STEPS buttons is pressed, steps are generated in pulses having durations of either 300 μs or 80 μs (offset is unaffected). Pulsed operation is useful when testing a device at power levels which might damage the device if applied for a sustained length of time. Pulsed steps of a 300 μs duration occur when the 300μs PULSED STEPS button is pressed. When the 80 μs PULSED STEPS button is pressed, the duration of the pulsed steps is 80 μs. When either the 300 μs button or the 80 μs button is pressed, the Collector Supply mode is automatically set to DC. If the 300 μs and 80 μs buttons are pressed together, the Collector Supply remains in the normal mode and 300 μs pulsed steps are produced. In all the previously mentioned cases, the pulses occur at the peak of the Collector Supply sweep and therefore only the normal and .5 times normal Step Generator rates are available for use.

Standard Test Fixture

The Standard Test Fixture, which slides into the front of the Type 576, provides a means of connecting the Collector Supply output, the Step Generator output and the display amplifiers to the device to be tested.

The Terminal Selector switch, located on the Standard Test Fixture, determines the state of the base and the emitter terminals of the device under test. The switch has two ranges: EMITTER GROUNDED and BASE GROUNDED. In the EMITTER GROUNDED range, the emitter terminal is connected to ground and the Terminal Selector switch determines the state of the base terminal. With the switch set to STEP GEN, the Step Generator output is applied to the base terminal. In the OPEN (OR EXT) position, the base terminal is left open. In this case measurements may be made with the base terminal left open or with an externally generated signal applied to it through the EXT BASE

TEST SET-UP CHART TYPE 576

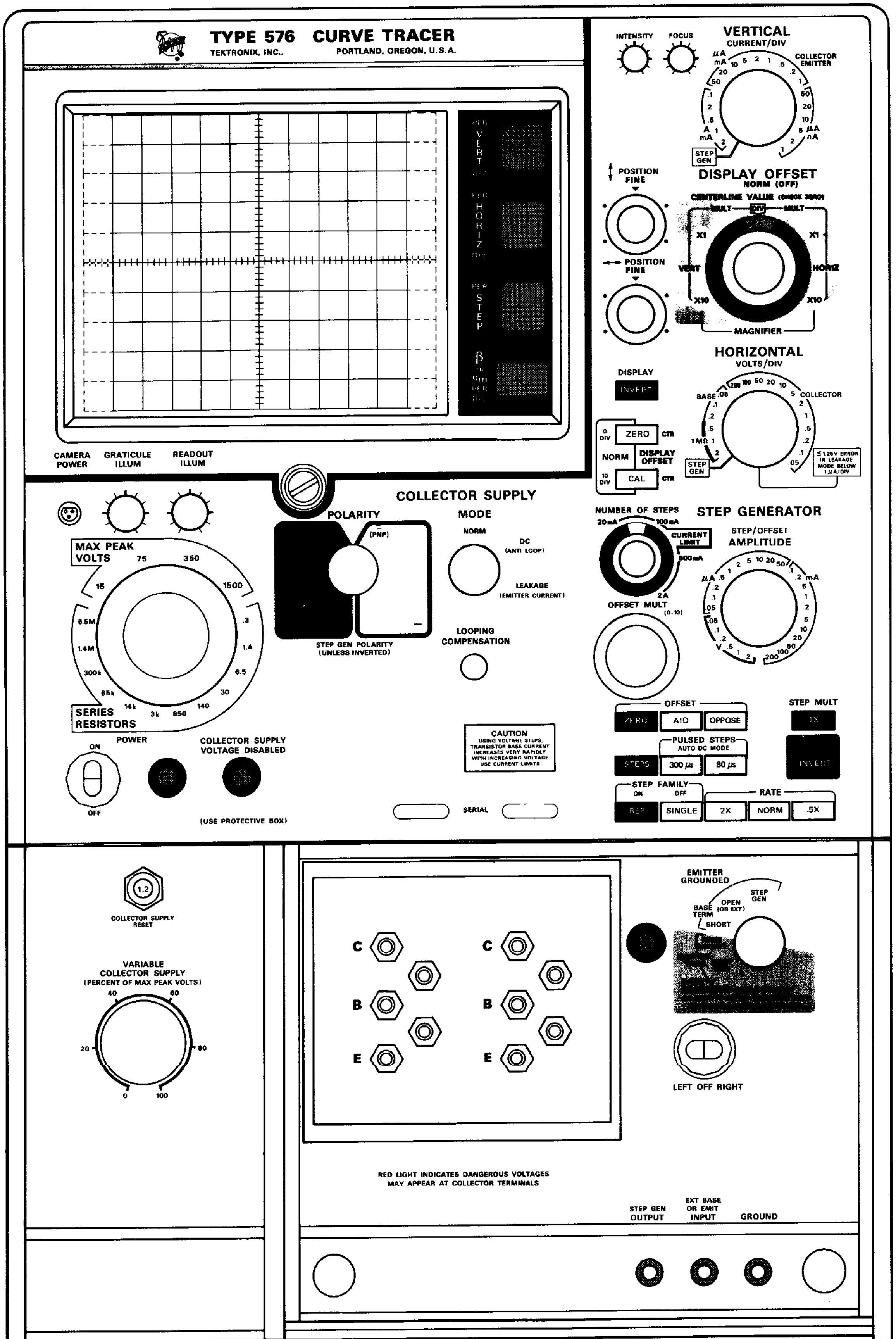


Fig. 2-25. Control setup chart for the Type 576 front-panel.

OR EMIT INPUT connector. When the Terminal Selector switch is set to BASE TERM SHORT, the base terminal is shorted to the emitter.

In the BASE GROUNDED range, the base terminal is connected to ground and the Terminal Selector switch determines the state of the emitter terminal. With the switch set to STEP GEN, the Step Generator output is inverted and applied to the emitter terminal. When the switch is set to OPEN (OR EXT) the emitter terminal is left open. In this case, measurements may be made with the emitter terminal left open or with an externally generated signal applied to it through the EXT BASE OR EMIT INPUT connector.

Tektronix Type 576 device testing accessories[3] may be plugged into the 10 Accessories connectors provided on the Standard Test Fixture. These accessories provide sockets into which semiconductors with various lead arrangements may be placed for testing. The 10 Accessories connectors allow the setting up of two devices at a time for comparison testing. The LEFT-OFF-RIGHT switch determines which device is under test. The 10 Accessories connectors also accept standard banana plugs so that a device may be connected to the Type 576 without using a specific device testing accessory.

The unlabeled Accessories connectors allow Kelvin sensing of voltage under high current conditions. Kelvin sensing means that voltage measurements on the collector and the emitter terminals of a device under test are made through separate contacts to the device leads which reduce contact resistance.

The STEP GEN OUTPUT connector allows the Step Generator output to be used externally. The EXT BASE OR EMIT INPUT connector allows application of an externally generated signal to either the base or the emitter of the device under test. The external signal is applied to whichever terminal is chosen by the Terminal Selector switch. The GROUND connector provides a Type 576 ground reference for signals generated or used external in Type 576.

[3]Some of these accessories are made of plastic and are susceptible to damage from excessive heat. If a device is likely to heat excessively a heat sink or the pulsed steps mode of operation should be used.

Polarities of the Collector Supply and Step Generator Output

Table 2-7 shows the polarities of the Collector Supply and the Step Generator output for various settings of the Collector Supply POLARITY switch and the Terminal Selector switch.

TABLE 2-7

Polarities of the Collector Supply and Step Generator Output

Switches		Polarities	
Collector Supply POLARITY	Terminal Selector	Collector Supply	Step Generator
−(PNP)	EMITTER GROUNDED	Negative going	Negative going[1]
−(PNP)	BASE GROUNDED	Negative going	Positive going
+(NPN)	EMITTER GROUNDED	Positive going	Positive going[1]
+(NPN)	BASE GROUNDED	Positive going	Negative going
AC	EMITTER GROUNDED	Positive and Negative going	Positive going[1]
AC	BASE GROUNDED	Positive and Negative going	Negative going

[1]May be inverted by pressing the POLARITY INVERT button.

APPLICATIONS

This part of the Operating Instructions describes the use of the Type 576 to measure some basic parameters of bipolar transistors, field effect transistors, unijunction transistors, silicon controlled rectifiers, signal and rectifier diodes, Zener diodes, and tunnel and back diodes. For each of the devices discussed, this section includes tables of Type 576 control settings required to make an accurate measurement without damaging the device under test. Below each table is a block diagram showing the connections of the collector supply, the step generator and the display amplifiers to the device under test, and a picture of a typical characteristic for the semiconductor type being discussed. Also included is a list of common measurements which may be made on the given devices with the Type 576 and a brief set of instructions on how to make each of these measurements.

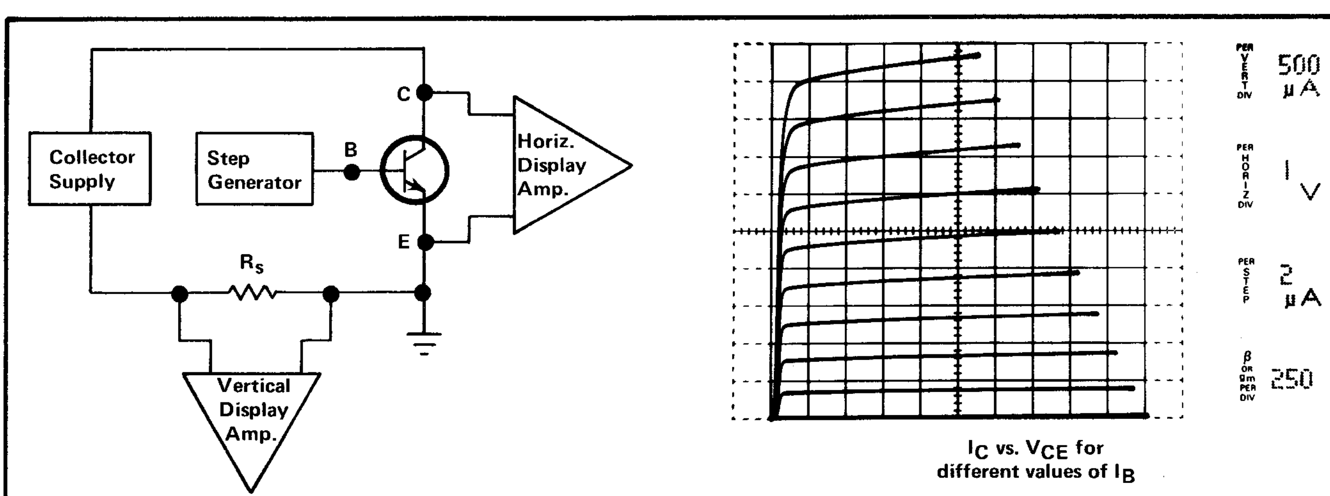
This section has been written with the assumption that the reader is familiar with the operation of the Type 576 as described at the beginning of the Operating Instructions. It is also assumed that the reader is familiar with the parameters being discussed. If an explanation or further information about semiconductor parameters and their measurement is needed, refer to the Tektronix Measurement Concepts book titled SEMICONDUCTOR DEVICE MEASUREMENTS which has been included as a standard accessory with the Type 576.

BIPOLAR TRANSISTORS

Required Type 576 Control Settings

Control	Required Setting
HORIZONTAL	COLLECTOR
POLARITY	+(NPN) or −(PNP) depending on the transistor type
PEAK POWER WATTS	Less than maximum power rating of device
AMPLITUDE	Current steps
STEPS	Pressed when using low base current
PULSED STEPS	Pressed when using high base current
Terminal Selector	EMITTER GROUNDED BASE TERM STEP GEN for common-emitter family
	BASE GROUNDED EMITTER TERM STEP GEN for common-base family
OFFSET	AID pressed if more than 10 steps are desired

Common-Emitter Family



I_C vs. V_{CE} for different values of I_B

Some Common Measurements

β (Static)

The static forward current transfer ratio (emitter grounded), h_{FE}, is I_C/I_B.

β (Small Signal)

The small-signal short-circuit forward current transfer ratio (emitter grounded), h_{fe}, is $\Delta I_C/\Delta I_B$. To determine h_{fe} at various points in a family of curves, multiply the vertical separation of two adjacent curves by the β OR g_m PER DIV readout. To make a more accurate measurement, see steps 69 through 74 of the First Time Operation instructions.

V_{CE} (Sat)

Saturation current and voltage is measured by expanding the display of the saturation region of the device by decreasing the horizontal deflection factor with the HORIZONTAL switch or the DISPLAY OFFSET MAGNIFIER. Saturation current can be adjusted to the desired operating point with the AMPLITUDE switch.

I_C vs. V_{BE}

Base-emitter voltage can be measured by setting the HORIZONTAL switch to the BASE range.

I_{CEO} and BV_{CEO}

Collector-emitter leakage current and collector-emitter breakdown voltage (base open) are measured by setting the Terminal Selector switch to BASE TERM OPEN (OR EXT). For small leakage currents set the MODE switch to LEAKAGE (EMITTER CURRENT). To measure breakdown voltage, increase both the horizontal deflection factor and the collector supply voltage.

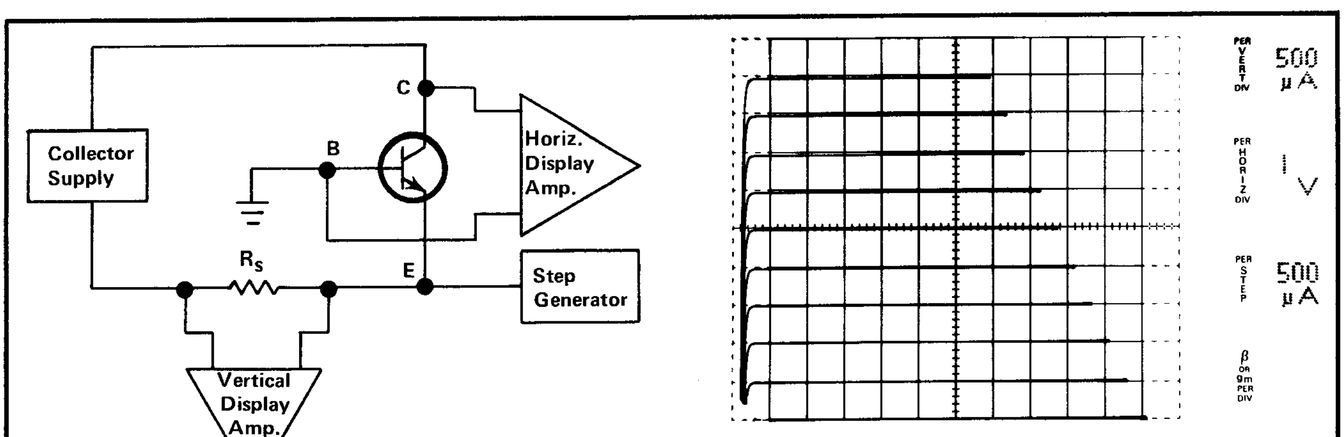
I_{CES} and BV_{CES}

Collector-emitter leakage current and collector-emitter breakdown voltage (base shorted to emitter) are measured the same as I_{CEO} and BV_{CEO} except that the Terminal Selector switch is set to BASE TERM SHORT.

I_{CER} and BV_{CER}

Collector-emitter leakage current and collector-emitter breakdown voltage (with a specified resistance between the base terminal and the emitter terminal) are measured the same as I_{CEO} and BV_{CEO} except that a specified resistance is connected between the base terminal and the emitter terminal.

Common-Base Family



I_C vs. V_{CB} for different values of I_E

Some Common Measurements

α (Small Signal)

The small-signal short-circuit forward current transfer ratio (base grounded), h_{fb}, can be measured from the common-base family display but is determined most easily by calculating it from the equation $\alpha = \beta/1 + \beta$.

I_{CBO} and BV_{CBO}

Collector-base leakage current and collector-base breakdown voltage (emitter open) is measured the same as I_{CEO} and BV_{CEO} except that the Terminal Selector switch is set to EMITTER TERM OPEN (OR EXT).

I_{EBO} and BV_{EBO}

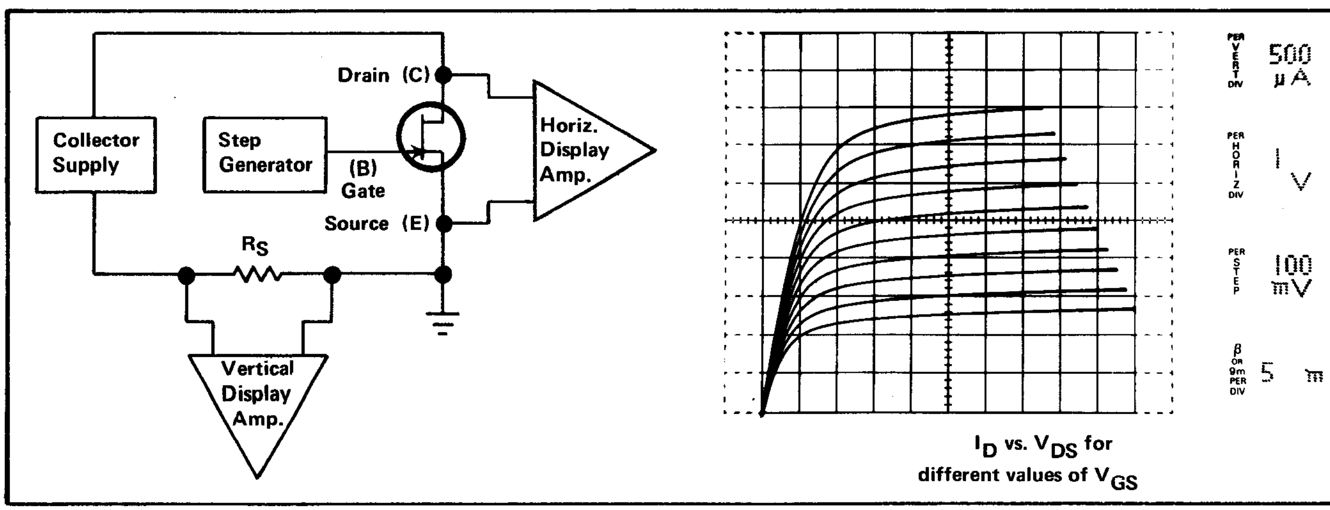
Emitter-base leakage current and emitter-base breakdown voltage (collector open) is measured the same as I_{CBO} and BV_{CBO} except that the device terminals are inverted in the device testing socket (collector lead in the emitter terminal of the socket and the emitter lead in the collector terminal).

FIELD EFFECT TRANSISTORS

Required Type 576 Control Settings

Control	Required Setting	
HORIZONTAL	COLLECTOR	
POLARITY	+(NPN) for N-channel device; −(PNP) for P-channel device	
PEAK POWER WATTS	Less than maximum power rating of device	
AMPLITUDE	Voltage Steps	
STEPS	Pressed	
Terminal Selector	EMITTER GROUNDED BASE TERM STEP GEN	
	Enhancement	Depletion
POLARITY INVERT	Released	Pressed
OFFSET with POLARITY INVERT button pressed	OPPOSE	ZERO or AID

Common-Source Family



I_D vs. V_{DS} for different values of V_{GS}

Some Common Measurements

g_m (Static)

The static transconductance (source grounded) is I_D/V_{GS}.

g_m (Small Signal)

The small-signal transconductance (source grounded) is $\Delta I_D/\Delta V_{GS}$. To determine g_m at various points in a family of curves, multiply the vertical separation of two adjacent curves by the β OR g_m PER DIV readout. To make a more accurate measurement, see steps 69 through 74 of the First Time Operation instructions.

I_{DSS} — Drain-source current with zero V_{GS} is measured from the common-source family, with the Terminal Selector switch set to BASE TERM SHORT. It should be measured above the knee of the curve.

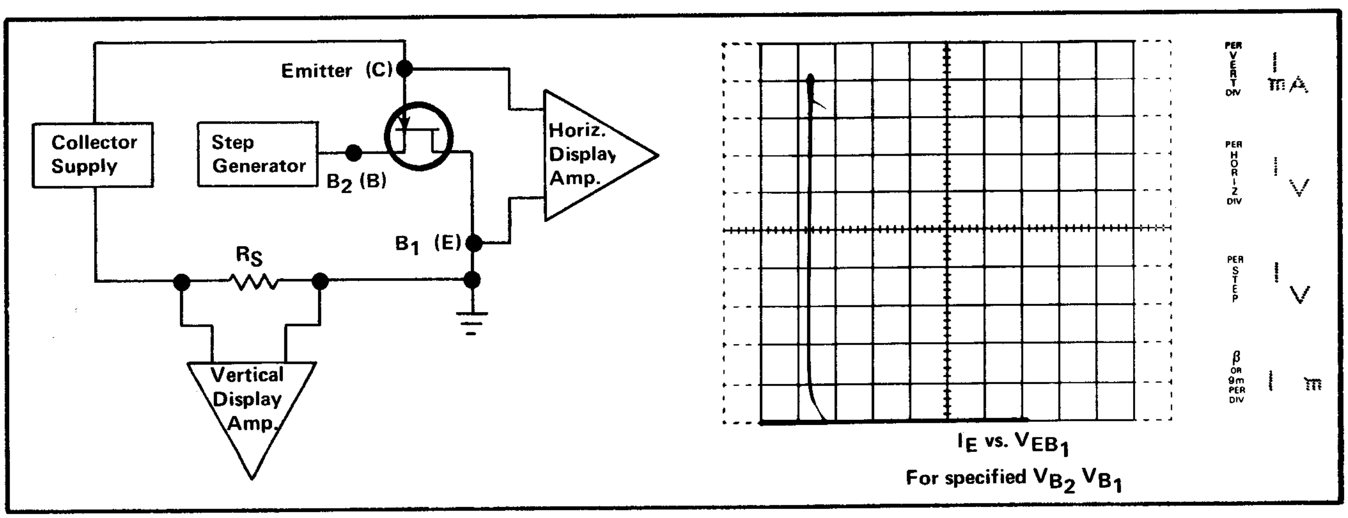
Pinch-Off Voltage (V_p) — Pinch-off voltage (V_p) can be measured by increasing the depletion voltage with the OFFSET MULT control and the AMPLITUDE switch until the specified pinch-off current is reached by the zero step (zero step only is obtained by pressing SINGLE button). Thus the pinch-off voltage is the setting of the OFFSET MULT control times the setting of the AMPLITUDE switch.

BV_{GSS} — Gate-source breakdown voltage with the drain shorted to the source can be measured by putting the gate lead of the device in the drain terminal of the test socket, the source lead in the gate terminal and the drain lead in the source terminal. Set the Terminal Selector switch to BASE TERM SHORT and reverse the collector supply polarity. This measurement should not be made on an insulated-gate device.

UNIJUNCTION TRANSISTORS

Required Type 576 Control Settings

Control	Required Setting
HORIZONTAL	COLLECTOR
POLARITY	+(NPN)
PEAK POWER WATTS	Less than maximum power rating of device
AMPLITUDE	Voltage
OFFSET	AID
STEP FAMILY	OFF (SINGLE)
Terminal Selector	BASE TERM STEP GEN



I_E vs. V_{EB_1}

For specified $V_{B_2} V_{B_1}$

Some Common Measurements

η — The intrinsic standoff ratio is $V_P - V_{EB_1}/V_{B_2}V_{B_1}$. In measuring η, $V_{B_2B_1}$ is determined by the OFFSET MULT control and the AMPLITUDE switch. $V_{B_2B_1}$ may be measured by setting the HORIZONTAL switch to the BASE range. V_P is determined by applying voltage between the emitter and the base$_1$ terminals using the VARIABLE COLLECTOR SUPPLY control. V_P is the voltage at which the emitter-base$_1$ junction becomes forward biased. V_{EB_1}, the turn on voltage of the emitter-base$_1$ junction is determined by setting the Terminal Selector switch to BASE TERM OPEN.

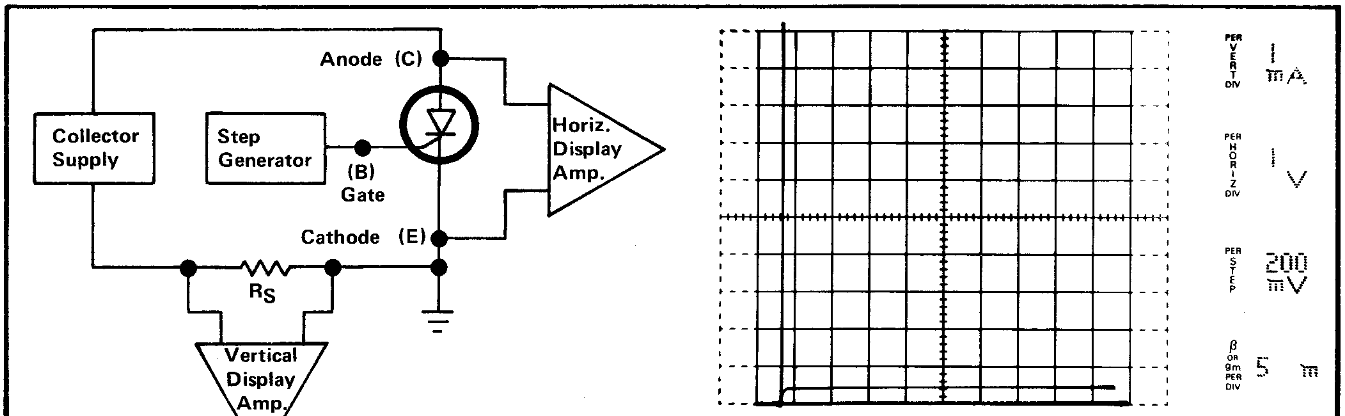
$R_{B_2B_1}$

The interbase resistance can be measured by placing the $base_2$ lead in the collector terminal of the test socket and the $base_1$ lead in the emitter terminal. Leave the emitter lead at the device open and apply voltage across the two bases with the VARIABLE COLLECTOR SUPPLY control.

SILICON CONTROLLED RECTIFIERS (SCRs)

Required Type 576 Control Settings

Control	Required Setting
HORIZONTAL	COLLECTOR
PEAK POWER WATTS	Less than maximum power rating of device
POLARITY	+(NPN)
STEPS	Pressed when using low gate voltage or current
PULSED STEPS	Pressed when using high gate voltage or current
Terminal Selector	EMITTER GROUNDED BASE TERM STEP GEN



I_F vs. V_F for different values of V_G

Some Common Measurements

Turn-on

The gate voltage or current at which the device turns on can be measured by applying a specified voltage between the anode and cathode terminals using the VARIABLE COLLECTOR SUPPLY control and applying current or voltage steps in small increments to the gate with the AMPLITUDE switch.

Forward Blocking Voltage

To measure the forward blocking voltage, set the Terminal Selector switch to BASE TERM OPEN (or SHORT depending on the specification) and turn the VARIABLE COLLECTOR SUPPLY control clockwise until the device switches to its low impedance state. The voltage at which switching occurs is the forward blocking voltage.

Holding Current

Holding current is measured in the same manner as forward blocking voltage. Holding current is the minimum current conducted by the device, while operating in its low impedance state, without turning off.

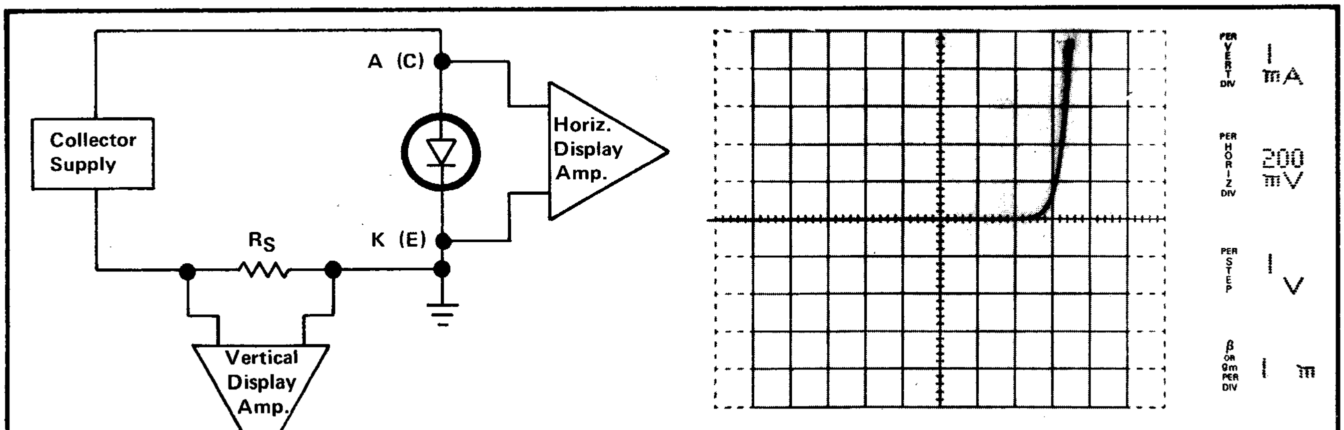
Reverse Blocking Voltage

The reverse blocking voltage is measured the same way as the forward blocking voltage except that the POLARITY switch is set to −(PNP).

SIGNAL DIODES AND RECTIFYING DIODES

Required Type 576 Control Settings

Control	Required Setting
HORIZONTAL	COLLECTOR
PEAK POWER WATTS	Less than maximum power rating of device
POLARITY	+(NPN)
Terminal Selector	EMITTER GROUNDED



I_F vs. V_F

Some Common Measurements

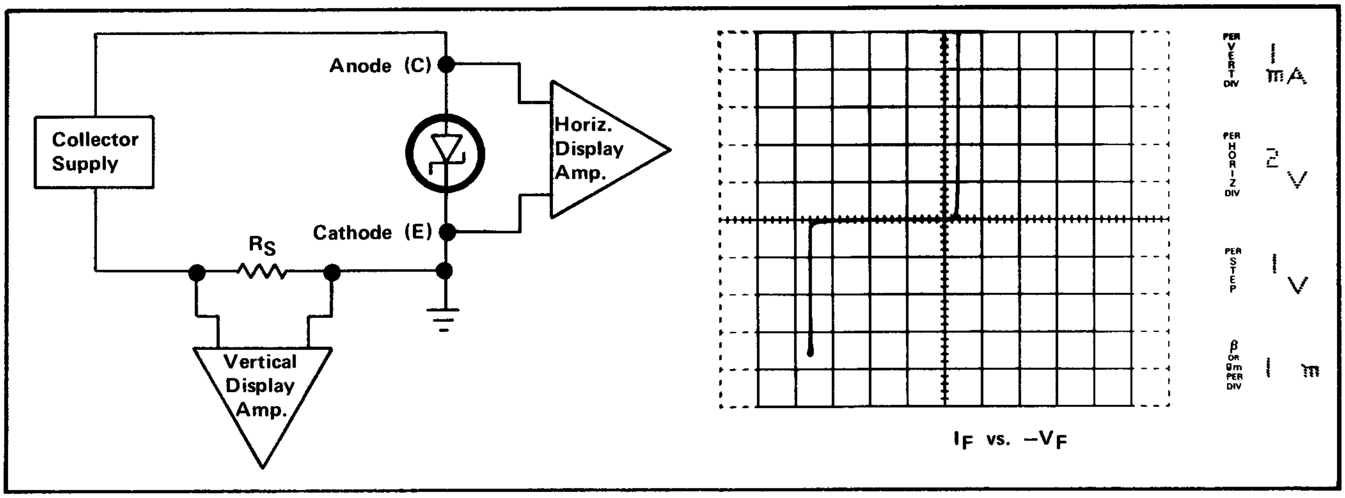
I_F and V_F — To measure forward current and voltage, put the cathode of the diode in the emitter terminal of the test socket and the anode of the diode in the collector terminal. Apply voltage to the device with the VARIABLE COLLECTOR SUPPLY control.

I_R and V_R — Current and voltage in the reverse direction are measured in the same manner as in the forward direction except that the POLARITY switch is set to −(PNP). For measurements of small amounts of reverse current, set the MODE switch to LEAKAGE (EMITTER CURRENT).

ZENER DIODES

Required Type 576 Control Settings

Control	Required Setting
HORIZONTAL	COLLECTOR
PEAK POWER WATTS	Less than maximum power rating of device
POLARITY	−(PNP)
Terminal Selector	EMITTER GROUNDED



I_F vs. $-V_F$

Some Common Measurements

V_Z and I_R

To measure Zener voltage or reverse current, put the cathode of the diode in the emitter terminal of the test socket and the anode of the diode in the collector terminal. Apply voltage to the device with the VARIABLE COLLECTOR SUPPLY control. For a more accurate measurement of Zener voltage, see steps 42 through 46 of the First Time Operation instructions. For measurements of small amounts of reverse current, set the MODE switch to LEAKAGE (EMITTER CURRENT).

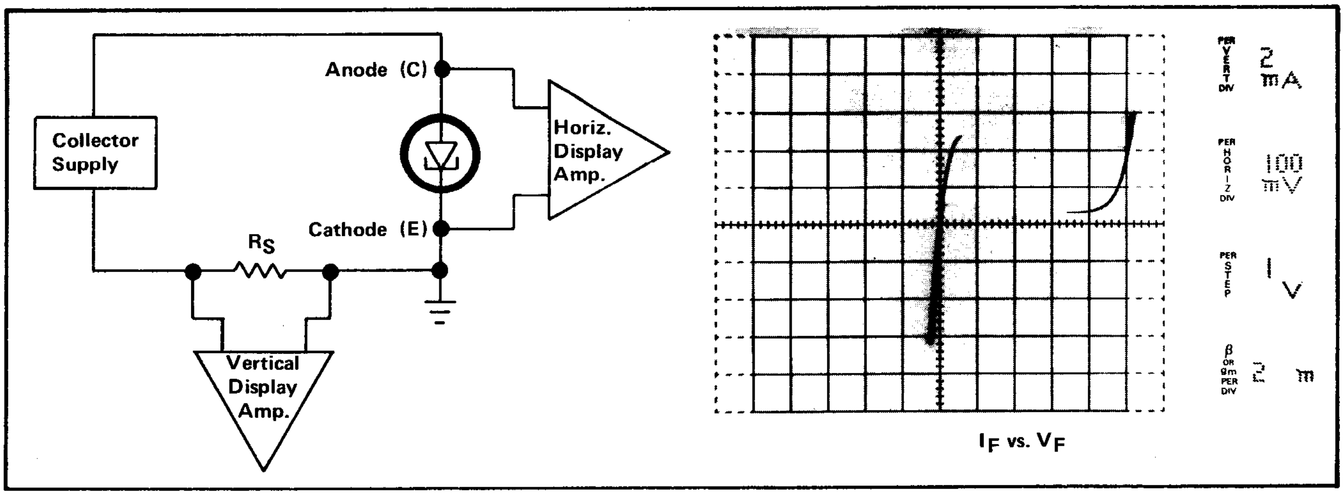
I_F and V_F

Current and voltage in the forward direction are measured in the same manner as in the reverse direction except that the POLARITY switch is set to +(NPN). For a display of currents and voltages in both directions, set the POLARITY switch to AC.

TUNNEL DIODES AND BACK DIODES

Required Type 576 Control Settings

Control	Required Setting
HORIZONTAL	COLLECTOR
PEAK POWER WATTS	Less than maximum power rating of device
POLARITY	+(NPN)
Terminal Selector	EMITTER GROUNDED



I_F vs. V_F

 Ⓐ

Some Common Measurements

I_F and V_F

To measure the forward current and voltage characteristics of a tunnel diode or a back diode, such as the peak point and valley point currents and voltages, put the cathode of the diode in the emitter terminal of the test socket and the anode of the diode in the collector terminal. Apply voltage to the device with the VARIABLE COLLECTOR SUPPLY control. For most accurate measurements of peak and valley points, use the magnified display offset as described in steps 42 through 46 of the First Time Operation instructions.

I_R and V_R

Current and voltage in the reverse direction are measured in the same manner as in the forward direction except that the POLARITY switch is set to —(PNP). For a display of currents and voltages in both directions, set the POLARITY switch to AC.

SECTION 3
CIRCUIT DESCRIPTION

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

General

This discussion of the Type 576 internal operation is divided into two parts: Block diagram description and circuit description. The block diagram description discusses the functions of the major circuits within the instrument, using the overall block diagram. The circuit description provides a detailed description of all the major circuits and the signal switching within the instrument.

It is suggested that the block diagrams and schematics which have been included in this manual be referred to while reading this circuit description. Individual block diagrams and simplified schematics of most of the major circuits and signal switching accompany the text of this section. An overall block diagram of the instrument, showing all the major circuits and a simplified version of the signal switching, is provided in the diagrams section at the back of the manual. Also in the diagrams section are complete schematics of all the circuitry within the Type 576 which include component part numbers and values.

BLOCK DIAGRAM DESCRIPTION

The Type 576 is a dynamic semiconductor tester which displays and allows measurement of semiconductor characteristics obtained under simulated operating conditions. The collector supply circuit and the step generator produce operating voltages and currents which are applied to the device under test. The display amplifiers measure the effects of these applied conditions. The tests result in curves of transistor, diode, and other semiconductor device characteristics traced on the face of a CRT.

The collector supply circuit produces full-wave rectified sine waves which may be either positive-going or negative-going or unrectified sine waves, depending on the position of the POLARITY switch. The amplitude of the signal can be varied from 0 to 1500 volts as determined by the MAX PEAK VOLTS switch and the VARIABLE COLLECTOR SUPPLY control. The Collector Supply output is applied to the collector (or equivalent) terminal of the device under test.

The step generator produces ascending steps of current or voltage at a normal rate of one step for each half-sine wave of the collector supply. The amount of current or voltage per step is controlled by the AMPLITUDE switch and the total number of steps is controlled by the NUMBER OF STEPS switch. The Step Generator output may be applied to either the base or the emitter (or equivalent) terminals of the device under test.

The display amplifiers are connected to the device under test. These amplifiers measure the effects of the collector supply and the step generator on the device under test, amplify the measurements, and apply the resulting voltages to the deflection plates of the CRT. The sensitivities of these amplifiers are controlled by the VERTICAL CURRENT/DIV switch and the HORIZONTAL VOLTS/DIV switch.

CIRCUIT DESCRIPTION

The following discussion provides a detailed circuit description of all the major circuits within the Type 576 and the Standard Test Fixture. This description explains the operation of the various circuits within the instrument, and the voltages and waveforms which can be expected from them. Discussion of basic electronics and simple electronic circuits will be kept at a minimum.

Collector Supply

The collector supply circuit produces an unrectified sine wave or a full-wave rectified sine wave with a peak amplitude which may be varied from 0 to 1500 volts peak in four ranges. The initial voltage for the collector supply comes from variable autotransformer T300 (see Fig. 3-1) which has a source voltage of 115 volts AC. The output of T300 is connected to the primary of sweep transformer T301 and is controlled by the VARIABLE COLLECTOR SUPPLY VOLTS control and varies from 0 to 115 volts. The MAX PEAK VOLTS switch allows the choice of four collector sweep voltage ranges by choosing pairs of transformer taps from the secondary of T301. The voltage from these taps is rectified by one of two diode bridge rectifier assemblies: the 500 volt assembly for the 15, 75 and 350 volt ranges and the 2 kilovolt assembly for the 1500 volt range.

The 500 volt rectifier assembly is used either as a center tapped full-wave rectifier or a bridge rectifier depending on the connection of the current return input to the collector supply. The current return comes from the non-grounded side of the current sensing resistor. Since the voltage level of the current return input is dependent on the current flowing through the current sensing resistor, the collector supply can be considered to be floating. For the 15 volt or 75 volt ranges, the current return is connected to the center tap of the sweep transformer secondary. In this case only two diodes of the 500 volt rectifier assembly are used as a full-wave rectifier. For the 350 volt range, the current return goes to the bridge rather than the center tap of the transformer. In this case, the whole 500 volt rectifier

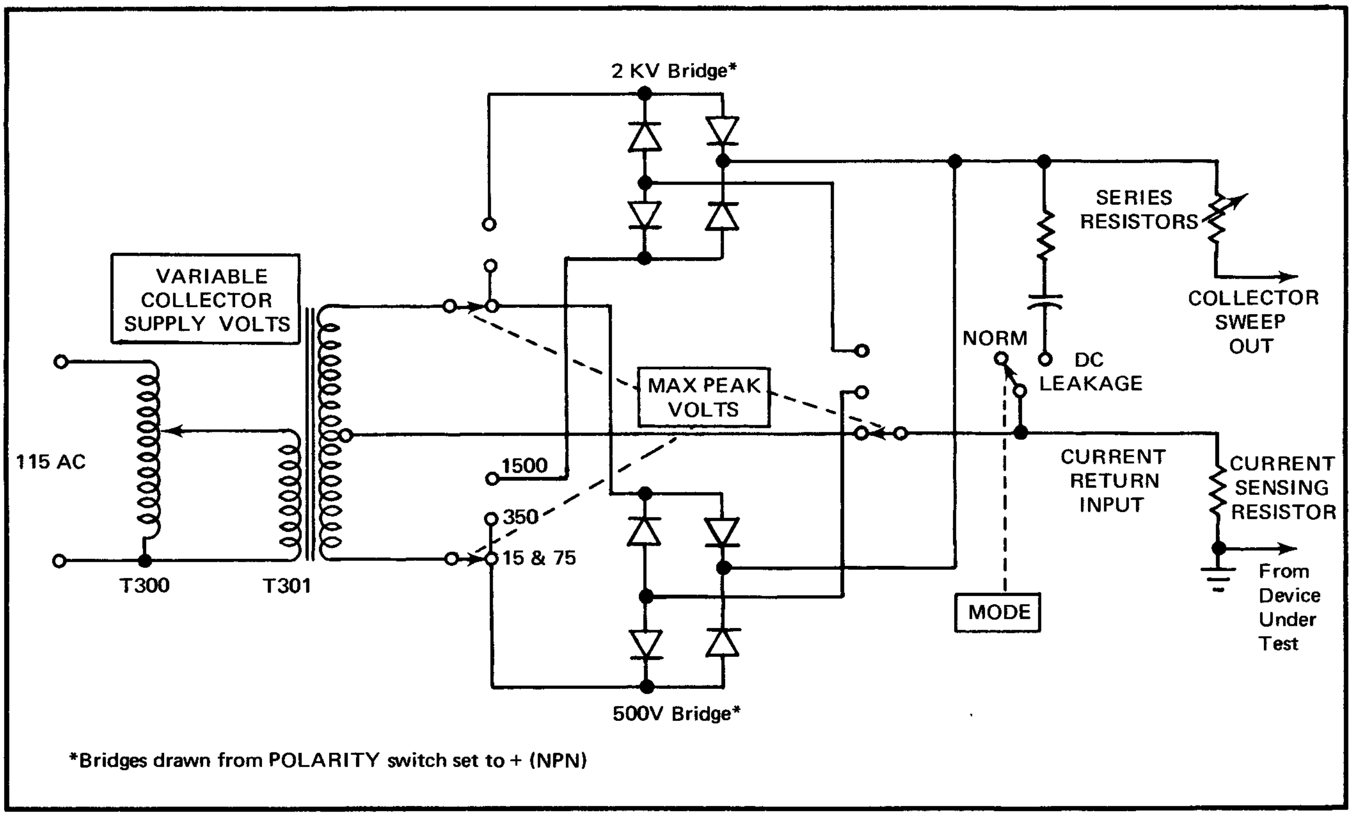


Fig. 3-1. Simplified schematic of collector supply circuit.

assembly is used for rectification. Operation in the 1500 volt range is similar to operation in the 350 volt range except that the 2 kilovolt bridge is used for rectification.

The POLARITY switch (see the Collector Supply schematic) allows the choice of three different sweep outputs from the collector supply by changing the output connections on the rectifier bridges. The possible outputs are positive-going +(NPN) or negative-going −(PNP) full-wave rectified sine waves or unrectified sine waves (AC). In all cases the peak amplitude of the collector sweep is controlled by the VARIABLE COLLECTOR SUPPLY control and the MAX PEAK VOLTS switch.

The MODE switch allows the choice of two different Collector Supply outputs: the normal collector sweep as has been previously mentioned and a DC collector voltage output. When the MODE switch is set to DC (ANTILOOP) or LEAKAGE (EMITTER CURRENT) the MAX PEAK VOLTS switch picks one of four resistor-capacitor combinations which is connected between the collector sweep output and the current return input. The purpose of these capacitors is to hold the collector sweep voltage at a constant DC level set by the VARIABLE COLLECTOR SUPPLY control. This holding is done by charging the capacitor up to maximum peak voltage as set by the VARIABLE COLLECTOR SUPPLY control and keeping them charged with the repetitive collector sweep. The result of charging these holding capacitors is a dot on the CRT rather than the normal sweep.

In series with the collector sweep are series resistors R345 through R355. The interconnected MAX PEAK VOLTS and PEAK POWER WATTS switches add these resistors in series according to the amount of peak collector current desired. The amount of this current is determined by the maximum power dissipation rating of the device under test.

Looping

There is a certain amount of non-discrete capacitance associated with the collector supply which causes an effect known as looping. Part of this undesired capacitance is stray capacitance, which provides an AC current path between the collector supply and chassis ground. The transformer and the guard box also exhibit some undesired capacitance between the guard box potential (common return point connected to guard box) and chassis ground. Fig. 3-2A shows that these two capacitances form a divider for AC current, the center of the divider being connected to the vertical amplifier.

During transitions of the collector sweep, some current will be transmitted by this undesired capacitance, bypassing the device under test. This current, however, is sensed by the vertical amplifier along with the collector current and causes the reading of collector current on the CRT to be incorrect. When the collector sweep rises, the undesired current will start positive and decrease to zero as the collector sweep reaches its peak. As the sweep falls, the stray current

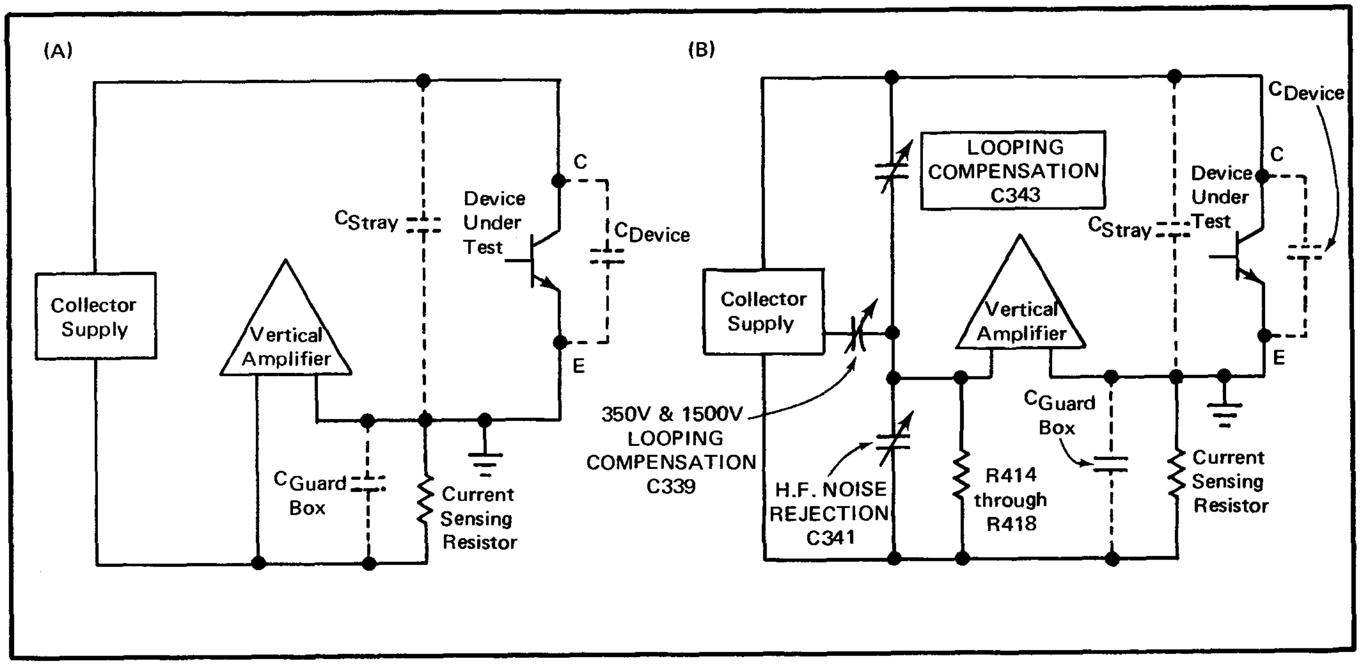


Fig. 3-2. (A) Undesired capacitance causing looping; (B) Looping compensation.

will go negative. The result on the CRT is a loop instead of a single line to represent the curve of I_C vs V_{CE}.

Looping Compensation

The LOOPING COMPENSATION adjustment, C343 (see Fig. 3-2B and the Collector Supply schematic), H.F. NOISE REJECTION adjustment C341 and R414 through R418 (see the Display Sensitivity Switching schematic) have been added to the circuitry as compensation for the stray and guard box capacitance previously discussed. In general, these adjustments will not compensate for device capacitance. This added capacitance forms a new capacitive divider which transmits AC current to the vertical amplifier in opposition to the current transmitted by the undesired capacitance. This opposing current, therefore, nulls the effect of the undesired capacitance which causes looping. In adjusting these added capacitors, C343 is adjusted to compensate for looping current transmitted from the collector sweep to ground, and C341 is adjusted to compensate for high frequency noise coming in on the line.

Another source of looping current is unbalance in the sweep transformer. As has been discussed in the collector supply circuit description, the sweep transformer is sometimes used in a full-wave rectifier arrangement. This method of transformer operation requires that the transformer be balanced about the center tap. LOOPING BALANCE adjustment C301 is adjusted to equalize the capacitance on both sides of the transformer center tap.

When the transformer is used in bridge operation, the voltage at one end is held essentially constant, and the transformer operates unbalanced. In this case, the transformer capacitance is added to the stray capacitance found between the Collector Supply and ground. 350 V and 1500 V LOOPING COMP adjustment C339 has been added between the transformer center tap and the junction of C343 and C341, for bridge operation of the Collector Supply to compensate for unbalanced operation of the transformer.

Interlock

The Type 576 has an interlock system designed to protect the user of the instrument from potentially dangerous voltages which may appear at the Collector terminals of the Standard Test Fixture. Fig. 3-3A shows a simplified schematic (see Collector Supply schematic for complete circuit) of this system.

Coil K323 enables or disables the Collector Supply output through K323-B, enabling it when the coil is energized. The coil is always energized when the MAX PEAK VOLTS switch is set to 15. When this switch is set to the 75, 350 or 1500 positions, one side of the coil is opened and the Collector Supply is disabled. The yellow COLLECTOR SUPPLY VOLTAGE DISABLED light is turned on through K323-A. In order to enable the Collector Supply under these conditions, the Protective Box must be put in place on the Standard Test Fixture and the lid closed. With the lid closed, High Voltage Interlock switch SW360 is closed and +12.5 volts is applied through the red DANGEROUS VOLTAGE light, B360, to coil K323, thus enabling the Collector Supply. With the coil now activated, the COLLECTOR SUPPLY VOLTAGE DISABLED light is turned off.

This interlock may be bypassed on the 75 or the 75 and 350 positions of the MAX PEAK VOLTS switch by reconnecting the wire connected to pin 1 of J300 to one of two alternate positions, labeled 75 and 350 in Fig. 3-3A. Changing the connection of this wire allows +12.5 volts to be applied to K323 through B360 regardless of the state of High Voltage Interlock switch SW360. The DANGEROUS VOLTAGE light is turned on in the 75, 350 and 1500 positions of the MAX PEAK VOLTS switch even if the interlock has been bypassed. If B360 were to burn out, the collector supply would be automatically disabled.

The interlock system may also be modified for use in all positions of the MAX PEAK VOLTS switch. This modification may be performed by removing the ground from the 15 V position of wafer 1R and connecting this position to the 75 V position of 1R. This wiring change makes it necessary to close SW360 (using the protective box) in order to activate K323 and enable the collector supply voltage.

These alternate connections are located on wafer 1F and 1R of the MAX PEAK VOLTS switch, inside the guard box on the left of the instrument. Fig. 3-3B shows a picture of this wafer and labels the alternate connections. The bypass modification is performed by soldering a jumper wire between terminals 1F19 and 1F20 (75 bypass) or between terminals 1F19 and 1F2 (75 and 350 bypass). To modify the interlock system for use on all maximum peak voltage ranges, unsolder the existing jumper wire connected between terminals 1R17 and 1R1, from 1R17 and resolder it to the buss wire connected to terminal 1R3. In unsoldering the jumper wire from terminal 1R17, be sure the white wire remains soldered to the terminal.

WARNING

The Type 576 is considered safe as shipped. Any modification of the interlock system in order to override its purpose of protecting operators from dangerous voltages, will make operation of the instrument potentially hazardous. Operators of the instrument should always be aware of the fact that when the red light is on dangerous voltages may appear at the Collector terminals.

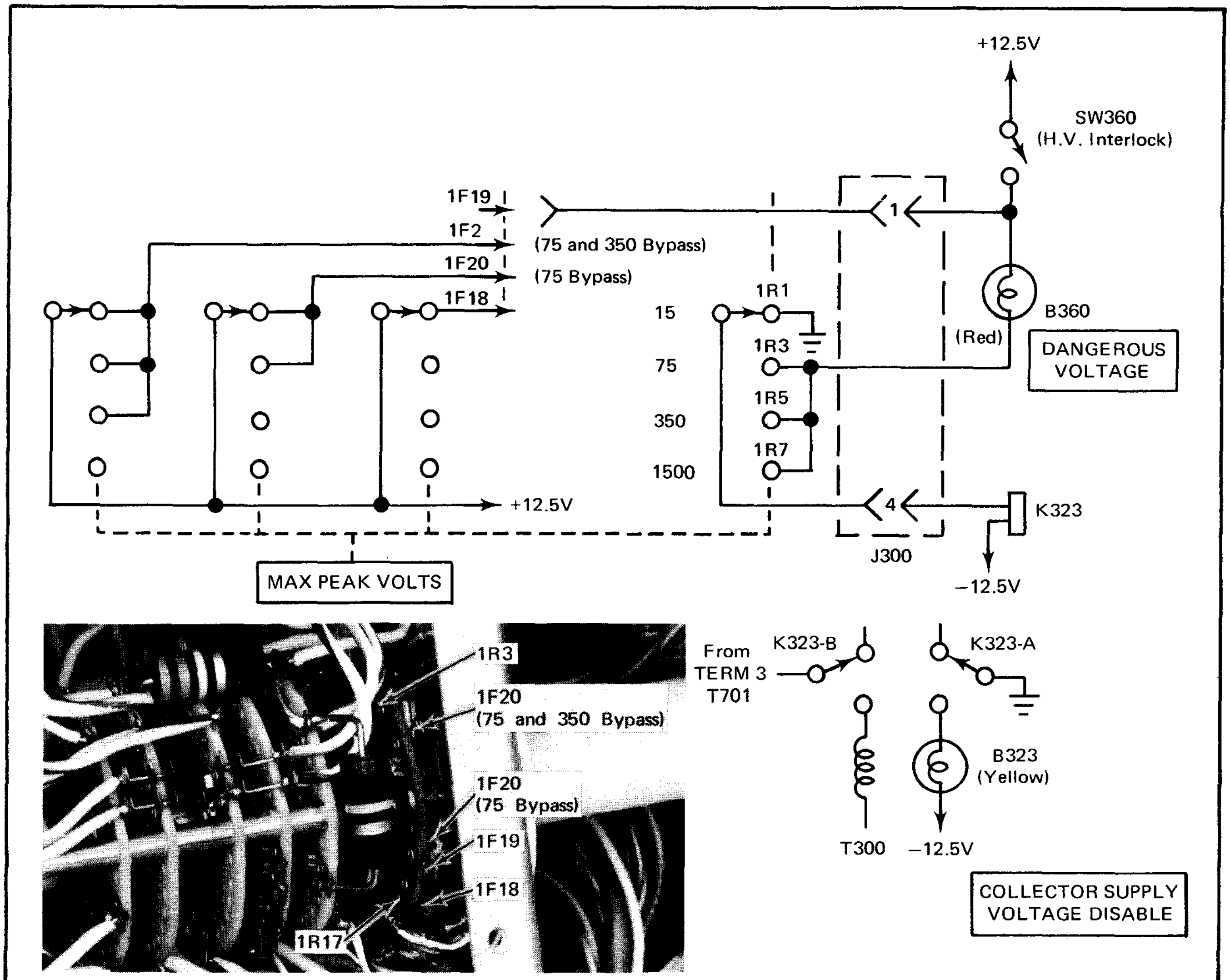
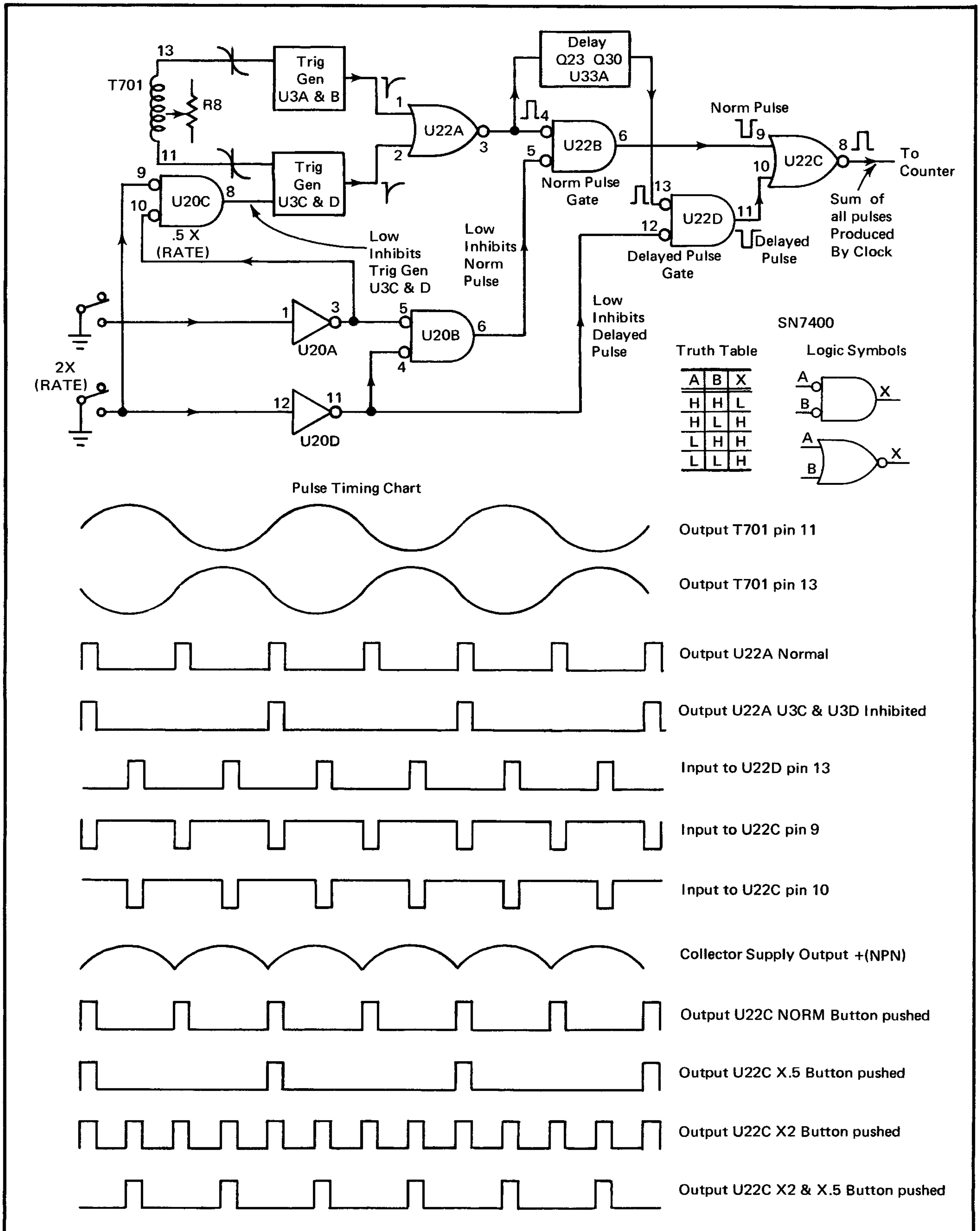


Fig. 3-3. (A) Simplified schematic of interlock circuit, (B) picture of wafer IF and IR of MAX PEAK VOLTS switch located inside guard box.



A	B	X
H	H	L
H	L	H
L	H	H
L	L	H

Fig. 3-4. Logic diagram, Pulse Timing chart for Step Generator Clock circuit.

Step Generator

The purpose of the step generator is to present a discrete level of current or voltage to the base or emitter (or equivalent terminals) of the device under test for each sweep, or change of direction of sweep, of the collector supply. These discrete levels are generated in the form of ascending steps which have a calibrated current or voltage separation.

The step generator circuit consists of four major sections: the clock, the counter, the digital-to-analog converter, and the pulsed steps operation section. The clock circuit produces negative-going clock pulses which determine the rate and phase, with respect to the collector supply, of the Step Generator output. The counter circuit counts these clock pulses and transforms each count into a digital code which controls the digital-to-analog converter. The digital-to-analog converter transforms the digital code into analog current which is summed at a current summing node and transmitted to the step amplifier. The pulsed steps operation circuit provides a variation of the Step Generator output where short duration pulsed steps rather than normal steps are generated.

Logic. The clock circuit, the counter circuit and a portion of the digital-to-analog circuit are digital circuits which make use of transistors and integrated circuits in digital configurations. The most convenient method of describing and understanding digital circuitry is through a logic description rather than a detailed circuit description. In order to make this description understandable by a wider range of readers, a simplified logic description, using high and low rather than true and false, has been utilized. A knowledge of basic logic symbols (NAND gates, NOR gates, flip-flops, etc.) and truth tables will help in understanding this description.

Simplified schematics of these circuits are shown in Figs. 3-4, 3-5 and 3-6. Also included in these figures are truth tables and some internal logic diagrams for the logic devices used. Pertinent logic level information for these logic devices is shown in blue on the Step Generator schematic. Familiarity with the logic symbols and related truth tables of these logic devices will greatly aid in understanding the following description.[1]

Clock. Sine waves produced at line frequency by transformer T701 provide the timing source for the clock (see the Step Generator schematic). Transformer T701, steering diodes D1-D2 and D10-D11, and trigger generators U3A-U3B and U3C-U3D operate together to produce low level pulses at the inputs of U22A. Using U3A-U3B as an example, each time the transformer voltage at the anode of D1 crosses zero going negative, D1 will turn off and D2 will turn on. When D2 is conducting, the voltage at the pin 1 input of U3A is held at a low voltage level. Since the other input to U3A, pin 2, is held at a high voltage level by voltage divider R4-R5, this low causes a high to appear at the output of U3A (see truth table for NOR gate shown in Fig. 3-4). This high is inverted by U3B and the resulting low is applied to the pin 1 input of U22A. This low output produced by the trigger generation continues until C5 charges to a high voltage level as determined by divider R4-R5. When the voltage at D1 crosses through zero going positive, D1 turns on and D2 turns off. With D2 off, both inputs to U3A are high, the output goes low and the output of U3B goes high. This is the quiescent state of the trigger generator. Trigger generator U3D-U3C operates the same as U3B-U3A except that the additional input at pin 9 of U3C allows the trigger generator to be inhibited when a low is applied to it.

Since Transformer T701 (see Fig. 3-4) is center tapped, the voltages at its outputs are equal and opposite. Since the two trigger generators are triggered by T701, they operate in opposite phase, producing alternate low level pulses at their outputs. Since T701 is in phase with the Collector Supply output, a pulse is generated by one of the trigger generators at the start of each collector sweep (assuming +NPN or −PNP polarity). ZERO CROSS adjustment R8 allows adjustment of trigger level of trigger generators.

With the NORM RATE button pressed, low pulses from the trigger generator are inverted to U22A and transmitted to norm pulse gate U22B. The pin 5 input to U22B is normally held high. A high at its other input, therefore, produces a low at its output. This low is applied to U22C, which produces a high level clock pulse to be applied to the counter circuit. With the NORM RATE button pressed, the rate of production of clock pulses (and therefore the step generator rate) is 120 pulses/second (assuming a 60 Hz line frequency) which is the normal collector supply rate.

High level output pulses from U22A are also applied to the base of Q23 (shown on the Step Generator schematic), the input to the delay circuit. This circuit generates clock pulses at the normal rate, but delayed (with respect to the start of each normal clock pulse) by a delay time equal to half the time duration between normal clock pulses. This delay circuit is triggered each time a high is produced at the output of U22A. This high turns on Q23, and pulls down on the base of Q30, turning it off. Since Q23 is pulling down on one side of C26, the other side begins charging. It continues to charge until a high enough voltage is reached to again turn on Q30. When Q30 turns on, a low level is produced at its collector, which is differentiated by C33 and R33 into a negative-going spike and applied to the input of inverter U33A. The result of this low at the input of U33A is a high at its output, and thus a high-level delayed pulse at the pin 13 input of U22D. The delay time of the half-step delay circuit is controlled by DELAY adjust-

[1]The schematics and block diagrams in this manual which involve digital logic are drawn in terms of negative logic. In negative logic, the true state is the more negative of the two logic levels and the false state is the more positive. The small circles on some of the input or output terminals of the logic symbols indicate a logic negation. Any terminal having a logic negation symbol on it will be at a false level when the related device is in its activated state. For further information see USA Standard Y32.14 1962.

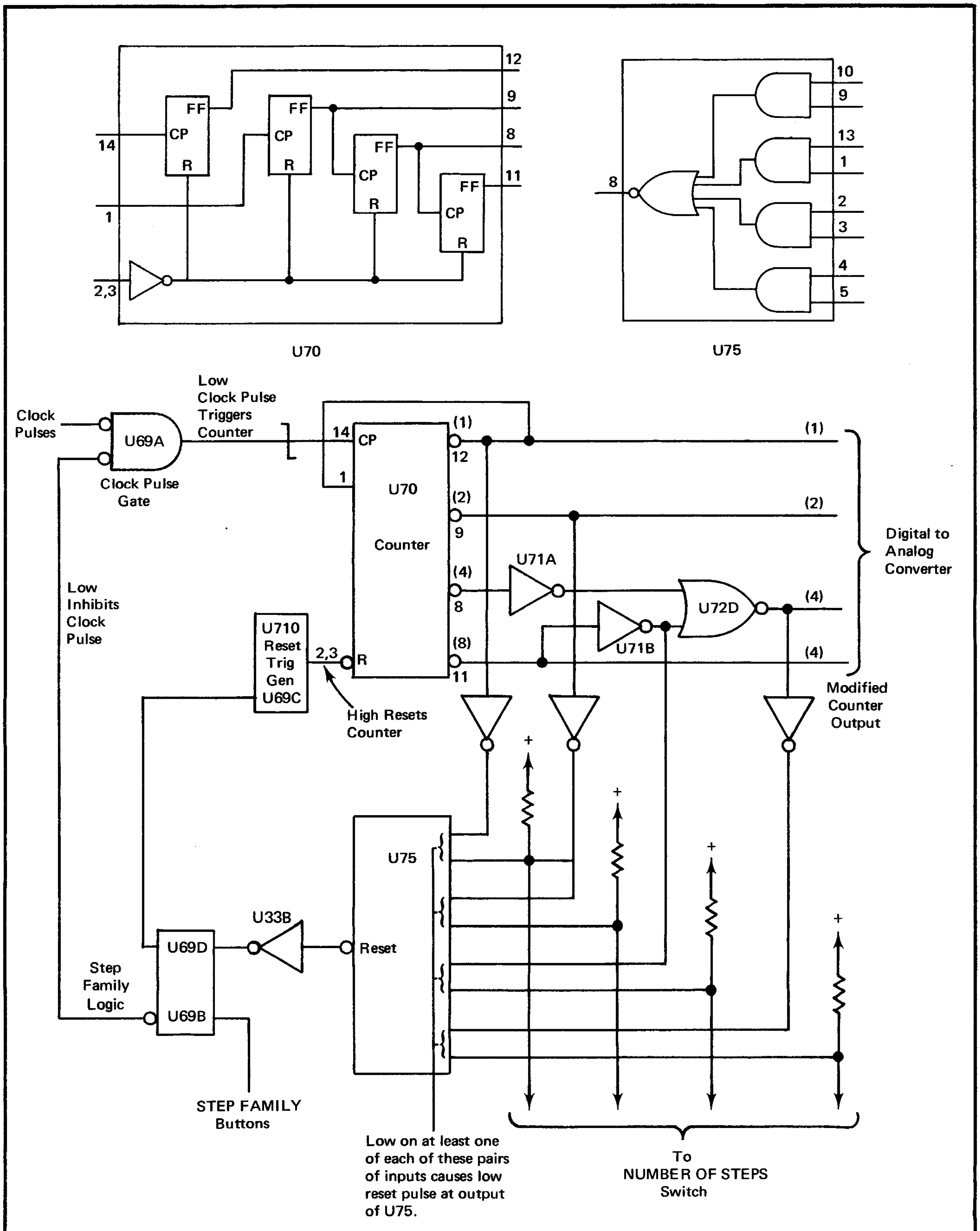


Fig. 3-5. Block diagram of counter and reset logic.

ment R24, which controls the charge time of C26. R24 is adjusted for a delay time equal to half the duration of a normal step (about 4167 μs). Delayed clock pulses, therefore, occur coincident with the peak of the Collector Supply output. SW27 lengthens the delay time of this circuit to 5000 μs when T701 is operated with a 50 Hz line frequency.

The clock circuit has two sources of clock pulses, the output of U22A and the output of the delay circuit. The various step generator rates are produced by inhibiting some of the clock pulses from these two sources from being summed by U22C. Three devices control the transmission of clock pulses through the circuit: Trig Gen Gate U20C, Norm Pulse Gate U22B and Delayed Pulse Gate U22D.

When the NORM RATE button is pressed, pin 9 of U3C is held high, enabling trigger generator U3D-U3C. A high is also applied to pin 5 of U22B, allowing the clock pulses from U22A to be transmitted to pin 9 of U22C. A low is applied to pin 12 of U22D, inhibiting the delayed clock pulse. When the .5X RATE button is pressed, the circuit operates as described for normal operation except that both inputs of U20C are held high, which holds pin 9 of U3C low and inhibits trigger generator U3C-U3D. The result is a step generator rate of half the normal rate, 60 steps/second (assuming a 60 Hz line frequency). Pressing the 2X RATE button causes normal operation of the circuit, except that a high is applied to pin 12 of U22D, allowing the delayed clock pulses to be applied to pin 10 of U22C. The step generator rate in this case is 240 steps/second. When both the 2X RATE and the .5X RATE buttons are pressed, the normal clock pulses are inhibited by a low at pin 5 of U22B and the delayed clock pulses are transmitted to U22C. In this case the Step Generator rate is normal, but the steps occur out of phase with the normal steps by the delay time of the delay circuit.

Counter. When the clock circuit generates a clock pulse, it is counted by the counter (see Fig. 3-5). The counter counts clock pulses until it reaches a preset number, then resets and begins counting again. Each time the counter counts, it changes a four-bit binary code which is applied to the digital-to-analog converter.

U70 is a divide-by-16 counter with the outputs of all four of its internal flip-flops utilized (see Fig. 3-5). A negative pulse at the pin 14 input of U70 causes a count to be recorded by the flip-flops. In recording a count, the flip-flops assume high or low states according to a 1-2-4-8 binary code. A high state represents the presents of either a 1, 2, 4 or 8. A low state represents a 0. Output terminals 12, 9, 8 and 11 of U70 represent 1, 2, 4 and 8 respectively. By connecting pin 8 and pin 11 of U70 to U72D through inverters, the 1-2-4-8 code of the U70 outputs is modified to a 1-2-4-4 code. The truth table in Table 3-1 shows the state of each modified counter output for successive counts counted by U70 up to 11. Whenever U70 is reset, it returns to the zero count state with lows on all the outputs.

TABLE 3-1

Normal and Modified Counter Output Codes

Count	Normal Code				Modified Code			
	Pins on U70				Pins on U70			U72D
	12	9	8	11	12	9	11	11
0	L	L	L	L	L	L	L	L
1	H	L	L	L	H	L	L	L
2	L	H	L	L	L	H	L	L
3	H	H	L	L	H	H	L	L
4	L	L	H	L	L	L	H	L
5	H	L	H	L	H	L	H	L
6	L	H	H	L	L	H	H	L
7	H	H	H	L	H	H	H	L
8	L	L	L	H	L	L	H	H
9	H	L	L	H	H	L	H	H
10	L	H	L	H	L	H	H	H
11	H	H	L	H	H	H	H	H

The counter may be reset after from 1 to 10 steps have been produced. The NUMBER OF STEPS switch determines on which clock pulse the counter is reset. This switch presets the inputs to U75, so that when the counter has counted the desired number of clock pulses, a high is generated at pins 2 and 3 of U70, resetting the counter. This high is obtained from a high at the output of reset trigger generator U75. U75 consists of four 2-input OR gates whose outputs are connected to a 4-input NAND gate. One input of each OR gate is connected through an inverter to an output of the modified counter. The other input is connected to a section of the NUMBER OF STEPS switch. When a low appears on one input of each OR gate of U75, all four inputs to the U75 NAND gate will be low and a high reset pulse is produced at the output. This condition of having at least one low on each OR gate of U75 is typically obtained by first setting lows on some of the OR gates through the NUMBER OF STEPS switch. The counter then counts until lows are produced by the modified counter output at the OR gates without preset lows. When no preset lows are applied to U75, the counter is reset when it reaches the eleventh step (1 + 2 + 4 + 4 = 11) when all modified counter outputs are low. It should be noted that the clock pulse which causes the counter to be reset is always one clock pulse more than the number selected by the NUMBER OF STEPS switch. The time duration from the point at which this extra clock pulse is counted by the counter to the point when the counter is reset is so short that the extra step never appears at the Step Generator output.

The high at the output of U75 is inverted by U33B (see the Step Generator Schematic) and again by U69C, producing a reset high at pin 2 and 3 of U70. U71D and C81 stretch the reset high to a long-enough duration to assure that the counter is reset.

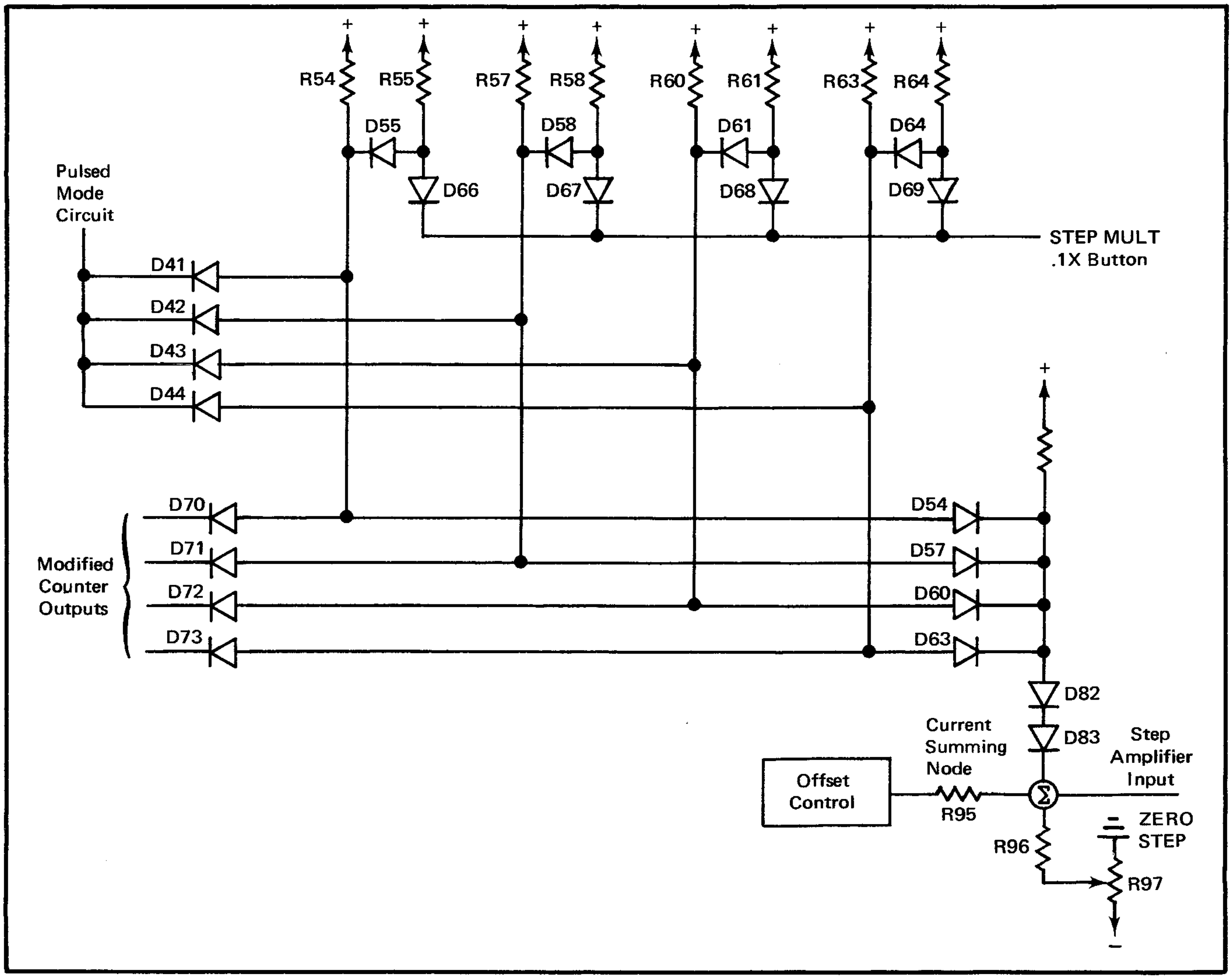


Fig. 3-6. Simplified schematic of Digital-To-Analog Converter.

The state of pin 2 of clock pulse enable U69A determines whether clock pulses are applied to the pin 14 input of U70. When the STEP FAMILY REP button is pressed, a low is applied to pin 5 of U69B, causing pin 2 of U69A to be held permanently high. In this state of U69A, all clock pulses applied to its pin 1 input are inverted, and become counter triggers. When the STEP FAMILY SINGLE button is pressed, a momentary low is applied to pin 5 of U69B which goes high as C78 charges. This momentary low enables U69A until one step family has been generated. When the reset high causes pin 4 of U69B to go high, a low is produced at the pin 2 input of U69A. This low inhibits clock pulses from being transmitted past U69A.

Digital-to-Analog Converter. The outputs of the modified counter are connected to the digital-to-analog converter. The purpose of this circuit is to convert the modified counter output code into analog current which is applied to the step amplifier input. The digital-to-analog converter consists of a set of current setting resistor pairs and four sets of current steering diodes.

The digital-to-analog converter conducts a constant amount of current, the amount of which is set by current setting resistor pairs R54-R55, R57-R58, R60-R61 and R63-R64 (see Fig. 3-6). Each resistor pair conducts a discrete amount of current which is a multiple of the modified counter code: one increment of current conducted by R54-R55, two increments by R57-R58, four by R60-R61 and four by R63-R64. Each successive increment of current causes one step to be generated at the Step Generator output.

The steering diodes determine where in the circuit current from these resistor pairs is conducted. Diodes D70, D71, D72 and D73 provide current paths between the modified counter outputs and the resistor pairs. Current is conducted by one of these diodes whenever its associated modified counter output is low.

Another set of current paths is provided by diodes D54, D57, D60 and D63. These diodes provide current paths between the current summing node (at the cathode of D83) and the current setting resistor pairs. It is these current paths which cause step current to be applied to the step amplifier input. Whenever a high appears at one of the modified counter outputs, its associated steering diode turns off and the current conducted by its associated resistor pair is applied to the step amplifier input.

The amount of current applied to the step amplifier input is a function of the modified counter output and may be determined by adding the currents conducted by each resistor pair associated with a modified counter output which is high. For example, if five counts have been recorded by the counter, highs appear at the cathodes of D70 and D72. The current applied to the step amplifier input is, therefore, one increment by R54-R55 plus four increments by R60-R61, totalling 5 increments. Thus five counts recorded by the counter results in five increments of analog current applied to the step amplifier input. The 1-2-4-4 modified counter code is designed so that the step current applied to the step amplifier input increases by one increment for each clock pulse counted by the counter (until the counter resets). ZERO STEP adjustment R97 controls the level of the zero step (with zero offset) by adjusting the quiescent current through D82 and D83.

Steering diodes D66, D67, D68 and D69 provide current paths for the currents conducted by R55, R58, R61 and R64, respectively, whenever the STEP MULT .1X button is pressed. (With the STEP MULT .1X button pressed D55, D58, D61 and D64 are reverse biased.) These new current paths reduce the amount current per increment which may be applied to the step amplifier input by a factor of 10. The result is that the normal step amplitude at the Step Generator output is reduced to one-tenth its normal value.

The fourth set of steering diodes, D41, D42, D43 and D44 is used only when the step generator is operating in the pulsed mode. In all other cases, their cathodes are held high and they have no effect on the current applied to the step amplifier input.

The current summing node sums current from R95 as well as the digital-to-analog converter. The zero step level may be offset either in the direction which steps are ascending or in the opposite direction of ascent as determined by the DC current conducted by R95. If offset in the direction of the steps is desired, the AID OFFSET button is pressed. This allows positive voltage to be applied to the base of Q90 using the OFFSET MULT control, which raises the emitter voltage of Q93 and causes current to be conducted through R95. When the OPPOSE OFFSET button is pressed, negative voltage is applied to the base of Q90 using the OFFSET MULT control, which causes current to be conducted through R95 in the opposite direction. OPPOSE OFFSET adjustment R85 and AID OFFSET adjustment R86 adjusts the offset level of the steps when the OPPOSE OFFSET and AID OFFSET buttons are pressed, respectively.

Pulsed Step Mode. When one of the PULSED STEPS buttons is pressed, the Step Generator output steps are reduced to short pulses. These pulsed steps are obtained by inhibiting the digital-to-analog converter for all but 300 μs or 80 μs of each step.

The digital-to-analog converter is inhibited by pressing either the 300 μs or the 80 μs PULSED STEPS button (see the Step Generator schematic). Pressing one of these buttons turns Q41 on and provides current paths for the resistor pairs through D41, D42, D43 and D44. The digital-to-analog converter is inhibited in this state because no step current is available to be applied to the step amplifier input, regardless of the condition of the modified counter output. The digital-to-analog converter remains inhibited until a negative-going trigger from the collector of Q30 reverse biases D39 and turns off Q41. With Q41 off, its collector goes high, turning on Q36 and reverse biasing steering diodes D41, D42, D43 and D44. The digital-to-analog converter is now enabled and free to produce a step in the manner described previously. The duration of the step is controlled by the charge time of C35. With Q36 on, its collector holds one side of C35 at about ground, allowing the other side to be charged through R39 (and R37 when the 300 μs button is pressed). C35 charges until D39 is forward biased and Q41 again turns on. With Q41 on, Q36 is turned off and the digital-to-analog converter is again inhibited by the steering diodes D41, D42, D43 and D44.

Since each pulsed step is triggered by a negative-going trigger from the delay circuit, the pulsed steps always appear at the peak of the Collector Supply output. When the step generator is operating in the pulsed step mode, the 2X RATE button is inhibited.

When Q41 is turned on, Q46 is turned off, which also turns off Q52. The emitter of Q52 is connected to the grid of the CRT, V897 (see the CRT Circuit schematic). When Q52 turns off, its emitter voltage goes negative, causing the intensity of the CRT display to be reduced. The display intensity remains reduced until Q41 turns off, allowing Q46 and Q52 to turn on. The CRT display in the pulsed step mode is, therefore, intensified only when a pulsed step occurs.

The Collector Supply schematic shows that when either the 300 μs or the 80 μs PULSED STEPS button is pressed, K320 is energized and the Collector Supply operates in its DC mode. It may also be seen, that if the 300 μs and 80 μs PULSED STEPS buttons are pressed together, 300 μs pulsed steps are generated and the collector supply operates in its normal mode (K320 is not energized).

Step Amplifier

The step amplifier transforms the output of the step generator into current or voltage steps of various amplitudes to be applied to the device under test. The AMPLITUDE switch, which is part of this circuit, determines the amplitude of the steps. The circuit consists of a current to voltage converter, an inverter and a differential output amplifier. The output amplifier has two modes of operation, one producing current steps and the other producing voltage steps.

The output of the Step Generator, which may be from one to ten current steps of 350 μA per step plus from one to ten steps of offset, is applied to the base of Q105A (see the Step Amplifier schematic). Q105A and B comprise a differential amplifier. As the base current of Q105A is decreased, the collector current of Q105B increases, raising the voltage at the base of Q110. Each current step at the base of Q105A, therefore, causes a positive voltage step at the base of Q110. These voltage steps are amplified and inverted by Q110, and part of the output is transmitted through R113, R112 and C112 creating negative feedback at the base of Q105A. R113 adjusts the feedback gain of current to voltage amplifier Q105 and Q110 for an output at the collector of Q110 of negative going steps with amplitudes of 1/2 volt/step.

Q117 and Q122 have been added to the current to voltage amplifier circuit to slow down the voltage transition from the level of the last step generated to the zero step level, in cases where this transition may cause damage to the device under test. When the preset number of steps has been produced at the Q110 output, a rapid transition occurs as the step returns to its starting point. This transition, when applied to the base of a transistor, rapidly turns it off. If a transistor is turned off in this manner when its collector is at a high level, a high inductive voltage kick will be produced in the collector supply transformer. Such an inductive voltage kick may be large enough to damage the transistor.

This circuit operates either when the 2X RATE button is pressed or when the 300 μs and 80 μs PULSED STEPS buttons are pressed together. In this case the emitter circuit of Q122 is opened, turning the transistor off. The source of FET Q117 is held at −11.3 volts by divider R116-D115-R108. When Q122 turns off, divider R119-R120-R121 sets the voltage at the gate of Q117 at −10.3 volts, turning the FET on. With Q117 on, its drain is held at about −11.3 volts, providing a constant voltage on the side of C114 connected to Q117. By holding one side of C114 at constant voltage and transmitting the output of Q110 across the other side, C114 becomes an integrator. The voltage transition of the Q110 output from the level of its last step to the starting level is, therefore, slowed down by integrator C114. When Q122 is turned on (normal or 0.5 times rate or DC mode), Q117 is held off by having about −34 volts at its gate. In this case, the current through R117 controls the voltage on Q117 side of C114, which moves up and down with changes in the output of Q110. C114, therefore, has little effect on the output of Q110 and causes no slowing of the voltage transition.

When relay K101A is in the − position, the output of Q110 is transmitted through inverter circuit Q130A and B and Q133 and inverted before it is applied to the output amplifier. The inverter is identical in operation to the current to voltage amplifier described previously. Since the input resistance (R125) and the feedback resistance (R137) are equal, the gain of the inverter is 1. INVERT ZERO adjustment R127 sets the voltage at the base of Q130A so that the initial level is the same for the non-inverted steps and the inverted steps.

The position of relay K101A is controlled by the COLLECTOR SUPPLY POLARITY switch, the STEP-OFFSET POLARITY INVERT button and the Terminal Selector switch in conjunction with the step generator polarity logic (see the Step Amplifier schematic). U33C and D, U72A, B and C form a coincidence gate. See Table 3-2 for a truth table of this gate. The output at pin 6 of U72B causes Q101 to turn on and off, thus switching relay K101A between + and −. If a high appears at the output of U72B, K101A switches to the − position and if a low appears, it remains in the + state. The inputs to U33C and D and to U72A and C are controlled by the voltage levels on connectors T and S as shown in Table 3-2. Setting the Terminal Selector switch to EMITTER TERM STEP GEN has the same effect on the voltage level of connector T as pressing the POLARITY INVERT button. If the POLARITY INVERT button is pressed, however, the Terminal Selector switch has no effect on the voltage level at connector T and vice versa.

TABLE 3-2

Step Generator Polarity Logic

COLLECTOR SUPPLY POLARITY	POLARITY INVERT	Connectors		Pin 6 U72B
		T	S	
AC	Pressed	H	L	H
AC	Not Pressed	H	H	L
+(NPN)	Pressed	H	L	H
+(NPN)	Not Pressed	H	H	L
−(PNP)	Pressed	L	L	L
−(PNP)	Not Pressed	L	H	H

Output Amplifier. The step output amplifier transforms the output steps of the current to voltage amplifier (or inverter) into current or voltage steps of various amplitudes as determined by the AMPLITUDE switch. It is basically a differential amplifier with separate feedback to each input. The negative input side of the amplifier controls the amplitude of the output steps. The positive input side of the amplifier provides either current regulation or a constant operating level. To obtain current steps (see Fig. 3-7A), the gain of the negative side of the differential amplifier is set for an output of 1 volt per step. This output is then transmitted through a variable resistance in series, Current Setting Resistors. With the constant voltage per step relationship across the current setting resistors, the current per step output can be varied by changing this resistance in series. To obtain voltage steps, the input resistance to the nega-

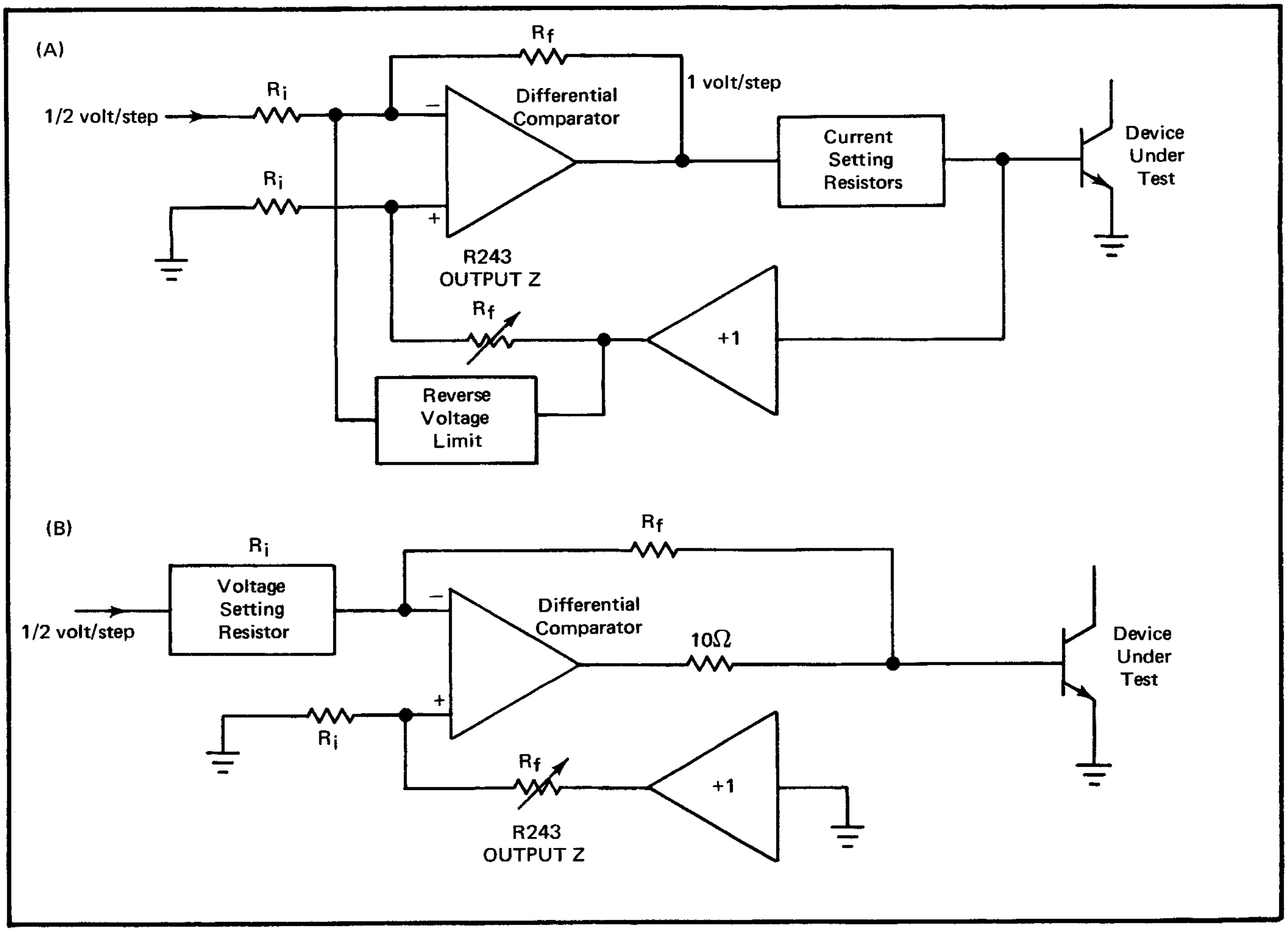


Fig. 3-7. Block diagram of Step Output Amplifier: (A) Current Mode, (B) Voltage Mode.

tive input, the voltage setting resistors, is changed, thus varying the feedback gain of that side of the differential amplifier. In this manner voltage steps of various amplitudes are obtained.

Current Mode. Input to the negative side of differential comparator Q150 (the base of Q150A) is always through VOLTAGE SETTING RESISTORS R141 through R145. In the current mode, this input resistance is set at 3.01 kΩ (R141) for all current positions of the AMPLITUDE switch. When 1/2 volt steps are applied to the base of Q150A through R141, they are inverted, applied to the base of Q164 and inverted again. The steps are then transmitted through emitter follower Q169 to the bases of Q172 and Q176. Depending on the position of relay contacts K102B and K102C, either Q172 and Q180 or Q176 and Q184 are turned on. If, for example, K102B and K102C are in the + positions signifying positive-going steps out, Q176 and Q184 are on the Q172 and Q180 are off. In this case the input to Q176 is negative-going steps. They are inverted by Q176 and the resulting positive-going steps are transmitted through emitter follower Q184 to the negative side of the floating 50-volt supply. Each time a positive step occurs at the negative side of the 50-volt supply, the supply is pushed up by the amount of the step. The positive side of the 50-volt supply is connected to both the feedback resistors and the input to the current setting resistors, so that each time the 50-volt supply is raised by a step, the voltage at this connecting point is also raised by the amount of the step. Due to the presence of the 50-volt supply, the voltage at the input to the current setting resistors is offset by 50 volts. To compensate for this offset, 50 volts of opposing offset is added to the input of the current setting resistors through relay K102A. If K102B and K102C are in their – positions, Q172 and Q180 are on and Q176 and Q184 are off. In this case negative-going steps are applied to the positive side of the 50-volt supply and negative-going steps appear at the input to the current setting resistors.

The output of the negative side of the differential amplifier at either K102B or K102C is fed back to the base of Q105A through feedback resistor R194. Since R194 is 6.04 kΩ and the input resistance, R141, is 3.01 kΩ, the feedback gain of this circuit is 2. For a half volt per step input, the resulting output of the negative side of the differential amplifier (as seen by the input to CURRENT SETTING RESISTORS R197 through R216) is steps of one volt per step, the zero level being at ground. (If offset has been added in the step generator circuit, the zero step level may range from 0 to 10 volts.)

The output end of the current setting resistors is connected through the device under test to ground. When voltage steps of 1 volt per step are applied between the input end of the current setting resistors and ground, current steps of variable amplitude flow through the device under test. The current amplitude of the steps is determined by AMPLITUDE switch SW195 (see Step Generator Switching schematic), which chooses various combinations of resistors R197 through R216.

In order to obtain calibrated current steps, the voltage across the current setting resistors must be held at 1 volt per step. The voltage at the output, however, may vary by the amount of the turn-on voltage of the device under test and alter the current per step output of the step generator. To compensate for this turn-on voltage, any variation from ground of voltage at the input to the device under test is transmitted through the +1 amplifier to the positive side of the differential amplifier. This starts a regulating process which causes the voltage at the input to the current setting resistors to move in the same direction as the turn-on voltage at the output, thus nullifying its effect.

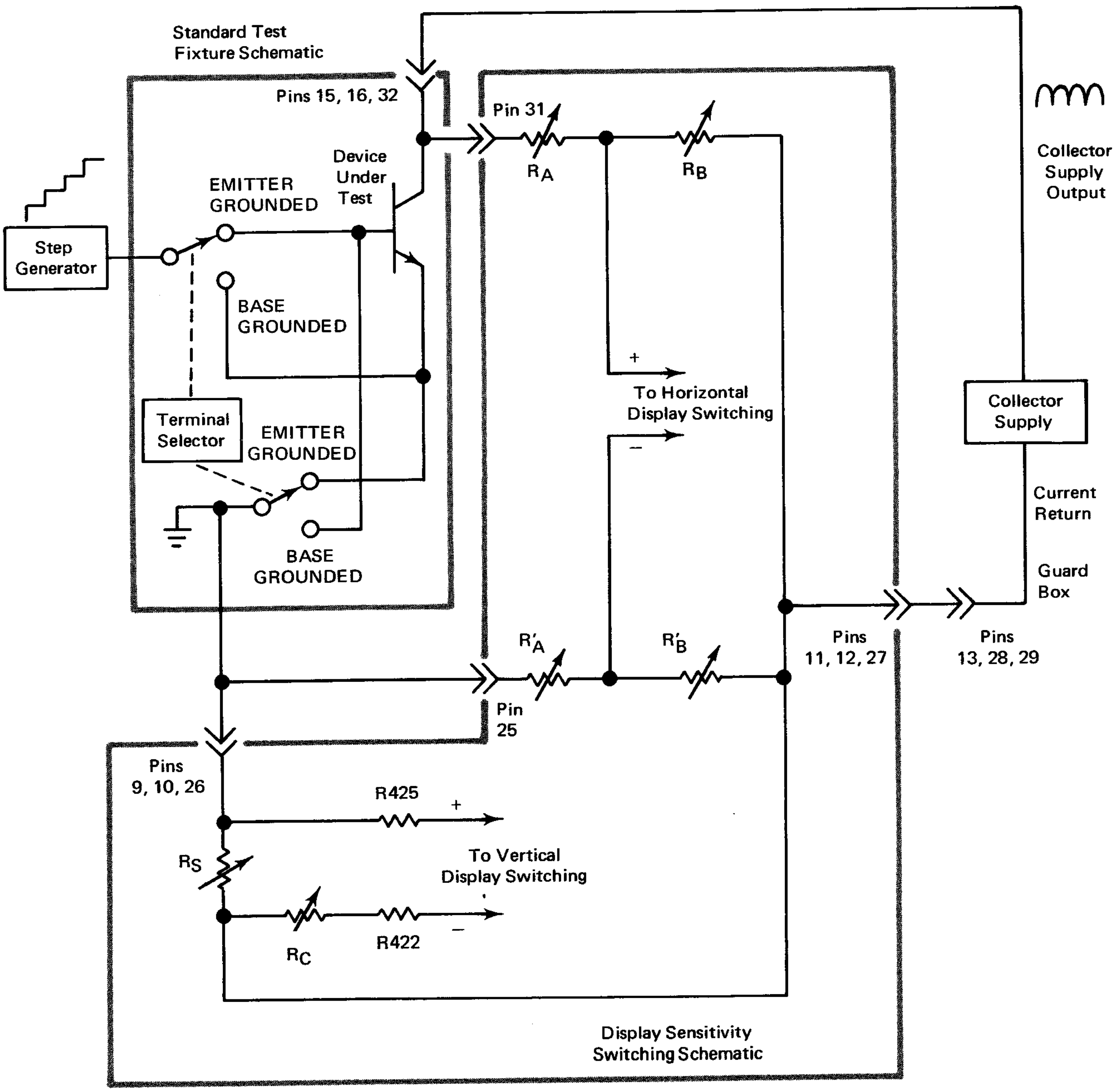
The +1 amplifier is made up of paraphase amplifier Q229A and B, constant current sources Q233 and Q226, and emitter followers Q235 and Q241. In the current mode, any voltage at the input of the device under test is transmitted through R220 to the high impedance gate input to Q229B. If, for example, this variation is a rise in voltage at the gate input, it will be accompanied by a rise in voltage at the drain of Q229A, due to the paraphase operation of Q229A and B. Raising the voltage at the Q226A drain raises the base of emitter follower Q235, and thus the base of emitter follower Q241. As the emitter of Q241 follows its base up, it pulls the voltage at the gate of Q266A up so that it is equal to the voltage at the gate of Q266B. This rise in voltage at the gate of Q266A is then transmitted to the base of Q150B (positive side of the differential amplifier) through feedback resistors R243 and R244. The +1 amplifier, therefore, transmits any voltage variation from the input to the device under test to the input to the base of Q150B with no change in amplitude or polarity. In performing this task, the +1 amplifier provides the voltage variation with a high impedance input and a low impedance output. When the rise in voltage at the base of Q150B has been transmitted to the input to the current setting resistors, it compensates for voltage variations at the input to the device under test holding the voltage across the current setting resistors at 1 volt per step. AMP BAL R224 adjusts the DC balance of paraphase amplifier Q229, and also compensates for unbalance in Q150. OUTPUT Z adjustment R243 adjusts the output impedance of the step amplifier.

Relay K101B and Q248 or Q250 are used to limit the voltage which may be applied to a device under test in the reverse direction using opposing offset. If, for example, positive going steps are to be applied to the device under test, K101B is in the + position. If negative offset is applied to the device under test by pushing the OPPOSE button and turning the OFFSET MULT control clockwise, the step generator will attempt to conduct negative current at the input to the device under test. In doing this, the voltage at the input and thus the voltage at the Q229B gate input is driven down. When the voltage goes approximately 2 volts below ground, Q248 turns on. With Q248 on, the negative-going voltage steps at the base of Q150A are limited, thus limiting the output of the output amplifier (the input to the device under test) to about 2 volts. This amount of voltage should not damage a device under test.

Voltage Mode. Voltage steps are obtained from the output amplifier in a manner similar to that used to obtain current steps. For voltage steps, however, the VOLTAGE SETTING RESISTORS are changed to obtain the various voltage amplitudes, rather than the CURRENT SETTING RESISTORS (which are held constant in the voltage mode). Also since it is not desirable to regulate the voltage at the input to the CURRENT SETTING RESISTORS in the voltage mode, the feedback to the positive side of the differential amplifier through the +1 amplifier is disconnected and the input to the +1 amplifier is connected to ground. The base of Q150B is, therefore, held at essentially ground. Since the output of the +1 amplifier is at ground, reverse voltage limiting transistors Q248 and Q250 are disabled in the voltage mode.

In the voltage mode when steps of 1/2 volt per step are applied to the step output amplifier, they are transmitted through VOLTAGE SETTING RESISTANCE R141 through R145, the input resistance. By varying this input resistance with respect to constant feedback resistance R194, the feedback gain of the negative side of the differential amplifier is changed, thus varying the amplitude of the voltage steps. After being conducted through the voltage setting resistors, the steps are amplified and transmitted through the negative side of the differential amplifier in the same manner as described in the current mode section. When the voltage steps reach the CURRENT SETTING RESISTORS, they are transmitted through a nominal resistance (R215 and R216) of 5 Ω, for all voltage positions of the AMPLITUDE switch, before being applied to the device under test. Voltage steps of varying amplitudes, as determined by the AMPLITUDE switch, are then developed across the input impedance of the device under test. Feedback to the input to the differential amplifier occurs at the output of the current setting resistors, therefore, minimizing the effect of R215 and R216.

When using voltage steps, the current conducted at the step generator input to the device under test may increase quite rapidly and possibly damage the device under test (especially when testing transistors). As a means of limiting this current in the voltage mode, current limiting resistors R185, R186 and R187 are added to the output amplifier circuit by the AMPLITUDE switch. These resistors limit current at the Step Generator Output by limiting current



Note:
Pin numbers refer to
Connector J360.

R_S — R405 through R409

R_C — R414 through R418

Note Overlap { R_A — R434 through R438
R_B — R437 through R440 (or open)

Note Overlap { R'_A — R442 through R444
R'_B — R442 through R445

Fig. 3-8. Simplified schematic of Display Sensitivity Switching and Standard Test Fixture schematics for measurement of collector current (I_C) and collector-emitter voltage (V_{CE}) or collector-base voltage (V_{CB}).

through R165, R166 and R167. As the voltage steps increase through Q176 and Q184 or through Q172 and Q180, the current increases through the current limiting resistors. This current increase causes the voltage drop across the resistors to increase. If positive-going steps are being produced, this increase in voltage drop is transmitted through Q176 and Q169 to the junction of R166 and R167. As the voltage drop increases, the voltage at this junction point goes down. When the voltage reaches about −2.3 volts, D165 forward biases, clamping the voltage at the base of Q169. This prevents generation of further steps. When negative-going steps are being produced, the drop across the current limiting resistors is transmitted through three base-emitter junctions, Q180, Q172 and Q169, to the junction of R166 and R167. As voltage drop increases, the voltage at the collector of Q164 goes up. When this voltage reaches +12.5 volts, Q169 is saturated, and again no further steps can be generated. The CURRENT LIMIT switch determines the number of resistors to be included in the current limiting resistance, therefore determining the amount of current necessary to either turn on D165 or saturate Q169.

VERTICAL AND HORIZONTAL DISPLAY

Signal Sensing and Display Sensitivity

Once the Collector Supply and the Step Generator Output have been applied to the device under test, measurements of the voltages and currents seen at the terminals of the device under test may be displayed on the vertical and horizontal axes of the CRT. These measurements are made by first sensing the current or voltage through current sensing resistors or voltage dividers, then amplifying the measurement with the display amplifiers and applying the measurement to the deflection plates of the CRT. The positions of the HORIZONTAL, the MODE and the Terminal Selector switches determine which measurements are made.

Collector Current Sensing. If the MODE switch is set to either NORM or DC, collector current (I_C) is measured on the vertical axis of the CRT. Collector current is measured by placing a resistor between ground and the current return to the collector supply and measuring the voltage developed across this resistor (see Fig. 3-8 and Fig. 3-9). By varying

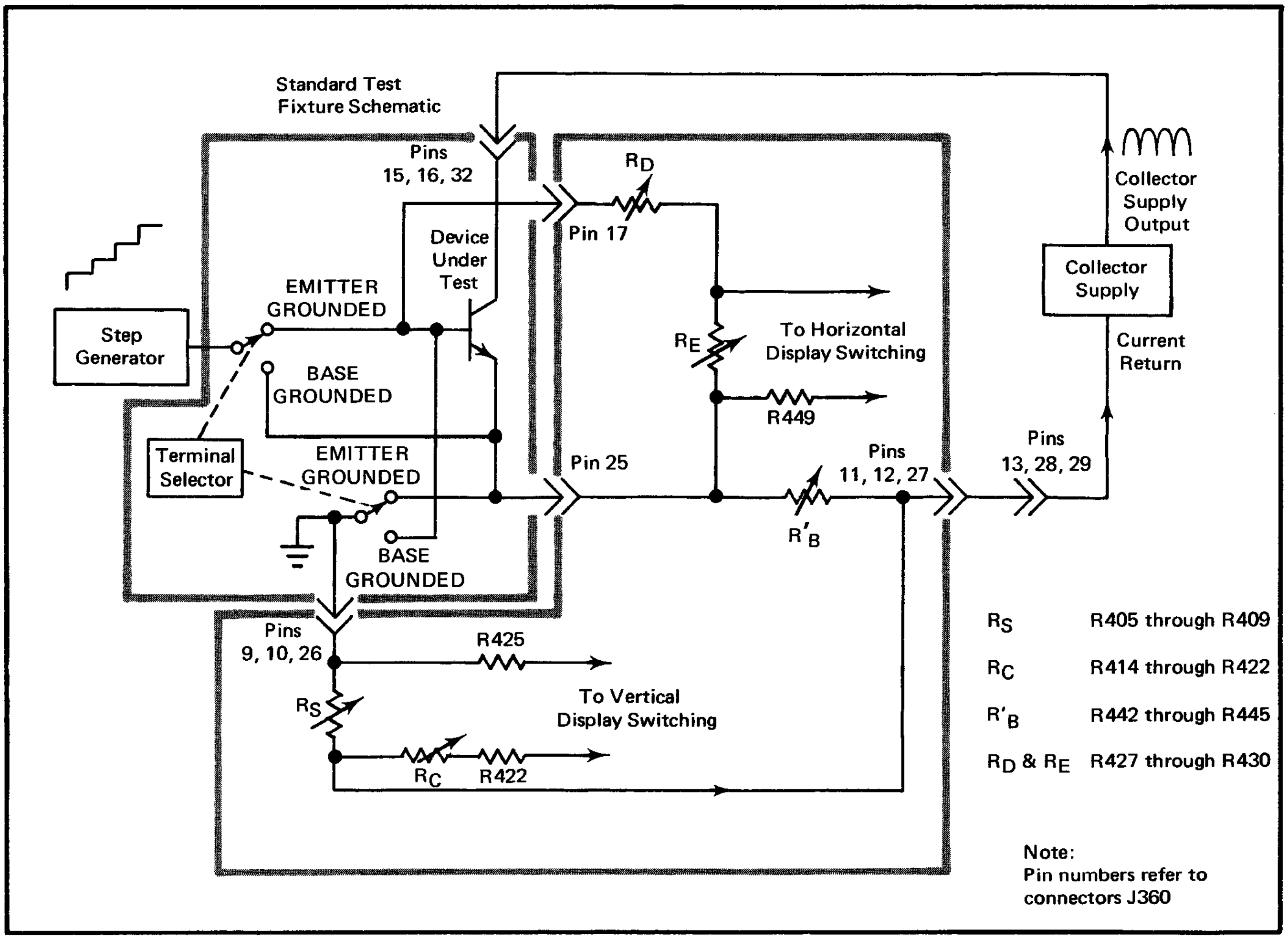


Fig. 3-9. Simplified schematic of Display Sensitivity Switching and Standard Test Fixture schematics for measurement of collector current (I_C) and base-emitter voltage (V_{BE}) on emitter-base voltage (V_{EB}).

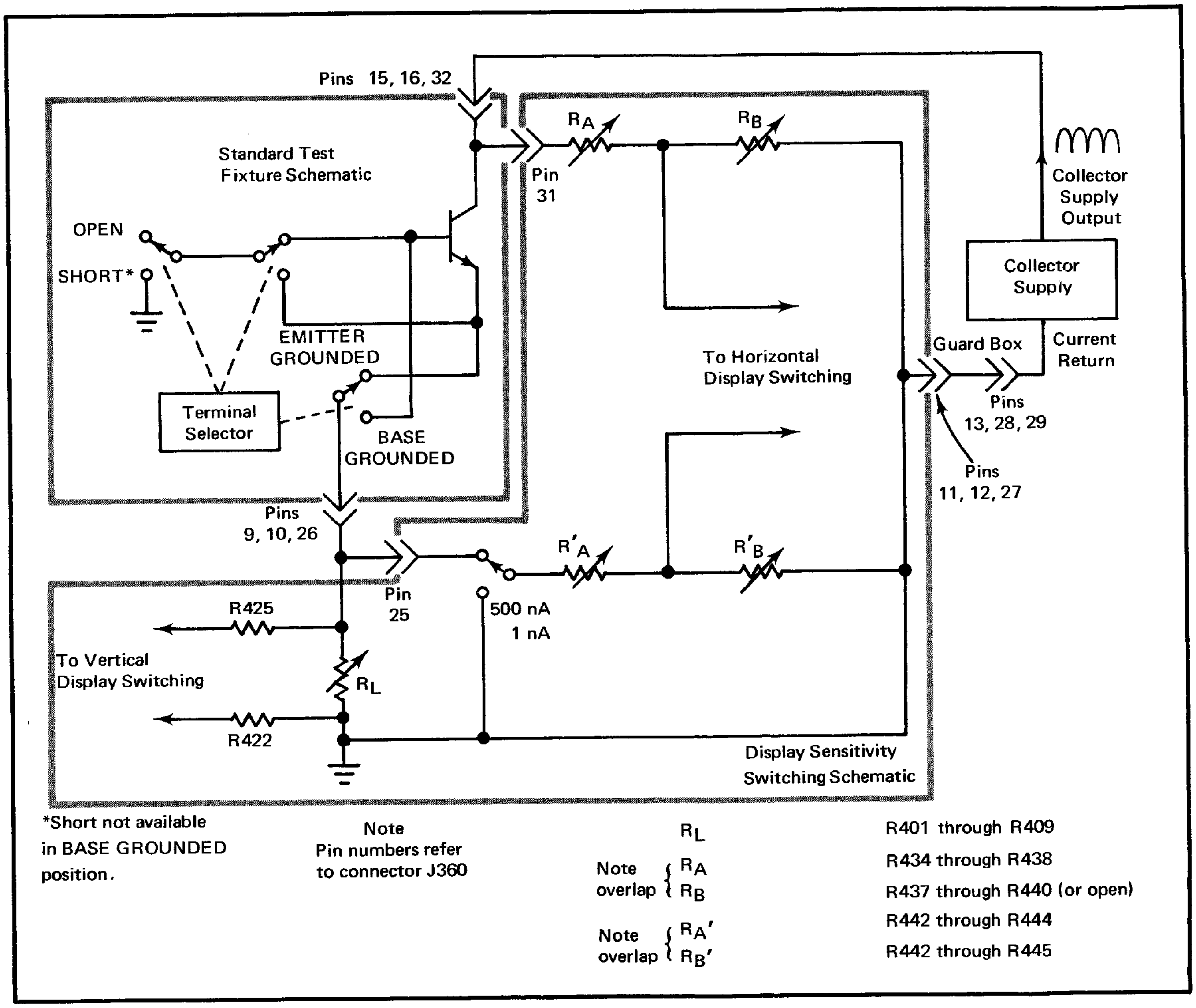


Fig. 3-10. Simplified schematic of Display Sensitivity switching and Standard Test Fixture schematics for measurement of emitter current (I_E) collector-base current (I_{CBO}) collector-emitter voltage (V_{CE}) or collector-base voltage (V_{CB}).

the value of this current sensing resistor (R_S), the deflection factor of the display on the CRT may be varied.

Leakage Current Sensing. If the MODE switch is set to LEAKAGE, emitter current (I_E) or collector-base current (I_{CBO}) is measured on the vertical axis of the CRT. Emitter current is measured by placing a current sensing resistance between the emitter terminal of the device under test and ground, and measuring the voltage developed across it (see Fig. 3-10). If emitter current is to be measured, the Terminal Selector switch must be set to GROUNDED EMITTER BASE TERM OPEN or BASE TERM SHORT. When the Terminal Selector switch is set to BASE GROUNDED EMITTER TERM OPEN, collector-base current is measured on the vertical axis. In this case the current sensing resistor is connected between the base terminal and ground. As when measuring collector current, the deflection factor of the display, when measuring emitter current and collector-base current, can be varied by varying the current sensing resistance. It should be noted that the deflection factor of the vertical display is always decreased 1000 times when the MODE switch is set to LEAKAGE and the collector supply operates in its DC mode.

Voltage Sensing Normal Mode. Either collector or base voltage may be measured on the horizontal axis of the CRT, depending on the position of the HORIZONTAL switch. When the HORIZONTAL switch is in its COLLECTOR range, voltage is measured between the collector and emitter terminals of the device under test, V_{CE} (Terminal Selector switch set to EMITTER GROUNDED), or between the collector and base terminals, V_{CB}, (Terminal Selector switch set at BASE GROUNDED). When the HORIZONTAL switch is in its BASE range, voltage is measured between the base and emitter terminals, V_{BE} (EMITTER GROUNDED), or between the emitter and base terminals,

V_{EB} (BASE GROUNDED). By use of a variable voltage divider across these terminals, the deflection factor of the horizontal display can be varied.

Voltage Sensing Leakage Mode. When the Mode switch is set to LEAKAGE, only the measurement of V_{CE} and V_{CB} are useful. In this situation a slight error in voltage measurement occurs whenever the VERTICAL switch is set within the 500 nA to 1 nA EMITTER range. In this range (see Fig. 3-10) the horizontal display is a measurement of collector voltage to ground, rather than collector to emitter or collector to base voltage. As discussed previously, when current measurements are made in the leakage mode, the current sensing resistor is between ground and the emitter or ground and the base terminal. Any measurement of voltage between the collector and ground, therefore, measures the voltage drop across the current sensing resistor and adds it to the desired measurement of V_{CE} or V_{CB}. The correct values of V_{CE} or V_{CB} can be determined by subtracting the voltage drop across the current sensing resistor from the total measurement shown on the horizontal axis of the CRT. See the Horizontal Measurement and Sensitivity section of the Operating Instructions for instructions on how to determine this error voltage.

Display of Step Generator. If either the VERTICAL or the HORIZONTAL switch is set to STEP GEN, the 1/2 volt steps at the input to the output amplifier section of the step amplifier (see Fig. 3-7) are applied to the inputs to the vertical display amplifier or the horizontal display amplifier (see Fig. 3-11). If both switches are set to STEP GEN, the 1/2 volt steps are applied to the Horizontal Display Amplifier only.

Vertical and Horizontal Positioning

The positioning of the display on the CRT is determined by current applied to the low impedance inputs of the Display Amplifiers at the emitters of Q533A and B in the vertical display amplifier, and Q633A and B in the horizontal display amplifier (see discussion of Display Amplifiers). This current comes from many individual current sources which are controlled by the POSITION switches, the FINE POSITION controls, the POLARITY switch and the DISPLAY OFFSET controls (see the Display Positioning schematic).

The POSITION switches and the FINE POSITION controls allow both coarse and fine positioning of the display. The current for the coarse control comes from resistors R480 through R483 (vertical) and R490 through R493 (horizontal). These resistors are all connected to the −75 volt supply, making them current sources. Each of these current sources is connected between a pair of contacts. When one contact of a pair is closed, this current flows into one side of the display amplifier. If the other contact of the pair is closed, the current flows into the other side of the amplifier. The matrixes for the POSITION cam switches show that at all times one contact of each pair must be closed, but never both closed at once. This assures that the sum of the positioning current flowing into the amplifiers is always a constant. Each POSITION switch provides 20 divisions of positioning in five division steps. The FINE POSITION controls, R488 (vertical) and R498 (horizontal) operate in a similar manner to the coarse controls except that the adjustment is continuously variable.

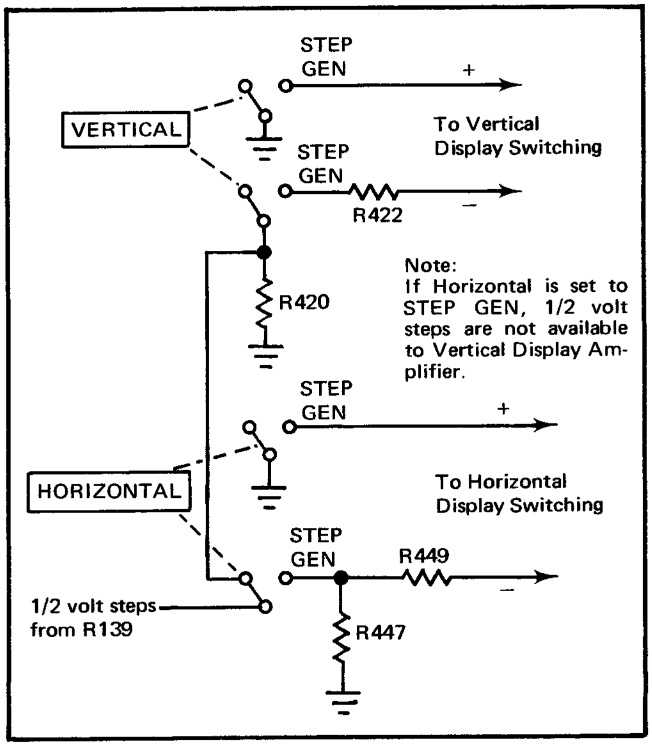


Fig. 3-11. Simplified schematic of Display Sensitivity Switching when VERTICAL and/or HORIZONTAL switches are set to STEP GEN.

The POLARITY switch provides automatic positioning of the display when switching between the AC, +(NPN) or −(PNP) positions of the switch. This positioning current is obtained in the same manner as the coarse positioning current. Current sources R474 and R475 (vertical) and R477 and R478 (horizontal) provide this positioning current.

The display may also be positioned by the calibrated CENTERLINE VALUE switch. This control effects the circuit only when the DISPLAY OFFSET Selector switch is switched to one of its VERT or HORIZ positions and affects only one display amplifier at a time. When the DISPLAY OFFSET Selector switch is set to NORM (OFF), current sources R468 and R469 (vertical) and R471 and R472 (horizontal) supply current to the display amplifiers. When, for example, the switch is set to VERT, R468 and R469 are disconnected from the circuit and an equal amount of current is supplied to the vertical display amplifier by current sources R450 through R464. These resistor-contact combinations are controlled by the CENTERLINE VALUE switch and operate identical to the POSITION switches. The CENTERLINE VALUE switch provides 10 divisions of calibrated positioning in half-division steps.

Display Switching

Once the desired voltages and currents have been sensed by the display sensitivity switching circuit, and once the desired positioning currents have been obtained from the display positioning circuit, the resulting voltage signals and positioning currents must be applied to the display amplifiers. Before being applied to the display amplifiers, however, these signals pass through the display switching circuit (see the Display Amplifiers and Display Positioning schematics).

Under normal operating conditions with neither the DISPLAY INVERT, the ZERO nor the CAL buttons pressed, these signals and currents pass directly to the display amplifiers. If the DISPLAY INVERT button is pressed, however, the signal and current input lines to both amplifiers are reversed. This causes the display on the CRT to be inverted, both vertically and horizontally.

The ZERO button, when pressed, disconnects the signal input lines from both pairs of high impedance inputs and shorts the input pairs together. This provides a zero reference for both display amplifiers. If the DISPLAY OFFSET controls are being used when the ZERO button is pressed, offset positioning current is caused to flow as if the CENTERLINE VALUE switch were set to 0 (see Display Positioning schematic and discussion of positioning).

The CAL button, when pressed, disconnects the signal input lines from both pairs of high impedance inputs and applies a substitute voltage across each input pair which should cause full graticule deflection (10 divisions by 10 divisions). This provides a means of checking the accuracy of calibration of the display amplifiers. The substitute voltage is determined by R501 through R513 and by D507. Since each display amplifier has three gains to check, three substitute voltages must be available. Relays K537C, K541C, K637C and K641C determine which voltages are applied to the high impedance input pairs for various settings of the VERTICAL and HORIZONTAL switches. If the DISPLAY OFFSET current controls are being used when the CAL button is pressed, offset current is caused to flow as if the CENTERLINE VALUE switch were set to 10.

Display Amplifiers

The vertical and horizontal display amplifiers are identical with a few minor exceptions. They are both differential amplifiers, each with two sets of differential inputs and one set of differential outputs. One set of differential inputs is high impedance and receives its inputs from the display sensitivity switching circuit. The other set of differential inputs is low impedance and their inputs are the differential positioning currents from the display positioning circuit. The differential outputs are connected to the deflection plates of the CRT and control the potential on the deflection plates.

The simplified schematic in Fig. 3-12 will help in understanding the operation of the display amplifiers. The display amplifiers control the voltage between the deflection plates of the CRT by controlling the currents through load resistors R_{L1} and R_{L2}. The currents I_{L1} and I_{L2} conducted by the load resistors are controlled by two means: differential current I_S and positioning currents I_{P1} and I_{P2}. The differential current flows through source coupling resistor R_S whenever there is a differential voltage signal applied to the high impedance gate inputs of FETS Q1A and Q1B. Positioning currents I_{P1} and I_{P2} are determined by the resistance between the emitter of Q2A and −75 volts and between Q2B and −75 volts, respectively.

The relationship between the load resistor currents and the other currents in the amplifier is as follows:

$$I_L = I_P - (I_D + I_S) \quad \text{(Equation 3-1)}$$

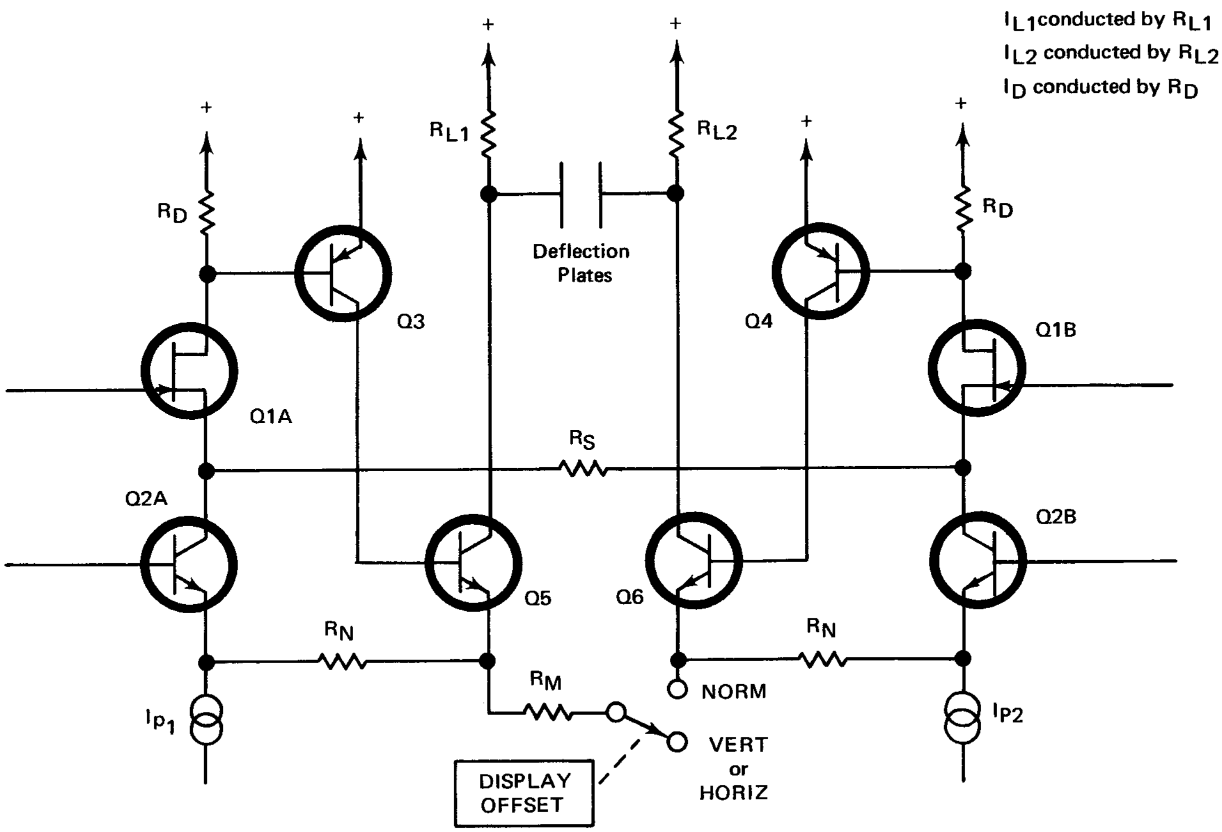
Equation 3-1 pertains to the currents which flow in one side of the amplifier. I_S is either positive or negative, depending on whether it adds to or subtracts from I_D. I_D represents the FET drain current. It originates from a constant current source and is the same in each side of the amplifier. This equation also shows that the load current is dependent on the interaction between the differential current (I_S) and the positioning current (I_P).

To understand the operation of this circuit, first assume that the amplifier is operating in a balanced condition where the two positioning currents are equal ($I_{P1} = I_{P2}$) and there is no voltage difference between the two high impedance inputs ($I_S = 0$). In this case, the load currents on each side of the amplifier are equal to I_{LO}. Equation 3-1, then, becomes:

$$I_{LO} = I_{L1} = I_{L2} = I_{P1} - I_D = I_{P2} - I_D \quad \text{(Equation 3-2)}$$

To illustrate the effect the high impedance inputs have on the load current, assume that a difference in voltage is applied across the gates of Q1A and Q1B, making the gate of Q1A more positive. This voltage differential causes differential current I_S to flow through source coupling resistance R_S. With this additional current (I_S) flowing through Q1A, less current is needed from Q2A to keep drain current I_D constant. The current conducted by Q2A is thus reduced to $I_D - I_S$. Since the positioning current I_{P1}, which supplies the current conducted by Q2A, is also constant, there is a surplus of positioning current created equal to I_S which must be conducted by Q5, and therefore R_{L1}. The load current is increased to $I_{L1} = I_{LO} + I_S$. On the other side of the amplifier, the current through Q2B is increased to $I_D + I_S$, which decreases the load current through Q6 and R_{L2} to $I_{L2} = I_{LO} - I_S$. For this example, it can be seen that whenever a differential voltage occurs between the two high impedance inputs, the load currents change, thus changing the voltage potential between the deflection plates of the CRT.

To illustrate the effect the positioning currents have on the load currents, assume that the voltages at the high



Substitutions from Display Amplifier Schematic

Vertical Amplifier	Simplified Schematic	Horizontal Amplifier
Q531A & B	Q1A & B	Q631A & B
Q533A & B	Q2A & B	Q633A & B
Q560	Q3	Q660
Q569	Q4	Q669
Q578	Q5	Q678
Q587	Q6	Q687

Fig. 3-12. Simplified schematic of display amplifier.

impedance inputs are equal ($I_S = 0$) and that the positioning currents are unequal ($I_{P1} \neq I_{P2}$). From Equation 3-1 the load currents are found to be:

$$I_{L1} = I_{P1} - I_D \quad \text{(Equation 3-3)}$$

$$I_{L2} = I_{P2} - I_D \quad \text{(Equation 3-4)}$$

By subtracting Equation 3-4 from Equation 3-3, it is shown that the difference in the two load currents exactly equal the difference in the two positioning currents.

$$I_{L1} - I_{L2} = I_{P1} - I_{P2} \quad \text{(Equation 3-5)}$$

Since the positioning currents are not unequal, the load currents (I_{L1} and I_{L2}) are unequal, which again changes the voltage potential between the deflection plates of the CRT.

These two examples have shown that the voltage between the deflection plates (and thus the position of the electron beam as it strikes the face of the CRT) is controlled by two means, the voltage applied to the high impedance inputs and the positioning currents applied to the low impedance inputs. Equation 3-1 shows this relationship.

It should be noted that it is transistors Q3 and Q4 which cause Q5 and Q6 to conduct more or less load current. As in previous examples, assume the normally constant drain current I_D conducted by Q1A is caused to increase either by increasing I_S or I_{P1}. This increase in I_D causes the source voltage of Q1A to go negative, causing Q3 to conduct more current. This in turn causes Q5 to conduct more current. The additional current conducted by Q5 reduces the current through Q2A and causes the drain current I_D to be reduced back to its normal constant value.

The gain of the display amplifiers is adjusted in two ways. The overall gain is controlled by varying the load resistance (R_{L1} and R_{L2}). Adjusting the load resistance affects the gain of the high impedance inputs, as well as that of the positioning current. R_{L1} and R_{L2} are adjusted so that the positioning inputs provide the proper deflection. Varying the source coupling resistance (R_S) sets the gain of the high impedance inputs only. R_S is adjusted to match the high impedance gain to the positioning inputs.

By switching R_M into the circuit, the overall display amplifier gain is increased by a factor of 10. Load currents I_{L1} and I_{L2} flow through resistors R_{N1} and R_{N2}. When R_M is in the circuit, any change in the current through R_{N1} and R_{N2} causes a voltage across R_M. This voltage across RM causes additional load current to be conducted by Q5 and Q6, load current which is not felt by the emitters of Q2A and Q2B. For a given change in current at the emitters of Q2A and Q2B, therefore, a greater change in load current through Q5 and Q6 occurs, causing additional gain of the display amplifier. The gain of the circuit under magnified conditions is controlled by adjusting R_M.

Vertical Display Amplifier

The Display Amplifiers schematic shows the complete schematic of the vertical display amplifier. The table in Fig. 3-12 relates the transistors and FETs in the simplified schematic with those in the actual schematic of this circuit.

The complete schematic shows that the high impedance inputs of the amplifier have three separate gains (R_S has three different values). As has been mentioned previously in the discussion of the signal sensing and display sensitivity, the deflection factor of the vertical display is partially determined before the measurement is applied to the high impedance inputs. The three gains of the vertical display amplifier allow the vertical display to have three different deflection factors for each voltage signal applied to the high impedance inputs in a 1-2-5 relationship. 1'S GAIN adjustment R541, 2'S GAIN adjustment R538 and 5'S GAIN adjustment R536 determine the three gains of the high impedance inputs. Relays K537A and K541A determine which resistors will control the gain for the various positions of the VERTICAL switch. VERT OUTPUT GAIN adjustment R592A and B determines the overall gain of the vertical display amplifier by allowing adjustment to the load resistors R_{L1} and R_{L2}.

The overall balance of the positioning currents of the vertical display amplifier is controlled by VERT CENT adjustment R581. In addition, 1'S BAL adjustment R550 and 2'S BAL adjustment R545 provide positioning current balance when the VERTICAL switch is set to a position with a one times or a two times multiplier, respectively. Relays K537B and K541B determine which resistors control the positioning current balance for various positions of the VERTICAL switch.

When the DISPLAY OFFSET Selector switch is set to VERT X10, R574 and VERT MAG GAIN adjustment R573 are added to the vertical display amplifier circuit. These resistors constitute R_M and increase the sensitivity of the vertical display 10 times. R580 is always in the circuit and gives the output stage an unmagnified gain of about 1.8.

Horizontal Display Amplifier

The Display Amplifiers schematic shows the complete schematic of the horizontal display amplifier. The table in Fig. 3-12 relates the transistors and FETs in the simplified schematic with those in the actual schematic of this circuit.

The horizontal display amplifier operates basically the same as the vertical display amplifier. 1'S GAIN adjustment R638, 2'S GAIN adjustment R636 and 5'S GAIN adjustment R641 control the three gains of the horizontal high impedance inputs. Relays K637A and K641A determine which resistors will control the gain for the various positions of the HORIZONTAL switch. HORIZ OUTPUT GAIN adjustment R692A and B controls the load resistance. ORTHOG adjustment R685 interacts with the vertical display amplifier and allows adjustment of the orthogonality of the display on the CRT. When the DISPLAY OFFSET Selector switch is set to HORIZ X10, R674 and HORIZ MAG GAIN adjustment R673 are added to the circuit and form R_M. R680, like R580, is always in the circuit and gives the output stage an unmagnified gain of about 1.8.

The overall balance of the position currents of the horizontal display amplifier is controlled by HORIZ CENT adjustment R681. In addition, 1'S BAL adjustment R650 and 5'S BAL adjustment R645 provide positioning current balance when the HORIZONTAL switch is set to a position with a one times or a five times multiplier, respectively. Relays K637B and K641B determine which resistors control the positioning current balance for various positions of the HORIZONTAL switch.

Readout

A display of the vertical and horizontal deflection factors, the step amplitude and the β or g_m per division (vertical deflection factor divided by step amplitude) is given to the right of the CRT. This display of numbers and units is obtained through the use of fiber-optic readout. Fiber-optic readout involves the use of plastic fibers of very small diameter, called light tubes, for transferring light from one place to another. The light tubes are designed so that the light incident at one end of the tube is transmitted through the tube to the other end. If the output end of the tube is viewed directly, the output light looks like a small dot. This transmission of light occurs even if the light tubes are bent at slight angles. In order to form a character, many light tubes are arranged so that their output ends, the dots of light, are in the configuration of the character to be formed. The input ends are then arranged so that they receive their incident light from the same light source. In some cases it may take two or more light sources to form one character. Whenever the proper light source (or sources) is illuminated, the desired character appears. It is the purpose of the readout circuitry, therefore, to light the readout lamps so the deflection factors they indicate correspond with the CRT display deflection factors determined by the positions of the VERTICAL and HORIZONTAL switches, the MODE switch, the DISPLAY OFFSET Selector switch, the AMPLITUDE switch and the .1X STEP MULT button.

The inputs for the readout logic come from logic lines whose logic levels are controlled by the switches shown on the Readout Switching and Interconnections schematic, or by externally provided logic levels. The form of the inputs is a high-low code. Normally all inputs are high and the code is determined by switching some of the logic lines to ground. Ground reference is generally provided directly as part of the switch. However, in the case of the vertical and horizontal switches, ground is provided through saturation transistors Q900 and Q943 respectively. If lows are applied to pins 7 and 20 of J363, these transistors are turned off. In this case ground reference for the affected logic lines must then be provided externally.

The readout logic (see Readout Logic schematic) primarily consists of integrated circuit decoders. These decoders receive inputs from the incoming logic lines in terms of the above-mentioned switch code. This input code is then translated into a high-low lamp code which appears on the output logic lines. Each of the output logic lines is connected to a readout lamp (see Readout Lamps schematics) and each lamp illuminates one character of one part of a character. A low on a readout lamp causes the lamp to light. The intensity of the readout is determined by the 0 to 4.5 volt supply.

The readout logic circuitry also generates a lamp code which produces a readout of beta or transconductance (g_m) per division. This β or g_m readout lamp code is obtained by dividing the vertical lamp code by the steps lamp code.

The decoders which control the horizontal deflection factor readout are U951 and U953. Inputs to these decoders are controlled by the HORIZONTAL switch, the DISPLAY OFFSET Selector switch or by externally applied inputs to J363. Outputs from these decoders go to the horizontal readout lamps. As an example of how a lamp code is generated, assume that the HORIZONTAL switch is set to .5 V COLLECTOR and the DISPLAY OFFSET Selector switch is set to NORM (OFF). Due to the closing of contacts by the HORIZONTAL cam switch (see the Readout Switching and Interconnections schematic), lows are applied to the inputs to U951 and U953 at connectors 13, T, and S of P950 (see Fig. 3-13). The other inputs to the horizontal decoders are held high. The output lamp code resulting from this input code is lows at lamp input connectors F, I, J, L, A, C, D and E. The resulting PER HORIZ DIV readout is 500 mV, which corresponds with the .5 V COLLECTOR position of the HORIZONTAL switch.

Decoders U956 and U960 control the vertical deflection factor readout. Inputs to these decoders are controlled by the VERTICAL switch, the DISPLAY OFFSET Selector switch, the MODE switch and externally applied inputs to J363. Outputs from these decoders go to the vertical readout lamps. The horizontal and vertical decoders are affected by these logic inputs, at pin U, pin Y and pin 12 of J363, whose logic levels may only be determined externally.

Decoders U965 and U970 control the step amplitude readout. Inputs to U965 and U970 are controlled by the AMPLITUDE switch, the STEP MULT .1X button and externally applied inputs to J361. Outputs from U965 and U970 go to the steps readout lamps.

The beta or g_m generator consists of U974, U975 and U976. The input code received by these decoders is a combination of logic levels coming in part from the vertical lamp code, and in part from the steps lamp code. The outputs from these decoders go to the beta readout lamps. Q960 and Q974 decode the logic levels appearing at pins 13 and 15 of U960 and pins 13 and 15 of U970. Q977 and Q979 provide a means of lighting the 1,4 lamp (connector BI) whenever the 2,5 lamp (connector AR) is off.

Power Supply

The Type 576 can be operated either from a 115-volt or a 230-volt line voltage source. The low voltage power supply (see Fig. 3-14) consists of a single transformer, T701, which has nine secondaries. This supply provides six regulated voltages: −75 volts, −12.5 volts, +5 volts, +12.5 volts, +15 volts and +100 volts. It also produces a regulated variable voltage of 0 to 4.5 volts, one unregulated voltage of +50 volts and an AC voltage to drive the POWER ON light and the GRATICULE ILLUM lights. The windings providing a source of clock pulses for the step generator and the CRT heater are among the nine secondaries of T701. All the regulated power supplies are completely short proof.

Input Circuit. When the POWER switch is switched to ON, line current flows from the input, P701 (see Power Supply schematic), through power switch SW701, fuse F701, Thermal Cutout TK701 and into the primary wind-

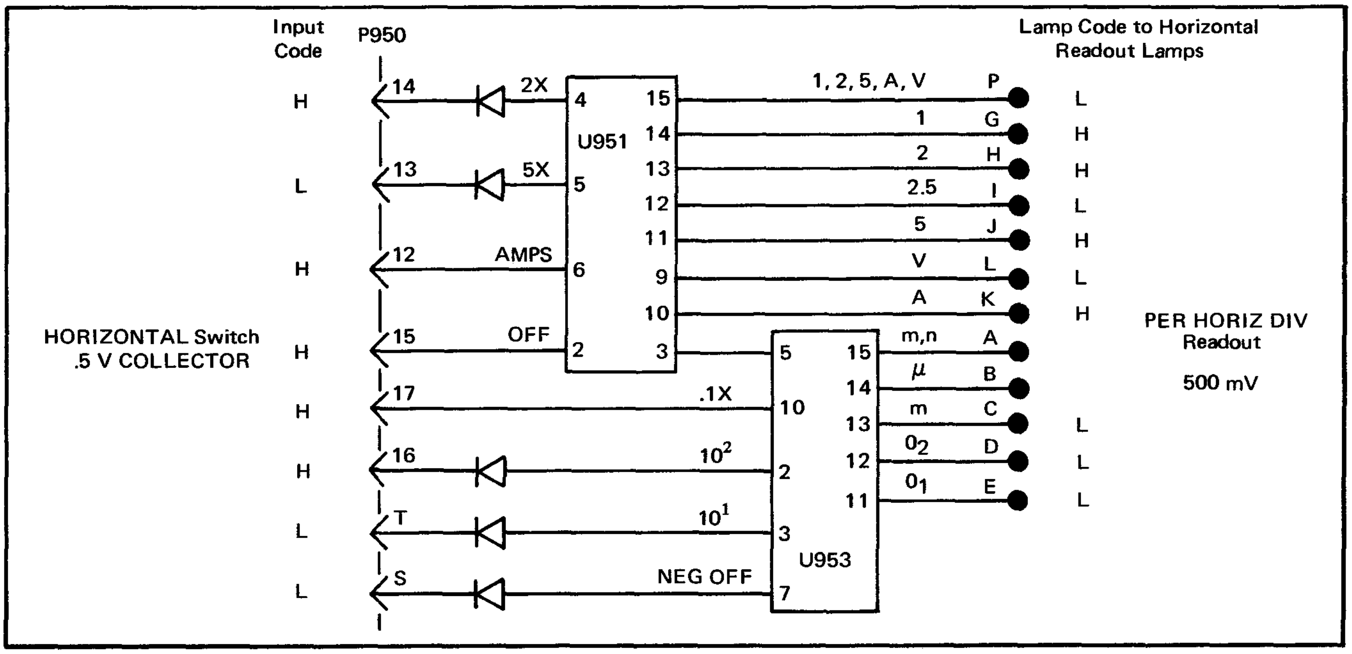


Fig. 3-13. Example of operation of Horizontal Readout decoders.

ings. For 115-volt operation the LINE SELECTOR switch connects thc two primaries in parallel and for 230-volt operation connects them in series. For 230-volt operation, F703 is connected into the circuit. The RANGE SELECTOR plug determines how many turns of each primary winding are utilized to compensate for variations in line voltage.

−75-volt Supply. The −75-volt supply consists of diode bridge D706 A, B, C and D, filter capacitors C706 and C707, comparator Q716A and B, emitter follower Q729, short protection Q725 and Q727, and series regulator Q734.

9-volt Zener diode D708 sets the base voltage of comparator transistor Q716A while the quiescent voltage at the base of Q716B is set by −75 V adjustment R721. Any variation in the −75-volt supply voltage is compared by Q716A and B. The resulting rise or fall in voltage across R715 is transmitted by Q729 to the base of series regulator Q734. Any change in voltage of the −75-volt supply will be opposed by a change in current through the series regulator.

The output current of the −75 volt supply is limited to a value less than normal whenever the supply is shorted to a voltage between −75 V and chassis ground. The supply current of the −75 volt supply is controlled by the voltage across R735, which is dependent on the base voltage of Q734. This voltage is in turn dependent on the voltage across R730 and R731. As the −75 volt supply becomes more positive (due to shorting it to a more positive supply), the voltage at the base of Q734 is raised, causing more supply current to be conducted through R735. As the supply voltage becomes more positive, the voltage at the junction of R730 and R731 rises high enough to turn on Q727. When Q727 turns on, it begins pulling down on the base voltage of Q729 and down on the base voltage of Q734, thus limiting the supply current. The output current of the −75-volt supply comes less, the closer the supply voltage is to ground.

D732 prevents the supply from going more than 0.6 volt above chassis ground if the −75 volt supply is shorted to a positive voltage. D722 protects the −12.5 volt supply if it is shorted to the −75 volt supply. If the −12.5 volt supply is pulled negative, D722 turns on when the supply is about at −15 volts which disables comparator Q716A and B. The −75 volt supply then limits current until both supplies are at about −2.5 volts. If the +12.5 volt supply is shorted to the +100 volt supply, Q725 turns on. When Q725 is on, it limits current through R735 in the same manner as discussed previously for Q727. The result of shorting the +12.5 volt supply to a more positive voltage is to turn off the −75 volts supply. Since the −75 volt supply is the reference for the −12.5 volt, +12.5 volt, +100 volt, and CRT voltage supplies, when the −75 volt supply is turned off, the other power supplies are turned off.

−12.5-volt Supply. The −12.5 volt supply consists of diode bridge D737A, B, C and D, filter capacitor C738, comparator Q744A and B, emitter follower Q750, short protection Q748 and series regulator Q756. This circuit regulates the −12.5-volt supply in essentially the same manner as the −75-volt supply operates.

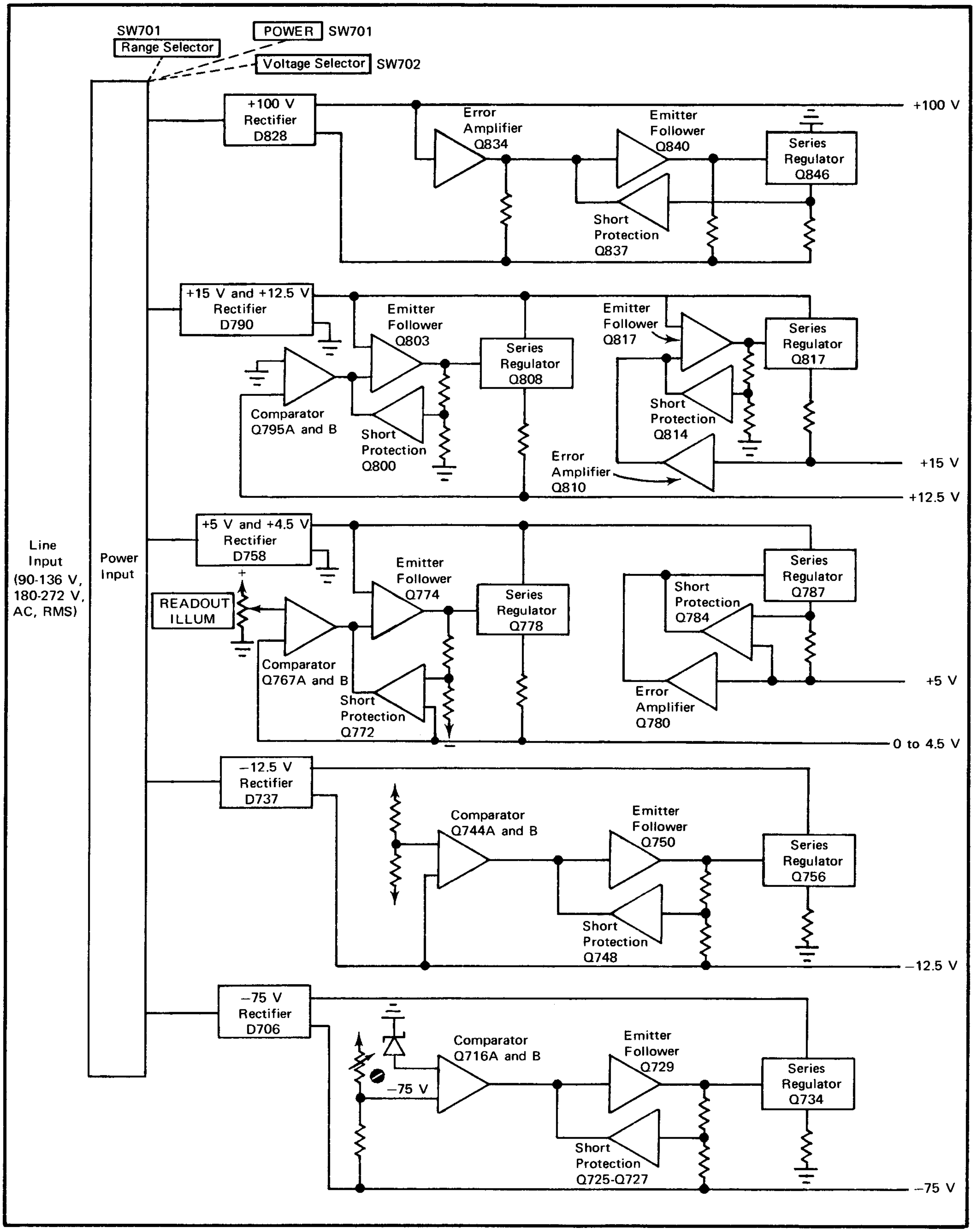


Fig. 3-14. Block diagram of L. V. Power Supply.

0 to +4.5-volt Variable Supply. The 0 to +4.5-volt variable supply consists of diode bridge D758A, B, C and D, filter capacitor C759, comparator Q767A and B, emitter follower Q774, short protection Q772 and series regulator Q778. This circuit operates in essentially the same manner as the −75-volt supply circuit. In this circuit, however, the reference voltage at the base of Q767A is variable from 0 volts to +4.5 volts by the READOUT ILLUM control, R760, and divider R762 and R763. The output current of the supply is limited by Q772.

+5-volt Supply. The +5-volt supply consists of error amplifier Q780, short protection Q784 and series regulator Q787. The supply shares diode bridge D758A, B, C and D and filter capacitors C758 and C759 with the +4.5-volt supply. Any variation in the +5-volt supply voltage is amplified by Q780, causing the base voltage of Q787 to vary in opposition to the variation of the supply. The current conducted through R788 by the supply is thus regulated, which in turn regulates the +5-volt supply. Q784 provides short protection by turning on whenever the current through R788 becomes excessive. When Q784 turns on, the base voltage of Q787 is pulled down, limiting the current through R788.

+12.5-volt Supply. The +12.5-volt supply consists of diode bridge D790A, B, C and D, filter capacitor C791, comparator Q795A and B, emitter follower Q803, short protection Q800, and series regulator Q808. This circuit operates in essentially the same manner as the −75-volt supply. Short protection of the +12.5-volt supply when it is shorted to a more positive voltage is provided by Q725 of the −75-volt supply. If the +12.5-volt supply voltage is pulled up, the base of Q725 is also pulled up, turning on Q725. With Q725 turned on, the base of Q729 is pulled down turning off the −75-volt supply, which will turn off the +12.5-volt supply.

+15-volt Supply, Camera Power. The +15-volt supply consists of error amplifier Q810, emitter follower Q817, short protection Q814 and series regulator Q819. The supply shares diode bridge D790 and filter capacitors C790 and C791 with the +12.5-volt supply. Any variation in the +15-volt supply voltage is amplified by Q810, causing an opposing variation in the voltage at the base of Q817. This opposing voltage variation is transmitted through the emitter of Q817 to the base of series regulator Q819 where it controls the current conducted by R819 and thus regulates the supply. When enough current is conducted by Q819 to turn on Q814, the voltage at the base of Q817 is pulled down, thus limiting the current through Q819.

+50-volt Supply. The +50-volt supply consists of diode bridge D821A, B, C and D, and filter capacitors C822 and C823. It is a floating unregulated supply used to power the step amplifier output.

+100-volt Supply. The +100-volt supply consists of diode bridge D828A, B, C and D, filter capacitor C829, error amplifier Q834, emitter follower Q840, short protection Q837 and series regulator Q846. Any variation in voltage by the +100-volt supply is amplified by Q834 and transmitted through Q840 to the base of Q846. Since any variation in the supply is inverted by Q834, the base voltage of Q846 will always move in opposition to a variation of the supply. The current conducted by R846, therefore, also is conducted so as to oppose any change in supply voltage. When enough current is conducted by Q846 to turn on Q837, the voltage at the base of Q840 is pulled down, thus limiting the current conducted by Q819.

CRT Voltage Supply

The CRT power supply produces two high voltages, −4 kV and +225 volts, for operation of the CRT and its related controls. In addition, the +225-volt supply is used by the display amplifiers. The source of power for the two supplies is a high frequency (about 28 kHz) Hartley oscillator which consists of Q851 and the two primaries of transformer T850. The collector of Q851 is connected through the collector primary, R850 and L850 to the +100-volt supply. When current flows through the collector primary, a magnetic field is built up in the transformer core. Due to this field, a reverse base current is caused to be conducted through Q851 by the base primary and Q851 is eventually turned off. With Q851 off, no current flows through the collector primary. The residual field in the transformer core now causes forward base current to be conducted through Q851, turning it on. As Q851 turns on, current again flows through the collector primary, thus beginning a new cycle. The frequency of the oscillator and thus the output current of the secondaries is controlled by the voltage on pin 2 of the base primary.

−4 kilovolt Supply. The −4 kV supply consists of half-wave rectifier D870, filter capacitors C870 and C871, and divider resistors R875 through R883. This supply is a half-wave rectified supply with D870 forward biasing on negative transistions of the voltage on the −4 kV secondary. The −4 kV supply voltage after being filtered by C870 and C871 is reduced by Zener diode D882 to provide the −3890 volt cathode voltage. The grid voltage is controlled by the divider made up of R882 and INTENSITY control R883. The voltage on the focus screen of the CRT is controlled by FOCUS control R880.

The −4 kV supply is regulated from a reference supply which is generated by the winding between terminals 6 and 5 of T850. This reference supply consists of half-wave rectifier D866 and D869, and filter capacitor C866. The regulator circuit consists of error amplifier Q859 and emitter follower Q855. Any variation in the reference supply voltage is transmitted to the base of Q859 through divider R860-R864. The variation is then amplified and inverted by Q859 and transmitted through Q855 to the base of Q851, where it regulates the drive of the oscillator. Any variation in current conducted by the −4 kV supply is conducted by R899, which causes the decoupled supply voltage at the emitter of Q859 to vary, thus compensating for current variation in the −4 kV supply.

Ⓐ

The voltage on the display geometry screen is controlled by GEOMETRY adjustment R893. The voltage on the display astigmatism screen is controlled by ASTIGMATISM adjustment R891. Current for the trace rotation controlling coil is controlled by TRACE ROTATION adjustment R897.

+225-volt Supply. The +225-volt supply is generated from the same transformer winding as the −4 kV reference supply. It consists of half-wave rectifier D868 and D865, filter capacitors C869, C868 and Q868. Regulation of the +225-volt supply is supplied by the reference supply through divider R860 through R864, and through emitter followers Q866 and Q868.

SECTION 4
MAINTENANCE

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

Introduction

This section of the manual provides information for use in preventive maintenance, troubleshooting and corrective maintenance of the Type 576.

PREVENTIVE MAINTENANCE

General

Preventive maintenance consists of cleaning, visual inspection, lubrication, etc. Preventive maintenance performed on a regular basis will improve the reliability of this instrument. The severity of the environmeent to which the Type 576 is subjected determines the frequency of maintenance.

Cleaning

The Type 576 should be cleaned as often as operating conditions require. Accumulation of dirt in the instrument can cause overheating and component breakdown. Dirt on components acts as an insulating blanket and prevents efficient heat dissipation. It can also provide an electrical conduction path.

Exterior. Loose dust accumulated on the outside of the Type 576 can be removed with a soft cloth or small paint brush. The paint brush is particularly useful for dislodging dirt on and around the front-panel controls. Dirt which remains can be removed with a soft cloth dampened in a mild detergent and water solution. Abrasive cleaners should not be used.

Interior. Dust in the interior of the instrument should be removed occassionally to prevent electrical conductivity under high-humidity conditions. The best way to clean the interior is to blow out the accumulated dust with dry, low-velocity air. Remove any dirt which remains with a soft paint brush or a cloth dampened with a mild detergent and water solution. A cotton-tipped applicator is useful for cleaning in narrow spaces or for cleaning ceramic terminal strips and circuit boards.

CAUTION

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

Lubrication

The reliability of potentiometers, rotary switches, and other moving parts can be maintained if they are kept properly lubricated. Use a cleaning-type lubricant (such as Tektronix Part No. 006-0218-00) on shaft bushings and switch contacts. Lubricate switch detents with a heavier grease (such as Tektronix Part No. 006-0219-00). Potentiometers that are not sealed should be lubricated with a lubricant which will not affect electrical characteristics (such as Tektronix Part No. 006-0220-00). Do not use excessive lubrication. A lubrication kit containing the necessary lubricants and instructions is available from Tektronix, Inc. (Order Tektronix Part No. 003-0342-00).

Visual Inspection

The Type 576 should be inspected occasionally for such defects as broken connections loose pin connections broken or damaged ceramic strips, improperly seated transistors, 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.

Transistor and Integrated Circuit

Periodic checks of individual transistors and integrated circuits are not recommended. The best check of them is their operation in the equipment, as reflected by a performance check or calibration procedure. Sub-standard performance will normally be detected at that time.

Recalibration

To ensure accurate measurements, check the calibration of this instrument after each 1000 hours of operation or, if used infrequently, every 6 months. In addition, replacement of components may necessitate reacalibration of the affected circuits. Complete calibration instructions are given in the Performance Check and Calibration section. This procedure may also be helpful in localizing certain troubles in the instrument. In some cases, minor troubles may be revealed and/or corrected by recalibration.

TROUBLESHOOTING

Introduction

The following information is provided for use with the other sections of this manual to facilitate troubleshooting of the Type 576 if trouble develops. An understanding of the operation of the Type 576 circuitry is also helpful for locating troubles. See the Circuit Description section for complete information.

Troubleshooting Aids

Diagrams. A complete set of circuit diagrams is given on foldout pages in Section 8. The circuit number and electrical value of each component in this instrument is shown on the appropriate diagram. Each main circuit is assigned a series of circuit numbers. Table 4-1 lists the main circuits in the Type 576 and the series of circuit numbers assigned to each. The portions of the circuit which are mounted on a circuit board are enclosed with a blue line on the circuit diagram.

TABLE 4-1
Components Numbers

Component Numbers on Diagrams	Diagram Number	Circuit
1-99	2,4	Step Generator
100-199	3,4	Step Amplifier
200-299	3,4	Step Amplifier
300-399	1,6	Collector Supply, Standard Test Fixture
400-499	5,8	Display Sensitivity Switching, Display Positioning
500-599	9	Vertical Display Amplifier
600-699	9	Horizontal Display Amplifier
700-799	13	Power Supply
800-899	14	CRT Circuit
900-999	10,11	Readout Switching and Interconnections, Readout Logic
1000-1199	12	Readout Lamps

Also included on the circuit diagrams are voltages and waveforms which can be expected at various points in the circuitry. A list of front-panel control settings which must be used to obtain the given voltages and waveforms is shown on the apron of circuit diagram number one.

Switch Wafer Identification. Switch wafers shown on the diagrams are coded to indicate the position of each wafer in the complete switch assembly. The numbered portion of the code refers to the wafer number counting from the front, or mounting end of the switch, toward the rear. The letters F and R indicate whether the front or rear of the wafer performs the particular switching function. For example, a wafer designated by 2R indicates that the rear of the second wafer (from the front) is used for this particular switching function.

Circuit Boards. Figs. 4-5 through 4-26 show the circuit boards used in the Type 576. On each of these pictures each electrical component on the board is identified by its circuit number. These pictures, used along with the circuit diagrams, aid in locating the components mounted on the circuit boards.

Wiring Color Code. All insulated wire and cable used in the Type 576 is color-coded to facilitate circuit tracing. Signal carrying leads have white backgrounds with one or two colored stripes. The signal carrying wire color-codes are given in Fig. 4-5 through 4-26 with the appropriate pin connection. Power supply leads have either a red background (positive supply) or a purple background (negative supply). Each power supply lead also has one colored stripe which represents its ordinal relationship to the other supplies having the same polarity, using the EIA resistor color code. Table 4-2 gives the wiring color-code for the power supply voltages used in the Type 576.

Table 4-2

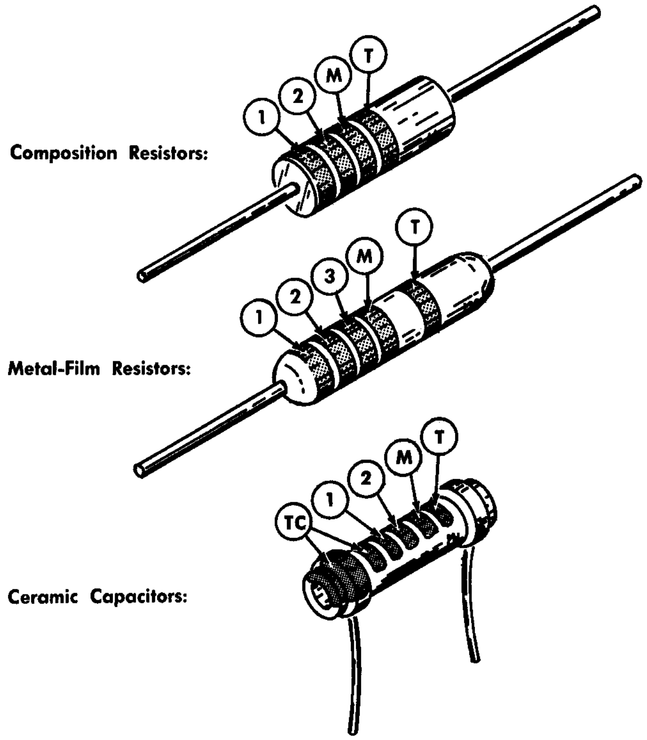
Power Supply Wiring Color

Supply	Background Color	Stripe Color
−75 volt	Purple	Red
−12.5 volt	Purple	Black
Var +4.5 volt	Brown	(none)
+5 volt	Red	Black
+12.5 volt	Red	Brown
+50 volt	Red	Yellow
+15 volt	Red	Orange
+100 volt	Red	Green
+225 volt	Red	Blue
−4 kV	White	Purple
Ground	Black	(none)

Resistor Color Code. In addition to the brown composition resistors, some metal-film resistors (identifiable by their gray body color) and some wire-wound resistors (usually light blue or dark gray) are used in the Type 576. The resistance value of a wire-wound resistor is printed on the body of the component. The resistance value of a composition resistor or metal-film resistor is color-coded on the component 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 (see Fig. 4-1). Metal-film resistors have five stripes consisting of three significant figures, a multiplier and a tolerance value.

Capacitor Marking. The capacitance value of a common disc capacitor or small electrolytic is marked in microfarads on the side of the component body. The white ceramic capacitors used in the Type 576 are color-coded in picofarads using a modified EIA code (see Fig. 4-1).

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 identifies the Tektronix Part Number using the resistor color-code system (e.g., a diode color-



(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.

coded blue or pink-brown-grey-green indicates Tektronix Part Number 152-0185-00). The cathode and anode ends of metal-encased diodes can be identified by the diode symbol marked on the body.

Transistor and Integrated Circuit Lead Configuration. Fig. 4-2 shows the lead configurations of the transistors and integrated circuits used in this instrument. This view is as seen from the bottom of the device.

Troubleshooting Equipment

The following equipment is useful for troubleshooting the Type 576:

1. Semiconductor Tester—Some means of testing the transistors, diodes and FETs used in this instrument is helpful. A transistor-curve tracer such as the Tektronix Type 576 will give the most complete information.

2. DC Voltmeter and Ohmmeter—A voltmeter for checking voltages with the circuit and an ohmmeter for checking resistors and diodes are required. For most applications a 20,000 ohm/volt VOM can be used to check voltages and resistances, if allowances are made for the circuit loading of a VOM when making voltage measurements at high-impedance points.

3. Test Oscilloscope—A test oscilloscope is required to view waveforms at different points in the circuit. An oscilloscope with DC to 10 MHz frequency response and 10 mV to 10 V/division vertical deflection factor is suggested. A 10X probe should be used to reduce circuit loading.

Troubleshooting Techniques

This troubleshooting procedure is arranged in an order which checks the simple trouble possibilities before proceeding with extensive troubleshooting. The first few checks ensure proper connection, operation and calibration. If the trouble is not located by these checks, the remaining steps aid in locating the defective component. When the defective component is located, it should be replaced following the replacement procedure given under Corrective Maintenance.

1. Check Control Settings. Incorrect control settings can indicate a trouble that does not exist. If there is any question about the correct function or operation of any control, see the Operating Instructions section of this manual.

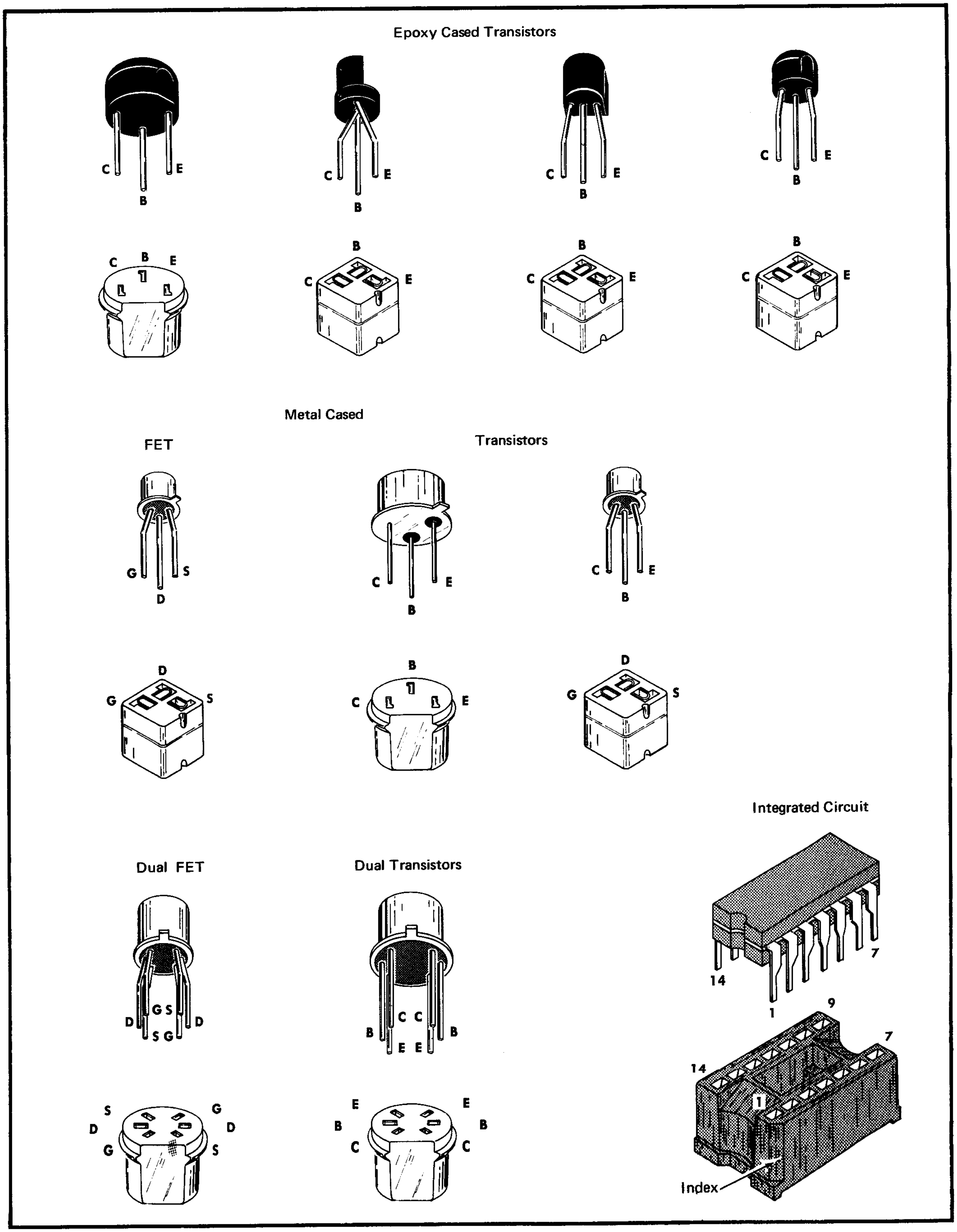


Fig. 4-2. Electrode configurations for socket-mounted semiconductor devices.

2. Check Instrument Calibration. Check the calibration of this instrument or of the affected circuit if the trouble is known to exist in one particular circuit. The apparent trouble may be only a result of misadjustment and may be corrected by calibration. Complete calibration instructions are given in the Performance Check and Calibration section of this manual.

3. Locating Malfunctioning Circuits. To locate the source of a malfunction in instrument operation, the trouble symptom will often indicate the identity of the faulty circuit(s). For example, if a display of the Collector Supply output can be obtained on the test oscilloscope CRT but a display of the Step Generator output cannot be obtained, the Step Generator is probably malfunctioning.

If the trouble symptom does not indicate which circuit(s) is causing problems (for example if there were no Collector Supply or Step Generator outputs), a more systematic troubleshooting procedure is necessary. Fig. 4-3 provides a general guide for locating the probable circuits which are causing the instrument to malfunction.

The following preliminary procedure ensures that the instrument malfunction is not caused by improper control settings and helps determine where to begin on the troubleshooting chart:

A. Set the following Type 576 controls to:

GRATICULE ILLUM	Fully Clockwise
READOUT ILLUM	Fully Clockwise
INTENSITY	Trace Visible
FOCUS	Centered
VERTICAL	1 mA
DISPLAY OFFSET Selector	NORM(OFF)
CENTERLINE VALUE	0
HORIZONTAL	2 V COLLECTOR
POSITION (Vert and Horiz)	Centered
FINE POSITION (Vert and Horiz)	Centered
ZERO	Released
CAL	Released
DISPLAY INVERT	Released
MAX PEAK VOLTS	15
PEAK POWER WATTS	0.5
VARIABLE COLLECTOR SUPPLY	Fully Clockwise
POLARITY	+(NPN)
MODE	NORM
LOOPING COMPENSATION	As Is
NUMBER OF STEPS	10
CURRENT LIMIT	20 mA
AMPLITUDE	2 V
OFFSET	ZERO
OFFSET MULT	0
STEPS	Pressed
PULSED STEPS	Released
STEP FAMILY	REP
RATE	NORM
POLARITY INVERT	Released
STEP MULT .1X	Released
Terminal Selector	BASE TERM STEP GEN (NORM)
LEFT-OFF-RIGHT	RIGHT

B. Turn on the Type 576 and allow a few minutes to warm up.

C. CHECK FOR—Display of Collector Supply sweep of about 15 volts peak on Type 576 CRT.

D. If no display can be obtained, connect the 10X probe between the test oscilloscope and the collector terminal on the right hand side of the Standard Test Fixture (connect ground lead to emitter terminal).

E. CHECK FOR—Display of Collector Supply output is a positive-going full-wave rectified sine wave of about 15 volts peak on test oscilloscope CRT.

F. Connect the probe to the right base terminal of the Standard Test Fixture.

G. CHECK FOR—Display of Step Generator output of positive-going steps of 2 volts/step on test oscilloscope CRT.

H. Start with the following step on Fig. 4-3 according to the results of the previous checks:

1. Step (A)—No Collector Supply output; Step Generator output or display on the Type 576 CRT.

2. Step (B)—No Collector Supply output or incorrect output, but Step Generator is displayed and the spot can be seen on the Type 576 CRT.

3. Step (C)—No Step Generator output (or incorrect output), but Collector Supply is displayed on the Type 576 CRT.

4. Step (D)—No display on type 576 CRT (or incorrect display), but Collector Supply output and Step Generator output are displayed properly on the test oscilloscope CRT.

After the defective circuit has been located, proceed with steps 4 through 8 to locate and repair the faulty components.

4. Visual Check. Visually check the portion of the instrument in which the trouble is located. Many troubles can be located by visual indications such as unsoldered connections, broken wires, damaged circuit boards, damaged components, etc.

5. Check Circuit Board Interconnections. After the trouble has been isolated to a particular circuit, check the pin connectors on the circuit board for correct connection. Figs. 4-5 through 4-26 show the correct connections of each board.

The pin connectors used in this instrument also provide a convenient means of circuit isolation. For example, if the

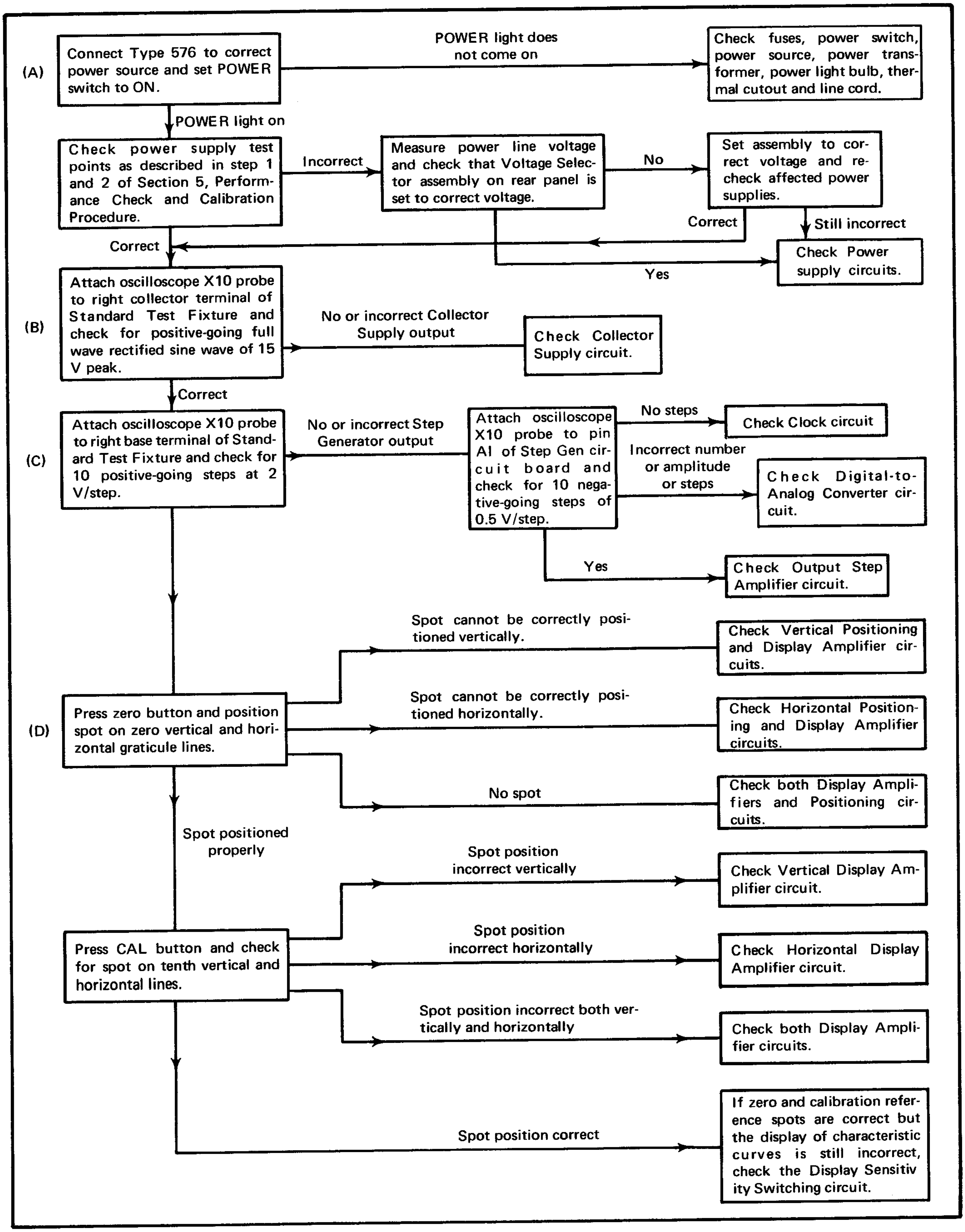


Fig. 4-3. Troubleshooting chart.

power supply is shorted, the defective circuit can be isolated by disconnecting the pin connectors at the boards until the shorting condition is removed.

6. Check Voltages and Waveforms. Often the defective component can be located by checking for the correct voltage or waveforms as given on the circuit diagrams on foldout pages in the back of this manual.

NOTE

Voltages and waveforms given on the diagrams are not absolute and may vary slightly between instruments. To obtain operating conditions similar to those used to take these readings, see the first diagram page.

7. Check Semiconductors. Most circuit failures result from the failure of a transistor, FET, diode, or integrated circuit due to normal aging and use. The following explains various methods of checking semiconductor devices. Insertion information is provided in Fig. 4-2.

TRANSISTORS. Transistor defects usually take the form of the transistor opening, shorting, or developing excessive leakage. The best method of checking transistors is by direct substitution. Be sure the voltage conditions of the circuit are not such that a replacement transistor might also be damaged. If substitute transistors are not available, use a dynamic tester (such as a Tektronix Type 576).

Static-type testers are not recommended since they do not check the device under operating conditions. However, if no other tester is immediately available, an ohmmeter will usually indicate when a transistor is totally bad. As a general rule, use the R X 1 k range where the current is usually limited to less than 2 mA and the internal voltage is usually 1 1/2 volts. Check the current and voltage of the ohmmeter by inserting a multimeter between the ohmmeter leads and measuring the current and voltage of the various ranges. After it has been determined which ohmmeter ranges will not harm the transistor, use those ranges to measure the transistor's resistance. Check the resistance in both directions through the junctions as listed in Table 4-3.

TABLE 4-3

Transistor Resistance Checks

Ohmmeter Connections[1]	Resistance Readings That Can Be Expected Using the R X 1 k Range
Emitter-Collector	High readings both ways (about 60 kΩ to around 500 kΩ).
Emitter-Base	High reading one way (about 200 kΩ or more). Low reading the other way (about 400 Ω to 2.5 kΩ
Base-Collector	High reading one way (about 500 kΩ or more). Low reading the other way (about 400 Ω to 2.5 kΩ).

FIELD EFFECT TRANSISTORS. The voltage and resistance of field effect transistors can be checked in the same manner as transistors. 1 1/2 V and less than 2 mA should be used for ohmmeter checks. Resistance readings should be:

drain-to-source	Less than 500 Ω
gate-to-source and gate-to-drain	400 Ω to 10 Ω (approximately) in one direction; more than 200 kΩ with leads reversed.

INTEGRATED CIRCUITS. Integrated circuits are best checked with a voltmeter, oscilloscope, or by direct substitution.

DIODES. Diodes (except for tunnel diodes) can be checked for an open or short-circuited condition by measuring the resistance between the terminals after unsoldering one end of the component. Use a resistance scale with an internal voltage between 800 mV and 3 volts. The resistance should measure very high (in megohm range) in one direction and low in the other.

8. Check Other Components. If the semiconductors in the circuit have been found to be good, the rest of the components should be checked. Components which are soldered in place are best checked by disconnecting one end. This isolates the measurement from the effects of surrounding circuitry.

9. Repair and Readjust the Circuit. 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. If a component has been replaced, recalibration is usually necessary.

Additional Troubleshooting Information

Troubleshooting the Readout. Malfunction of the readout display can be caused by three things: a burned out readout lamp, improper operation of the readout logic or improper operation of a cam switch. The best method of locating the malfunction is by checking the inputs and the outputs of the decoders for various positions of the front panel switches. Tables 4-4 through 4-7 show to which decoders the pins on the J950 are inputs. The state of these pins (high or low) for various front-panel control settings can be obtained from the Readout Switching and Interconnections schematic in the Diagrams section. The outputs of the decoders are checked by first determining what the readout ought to be for the given settings of the front-panel controls (be sure to note the effects of the MODE switch, DISPLAY OFFSET Selector switch and STEP MULT .1X button). When the proper readout has been determined, locate the pins on the Readout Logic circuit board which must be low to cause that readout (see Tables 4-4 through 4-7). When the proper states of the inputs and outputs of the decoders have been determined, check these levels with a voltmeter.

TABLE 4-4

Input and Output Lines to
Horizontal Decoders U951 and U953

Inputs		Outputs	
Pins on J950	Title	Solder Point on Readout Logic Circuit Board	Title (Lamp)
14	2X	F	1, 2, 4, A, V
13	5X	G	1
12	AMPS	H	2
15	OFF	I	2, 5
17	.1X	J	5
16	10^2	L	V
T	10^1	K	A
S	NEG EXP	A	m, n
		B	μ
		C	m
		D	0_2
		E	0_1

TABLE 4-5

Input and Output Lines to
Vertical Decoders U956 and U960

Inputs		Outputs	
Pins on J950	Title	Solder Point on Readout Logic Circuit Board	Title (Lamp)
19	2X	V	1, 2, 5, A, V
18	5X	W	1
U	Volts	X	2
V	OFF	Y	2, 5
W	.1X	Z	5
Y	10X	AA	V
20	10^{-1}	AB	A
21	10^{-2}	U	0_1
22	10^{-4}	T	0_2
X	10^{-3}	S	m
		R	μ
		O	m, n

1. If the inputs to the decoders are incorrect, something is wrong with one of the cam switches.

2. If the inputs to the decoders are correct, but the outputs are incorrect, the decoders are malfunctioning.

3. If the outputs of the decoders are correct, something is wrong with a fiber-optic and lamp assembly (probably a burned out lamp).

TABLE 4-6

Input and Output Lines
to Steps Decoders U965 and U970

Inputs		Outputs	
Pins on J950	Titles	Solder Point on Readout Logic Circuit Board	Title (Lamp)
F	2X	AH	1,2,5,A,V
5	5X	AI	1
4	VOLTS	AJ	2
H	OFF	AK	2,5
J	.1X	AL	5
K	10X	AM	V
8	10^{-1}	AN	A
9	10^{-2}	AG	0_1
10	10^{-4}	AF	0_2
6	10^{-8}	AE	M
		AD	μ
		AC	m,n

TABLE 4-7

Input and Output Lines
To Beta Decoders U974, U975 and U976

Inputs		Outputs	
Solder Points on Readout Logic Circuit Board	Titles (Lamps)	Solder Points on Readout Logic Circuit Board	Titles (Lamps)
R	μ (vert)	AW	K
S	m (vert)	AX	K,M
Collector Q960)	n (vert)	AY	m
AE	m (steps)	AZ	K,μ
Collector Q974	n (steps)	BA	μ
AD	μ (steps)	BD	5_2
AG	0_1 (steps)	BE	DEC PT
AF	0_2 (steps)	BF	0, 5_2
U	0_1 (vert)	BG	0_1
T	0_2 (vert)	BH	0_2
X	2 (vert)	AQ	4,5
Z	5 (vert)	AV	1,2,4
AL	5 (steps)	AS	2
AJ	2,5 (steps)	AT	2,4,5
Collector Q984	BETA OFF	AV	1,4,5
		AR	2,5
		BI	1,4

See the section of the Circuit Description on readout for further information and an example of the operation of the readout system.

TABLE 4-8

Supply Voltages When One Supply is Shorted to Ground

Shorted Supply	Supply Voltages (Approximate)								
	−75	−12.5	+12.5	+100	+225	−4 kV	+4.5*	+5	+15
−75	0	0	1	3	0	0	0	0.5	1
−12.5	−35	0	1.5	3	0	0	1	1	1
+12.5	−75	0	0	0	0	0	0	0	1.5
+100	−75	−1	1.5	0	0	0	0	0	0
+225	−75	−12.5	5	8	0	0	2	3	6
−4 kV	−75	−12.5	5	8	0	0	2	3	6
4.5*	−75	−12.5	+12.5	+100	+225	−4 kV	0	+5	+15
+5	−75	−12.5	+12.5	+100	+225	−4 kV	+4.5	0	+15
+15	−75	−12.5	+12.5	+100	+225	−4 kV	+4.5	+5	0

Power Supply. A malfunction in the power supply is often caused by one or more supplies being shorted to ground. Table 4-8 indicates the states of all the power supplies in the instrument when one of them is shorted to ground. This table does not give values in cases when more than one supply is shorted to ground or when one supply is shorted to another supply. In these cases, the table only indicates interrelationships between supplies. Table 4-9 gives resistance values of the supplies to ground as measured by a VOM. Be sure the instrument is turned off when making these measurements.

TABLE 4-9

Power Supply Resistance Check[1]

Supply	VOM Scale	Resistance	
		Leads +	Leads −
−75	1 kΩ	1.5 k	1.9 k
+100	1 kΩ	5 k	1.8 k
+15	1 kΩ	23 k	2 k
+225	1 kΩ	36 k	12 k
−12.5	10 Ω	25 Ω	35 Ω
+12.5	10 Ω	16 Ω	31 Ω
+5	10 Ω	28 Ω	90 Ω
+4.5[2]	10 Ω	35 Ω	100 Ω

[1] **Type 576 turned off.**

[2] **READOUT ILLUM control fully clockwise.**

CORRECTIVE MAINTENANCE

General

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

Obtaining Replacement Parts

Standard Parts. All electrical and mechanical part replacements for the Type 576 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 list 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, particularly at the upper frequency limits of the instrument. 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 576. These parts are manufactured or selected by Tektronix, Inc. to meet specific performance requirements, or are manufactured for Tektronix, Inc. in accordance with our specifications. Each special part is indicated in the electrical 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 components 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, as 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. 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 off the excess lead that protrudes through the board (if not clipped in step 3).

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.

A sample roll of solder containing about 3% silver is mounted on the right side of the instrument below the bracket holding the VERT OUTPUT GAIN and HORIZ OUTPUT GAIN adjustments. Additional solder of the same type should be available locally, or it can be purchased from Tektronix, Inc. in one-pound rolls. order by Tektronix Part No. 251-0514-00.

Observe the following precautions when soldering to a ceramic terminal strip:

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 to metal termianls (e.g., switch 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 to a metal terminal:

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 Removal and Replacement

WARNING

Disconnect the instrument from the power source before replacing components.

Not all the components in this instrument are accessible without first removing some obstructions, such as circuit boards, CRT and shield or the guard box. None of these obstructions, however, are difficult to remove or replace.

CRT and Shield. To remove the CRT or the CRT and shield, follow these procedures:

Removal of CRT

1. Remove the bezel from the Type 576 front panel.

2. Remove the power cord retainer from the rear panel.

3. Disconnect the connector on the rear of the CRT by pulling on the white handle.

4. Disconnect the pin connectors from the side of the CRT.

5. Loosen the CRT clamp by loosening the two screws on the top rear of the shield.

6. Push the CRT from the rear, while pulling it from the front.

Removal of the CRT Shield

1. Remove the CRT.

2. Disconnect the shield from the rear by loosening the screw which clamps the shield to the rear panel.

3. Disconnect the pin connectors from the graticule light circuit board.

4. Remove the two screws securing the shield to the front panel.

5. Pull the shield out from the front.

To replace the CRT and shield reverse these procedures.

Guard Box. The guard box may be removed by the following procedure:

1. Remove the bottom panel from the instrument.

2. Remove the screws from the bottom of the chassis which holds the guard box in place.

3. Disconnect the MAX PEAK VOLTS and the PEAK POWER WATTS switches from the front panel.

4. Disconnect connector J300 from the guard box.

5. Pull the guard box out from the bottom of the instrument.

To replace the guard box, perform this procedure in reverse.

Circuit Board Replacement. 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. 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.

Use the following procedure to remove a circuit board.

1a. To lift the board for maintenance or access to areas beneath the board, disconnect the pin connectors which might impair lifting.

1b. To completely remove the board disconnect all the remaining pin connectors.

2. Remove all screws holding the board to the chassis.

3. Lift the circuit board partially or all the way out of the instrument. Do not force or bend the board.

4. To replace the board, reverse the order of removal. Correct location of the pin connectors is shown in Figs. 4-5 through 4-26. Replace the pin connectors carefully so they mate correctly with the pins. If forced into place incorrectly the pin connectors may be damaged.

Cam Switches. A cam switch and its associated circuit board forms an assembly. It is suggested that maintenance of a cam switch which involves separating the two parts of the assembly be done only by experienced technicians.

Removal of a Cam Switch Assembly.

1a. To remove the cam switch assembly for maintenance or access to areas beneath, disconnect only those pin connectors which might impair lifting.

1b. To completely remove the assembly disconnect all the pin connectors.

2. Disconnect the switch from the front panel.

3. Disconnect the circuit board from the rear mounting bracket.

NOTE

The thin film resistors on some of the cam switch assemblies are brittle. Do not bend them when handling.

Replacement of a Cam Switch Assembly.

1. Connect the switch to the front panel.

2. Connect the circuit board to the rear mounting bracket.

NOTE

Do not bend the circuit board while securing it to the rear mounting bracket. If the circuit board must be bent to secure the board to the rear mounting bracket, re-adjust the rear mounting bracket.

3. Reconnect the pin connections to the proper pins (see Figs. 4-5 through 4-26).

Rotary Switches. Individual wafers or mechanical parts of rotary switches are normally not replaceable. If a switch is defective, replace the entire assembly. Replacement switches can be ordered either wired or unwired; refer to the Electrical Parts List for the applicable part number.

When replacing a switch, tag the leads and switch terminals with corresponding identification tags as the leads are disconnected. Then, use the old switch as a guide for installing the new one. An alternative method is to draw a sketch of the switch layout and record the wire color at each terminal. When soldering to the new switch, be careful that the solder does not flow beyond the rivets of the switch terminals. Spring tension of the switch contact can be destroyed by excessive solder.

Semiconductor Replacement. Semiconductors should not be replaced unless they are actually defective. If removed from their sockets during routine maintenance, return them to their original sockets. Unnecessary replacement or exchange of semiconductors may affect the calibration of this instrument. When semiconductors are replaced, check the operation of that part of the instrument which may be affected.

CAUTION

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

Replacement semiconductors should be of the original type or a direct replacement. Fig. 4-2 shows the lead configuration of the semiconductors used in this instrument. Some plastic case transistors have lead configurations which do not agree with those shown here. If a semiconductor is replaced by one which is made by a different manufacturer than the original, check the manufacturer's basing diagram for correct basing. All transistor sockets in this instrument are wired for the basing used for metal-case transistors. Use silicone grease when replacing transistors which have heat radiators. Use silicone grease when replacing transistors which have heat radiators or are mounted on the chassis. Replace the silicone grease when replacing these transistors.

WARNING

Handle silicone grease with care. Avoid getting silicone grease in the eyes. Wash hands thoroughly after use.

Relay Replacement. Relays like the one on the Step Generator circuit board (Tektronix Part No. 148-0044-00) may be turned either direction when connected to the circuit board.

Fuse Replacement. The power-line fuses are located on the rear panel in the Voltage Selector Assembly. See the electrical parts list for the values of the fuses.

Graticule Lamp Replacement. The graticule and readout title lamps may be removed from the rear of the graticule lamp circuit board by lifting the retainers from the contact of the lamp and pulling the lamp out from the rear.

Readout Lamp Replacement. Use the following procedure to replace a readout lamp:

1. Remove the bezel from the Type 576 front-panel.

2. Pull the readout assembly from the instrument.

3. Remove the metal cover from the readout assembly which has a burned out lamp.

CAUTION

Do not loosen or remove heat sinks or readout shelves when replacing readout lamps.

4. If the lamp to be replaced is connected to one of the rear readout lamp circuit boards, disconnect the readout logic circuit board from the readout assembly.

5. Unsolder the lamp leads of the burned out lamp from the back of the readout lamp circuit board. To determine which leads to unsolder, locate the pin on the readout logic circuit board which pertains to the burned out lamp, and follow the color-coded wire from that pin to the readout lamp circuit board.

6. Pull the readout lamp circuit board (and black plastic mounting) far enough away from its holder to replace the damaged lamp and replace the circuit board.

7. Solder the new lamp leads to the readout lamp circuit board.

8. Replace the readout lamp assembly cover (and readout logic circuit board if removed).

Ceramic Terminal Strip Replacement. A complete ceramic terminal strip assembly is shown in Fig. 4-4. 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 Tektornix Part Numbers for the ceramic strips and spacers used in this instrument are given in the Mechanical Part List.

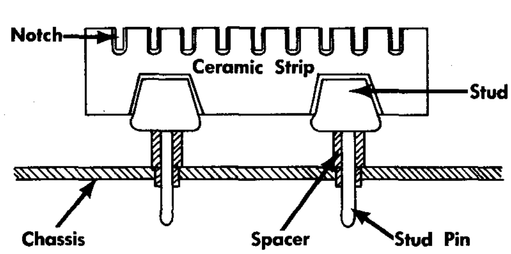


Fig. 4-4. Ceramic terminal strip assembly.

To replace a ceramic terminal strips, 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 showing the location of the components and connections.

2. Pry or pull the damaged strip from 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 studs on the new ceramic strip are longer than those on the old one, cut off the excess length before the new strip is put in place.

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

Transformer Replacement. The power transformer and the collector supply transformer in this instrument are warranted for the life of the instrument. If either transformer becomes defective, contact your local Tektronix Field Office or representative for a warranty replacement (see the Warranty note in the front of this manual). Be sure to replace only with a direct replacement Tektronix transformer.

Recalibration After Repair

After any electrical component has been replaced, the calibration of the associated circuit should be checked, as well as the calibration of other closely related circuits. Since the Power Supply affects all circuits, calibration of the entire instrument should be checked if work has been done in the Power Supply or if the power transformer has been replaced. The Performance Check and Calibration Procedure in Section 5 provides a means of checking instrument operation and making necessary adjustments.

TEST FIXTURE INTERFACE

The following two tables show pertinent information about the Test Fixture Interface located on the Type 576 front panel. This interface consists of four connectors: J360, J361, J362 and J363 (see the Test Fixture Connectors schematic in the Diagrams section). In Table 4-11, where a pin provides an output or accepts an input level, the entry listed under "true" or "false" indicates the state of the terminal which produces the desired level. In indicating logic levels, negative logic is used. In negative logic, a low voltage level (true) activates the function.

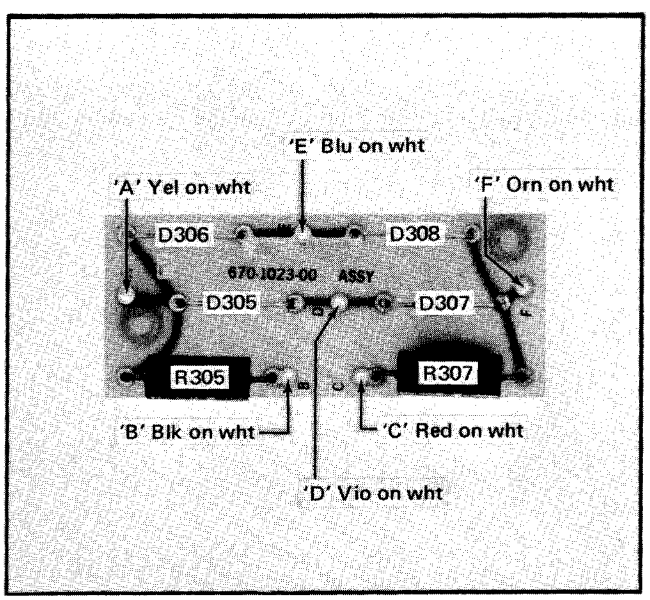


Fig. 4-5. Component locations and wiring color codes on 2 kV Bridge circuit board.

TABLE 4-10

Explanation of the terms Sink and Source

INPUTS	OUTPUTS
Current Sinking When terminal accepts current from external circuit.	Current Sinking When terminal accepts current from external load.
Current Sourcing When terminal supplies current into external circuit.	Current Sourcing When terminal supplies current into external load.

TABLE 4-11

Test Fixture Interface

J360 Pin	J361 Pin	J362 Pin	J363 Pin	Description	Performance	
				Input Signal Logic Levels	**Input controls indicated function. 25 V maximum safe input.**	
					True	False
2				Step Generator Polarity Invert	Drive terminal to between 0 V (ground) and +0.8 V. Terminal sources 5 mA or less into external circuits.	Provide effective open circuit. Terminal must source 1 μA or less. Terminal open circuit voltage is +3 V to +5 V.
3				Step Generator Readout Off	Drive terminal to between 0 V (ground) and +1.5 V. Terminal sources 5 mA or less into external circuit.	
4				Beta Readout Off		
	15			Step Generator Readout 10X Multiplier		
			6	External Vertical Display Enable	Drive terminal to between 0 V (ground) and +1.5 V. Terminal sources 50 mA or less into external circuit.	Provide effective open circuit. Terminal must source 100 μA or less. Terminal open circuit voltage is the +12.5 V supply.
		1		Collector Supply DC Mode		
			7	Vertical Readout Remote Control	Drive terminal is between 0 V (ground) and +1.5 V. Terminal sources 5 mA or less into external circuit. Changes convertible vertical outputs to inputs.	Provide effective open circuit. Terminal must source 1 μA or less. Terminal must source 1 μA or less. Terminal open circuit voltage is +3 V to +10 V.
			8	Vertical Readout Off	Drive terminal to between 0 V (ground) and +1.5 V. Terminal sources 5 mA or less into external circuit.	Provide effective open circuit. Terminal must source 1 μA or less. Terminal open circuit voltage is +3 V to +5 V.
			9	Vertical Readout in Volts		
			10	Vertical Readout 10X Multiplier		
			19	External Horizontal Display Enable	Drive terminal to between 0 V (ground) and +1.5 V. Terminal sources 50 mA or less into external circuit.	Provide effective open circuit. Terminal must source 100 μA or less. Terminal open circuit voltage is the +12.5 V supply
			20	Horizontal Readout Remote Control	Drive terminal to between 0 V (ground) and +1.5 V. Terminal sources 5 mA or less into external circuit. Changes convertible horizontal outputs into inputs.	Provide effective open circuit. Terminal must source 1 μA or less. Terminal open circuit voltage is +3 V to +10 V.

J360 Pin	J361 Pin	J362 Pin	J363 Pin	Description	Performance	
				Input Signal Logic Levels (cont)		
					True	False
			21	Horizontal Readout Off	Drive terminal to between 0 V (ground) and +1.5 V. Terminal sources 5 mA or less into external circuit	Provide effective open circuit. Terminal must source 1 μA or less. Terminal open circuit voltage is +3 V to +5 V.
			22	Horizontal Readout in Amps		
				Output Signal Logic	**Indicates state of instrument operation. Either True or False, depending on setting of instrument controls.**	
					True	False
	6			Negative Step Polarity	Drive terminal to between 0 V (ground) and +1.5 V. Terminal can sink 50 mA or less from external load.	Provide effective open circuit. Terminal must sink or source 100 μA or less. Terminal open circuit voltage is the +12.5 V supply.
	11			Step Generator Amplitude, 10^{-1} Decade		Provide effective open circuit. Open circuit voltage is +3 V to +5 V. Terminal must source 1 μA or less. With external load returned to voltage between +5 V and +25 V, terminal sinks 0.1 μA or less.
	12			Step Generator Amplitude, 10^{-2} Decade		
	13			Step Generator Amplitude 2X Switch Position		
	14			Step Generator Amplitude 5X Switch Position		
	16			Step Generator, 10^{-4} or 10^{-8} Decade or Volts		
		2		Negative Collector Sweep Polarity		Provide effective open circuit. With external load returned to voltage of +25 V or less, terminal sinks 0.1 μA or less.
		3		15 V Range		
		4		75 V Range		
		5		350 V Range		

J360 Pin	J361 Pin	J362 Pin	J363 Pin	Description	Performance			
				Convertible Outputs	**Outputs indicate state of instrument operation. When converted to inputs, they control the indicated function.**			
				Vertical Logic Levels	Vertical outputs converted to inputs by True state at J363 pin 7 25 V maximum input voltage.			
					Outputs		Inputs	
					True	False	True	False
			1	Vertical 10^{-1} Decade Information	Drive terminal to between 0 V and 1.5 V. Terminal can sink 50 mA or less from external load.	Provide effective open circuit voltage. Terminal open circuit voltage is +3 V to +5 V. Terminal must source 1 µA or less. If external circuit load is returned to a voltage between +5 V and +25 V, terminal sinks 0.1 µA or less.	Drive terminal to between 0 V and +1.5 V. Terminal sources 5 mA or less into external circuit.	Provide effective open circuit. Terminal must source 1 µA or less. Terminal open circuit voltage is +3 V to +5 V.
			2	Vertical 10^{-2} Decade Information				
			3	Vertical 10^{-4} Decade Information				
			4	Vertical 2X Switch Position or 50 mV/DIV Deflection Factor		Provide effective open circuit voltage. Open circuit voltage. Open circuit voltage of the +12.5 V supply. Terminal must sink or source 100 µA or less.	Drive terminal to between 0 V and +1.5 V. Terminal sources 50 mA or less into external circuit.	Provide effective open circuit. Open circuit voltage is the +12.5 V supply. Terminal must source 100 µA or less.
			5	Vertical 5X Switch Position or 125 mV/DIV DIV Deflection Factor.				

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J360 Pin	J361 Pin	J362 Pin	J363 Pin	Description	Performance			
				Convertibles (Cont)				
				Vertical Logic Levels				
					Outputs		Inputs	
					True	False	True	False
			13	Vertical 10^{-3} Leakage		Provide effective open circuit. Terminal open circuit voltage of +3 V to +5 V. Terminal must source 1 μA or less. If external circuit is returned to a voltage between +5 V and +25 V, terminal sinks 0.1 μA or less.	Drive terminal to between 0 V and +1.5 V. Terminal sources 5 mA or less into external circuit.	Provide effective open circuit. Terminal must source 1 μA or less. Terminal open circuit voltage is +3 V to +5 V.
				Horizontal Logic Levels	Horizontal outputs converted to inputs by True state at J363, Pin 20.			
					Outputs		Inputs	
					True	False	True	False
			14	Horizontal 10^{-1} Decade Information	Drive terminal to between 0 V and +1.5 V. Terminal can sink 50 mA or less from external load.	Provide effective open circuit voltage. Terminal open circuit voltage is +3 V to +5 V. Terminal must source 1 μA or less. If external circuit load is returned to a voltage between +5 V and +25 V, terminal sinks 0.1 μA or less.	Drive terminal to between 0 V and +1.5 V. Terminal sources 5 mA or less into external circuit.	Provide effective open circuit. Terminal must source 1 μA or less. Terminal open circuit voltage is +3 V to +5 V.
			15	Horizontal 10^{-2} Decade Information				
			16	Horizontal Decade Negative Exponent Control				

J360 Pin	J361 Pin	J362 Pin	J363 Pin	Description	Performance			
				Convertibles (Cont)				
				Horizontal Logic Levels				
					Outputs		Inputs	
					True	False	True	False
			17	Horizontal 2X Switch Position or 200 mV/DIV Deflection Factor		Provide effective open circuit voltage. Open circuit voltage is the +12.5 V. Terminal must sink or source 100 μA or less.	Drive terminal to between 0 V and +1.5 V. Terminal sources 50 mA or less into external circuit.	Provide effective open circuit. Open circuit voltage is the +12.5 V supply. Terminal must source 100 μA or less.
			18	Horizontal 5X Switch Position or 50 mV/DIV Deflection Factor				
				Power Supply Outputs	**Recommended maximum rate of load current changes: 1 mA/μs**			
18				+5 V	Maximum load 100 mA			
19				−75 V	Maximum load 15 mA			
20				+100 V	Maximum load 25 mA			
21				−12.5 V	Maximum load 100 mA			
22				+12.5 V	Maximum load 500 mA			
23				Ground				
	1			AC Power				
				Collector Supplies				
6				Safety Interlock Bypass	Normally open-ended. Can be wired for bypass on 75 V and 350 V ranges. +12.5 V present when bypassed range is selected.			
7				Safety Interlock	Open circuit on 15 V range. −12.5 V on all other ranges. If grounded, activates collector power supply.			
24				Looping Compensation	Capacitive coupled to Collector Supply output.			
15, 16 32				Collector Supply Out	15 V Range: 10 A continuous peak current. 75 V Range: 2 A continuous peak current. 350 V Range: 0.5 A continuous peak current. 1500 V Range: 100 mA continuous peak current.			
13, 28, 29				Collector Current Return	Returns for all collector currents as well as 15 V AC and 75 V AC Power.			

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J360 Pin	J361 Pin	J362 Pin	J363 Pin	Description	Performance
				Collector Supplies (Cont)	
7				Return for 350 V AC Power	
18, 15, 16				15 V, 75 V, 350 V AC Power Out	Selected by front panel switch. Same current limits as Collector Supply output on J1, Pins 15, 16, 32.
				Step Generator	
1				Step Generator Output	
	7			Plus or Minus 1/2 V/ Step Output	Plus or minus half volt per step regardless of AMPLITUDE switch setting. Series resistance of 470 Ω.
	8			Pulse Output	300 μs or 80 μs pulses, +12 V amplitude, in pulsed mode only. Series resistance of 470 Ω.
				Sensing	
5				Switched Ground	Ground in NORM and DC Modes; open in LEAKAGE.
8				Looping Compensation	Sensing into Vertical Amplifier.
9, 10, 26					Current in
11, 12 27					Current out
17				Base Volts	
25				Emitter Volts	
31				Collector Volts	
				Display Amplifier External Inputs	
			11		Differential: Negative vertical input. Activated by True state at J363, Pin 6.
			12		Positive vertical input. Activated by True state at J363, Pin 6.
			23		Negative horizontal input. Activated by True state at J363, Pin 19.
			24		Positive horizontal input. Activated by True state at J363, Pin 19.

J360 Pin	J361 Pin	J362 Pin	J363 Pin	Description	Performance
				Input Requirements (Cont)	
				Maximum Safe Overload	Equivalent of plus or minus 12 divisions of deflection, depending on which amplifier sensitivity is selected by logic switching.
				Input Offset Current	1 nA or less
				Noise	300 μV or less or 100 pA or less.
				Response Time	20 μs or less to settle within 2% of final value with step input.
				Common Mode Rejection	At least 100:1 at 1 kHz or less.
				Maximum Common Mode Input	5 times the deflection factor.
				Input Impedance	At least 100 MΩ paralleled by approximately 70 pF.
				Deflection Factors	
				Vertical	25 mV/division normal; 50 mV/division with True Input at J363, Pin 4; 125 mV/division with True Input at J363, Pin 5.
				Horizontal	100 mV/division normal; 200 mV/division with True Input at J363, Pin 17; 50 mV/division with True Input at J363, Pin 18.

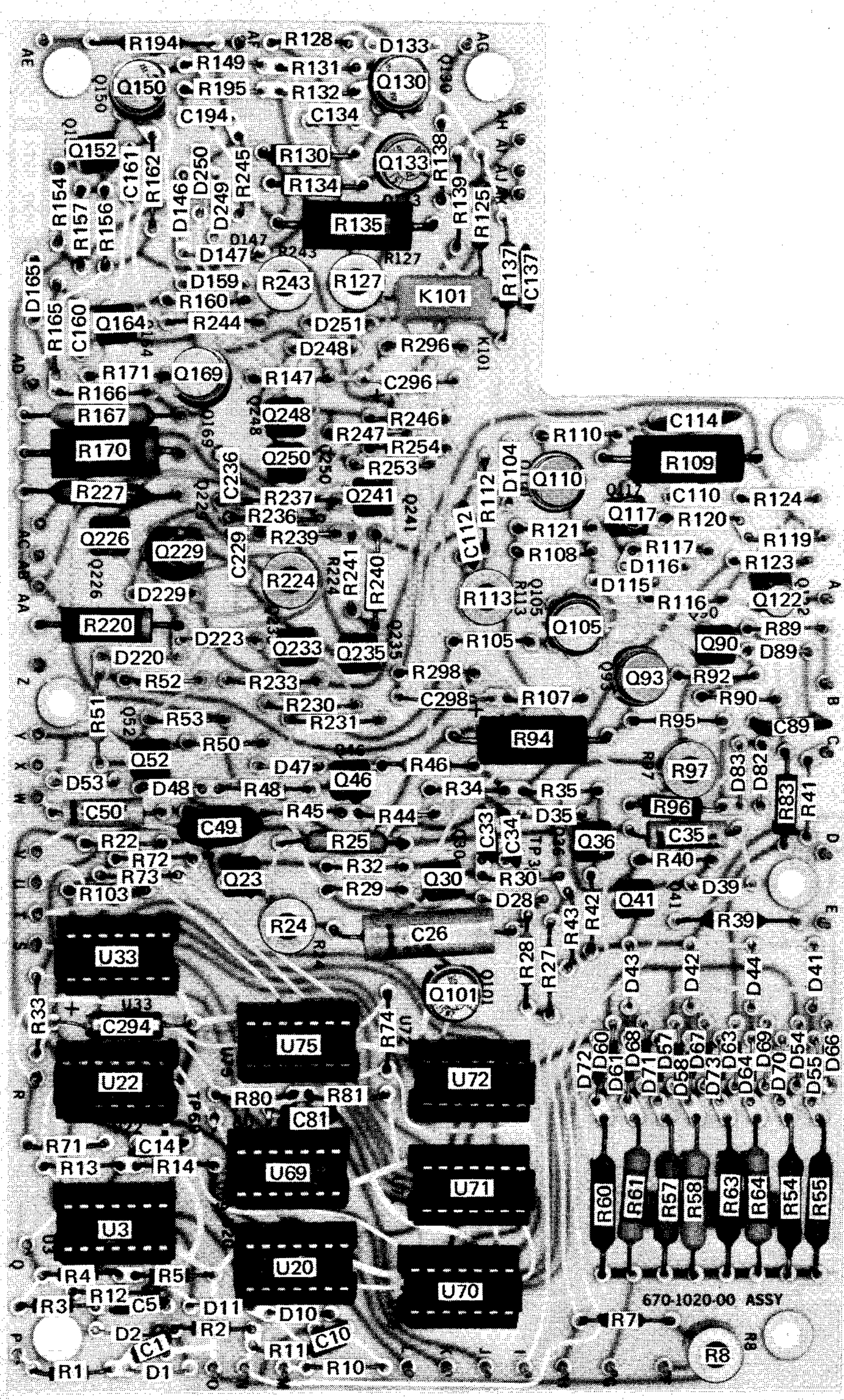

Fig. 4-6. Component locations on Step Gen circuit board.

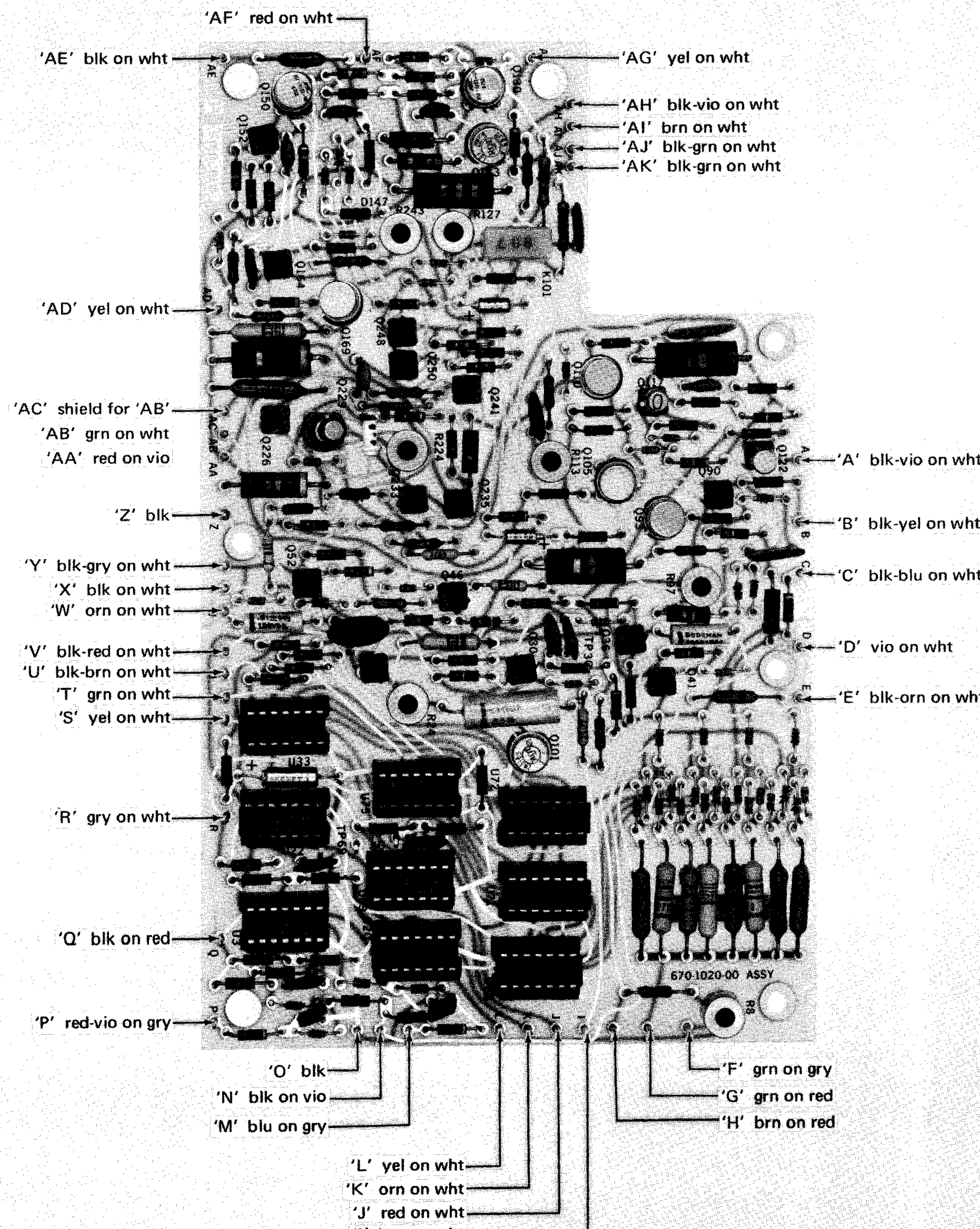

Fig. 4-7. Wiring colors code on Step Gen circuit board.

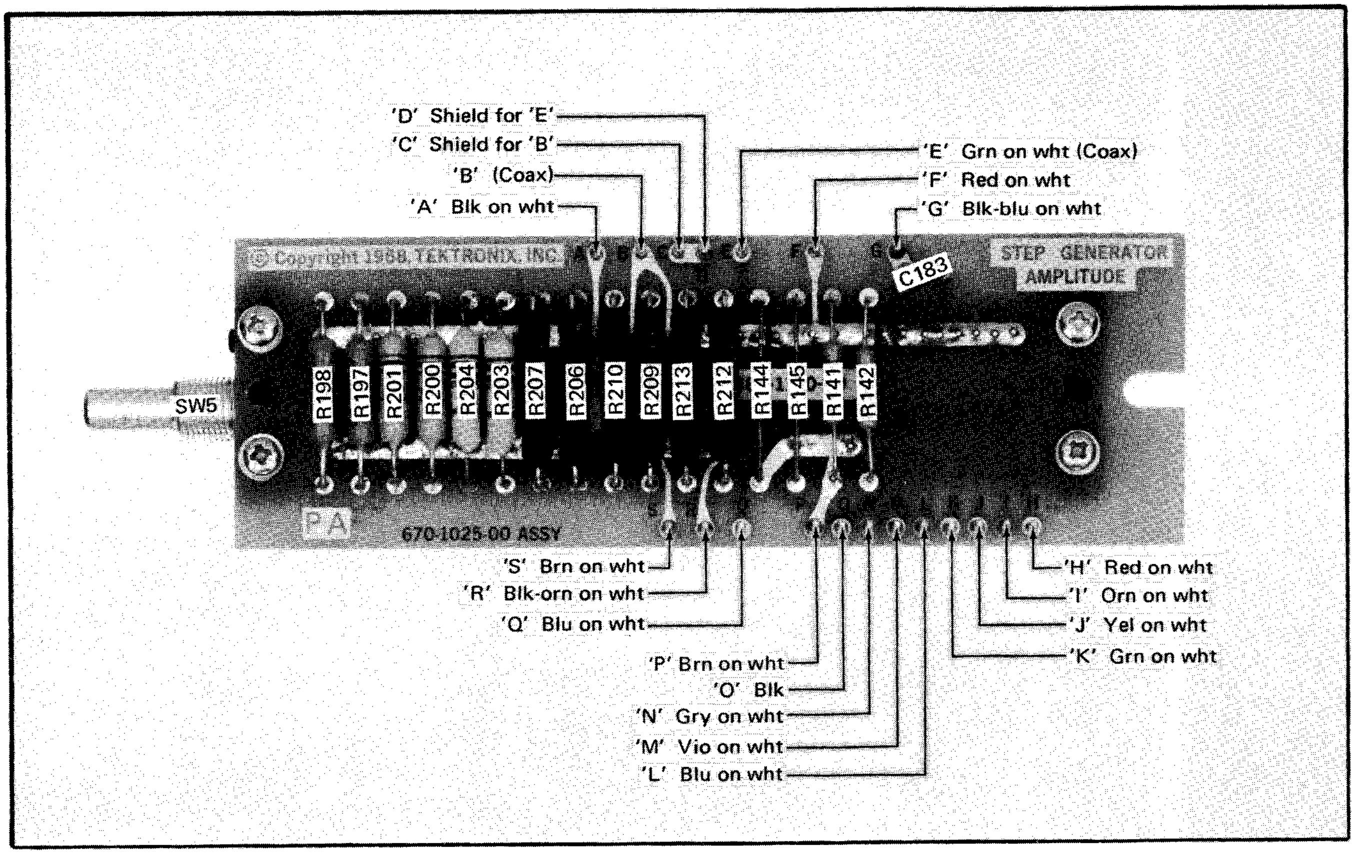

Fig. 4-8. Component locations and wiring color codes on Step Generator Amplitude circuit board.

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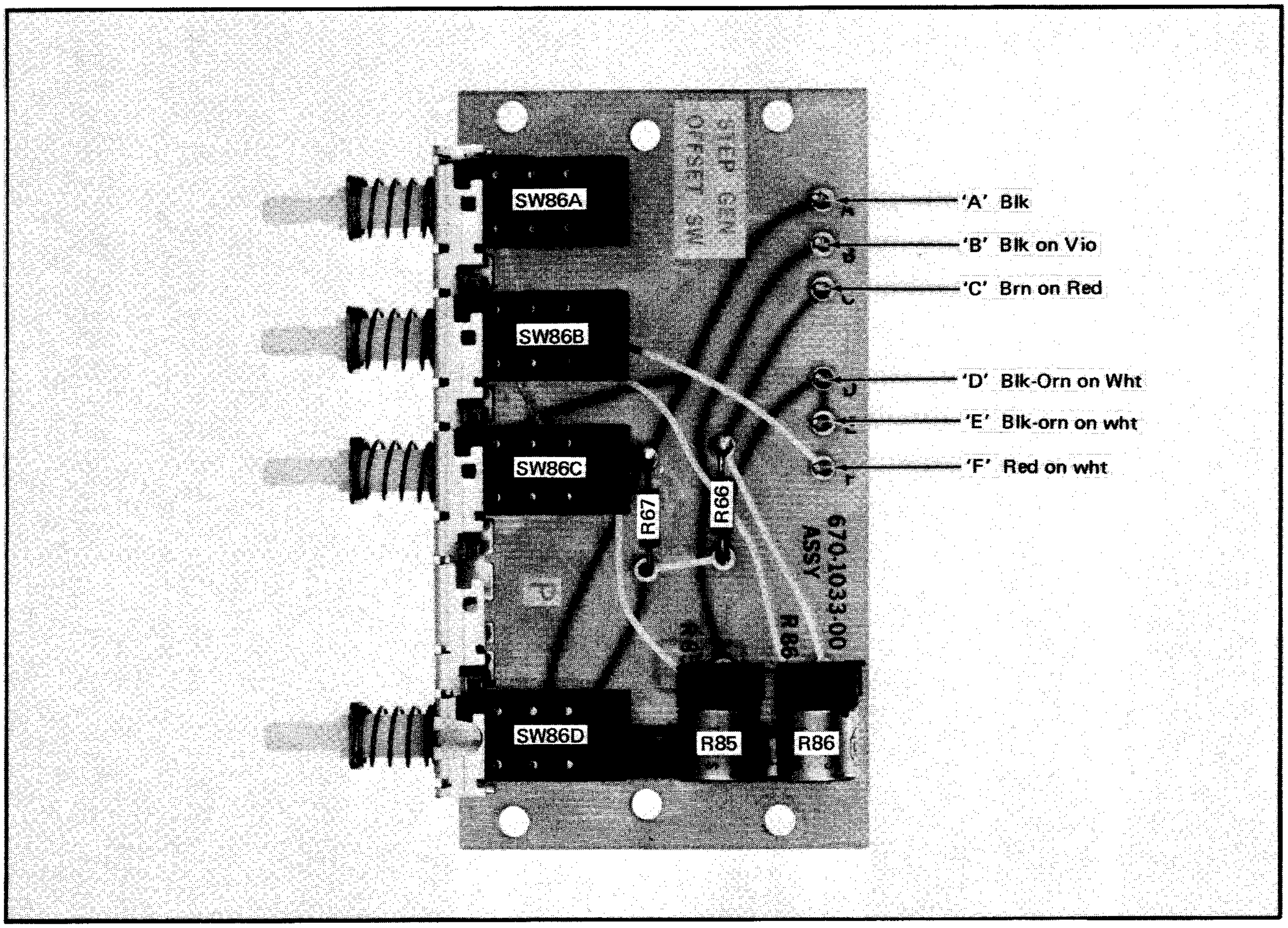

Fig. 4-9. Component locations and wiring color codes on Step Gen Offset circuit board.

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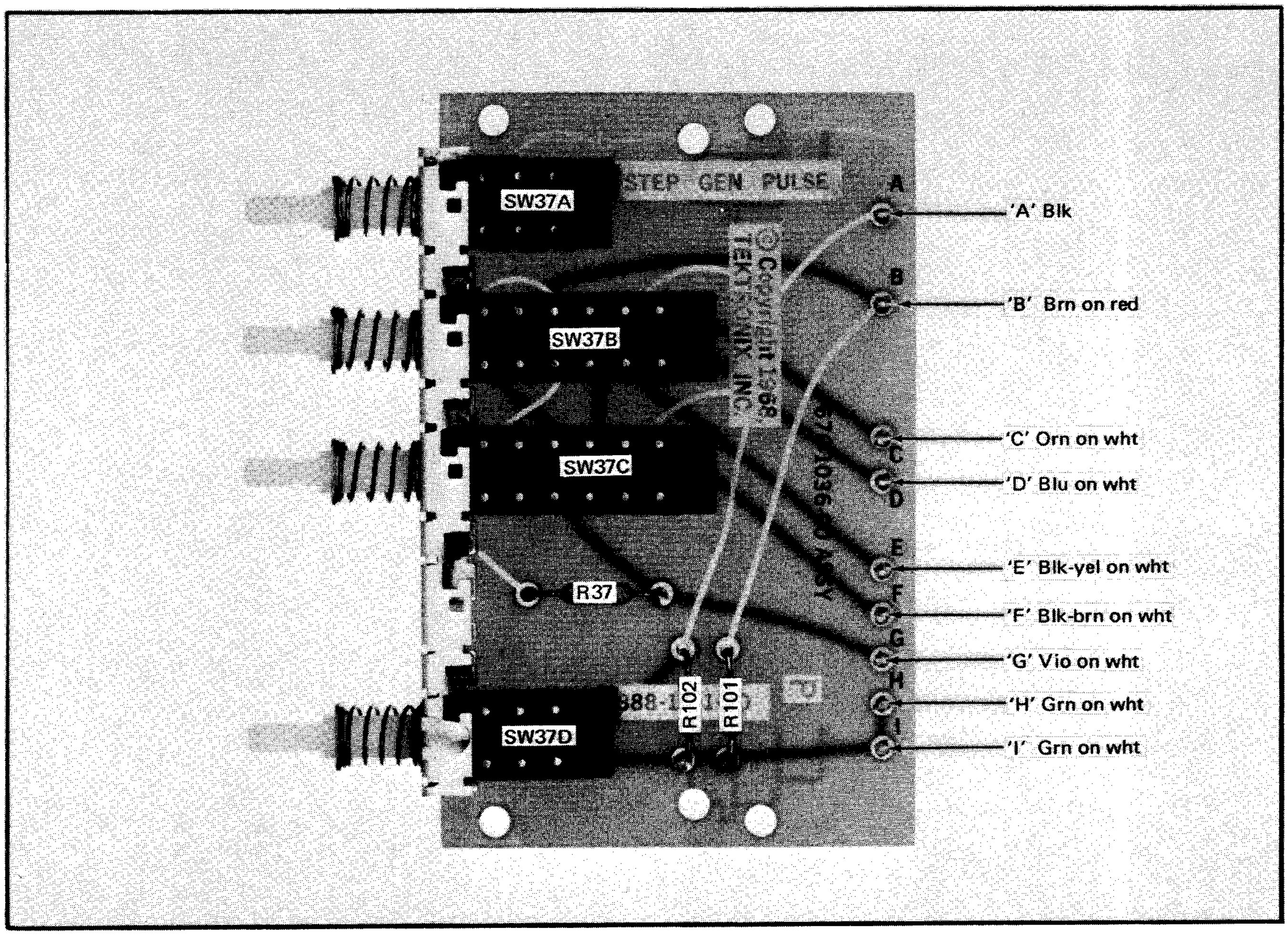

Fig. 4-10. Component locations and wiring color codes on Step Gen Pulse circuit board.

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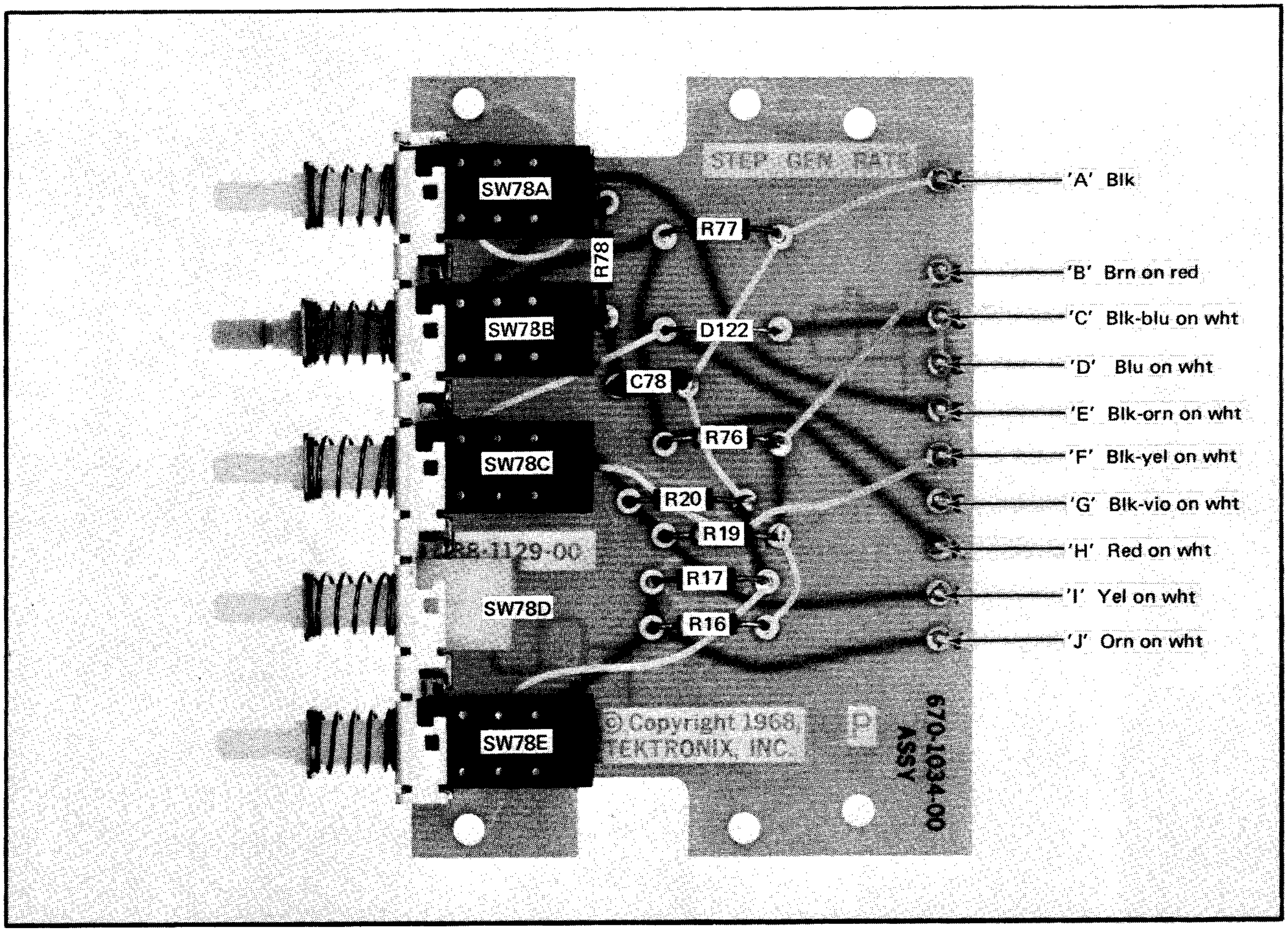

Fig. 4-11. Component locations and wiring color codes on Step Gen Rate circuit board.

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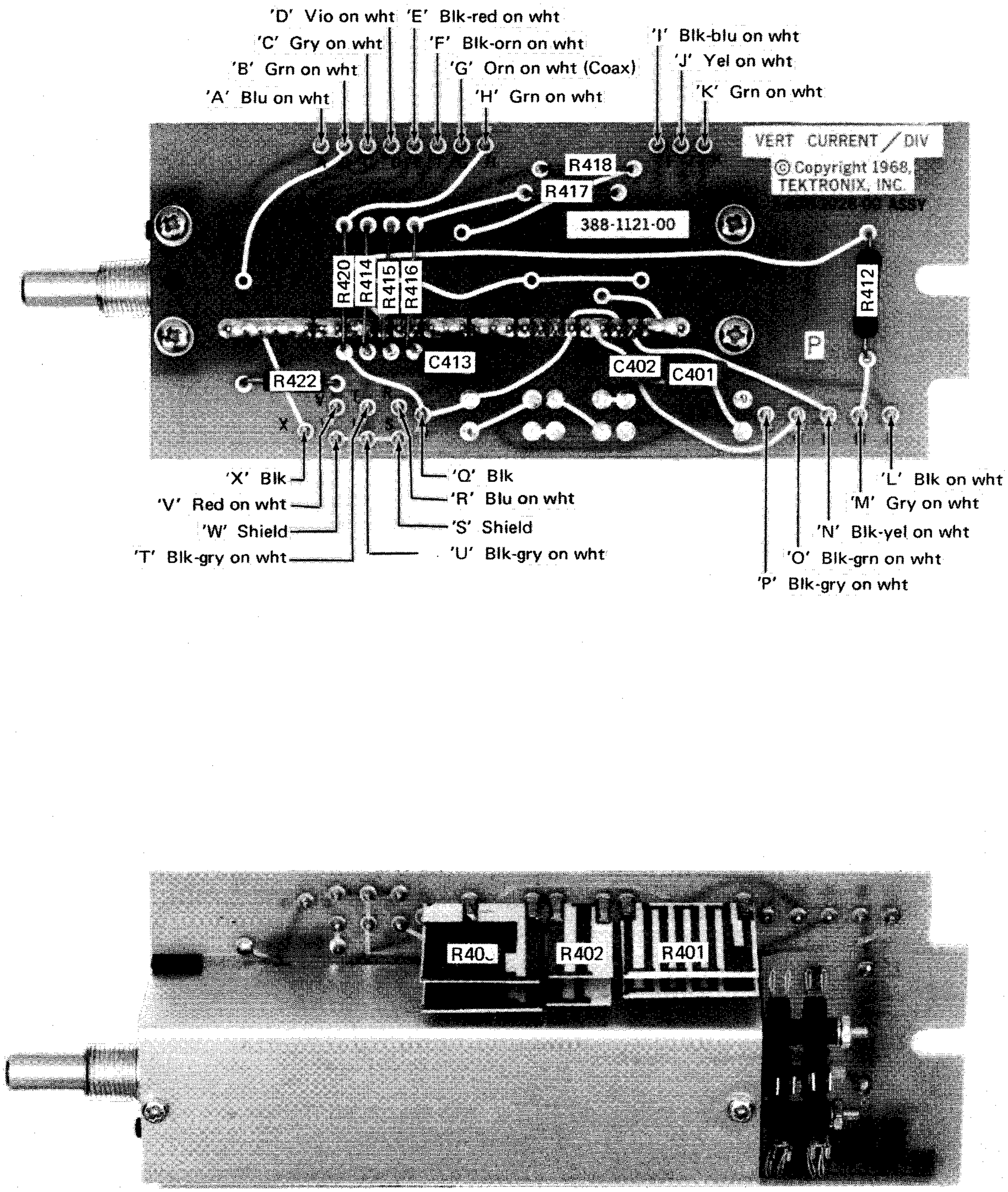

Fig. 4-12. Component location and wiring color codes on Vert Current/Div circuit board.

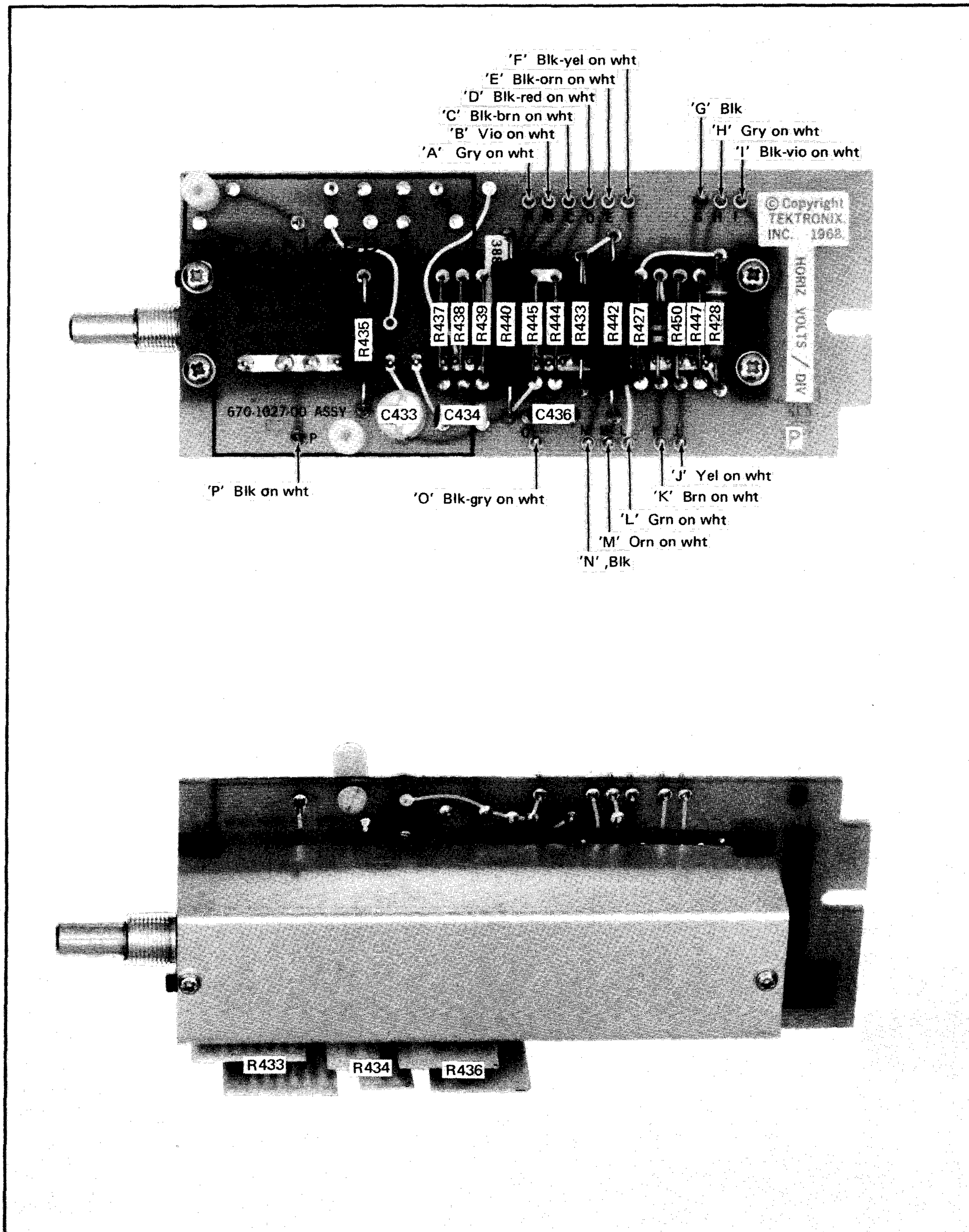

Fig. 4-13. Component locations and wiring color codes on Horiz Volts/Div circuit board.

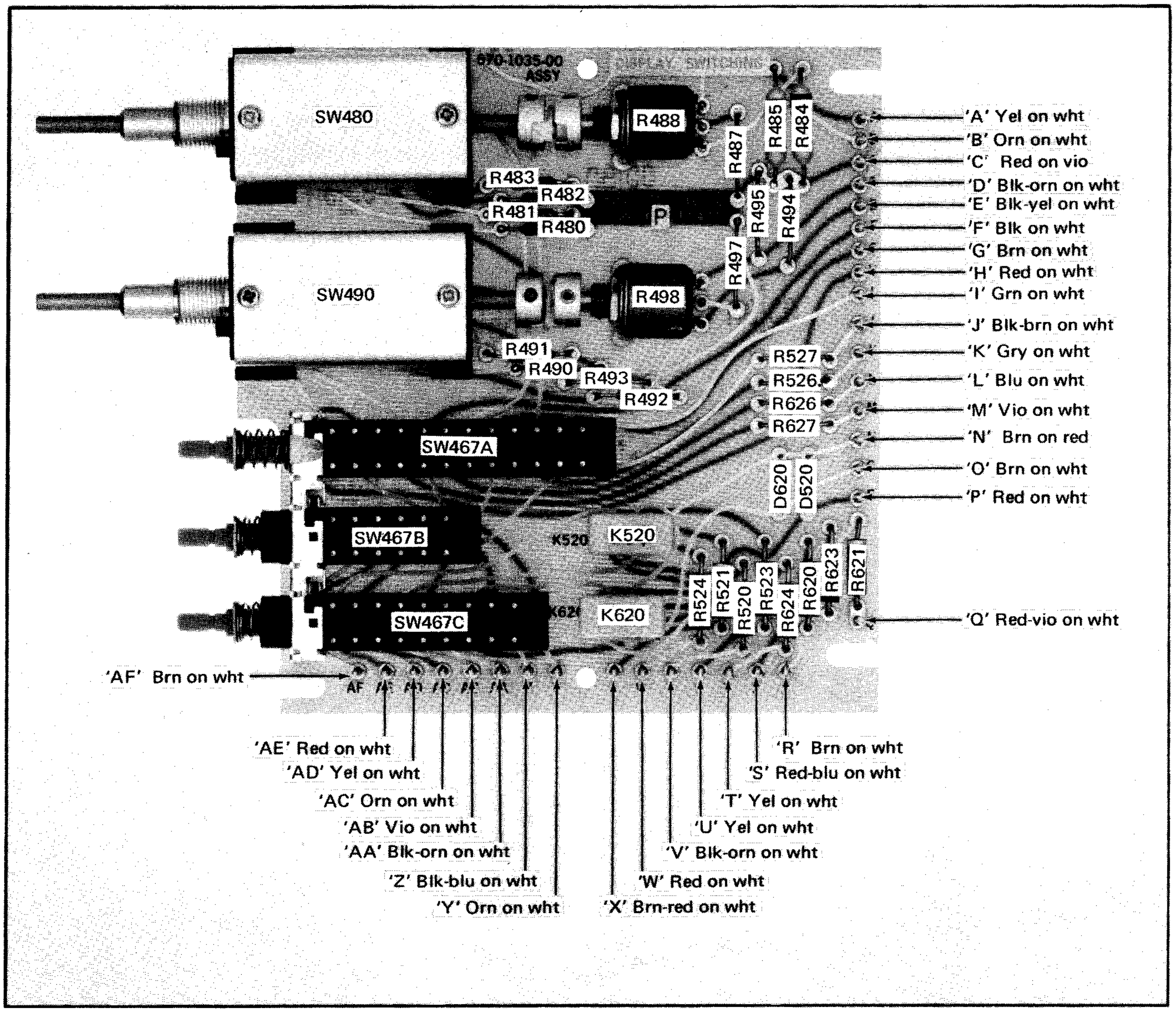

Fig. 4-14. Component location and wiring color codes on Display Switching circuit board.

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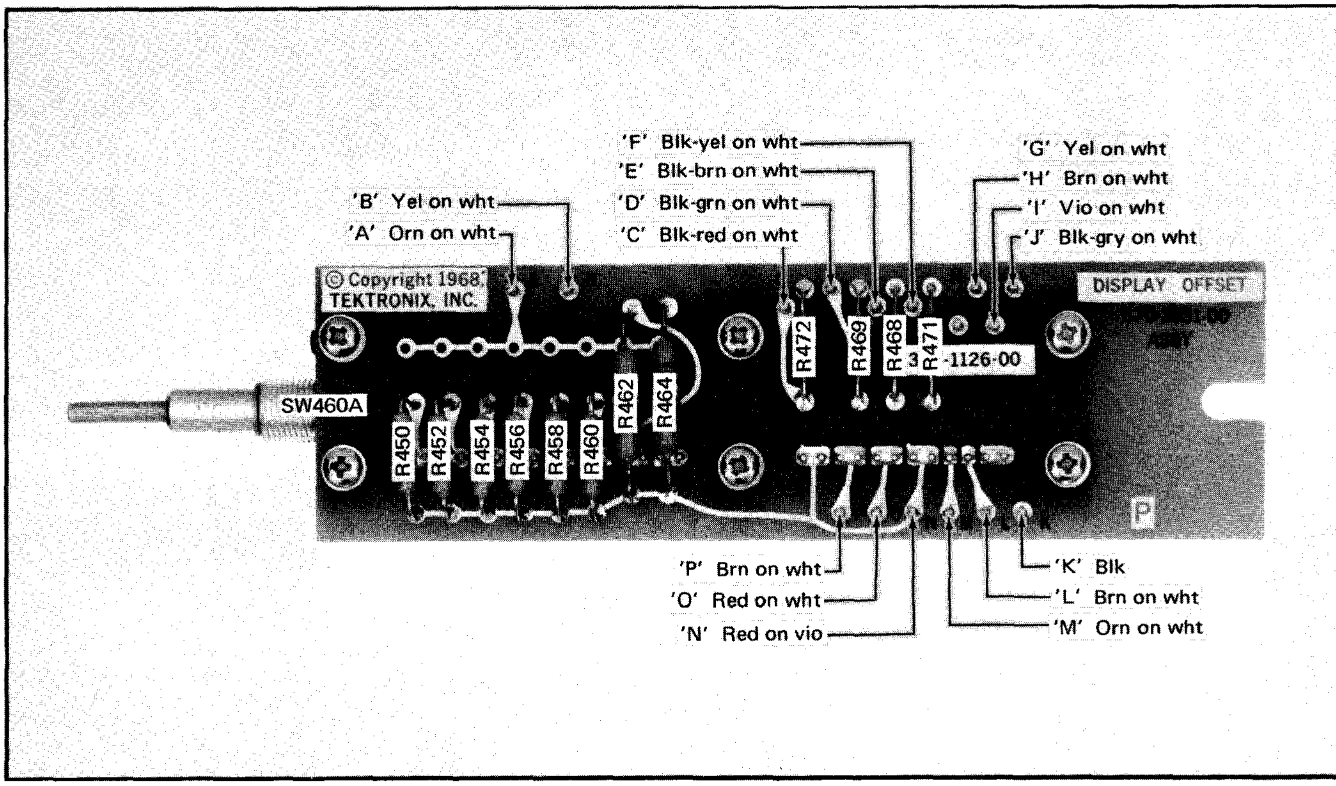

Fig. 4-15. Component locations and wiring color codes on Display Offset circuit board.

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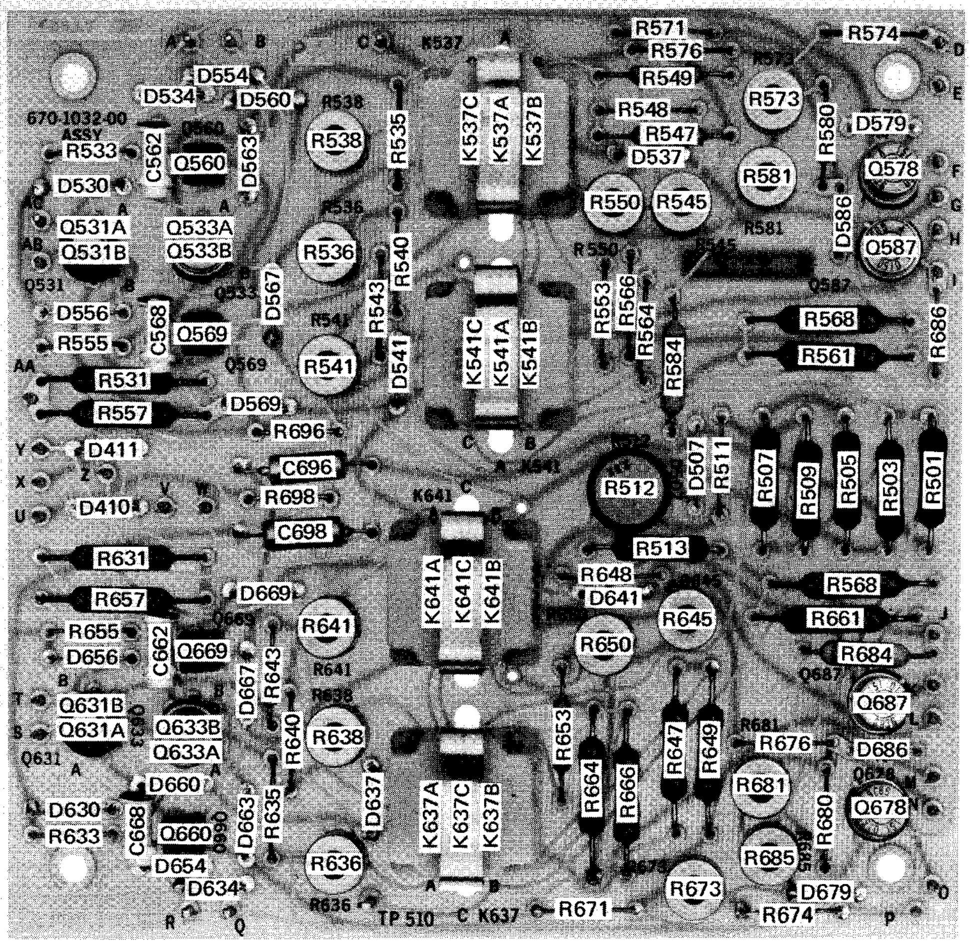

Fig. 4-16. Component locations on Display Amp circuit board.

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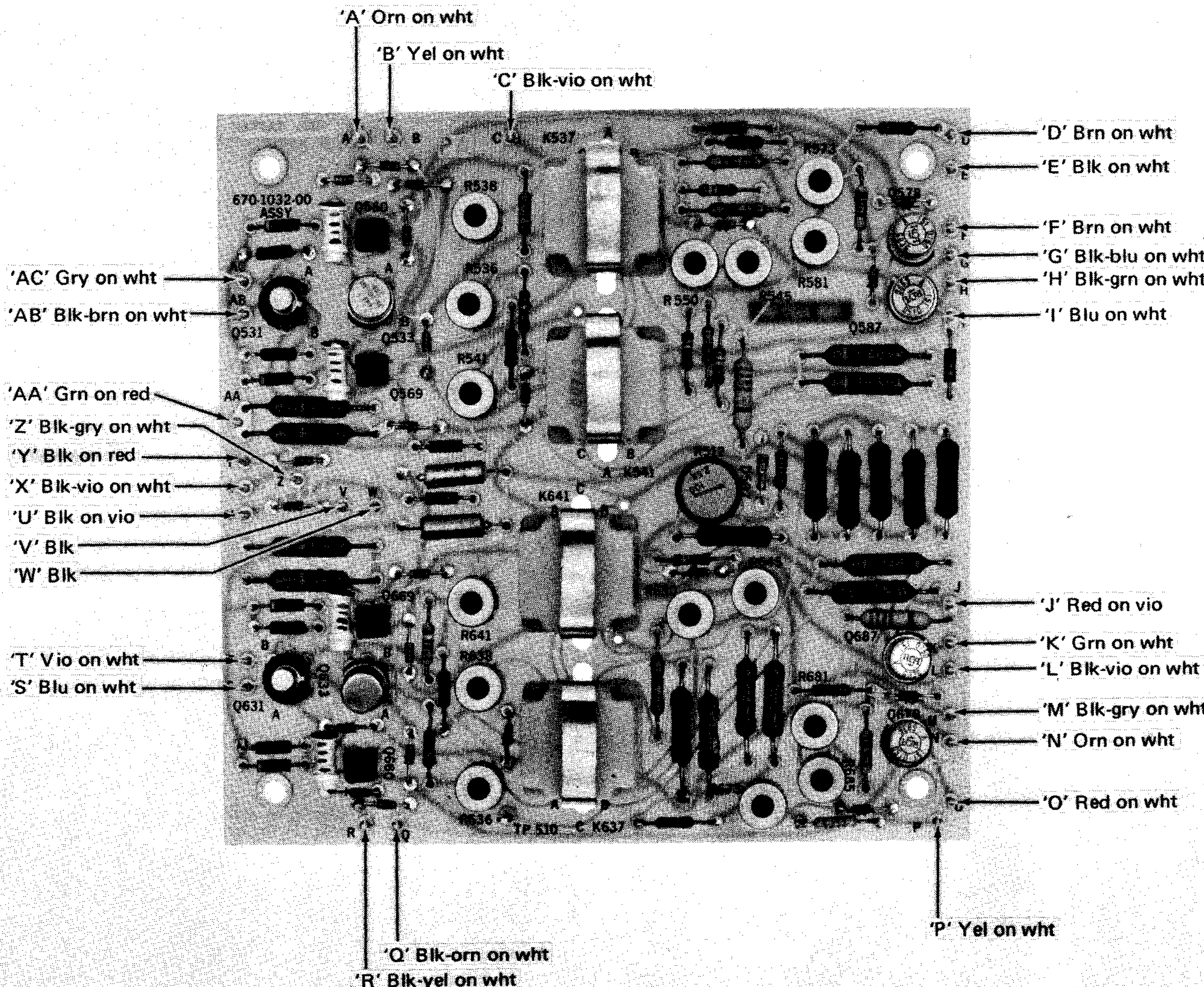

Fig. 4-17. Wiring color codes on Display Amp circuit board.

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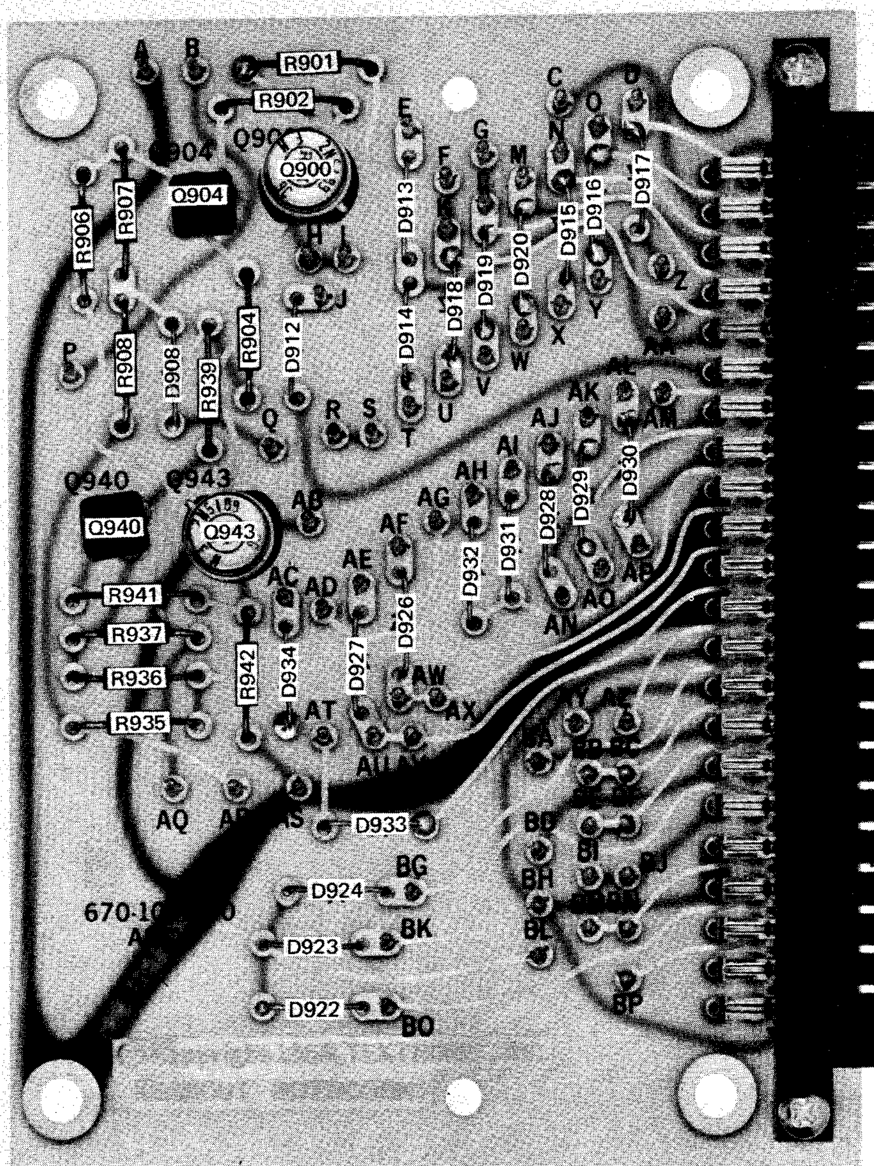

Fig. 4-18. Component locations on Readout Interconn circuit board.

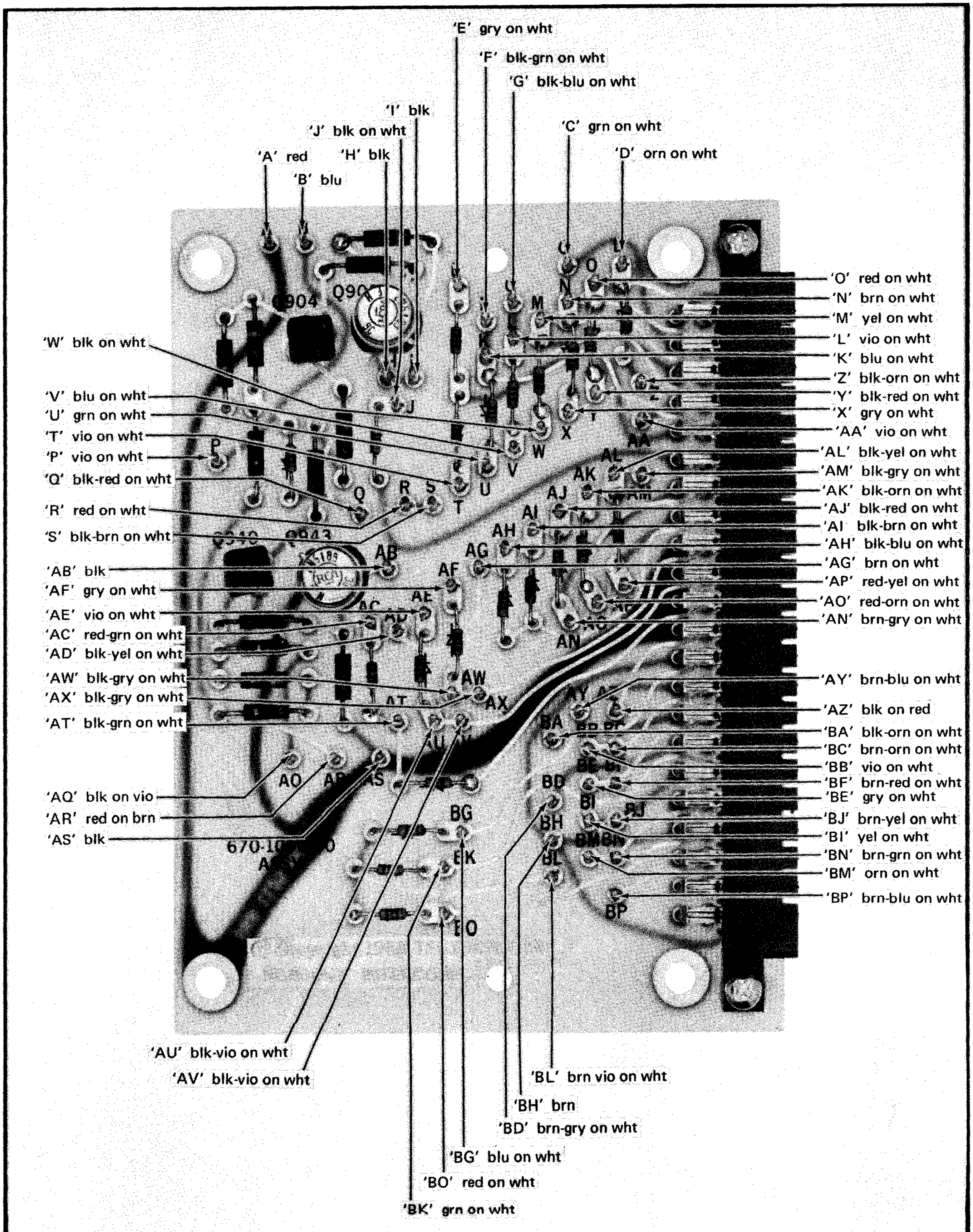

Fig. 4-19. Wiring color codes on Readout Interconn circuit board.

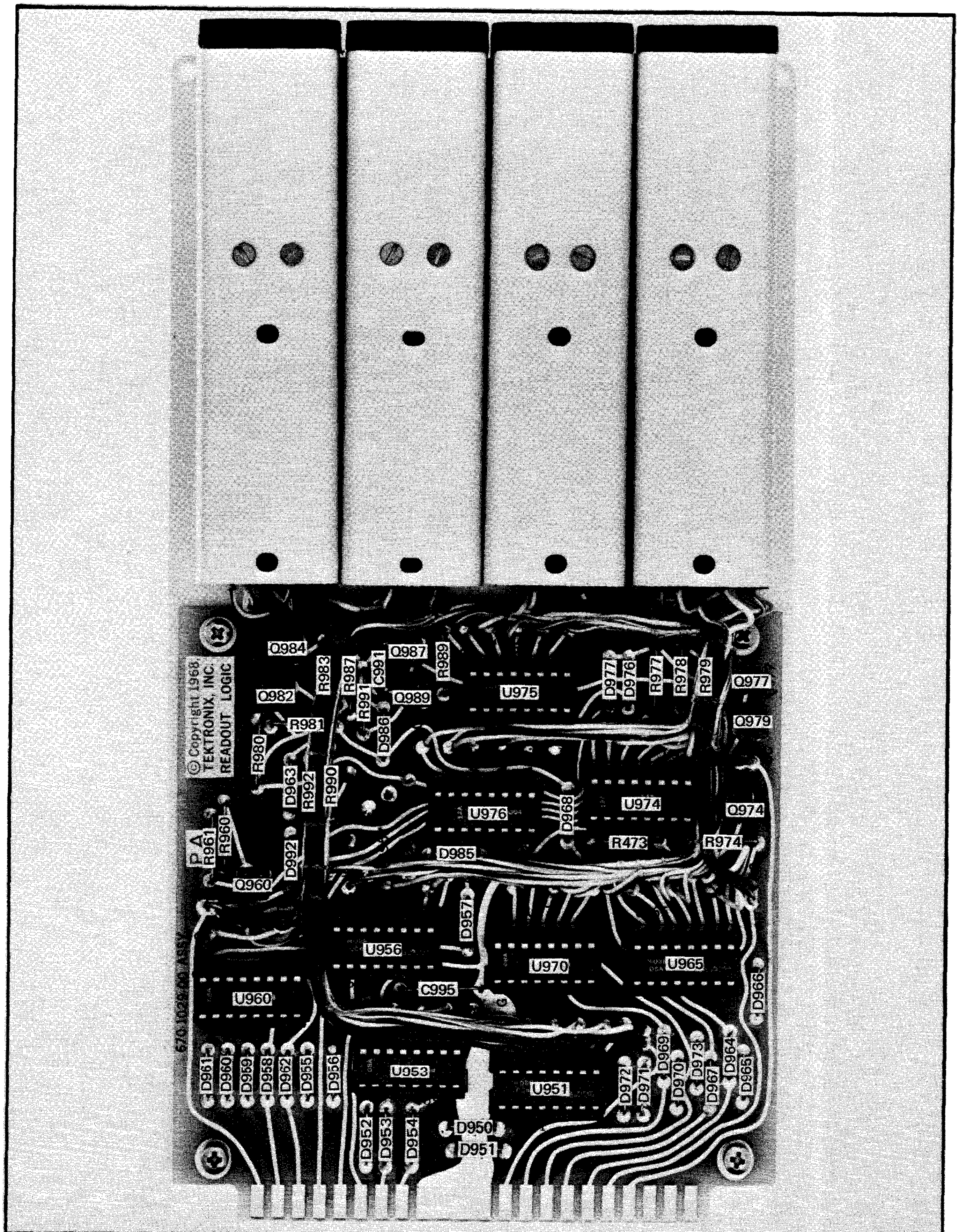

Fig. 4-20. Component locations on Readout Logic circuit board.

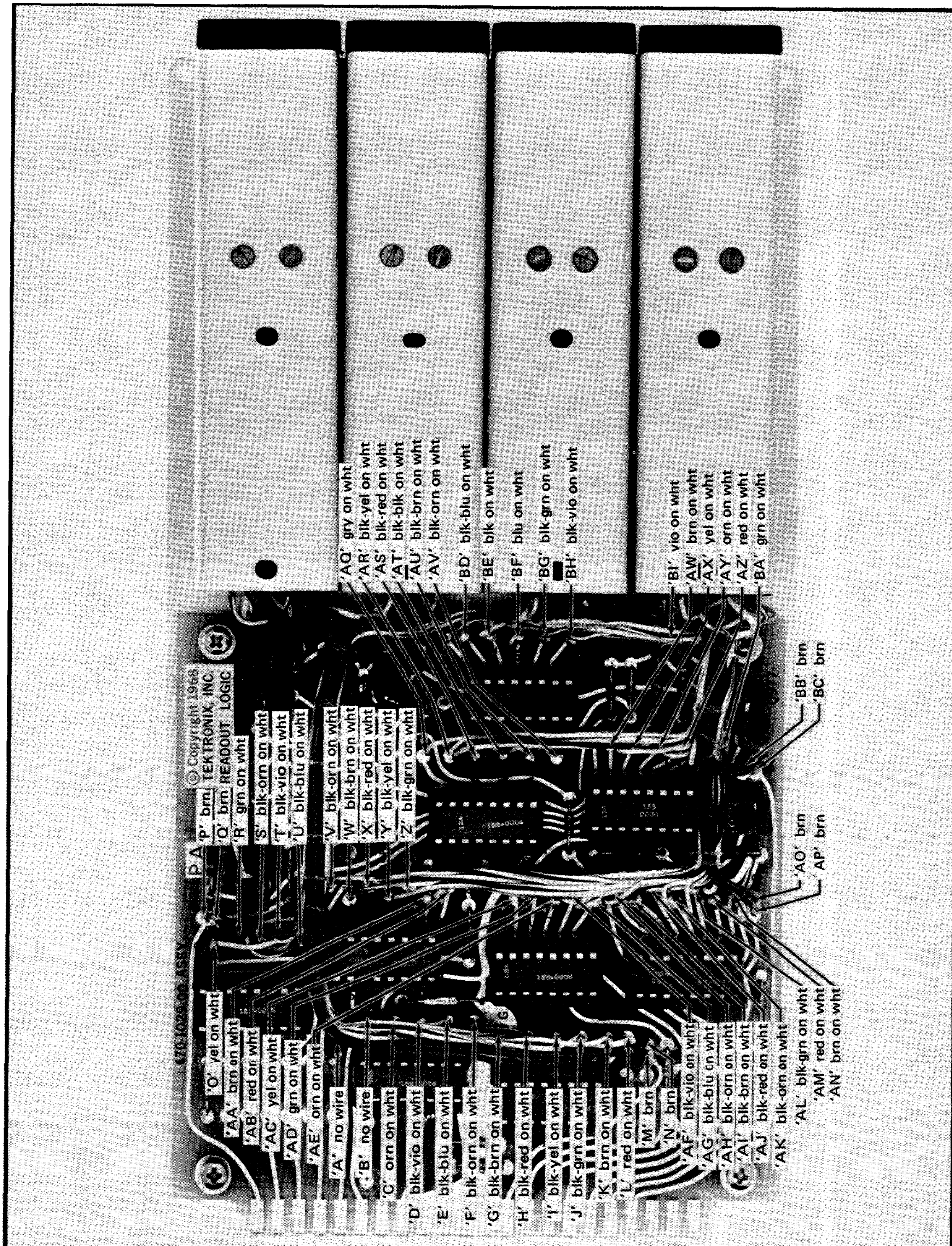

Fig. 4-21. Wiring color codes on Readout logic circuit board.

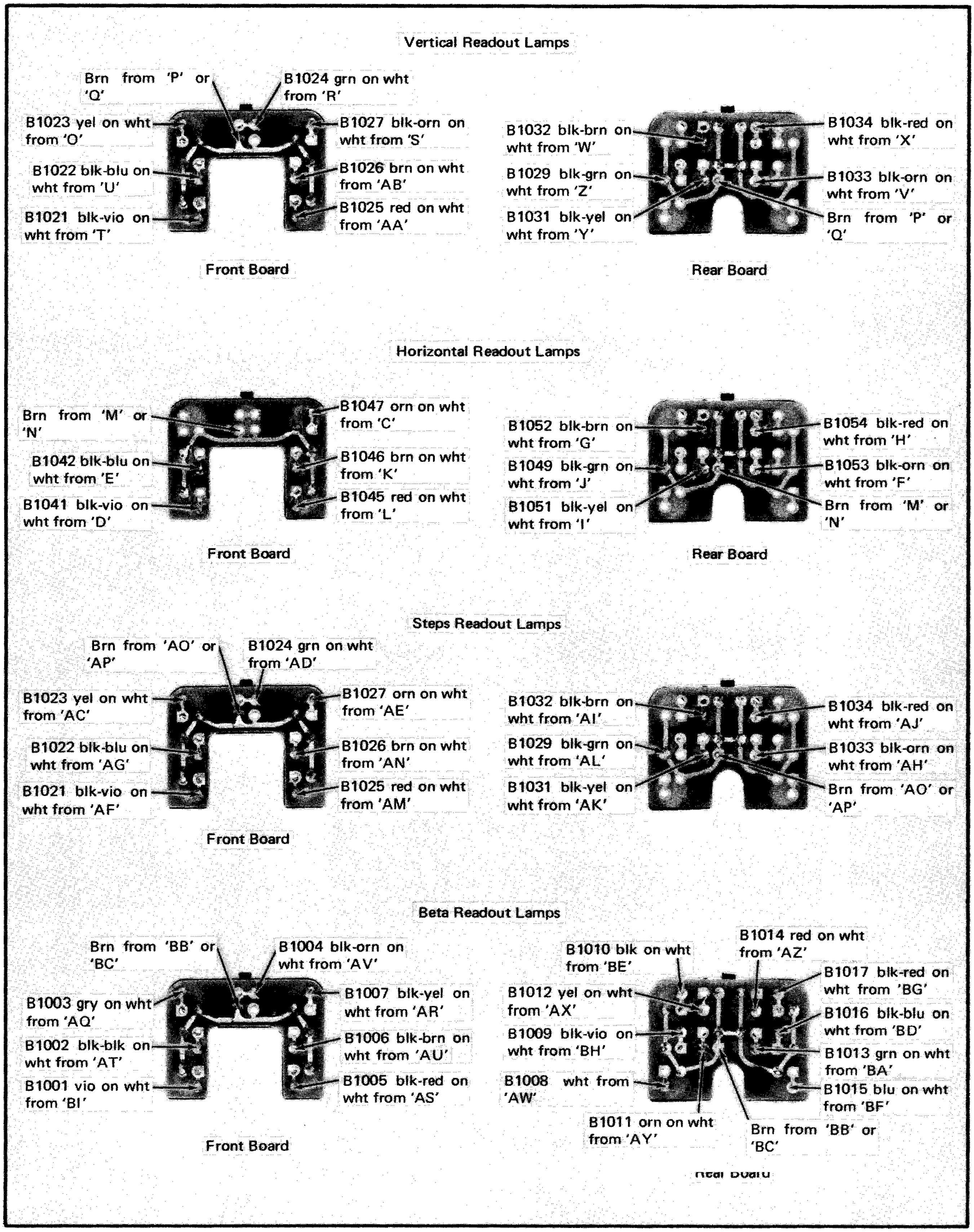

Fig. 4-22. Component locations and wiring color codes on Readout Lamp circuit boards.

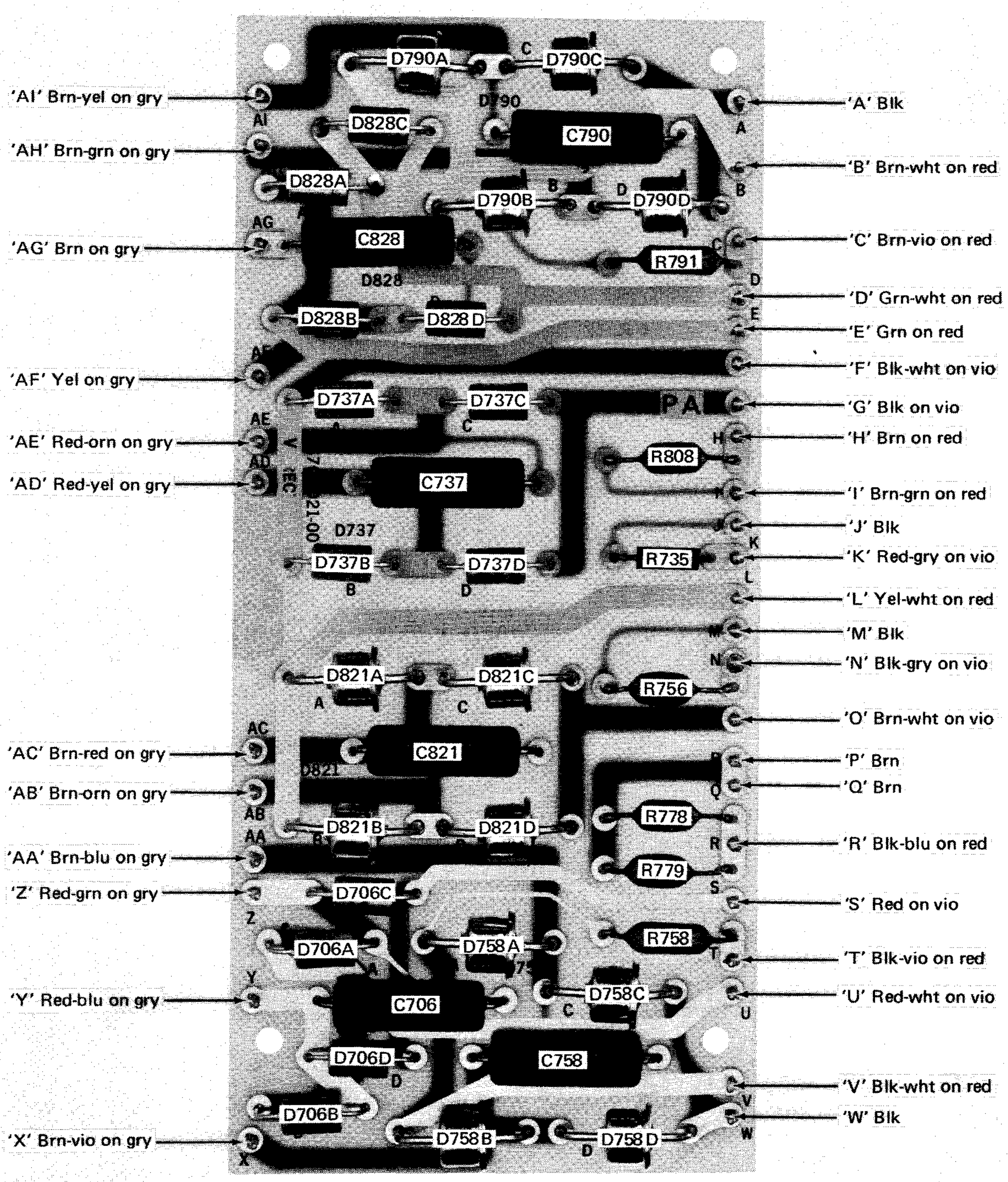

Fig. 4-23. Component locations and wiring color codes on L. V. Rectifiers circuit board.

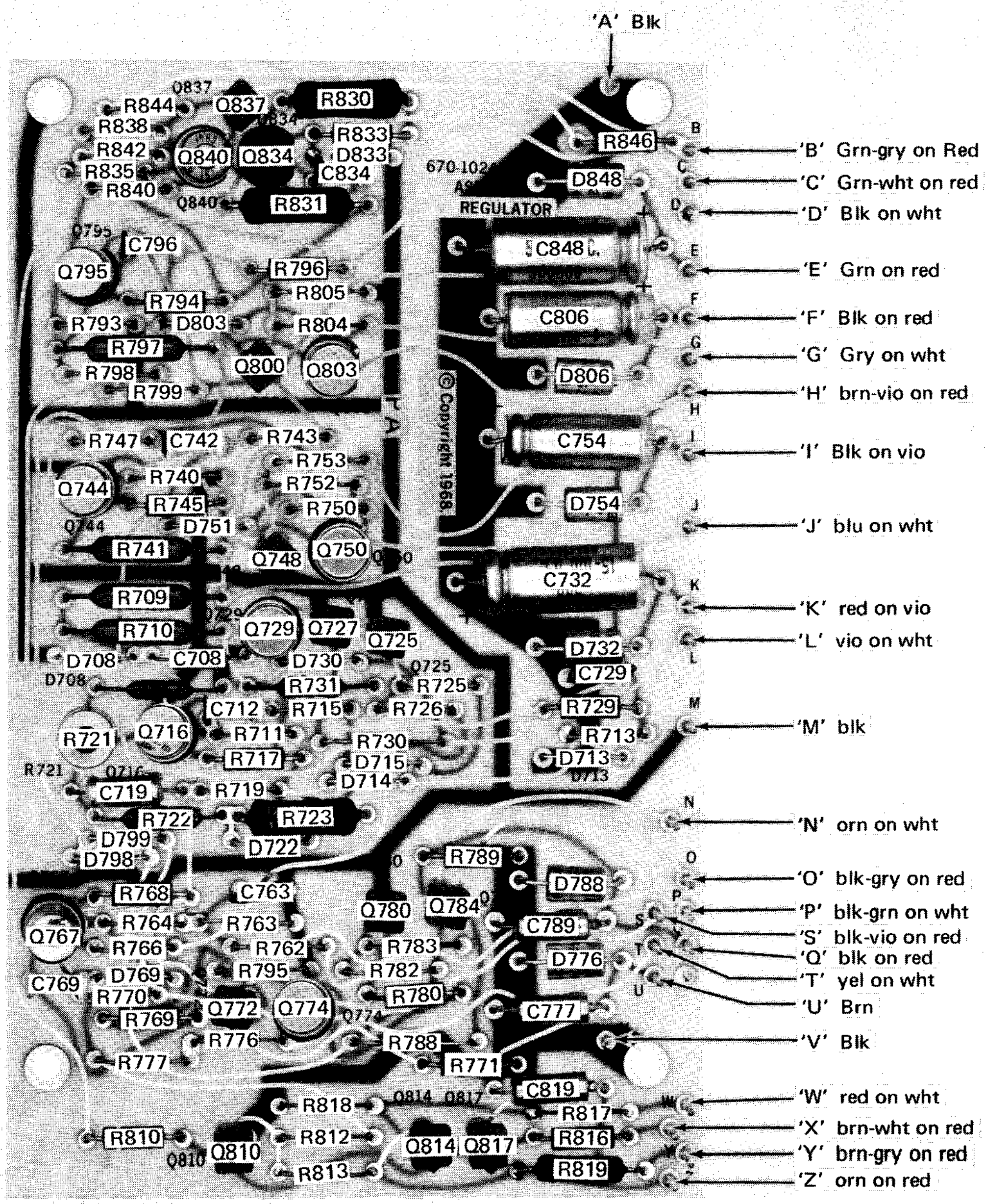

Fig. 4-24. Component locations and wiring color codes on L. V. Regulator circuit board.

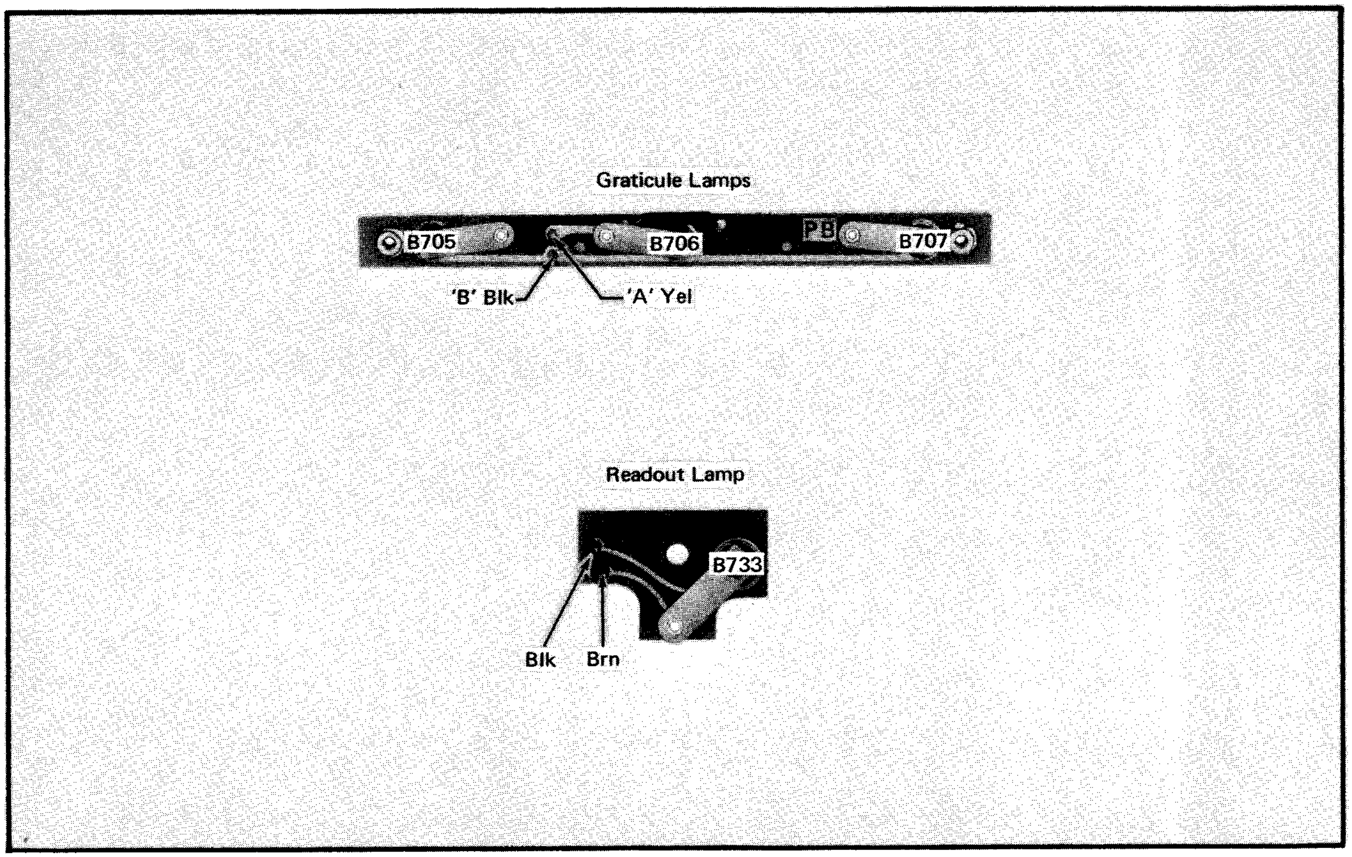

Fig. 4-25. Component locations and wiring color codes for Grat. Lamps and Readout Lamp circuit boards.

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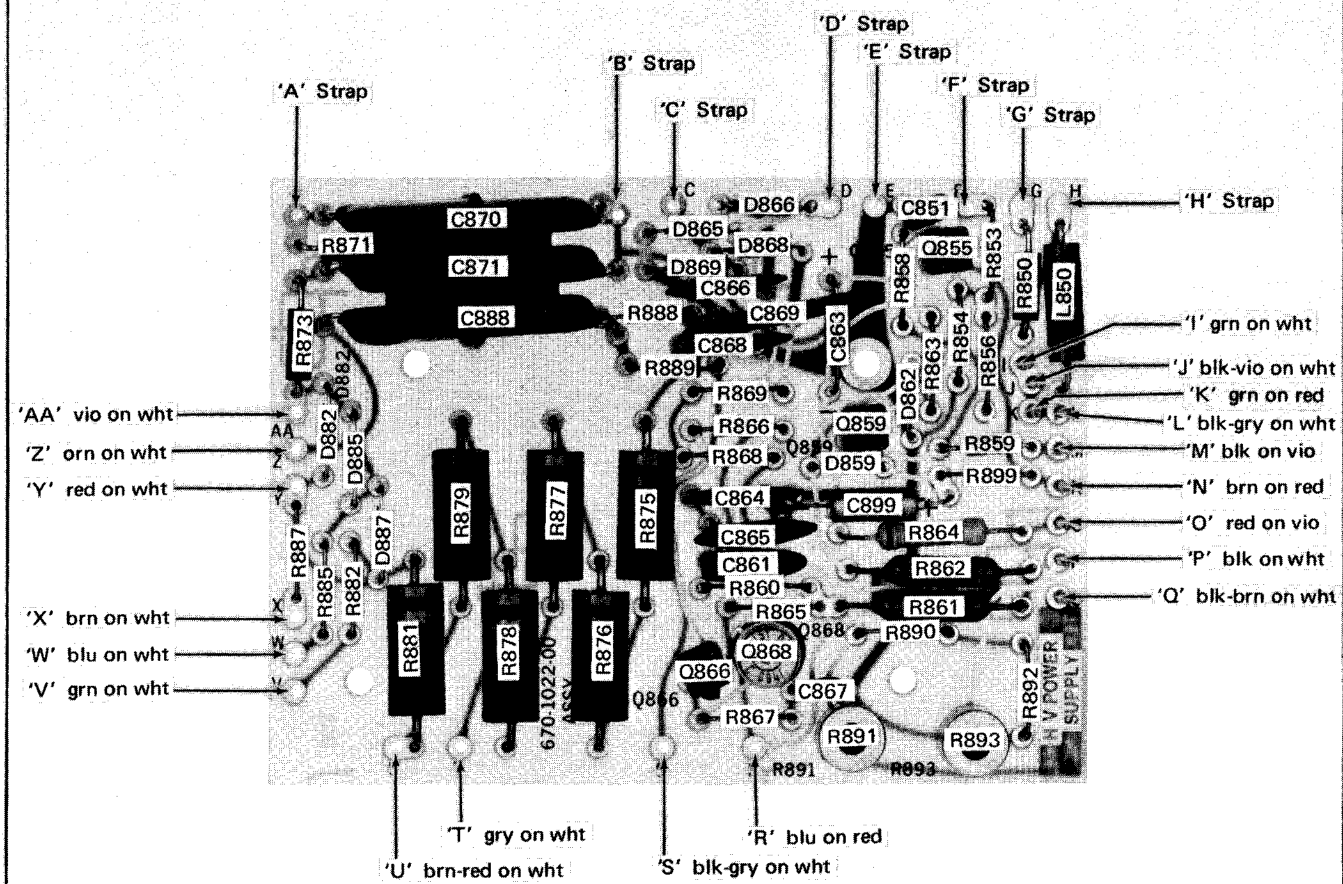

Fig. 4-26. Component locations and wiring color codes on H. V. Power Supply circuit board.

NOTES

SECTION 5
PERFORMANCE CHECK/CALIBRATION

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

General

This combined performance check and calibration procedure provides both a method of comparing the instrument to performance requirements given in the Specification section and a method of adjusting any instrument characteristics which do not meet this specification. A performance check and calibration record is included at the beginning of the procedure for use as a check list to verify correct calibration and operation of the Type 576 or as a guide for quick calibration by an experienced calibrator.

The Type 576 should be checked and recalibrated after each 1000 hours of operation or at least once every 6 months to ensure that it is operating properly. In addition, portions of the instrument will require recalibration if components are replaced or other electrical repairs are made.

The step by step instructions in this procedure furnish an orderly approach to the isolation of possible malfunctions and thus serve as an aid in troubleshooting the instrument. Any maintenance that is known to be needed should be performed before starting the calibration procedure. If any troubles become apparent during calibration, these also should be corrected before proceeding. Repair and servicing information is given in the Maintenance section.

Equipment Required

The following (or equivalent) items of equipment are required for a complete calibration of the Type 576. The equipment is illustrated in Fig. 5-1. If substitute equipment is used, its accuracy must exceed the tolerances to be measured by at least 4 times in order to make an accurate measurement. If the tolerance to be measured is less than 1%, the accuracy of the test equipment must exceed the tolerance by at least 10 times.

1. Test oscilloscope, Tektronix Type 547 with Type W Differential Comparator Plug-In Unit. Minimum alternate requirements: Bandwidth from DC to 100 kHz; sweep rates from 0.2 ms/cm to 5 μs/cm; vertical deflection factors from 1 mV/cm to 500 mV/cm; accuracy of voltage measurement within 3%; internal comparison voltage provided with accuracy of 0.5%; AC and DC vertical input coupling; internal triggering.

2. Type 576 Calibration Fixture (Tektronix Part No. 067-0599-00).

3. Variable autotransformer (e.g., General Radio, Variac Type W10MT3W). Minimum requirements: Output voltage variable from 90 to 136 volts AC RMS for 115-volt operation or from 180 to 272 volts AC RMS for 230-volt operation; output power rating at least 305 watts. If monitor voltmeter is not included, separate AC voltmeter is required.

4. DC voltmeter (e.g., Fluke Model 801B differential voltmeter or suitable digital voltmeter). Minimum requirements: Voltage range from 0 volts to 250 volts; basic accuracy within 0.6%; accuracy within 0.05% at −75 volts.

5. DC Voltmeter—High Voltage (e.g., Triplett Model 630 NA). Requirements: Measure -5000 volts, accuracy within 3%.

6. 1X test probe, Tektronix P6011, with BNC connectors. Tektronix Part No. 010-0193-00.

7. 42 inch coaxial cable. Characteristic impedance approximately 93 Ω; BNC connectors. Tektronix Part No. 012-0075-01.

8. 4 inch patch cord. Standard banana plugs at each end.

9. Plastic screwdriver type adjustment tool. Tektronix Part No. 003-0000-00.

10. Small screwdriver.

PERFORMANCE CHECK/CALIBRATION RECORD AND INDEX

The following abridged performance check and calibration procedure has been provided for use as a record of performance check and/or calibration or as a guide for an experienced calibrator. It may also serve as an index to locate a particular step in the procedure.

Type 576, Serial No.
Performance Check/Calibration Date
Checked/Calibrated by

POWER SUPPLY

1. Adjust −75-Volt Supply
   Adjust R721 for −75 volts ±0.375 volts.

2. Check Other Power Supply Voltages
   See complete procedure for Specifications.

PERFORMANCE CHECK AND CALIBRATION PROCEDURE

The following procedure is arranged to allow: (1) Checking of the performance of the Type 576 with respect to tolerances given in Section 1; (2) complete or partial adjustment of the Type 576 internal controls without a complete performance check, or (3) a complete recalibration of the Type 576, which includes adjustment of internal controls as well as a complete performance check. To perform any of the above operations, use one of the following methods:

Performance Check Only. Start with the PRELIMINARY PROCEDURE Performance Check Only and perform only those steps with titles starting with the word Check, through the main procedure and the Performance Check and Calibration Record.

Adjustment Only. Start with the PRELIMINARY PROCEDURE—Calibration and perform only those steps with titles starting with the word Adjust, throughout the main procedure and the Performance Check and Calibration Record. The part of an adjust step involving the actual adjustment is printed in red.

Calibration. Start with the PRELIMINARY PROCEDURE—Calibration and perform all the steps throughout the main procedure or the Calibration and Performance Check Record.

When doing a complete calibration or a complete adjustment of internal controls of the instrument, the best overall performance will be obtained if each adjustment is made to the exact setting, even if the observed performance is within tolerance. When doing only a partial adjustment, however, do not readjust any controls unless the observed performance is not within tolerance. In either case, do not preset any adjustments unless they are known to be significantly out of adjustment or unless repairs have been made in the circuit. In these instances, set the particular controls to midrange.

A picture of the Type 576 and the equipment required to calibrate it or check its performance is given in Fig. 5-1. Following this picture is a complete list of initial control settings for the Type 576 and significant control settings of the test instruments. Partial lists of initial control settings are also provided at various places in the main body of the text. Any control setting not listed in one of these partial lists can be assumed to be set to the position as designated at the beginning of the procedure. These control settings can be used no matter which of the three procedures is to be used. If adjustments and/or checks are made without following one of the three procedures, start with the list of control settings preceeding the desired adjustment or check and follow the sequence up to the desired step, making changes in control settings as indicated.

PRELIMINARY PROCEDURE

Performance Check Only

1. Set the Line Voltage Selector assembly switches and the 60 Hz-50 Hz switch on the Type 576 rear panel in accordance with the line voltage source to be used.

2. Connect the Type 576 to the line voltage source.

3. Remove the Standard Test Fixture from the Type 576 and install the Calibration Fixture (Tektronix Part No. 067-0599-00) in the Type 576.

4. Turn on the Type 576. Allow at least 5 minutes warm-up at an ambient temperature between 0°C and +50°C (+32°F and +122°F) before making any checks.

5. Set the controls as shown at the beginning of the procedure and start the performance check procedure with step 5.

Calibration

1. Remove the side panels and the Standard Test Fixture from the Type 576.

2. Set the Line Voltage Selector assembly switches and the 60 Hz-50 Hz switch on the Type 576 rear panel in accordance with the line voltage source to be used.

3. Connect the autotransformer and other test instruments to a suitable power source Connect the Type 576 to the autotransformer output.

4. Set the autotransformer for the line voltage and range chosen on the Type 576 Line Voltage Selector assembly.

5. Turn on the autotransformer, the Type 576 and the test oscilloscope. Allow at least 5 minutes warmup at an ambient temperature of +25°C ±5°C (+77°F ±9°F) before making any checks or adjustments.

6. Connect the 1X probe to vertical input A of the test oscilloscope.

7. Set the instrument controls as shown at the beginning of the procedure and start the adjustment and calibration procedure with step 1.

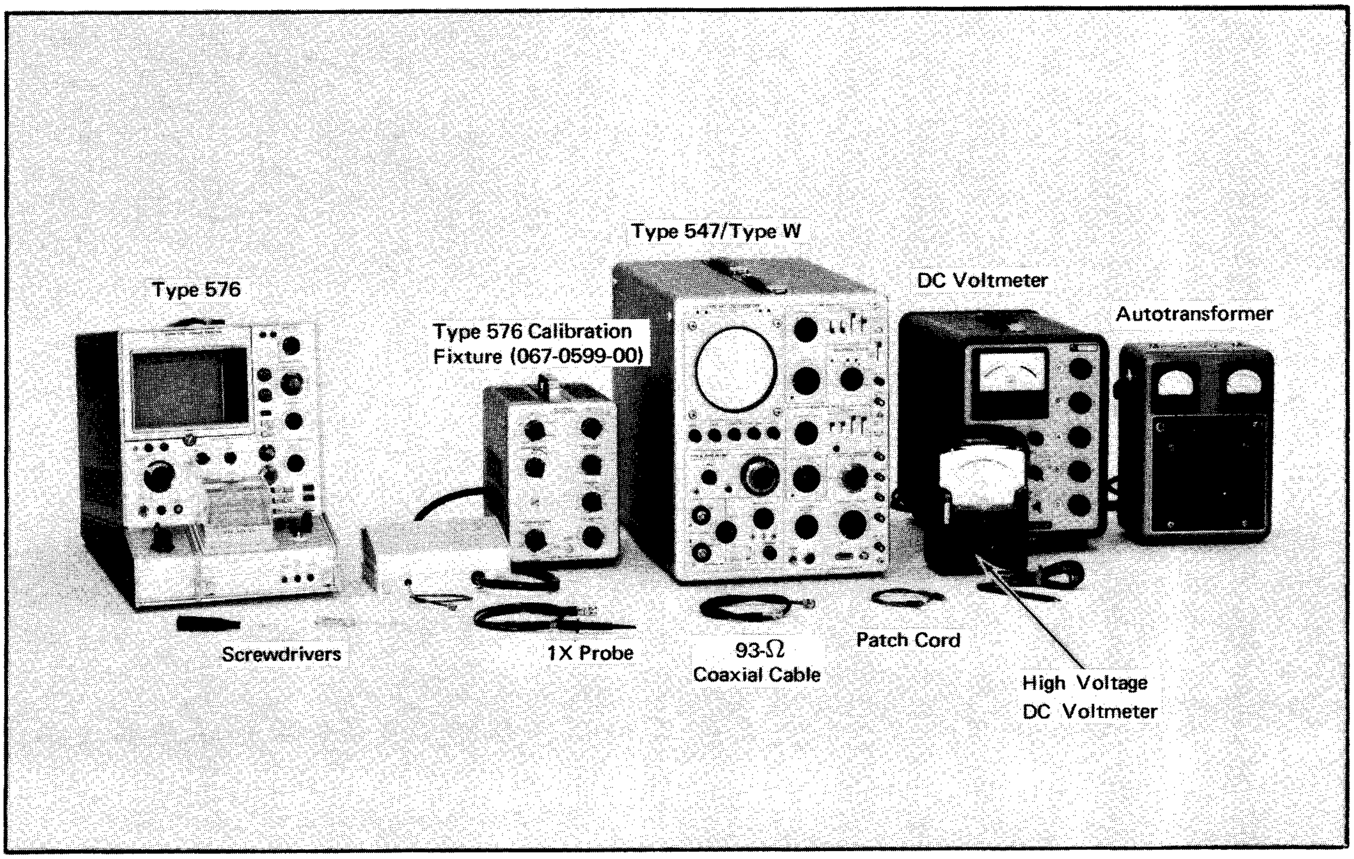

Fig. 5-1. Type 576 and test equipment.

INITIAL CONTROL SETTINGS

Type 576

GRATICULE ILLUM	Graticule lines visible
READOUT ILLUM	Fully Clockwise
INTENSITY	Fully Counterclockwise
FOCUS	Fully Counterclockwise
VERTICAL	10 mA
DISPLAY OFFSET Selector	NORM (OFF)
CENTERLINE VALUE	5
HORIZONTAL	2 V COLLECTOR
Vertical POSITION	Control Centered
Vertical FINE POSITION	Control Centered
Horizontal POSITION	Control Centered
Horizontal FINE POSITION	Control Centered
ZERO	Released
CAL	Released
DISPLAY INVERT	Released
MAX PEAK VOLTS	15
PEAK POWER WATTS	0.5
VARIABLE COLLECTOR SUPPLY	Fully Counterclockwise
POLARITY	AC
MODE	NORM
LOOPING COMPENSATION	As is
NUMBER OF STEPS	10
CURRENT LIMIT	2 A
AMPLITUDE	2 V
OFFSET	ZERO
OFFSET MULT	10.00
STEPS	Pressed
PULSED STEPS	Released
STEP FAMILY	REP
RATE	NORM
POLARITY INVERT	Released
STEP MULT .1X	Released

Type 576 Calibration Fixture (067-0599-00)

Function	Step Gen
Calibrator Range	200 mV Cal
Vertical	10 A (fully counterclockwise)
Display Offset Multiplier	0
Horizontal	0.5 Collector
Step Generator	.05 μA
Step Generator Loads	Off

Test Oscilloscope

Time/Cm	5 ms
Triggering	Trig, +, AC, Line
Millivolts/Cm	20
Input Atten	1
Input Coupling	AC (Both Channels)
Vc Range	0
Comparison Voltage	0.000
Position	Display Centered

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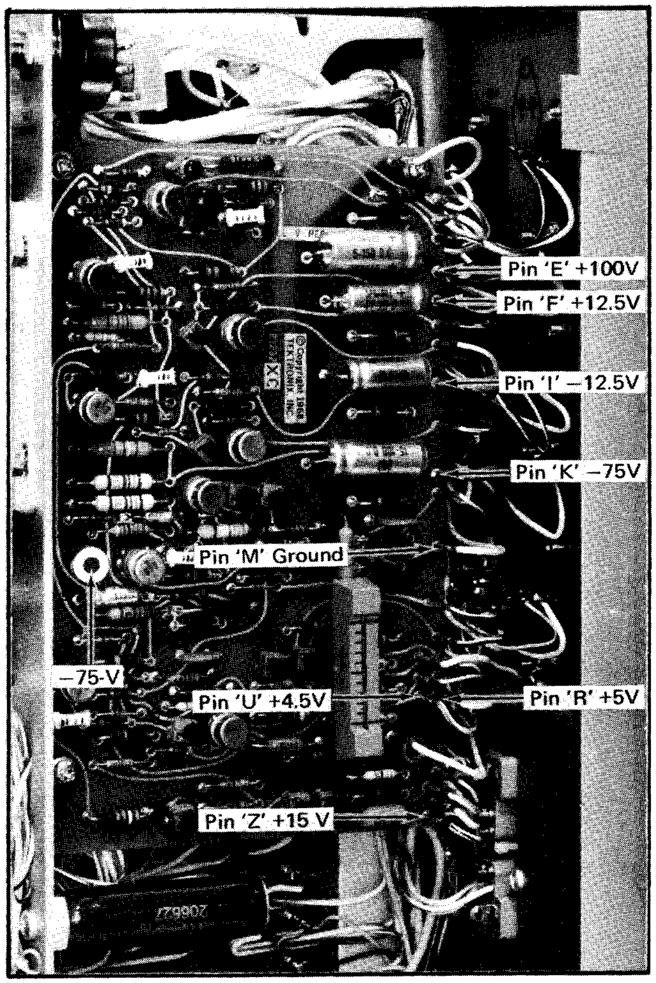

Fig. 5-2. L. V. REGULATOR circuit board: Location of test points and adjustments in steps 1 through 3.

POWER SUPPLY

1. Adjust −75 Volt Supply

a. Set the Type 576 controls as shown above.

b. Position the instrument so that the L. V. REGULATOR circuit board (left side of instrument) is visible.

c. Connect the negative lead of the DC voltmeter to ground, pin M on the L. V. REGULATOR board, (See Fig. 5-2). Connect the positive lead to the −75 volt supply, pin K. Be sure the polarity of the DC voltmeter is set for measuring a negative voltage.

d CHECK FOR—DC Voltmeter reading of −75 volts ±0.375 volts (±0.5%).

e. ADJUST—R721, −75-V adjustment (see Fig. 5-2) if the voltage is not correct.

NOTE

The voltage level of the −75-volt supply affects the calibration of the entire instrument. Any adjustment of R721 will probably require the readjustment of all other instrument adjustments as well.

f. (If doing only adjust steps disconnect the meter leads and go to step 4).

2. Check Other Power Supply Voltages

a. Move the positive lead of the DC voltmeter to the power supply test points (other than −75 volts) listed in Table 5-1. (Change polarity of voltmeter for positive voltages.)

b. CHECK FOR—Meter reading of the power supply voltage within the tolerance given in the accuracy column of Table 5-1.

c. Disconnect the DC voltmeter leads from the Type 576.

d. Connect the negative lead of the High Voltage DC Voltmeter to ground (pin M of the L. V. REGULATOR circuit board). Be sure the polarity of the meter is set for measuring a negative voltage.

e. Set the meter for measuring −4 kV.

f. Connect the positive lead of the meter to the arm of the INTENSITY control, R883 (see Fig. 5-3), connected to the white and purple wire.

g. CHECK FOR—Meter reading of −4000 volts.

h. Disconnect the High Voltage DC Voltmeter leads from the Type 576.

3. Check Power Supply Regulation

a. Trigger the test oscilloscope on the internal line signal.

b Connect the 1X test probe ground clip to pin M on the L. V. REGULATOR circuit board.

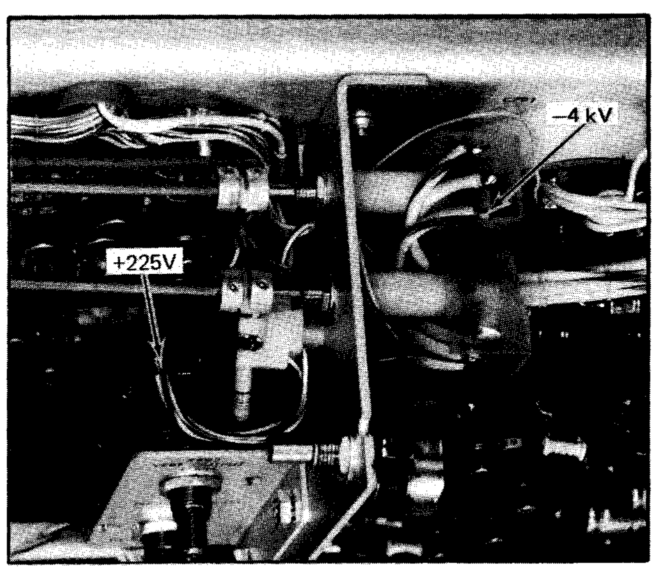

Fig. 5-3. Location of high voltage test points on right side of instrument.

TABLE 5-1

POWER SUPPLY VOLTAGE AND REGULATION CHECKS

Voltage	Accuracy	Total Output Noise and Line Frequency Ripple, Peak to Peak	Location of Test Point
−75		5 mV	Pin K
−12.5	±0.31 volts	5 mV	Pin I
Variable +4.5	±0.3 volts (at maximum setting)	20 mV	Pin U
+5	±0.25 volts	10 mV	Pin R
+12.5	±0.31 volts	5 mV	Pin F
+15	±0.75 volts	20 mV	Pin Z
+100	±2.5 volts	20 mV of –28 kHz high voltage oscillator ripple and line frequency ripple	Pin E
+225	±9 volts	80 mV or –28 kHz high voltage oscillator ripple and line frequency ripple	Left arm of R592 VERT OUTPUT GAIN (see Fig. 5-3)

c. Set the autotransformer for the highest voltage within the voltage range selected by the Line Voltage Selector assembly on the rear panel.

d. Connect the 1X test probe tip to the test points of each of the power supplies given in Table 5-1.

e. CHECK FOR—Test oscilloscope display of power supply ripple with the line frequency ripple peak to peak amplitude not exceeding the maximum value given in Table 5-1. On the +100-volt and the +225-volt supplies, set the test oscilloscope Time/Cm to 50 μs and check the 20 kHz ripple.

f. Install the Type 576 Calibration Fixture, Tektronix Part No. 067-0599-00) and adjust its controls as shown in the list of initial control settings. Connect the camera power plug on the Calibration Fixture to the CAMERA POWER connector on the Type 576.

g. Set the autotransformer for the lowest voltage within the voltage range selected by the Line Voltage Selector assembly on the rear panel.

h. Repeat parts d and e.

i. Disconnect the probe from the Type 576 and the test oscilloscope vertical input.

CRT AND READOUT

4. Adjust CRT Controls

a. Turn the INTENSITY control clockwise until a large spot is visible on the CRT.

b. CHECK FOR—Spot with a circular shape.

c. ADJUST—R891, ASTIGMATISM adjustment on the right side of the instrument (see Fig. 5-4) if the spot is not circular.

d. Turn the FOCUS control clockwise until the spot is the smallest possible.

CAUTION

When a single spot is being displayed on the Type 576 CRT, set the intensity low enough to prevent burning the CRT phosphor.

e. Position the spot to the center of the CRT graticule using the FINE POSITION controls.

f. Set the VARIABLE COLLECTOR SUPPLY control for a trace 10 divisions long.

g. CHECK FOR—Trace parallel with the horizontal centerline (see Fig. 5-5).

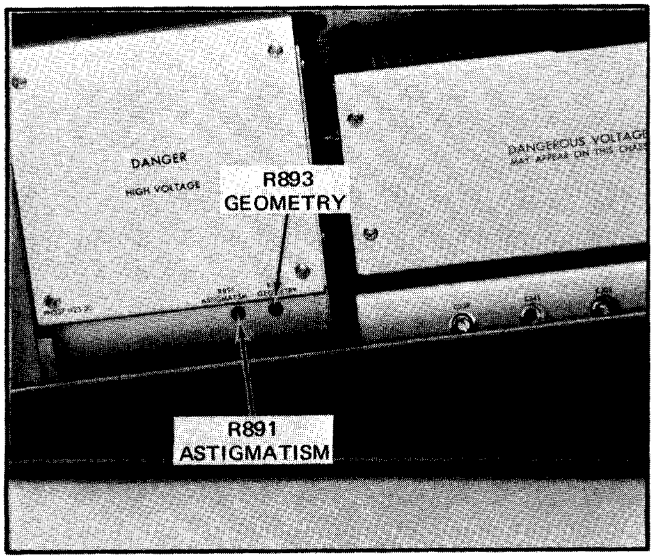

Fig. 5-4. Location of adjustments in step 4.

h. ADJUST—R897, TRACE ROTATION adjustment, (see Fig. 5-4) if the trace is not parallel.

i. Set the Calibration Fixture Step Generator Loads switch to 1 K Collector Short.

j. CHECK FOR—Trace parallel with the vertical centerline (see Fig. 5-4).

k. ADJUST—R685, ORTHOGONALITY adjustment, on the DISPLAY AMP circuit board (see Fig. 5-6) if the trace is not parallel.

l. Using the horizontal POSITION control, position the trace on the zero vertical graticule line of the CRT (see Fig. 5-5).

m. CHECK FOR—Geometry of the trace (minimum bowing).

n. ADJUST—R893, GEOMETRY adjustment (see Fig. 5-4) for minimum bowing of trace.

o. Position trace on the tenth solid vertical graticule line (see Fig. 5-5).

p. Repeat parts m and n.

q. Set the Calibration Fixture Step Generator Loads switch to Off.

r. Repeat parts m and n.

s. Position the trace to the tenth horizontal graticule line.

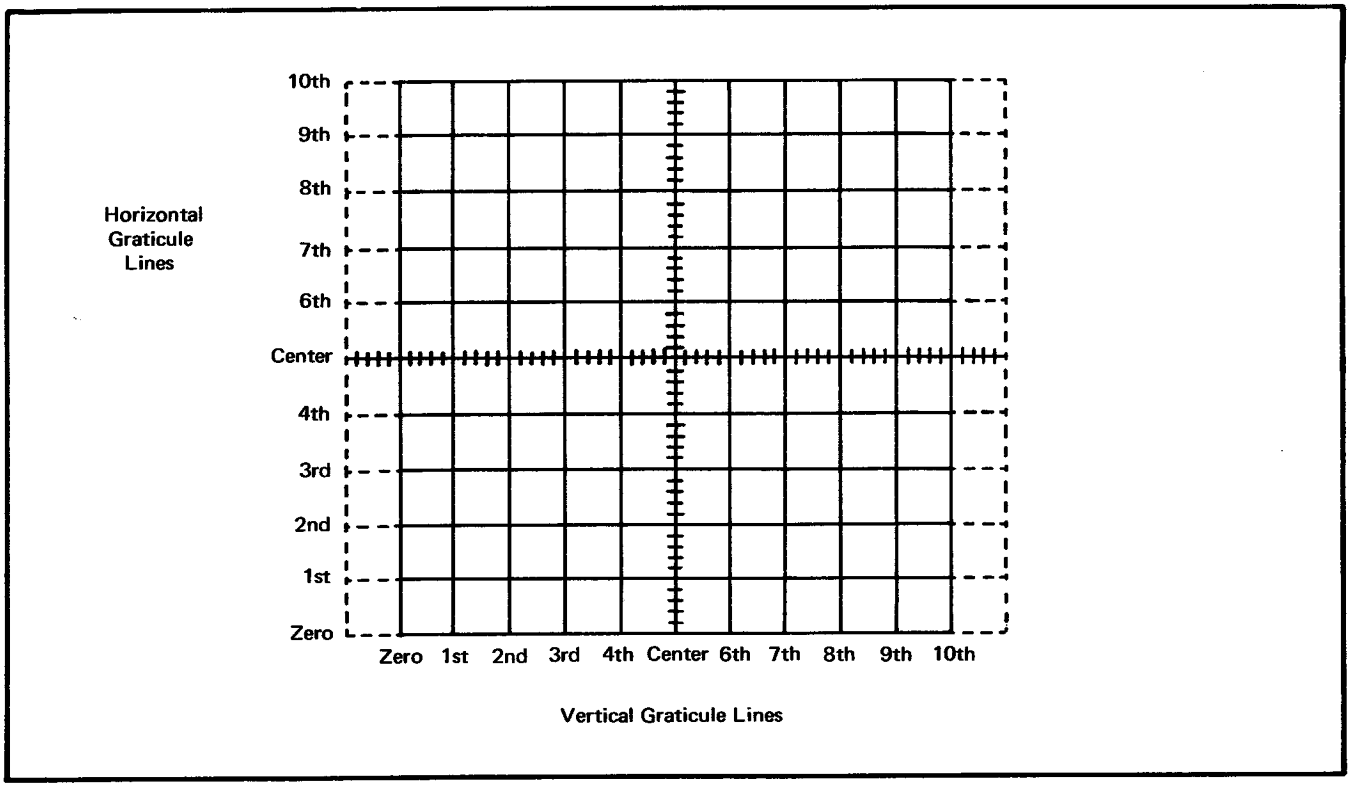

Fig. 5-5. Graticule line labels.

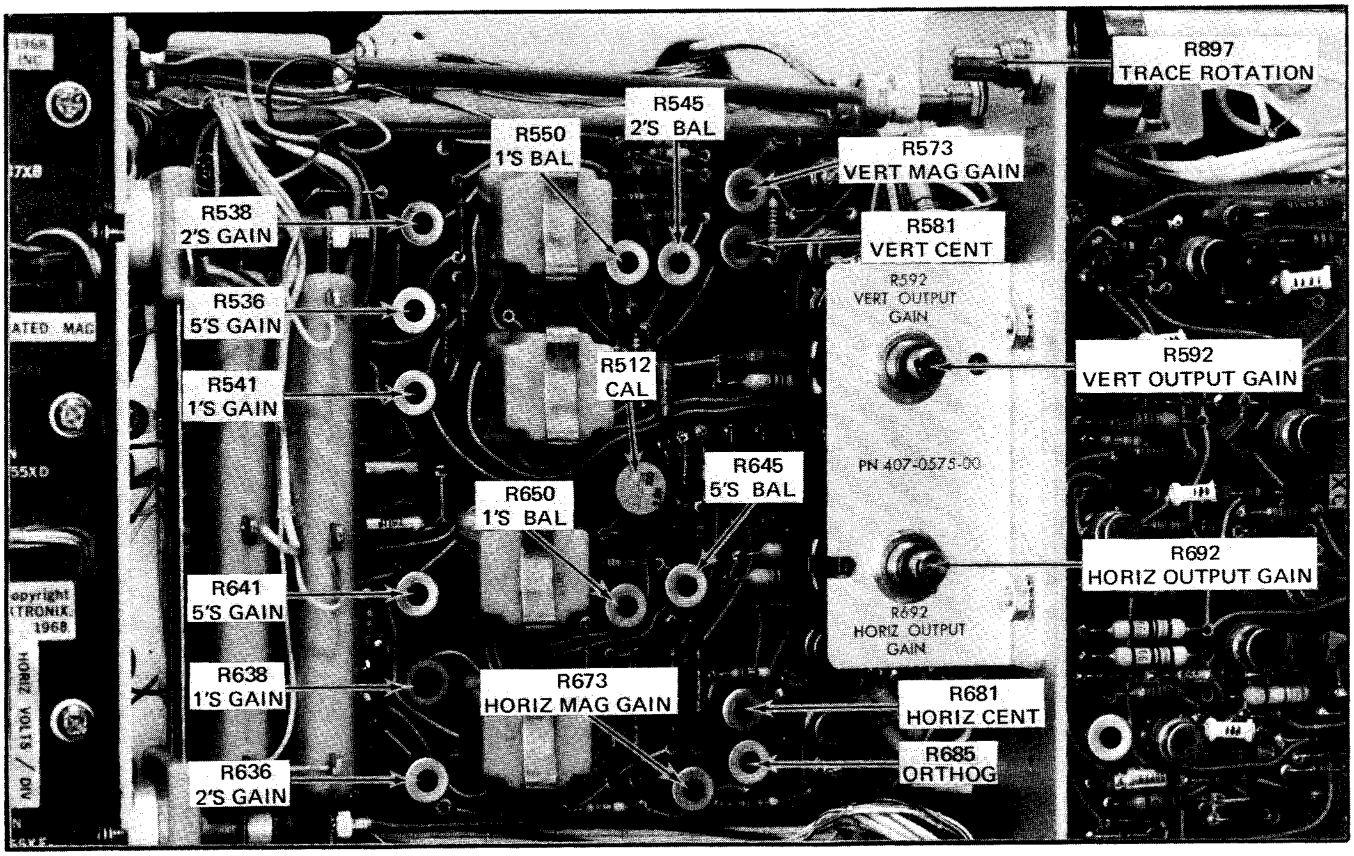

Fig. 5-6. DISPLAY AMP circuit board: Location of adjustments in step 4 and steps 7 through 13.

t. Repeat parts m and n.

u. Position the trace to the center horizontal graticule line.

v. Turn the VARIABLE COLLECTOR SUPPLY control and the FOCUS control fully counterclockwise and recheck adjustment of astigmatism and focus as in parts b through d.

w. Set the Type 576 VERTICAL switch to .5 A.

5. Check CRT Controls

a Turn the GRATICULE ILLUM control throughout its range.

b. CHECK FOR—Continuous increase in graticule illumination when the control is turned from its fully counter clockwise position to its fully clockwise position.

c. Set the control so that the graticule lines are visible.

d. Turn the INTENSITY control throughout its range.

e. CHECK FOR—Continuous increase in the brightness of the spot when the control is turned from its fully counterclockwise position to its fully clockwise position.

CAUTION

When a single spot is being displayed on the Type 576 CRT, set the intensity low enough to prevent burning the CRT phosphor.

f. Set the control for a visible spot.

g. Turn the FOCUS control throughout its range.

h. CHECK FOR—Spot in focus in the center range of the control.

i. Set the control for the smallest possible spot.

6. Check Readout

a. Turn the READOUT ILLUM control throughout its range.

b. CHECK FOR—Continuous increase in the readout illumination when the control is turned from its fully counterclockwise position to its fully clockwise position.

c. Set the control for a visible readout.

d. Turn the Type 576 VERTICAL switch throughout its range.

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e. CHECK FOR—PER VERT DIV readout coinciding with setting of the VERTICAL switch using COLLECTOR current units. (The readout should be blank for the STEP GEN position of the switch.)

f. Set the Type 576 DISPLAY OFFSET Selector switch to VERT X10 and turn the VERTICAL switch throughout its range.

g. CHECK FOR—PER VERT DIV readout of 10 times less than the setting of the VERTICAL switch using COLLECTOR current units.

h. Set the Type 576 MODE switch to LEAKAGE and the DISPLAY OFFSET Selector switch to NORM (OFF).

i. Turn the VERTICAL switch throughout its range.

j. CHECK FOR—PER VERT DIV readout coinciding with setting of the VERTICAL switch using EMITTER current units.

k. Set the DISPLAY OFFSET Selector switch to VERT X10 and turn the VERTICAL switch throughout its range.

l. CHECK FOR—PER VERT DIV readout of 10 times less than the setting of the VERTICAL switch using EMITTER current. (Readout should be blank for 1 nA, 2 nA and 5 nA settings of VERTICAL switch.)

m. Set the Type 576 DISPLAY OFFSET Selector switch to NORM (OFF) and turn the HORIZONTAL switch throughout its range.

n CHECK FOR—PER HORIZ DIV readout coinciding with the setting of the HORIZONTAL switch. (The readout should be blank for the STEP GEN position of the switch.)

o. Set the DISPLAY OFFSET Selector switch to HORIZ X10 and turn the HORIZONTAL switch throughout its range.

p. CHECK FOR—PER HORIZ DIV readout of 10 times less than the setting of the HORIZONTAL switch.

q. Turn the Type 576 AMPLITUDE switch throughout its range.

r. CHECK FOR—PER STEP readout coinciding with the setting of the AMPLITUDE switch.

s. Press the Type 576 STEP MULT .1X button and turn the AMPLITUDE switch throughout its range.

t. CHECK FOR—PER STEP readout 10 times less than the setting of the AMPLITUDE switch.

u. Release STEP MULT .1X button.

NOTE

It is a tedious process to check all the possible positions of the VERTICAL and AMPLITUDE switches which will provide a β OR g_m PER DIV readout. The following procedure checks only that all β OR g_m PER DIV fiber-optics will light up.

v. Set the Type 576 VERTICAL and AMPLITUDE switches as shown in Table 5-2.

TABLE 5-2
Check β OR g_m PER DIV Readout

VERTICAL	AMPLITUDE	β OR g_m PER DIV
200 μA	2 V	100 μ
200 μA	.1 V	2 m
200 μA	.05 μA	4 k
500 μA	.1 μA	5 k
500 μA	.2 μA	2.5 k
500 μA	1 μA	500

w. CHECK FOR—β OR g_m PER DIV readout coinciding with the third column of Table 5-2.

x. Set the following Type 576 controls to:

VERTICAL	.5 A
DISPLAY OFFSET Selector	NORM (OFF)
HORIZONTAL	2 V COLLECTOR
AMPLITUDE	2 V

DISPLAY AMPLIFIERS

7. Adjust Balance of Horizontal Display Amplifier

a. Set the Type 576 DISPLAY OFFSET Selector switch to HORIZ X10 and position the spot to the center of the graticule using the FINE POSITION controls.

b. Set the Type 576 DISPLAY OFFSET Selector switch to HORIZ X1.

c. CHECK FOR—Spot in center of graticule.

d. ADJUST—R681, HORIZ CENT adjustment, on the DISPLAY AMP circuit board (see Fig. 5-6) if the spot is not centered.

e. Repeat parts a through c until no movement of the spot occurs between the two settings of the DISPLAY OFFSET Selector switch.

f. Set the following Type 576 controls to:

DISPLAY OFFSET Selector	HORIZ X10
HORIZONTAL	1 V COLLECTOR

g. CHECK FOR—Spot centered on graticule

h. ADJUST—R650, 1'S BAL adjustment, (see Fig. 5-6) if the spot is not centered.

i. Set the HORIZONTAL switch to .5 V COLLECTOR.

j. CHECK FOR—Spot centered on graticule.

k. ADJUST—R645, 5'S BAL adjustment, (see Fig. 5-6) if the spot is not centered.

l. Set the HORIZONTAL switch to 2 V COLLECTOR and recheck the adjustments made in parts a through k.

8. Adjust Balance of Vertical Display Amplifier

a. Set the DISPLAY OFFSET Selector switch to VERT X10 and position the spot to the center of the graticule using the FINE POSITION controls.

b. Set the DISPLAY OFFSET Selector switch to VERT X1.

c. CHECK FOR—Spot centered on graticule.

d. ADJUST—R581, VERT CENT adjustment, (see Fig. 5-6) if the spot is not centered.

e. Repeat parts a through d until no movement of the spot occurs between the two settings of the DISPLAY OFFSET Selector switch.

f. Set the following Type 576 controls to:

DISPLAY OFFSET Selector	VERT X10
VERTICAL	1 A

g. CHECK FOR—Spot centered on graticule.

h. ADJUST—R550, 1'S BAL adjustment, (see Fig. 5-6) if the spot is not centered.

i. Set the VERTICAL switch to 2 A.

j. CHECK FOR—Spot centered on graticule.

k. ADJUST—R545, 2'S BAL adjustment, (see Fig. 5-6) if the spot is not centered.

l. Set the VERTICAL switch to .5 A and recheck the adjustments made in parts a through k.

9. Adjust Horizontal CRT Gain

a. Set the DISPLAY OFFSET Selector switch to NORM (OFF) and the POLARITY switch to +(NPN).

b. CHECK FOR—Spot on zero vertical graticule line ±0.1 division.

c. ADJUST—R692, HORIZ OUTPUT GAIN adjustment (see Fig. 5-6) if the spot is not on the prescribed vertical graticule line.

d. Set the POLARITY switch to −(PNP).

e CHECK FOR—Spot on tenth vertical graticule line ±0.1 division

f. ADJUST—R692, HORIZ OUTPUT GAIN adjustment, if spot is not on the prescribed horizontal graticule line.

g. Set the POLARITY switch to +(NPN) and repeat parts b through f until 10 divisions of horizontal deflection is obtained between the two given positions of the POLARITY switch.

10. Adjust Vertical CRT Gain

a. Set the POLARITY switch to +(NPN).

b. CHECK FOR—Spot on zero horizontal graticule line ±0.1 division.

c. ADJUST—R592, VERT OUTPUT GAIN adjustment, (see Fig. 5-6) if the spot is not on the prescribed vertical graticule line.

d. Set the POLARITY switch to −(PNP).

e. CHECK FOR—Spot on tenth horizontal graticule line ±0.1 division.

f. ADJUST—R592, VERT OUTPUT GAIN adjustment, if the spot is not on the prescribed vertical graticule line.

g. Set the POLARITY switch to +(NPN) and repeat parts b through f until 10 divisions of vertical deflection is obtained between the two given positions of the POLARITY switch.

h. Set the POLARITY switch to AC.

11. Adjust Vertical and Horizontal Magnifier Gains

a. Set DISPLAY OFFSET Selector switch to HORIZ X10 and position the spot on the center vertical graticule line with the horizontal FINE POSITION control.

b. Switch the CENTERLINE VALUE switch between the 4.5 and the 5.5 positions.

c. CHECK FOR—Spot deflected 10 divisions horizontally, when the CENTERLINE VALUE switch is switched from 4.5 to 5.5.

d. ADJUST—R673, HORIZ MAG GAIN adjustment, (see Fig. 5-5) if the spot deflection is not correct.

e. Set the DISPLAY OFFSET Selector switch to VERT X10 and the CENTERLINE VALUE switch to 5.

f. Position the spot on the center horizontal graticule line with the vertical FINE POSITION control.

g. Switch the CENTERLINE VALUE switch between the 4.5 and 5.5 positions.

h. CHECK FOR—Spot deflected 10 divisions vertically when the CENTERLINE VALUE switch is switched from 4.5 to 5.5.

i. ADJUST—R573, VERT MAG GAIN adjustment, (see Fig. 5-6) if the spot deflection is not correct.

12. Adjust Horizontal Display Amplifier Gains

a. Set the following Type 576 controls to:

HORIZONTAL	2 V COLLECTOR
DISPLAY OFFSET Selector	HORIZ X10
CENTERLINE VALUE	0
POLARITY	+(NPN)

b. Set the Calibration Fixture FUNCTION switch to HORIZ AMPL CAL.

c. Position the spot vertically to the zero horizontal graticule line and horizontally to the center vertical graticule line using the Type 576 FINE POSITION controls.

d Set the Type 576 CENTERLINE VALUE switch to 10.

e. Set the Calibration Fixture Display Offset Multiplier switch to 10.

f. CHECK FOR—Spot centered on graticule horizontally.

g. ADJUST—R636, 2'S GAIN adjustment, (see Fig. 5-6) if the spot is not centered

h. Press the Type 576 CAL button.

i. CHECK FOR—Spot centered horizontally on tenth horizontal graticule line.

j. ADJUST—R512, CAL adjustment, (see Fig. 5-6) if the spot is not centered

k. Release the Type 576 CAL button and set the HORIZONTAL switch to 1 V COLLECTOR.

l. Set the Calibration Fixture Calibrator Range switch to 100 mV.

m. CHECK FOR—Spot centered horizontally on the graticule.

n. Adjust—R638, 1'S GAIN adjustment (see Fig. 5-6) if the spot is not centered.

o. Set the Type 576 HORIZONTAL switch to .5 V COLLECTOR.

p. Set the Calibration Fixture Calibrator Range to 50 mV.

q. CHECK FOR—Spot horizontally centered.

r. ADJUST—R641, 5'S GAIN adjustment, (see Fig. 5-6) if the spot is not centered

13. Adjust Vertical Display Amplifier

a . Set the following Type 576 controls to:

VERTICAL .5 A	
DISPLAY OFFSET Selector	VERT X10
CENTERLINE VALUE	0

b. Set the following Calibration Fixture controls to:

Function	Vert Ampl Cal
Calibration Range	125 mV
Display Offset Multiplier	0

c. Position the spot vertically onto the center horizontal graticule line and horizontally onto the zero vertical graticule line using the Type 576 FINE POSITION controls.

d. Set the Type 576 CENTERLINE VALUE switch to 10.

e. Set the Calibration Fixture Display Offset Multiplier switch to 10.

f. CHECK FOR—Spot centered vertically.

g. ADJUST—R536, 5'S GAIN adjsutment, (see Fig. 5-6) if the spot is not centered.

h. Set the Type 576 VERTICAL switch to .2 A.

i. Set the Calibration Fixture Calibration Range switch to 50 mV.

j. CHECK FOR—Spot centered vertically.

k. ADJUST—R538, 2'S GAIN adjustment, (see Fig. 5-6) if the spot is not centered.

l. Set the Type 576 VERTICAL switch to .1 A.

m. Set the Calibration Fixture Calibration Range switch to 25 mV.

n. CHECK FOR—Spot centered vertically.

o. ADJUST—R541, 1'S GAIN adjustment (see Fig. 5-6) if the spot is not centered.

14. Adjust Horizontal Compensation

a. Set the following Type 576 controls to

VERTICAL	2 mA
DISPLAY OFFSET Selector	HORIZ X10
CENTERLINE VALUE	0
HORIZONTAL	50 V COLLECTOR

b. Set the Calibration Fixture Function switch to Horiz Compensation.

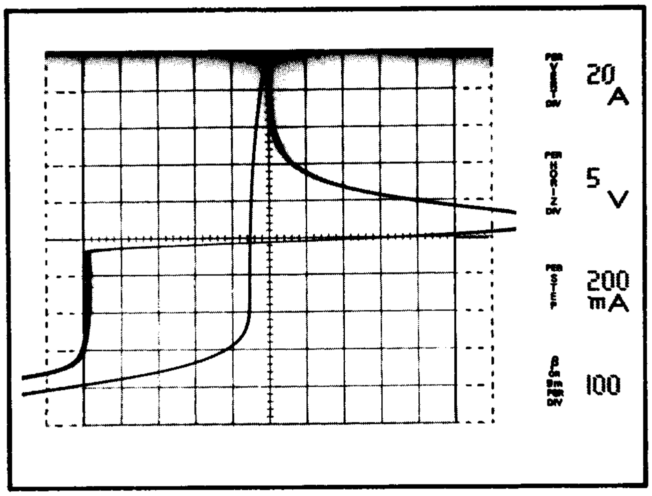

Fig. 5-7. Type 576 display of waveform for making adjustment of horizontal compensation.

c. Position the display onto the CRT (see Fig. 5-7).

d. CHECK FOR—Tail on the upper portion of the display parallel with the vertical graticule lines (see Fig. 5-7).

e. ADJUST—C433, HORIZ COMP adjustment, on the HORIZ VOLTS/DIV circuit board (see Fig. 5-9) if the display is not vertical.

f. (If doing Adjust steps only, go to step 21.)

g. Set the following Type 576 controls to:

VERTICAL	.5 A
DISPLAY OFFSET Selector	NORM (OFF)
HORIZONTAL	2 V COLLECTOR
POLARITY	AC
POSITION (Vertical and Horizontal)	Centered

h. Set the following Calibration Fixture controls to:

Function	Step Gen
Display Offset Multiplier	0
Calibration Range	200 mV

15. Check Horizontal and Vertical Positioning

a. Turn the horizontal FINE POSITION control throughout its range.

b. CHECK FOR—Spot moving at least ±2.5 divisions horizontally about the center vertical graticule line (see Fig. 5-5).

c. Turn the vertical FINE POSITION control throughout its range

d. CHECK FOR—Spot moving at least ±2.5 divisions vertically about the center horizontal graticule line.

e. Press Type 576 ZERO button and center the spot on the graticule using the FINE POSITION controls.

f. Set the Type 576 POLARITY switch to +(NPN).

g. If the spot is not located at the intersection of the zero horizontal and vertical graticule lines (see Fig. 5-5), press the Type 576 ZERO button and re-position the spot using the FINE POSITION controls.

h. Switch horizontal POSITION switch to both clockwise positions.

i. CHECK FOR—Spot moving 5 divisions to the right ±0.1 division each time the switch is switched one position.

j. Switch vertical POSITION switch to both clockwise positions.

k. CHECK FOR—Spot moving up 5 divisions ±0.1 divisions each time the switch is switched one position.

l. Set the following Type 576 controls to:

POSITION (Vertical and Horizontal)	Centered
POLARITY	−(PNP)

m. If the spot is not located at the intersection of the tenth horizontal and vertical graticule lines (see Fig. 5-5), press the Type 576 ZERO button and re-position the spot using the FINE POSITION controls.

n. Switch horizontal POSITION switch to both counterclockwise positions.

o. CHECK FOR—Spot moving 5 divisions to the left ±0.1 division each time the switch is switched one position.

p. Switch vertical POSITION switch to both counterclockwise positions.

q. CHECK FOR—Spot moving 5 divisions down ±0.1 division each time the switch is switched one position.

16. Check ZERO, CAL and DISPLAY INVERT Buttons

a. Reset the Type 576 POSITION switches to their center positions.

b. Press the Type 576 ZERO button and check that the spot is still located at the intersection of the tenth horizontal and vertical graticule lines.

c. Release the Type 576 ZERO button and press the CAL button.

d. CHECK FOR—Spot located at the intersection of the zero horizontal and vertical graticule lines ±0.15 division horizontally and vertically.

e. Set the Type 576 VERTICAL switch to .2 A and the HORIZONTAL switch to 1 V COLLECTOR.

f. Press the Type 576 CAL button.

g. CHECK FOR—Spot located in the intersection of the zero horizontal and vertical graticule lines ±0.15 divisions.

h. Set the Type 576 VERTICAL switch to .1 A and the HORIZONTAL switch to .5 V COLLECTOR.

i. Press the Type 576 CAL button.

j. CHECK FOR—Spot located at the intersection of the zero horizontal and vertical graticule lines ±0.15 division horizontally and vertically.

k. Release CAL button and press the DISPLAY INVERT button.

l. CHECK FOR—Spot located at the intersection of the zero horizontal and vertical graticule lines.

17. Check Horizontal and Vertical Display Offset and Magnifier

a. Set the following Type 576 controls to:

VERTICAL	.5 A
DISPLAY OFFSET Selector	HORIZ X10
HORIZONTAL	2 V COLLECTOR
DISPLAY INVERT	Released
POLARITY	+(NPN)

b. Set the Calibration Fixture Function switch to Horiz Ampl Cal.

c. Press the ZERO button and center the spot horizontally on the graticule. Release the ZERO button.

d. Turn the Type 576 CENTERLINE VALUE switch and the Calibration Fixture Display Offset Multiplier switch, together, throughout their ranges.

e. CHECK FOR—Spot centered horizontally for each position of the CENTERLINE VALUE switch within the tolerances shown in Table 5-3.

f. When the CENTERLINE VALUE switch is set to 10, press the ZERO button and be sure the spot is centered horizontally.

g. Press the CAL button.

h. CHECK FOR—Spot centered horizontally ±0.5 division.

i. Set the following Type 576 controls to:

DISPLAY OFFSET Selector	VERT X10
CENTERLINE VALUE	0
CAL	Released

TABLE 5-3
Accuracy of Centerline Value

CENTERLINE VALUE Switch Setting	Spot Centered Horizontally
0.5	±0.2 divisions
1.0	±0.4 divisions
1.5	±0.5 divisions
2.0	±0.6 divisions
2.5	±0.8 divisions
3.0	±0.9 divisions
3.5	±1.1 divisions
4.0	±0.8 divisions
4.5	±0.9 divisions
5.0	±1.0 divisions
5.5	±1.1 divisions
6.0	±1.2 divisions
6.5	±1.3 divisions
7.0	±1.4 divisions
7.5	±1.5 divisions
8.0	±1.6 divisions
8.5	±1.7 divisions
9.0	±1.8 divisions
9.5	±1.9 divisions
10.0	±2.0 divisions

j. Set the following Calibration Fixture controls to:

Function	Vert Ampl Cal
Calibration Range	125 mV
Display Offset Multiplier	0

k. Press the ZERO button and center the spot vertically on the graticule.

l. Turn the Type 576 CENTERLINE VALUE switch and the Calibration Fixture Display Offset Multiplier switch, together, throughout their ranges.

m. CHECK FOR—Spot centered vertically for each position of the CENTERLINE VALUE switch within the tolerances shown in Table 5-3.

n. When the CENTERLINE VALUE switch is set to 10, press the ZERO button and be sure the spot is centered vertically.

o. Press the Cal button.

p. CHECK FOR—Spot centered vertically ±0.5 division.

18. Check Horizontal Display Accuracy

a. Set the following Type 576 controls to:

DISPLAY OFFSET Selector	NORM (OFF)
HORIZONTAL	.05 COLLECTOR
VARIABLE COLLECTOR SUPPLY	Fully Counterclockwise
PEAK POWER WATTS	220
MAX PEAK VOLTS	1500
MODE	DC

b. Set the Calibration Fixture Function switch to Horiz Atten Check.

c. Press the ZERO button and position the spot to the intersection of the zero vertical and horizontal graticule lines.

d. Turn the Type 576 VARIABLE COLLECTOR SUPPLY control fully clockwise.

e. CHECK FOR—Spot on tenth vertical graticule line ±0.3 division (±3%).

f. Turn the Type 576 HORIZONTAL switch and the Calibration Fixture Horizontal switch together throughout their ranges.

g. CHECK FOR—Spot on tenth vertical graticule line ±0.3 division (±3%) for each position of the HORIZONTAL switch except the 200 COLLECTOR and STEP GEN positions. In the 200 COLLECTOR position the spot should be in the center vertical line ±0.15 division (±3%). In the STEP GEN position, 11 spots will be displayed horizontally. The eleventh spot should be on the tenth vertical graticule line ±0.4 division (±4%). Note: the horizontal base input impedance is automatically checked by this procedure.

19. Check Vertical Display Accuracy

a. Set the following Type 576 controls to:

VARIABLE COLLECTOR SUPPLY	Fully Counterclockwise
MAX PEAK VOLTS	15
VERTICAL	2 A
HORIZONTAL	200 V COLLECTOR
PULSED STEPS	300 µs
STEP FAMILY	SINGLE

b. Set the Calibration Fixture Function switch to Vertical Current Check.

c. Press the ZERO button and position the spot on the zero horizontal line.

d. Turn the VARIABLE COLLECTOR SUPPLY control fully clockwise.

e. CHECK FOR—Spot on fifth horizontal graticule line ±0.15 division (±3%).

f. Turn the Type 576 VERTICAL switch and the Calibration Fixture Vertical switch, together, throughout their ranges.

g. CHECK FOR—Spot on tenth horizontal graticule line ±0.3 division (±3%) for all positions of the VERTICAL switch. (The STEPS button may be pressed when the Calibration Fixture Vertical switch is in the 10 mA position.)

h. Set the following Type 576 controls to:

VERTICAL	5 µA EMITTER
MODE	LEAKAGE

i. Set the Calibration Fixture Vertical control to 50 µA.

j. Turn the Type 576 VERTICAL switch and the Calibration Fixture Vertical switch, together clockwise throughout their ranges.

k. CHECK FOR—Spot on tenth horizontal graticule line ±0.3 division ±1 nA (±3% ±1 nA) for all positions of the Type 576 VERTICAL switch except the 1 nA, 2 nA and 5 nA positions. In these positions the accuracy is within 0.5 division ±1 nA (5% ±1 nA).

l. Set the following Type 576 controls to:

VERTICAL	STEP GEN
VARIABLE COLLECTOR SUPPLY	Fully Counterclockwise
STEP FAMILY	REP

m. CHECK FOR—11 spots displayed vertically with the eleventh spot on the tenth horizontal graticule line ±0.4 division (±4%).

20. Check Horizontal and Vertical Displayed Noise

a. Turn off the Type 576 and remove the Calibration Fixture.

b. Install the Standard Test Fixture in the Type 576 and turn on the instrument.

c. Set the following Type 576 controls to:

VERTICAL	2 A
DISPLAY OFFSET Selector	HORIZ X10
CENTERLINE VALUE	5
HORIZONTAL	.05 V COLLECTOR
POLARITY	AC
MODE	NORM
STEP FAMILY	SINGLE

d. Position the spot on the CRT.

e. CHECK FOR—Spot no greater than 0.6 division horizontally (3 mV peak to peak).

f. Set the following Type 576 controls to:

VERTICAL	1 µA
DISPLAY OFFSET Selector	VERT X10
HORIZONTAL	200 V COLLECTOR

g. Position the spot on the CRT. Use the CENTERLINE VALUE switch if necessary.

h. CHECK FOR—Spot no greater than 0.5 divisions vertically (50 nA peak to peak).

i. Set the Type 576 MODE switch to LEAKAGE.

j. Position the spot on the CRT. Use the CENTERLINE VALUE switch if necessary.

k. CHECK FOR—Spot no greater than .2 division vertically (.2 nA peak to peak).

l. Turn off the Type 576 and remove the Standard Test Fixture.

m. Install the Calibration Fixture in the Type 576 and turn on the instrument.

NOTES

STEP GENERATOR

Initial Control Settings

Type 576

VERTICAL	STEP GEN
DISPLAY OFFSET Selector	HORIZ X10
CENTERLINE VALUE	5
HORIZONTAL	5 V COLLECTOR
POSITION (Vertical and Horizontal)	Centered
MAX PEAK VOLTS	15
PEAK POWER WATTS	0.5
VARIABLE COLLECTOR SUPPLY	Fully Clockwise
POLARITY	AC
MODE	NORM
AMPLITUDE	2 V
NUMBER OF STEPS	1
STEPS	Pressed
STEP FAMILY	REP
RATE	NORM

Type 576 Calibration Fixture

Function	Step Gen
Step Generator Loads	Step Gen

Test Oscilloscope

Time/Cm	2 ms
Triggering	Trig, +, AC, Internal
Millivolts/Cm	50
Input Attenuation	R ∞
Input Coupling	DC
Vc Range	0
Comparison Voltage	10.000
Position	Display Centered

21. Adjust Zero Crossings and Step Delay

a. Position the crossover point of the two traces to the center of the graticule using the Type 576 horizontal FINE POSITION controls.

b. CHECK FOR—Crossover lines together at center (see Fig. 5-8).

c. ADJUST—R8, ZERO CROSS adjustment, (see Fig. 5-9) if the display is not correct.

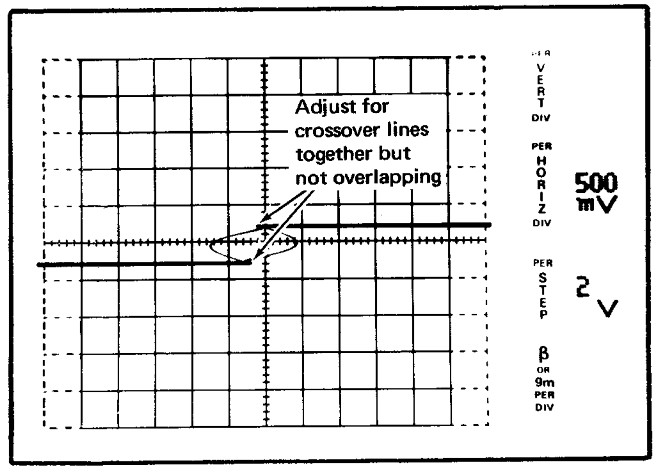

Fig. 5-8. Type 576 display of crossover lines for adjusting ZERO CROSS adjustment R8.

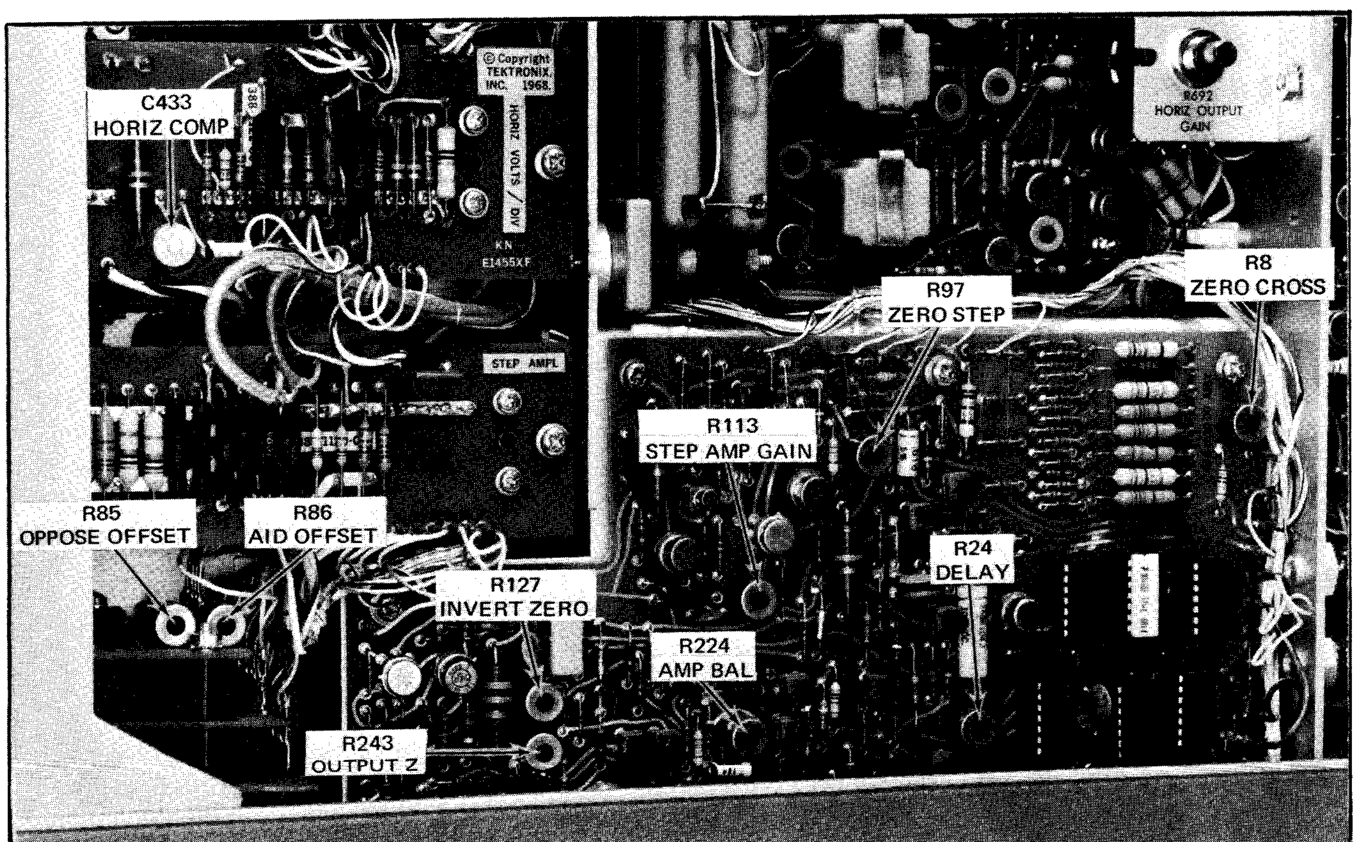

Fig. 5-9. STEP GEN circuit board: Location of adjustments in step 14 and steps 22 through 26.

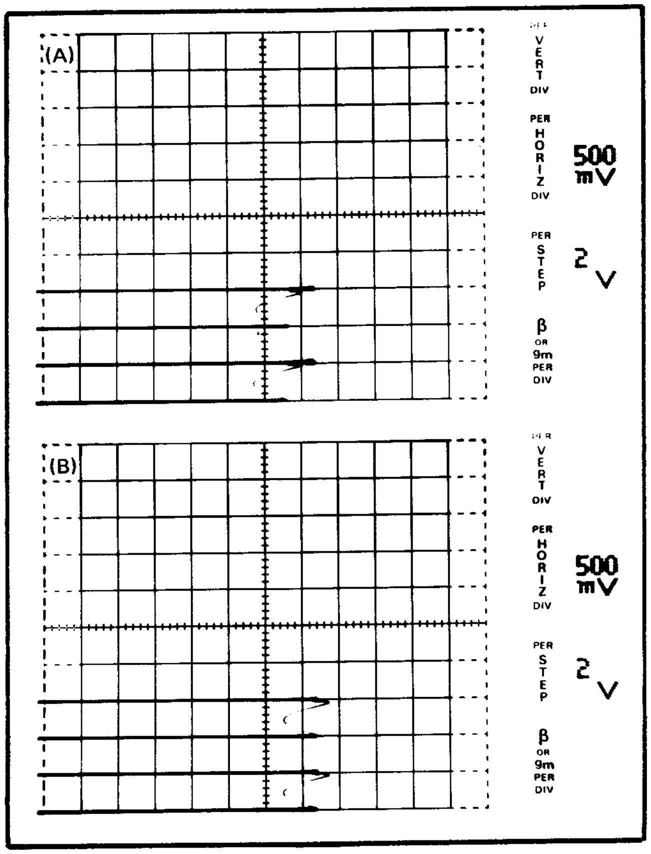

Fig. 5-10. Type 576 display of Collector Supply peaks for adjusting DELAY adjustment R24: (A) incorrect adjustment; (B) correct adjustment.

d. Set the following Type 576 controls to:

POLARITY	+(NPN)
NUMBER OF STEPS	3
RATE	2X

e. Turn the Type 576 CENTERLINE VALUE switch clockwise until the peaks of the Collector Supply output are displayed on the CRT (see Fig. 5-10A).

f. CHECK FOR—Step occurring exactly at the peak of the Collector Supply output (see Fig. 5-10B).

g. ADJUST—R24, DELAY adjustment, (see Fig. 5-9) if the steps do not occur at the peak of the Collector Supply output.

22. Adjust Zero Step Level

a. Set the following Type 576 controls to:

CENTERLINE VALUE	0
HORIZONTAL	.05 V BASE
VARIABLE COLLECTOR SUPPLY	Fully Counterclockwise
AMPLITUDE	.05 V
STEP FAMILY	SINGLE

b. Press the Type 576 ZERO button and center the spot horizontally on the graticule using the horizontal FINE POSITION control.

c. Release the ZERO button.

d. CHECK FOR—Spot horizontally centered on the graticule.

e. ADJUST—R224, AMP BAL adjustment, (see Fig. 5-9) if the spot is not centered.

f. Set the Type 576 AMPLITUDE switch to 2 V.

g. CHECK FOR—Spot horizontally centered on the graticule.

h. ADJUST—R97, ZERO STEP adjustment, (see Fig. 5-9) if the display is not centered.

i. Reset the AMPLITUDE switch to .05 V.

j. Repeat parts b through i until the spot remains centered when the AMPLITUDE switch is switched between the .05 V and the 2 V positions.

k. Set the Type 576 AMPLITUDE switch to 2 V and press the POLARITY INVERT button.

l. CHECK FOR—Spot centered horizontally on the graticule.

m. ADJUST—R127, INVERT ZERO adjustment, (see Fig. 5-9) if the spot is not centered.

23. Adjust Step Amplifier Gain

a. Set the following Type 576 controls to:

NUMBER OF STEPS	10
AMPLITUDE	1 V
STEP FAMILY	REP
POLARITY INVERT	Released

b. Set the following Calibration Fixture controls to:

Function	Step Gen
Step Generator	.05 μA

c. Set the test oscilloscope controls as shown in the initial setup which precedes the Step Generator section of this procedure.

d. Connect a 93 Ω cable with BNC—connectors between the External Monitor on the Calibration Fixture and the Channel A Input of the test oscilloscope.

e. Trigger the test oscillscope display and center the zero step of the Step Generator output on the center horizontal line of the test oscilloscope CRT graticule.

f. Set the test oscilloscope Vc Range switch to +11.

g. CHECK FOR—Tenth step on the center horizontal line of the test oscilloscope graticule ±4 divisions (±2%).

h. ADJUST—R113, STEP AMP GAIN adjustment, (see Fig. 5-8) if the tenth step is not centered.

i. Press the AID OFFSET button.

j. CHECK FOR—Zero step with offset at same level as the tenth step without offset ±4 divisions (±2%).

k. AJDUST—R86, AID OFFSET adjustment, (see Fig. 5-9) if the level of the zero step with offset is not correct.

l. Press the Type 576 ZERO OFFSET button.

m. Set the test oscilloscope Vc Range switch to 0.

n. Check that the zero step is positioned on the center horizontal graticule line.

o. Press the Type 576 OPPOSE OFFSET button.

p. CHECK FOR—Tenth step with opposing offset at the same level as the zero step without offset ±4 divisions (±2%).

q. ADJUST—R85, OPPOSE OFFSET adjustment, (see Fig 5-9) if the level of the tenth step with offset is not correct.

24. Adjust Current Balance

a. Set the following Type 576 controls to:

HORIZONTAL	.1 V BASE
DISPLAY OFFSET Selector	HORIZ X1
CENTERLINE VALUE	5
AMPLITUDE	50 μA
OFFSET	ZERO

b. Set the following Calibration Fixture controls to:

Step Generator	50 μA
Step Generator Loads	1 K Collector Short

c. Position the tenth spot to the intersection of the tenth horizontal and center vertical graticule lines.

d. Set the DISPLAY OFFSET Selector switch to HORIZ X10.

e. Reposition the spot to the intersection of the tenth horizontal and center vertical graticule line.

f. Set the Calibration Fixture Step Generator Loads switch to 1 K + 18 K.

g. CHECK FOR—Spot centered horizontally.

h. ADJUST—R243, OUTPUT Z adjustment, (see Fig. 5-9) if the spot is not centered.

i. Turn the Step Generator Loads switch back and forth between the 1 K Collector Short and the 1 K + 18 K positions and check for no movement of the spot between the two positions.

j. Set the Type 576 AMPLITUDE switch to 2 V.

k. Set the following Calibration Fixture controls to:

Step Generator	2 V
Step Generator Loads	Step Gen

25. Check Step Generator Accuracy

a. Set the test oscilloscope controls to:

Vc Range	+11
Comparison Voltage	0.000

b. Position the zero step to the center horizontal graticule line of the test oscilloscope.

c. Set the test oscilloscope Comparison Voltage to 1.000.

d. CHECK FOR—Step on test oscilloscope center horizontal graticule line ±1 division (±5% of 1 V).

e. Turn the test oscilloscope Comparison Voltage switch throughout its range.

f. CHECK FOR—Each step on the test oscilloscope graticule at the same level as the previous step ±1 division (±5% of 1 V), for each position of the Comparison Voltage switch.

g. Turn the Type 576 AMPLITUDE switch and the Calibration Fixture Step Generator switch, together, throughout their ranges.

h. CHECK FOR—Tenth step on test oscilloscope center horizontal graticule line ±4 divisions (±2% of total output).

i. For the .1 V, .5 μA, 1 mA and 200 mA positions, set the Test Oscilloscope controls as in part a and repeat parts b through f.

j. Press the Type 576 STEP MULT .1X button.

k. Set the following test oscilloscope controls to:

Vc Range	+1.1
Comparison Voltage	0.000
Millivolts/Cm	10

l. Position the zero step to the center horizontal graticule line of the test oscilloscope.

m. Set the test oscilloscope Comparison Voltage switch to 1.000

n. CHECK FOR—Step on test oscilloscope center horizontal graticule line ±1 division (±10% of 0.1 volts).

o. Turn the test oscilloscope Comparison Voltage switch throughout its range.

p. CHECK FOR--Each step on the test oscilloscope graticule at the same level as the previous step ±1 division

(±10% of 0.1 volts) for each position of the Comparison Voltage switch.

q. Turn the Type 576 AMPLITUDE switch and the Calibration Fixture Step Generator switch, together, throughout their ranges.

r. CHECK FOR—Tenth step on test oscilloscope center horizontal graticule line ±2 divisions (±2% of total output).

s. For the 1 mA, 5 μA, 1 V and 2 V positions, repeat parts k through p.

26. Check Offset Multiplier

a. Set the following Type 576 controls to:

OFFSET MULT	0.00
OFFSET	AID
AMPLITUDE	1 V
STEP MULT .1X	Released

b. Set the Calibration Fixture Step Generator switch to 1 V.

c. Set the following test oscilloscope controls to:

Millivolts/cm	50
Vc Range	+11
Comparison Voltage	10.000

d. Position the tenth step on the test oscilloscope center horizontal graticule line.

e. Turn the Type 576 OFFSET MULT control throughout its range.

f. CHECK FOR—Step at test oscilloscope center horizontal line for each complete revolution of the OFFSET MULT control.

g. Set the Type 576 OFFSET MULT control to 10.00.

27. Check Maximum Current Output in Current Mode

a. Set the Type 576 AMPLITUDE switch and the Calibration Fixture Step Generator switch as shown in Table 5-4.

b. Set the following test oscilloscope controls to:

Time/Cm	5 ms
Vc Range	0
Millivolts/cm	20
Input Attenuation	100

c. For each group of settings shown in Table 5-4, press the Type 576 ZERO OFFSET button and adjust the test oscilloscope Millivolts/Cm Variable for three divisions of deflection on the Test oscilloscope CRT. With 3 divisions of deflection, position the zero step on the bottom horizontal graticule line and press the Type 576 AID OFFSET button.

d. CHECK FOR—Display of step family with tenth step offset to the top horizontal graticule line of the graticule.

TABLE 5-4

Check Maximum Current in Current Mode

AMPLITUDE	Step Generator
100 mA[1]	200 mA
1 mA	2 mA
.1 mA	.2 mA
5 μA	10 μA

[1] Tenth step should be at least 4.5 divisions from bottom horizontal graticule line.

28. Check Reverse Current and Voltage Limits

a. Set the following Type 576 controls to:

AMPLITUDE	2 mA
OFFSET	OPPOSE

b. Set the Calibration Fixture Step Generator switch to 10 mA.

c. Set the test oscilloscope Millivolts/Cm switch to 10.

d. CHECK FOR—Current limit between one and two divisions below the tenth step (see Fig. 5-11A).

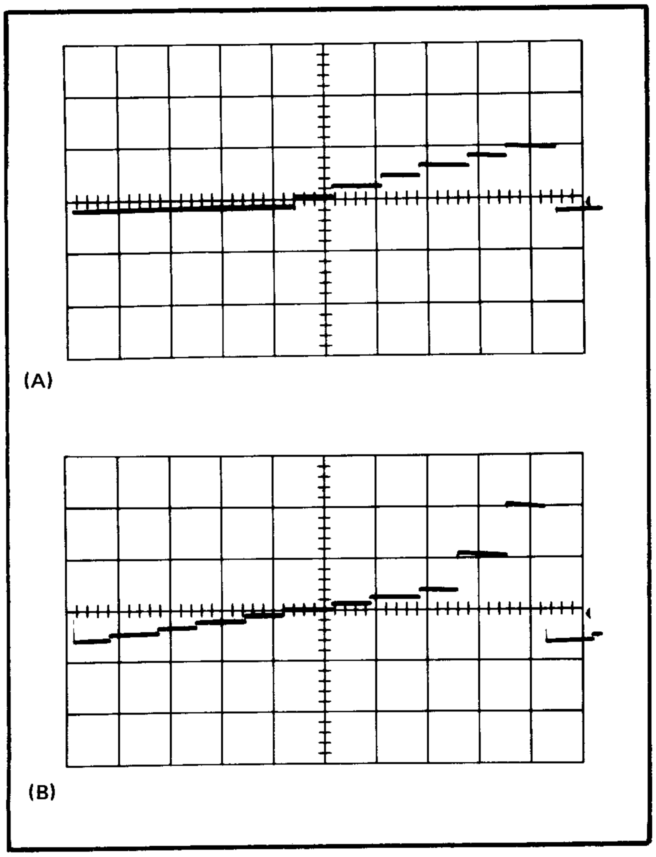

Fig. 5-11. Test oscilloscope display of reverse voltage and current limit: (A) reverse current limit; (B) reverse voltage limit.

e. Set the Calibration Fixture Step Generator switch to 2 mA.

f. CHECK FOR—Voltage limit between 1 and 3 divisions below the tenth step (1 to 3 volts). See Fig. 5-11B.

g. Set the Type 576 AMPLITUDE switch to 2 V.

h. Set the Calibration Fixture Step Generator switch to 10 mA.

i. CHECK FOR—Current limit between one and two divisions below the tenth step.

29. Check Maximum Voltage in Voltage Mode

a. Set the Calibration Fixture Step Generator Loads switch to 40 V Load.

b. Set the Type 576 AMPLITUDE switch and the test oscilloscope Millivolts/Cm and Input Attenuation switches as shown in Table 5-5.

TABLE 5-5
Check Maximum Voltage in Voltage Mode

AMPLITUDE	Millivolts/cm	Input Atten
2 V	10	1000
1 V	5	1000
.5 V	20	100
.2 V	10	100
.1 V	5	100
.05 V	20	10

c. For each group of settings shown in Table 5-5, press the Type 576 ZERO OFFSET button and adjust the test oscilloscope Millivolts/Cm Variable for 2 divisions of deflection on the test oscilloscope CRT. With 2 divisions of deflection, position the zero step one division below the center horizontal graticule line and press the AID OFFSET button

d. CHECK FOR—Display of the step family with the tenth step offset to the top horizontal graticule line of the CRT.

e. Press the Type 576 OPPOSE OFFSET button.

f. CHECK FOR—Display of the step family with the zero step offset to the bottom horizontal graticule line of the CRT.

30. Check Short Circuit Current Limiting in Voltage Mode

a Set the following Type 576 controls to:

DISPLAY OFFSET Selector	HORIZ X10
CENTERLINE VALUE	0.5
OFFSET	AID
VERTICAL	2 A

b. Set the following Calibration Fixture controls to:

Step Generator	100 mA
Step Generator Loads	.1 Ω

c. Press the Type 576 ZERO button and position the spot to the zero vertical and center horizontal graticule lines of the Type 576. Release the ZERO button.

d. Set the Type 576 CURRENT LIMIT and HORIZONTAL switches as shown in Table 5-6.

e. CHECK FOR—Spot displaced from zero vertical graticule line no more than the maximum shown in Table 5-6 when the Type 576 AMPLITUDE switch is turned through its voltage range. When the Type 576 CURRENT LIMIT switch is set to 100 mA and 20 mA, set the Calibration Fixture Step Generator Loads switch to Step Gen.

31. Check Miscellaneous Step Generator Buttons

a. Set the following Type 576 controls to:

AMPLITUDE	1 V
OFFSET	ZERO
RATE	.5X

b. Set the following Calibration Fixture controls to:

Function	Step Generator Check
Step Generator	1 V

TABLE 5-6
Check Short Circuit Current Limit

CURRENT LIMIT	HORIZONTAL (BASE)	Max Displacement from Zero Vertical Graticule Line	Tolerance
2 A	.5	4 divisions +2 divisions	2 A +50% −0%
500 mA	.1	5 div +2.5 div	500 mA +50% −0%
100 mA[1]	.2	5 div +2.5 div	100 mA+50% −0%
20 mA[1]	.05	4 div +2 div	20 mA +50% −0%

[1] Set the Type 576 DISPLAY OFFSET Selector switch to NORM (OFF) and position zero spot on zero vertical graticule line.

c. Set the following test oscilloscope controls to:

Time/Cm	20 ms
Triggering Slope	−
Millivolts/Cm	50
Input Attenuation	100

d. CHECK FOR—Step family with duration of approximately 9.2 divisions, 18.4 ms, for a 60 Hz line frequency (22.0 ms for a 50 Hz line frequency).

e. Set the test oscilloscope Time/Cm switch to 10 ms.

f. Adjust the test oscilloscope Variable Time/Cm control for a step family with the beginning of the zero step on the first vertical graticule line of the test oscilloscope and the tenth step on the eleventh graticule line

g. Press the Type 576 NORM RATE button.

h. CHECK FOR—Two step families per 10 divisions

i. Press the Type 576 2X RATE button.

j. CHECK FOR—Four step families per 10 divisions

k. Press the Type 576 STEP/OFFSET POLARITY INVERT button.

l. CHECK FOR—Step families inverted.

m. Set the test oscilloscope Time/cm switch to 5 ms and trigger slope to −.

n. Press the Type 576 STEP FAMILY SINGLE button. Press it again.

o. CHECK FOR—Single step family generated each time the SINGLE button is pressed.

p. Press the Type 576 REP STEP FAMILY button and release the POLARITY INVERT button.

q. Turn the Type 576 NUMBER OF STEPS switch throughout its range.

r. CHECK FOR—Number of steps per family reduced by one each time the switch is turned one position counterclockwise.

s. Press the Type 576 300 μs PULSED STEPS button and set the NUMBER OF STEPS switch to 1.

t. Set the test oscilloscope Time/Cm switch to 50 μs (Calibrated) and the Millivolts/Cm switch to 5.

u. Trigger the display on the CRT.

v. CHECK FOR—Pulsed step with a width of 6 div, +1.1 div, −0.3 div (300 μs, +20%, −5%).

w. Press the Type 576 80 μs PULSED STEPS button.

x. CHECK FOR—Pulsed step with a width of 1.6 div, +0.3 div −0.1 div (80 μs, +20% −5%).

NOTES

COLLECTOR SUPPLY

Initial Control Settings

Type 576

VERTICAL	20 mA
DISPLAY OFFSET Selector	NORM (OFF)
CENTERLINE VALUE	0
HORIZONTAL	2 V COLLECTOR
POSITION (Vertical and Horizontal)	Controls Centered
FINE POSITION (Vertical and Horizontal)	Controls Centered
MAX PEAK VOLTS	15
PEAK POWER WATTS	220
VARIABLE COLLECTOR SUPPLY	Fully Counterclockwise
PEAK POWER WATTS	220
VARIABLE COLLECTOR SUPPLY	Fully Counterclockwise
POLARITY	AC
MODE	NORM
STEP FAMILY	REP

Type 576 Calibration Fixture

Function	Step Gen
Step Generator Loads	Coll Voltage ÷ 10 Into 1 MΩ

Test Oscilloscope

Time/Cm	5 ms (Calibrated)
Triggering	Trig, +, AC, Int
Vc Range	0
Input Coupling	AC
Input Attenuation	100
Millivolts/Cm	10

32. Check Collector Supply Polarity and Ripple

a. Turn the Type 576 VARIABLE COLLECTOR SUPPLY fully clockwise and trigger the test oscilloscope display.

b. CHECK FOR—Display of Type 576 Collector Supply output in AC polarity (sine wave).

c. Set the Type 576 POLARITY switch to +(NPN).

d. CHECK FOR—Display of Collector Supply output in +(NPN) polarity (full wave rectified positive-going sine wave).

e. Set the Type 576 POLARITY switch to −(PNP).

f. CHECK FOR—Display of Collector Supply output in −(PNP) polarity (full wave rectified negative-going sine wave).

g. Set the following Type 576 controls to:

POLARITY	+(NPN)
MODE	DC
VARIABLE COLLECTOR SUPPLY	Fully Clockwise

h. Set the Type 576 MAX PEAK VOLTS switch and the test oscilloscope Input Attenuation switch and Millivolts/Cm switch as shown in Table 5-7.

i. For each group of settings shown in Table 5-7, trigger the test oscilloscope display and position the display of ripple onto the CRT.

j. CHECK FOR—Display of DC mode ripple within tolerances shown in Table 5-7.

33. Check Collector Supply Peak Voltages and Currents

a. Set the Calibration Fixture Step Generator Loads switch to Off.

b. Set the Type 576 VARIABLE COLLECTOR SUPPLY fully counterclockwise and the MODE switch to NORM.

c. Position the spot to the zero vertical line and the center horizontal line of the Type 576 CRT graticule.

d. Set the Type 576 HORIZONTAL and MAX PEAK VOLTS switches as shown in Table 5-8.

e. For each group of settings, turn the Type 576 VARIABLE COLLECTOR SUPPLY control fully clockwise and check for a peak voltage as shown in Table 5-8.

TABLE 5-7

Check Collector Supply Ripple

MAX PEAK VOLTS	Input Atten	mV/cm	Ripple (peak-to-peak)	Tolerance
15	1	10	±1.5 div	15 V ±1%
75	1	50	±1.5 div	75 V ±1%
350	10	20	±1.75 div	350 V ±1%
1500	100	10	±3.0 div[1]	1500 V ±1%

[1]Calibration Fixture 10X attenuator causes ripple to be doubled in this case.

TABLE 5-8
Check Collector Supply Peak Voltages

HORIZONTAL	MAX PEAK VOLTS	Peak Volts	Tolerance
2	15	7.5 div, +1.5 div −0.38 div	15 V, +20% −5%
10	75	7.5 div, +1.5 div −0.38 div	75 V, +20% −5%
50	350	7.5 div, +1.5 div −0.38 div	350 V, +20% −5%
200	1500	7.5 div, +1.5 div −0.38 div	1500 V, +20% −5%

f. Set the Type 576 VARIABLE COLLECTOR SUPPLY fully counterclockwise and the MAX PEAK VOLTS switch to 15.

g. Set the Calibration Fixture Step Generator Loads switch to 1 K Collector Short.

h. Set the Type 576 MAX PEAK VOLTS and VERTICAL switches as shown in Table 5-9.

TABLE 5-9
Check Collector Supply Peak Current

VERTICAL	MAX PEAK VOLTS	Peak Current
20 mA	1500	10 divisions (20 mA)
.1 A	350	10 divisions (1 A)
.5 A	75	8 divisions (4 A)
2 A	15	10 divisions (20 A)

i. Position the spot to the zero vertical and horizontal graticule lines of the Type 576 CRT.

j. For each Type 576 MAX PEAK VOLTS setting, turn the VARIABLE COLLECTOR SUPPLY control clockwise until the peak current shown in Table 5-9 is reached, then return the VARIABLE COLLECTOR SUPPLY control to its fully counterclockwise position.

CAUTION

Do not exceed the rating of the collector supply as shown in Table 5-9. Return the VARIABLE COLLECTOR SUPPLY control to its fully counterclockwise position as soon as the maximum current has been obtained.

k. Set the Type 576 Calibration Fixture Step Generator Loads switch to Off.

34. Check Interlock System.

a Turn off the Type 576.

b. Disconnect the Calibration Fixture from the Type 576 and install the Standard Test Fixture.

c. Install the universal transistor adapter (Tektronix Part No. 013-0098-00) on the Standard Test Fixture.

d. Install the protective box on the Standard Test Fixture, close the lid and turn on the Type 576.

e. Set the following Type 576 controls to:

VERTICAL	1 mA
HORIZONTAL	.5 V COLLECTOR
MAX PEAK VOLTS	15
PEAK POWER WATTS	220
VARIABLE COLLECTOR SUPPLY	Fully Counterclockwise
Terminal Selector	BASE TERM STEP GEN (NORM)

f. Turn the VARIABLE COLLECTOR SUPPLY for a trace five divisions long.

g. Lift the lid of the protective box.

h. CHECK FOR—No change in the trace on the CRT and the yellow and red lights off.

i. Set the Type 576 MAX PEAK VOLTS switch to the 75, 350 and 1500 positions. Set the HORIZONTAL switch to 2 V, 10 V and 100 V, respectively.

j. In each position of the MAX PEAK VOLTS switch lift and close the lid of the protective box.

k. CHECK FOR—Red light on and trace appearing on the CRT when the lid is closed; yellow light on and no trace when the lid is open.

35. Adjust Looping Compensation

a. Set the following Type 576 controls to:

VERTICAL	1 μA
HORIZONTAL	2 V COLLECTOR
MAX PEAK VOLTS	15
VARIABLE COLLECTOR SUPPLY	Fully Clockwise
LOOPING COMPENSATION	Centered
LEFT-OFF-RIGHT	LEFT

b. CHECK FOR—Trace which is a single loop (see Fig. 5-12A).

c. ADJUST—C301, LOOPING BALANCE adjustment, on the left side of the instrument (see Fig. 5-13) if the trace has two loops.

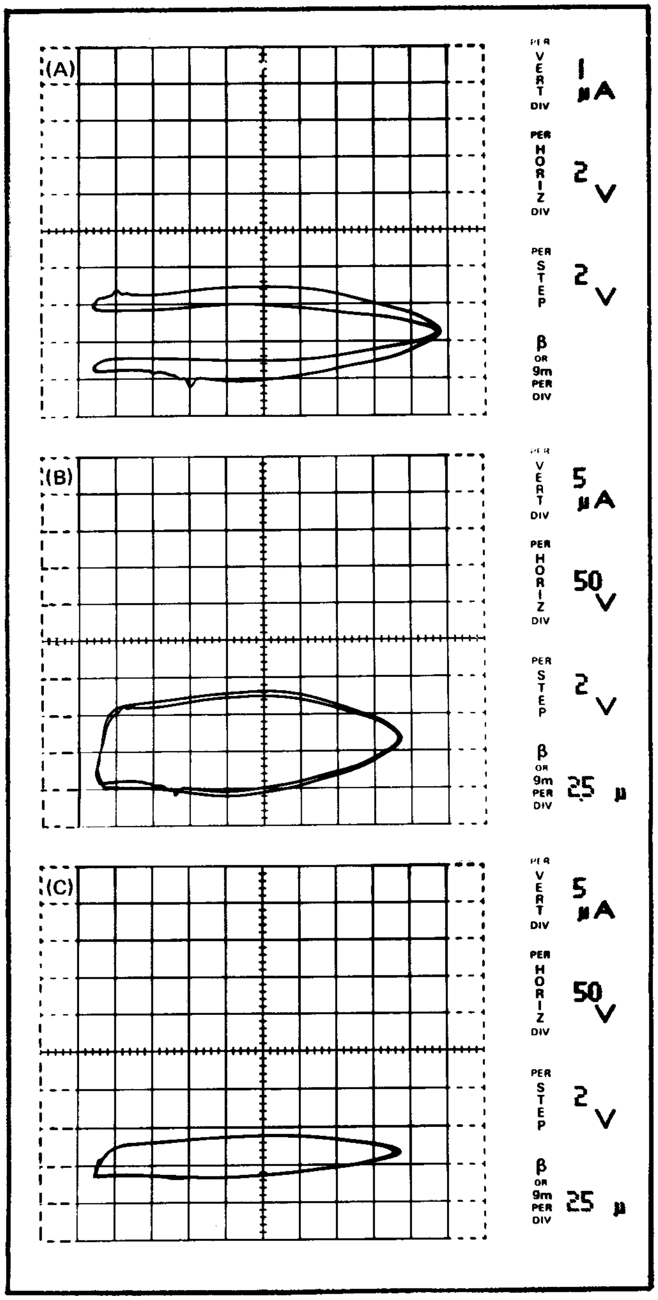

Fig. 5-12. Type 576 display of looping: (A) Display of undesirable double loop; (B) Display of uncompensated looping; (C) Display of compensated looping.

d. Set the following Type 576 controls to:

MAX PEAK VOLTS	350
HORIZONTAL	50 V COLLECTOR
VERTICAL	10 µA (if trace is not on CRT)

e. CHECK FOR—Minimum high frequency noise on trace.

f. ADJUST—C341, H. F. NOISE REJECTION adjustment, (see Fig. 5-13) for minimum high frequency noise. Do not adjust C341 more than a few turns clockwise.

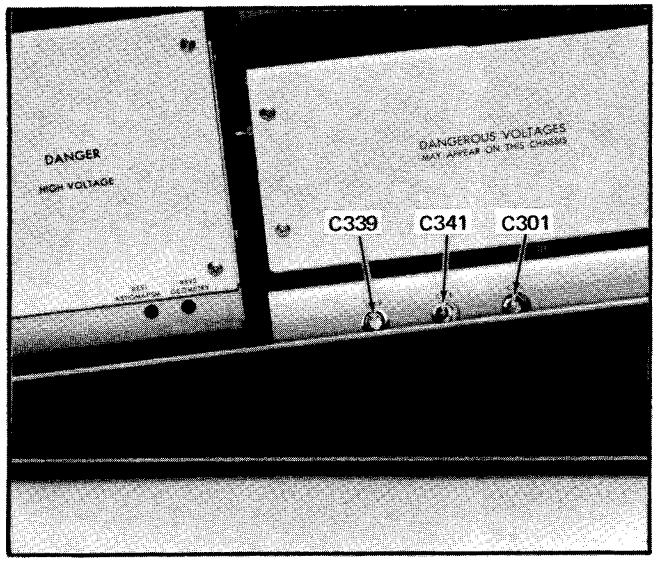

Fig. 5-13. Location of adjustments in step 35.

g. CHECK FOR—Minimum vertical width of trace loop (see Fig. 5-12B and C).

h. ADJUST—C339, 350 V and 1500 V LOOPING COMPENSATION adjustment, (see Fig. 5-13) for minimum width of trace loop.

i. Set the following Type 576 controls to:

VERTICAL	1 µA
HORIZONTAL	2 V COLLECTOR
MAX PEAK VOLTS	15

j. CHECK FOR—Minimum vertical width of trace loop.

k. ADJUST—LOOPING COMPENSATION control and C301, LOOPING BALANCE adjustment (see Fig. 5-13), for minimum vertical width of the trace loop.

l. Set the following Type 576 controls to:

HORIZONTAL	50 V COLLECTOR
MAX PEAK VOLTS	350

m. Repeat parts g through k.

n. For a complete calibration or adjustments only, this completes the procedure.

36. Check and Adjust Looping Compensation

a. Set the following Type 576 controls to:

VERTICAL	1 µA
HORIZONTAL	2 V COLLECTOR
MAX PEAK VOLTS	15
VARIABLE COLLECTOR SUPPLY	Fully Clcokwise

b. CHECK FOR—Minimum vertical width of the trace loop (see Fig. 5-12B and C).

c. ADJUST—LOOPING COMPENSATION control for minimum vertical width of the trace loop.

d. This completes the Type 576 performance check procedure.

PARTS LIST ABBREVIATIONS

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

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 or model 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.

SPECIAL NOTES AND SYMBOLS

×000	Part first added at this serial number
00×	Part removed after this serial number
*000-0000-00	Asterisk preceding Tektronix Part Number indicates manufactured by or for Tektronix, Inc., or reworked or checked components.
Use 000-0000-00	Part number indicated is direct replacement.

SECTION 6
ELECTRICAL PARTS LIST

Values are fixed unless marked Variable.

Bulbs

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
B323	150-0089-00			Incandescent, 14 V, 80 mA, amber lens
B360	150-0090-00			Incandescent, 14 V, 80 mA, red lens
B704	150-0087-00			Incandescent, 6.3 V, 0.2 A, green lens
B705	150-0029-00			GE 349
B706	150-0029-00			GE 349
B707	150-0029-00			GE 349
B773	150-0029-00			GE 349
B885	150-0067-00	XB020000		Neon, 5AH-B
B886	150-0067-00	XB020000		Neon, 5AH-B
B887	150-0030-00	XB020000		Neon, NE 2 V

Capacitors

Tolerance ±20% unless otherwise indicated.

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
C1	283-0177-00			1 µF	Cer	25 V	+80%—20%
C5	283-0003-00	B010100	B019999	0.01 µF	Cer	150 V	
C5	283-0051-00	B020000		0.0033 µF	Cer	100 V	5%
C10	283-0177-00			1 µF	Cer	25 V	+80%—20%
C14	283-0003-00	B010100	B019999	0.01 µF	Cer	150 V	
C14	283-0051-00	B020000		0.0033 µF	Cer	100 V	5%
C26	285-0703-00			0.1 µF	PTM	100 V	5%
C33	283-0078-00			0.001 µF	Cer	500 V	
C34	283-0003-00			0.01 µF	Cer	150 V	
C35	285-0598-00			0.01 µF	PTM	100 V	5%
C49	283-0104-00			2000 pF	Cer	500 V	5%
C50	285-0598-00			0.01 µF	PTM	100 V	5%
C78	283-0080-00			0.022 µF	Cer	25 V	+80%—20%
C81	283-0003-00			0.01 µF	Cer	150 V	
C89	283-0026-00			0.2 µF	Cer	25 V	
C110	283-0032-00			470 pF	Cer	500 V	5%
C112	283-0128-00			100 pF	Cer	500 V	5%
C114	283-0092-00			0.03 µF	Cer	200 V	+80%—20%
C134	283-0032-00			470 pF	Cer	500 V	5%
C137	283-0128-00			100 pF	Cer	500 V	5%
C160	283-0144-00			33 pF	Cer	500 V	1%
C161	283-0032-00			470 pF	Cer	500 V	5%
C172	283-0000-00			0.001 µF	Cer	500 V	
C177	283-0000-00			0.001 µF	Cer	500 V	
C182	283-0079-00			0.01 µF	Cer	250 V	
C183	283-0177-00			1 µF	Cer	25 V	+80%—20%
C187	281-0550-00	XB120000		120 pF	Cer	500 V	10%
C188	290-0410-00			15 µF	Elect.	100 V	+50%—10%

Bulbs *(cont,*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
C189	290-0410-00			15 μF	Elect.	100 V	+50%—10%
C194	283-0032-00			470 pF	Cer	500 V	5%
C229	281-0504-00			10 pF	Cer	500 V	10%
C236	283-0032-00			470 pF	Cer	500 V	5%
C294	290-0297-00			39 μF	Elect.	10 V	10%
C296	290-0136-00			2.2 μF	Elect.	20 V	
C298	290-0136-00			2.2 μF	Elect.	20 V	
C300	285-0718-00			3.75 μF	PTM		10%
C301	281-0143-00			3.5-27 pF, Var	Air		
C323	283-0177-00			1 μF	Cer	25 V	+80%—20%
C326	290-0409-00			1000 μF	Elect.	25 V	+75%—10%
C329	290-0408-00			100 μF	Elect.	100 V	+50%—10%
C332	290-0213-00			10 μF	Elect.	450 V	
C335	285-0787-00			0.47 μF	PTM	1000 V	
C336	285-0787-00			0.47 μF	PTM	1000 V	
C339	281-0144-00			4-50 pF, Var	Air		
C341	281-0141-00			65-340 pF, Var	Mica		
C343	281-0142-00			5-75 pF, Var	Air		
C401	283-0078-00			0.001 μF	Cer	500 V	
C402	283-0068-00			0.01 μF	Cer	500 V	
C403	283-0008-00	B010100	B019999	0.1 μF	Cer	500 V	
C403	283-0189-00	B020000		0.1 μF	Cer	400 V	
C413	283-0605-00			678 pF	Mica	300 V	1%
C432	281-0159-00	XB090000		1.8-5.1 pF, Var	Air		
C433	281-0091-00	B010100	B089999	2-8 pF, Var	Cer		
C433	281-0601-00	B090000		7.5 pF	Cer	500 V	±0.5 pF
C434	281-0572-00	B010100	B089999	6.8 pF	Cer	500 V	±0.5 pF
C434	281-0601-00	B090000		7.5 pF	Cer	500 V	±0.5 pF
C435	281-0637-00	XB090000		91 pF	Cer	500 V	5%
C436	283-0616-00	B010100	B089999	75 pF	Mica	500 V	5%
C436	281-0637-00	B090000		91 pF	Cer	500 V	5%
C437	281-0546-00	XB090000		330 pF	Cer	500 V	10%
C438	283-0626-00	XB090000		1800 pF	Mica	500 V	5%
C562	281-0625-00			35 pF	Cer	500 V	5%
C568	281-0625-00			35 pF	Cer	500 V	5%
C662	281-0625-00			35 pF	Cer	500 V	5%
C668	281-0625-00			35 pF	Cer	500 V	5%
C696	290-0135-00			15 μF	Elect.	20 V	
C698	290-0135-00			15 μF	Elect.	20 V	
C706	285-0515-00			0.022 μF	MT	400 V	
C707	290-0173-00			200 μF	Elect.	250 V	
C708	290-0136-00			2.2 μF	Elect.	20 V	
C712	281-0536-00			1000 pF	Cer	500 V	10%
C719	290-0305-01			3 μF	Elect.	150 V	10%
C729	283-0004-00			0.02 μF	Cer	150 V	
C732	290-0410-00			15 μF	Elect.	100 V	+50%—10%
C737	285-0515-00			0.022 μF	MT	400 V	
C738	290-0411-00			4200 μF	Elect.	30 V	+100%—10%
C742	281-0504-00			10 pF	Cer	500 V	10%
C754	290-0287-00			47 μF	Elect.	25 V	
C758	285-0515-00			0.022 μF	MT	400 V	
C759	290-0321-00			11000 μF	Elect.	15 V	+100%—10%
C763	283-0004-00			0.02 μF	Cer	150 V	
C769	281-0630-00			390 pF	Cer	500 V	5%

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Capacitors (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
C777	290-0297-00			39 μF	Elect.	10 V	10%
C789	290-0297-00			39 μF	Elect.	10 V	10%
C790	285-0515-00			0.022 μF	MT	400 V	
C791	290-0411-00			4200 μF	Elect.	30 V	+100—10%
C796	281-0504-00			10 pF	Cer	500 V	10%
C806	290-0287-00			47 μF	Elect.	25 V	
C810	281-0523-00			100 pF	Cer	350 V	
C819	290-0135-00			15 μF	Elect.	20 V	
C821	285-0515-00			0.022 μF	MT	400 V	
C822	290-0310-00			2000 μF	Elect.	75 V	+75%—10%
C823	290-0310-00			2000 μF	Elect.	75 V	+75%—10%
C828	285-0515-00			0.022 μF	MT	400 V	
C829	290-0173-00			200 μF		250 V	
C834	281-0510-00			22 pF	Cer	500 V	
C848	290-0149-00			5 μF	Elect.	150 V	
C850	290-0412-00			100 μF	Elect.	150 V	+100%—10%
C851	283-0177-00			1 μF	Cer	25 V	+80%—20%
C861	283-0079-00			0.01 μF	Cer	250 V	
C863	290-0134-00			22 μF	Elect.	15 V	
C864	283-0006-00			0.02 μF	Cer	500 V	
C865	283-0006-00			0.02 μF	Cer	500 V	
C866	283-0006-00			0.02 μF	Cer	500 V	
C867	283-0000-00			0.001 μF	Cer	500 V	
C868	283-0006-00			0.02 μF	Cer	500 V	
C869	283-0006-00			0.02 μF	Cer	500 V	
C870	283-0071-00			0.0068 μF	Cer	5000 V	
C871	283-0071-00			0.0068 μF	Cer	5000 V	
C888	283-0071-00			0.0068 μF	Cer	5000 V	
C899	290-0134-00			22 μF	Elect.	15 V	

Semiconductor Device, Diodes

Ckt. No.	Tektronix Part No.	Eff	Disc	Description	
D1	*152-0185-00			Silicon	Replaceable by 1N4152
D2	*152-0185-00			Silicon	Replaceable by 1N4152
D10	*152-0185-00			Silicon	Replaceable by 1N4152
D11	*152-0185-00			Silicon	Replaceable by 1N4152
D28	*152-0185-00			Silicon	Replaceable by 1N4152
D35	*152-0185-00			Silicon	Replaceable by 1N4152
D39	*152-0185-00			Silicon	Replaceable by 1N4152
D41	*152-0185-00			Silicon	Replaceable by 1N4152
D42	*152-0185-00			Silicon	Replaceable by 1N4152
D43	*152-0185-00			Silicon	Replaceable by 1N4152
D44	*152-0185-00			Silicon	Replaceable by 1N4152
D47	*152-0185-00			Silicon	Replaceable by 1N4152
D48	*152-0185-00			Silicon	Replaceable by 1N4152
D53	*152-0185-00			Silicon	Replaceable by 1N4152
D54	*152-0185-00			Silicon	Replaceable by 1N4152

Capacitors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc		Description
D55	*152-0185-00			Silicon	Replaceable by 1N4152
D57	*152-0185-00			Silicon	Replaceable by 1N4152
D58	*152-0185-00			Silicon	Replaceable by 1N4152
D60	*152-0185-00			Silicon	Replaceable by 1N4152
D61	*152-0185-00			Silicon	Replaceable by 1N4152
D63	*152-0185-00			Silicon	Replaceable by 1N4152
D64	*152-0185-00			Silicon	Replaceable by 1N4152
D66	*152-0185-00			Silicon	Replaceable by 1N4152
D67	*152-0185-00			Silicon	Replaceable by 1N4152
D68	*152-0185-00			Silicon	Replaceable by 1N4152
D69	*152-0185-00			Silicon	Replaceable by 1N4152
D70	*152-0185-00			Silicon	Replaceable by 1N4152
D71	*152-0185-00			Silicon	Replaceable by 1N4152
D72	*152-0185-00			Silicon	Replaceable by 1N4152
D73	*152-0185-00			Silicon	Replaceable by 1N4152
D82	*152-0185-00			Silicon	Replaceable by 1N4152
D83	*152-0185-00			Silicon	Replaceable by 1N4152
D89	*152-0185-00			Silicon	Replaceable by 1N4152
D102	*152-0185-00			Silicon	Replaceable by 1N4152
D104	*152-0185-00			Silicon	Replaceable by 1N4152
D115	*152-0185-00			Silicon	Replaceable by 1N4152
D116	*152-0185-00			Silicon	Replaceable by 1N4152
D122	*152-0185-00			Silicon	Replaceable by 1N4152
D133	*152-0185-00			Silicon	Replaceable by 1N4152
D146	*152-0185-00			Silicon	Replaceable by 1N4152
D147	152-0217-00			Zener	1N756A, 400 mW, 8.2 V, 5%
D159	*152-0185-00			Silicon	Replaceable by 1N4152
D165	*152-0185-00			Silicon	Replaceable by 1N4152
D179	152-0198-00			Silicon	MR 1032A, 200 V PIV, 3 A
D185	152-0198-00			Silicon	MR 1032A, 200 V PIV, 3 A
D188	152-0040-00			Silicon	400 V, 1 A
D189	152-0040-00			Silicon	400 V, 1 A
D220	*152-0324-00			Silicon	Tek Spec
D223	*152-0324-00			Silicon	Tek Spec
D229	*152-0185-00			Silicon	Replaceable by 1N4152
D248	*152-0185-00			Silicon	Replaceable by 1N4152
D249	*152-0185-00			Silicon	Replaceable by 1N4152
D250	*152-0185-00			Silicon	Replaceable by 1N4152
D251	*152-0185-00			Silicon	Replaceable by 1N4152
D305	152-0385-00			Silicon	Rectifier, 2000 V, 100 mA
D306	152-0385-00			Silicon	Rectifier, 2000 V, 100 mA
D307	152-0385-00			Silicon	Rectifier, 2000 V, 100 mA
D308	152-0385-00			Silicon	Rectifier, 2000 V, 100 mA
D310A,B,C,D	*152-0404-00			Silicon	Assembly, W/Heat Sink
D320	*152-0185-00			Silicon	Replaceable by 1N4152

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Semiconductor Device, Diodes *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc		Description
D410	*152-0185-00			Silicon	Replaceable by 1N4152
D411	*152-0185-00			Silicon	Replaceable by 1N4152
D507	152-0212-00			Zener	1N936, 500 mW, 9 V, 5% TC
D520	*152-0185-00			Silicon	Replaceable by 1N4152
D530	*152-0324-00			Silicon	Tek Spec
D534	*152-0185-00			Silicon	Replaceable by 1N4152
D537	*152-0185-00			Silicon	Replaceable by 1N4152
D541	*152-0185-00			Silicon	Replaceable by 1N4152
D554	*152-0185-00			Silicon	Replaceable by 1N4152
D556	*152-0324-00			Silicon	Tek Spec
D560	*152-0185-00			Silicon	Replaceable by 1N4152
D563	*152-0185-00			Silicon	Replaceable by 1N4152
D567	*152-0185-00			Silicon	Replaceable by 1N4152
D569	*152-0185-00			Silicon	Replaceable by 1N4152
D579	152-0141-02			Silicon	1N4152
D586	152-0141-02			Silicon	1N4152
D620	*152-0185-00			Silicon	Replaceable by 1N4152
D630	*152-0324-00			Silicon	Tek Spec
D634	*152-0185-00			Silicon	Replaceable by 1N4152
D637	*152-0185-00			Silicon	Replaceable by 1N4152
D641	*152-0185-00			Silicon	Replaceable by 1N4152
D654	*152-0185-00			Silicon	Replaceable by 1N4152
D656	*152-0324-00			Silicon	Tek Spec
D660	*152-0185-00			Silicon	Replaceable by 1N4152
D663	*152-0185-00			Silicon	Replaceable by 1N4152
D667	*152-0185-00			Silicon	Replaceable by 1N4152
D669	*152-0185-00			Silicon	Replaceable by 1N4152
D679	152-0141-02			Silicon	1N4152
D686	152-0141-02			Silicon	1N4152
D706A,B,C,D(4)	152-0066-00			Silicon	1N3194
D708	152-0212-00			Zener	1N936 500 mW, 9 V, 5% TC
D713	152-0280-00			Zener	1N753A 400 mW, 6.2 V, 5%
D714	*152-0185-00			Silicon	Replaceable by 1N4152
D715	*152-0185-00			Silicon	Replaceable by 1N4152
D722	*152-0233-00			Silicon	Tek Spec
D730	*152-0185-00			Silicon	Replaceable by 1N4152
D732	152-0066-00			Silicon	1N3194
D737A,B,C,D(4)	152-0066-00			Silicon	1N3194
D751	*152-0185-00			Silicon	Replaceable by 1N4152
D754	152-0066-00			Silicon	1N3194
D758A,B,C,D(4)	152-0198-00			Silicon	MR 1032A 200 V PIV, 3A
D769	*152-0185-00			Silicon	Replaceable by 1N4152
D776	152-0066-00			Silicon	1N3194
D788	152-0066-00			Silicon	1N3194
D790A,B,C,D(4)	152-0198-00			Silicon	MR 1032A 200 V PIV, 3A

Semiconductor Device, Diodes *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc		Description
D798	*152-0185-00			Silicon	Replaceable by 1N4152
D799	*152-0185-00			Silicon	Replaceable by 1N4152
D803	*152-0185-00			Silicon	Replaceable by 1N4152
D806	152-0066-00			Silicon	1N3194
D821A,B,C,D(4)	152-0198-00			Silicon	MR 1032A 200 V PIV, 3A
D828A,B,C,D(4)	152-0066-00			Silicon	1N3194
D833	*152-0233-00			Silicon	Tek Spec
D848	152-0066-00			Silicon	1N3194
D859	*152-0185-00			Silicon	Replaceable by 1N4152
D862	*152-0185-00			Silicon	Replaceable by 1N4152
D865	*152-0107-00			Silicon	Replaceable by 1N647
D866	*152-0107-00			Silicon	Replaceable by 1N647
D868	*152-0107-00			Silicon	Replaceable by 1N647
D869	*152-0107-00			Silicon	Replaceable by 1N647
D870	152-0408-00			Silicon	Rectifier 10,000 V, 5 mA fast reverse recovery
D882	152-0288-00			Zener	.4M140Z5 400 mV, 140 V, 5%
D885	152-0242-00	B010100	B019999X	Silicon	225 V, 100 mA
D887	152-0242-00	B010100	B019999X	Silicon	225 V, 100 mA
D908	*152-0185-00			Silicon	Replaceable by 1N4152
D912	*152-0185-00			Silicon	Replaceable by 1N4152
D913	*152-0185-00			Silicon	Replaceable by 1N4152
D914	*152-0185-00			Silicon	Replaceable by 1N4152
D915	*152-0185-00			Silicon	Replaceable by 1N4152
D916	*152-0185-00			Silicon	Replaceable by 1N4152
D917	*152-0185-00			Silicon	Replaceable by 1N4152
D918	*152-0185-00			Silicon	Replaceable by 1N4152
D919	*152-0185-00			Silicon	Replaceable by 1N4152
D920	*152-0185-00			Silicon	Replaceable by 1N4152
D922	*152-0185-00			Silicon	Replaceable by 1N4152
D923	*152-0185-00			Silicon	Replaceable by 1N4152
D924	*152-0185-00			Silicon	Replaceable by 1N4152
D926	*152-0185-00			Silicon	Replaceable by 1N4152
D927	*152-0185-00			Silicon	Replaceable by 1N4152
D928	*152-0185-00			Silicon	Replaceable by 1N4152
D929	*152-0185-00			Silicon	Replaceable by 1N4152
D930	*152-0185-00			Silicon	Replaceable by 1N4152
D931	*152-0185-00			Silicon	Replaceable by 1N4152
D932	*152-0185-00			Silicon	Replaceable by 1N4152
D933	*152-0185-00			Silicon	Replaceable by 1N4152
D934	*152-0185-00			Silicon	Replaceable by 1N4152

Fuses

F701	159-0011-00	6¼ A	3 AG Slo-Blo
F702	159-0027-00	4 A	3 AG Slo-Blo

Connectors

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
J300	131-0689-00			Receptacle, electrical, 15 contact, female
J360	131-0097-00			32 contact, female
J361	131-0018-00			l6 contact, female
J362	131-0018-00			l6 contact, female
J363	131-0148-00			24 contact, female
J372	136-0140-00			Banana Jack assembly
J373	136-0140-00			Banana Jack assembly
J374	136-0140-00			Banana Jack assembly
J819	131-0717-00			Receptacle, electrical, 3 contact, female
P300	131-0690-00			Receptacle, electrical, 15 male pins
P360	131-0096-00			32 contact, male

Inductors

Ckt. No.	Tektronix Part No.	Eff	Disc	Description
L300	*108-0521-00			Toroid, 10 mH
L370	276-0549-00			Core, ferrite
L371	276-0549-00			Core, ferrite
L375	276-0549-00			Core, ferrite
L850	*108-0237-00			80 μH
L897	*108-0518-00			Trace Rotator

Relays

Ckt. No.	Tektronix Part No.	Eff	Disc	Description
K101	148-0044-00			Relay, Armature 12 V DC, 425 Ω coil
K102	148-0045-00			Relay, Armature 12 V DC, 185 Ω coil
K320	148-0047-00			Relay, Armature 12 V DC, 10 A
K323	148-0022-00	B010100	B129999	Relay, Armature 12 V DC, 185 Ω coil
K323	148-0047-00	B130000		Relay, Armature 12 V DC, 10 A
K520	148-0044-00			Relay, Armature 12 V DC, 425 Ω coil
K537	148-0027-00			Relay, Armature, 12 V DC, 300 Ω coil
K541	148-0027-00			Relay, Armature, 12 V DC, 300 Ω coil
K620	148-0044-00			Relay, Armature, 12 V DC, 425 Ω coil
K637	148-0027-00			Relay, Armature, 12 V DC, 300 Ω coil
K641	148-0027-00			Relay, Armature, 12 V DC, 300 Ω coil

Transistors

Ckt. No.	Tektronix Part No.	Eff	Disc	Description	
Q23	151-0190-00			Silicon	2N3904
Q30	151-0190-00			Silicon	2N3904
Q36	151-0190-00			Silicon	2N3904
Q41	151-0190-00			Silicon	2N3904
Q46	151-0190-00			Silicon	2N3904
Q52	*151-0219-00			Silicon	Replaceable by 2N4250
Q90	*151-0219-00			Silicon	Replaceable by 2N4250
Q93	*151-0136-00			Silicon	Replaceable by 2N3053
Q101	151-0260-00			Silicon	2N5189
Q105	*151-0261-00			Silicon	Dual, Tek Spec
Q110	*151-0136-00			Silicon	Replaceable by 2N3053
Q117	151-1021-00			Silicon	FET
Q122	151-0250-00			Silicon	2N5184
Q130	151-0232-00			Silicon	Dual
Q133	151-0208-00			Silicon	2N4036

Transistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc		Description
Q150	151-0232-00			Silicon	Dual
Q152	151-0190-00			Silicon	2N3904
Q164	*151-0219-00			Silicon	Replaceable by 2N4250
Q169	*151-0136-00			Silicon	Replaceable by 2N3053
Q172	151-0226-00			Silicon	2N3767
Q176	151-0227-00			Silicon	2N3741
Q180	*151-0140-00			Silicon	Selected from 2N3055
Q184	*151-0140-00			Silicon	Selected from 2N3055
Q226	151-0190-00			Silicon	2N3904
Q229	151-1029-00			Silicon	Dual, FET
Q233	*151-0219-00			Silicon	Replaceable by 2N4250
Q235	151-0273-00			Silicon	2N5249
Q241	*151-0219-00			Silicon	Replaceable by 2N4250
Q248	151-0190-00			Silicon	2N3904
Q250	*151-0219-00			Silicon	Replaceable by 2N4250
Q531	151-1029-00			Silicon	Dual, FET
Q533	151-0232-00			Silicon	Dual
Q560	*151-0219-00			Silicon	Replaceable by 2N4250
Q569	*151-0219-00			Silicon	Replaceable by 2N4250
Q578	*151-0150-00			Silicon	Selected from 2N3440
Q587	*151-0150-00			Silicon	Selected from 2N3440
Q631	151-1029-00			Silicon	Dual, FET
Q633	151-0232-00			Silicon	Dual
Q660	*151-0219-00			Silicon	Replaceable by 2N4250
Q669	*151-0219-00			Silicon	Replaceable by 2N4250
Q678	*151-0150-00			Silicon	Selected from 2N3440
Q687	*151-0150-00			Silicon	Selected from 2N3440
Q716	151-0232-00			Silicon	Dual
Q725	151-0190-00			Silicon	2N3904
Q727	151-0190-00			Silicon	2N3904
Q729	*151-0136-00			Silicon	Replaceable by 2N3053
Q734	*151-0256-00			Silicon	Tek Spec
Q744	151-0232-00			Silicon	Dual
Q748	151-0190-00			Silicon	2N3904
Q750	*151-0136-00			Silicon	Replaceable by 2N3053
Q756	*151-0140-00			Silicon	Selected from 2N3055
Q767	151-0232-00			Silicon	Dual
Q772	151-0190-00			Silicon	2N3904
Q774	*151-0136-00			Silicon	Replaceable by 2N3053
Q778	*151-0140-00			Silicon	Selected from 2N3055
Q780	151-0190-00			Silicon	2N3904
Q784	151-0190-00			Silicon	2N3904
Q787	*151-0148-00			Silicon	Selected from 40250 (RCA)
Q795	151-0232-00			Silicon	Dual
Q800	151-0190-00			Silicon	2N3904

Relays *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
Q803	*151-0136-00			Silicon	Replaceable by 2N3053		
Q808	*151-0140-00			Silicon	Selected from 2N3055		
Q810	151-0190-00			Silicon	2N3904		
Q814	151-0190-00			Silicon	2N3904		
Q817	151-0190-00			Silicon	2N3904		
Q819	*151-0148-00			Silicon	Selected from 40250 (RCA)		
Q834	*151-0228-00			Silicon	Tek Spec		
Q837	151-0190-00			Silicon	2N3904		
Q840	*151-0150-00			Silicon	Selected from 2N3440		
Q846	*151-0256-00			Silicon	Tek Spec		
Q851	151-0251-00			Silicon	2N4240		
Q855	151-0190-00			Silicon	2N3904		
Q859	*151-0219-00			Silicon	Replaceable by 2N4250		
Q866	151-0190-00			Silicon	2N3904		
Q868	*151-0150-00			Silicon	Selected from 2N3440		
Q900	151-0260-00			Silicon	2N5189		
Q904	151-0207-00			Silicon	2N3415		
Q940	151-0207-00			Silicon	2N3415		
Q943	151-0260-00			Silicon	2N5189		

Resistors

Resistors are fixed, composition, ±10% unless otherwise indicated.

R1	315-0470-00			47 Ω	1/4 W		5%
R2	315-0752-00			7.5 kΩ	1/4 W		5%
R3	315-0683-00			68 kΩ	1/4 W		5%
R4	315-0622-00			6.2 kΩ	1/4 W		5%
R5	315-0223-00	B010100	B019999	22 kΩ	1/4 W		5%
R5	315-0103-00	B020000		10 kΩ	1/4 W		5%
R7	321-0204-00			1.3 kΩ	1/8 W	Prec	1%
R8	311-0704-00			500 Ω, Var			
R10	315-0470-00			47 Ω	1/4 W		5%
R11	315-0752-00			7.5 kΩ	1/4 W		5%
R12	315-0683-00			68 kΩ	1/4 W		5%
R13	315-0622-00			6.2 kΩ	1/4 W		5%
R14	315-0223-00	B010100	B019999	22 kΩ	1/4 W		5%
R14	315-0103-00	B020000		10 kΩ	1/4 W		5%
R16	315-0473-00			47 kΩ	1/4 W		5%
R17	315-0223-00			22 kΩ	1/4 W		5%
R19	315-0473-00			47 kΩ	1/4 W		5%
R20	315-0223-00			22 kΩ	1/4 W		5%
R22	315-0223-00			22 kΩ	1/4 W		5%
R24	311-0732-00			1 kΩ, Var			
R25	322-0251-00			4.02 kΩ	1/4 W	Prec	1%
R27	321-0297-00			12.1 kΩ	1/8 W	Prec	1%

Resistors (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R28	321-0364-00			60.4 kΩ	⅛ W	Prec	1%
R29	315-0104-00			100 kΩ	¼ W		5%
R30	315-0472-00			4.7 kΩ	¼ W		5%
R32	315-0223-00			22 kΩ	¼ W		5%
R33	315-0622-00			6.2 kΩ	¼ W		5%
R34	315-0223-00			22 kΩ	¼ W		5%
R35	315-0472-00			4.7 kΩ	¼ W		5%
R37	321-0335-00			30.1 kΩ	⅛ W	Prec	1%
R39	322-0298-00			12.4 kΩ	¼ W	Prec	1%
R40	315-0104-00			100 kΩ	¼ W		5%
R41	315-0471-00			470 Ω	¼ W		5%
R42	315-0223-00			22 kΩ	¼ W		5%
R43	315-0472-00			4.7 kΩ	¼ W		5%
R44	315-0393-00			39 kΩ	¼ W		5%
R45	315-0103-00			10 kΩ	¼ W		5%
R46	321-0280-00			8.06 kΩ	⅛ W	Prec	1%
R48	321-0258-00			4.75 kΩ	⅛ W	Prec	1%
R50	315-0471-00			470 Ω	¼ W		5%
R51	321-0348-00			41.2 kΩ	⅛ W	Prec	1%
R52	315-0153-00			15 kΩ	¼ W		5%
R53	315-0563-00			56 kΩ	¼ W		5%
R54	309-0329-00	B010100	B019999	2.87 MΩ	½ W	Prec	1%
R54	323-0525-00	B020000		2.87 MΩ	½ W	Prec	1%
R55	323-0433-00			316 kΩ	½ W	Prec	1%
R57	323-0712-00			1.43 MΩ	½ W	Prec	½%
R58	323-0404-00			158 kΩ	½ W	Prec	1%
R60	323-0467-00			715 kΩ	½ W	Prec	1%
R61	323-0375-01			78.7 kΩ	½ W	Prec	½%
R63	323-0467-00			715 kΩ	½ W	Prec	1%
R64	323-0375-01			78.7 kΩ	½ W	Prec	½%
R66	315-0473-00			47 kΩ	¼ W		5%
R67	315-0223-00			22 kΩ	¼ W		5%
R71	315-0622-00			6.2 kΩ	¼ W		5%
R72	315-0622-00			6.2 kΩ	¼ W		5%
R73	315-0622-00			6.2 kΩ	¼ W		5%
R74	315-0622-00			6.2 kΩ	¼ W		5%
R76	315-0473-00			47 kΩ	¼ W		5%
R77	315-0223-00			22 kΩ	¼ W		5%
R78	315-0105-00			1 MΩ	¼ W		5%
R80	315-0622-00			6.2 kΩ	¼ W		5%
R81	315-0223-00			22 kΩ	¼ W		5%
R83	301-0275-00			2.7 MΩ	½ W		5%
R85	311-0863-00			500 Ω, Var			
R86	311-0863-00			500 Ω, Var			
R88	311-0386-00			2 kΩ, Var			
R89	315-0221-00			200 Ω	¼ W		5%

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Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R90	315-0104-00			100 kΩ	¼ W		5%
R92	315-0101-00			100 Ω	¼ W		5%
R94	305-0103-00			10 kΩ	2 W		5%
R95	321-0242-00			3.24 kΩ	⅛ W	Prec	1%
R96	301-0204-00			200 kΩ	½ W		5%
R97	311-0836-00			5 kΩ, Var			
R101	315-0473-00			47 kΩ	¼ W		5%
R102	315-0223-00			22 kΩ	¼ W		5%
R103	315-0622-00			6.2 kΩ	¼ W		5%
R105	315-0512-00			5.1 kΩ	¼ W		5%
R107	315-0102-00			1 kΩ	¼ W		5%
R108	315-0563-00			56 kΩ	¼ W		5%
R109	305-0113-00	B010100	B019999	11 kΩ	2 W		5%
R109	308-0286-00	B020000		8.2 kΩ	3 W	WW	5%
R110	315-0330-00			33 Ω	¼ W		5%
R112	321-0204-00			1.3 kΩ	⅛ W	Prec	1%
R113	311-0827-00			250 Ω, Var			
R116	315-0474-00			470 kΩ	¼ W		5%
R117	315-0105-00			1 MΩ	¼ W		5%
R119	315-0104-00			100 kΩ	¼ W		5%
R120	315-0205-00			2 MΩ	¼ W		5%
R121	315-0205-00			2 MΩ	¼ W		5%
R123	315-0202-00			2 kΩ	¼ W		5%
R124	315-0102-00			1 kΩ	¼ W		5%
R125	322-0239-01			3.01 kΩ	¼ W	Prec	½%
R127	311-0840-00			20 kΩ, Var			
R128	315-0564-00			560 kΩ	¼ W		5%
R130	301-0363-00			36 kΩ	½ W		5%
R131	315-0823-00			82 kΩ	¼ W		5%
R132	315-0152-00			1.5 kΩ	¼ W		5%
R134	302-0330-00			33 Ω	½ W		
R135	305-0133-00	B010100	B019999	13 kΩ	2 W		5%
R135	305-0113-00	B020000		11 kΩ	2 W		5%
R137	322-0239-01			3.01 kΩ	¼ W	Prec	½%
R138	315-0471-00			470 Ω	¼ W		5%
R139	321-0289-00			10 kΩ	⅛ W	Prec	1%
R141	322-0239-01			3.01 kΩ	¼ W	Prec	½%
R142	322-0239-01			3.01 kΩ	¼ W	Prec	½%
R144	321-0685-00			30 kΩ	⅛ W	Prec	½%
R145	321-0685-00			30 kΩ	⅛ W	Prec	½%
R147	315-0472-00			4.7 kΩ	¼ W		5%
R149	315-0334-00			330 kΩ	¼ W		5%
R154	315-0104-00			100 kΩ	¼ W		5%
R156	315-0163-00			16 kΩ	¼ W		5%
R157	315-0683-00			68 kΩ	¼ W		5%

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R160	315-0102-00			1 kΩ	¼ W		5%
R162	321-0285-00			9.09 kΩ	⅛ W	Prec	1%
R165	321-0234-00	B010100	B019999	2.67 kΩ	⅛ W	Prec	1%
R165	321-0232-00	B020000		2.55 kΩ	⅛ W	Prec	1%
R166	321-0193-00			1 kΩ	⅛ W	Prec	1%
R167	323-0345-00			38.3 kΩ	½ W	Prec	1%
R170	305-0752-00			7.5 kΩ	2 W		5%
R171	315-0470-00			47 Ω	¼ W		5%
R174	301-0470-00			47 Ω	½ W		5%
R177	301-0470-00			47 Ω	½ W		5%
R182	308-0204-00			1 Ω	10 W	WW	5%
R185	301-0470-00	B010100	B019999	47 Ω	½ W		5%
R185	323-0065-00	B020000		46.4 Ω	½ W	Prec	1%
R186	301-0150-00			15 Ω	½ W		5%
R187	308-0441-00			3 Ω	3 W	WW	5%
R189	304-0223-00	XB100000		22 kΩ	1 W		
R190	303-0162-00			1.6 kΩ	1 W		5%
R192	308-0135-00			5 kΩ	5 W	WW	5%
R194	322-0268-00			6.04 kΩ	¼ W	Prec	1%
R195	315-0153-00			15 kΩ	¼ W		5%
R196	301-0102-00	XB100000		1 kΩ	½ W		5%
R197	309-0095-00	B010100	B049999	10 MΩ	½ W	Prec	1%
R197	323-0577-01	B050000	B109999	10 MΩ	½ W	Prec	½%
R197	325-0071-00	B110000		10 MΩ	1 W	Prec	½%
R198	309-0095-00	B010100	B049999	10 MΩ	½ W	Prec	1%
R198	323-0577-01	B050000	B109999	10 MΩ	½ W	Prec	½%
R198	325-0071-00	B110000		10 MΩ	1 W	Prec	½%
R200	323-0481-01			1 MΩ	½ W	Prec	½%
R201	323-0481-01			1 MΩ	½ W	Prec	½%
R203	323-0385-01			100 kΩ	½ W	Prec	½%
R204	323-0385-01			100 kΩ	½ W	Prec	½%
R206	308-0538-00			10 kΩ	5 W	WW	½%
R207	308-0538-00			10 kΩ	5 W	WW	½%
R209	308-0537-00			1 kΩ	5 W	WW	½%
R210	308-0537-00			1 kΩ	5 W	WW	½%
R212	308-0545-00			100 Ω	5 W	WW	½%
R213	308-0545-00			100 Ω	5 W	WW	½%
R214	308-0545-00	XB100000		100 Ω	5 W	WW	½%
R215	308-0512-00	B010100	B099999	10 Ω	55 W	WW	½%
R215	308-0591-00	B100000		40 Ω	55 W	WW	½%
R216	308-0512-00	B010100	B099999	10 Ω	55 W	WW	½%
R216	308-0591-00	B100000		40 Ω	55 W	WW	½%
R220	303-0473-00			47 kΩ	1 W		5%
R224	311-0884-00			100 Ω, Var			
R227	323-0337-00			31.6 kΩ	½ W	Prec	1%
R230	321-0370-00			69.8 kΩ	⅛ W	Prec	1%
R231	321-0335-00			30.1 kΩ	⅛ W	Prec	1%
R233	321-0370-00			69.8 kΩ	⅛ W	Prec	1%
R236	321-0326-00			24.3 kΩ	⅛ W	Prec	1%
R237	321-0397-00			133 kΩ	⅛ W	Prec	1%
R239	315-0473-00			47 kΩ	¼ W		5%
R240	301-0163-00			16 kΩ	½ W		5%

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R241	315-0153-00			15 kΩ	¼ W		5%
R243	311-0732-00			1 kΩ, Var			
R244	321-0312-00	B010100	B019999	17.4 kΩ	⅛ W	Prec	1%
R244	321-0313-00	B020000		17.8 kΩ	⅛ W	Prec	1%
R245	315-0331-00			330 Ω	¼ W		5%
R246	315-0102-00			1 kΩ	¼ W		5%
R247	315-0183-00			18 kΩ	¼ W		5%
R253	315-0183-00			18 kΩ	¼ W		5%
R254	315-0102-00			1 kΩ	¼ W		5%
R296	307-0106-00			4.7 Ω	¼ W		5%
R298	307-0106-00			4.7 Ω	¼ W		5%
R300	308-0568-00			35 Ω	5 W	WW	5%
R305	306-0101-00			100 Ω	2 W		
R307	306-0101-00			100 Ω	2 W		
R317	305-0334-00			330 kΩ	2 W		5%
R318	305-0334-00			330 kΩ	2 W		5%
R319	305-0104-00			100 kΩ	2 W		5%
R323	315-0101-00			100 Ω	¼ W		5%
R325	308-0244-00			0.3 Ω	2 W	WW	
R326	301-0152-00			1.5 kΩ	½ W		5%
R328	308-0179-00			5 Ω	5 W	WW	5%
R329	303-0153-00			15 kΩ	1 W		5%
R331	308-0075-00			100 Ω	3 W	WW	5%
R332	306-0224-00			220 kΩ	2 W		
R334	308-0230-00			2.7 kΩ	3 W	WW	5%
R335	305-0475-00			4.7 MΩ	2 W		5%
R336	305-0475-00			4.7 MΩ	2 W		5%
R346	308-0533-00			6.2 Ω (tapped at 1.1 Ω, 5%)	65 W	WW	5%
R348	308-0534-00			133.5 Ω (tapped at 23.5 Ω, 2%)	65 W	WW	2%
R350	308-0535-00			2.86 kΩ (tapped at 510 Ω, 2%)	65 W	WW	2%
R352	308-0536-00			11 kΩ	65 W	WW	2%
R354	*307-0204-00			6.486 MΩ (tapped at 51 kΩ 27 W; 235 kΩ 5 W; 1.1 MΩ 0.7 W & 5.1 MΩ 3 W)			2%
R370	301-0220-00			22 Ω	½ W		5%
R373	301-0220-00			22 Ω	½ W		5%
R401	*312-0653-00			22.5 MΩ		Film	1/20%
R402	*312-0654-00			2.25 MΩ		Film	1/20%
R403	*312-0655-00			250 kΩ		Film	
R405 }	*308-0509-00			0.250 Ω	0.025 Ω tap	Current Sensing Resistors Assy.	
R407 }				24.775 Ω	w/2.25 Ω tap		
R409 }				2.7525 kΩ	w/227.5 Ω tap		
R411	308-0018-00			2.5 kΩ	10 W	WW	5%
R412	308-0499-00	B010100	B010129X	0.5 Ω	2.5 W	WW	

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R414	307-0103-00			2.7 Ω	¼ W		5%
R415	321-0039-00			24.9 Ω	⅛ W	Prec	1%
R416	321-0135-00			249 Ω	⅛ W	Prec	1%
R417	321-0231-00			2.49 kΩ	⅛ W	Prec	1%
R418	321-0327-00			24.9 kΩ	⅛ W	Prec	1%
R420	321-0243-00			3.32 kΩ	⅛ W	Prec	1%
R422	301-0273-00			27 kΩ	½ W		5%
R425	303-0273-00			27 kΩ	1 W		5%
R427	321-0645-00			100 kΩ	⅛ W	Prec	½%
R428	323-0611-03			900 kΩ	½ W	Prec	¼%
R430	302-0273-00			27 kΩ	½ W		
R433	*312-0653-00			22.5 MΩ		Film	1/20%
R434	*312-0654-00			2.25 MΩ		Film	1/20%
R435	304-0273-00			27 kΩ	1 W		
R436	*312-0655-00	B010100	B089999	250 kΩ		Film	
R436	*312-0661-00	B090000		225 kΩ	(2 matched resistors)		
R437	321-0231-00	B010100	B099999	2.49 kΩ	⅛ W	Prec	1%
R437	301-0105-00	B090000		1 MΩ	½ W		5%
R438	321-0135-00	B010100	B089999	249 Ω	⅛ W	Prec	1%
R438	301-0362-00	B090000		3.6 kΩ	½ W		5%
R439	321-1231-01			2.52 kΩ	⅛ W	Prec	½%
R440	308-0544-00			22.5 kΩ	5 W	WW	¼%
R442	308-0544-00			22.5 kΩ	5 W	WW	¼%
R443	308-0539-00			2.25 kΩ	3 W	WW	½%
R444	321-0131-00			226 Ω	⅛ W	Prec	1%
R445	321-0039-00			24.9 Ω	⅛ W	Prec	1%
R447	321-0198-00			1.13 kΩ	⅛ W	Prec	1%
R449	302-0273-00			27 kΩ	½ W		
R450	322-0673-03			500 kΩ	¼ W	Prec	¼%
R452	322-0673-03			500 kΩ	¼ W	Prec	¼%
R454	322-0673-03			500 kΩ	¼ W	Prec	¼%
R456	322-0673-03			500 kΩ	¼ W	Prec	¼%
R458	322-0673-03			500 kΩ	¼ W	Prec	¼%
R460	322-0673-03			500 kΩ	¼ W	Prec	¼%
R462	323-0498-00			1.5 MΩ	½ W	Prec	1%
R464	323-0498-00			1.5 MΩ	½ W	Prec	1%
R468	321-0402-01			150 kΩ	⅛ W	Prec	½%
R469	321-0402-01			150 kΩ	⅛ W	Prec	½%
R471	321-0402-01			150 kΩ	⅛ W	Prec	½%
R472	321-0402-01			150 kΩ	⅛ W	Prec	½%
R474	321-0402-01			150 kΩ	⅛ W	Prec	½%
R475	321-0402-01			150 kΩ	⅛ W	Prec	½%
R477	321-0402-01			150 kΩ	⅛ W	Prec	½%
R478	321-0402-01			150 kΩ	⅛ W	Prec	½%
R480	321-0402-01			150 kΩ	⅛ W	Prec	½%
R481	321-0402-01			150 kΩ	⅛ W	Prec	½%
R482	321-0402-01			150 kΩ	⅛ W	Prec	½%
R483	321-0402-01			150 kΩ	⅛ W	Prec	½%

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R484	322-0402-00			150 kΩ	¼ W	Prec	1%
R485	322-0402-00			150 kΩ	¼ W	Prec	1%
R487	321-0385-00			100 kΩ	⅛ W	Prec	1%
R488	311-0881-00			20 kΩ, Var			
R490	321-0402-01			150 kΩ	⅛ W	Prec	½%
R491	321-0402-01			150 kΩ	⅛ W	Prec	½%
R492	321-0402-01			150 kΩ	⅛ W	Prec	½%
R493	321-0402-01			150 kΩ	⅛ W	Prec	½%
R494	321-0397-00			133 kΩ	⅛ W	Prec	1%
R495	321-0397-00			133 kΩ	⅛ W	Prec	1%
R497	321-0385-00			100 kΩ	⅛ W	Prec	1%
R498	311-0881-00			20 kΩ, Var			
R501	308-0542-00			500 Ω	3 W	WW	1/10%
R503	308-0542-00			500 Ω	3 W	WW	1/10%
R505	308-0541-00			1 kΩ	3 W	WW	1/10%
R507	308-0542-00			500 Ω	3 W	WW	1/10%
R509	308-0540-00			1.5 kΩ	3 W	WW	1/10%
R511	321-0300-00			13 kΩ	⅛ W	Prec	1%
R512	311-0540-00			2.5 kΩ, Var			
R513	308-0543-00			8.25 kΩ	3 W	WW	1%
R520	302-0473-00			47 kΩ	½ W		
R521	302-0473-00			47 kΩ	½ W		
R523	302-0183-00			18 kΩ	½ W		
R524	302-0183-00			18 kΩ	½ W		
R526	315-0102-00			1 kΩ	¼ W		5%
R527	315-0102-00			1 kΩ	¼ W		5%
R531	323-0366-00			63.4 kΩ	½ W	Prec	1%
R533	315-0470-00			47 Ω	¼ W		5%
R535	321-0187-00			866 Ω	⅛ W	Prec	1%
R536	311-0827-00			250 Ω, Var			
R538	311-0886-00			50 Ω, Var			
R540	321-0144-00			309 Ω	⅛ W	Prec	1%
R541	311-0886-00			50 Ω, Var			
R543	321-0140-00			280 Ω	⅛ W	Prec	1%
R545	311-0831-00			100 kΩ, Var			
R547	322-0481-00			1 MΩ	¼ W	Prec	1%
R548	321-0452-00			499 kΩ	⅛ W	Prec	1%
R549	322-0481-00			1 MΩ	¼ W	Prec	1%
R550	311-0883-00			50 kΩ, Var			
R553	321-0423-00			249 kΩ	⅛ W	Prec	1%
R555	315-0470-00			47 Ω	¼ W		5%
R557	323-0366-00			63.4 kΩ	½ W	Prec	1%
R561	323-0349-00			42.2 kΩ	½ W	Prec	1%
R564	321-0452-00			499 kΩ	⅛ W	Prec	1%
R566	321-0452-00			499 kΩ	⅛ W	Prec	1%

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R568	323-0349-00			42.2 kΩ	½ W	Prec	1%
R571	321-0281-00			8.25 kΩ	⅛ W	Prec	1%
R573	311-0827-00			250 Ω, Var			
R574	321-0186-00			845 Ω	⅛ W	Prec	1%
R576	321-0281-00			8.25 kΩ	⅛ W	Prec	1%
R580	321-0318-00			20 kΩ	⅛ W	Prec	1%
R581	311-0885-00			200 kΩ, Var			
R584	322-0609-00			333 kΩ	¼ W	Prec	1%
R590	323-0374-00			76.8 kΩ	½ W	Prec	1%
R592 A, B	311-0090-00			2 x 20 kΩ, Var			
R594	323-0374-00			76.8 kΩ	½ W	Prec	1%
R620	302-0473-00			47 kΩ	½ W		
R621	302-0473-00			47 kΩ	½ W		
R623	302-0183-00			18 kΩ	½ W		
R624	302-0183-00			18 kΩ	½ W		
R626	315-0102-00			1 kΩ	¼ W		5%
R627	315-0102-00			1 kΩ	¼ W		5%
R631	323-0366-00			63.4 kΩ	½ W	Prec	1%
R633	315-0470-00			47 Ω	¼ W		5%
R635	321-0198-00			1.13 kΩ	⅛ W	Prec	1%
R636	311-0827-00			250 Ω, Var			
R638	311-0884-00			100 Ω, Var			
R640	321-0170-00			576 Ω	⅛ W	Prec	1%
R641	311-0886-00			50 Ω, Var			
R643	321-0171-00			590 Ω	⅛ W	Prec	1%
R645	311-0831-00			100 kΩ, Var			
R647	309-0023-00	B010100	B019999	2 MΩ	½ W	Prec	1%
R647	323-0510-00	B020000		2 MΩ	½ W	Prec	1%
R648	321-0452-00			499 kΩ	⅛ W	Prec	1%
R649	309-0023-00	B010100	B019999	2 MΩ	½ W	Prec	1%
R649	323-0510-00	B020000		2 MΩ	½ W	Prec	1%
R650	311-0831-00			100 kΩ, Var			
R653	322-0481-00			1 MΩ	¼ W	Prec	1%
R655	315-0470-00			47 Ω	¼ W		5%
R657	323-0366-00			63.4 kΩ	½ W	Prec	1%
R661	323-0349-00			42.2 kΩ	½ W	Prec	1%
R664	309-0023-00	B010100	B019999	2 MΩ	½ W	Prec	1%
R664	323-0510-00	B020000		2 MΩ	½ W	Prec	1%
R666	309-0023-00	B010100	B019999	2 MΩ	½ W	Prec	1%
R666	323-0510-00	B020000		2 MΩ	½ W	Prec	1%
R668	323-0349-00			42.2 kΩ	½ W	Prec	1%
R671	321-0281-00			8.25 kΩ	⅛ W	Prec	1%
R673	311-0827-00			250 Ω, Var			
R674	321-0194-00			1.02 kΩ	⅛ W	Prec	1%
R676	321-0281-00			8.25 kΩ	⅛ W	Prec	1%

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R680	321-0337-00			31.6 kΩ	⅛ W	Prec	1%
R681	311-0885-00			200 kΩ, Var			
R684	322-0609-00			333 kΩ	¼ W	Prec	1%
R685	311-0695-00			1 MΩ, Var			
R686	315-0106-00			10 MΩ	¼ W		5%
R690	323-0374-00			76.8 kΩ	½ W	Prec	1%
R692 A, B	311-0090-00			2 x 20 kΩ, Var			
R694	323-0374-00			76.8 kΩ	½ W	Prec	1%
R696	315-0220-00			22 Ω	¼ W		5%
R698	315-0220-00			22 Ω	¼ W		5%
R704	311-0939-00			25 Ω, Var			
R705	308-0269-00			22 Ω	3 W	WW	5%
R709	323-0313-00			17.8 kΩ	½ W	Prec	1%
R710	323-0313-00			17.8 kΩ	½ W	Prec	1%
R711	315-0471-00			470 Ω	¼ W		5%
R713	315-0103-00			10 kΩ	¼ W		5%
R715	315-0103-00			10 kΩ	¼ W		5%
R717	301-0303-00			30 kΩ	½ W		5%
R719	315-0102-00			1 kΩ	¼ W		5%
R720	322-0210-00			1.5 kΩ	¼ W	Prec	1%
R721	311-0704-00			500 Ω, Var			
R722	322-0205-00			1.33 kΩ	¼ W	Prec	1%
R723	308-0566-00			12.5 kΩ	4 W	WW	1%
R725	315-0163-00			16 kΩ	¼ W		5%
R726	315-0133-00			13 kΩ	¼ W		5%
R729	301-0102-00			1 kΩ	½ W		5%
R730	321-0150-00			357 Ω	⅛ W	Prec	1%
R731	322-0344-00			37.4 kΩ	¼ W	Prec	1%
R735	307-0051-00			2.7 Ω	½ W		5%
R740	321-0260-00			4.99 kΩ	⅛ W	Prec	1%
R741	323-0327-00			24.9 kΩ	½ W	Prec	1%
R743	315-0103-00			10 kΩ	¼ W		5%
R745	301-0303-00			30 kΩ	½ W		5%
R747	315-0101-00			100 Ω	¼ W		5%
R750	315-0101-00			100 Ω	¼ W		5%
R752	321-0150-00			357 Ω	⅛ W	Prec	1%
R753	321-0277-00			7.5 kΩ	⅛ W	Prec	1%
R756	308-0245-00			0.6 Ω	2 W	WW	5%
R758	308-0269-00			22 Ω	3 W	WW	5%
R760	311-0310-00			5 kΩ, Var			
R762	321-0277-00			7.5 kΩ	⅛ W	Prec	1%
R763	321-0254-00			4.32 kΩ	⅛ W	Prec	1%
R764	315-0101-00			100 Ω	¼ W		5%
R766	315-0101-00			100 Ω	¼ W		5%
R768	301-0152-00			1.5 kΩ	½ W		5%

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R769	301-0202-00			2 kΩ	½ W		5%
R770	315-0101-00			100 Ω	¼ W		5%
R771	301-0111-00			110 Ω	½ W		5%
R775	321-0237-00			2.87 kΩ	⅛ W	Prec	1%
R776	321-0148-00			340 Ω	⅛ W	Prec	1%
R777	321-0339-00			33.2 kΩ	⅛ W	Prec	1%
R778	308-0244-00			0.3 Ω	2 W	WW	
R779	308-0244-00			0.3 Ω	2 W	WW	
R780	301-0471-00			470 Ω	½ W		5%
R782	321-0254-00			4.32 kΩ	⅛ W	Prec	1%
R783	321-0302-00			13.7 kΩ	⅛ W	Prec	1%
R788	308-0420-00	B010100	B119999	1.8 Ω	1.5 W	WW	3%
R788	308-0365-00	B120000		1.5 Ω	3 W	WW	5%
R789	301-0111-00			110 Ω	½ W		5%
R791	308-0269-00			22 Ω	3 W	WW	5%
R793	315-0471-00			470 Ω	¼ W		5%
R794	301-0363-00			36 kΩ	½ W		5%
R796	301-0823-00			82 kΩ	½ W		5%
R797	323-0335-00			30.1 kΩ	½ W	Prec	1%
R798	321-0231-00			2.49 kΩ	⅛ W	Prec	1%
R799	321-0232-00			2.55 kΩ	⅛ W	Prec	1%
R804	321-0150-00			357 Ω	⅛ W	Prec	1%
R805	321-0277-00			7.5 kΩ	⅛ W	Prec	1%
R808	308-0244-00			0.3 Ω	2 W	WW	
R810	301-0393-00			39 kΩ	½ W		5%
R811	315-0101-00	XB040000		100 Ω	¼ W		5%
R812	321-0300-00			13 kΩ	⅛ W	Prec	1%
R813	321-0302-00			13.7 kΩ	⅛ W	Prec	1%
R816	301-0220-00			22 Ω	½ W		5%
R817	321-0152-00			374 Ω	⅛ W	Prec	1%
R818	321-0283-00			8.66 kΩ	⅛ W	Prec	1%
R819	308-0459-00			1.1 Ω	3 W	WW	5%
R822	308-0188-00			3 Ω	25 W	WW	5%
R823	301-0223-00			22 kΩ	½ W		5%
R825	308-0188-00			3 Ω	25 W	WW	5%
R830	308-0564-00			20 kΩ	4 W	WW	1%
R831	308-0565-00			15 kΩ	4 W	WW	1%
R833	301-0563-00			56 kΩ	½ W		5%
R835	315-0273-00			27 kΩ	¼ W		5%
R838	315-0104-00			100 kΩ	¼ W		5%
R840	315-0471-00			470 Ω	¼ W		5%
R842	315-0271-00			270 Ω	¼ W		5%
R844	315-0471-00			470 Ω	¼ W		5%
R846	307-0051-00			2.7 Ω	½ W		5%
R850	308-0532-00			10 Ω	2 W	WW	3%
R851	308-0503-00			6.8 Ω	2.5 W	WW	5%

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R853	315-0102-00			1 kΩ	¼ W		5%
R854	315-0472-00			4.7 kΩ	¼ W		5%
R856	315-0472-00			4.7 kΩ	¼ W		5%
R858	315-0152-00			1.5 kΩ	¼ W		5%
R859	315-0154-00			150 kΩ	¼ W		5%
R860	321-0321-00			21.5 kΩ	⅛ W	Prec	1%
R861	323-0388-00			107 kΩ	½ W	Prec	1%
R862	323-0386-00			102 kΩ	½ W	Prec	1%
R863	315-0471-00			470 Ω	¼ W		5%
R864	323-0378-00			84.5 kΩ	½ W	Prec	1%
R865	315-0471-00			470 Ω	¼ W		5%
R866	315-0562-00			5.6 kΩ	¼ W		5%
R867	315-0102-00			1 kΩ	¼ W		5%
R868	315-0471-00			470 Ω	¼ W		5%
R869	315-0221-00			220 Ω	¼ W		5%
R870	303-0223-00	B010100	B019999	22 kΩ	1 W		5%
R870	301-0223-00	B020000		22 kΩ	½ W		5%
R871	301-0103-00			10 kΩ	½ W		5%
R873	301-0103-00			10 kΩ	½ W		5%
R875	305-0365-00			3.6 MΩ	2 W		5%
R876	305-0365-00			3.6 MΩ	2 W		5%
R877	305-0365-00			3.6 MΩ	2 W		5%
R878	305-0335-00			3.3 MΩ	2 W		5%
R879	305-0156-00			15 MΩ	2 W		5%
R880	311-0254-00			5 MΩ, Var			
R881	305-0335-00			3.3 MΩ	2 W		5%
R883	311-0397-01			2 MΩ, Var			5%
R885	315-0104-00			100 kΩ	¼ W		5%
R886	315-0273-00			27 kΩ	¼ W		5%
R887	315-0474-00			470 kΩ	¼ W		5%
R888	315-0473-00			47 kΩ	¼ W		5%
R889	315-0103-00			10 kΩ	¼ W		5%
R890	315-0333-00			33 kΩ	¼ W		5%
R891	311-0885-00			200 kΩ, Var			
R892	315-0333-00			33 kΩ	¼ W		5%
R893	311-0885-00			200 kΩ, Var			
R897	311-0141-00			2 kΩ, Var			
R899	315-0152-00			1.5 kΩ	¼ W		5%
R901	315-0681-00			680 Ω	¼ W		5%
R902	315-0151-00			150 Ω	¼ W		5%
R904	315-0161-00			160 Ω	¼ W		5%
R906	315-0203-00			20 kΩ	¼ W		5%
R907	315-0242-00			2.4 kΩ	¼ W		5%
R908	315-0302-00			3 kΩ	¼ W		5%
R935	315-0302-00			3 kΩ	¼ W		5%

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description		
R936	315-0242-00			2.4 kΩ	¼ W	5%
R937	315-0203-00			20 kΩ	¼ W	5%
R939	315-0161-00			160 Ω	¼ W	5%
R941	315-0151-00			150 Ω	¼ W	5%
R942	315-0681-00			680 Ω	¼ W	5%

Switches

Ckt. No.	Wired or Unwired	Eff	Disc	Type	Description
SW27	260-0675-00			Slide	.5 X
SW37A, SW37B, SW37C, SW37D	260-1039-00			4 Button Push	STEPS 300 μS 80 μS INVERT
SW73A, SW73B	260-1028-00			Rotary	NUMBER OF STEPS CURRENT LIMIT
SW78A, SW78B, SW78C, SW78D, SW78E	260-1040-00			5 Button Push	REP SINGLE 2X NORM .5X
SW86A, SW86B, SW86C, SW86D	260-1041-00			4 Button Push	ZERO AID OPPOSE .1X
SW195	670-1025-00	B010100	B089999	Cam	AMPLITUDE
SW195	*670-1025-01	B100000		Cam	AMPLITUDE
SW300	260-1042-00			Circuit Breaker	COLLECTOR SUPPLY RESET
SW310A, SW310B	260-1037-00			Rotary	MAX PEAK VOLTS SERIES RESISTORS
SW315A	260-1032-00			Rotary	POLARITY
SW315B	260-1031-00			Rotary	POLARITY (Rear)
SW320	260-1030-00			Rotary	MODE
SW360[1]					
SW371	260-1048-00			Lever	TRANSISTOR SELECTOR
SW375	260-1029-00			Rotary	TERMINAL SELECTOR
SW400 A, B	670-1026-00	B010100	B099999	Cam	VERTICAL CURRENT/DIV
SW400 A, B	670-1026-01	B100000		Cam	VERTICAL CURRENT/DIV
SW430	670-1027-00	B010100	B089999	Cam	HORIZONTAL VOLTS/DIV
SW430	*670-1027-01	B090000		Cam	HORIZONTAL VOLTS/DIV
SW460 A, B	670-1031-00			Cam	DISPLAY OFFSET
SW467A, SW467B, SW467C	260-1038-00			3 Button Push	INVERT ZERO CAL
SW480[2]	670-1035-00			Cam	VERTICAL POSITION
SW490[3]	670-1035-00			Cam	HORIZONTAL POSITION
SW701	260-0276-00			Toggle	POWER
SW702[4]					
SW703[4]					

[1]See Mechanical Parts List for replacement assembly.
[2]Furnished as a unit with SW490.
[3]Furnished as a unit with SW480.
[4]See Mechanical Parts List. Line Voltage Selector Body.

Thermal Cutouts

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
TK346	260-0638-00			Opens at 75° F ±3°
TK701	260-0227-00			165° F

Transformers

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
T300	120-0476-00			Variable Power AC 50/60 Hz
T301	*120-0611-00			Collector Sweep
T701	*120-0610-00			L. V. Power
T850	*120-0612-00	B010100	B019999	H. V. Power
T850	*120-0612-01	B020000		H. V. Power

Test Points

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
TP30	*214-0579-00			Pin, test point
TP69	*214-0579-00			Pin, test point
TP80	*214-0579-00			Pin, test point
TP510	*214-0579-00			Pin, test point

Integrated Circuits

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
U3	156-0030-00			Quad 2-Input Gate Replaceable by T. I. SN7400N
U20	156-0030-00			Quad 2-Input Gate Replaceable by T. I. SN7400N
U22	156-0030-00			Quad 2-Input Gate Replaceable by T. I. SN7400N
U33	156-0030-00			Quad 2-Input Gate Replaceable by T. I. SN7400N
U69	156-0030-00			Quad 2-Input Gate Replaceable by T. I. SN7400N
U70	156-0032-00			4-Bit Binary Counter Replaceable by SN7493N
U71	156-0029-00			Hex Inverter/Quad 2-Input Gate Replaceable by Fairchild 9016
U72	156-0030-00			Quad 2-Input Gate Replaceable by T. I. SN7400N
U75	156-0031-00			4-Wide 2-Input And-or-Invert Gate, Replaceable by T. I. SN7454N

Electron Tube

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
V897	*154-0563-00	B010100	B059999	T5760-2-1 CRT Standard Phosphor
V897	*154-0563-01	B060000		T5760-31-1 CRT Standard Phosphor

READOUT CIRCUIT CARD ASSEMBLY
Not included in Type 576 MOD 301W

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
	*672-0405-00			Complete Card
				Bulbs
B1001	150-0048-00	1	4	Incandescent, #683, 5 V
B1001	150-0048-01	5		Incandescent, #683, 5 V, selected
B1002	150-0048-00	1	4	Incandescent, #683, 5 V
B1002	150-0048-01	5		Incandescent, #683, 5 V, selected
B1003	150-0048-00	1	4	Incandescent, #683, 5 V
B1003	150-0048-01	5		Incandescent, #683, 5 V, selected
B1004	150-0048-00	1	4	Incandescent, #683, 5 V
B1004	150-0048-01	5		Incandescent, #683, 5 V, selected
B1005	150-0048-00	1	4	Incandescent, #683, 5 V
B1005	150-0048-01	5		Incandescent, #683, 5 V, selected
B1006	150-0048-00	1	4	Incandescent, #683, 5 V
B1006	150-0048-01	5		Incandescent, #683, 5 V, selected
B1007	150-0048-00	1	4	Incandescent, #683, 5 V
B1007	150-0048-01	5		Incandescent, #683, 5 V, selected
B1008	150-0048-00	1	4	Incandescent, #683, 5 V
B1008	150-0048-01	5		Incandescent, #683, 5 V, selected
B1009	150-0048-00	1	4	Incandescent, #683, 5 V
B1009	150-0048-01	5		Incandescent, #683, 5 V, selected
B1010	150-0048-00	1	4	Incandescent, #683, 5 V
B1010	150-0048-01	5		Incandescent, #683, 5 V, selected
B1011	150-0048-00	1	4	Incandescent, #683, 5 V
B1011	150-0048-01	5		Incandescent, #683, 5 V, selected
B1012	150-0048-00	1	4	Incandescent, #683, 5 V
B1012	150-0048-01	5		Incandescent, #683, 5 V, selected
B1013	150-0048-00	1	4	Incandescent, #683, 5 V
B1013	150-0048-01	5		Incandescent, #683, 5 V, selected
B1014	150-0048-00	1	4	Incandescent, #683, 5 V
B1014	150-0048-01	5		Incandescent, #683, 5 V, selected
B1015	150-0048-00	1	4	Incandescent, #683, 5 V
B1015	150-0048-01	5		Incandescent, #683, 5 V, selected
B1016	150-0048-00	1	4	Incandescent, #683, 5 V
B1016	150-0048-01	5		Incandescent, #683, 5 V, selected
B1017	150-0048-00	1	4	Incandescent, #683, 5 V
B1017	150-0048-01	5		Incandescent, #683, 5 V, selected
B1021 (2)	150-0048-00	1	4	Incandescent, #683, 5 V
B1021 (2)	150-0048-01	5		Incandescent, #683, 5 V, selected
B1022 (2)	150-0048-00	1	4	Incandescent, #683, 5 V
B1022 (2)	150-0048-01	5		Incandescent, #683, 5 V, selected
B1023 (2)	150-0048-00	1	4	Incandescent, #683, 5 V
B1023 (2)	150-0048-01	5		Incandescent, #683, 5 V, selected

Readout Circuit Card Assembly *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
				Bulbs (cont)
B1024 (2)	150-0048-00	1	4	Incandescent, #683, 5 V
B1024 (2)	150-0048-01	5		Incandescent, #683, 5 V, selected
B1025 (2)	150-0048-00	1	4	Incandescent, #683, 5 V
B1025 (2)	150-0048-01	5		Incandescent, #683, 5 V, selected
B1026 (2)	150-0048-00	1	4	Incandescent, #683, 5 V
B1026 (2)	150-0048-01	5		Incandescent, #683, 5 V, selected
B1027 (2)	150-0048-00	1	4	Incandescent, #683, 5 V
B1027 (2)	150-0048-01	5		Incandescent, #683, 5 V, selected
B1029 (2)	150-0048-00	1	4	Incandescent, #683, 5 V
B1029 (2)	150-0048-01	5		Incandescent, #683, 5 V, selected
B1031 (2)	150-0048-00	1	4	Incandescent, #683, 5 V
B1031 (2)	150-0048-01	5		Incandescent, #683, 5 V, selected
B1032 (2)	150-0048-00	1	4	Incandescent, #683, 5 V
B1032 (2)	150-0048-01	5		Incandescent, #683, 5 V, selected
B1033 (2)	150-0048-00	1	4	Incandescent, #683, 5 V
B1033 (2)	150-0048-00	5		Incandescent, #683, 5 V, selected
B1034 (2)	150-0048-00	1	4	Incandescent, #683, 5 V
B1034 (2)	150-0048-01	5		Incandescent, #683, 5 V, selected
B1041	150-0048-00	1	4	Incandescent, #683, 5 V
B1041	150-0048-01	5		Incandescent, #683, 5 V, selected
B1042	150-0048-00	1	4	Incandescent, #683, 5 V
B1042	150-0048-01	5		Incandescent, #683, 5 V, selected
B1045	150-0048-00	1	4	Incandescent, #683, 5 V
B1045	150-0048-01	5		Incandescent, #683, 5 V, selected
B1046	150-0048-00	1	4	Incandescent, #683, 5 V
B1046	150-0048-01	5		Incandescent, #683, 5 V, selected
B1047	150-0048-00	1	4	Incandescent, #683, 5 V
B1047	150-0048-01	5		Incandescent, #683, 5 V, selected
B1049	150-0048-00	1	4	Incandescent, #683, 5 V
B1049	150-0048-01	5		Incandescent, #683, 5 V, selected
B1051	150-0048-00	1	4	Incandescent, #683, 5 V
B1051	150-0048-01	5		Incandescent, #683, 5 V, selected
B1052	150-0048-00	1	4	Incandescent, #683, 5 V
B1052	150-0048-01	5		Incandescent, #683, 5 V, selected
B1053	150-0048-00	1	4	Incandescent, #683, 5 V
B1053	150-0048-01	5		Incandescent, #683, 5 V, selected
B1054	150-0048-00	1	4	Incandescent, #683, 5 V
B1054	150-0048-01	5		Incandescent, #683, 5 V, selected

Capacitors

Tolerance ±20% unless otherwise indicated.

Ckt. No.	Tektronix Part No.	Eff	Disc	Description			
C991	283-0003-00			0.01 μF	Cer	150 V	
C995	290-0246-00			3.3 μF	Elect.	15 V	10%

Readout Circuit Card Assembly *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc		Description
					Semiconductor Device, Diodes
D950	*152-0185-00			Silicon	Replaceable by 1N4152
D951	*152-0185-00			Silicon	Replaceable by 1N4152
D952	*152-0185-00			Silicon	Replaceable by 1N4152
D953	*152-0185-00			Silicon	Replaceable by 1N4152
D954	*152-0185-00			Silicon	Replaceable by 1N4152
D955	*152-0185-00			Silicon	Replaceable by 1N4152
D956	*152-0185-00			Silicon	Replaceable by 1N4152
D957	*152-0185-00			Silicon	Replaceable by 1N4152
D958	*152-0185-00			Silicon	Replaceable by 1N4152
D959	*152-0185-00			Silicon	Replaceable by 1N4152
D960	*152-0185-00			Silicon	Replaceable by 1N4152
D961	*152-0185-00			Silicon	Replaceable by 1N4152
D962	*152-0185-00			Silicon	Replaceable by 1N4152
D963	*152-0185-00			Silicon	Replaceable by 1N4152
D964	*152-0185-00			Silicon	Replaceable by 1N4152
D965	*152-0185-00			Silicon	Replaceable by 1N4152
D966	*152-0185-00			Silicon	Replaceable by 1N4152
D967	*152-0185-00			Silicon	Replaceable by 1N4152
D968	*152-0185-00			Silicon	Replaceable by 1N4152
D969	*152-0185-00			Silicon	Replaceable by 1N4152
D970	*152-0185-00			Silicon	Replaceable by 1N4152
D971	*152-0185-00			Silicon	Replaceable by 1N4152
D972	*152-0185-00			Silicon	Replaceable by 1N4152
D973	*152-0185-00			Silicon	Replaceable by 1N4152
D976	*152-0185-00			Silicon	Replaceable by 1N4152
D977	*152-0185-00			Silicon	Replaceable by 1N4152
D985	*152-0185-00			Silicon	Replaceable by 1N4152
D986	*152-0185-00			Silicon	Replaceable by 1N4152
D992	*152-0185-00			Silicon	Replaceable by 1N4152
					Transistors
Q960	151-0190-00			Silicon	2N3904
Q974	151-0190-00			Silicon	2N3904
Q977	151-0190-00			Silicon	2N3904
Q979	151-0190-00			Silicon	2N3904
Q982	*151-0219-00			Silicon	Replaceable by 2N4250
Q984	151-0190-00			Silicon	2N3904
Q987	151-0190-00			Silicon	2N3904
Q989	151-0190-00			Silicon	2N3904

Resistors

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description		

Resistors are fixed, composition, ±10% unless otherwise indicated.

Ckt. No.	Tektronix Part No.	Eff	Disc	Description		
R950	316-0104-00	X2	3X	100 kΩ	1/4 W	
R951	316-0104-00	X2	3X	100 kΩ	1/4 W	
R952	316-0104-00	X2	3X	100 kΩ	1/4 W	
R953	316-0104-00	X2	3X	100 kΩ	1/4 W	
R954	316-0104-00	X2	3X	100 kΩ	1/4 W	
R955	316-0104-00	X2	3X	100 kΩ	1/4 W	
R956	316-0104-00	X2	3X	100 kΩ	1/4 W	
R958	316-0104-00	X2	3X	100 kΩ	1/4 W	
R959	316-0104-00	X2	3X	100 kΩ	1/4 W	
R960	315-0102-00			1 kΩ	1/4 W	5%
R961	315-0472-00			4.7 kΩ	1/4 W	5%
R962	316-0104-00	X2	3X	100 kΩ	1/4 W	
R963	316-0104-00	X2	3X	100 kΩ	1/4 W	
R964	316-0104-00	X2	3X	100 kΩ	1/4 W	
R966	316-0104-00	X2	3X	100 kΩ	1/4 W	
R967	316-0104-00	X2	3X	100 kΩ	1/4 W	
R968	316-0104-00	X2	3X	100 kΩ	1/4 W	
R969	316-0104-00	X2	3X	100 kΩ	1/4 W	
R970	316-0104-00	X2	3X	100 kΩ	1/4 W	
R971	316-0104-00	X2	3X	100 kΩ	1/4 W	
R973	315-0102-00			1 kΩ	1/4 W	5%
R974	315-0472-00			4.7 kΩ	1/4 W	5%
R977	315-0103-00			10 kΩ	1/4 W	5%
R978	315-0431-00			430 Ω	1/4 W	5%
R979	315-0102-00			1 kΩ	1/4 W	5%
R980	315-0223-00			22 kΩ	1/4 W	5%
R981	315-0223-00			22 kΩ	1/4 W	5%
R983	315-0103-00			10 kΩ	1/4 W	5%
R987	315-0102-00			1 kΩ	1/4 W	5%
R989	315-0472-00			4.7 kΩ	1/4 W	5%
R990	315-0431-00			430 Ω	1/4 W	5%
R991	315-0103-00			10 kΩ	1/4 W	5%
R992	315-0431-00			430 Ω	1/4 W	5%

Integrated Circuits

Ckt. No.	Tektronix Part No.	Eff	Disc	Description
U951	*155-0007-00	1	3	Monolithic
U951	*155-0007-01	4		Monolithic
U953	*155-0008-00	1	3	Monolithic
U953	*155-0008-01	4		Monolithic
U956	*155-0007-00	1	3	Monolithic
U956	*155-0007-01	4		Monolithic
U960	*155-0008-00	1	3	Monolithic
U960	*155-0008-01	4		Monolithic
U965	*155-0007-00	1	3	Monolithic
U965	*155-0007-01	4		Monolithic
U970	*155-0008-00	1	3	Monolithic
U970	*155-0008-01	4		Monolithic
U974	*155-0006-00	1	2	Monolithic
U974	*155-0006-01	3		Monolithic
U975	*155-0005-00			Monolithic
U976	*155-0004-00	1	2	Monolithic
U976	*155-0004-01	3		Monolithic

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations which appear either on the back of the diagrams or on pullout pages immediately following the diagrams of the instruction manual.

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.

Assembly and/or Component
  Detail Part of Assembly and/or Component
  mounting hardware for Detail Part
    Parts of Detail Part
    mounting hardware for Parts of Detail Part
mounting hardware for Assembly and/or Component

Mounting hardware always appears 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.

Mounting hardware must be purchased separately, unless otherwise specified.

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 or model 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.

ABBREVIATIONS AND SYMBOLS

For an explanation of the abbreviations and symbols used in this section, please refer to the page immediately preceding the Electrical Parts List in this instruction manual.

INDEX OF MECHANICAL PARTS LIST ILLUSTRATIONS

(Located behind diagrams)

SECTION 7
MECHANICAL PARTS LIST

FIG. 1 FRONT

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
1-1	333-1155-01			1	PANEL, front
	- - - - - -			-	mounting hardware: (not included w/panel)
	211-0001-00			2	SCREW, 2-56 x 1/4 inch, PHS
-2	124-0219-00			1	STRIP, trim
-3	366-0494-00			1	KNOB, gray—READOUT ILLUM
	- - - - - -			-	knob includes:
	213-0153-00			1	SCREW, set, 5-40 x 0.125 inch, HSS
-4	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
	210-0940-00			1	WASHER, flat, 1/4 ID x 3/8 inch OD
-5	210-0583-00			1	NUT, hex., 1/4-32 x 5/16 inch
-6	366-0494-00			1	KNOB, gray—GRATICULE ILLUM
	- - - - - -			-	knob includes:
	213-0153-00			1	SCREW, set, 5-40 x 0.125 inch, HSS
-7	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
-8	210-0223-00			1	LUG, solder, 1/4 ID x 7/16 inch OD, SE
	210-0940-00			1	WASHER, flat, 1/4 ID x 3/8 inch OD
-9	210-0583-00			1	NUT, hex., 1/4-32 x 5/16 inch
-10	366-1028-00			1	KNOB, gray—POLARITY
	- - - - - -			-	knob includes:
	213-0153-00			1	SCREW, set, 5-40 x 0.125 inch, HSS
-11	260-1032-00			1	SWITCH, unwired—POLARITY
	- - - - - -			-	mounting hardware: (not included w/switch)
	210-0978-00			1	WASHER, flat, 3/8 ID x 1/2 inch OD
	210-0590-00			1	NUT, hex., 3/8-32 x 7/16 inch
-12	366-1028-00			1	KNOB, gray—MODE
	- - - - - -			-	knob includes:
	213-0153-00			2	SCREW, set, 5-40 x 0.125 inch, HSS
-13	260-1030-00			1	SWITCH, unwired—MODE
	- - - - - -			-	mounting hardware: (not included w/switch)
	210-0978-00			1	WASHER, flat, 3/8 ID x 1/2 inch OD
	210-0590-00			1	NUT, hex., 3/8-32 x 7/16 inch
-14	366-0494-00			1	KNOB, gray—LOOPING COMPENSATION
	- - - - - -			-	knob includes:
	213-0153-00			1	SCREW, set, 5-40 x 0.125 inch, HSS
-15	366-1124-00			1	KNOB, gray—VERTICAL CURRENT/DIV
	- - - - - -			-	knob includes:
	213-0153-00			2	SCREW, set, 5-40 x 0.125 inch, HSS
-16	366-0491-01			1	KNOB, gray—DISPLAY OFFSET
	- - - - - -			-	knob includes:
	213-0153-00			1	SCREW, set, 5-40 x 0.125 inch, HSS

FIG. 1 FRONT *(Cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description 1 2 3 4 5
1-17	366-1090-00			1	KNOB, gray—CENTERLINE VALUE
	- - - - - -			-	knob includes:
	213-0153-00			1	SCREW, set, 5-40 x 0.125 inch, HSS
-18	366-1124-00			1	KNOB, gray—HORIZONTAL VOLTS/DIV
	- - - - - -			-	knob includes:
	213-0153-00			2	SCREW, set 5-40 x 0.125 inch, HSS
-19	366-1124-00			1	KNOB, gray—AMPLITUDE
	- - - - - -			-	knob includes:
	213-0153-00			2	SCREW, set, 5-40 x 0.125 inch, HSS
-20	260-0276-00			1	SWITCH, toggle—POWER
	- - - - - -			-	mounting hardware: (not included w/switch)
	354-0055-00			1	RING, locking
-21	337-0398-00			1	SHIELD
	210-0902-00			1	WASHER, flat, 0.470 ID x $^{21}/_{32}$ inch OD
	210-0473-00			1	NUT, 12 sided, $^{15}/_{32}$-32 x $^{5}/_{64}$ inch
-22	366-0379-01			1	KNOB, gray—CURRENT LIMIT
	- - - - - -			-	knob includes
	213-0153-00			1	SCREW, set, 5-40 x 0.125 inch, HSS
-23	366-1092-00			1	KNOB, gray—NUMBER OF STEPS
	- - - - - -			-	knob includes
	213-0153-00			1	SCREW, set, 5-40 x 0.125 inch, HSS
-24	260-1028-00			1	SWITCH, unwired—NUMBER OF STEPS
	- - - - - -			-	mounting hardware: (not included w/switch)
	210-0978-00			1	WASHER, flat, $^{3}/_{8}$ ID x $^{1}/_{2}$ inch OD
	210-0590-00			1	NUT, hex., $^{3}/_{8}$-32 x $^{7}/_{16}$ inch
-25	366-0392-00			1	KNOB, gray—INTENSITY
-26	366-0392-00			1	KNOB, gray—FOCUS
-27	366-1125-00			1	KNOB, gray—FINE (vertical)
	- - - - - -			-	knob includes:
	213-0153-00			1	SCREW, set, 5-40 x 0.125 inch, HSS
-28	366-1027-00			1	KNOB, gray—POSITION (vertical)
	- - - - - -			-	knob includes:
	213-0153-00			1	SCREW, set, 5-40 x 0.125 inch, HSS
-29	366-1125-00			1	KNOB, gray—FINE (horizontal)
	- - - - - -			-	knob includes:
	213-0153-00			1	SCREW, set, 5-40 x 0.125 inch, HSS
-30	366-1027-00			1	KNOB, gray—POSITION (horizontal)
	- - - - - -			-	knob includes:
	213-0153-00			1	SCREW, set, 5-40 x 0.125 inch, HSS
-31	366-1048-08			1	PUSHBUTTON—INVERT
-32	366-1048-11			1	PUSHBUTTON—ZERO
-33	366-1048-09			1	PUSHBUTTON—CAL
	670-1035-00			1	ASSEMBLY, circuit board—DISPLAY SWITCHING
	- - - - - -			-	assembly includes:
-34	388-1130-00			1	BOARD, circuit
-35	131-0633-00			31	TERMINAL, pin
-36	136-0252-01			16	SOCKET, pin connector
-37	260-1038-00			1	SWITCH, push, 3 button
-38	131-0604-00			16	CONTACT—POST ASSEMBLY
-39	401-0053-00			2	BEARING, front
	- - - - - -			-	mounting hardware for each: (not included w/bearing)
-40	211-0116-00			2	SCREW, sems, 4-40 x $^{5}/_{16}$ inch, PHB
	210-0591-00			2	NUT, hex., 4-40 x $^{3}/_{16}$ inch

FIG. 1 FRONT *(Cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description 1 2 3 4 5
1-41	354-0219-00			2	RING, retaining
-42	214-1127-00			2	ROLLER, detent
-43	214-1126-01			2	SPRING, flat
-44	105-0089-00			2	DRUM, cam switch
-45	401-0060-00			2	BEARING, rear
	- - - - - -			-	mounting hardware for each: (not included w/bearing)
-46	211-0116-00			2	SCREW, sems, 4-40 x $^5/_{16}$ inch, PHB
-47	210-0591-00			2	NUT, hex., 4-40 x $^3/_{16}$ inch
-48	200-0994-00			2	COVER
	- - - - - -			-	mounting hardware for each: (not included w/cover)
-49	211-0079-00			2	SCREW, 2-56 x $^3/_{16}$ inch, PHS
	210-0046-00			2	LOCKWASHER, internal, 0.261 ID x 0.400 inch OD
	210-0583-00			2	NUT, hex., $^1/_4$-32 x $^5/_{16}$ inch
-50	384-0313-00			2	SHAFT
	376-0051-00			2	COUPLING
	- - - - - -			-	coupling includes:
-51	376-0049-00			1	COUPLING, plastic
-52	354-0251-00			2	RING, coupling
	213-0022-00			4	SCREW, set, 4-40 x $^3/_{16}$ inch, HSS
-53	- - - - - -			2	RESISTOR, variable
	- - - - - -			-	mounting hardware for each: (not included w/resistor)
-54	407-0579-00			1	BRACKET
	210-0046-00			1	LOCKWASHER, internal, 0.261 ID x 0.400 inch OD
-55	210-0583-00			1	NUT, hex., $^1/_4$-32 x $^5/_{16}$ inch
	- - - - - -			-	mounting hardware: (not included w/assembly)
-56	211-0601-00			3	SCREW, sems, 6-32 x 0.313 inch, PHB
	210-0978-00			2	WASHER, flat, $^3/_8$ ID x $^1/_2$ inch OD
	210-0012-00			2	LOCKWASHER, internal, $^3/_8$ ID x $^{11}/_{16}$ inch OD
-57	210-0590-00			2	NUT, hex., $^3/_8$-32 x $^7/_{16}$ inch
-58	366-1048-05			1	PUSHBUTTON—ZERO
-59	366-1048-12			1	PUSHBUTTON—AID
-60	366-1048-15			1	PUSHBUTTON—OPPOSE
-61	366-1048-07			1	PUSHBUTTON—.1X
-62	366-1048-04			1	PUSHBUTTON—STEPS
-63	366-1048-13			1	PUSHBUTTON—300 μs
-64	366-1048-16			1	PUSHBUTTON—80 μs
-65	366-1048-08			1	PUSHBUTTON—INVERT
-66	366-1048-06			1	PUSHBUTTON—REP
-67	366-1048-14			1	PUSHBUTTON—SINGLE
-68	366-1048-03			1	PUSHBUTTON—2X
-69	366-1048-17			1	PUSHBUTTON—NORM
-70	366-1048-18			1	PUSHBUTTON—.5X

FIG. 1 FRONT *(Cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
1-	672-0407-00			1	ASSEMBLY, pushbutton switch
	- - - - - -			-	assembly includes:
-71	670-1033-00			1	ASSEMBLY, circuit board—STEP GEN OFFSET
	- - - - - -			-	assembly includes:
	388-1128-00			1	BOARD, circuit
-72	131-0633-00			6	TERMINAL, pin
-73	260-1041-00			1	SWITCH, push, 4 button
-74	670-1036-00			1	ASSEMBLY, circuit board—STEP GEN PULSE
	- - - - - -			-	assembly includes:
	388-1131-00			1	BOARD, circuit
-75	131-0633-00			9	TERMINAL, pin
-76	260-1039-00			1	SWITCH, push, 5 button
-77	670-1034-00			1	ASSEMBLY, circuit board—STEP GEN RATE
	- - - - - -			-	assembly includes:
	388-1129-00			1	BOARD, circuit
-78	131-0633-00			11	TERMINAL pin
-79	260-1040-00			1	SWITCH, push, 5 button
	- - - - - -			-	mounting hardware: (not included w/assembly)
-80	211-0027-00			4	SCREW, 4-40 x 1 1/2 inches, RHS
-81	361-0229-00			2	SPACER, circuit board
-82	361-0231-00			2	SPACER, circuit board
	210-0994-00			4	WASHER, flat, 0.125 ID x 0.250 inch OD
-83	210-0586-00			4	NUT, keps, 4-40 x 1/4 inch
	- - - - - -			-	mounting hardware: (not included w/assembly)
-84	211-0012-00			4	SCREW, 4-40 x 3/8 inch, PHS
-85	366-1095-00			1	KNOB, gray—PEAK POWER WATTS
	- - - - - -			-	knob includes:
	213-0153-00			4	SCREW, set, 5-40 x 0.125 inch, HSS
-86	354-0337-00			1	RING, knob skirt—MAX PEAK VOLTS
	- - - - - -			-	ring includes:
	213-0153-00			1	SCREW, set, 5-40 x 0.125 inch, HSS
-87	358-0254-00			1	BUSHING, hex.
	210-0049-00			1	LOCKWASHER, internal, 5/8 ID x 7/8 inch OD
-88	210-0579-00			1	Nut, hex., 5/8-24 x 3/4 inch
-89	136-0164-00			2	SOCKET, lamp, w/hardware
	- - - - - -			-	mounting hardware for each: (not included w/socket)
-90	220-0480-02			1	NUT, 12 sided, 0.377-32 x 0.438 inch
-91	210-0978-00			1	WASHER, flat, 3/8 ID x 1/2 inch OD
-92	331-0231-00			1	DIAL
-93	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
-94	201-0013-00			1	CUP, mounting, plastic
-95	131-0672-00			1	CONTACT, electrical
-96	200-0915-01			1	BEZEL
	- - - - - -			-	mounting hardware: (not included w/bezel)
-97	213-0201-00			1	SCREW, 10-24 x 0.320 inch, PHS

FIG. 1 FRONT *(Cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
1-98	378-0616-00			1	FILTER, light, CRT
-99	337-1118-00			1	SHIELD, implosion
	- - - - - -			-	mounting hardware: (not included w/shield)
-100	211-0079-00			3	SCREW, 2-56 x $^{3}/_{16}$ inch, OHS
-101	386-1598-00			1	LIGHT CONDUCTOR, readout illumination
-102	331-0230-00			1	MASK, readout
	- - - - - -			-	mounting hardware: (not included w/mask)
	211-0073-00			2	SCREW, 2-56 x $^{7}/_{32}$ inch, FHS
-103	366-1007-00			1	KNOB, gray—VARIABLE COLLECTOR SUPPLY
	- - - - - -			-	knob includes:
	213-0153-00			1	SCREW, set, 5-40 x 0.125 inch, HSS
-104	- - - - - -			1	TRANSFORMER, variable
	- - - - - -			-	mounting hardware: (not included w/transformer)
-105	210-0012-00			1	LOCKWASHER, internal, $^{3}/_{8}$ ID x $^{1}/_{2}$ inch OD
	210-0978-00			1	WASHER, flat, $^{3}/_{8}$ ID x $^{1}/_{2}$ inch OD
-106	210-0590-00			1	NUT, hex., $^{3}/_{8}$-32 x $^{7}/_{16}$ inch
-107	260-1042-00			1	SWITCH, push—COLLECTOR SUPPLY RESET
	- - - - - -			-	mounting hardware: (not included w/switch)
-108	210-0590-00			2	NUT, hex., $^{3}/_{8}$-32 x $^{7}/_{16}$ inch
	210-0978-00			1	WASHER, flat, $^{3}/_{8}$ ID x $^{1}/_{2}$ inch OD
	210-0012-00			1	LOCKWASHER, internal, $^{3}/_{8}$ ID x $^{1}/_{2}$ inch OD
-109	333-1200-01			1	PANEL, front, variable transformer
-110	200-0937-00			1	COVER, variable transformer
	- - - - - -			-	mounting hardware: (not included w/cover)
-111	212-0023-00			2	SCREW, 8-32 x $^{3}/_{8}$ inch, PHS
-112	426-0483-01			1	FRAME SECTION, cabinet
	- - - - - -			-	mounting hardware: (not included w/frame section)
-113	212-0023-00			2	SCREW, 8-32 x $^{3}/_{8}$ inch, PHS
-114	212-0043-00			2	SCREW, 8-32 x $^{1}/_{2}$ inch, 100° csk, FHS
-115	220-0533-00			1	NUT PLATE
-116	426-0470-01			1	FRAME-PANEL, cabinet
-117	131-0018-00			2	CONNECTOR, 16 contact, female
	- - - - - -			-	mounting hardware for each: (not included w/connector)
-118	211-0012-00			2	SCREW, 4-40 x $^{3}/_{8}$ inch, PHS
-119	210-0586-00			2	NUT, keps, 4-40 x $^{1}/_{4}$ inch
-120	131-0097-00			1	CONNECTOR, 32 contact, female
	- - - - - -			-	mounting hardware: (not included w/connector)
	211-0012-00			2	SCREW, 4-40 x $^{3}/_{8}$ inch, PHS
	210-0586-00			2	NUT, keps, 4-40 x $^{1}/_{4}$ inch

FIG. 1 FRONT *(Cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description 1 2 3 4 5
1-121	131-0148-00			1	CONNECTOR, 24 contact, female
	- - - - - -			-	mounting hardware: (not included w/connector)
-122	211-0012-00			2	SCREW, 4-40 x 3/8 inch, PHS
-123	210-0586-00			2	NUT, keps, 4-40 x 1/4 inch
	337-1194-00			1	SHIELD, transistor
	- - - - - -			-	shield includes
-124	337-1147-01			1	SHIELD, electrical, lid
-125	214-1180-00			2	HINGE, spring
-126	337-1148-00			1	SHIELD, electrical, wraparound
-127	214-1181-00			1	ACTUATOR, switch
-128	214-1182-00			1	SPRING
-129	343-0218-00			1	RETAINER, spring
-130	386-1544-00			1	PLATE, mounting, plastic
	- - - - - -			-	mounting hardware: (not included w/plate)
-131	211-0025-00			3	SCREW, 4-40 x 3/8 inch, 100° csk, FHS
-132	131-0031-00			10	CONNECTOR, jack, female
	- - - - - -			-	mounting hardware for each: (not included w/connector)
-133	210-0455-00			2	NUT, hex., 1/4-28 x 3/8 inch
	210-0223-00			1	LUG, solder, 1/4 ID x 7/16 inch OD, SE
-134	131-0749-00			1	CONTACT, upper
-135	131-0748-00			1	CONTACT, lower
-136	361-0259-00			1	SPACER
-137	337-1152-00			1	SHIELD
-138	211-0112-00			2	SCREW, 2-56 x 0.312 inch, PHS
-139	333-1190-01			1	PANEL, front
-140	386-1546-00			1	SUB-PANEL
-141	366-1126-00			1	KNOB, lever, gray—LEFT OFF RIGHT
-142	260-1048-00			1	SWITCH, lever—LEFT OFF RIGHT
	- - - - - -			-	mounting hardware: (not included w/switch)
	354-0055-00			1	RING, locking
	361-0262-00			1	SPACER
	210-0902-00			1	WASHER, flat, 0.470 ID x 21/32 inch OD
-143	210-0473-00			1	NUT, 12 sided, 15/32-32 x 0.634 inch
-144	366-1028-00			1	KNOB, gray—TERMINAL SELECTOR
	- - - - - -			-	knob includes:
	213-0153-00			1	SCREW, set, 5-40 x 0.125 inch, HSS
-145	260-1029-00			1	SWITCH, unwired—TERMINAL SELECTOR
	- - - - - -			-	mounting hardware: (not included w/switch)
	210-0840-00			1	WASHER, flat, 0.390 ID x 9/16 inch OD
-146	210-0413-00			1	NUT, hex., 3/8-32 x 1/2 inch
-147	136-0140-00			3	SOCKET, banana jack
	- - - - - -			-	mounting hardware for each: (not included w/socket)
	210-0904-00			1	WASHER, fiber, shouldered, 1/4 ID x 1/2 inch OD
-148	210-0465-00			2	NUT, hex., 1/4-32 x 3/8 inch
	210-0223-00			1	LUG, solder, 1/4 ID x 7/16 inch OD, SE

FIG. 1 FRONT *(Cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
1-149	136-0164-00			1	SOCKET, lamp, w/hardware
	- - - - - -			-	mounting hardware: (not included w/socket)
-150	220-0480-02			1	LUG, 12 sided, 0.377-32 x 0.438 inch
-151	210-0255-00			1	LUG, solder
-152	131-0096-00			1	CONNECTOR, 32 pin, male
	- - - - - -			-	mounting hardware: (not included w/connector)
-153	211-0008-00			2	SCREW, 4-40 x 1/4 inch, PHS
-154	210-0586-00			2	NUT, keps, 4-40 x 1/4 inch
-155	390-0098-00			1	CABINET BOTTOM
	- - - - - -			-	mounting hardware: (not included w/cabinet bottom)
-156	211-0504-00			6	SCREW, 6-32 x 1/4 inch, PHS
-157	390-0083-00			1	CABINET SIDE, left
	- - - - - -			-	mounting hardware: (not included w/cabinet side)
-158	213-0146-00			3	SCREW, thread forming, #6 x 0.313 inch PHS
-159	390-0082-00			1	CABINET SIDE, right
	- - - - - -			-	mounting hardware: (not included w/cabinet side)
-160	213-0146-00			3	SCREW, thread forming, #6 x 0.313 inch PHS
-161	366-0125-00			2	KNOB, plug-in securing
	- - - - - -			-	each knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 7/16 inch, HSS
-162	384-0715-00			2	ROD, securing
	- - - - - -			-	each rod includes:
-163	354-0025-00			1	RING, securing
-164	210-0894-00			2	WASHER, plastic, 0.190 ID x 7/16 inch OD
-165	179-1377-00			1	CABLE HARNESS, main, test fixture
-166	179-1378-00			1	CABLE HARNESS, high voltage, test fixture
-167	179-1371-00			1	CABLE HARNESS, connector
	- - - - - -			-	cable harness includes:
-168	131-0371-00			36	CONNECTOR, terminal
-169	131-0717-00			1	CONNECTOR, receptacle, 3 contact, female, w/hardware
-170	670-0778-00			1	ASSEMBLY, circuit board—READOUT ILLUM
	- - - - - -			-	assembly includes:
	388-1316-00			1	BOARD, circuit
-171	131-0633-00			2	TERMINAL, pin
	131-0704-00			1	CONTACT, electrical (not shown)
	210-0759-00			1	EYELET (not shown)
	210-0957-00			1	WASHER, flat, 1/16 ID x 1/8 inch OD (not shown)
	- - - - - -			-	mounting hardware: (not included w/assembly)
-172	211-0116-00			1	SCREW, sems, 4-40 x 5/16 inch, PHB
173	407-0634-00			1	BRACKET, circuit board
	- - - - - -			-	mounting hardware: (not included w/bracket)
-174	211-0007-00			2	SCREW, 4-40 x 3/16 inch, PHS

FIG. 2 SWITCHES

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description 1 2 3 4 5
2-	670-1026-00			1	ASSEMBLY, circuit board—VERTICAL CURRENT/DIV
	- - - - - -			-	assembly includes:
-1	388-1121-00			1	BOARD, circuit
-2	131-0633-00			30	TERMINAL, pin
-3	131-0639-00			12	CONTACT, electrical
-4	131-0604-00			30	CONTACT-POST ASSEMBLY
-5	401-0054-00			1	BEARING, front
	- - - - - -			-	mounting hardware: (not included w/bearing)
-6	211-0116-00			2	SCREW, sems, 4-40 x 5/16 inch, PHB
-7	210-0591-00			2	NUT, hex., 4-40 x 3/16 inch
-8	354-0219-00			1	RING, retaining
-9	214-1127-00			1	ROLLER, detent
-10	214-1139-00			1	SPRING, flat
	214-1139-03			1	SPRING, flat
-11	105-0085-00			1	DRUM, cam switch
-12	401-0056-00			1	BEARING, rear
	- - - - - -			-	mounting hardware: (not included w/bearing)
-13	211-0116-00			2	SCREW, sems, 4-40 x 5/16 inch, PHB
-14	210-0591-00			2	NUT, hex., 4-40 x 3/16 inch
-15	263-0511-00			1	SWITCH SECTION
	- - - - - -			-	mounting hardware: (not included w/switch section)
-16	211-0100-00			2	SCREW, 2-56 x 3/4 inch, RHS
	210-0053-00			2	LOCKWASHER, split, #2
-17	210-0405-00			2	NUT, hex., 2-56 x 3/16 inch, PHS
-18	200-0940-00			1	COVER
	- - - - - -			-	mounting hardware: (not included w/cover)
-19	211-0079-00			2	SCREW, 2-56 x 3/16 inch, PHS
	210-0001-00			2	LOCKWASHER, internal, #2
-20	210-0405-00			2	NUT, hex., 2-56 x 3/16 inch
	- - - - - -			-	mounting hardware: (not included w/assembly)
-21	211-0601-00			1	SCREW, sems, 6-32 x 0.313 inch, PHB
	210-0012-00			1	LOCKWASHER, internal, 3/8 ID x 1/2 inch OD
	210-0978-00			1	WASHER, flat, 3/8 ID x 1/2 inch OD
	210-0590-00			1	NUT, hex., 3/8-32 x 7/16 inch
	670-1031-00			1	ASSEMBLY, circuit board—DISPLAY OFFSET
	- - - - - -			-	assembly includes:
-22	388-1126-00			1	BOARD, circuit
-23	131-0633-00			16	TERMINAL, pin
-24	131-0604-00			28	CONTACT-POST ASSEMBLY
-25	401-0054-00			1	BEARING, front
	- - - - - -			-	mounting hardware: (not included w/bearing)
-26	211-0116-00			2	SCREW, sems, 4-40 x 5/16 inch, PHB
-27	210-0591-00			2	NUT, hex., 4-40 x 3/16 inch
-28	354-0219-00			2	RING, retaining
-29	214-1127-00			2	ROLLER, detent
-30	214-1139-02			2	SPRING, flat
-31	214-1139-03			2	SPRING, flat
-32	105-0095-00			1	DRUM, cam switch

FIG. 2 SWITCHES *(Cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	1 2 3 4 5 Description
2-33	401-0055-00			1	BEARING, center
	- - - - - -			-	mounting hardware: (not included w/bearing)
-34	211-0116-00			2	SCREW, sems, 4-40 x $^5/_{16}$ inch, PHB
-35	210-0591-00			2	NUT, hex., 4-40 x $^3/_{16}$ inch
-36	105-0093-00			1	DRUM, cam switch
-37	407-0057-00			1	BEARING, front, w/o threads
	- - - - - -			-	mounting hardware: (not included w/bearing)
-38	211-0116-00			2	SCREW, sems, 4-40 x $^5/_{16}$ inch, PHB
-39	210-0591-00			2	NUT, hex., 4-40 x $^3/_{16}$ inch
-40	200-0944-00			1	COVER
	- - - - - -			-	mounting hardware: (not included w/cover)
-41	211-0079-00			3	SCREW, 2-56 x $^3/_4$ inch, PHS
	210-0001-00			3	LOCKWASHER, internal, #2
-42	210-0405-00			3	NUT, hex., 2-56 x $^3/_{16}$ inch
	- - - - - -			-	mounting hardware: (not included w/assembly)
-43	211-0601-00			1	SCREW, sems, 6-32 x 0.313 inch, PHB
	210-0012-00			1	LOCKWASHER, internal, $^3/_8$ ID x $^1/_2$ inch OD
	210-0978-00			1	WASHER, flat, $^3/_8$ ID x $^1/_2$ inch OD
	210-0590-00			1	NUT, hex., $^3/_8$-32 x $^7/_{16}$ inch
	670-1027-00			1	ASSEMBLY, circuit board—HORIZONTAL VOLTS/DIV
	- - - - - -			-	assembly includes:
-44	388-1122-00			1	BOARD, circuit
-45	131-0633-00			16	TERMNIAL, pin
-46	131-0639-00			12	CONTACT, electrical
-47	131-0604-00			27	CONTACT-POST ASSEMBLY
-48	337-1137-00			1	SHIELD
	- - - - - -			-	mounting hardware: (not included w/shield)
-49	211-0040-00			4	SCREW, 4-40 x $^1/_4$ inch, BH Plastic
-50	384-0536-00			2	ROD, spacing, plastic
-51	401-0054-00			1	BEARING, front
	- - - - - -			-	mounting hardware: (not included w/bearing)
	211-0116-00			2	SCREW, sems, 4-40 x $^5/_{16}$ inch, PHB
-52	210-0591-00			2	NUT, hex., 4-40x $^3/_{16}$ inch
-53	354-0219-00			1	RING, retaining
-54	214-1127-00			1	ROLLER, detent
-55	214-1139-02			1	SPRING, flat
-56	214-1139-03			1	SPRING, flat
-57	105-0091-00			1	DRUM, cam switch
-58	401-0056-00			1	BEARING, rear
	- - - - - -			-	mounting hardware: (not included w/bearing)
-59	211-0116-00			2	SCREW, sems, 4-40 x $^5/_{16}$ inch, PHB
-60	210-0591-00			2	NUT, hex., 4-40 x $^3/_{16}$ inch

FIG. 2 SWITCHES *(Cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
2-61	200-0943-00			1	COVER
	- - - - - -			-	mounting hardware: (not included w/cover)
-62	211-0079-00			2	SCREW, 2-56 x $^3/_{16}$ inch, PHS
	210-0001-00			2	LOCKWASHER, internal, #2
-63	210-0405-00			2	NUT, hex., 2-56 x $^3/_{16}$ inch
	- - - - - -			-	mounting hardware: (not included w/assembly)
-64	211-0601-00			1	SCREW, sems, 6-32 x 0.313 inch, PHB
	210-0012-00			1	LOCKWASHER, internal, $^3/_8$ ID x $^1/_2$ inch OD
	210-0978-00			1	WASHER, flat, $^3/_8$ ID x $^1/_2$ inch OD
	210-0590-00			1	NUT, hex., $^3/_8$-32 x $^7/_{16}$ inch
	670-1025-00			1	ASSEMBLY, circuit board—AMPLITUDE
	- - - - - -			-	assembly includes:
-65	388-1120-00			1	BOARD, circuit
-66	131-0633-00			17	TERMINAL, pin
-67	131-0604-00			39	CONTACT-POST ASSEMBLY
-68	401-0054-00			1	BEARING, front
	- - - - - -			-	mounting hardware: (not included w/bearing)
-69	211-0116-00			2	SCREW, sems, 4-40 x $^5/_{16}$ inch, PHB
-70	210-0591-00			2	NUT, hex., 4-40 x $^3/_{16}$ inch
-71	354-0219-00			1	RING, retaining
-72	214-1127-00			1	ROLLER, detent
-73	214-1139-02			1	SPRING, flat
-74	214-1139-03			1	SPRING, flat
-75	105-0087-00			1	DRUM, cam switch
-76	401-0056-00			1	BEARING, rear
	- - - - - -			-	mounting hardware: (not included w/bearing)
-77	211-0116-00			2	SCREW, sems, 4-40 x $^5/_{16}$ inch, PHB
-78	210-0591-00			2	NUT, hex., 4-40 x $^3/_{16}$ inch
-79	200-0941-00			1	COVER
	- - - - - -			-	mounting hardware: (not included w/cover)
-80	211-0079-00			2	SCREW, 2-56 x $^3/_{16}$ inch, PHS
	210-0001-00			2	LOCKWASHER, internal, #2
-81	210-0405-00			2	NUT, hex., 2-56 x $^3/_{16}$ inch
	- - - - - -			-	mounting hardware: (not included w/assembly)
-82	211-0601-00			1	SCREW, sems, 6-32 x 0.313 inch, PHB
	210-0012-00			1	LOCKWASHER, internal, $^3/_8$ ID x $^1/_2$ inch OD
	210-0978-00			1	WASHER, flat, $^3/_8$ ID x $^1/_2$ inch OD
	210-0590-00			1	NUT, hex., $^3/_8$-32 x $^7/_{16}$ inch
-83	441-0851-00			1	CHASSIS, circuit board
	- - - - - -			-	mounting hardware: (not included w/chassis)
-84	129-0208-00			7	POST, metal

FIG. 2 SWITCHES *(Cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
2-85	670-1020-00			1	ASSEMBLY, circuit board—STEP GEN
	- - - - - -			-	assembly includes:
	388-1115-00			1	BOARD, circuit
-86	131-0633-00			37	TERMINAL, pin
-87	214-0579-00			3	PIN, test point
-88	136-0183-00			5	SOCKET, transistor, 3 pin
-89	136-0220-00			17	SOCKET, transistor, 3 pin
-90	136-0235-00			4	SOCKET, semiconductor, 6 pin
-91	136-0252-01			8	SOCKET, pin connector
-92	136-0269-00			9	SOCKET, integrated circuit
	- - - - - -			-	mounting hardware: (not included w/assembly)
-93	211-0601-00			7	SCREW, sems, 6-32 x 0.313 inch, PHB
-94	343-0088-00			2	CLAMP, cable, plastic, small
-95	358-0215-00			2	BUSHING, plastic
-96	220-0532-00			4	NUT, block, plastic
	- - - - - -			-	mounting hardware for each: (not included w/nut)
-97	211-0157-00			2	SCREW, 4-40 x 5/16 inch, HHS
-98	407-0576-00			1	BRACKET
	- - - - - -			-	mounting hardwaer: (not included w/bracket)
	210-0804-00			2	WASHER, flat, 0.170 ID x 3/8 inch OD
	212-0004-00			2	SCREW, 8-32 x 5/16 inch, PHS
-99	- - - - - -			1	RESISTOR
	- - - - - -			-	mounting hardware: (not included w/resistor)
-100	211-0553-00			1	SCREW, 6-32 x 1 1/2 inches, RHS
	210-0808-00			1	WASHER, centering
	210-0478-00			1	NUT, hex., 6-32 x 5/16 inch
-101	211-0507-00			1	SCREW, 6-32 x 5/16 inch, PHS
-102	- - - - - -			1	RESISTOR ASSEMBLY, w/hardware
-103	407-0516-00			1	BRACKET
	- - - - - -			-	mounting hardware: (not included w/bracket)
	212-0023-00			4	SCREW, 8-32 x 5/16 inch, PHS
	210-0458-00			2	NUT, keps, 8-32 x 11/32 inch
-104	- - - - - -			2	RESISTOR
	- - - - - -			-	mounting hardware for each: (not included w/resistor)
-105	212-0037-00			1	SCREW, 8-32 x 1 3/4 inches, Fil HS
	210-0008-00			1	LOCKWASHER, internal, #8
	210-0601-00			1	EYELET
	210-0462-00			1	NUT, hex., 8-32 x 1/2 inch, PHS
-106	212-0004-00			1	SCREW, 8-32 x 5/16 inch, PHS

FIG. 2 SWITCHES *(Cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	1 2 3 4 5 Description
2-107	136-0270-00			1	SOCKET, transistor, 2 pin
	- - - - - -			-	mounting hardware: (not included w/socket)
-108	211-0062-00			2	SCREW, 2-56 x $^5/_{16}$ inch, RHS
	210-0001-00			2	LOCKWASHER, internal, #2
-109	210-0405-00			2	NUT, hex., 2-56 x $^3/_{16}$ inch
-110	- - - - - -			1	TRANSISTOR
	- - - - - -			-	mounting hardware: (not included w/transistor)
-111	213-0104-00			2	SCREW, thread forming, #6 x $^3/_8$ inch, THS
	386-0143-00			1	PLATE, insulaitng
-112	136-0193-00			1	SOCKET, relay
	- - - - - -			-	mounting hardware: (not included w/socket)
-113	211-0008-00			1	SCREW, 4-40 x $^1/_4$ inch, PHS
	214-0536-00			1	SPRING, ground wire
-114	210-0586-00			1	NUT, keps, 4-40 x $^1/_4$ inch
-115	214-0210-00			1	ASSEMBLY, solder spool
	- - - - - -			-	assembly includes:
	214-0209-00			1	SPOOL, w/o solder
	- - - - - -			-	mounting hardware: (not included w/assembly)
	361-0007-00			1	SPACER, plastic, 0.188 inch long
-116	- - - - - -			1	SWITCH, thermal cutout
	- - - - - -			-	mounting hardware: (not included w/switch)
-117	211-0504-00			2	SCREW, 6-32 x $^1/_4$ inch, PHS
-118	407-0575-00			1	BRACKET
	- - - - - -			-	mounting hardware: (not included w/bracket)
-119	211-0507-00			2	SCREW, 6-32 x $^5/_{16}$ inch, PHS
-120	- - - - - -			3	RESISTOR, variable
	- - - - - -			-	mounting hardware for each: (not included w/resistor)
-121	210-0840-00			1	WASHER, flat, 0.390 ID x $^9/_{16}$ inch OD
-122	210-0413-00			1	NUT, hex., $^3/_8$-32 x $^1/_2$ inch

FIG. 2 SWITCHES *(Cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	1 2 3 4 5 Description
2-123	384-0466-00			2	SHAFT, extension
	376-0051-00			2	COUPLING, flexible
	- - - - - -			-	each coupling includes:
-124	354-0251-00			2	RING, coupling
-125	376-0049-00			1	COUPLING, plastic
	213-0022-00			4	SCREW, set, 4-40 x 3/16 inch, HSS
-126	- - - - - -			2	RESISTOR, variable
	- - - - - -			-	mounting hardware for each: (not included w/resistor)
-127	210-0046-00			1	LOCKWASHER, internal, 0.261 ID x 0.400 inch OD
	210-0940-00			1	WASHER, flat, 1/4 ID x 3/8 inch OD
-128	210-0583-00			1	NUT, hex., 1/4-32 x 5/16 inch
-129	348-0067-00			1	GROMMET, plastic, 5/16 inch diameter
-130	348-0055-00			1	GROMMET, plastic, 1/4 inch diameter
-131	214-0119-00			1	STRIP, ceramic, 7/16 inch h, w/2 notches
	- - - - - -			-	strip includes:
	355-0046-00			1	STUD, plastic
	- - - - - -			-	mounting hardware: (not included w/strip)
	361-0009-00			1	SPACER, plastic, 0.406 inch long
-132	124-0092-00			1	STRIP, ceramic, 7/16 inch h, w/3 notches
	- - - - - -			-	strip includes:
	355-0046-00			1	STUD, plastic
	- - - - - -			-	mounting hardware (not included w/strip)
	361-0009-00			1	SPACER, plastic, 0.406 inch long
-133	200-0608-00			2	COVER, plastic

FIG. 3 CHASSIS

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description 1 2 3 4 5
3-	672-0405-00			1	ASSEMBLY, circuit card—READOUT
	- - - - - -			-	assembly includes:
-1	670-0614-00			3	ASSEMBLY, circuit board—VERT, STEP & BETA
-2	670-0615-00			1	ASSEMBLY, circuit board—HORIZ
-3	670-0616-00			1	ASSEMBLY, circuit board—BETA
-4	670-0617-00			3	ASSEMBLY, circuit board—VERT, HORIZ & STEP
-5	331-0227-00			1	READOUT ASSEMBLY
	- - - - - -			-	readout assembly includes:
-6	200-0921-00			4	COVER, readout assembly
	- - - - - -			-	mounting hardware for each: (not included w/cover)
-7	211-0087-00			2	SCREW, 2-56 x 3/16 inch, FHS
-8	179-1337-00			1	CABLE HARNESS, readout assembly
-9	670-1029-00			1	ASSEMBLY, circuit board—READOUT LOGIC
	- - - - - -			-	assembly includes:
	388-1124-00			1	BOARD, circuit
-10	136-0220-00			8	SOCKET, transistor, 3 pin
-11	136-0260-00			9	SOCKET, semiconductor, 16 pin
	- - - - - -			-	mounting hardware: (not included w/assembly)
-12	211-0116-00			4	SCREW, sems, 4-40 x 5/16 inch, PHB
-13	407-0572-00			1	BRACKET, readout chassis
	- - - - - -			-	mounting hardware: (not included w/bracket)
-14	211-0504-00			4	SCREW, 6-32 x 1/4 inch, PHS
-15	351-0179-00			2	GUIDE, readout chassis
	- - - - - -			-	mounting hardware for each: (not included w/guide)
-16	211-0008-00			3	SCREW, 4-40 x 1/4 inch, PHS
-17	670-1030-00			1	ASSEMBLY, circuit board—READOUT INTERCONN
	- - - - - -			-	assembly includes:
	388-1125-00			1	BOARD, circuit
-18	131-0633-00			67	TERMINAL, pin
-19	131-0697-00			1	CONNECTOR, electrical, 44 pin, female
	- - - - - -			-	mounting hardware: (not included w/connector)
-20	211-0015-00			2	SCREW, 4-40 x 1/2 inch RHS
-21	210-0994-00			2	WASHER, flat, 0.125 ID x 0.250 inch OD
-22	210-0406-00			2	NUT, hex., 4-40 x 3/16 inch
-23	136-0183-00			2	SOCKET, transistor, 3 pin
-24	136-0220-00			2	SOCKET, transistor, 3 pin
	- - - - - -			-	mounting hardware: (not included w/assembly)
-25	211-0116-00			4	SCREW, sems, 4-40 x 5/16 inch, PHB
-26	441-0845-00			1	CHASSIS, main
-27	210-0201-00			2	LUG, solder, SE #4
	- - - - - -			-	mounting hardware: (not included w/lug)
-28	213-0044-00			1	SCREW, thread forming, 5-32 x 3/16 inch, PHS

FIG. 3 CHASSIS *(Cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description 1 2 3 4 5
3-29	210-0201-00			1	LUG, solder, SE #4
	- - - - - -			-	mounting hardware: (not included w/lug)
-30	213-0044-00			1	SCREW, thread forming, 5-32 x 3/16 inch, PHS
-31	348-0031-00			4	GROMMET, plastic, 3/32 inch diameter
-32	348-0055-00			1	GROMMET, plastic, 1/4 inch diameter
-33	348-0063-00			1	GROMMET, plastic, 1/2 inch diameter
-34	348-0064-00			2	GROMMET, plastic, 5/8 inch diameter
-35	358-0166-00			1	BUSHING, plastic, black
-36	407-0573-00			1	BRACKET
	- - - - - -			-	mounting hardware: (not included w/bracket)
-37	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch
-38	407-0578-00			1	BRACKET, relay
	- - - - - -			-	mounting hardware: (not included w/bracket)
-39	211-0504-00			2	SCREW, 6-32 x 1/4 inch, PHS
-40	136-0215-00			1	SOCKET, relay
	- - - - - -			-	mounting hardware: (not included w/socket)
-41	211-0008-00			1	SCERW, 4-40 x 1/4 inch, PHS
	214-0538-00			1	SPRING, ground wire
-42	210-0586-00			1	NUT, keps, 4-40 x 1/4 inch
-43	- - - - - -			1	RESISTOR
	- - - - - -			-	mounting hardware: (not included w/resistor)
-44	211-0553-00			1	SCREW, 6-32 x 1 1/2 inches, RHS
-45	210-0601-00			1	EYELET
	210-0478-00			1	NUT, resistor mounting
-46	210-0202-00			1	LUG, solder, SE #6
-47	- - - - - -			2	RESISTOR
	- - - - - -			-	mounting hardware: (not included w/resistor)
-48	211-0511-00			2	SCREW, 6-32 x 1/2 inch, PHS
	210-0803-00			2	WASHER, flat, 0.150 ID x 3/8 inch OD
-49	210-0478-00			2	NUT, resistor mounting
-50	214-1130-00			1	HEAT SINK
	- - - - - -			-	mounting hardware: (not included w/heat sink)
-51	210-0457-00			4	NUT, keps, 6-32 x 5/16 inch
-52	- - - - - -			2	TRANSISTOR
	- - - - - -			-	mounting hardware for each: (not included w/transistor)
-53	211-0511-00			2	SCREW, 6-32 x 1/2 inch PHS
-54	210-0978-00			1	PLATE, mica
-55	210-0975-00			2	WASHER, plastic, shouldered, 0.140 ID x 0.175 inch OD
	210-0803-00			2	WASHER, flat, 0.150 ID x 3/8 inch OD
	210-0202-00			1	LUG, solder, SE #6
-56	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch

FIG. 3 CHASSIS *(Cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
3-57	- - - - - -			2	TRANSISTOR
	- - - - - -			-	mounting hardware for each: (not included w/transistor)
-58	211-0511-00			2	SCREW, 6-32 x 1/2 inch, PHS
-59	386-0143-00			1	PLATE, mica
-60	210-0935-00			2	WASHER, fiber, shouldered, 0.140 ID x 0.375 inch OD
	210-0803-00			2	WASHER, flat, 0.150 ID x 3/8 inch OD
	210-0202-00			1	LUG, solder, SE #6
-61	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch
-62	670-1032-00			1	ASSEMBLY, circuit board—DISPLAY AMP
	- - - - - -			-	assembly includes:
	388-1127-00			1	BOARD, circuit
-63	131-0633-00			29	TERMINAL, pin
-64	136-0183-00			4	SOCKET, transistor, 3 pin
-65	136-0220-00			4	SOCKET, transistor, 3 pin
-66	136-0235-00			4	SOCKET, semiconductor, 6 pin
-67	214-0579-00			1	PIN, test point
	- - - - - -			-	mounting hardware: (not included w/assembly)
-68	211-0601-00			4	SCREW, sems, 6-32 x 0.438 inch, PHB
-69	670-1024-00			1	ASSEMBLY, circuit board—L V REGULATOR
	- - - - - -			-	assembly includes:
	388-1119-00			1	BOARD, circuit
-70	131-0633-00			25	TERMINAL, pin
-71	136-0183-00			6	SOCKET, transistor, 3 pin
-72	136-0220-00			11	SOCKET, transistor, 3 pin
-73	136-0235-00			4	SOCKET, semiconductor, 6 pin
	- - - - - -			-	mounting hardware: (not included w/assembly)
-74	211-0602-00			4	SCREW, sems 6-32 x 0.438 inch, PHB
-75	670-1021-00			1	ASSEMBLY, circuit board—L V RECTIFIER
	- - - - - -			-	assembly includes:
	388-1116-00			1	BOARD, circuit
-76	131-0633-00			36	TERMINAL, pin
	- - - - - -			-	mounting hardware: (not included w/assembly)
-77	211-0602-00			4	SCREW, sems, 6-32 x 0.438 inch, PHB
-78	129-0197-00			4	POST, dual, plastic
	- - - - - -			-	mounting hardware for each: (not included w/post)
-79	211-0507-00			1	SCREW, 6-32 x 7/8 inch, PHS
-80	- - - - - -			1	TRANSFORMER
	- - - - - -			-	transformer includes:
-81	212-0516-00			4	SCREW, 10-32 x 2 inches, HHS
	210-0813-00			4	WASHER, fiber, shouldered, #10
-82	407-0571-00			1	BRACKET
	- - - - - -			-	mounting hardware: (not included w/transformer)
	212-0023-00			2	SCREW, 8-32 x 3/8 inch, PHS
-83	220-0533-00			1	NUT, plate
-84	220-0410-00			4	NUT, keps, 10-32 x 3/8 inch

FIG. 3 CHASSIS *(Cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
3-85	200-0538-00			4	COVER, capacitor, plastic, 1.365 ID x 1.644 inches long
-86	200-0293-00			3	COVER, capacitor, plastic, 1.365 ID x 2 9/16 inches long
-87	- - - - - -			7	CAPACITOR
	- - - - - -			-	mounting hardware for each: (not included w/capacitor)
-88	211-0516-00			2	SCREW, 6-32 x 7/8 inch, PHS
-89	432-0048-00			1	BASE, capacitor mounting, plastic
-90	386-0254-00			1	PLATE, fiber, large
-91	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch
-92	343-0089-00			2	CLAMP, cable, plastic, large
-93	179-1370-00			1	CABLE HARNESS, power
	- - - - - -			-	cable harness includes:
-94	131-0371-00			60	CONNECTOR, terminal (for small wire)
-95	131-0667-00			8	CONNECTOR, terminal (for large wire)
-96	179-1369-00			1	CABLE HARNESS, chassis
	- - - - - -			-	cable harness includes:
-97	131-0371-00			213	CONNECTOR, terminal
-98	179-1373-00			1	CABLE HARNESS, relay
-99	124-0086-00			1	STRIP, ceramic, 3/4 inch h, w/2 notches
	- - - - - -			-	strip includes:
	355-0082-00			1	STUD, plastic
	- - - - - -			-	mounting hardware: (not included w/strip)
	361-0009-00			1	SPACER, plastic, 0.406 inch long
-100	124-0088-00			4	STRIP, ceramic, 3/4 inch h, w/4 notches
	- - - - - -			-	each strip includes:
	355-0082-00			2	STUD, plastic
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0009-00			2	SPACER, plastic, 0.406 inch long
-101	124-0119-00			1	STRIP, ceramic, 7/16 inch h, w/2 notches
	- - - - - -			-	strip includes:
	355-0046-00			1	STUD, plastic
	- - - - - -			-	mounting hardware: (not included w/strip)
	361-0009-00			1	SPACER, plastic, 0.406 inch long

FIG. 4 COLLECTOR SUPPLY

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
4-1	260-1037-00			1	SWITCH, unwired—MAX PEAK VOLTS
	- - - - - -			-	mounting hardware: (not included w/switch)
-2	210-0449-00			2	NUT, hex., 5-40 x 1/4 inch
	210-0801-00			4	WASHER, flat, 0.150 ID x 0.281 inch OD
-3	386-1550-00			1	PLATE, mounting, switch alignment
-4	210-0949-00			3	WASHER, flat, 9/64 ID x 1/2 inch OD
-5	211-0603-00			3	SCREW, 6-32 x 3/8inch, HHS
-6	210-0049-00			1	LOCKWASHER, internal, 5/8 ID x 7/8 inch OD
-7	210-0579-00			1	NUT, hex., 5/8-24 x 3/4 inch
-8	376-0083-00			1	COUPLER HALF, shaft, female
	- - - - - -			-	coupler half includes:
	213-0178-00			1	SCREW, set, 4-40 x 1 inch, HSS
-9	376-0084-00			1	COUPLING, shaft, flex
	- - - - - -			-	coupling includes:
	213-0153-00			4	SCREW, set, 5-40 x 0.125 inch, HSS
-10	384-0451-00			1	EXTENSION SHAFT, 2.6 inches long
-11	376-0082-00			1	COUPLER HALF, shaft, male
	- - - - - -			-	coupler half includes:
	213-0178-00			1	SCREW, set, 4-40 x 1/8 inch, HSS
-12	384-0453-00			1	EXTENSION SHAFT, 1.62 inches long
-13	361-0220-00			1	SPACER, sleeve
	- - - - - -			-	spacer includes:
	213-0153-00			2	SCREW, set, 5-40 x 0.125 inch, HSS
-14	260-1031-00			1	SWITCH, unwired—POLARITY (rear)
	- - - - - -			-	mounting hardware: (not included w/switch)
-15	210-0012-00			1	LOCKWASHER, internal, 3/8 ID x 1/2 inch OD
	210-0207-00			1	LUG, solder, 3/8 ID x 5/8 inch OD, SE
	210-0013-00			1	LOCKWASHER, internal, 3/8 ID x 11/16 inch OD
	210-1085-00			1	WASHER, flat, 0.375 ID x 0.750 inch OD
-16	210-0413-00			1	NUT, hex., 3/8-32 x 1/2 inch
-17	376-0086-00			1	COUPLING, shaft, flex
-18	- - - - - -			1	CAPACITOR
	- - - - - -			-	mounting hardware: (not included w/capacitor)
-19	211-0507-00			2	SCREW, 6-32 x 5/16 inch, PHS
-20	384-0250-00			1	EXTENSION SHAFT, 3.001 inches long
	376-0052-00			1	COUPLING, shaft, flex
	- - - - - -			-	coupling includes:
-21	354-0251-00			1	RING, coupling, 1/4 inch ID
-22	376-0049-00			1	COUPLING, plastic
-23	354-0261-00			1	RING, coupling, 1/8 inch ID
	213-0022-00			2	SCREW, set, 4-40 x 3/16 inch, HSS
	213-0075-00			2	SCREW, set, 4-40 x 3/32 inch, HSS
	213-0115-00			1	SCREW, set, 4-40 x 5/16 inch, HSS
-24	131-0689-00			1	CONNECTOR, receptacle, 15 contact, female
	- - - - - -			-	mounting hardware: (not included w/connector)
-25	211-0016-00			2	SCREW, 4-40 x 5/8 inch, PHS
-26	210-0586-00			2	NUT, keps, 4-40 x 1/4 inch

FIG. 4 COLLECTOR SUPPLY *(Cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
4-27	407-0519-00			1	BRACKET, switch
	- - - - - -			-	mounting hardware: (not included w/bracket)
-28	211-0507-00			2	SCREW, 6-32 x $^5/_{16}$ inch, PHS
	210-0803-00			2	WASHER, flat, 0.150 ID x $^3/_8$ inch OD
-29	129-0207-00			1	POST, 8.5 inches long
	- - - - - -			-	mounting hardware: (not included w/post)
-30	211-0507-00			2	SCREW, 6-32 x $^5/_{16}$ inch, PHS
-31	337-1120-00			1	SHIELD
	- - - - - -			-	mounting hardware: (not included w/shield)
-32	211-0504-00			4	SCREW, 6-32 x $^1/_4$ inch, PHS
-33	- - - - - -			1	DIODE
	- - - - - -			-	mounting hardware: (not included w/diode)
-34	211-0507-00			4	SCREW, 6-32 x $^5/_{16}$ inch, PHS
-35	670-1023-00			1	ASSEMBLY, circuit board—2KV BRIDGE
	- - - - - -			-	assembly includes:
	388-1118-00			1	BOARD, circuit
	- - - - - -			-	mounting hardware: (not included w/assembly)
-36	211-0028-00			2	SCREW, 4-40 x $^3/_{16}$ inch, BH Plastic
-37	385-0109-00			2	ROD, plastic
-38	211-0008-00			2	SCREW, 4-40 x $^1/_4$ inch, PHS
-39	- - - - - -			5	RESISTOR
	- - - - - -			-	mounting hardware: (not included w/resistor)
-40	212-0029-00			2	SCREW, 8-32 x 3 inches, HHS
-41	386-1645-00			1	BRACKET
	166-0032-00			2	SPACER
	210-0804-00			2	WASHER, flat, 0.170 ID x $^3/_8$ inch OD
-42	210-0940-00			2	WASHER, flat, $^1/_4$ ID x $^3/_8$ inch OD
-43	210-0839-00			2	WASHER, spring tension, $^1/_4$ ID x $^7/_{16}$ inch OD
-44	361-0257-00			2	SPACER
	210-0812-00			4	WASHER, fiber, #10
-45	210-0458-00			4	NUT, keps, 8-32 x $^{11}/_{32}$ inch
-46	337-1096-00			1	SHIELD, wraparound
-47	337-1095-00			1	SHIELD, bottom
	- - - - - -			-	mounting hardware: (not included w/shield)
-48	211-0504-00			7	SCREW, 6-32 x $^1/_4$ inch, PHS
-49	348-0056-00			1	GROMMET, plastic, $^3/_8$ inch diameter
-50	407-0574-00			1	BRACKET, transformer mounting
	- - - - - -			-	mounting hardware: (not included w/bracket)
-51	211-0531-00			4	SCREW, 6-32 x $^3/_8$ inch, Fil HS

FIG. 4 COLLECTOR SUPPLY *(Cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description 1 2 3 4 5
4-52	386-1525-00			1	SUPPORT, bracket
	- - - - - -			-	mounting hardware: (not included w/support)
-53	212-0070-00			2	SCREW, 8-32 x $^5/_{16}$ inch, 100° csk, FHS
-54	212-0004-00			4	SCREW, 8-32 x $^5/_{16}$ inch, PHS
-55	358-0215-00			1	BUSHING, U shaped
-56	343-0088-00			1	CLAMP, cable, plastic, small
-57	210-0201-00			1	LUG, solder, SE #4
	- - - - - -			-	mounting hardware: (not included w/lug)
-58	213-0044-00			1	SCREW, thread forming, 5-32 x $^3/_{16}$ inch, PHS
-59	214-0539-00			1	SPRING, retainer, relay
-60	136-0193-00			1	SOCKET, relay, 9 pin
	- - - - - -			-	mounting hardware: (not included w/socket)
	210-0586-00			1	NUT, keps, 4-40 x $^1/_4$ inch
-61	211-0038-00			1	SCREW, 4-40 x $^5/_{16}$ inch, 100° csk, FHS
-62	407-0582-00			1	BRACKET, capacitor
	- - - - - -			-	mounting hardware: (not included w/bracket)
-63	211-0507-00			4	SCREW, 6-32 x $^5/_{16}$ inch, PHS
-64	- - - - - -			1	CAPACTOR
	- - - - - -			-	mounting hardware: (not included w/capacitor)
-65	210-0865-00			2	WASHER, fiber, shouldered, $^3/_8$ ID x $^5/_8$ inch OD
	210-0840-00			1	WASHER, flat, 0.390 ID x $^9/_{16}$ inch OD
-66	210-0413-00			1	NUT, hex., $^3/_8$-32 x $^1/_2$ inch
-67	- - - - - -			1	CAPACITOR
	- - - - - -			-	mounting hardware: (not included w/capacitor)
-68	210-0020-00			1	LOCKWASHER, internal, #12
	210-0971-00			1	WASHER, flat, 0.219 ID x 0.350 inch OD
-69	220-0549-00			1	NUT, hex., 0.219-40 x 0.375 inch
-70	- - - - - -			1	CAPACITOR
	- - - - - -			-	mounting hardware: (not included w/capacitor)
-71	210-0012-00			1	LOCKWASHER, internal, $^3/_8$ ID x $^1/_2$ inch OD
	210-0840-00			1	WASHER, flat, 0.390 ID x $^9/_{16}$ inch OD
-72	210-0413-00			1	NUT, hex., $^3/_8$-32 x $^1/_2$ inch
-73	- - - - - -			1	CAPACITOR
	- - - - - -			-	mounting hardware: (not included w/capacitor)
-74	407-0270-00			2	BRACKET, mounting
	210-0006-00			2	LOCKWASHER, internal #6
-75	210-0407-00			2	NUT, hex., 6-32 x $^1/_4$ inch

FIG. 4 COLLECTOR SUPPLY *(Cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description 1 2 3 4 5
4-76	- - - - - -			1	TOROID
	- - - - - -			-	mounting hardware: (not included w/toroid)
-77	212-0094-00			1	SCREW, 8-32 x 1 $^1/_8$ inches, PHS
-78	348-0079-00			1	FOOT, plastic
-79	- - - - - -			1	TRANSFORMER
	- - - - - -			-	mounting hardware: (not included w/transformer)
-80	212-0516-00			4	SCREW, 10-32 x 2 inches, HHS
-81	210-0812-00			4	WASHER, fiber, #10
	210-0805-00			4	WASHER, flat, 0.204 ID x 0.438 inch OD
-82	220-0410-00			4	NUT, keps, 10-32 x $^3/_8$ inch
-83	179-1375-00			1	CABLE HARNESS, collector supply #1
-84	179-1376-00			1	CABLE HARNESS, collector supply #2
-85	179-1374-00			1	CABLE HARNESS, low voltage
-86	124-0089-00			4	STRIP, ceramic, $^3/_4$ inch h, w/7 notches
	- - - - - -			-	each strip includes:
	355-0046-00			2	STUD, plastic
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0007-00			2	SPACER, plastic, 0.188 inch long
-87	124-0092-00			1	STRIP, ceramic, $^7/_{16}$ inch h, w/3 notches
	- - - - - -			-	strip includes:
	355-0046-00			1	STUD, plastic
	- - - - - -			-	mounting hardware: (not included w/strip)
	361-0007-00			1	SPACER, plastic, 0.188 inch long
-88	- - - - - -			1	SWITCH, thermal cutout
	- - - - - -			-	mounting hardware (not included w/switch)
-89	211-0008-00			2	SCREW, 4-40 x $^1/_4$ inch, PHS
	210-0586-00			2	NUT, keps, 4-40 x $^1/_4$ inch
-90	131-0690-00			1	CONNECTOR, receptacle, 15 pin, male
-91	337-1174-00			1	SHIELD, electrical
	- - - - - -			-	mounting hardware: (not included w/shield)
	212-0023-00			2	SCREW, 8-32 x $^3/_8$ inch, PHS (not shown)

FIG. 5 CRT & REAR

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
5-1	386-1510-00			2	SUPPORT, CRT, top right & bottom left
	------			-	mounting hardware for each: (not included w/support)
-2	212-0084-00			1	SCREW, 8-32 x 5/16 inch, HHS
	210-0858-00			1	WASHER, flat, 11/64 ID x 1/2 inch OD
-3	386-1509-00			2	SUPPORT, CRT, top left & bottom right
	------			-	mounting hardware for each: (not included w/support)
-4	212-0084-00			1	SCREW, 8-32 x 5/16 inch, HHS
	210-0858-00			1	WASHER, flat, 11/64 ID x 1/2 inch OD
-5	378-0601-00			1	REFLECTOR, light
-6	670-1028-00			1	ASSEMBLY, circuit board—GRATICULE LAMP
	------			-	assembly includes:
	388-1123-00			1	BOARD, circuit
-7	129-0205-00			2	POST
-8	131-0633-00			2	TERMINAL, pin
	131-0704-00			3	CONTACT, electrical
	210-0957-00			3	WASHER, flat, 1/16 ID x 1/8 inch OD
	210-0759-00			3	EYELET
	361-0279-00			2	SPACER
	------			-	mounting hardware: (not included w/assembly)
-9	213-0202-00			2	SCREW, 2-56 x 0.625 inch, FHS
-10	337-1119-01			1	SHIELD, CRT
	------			-	mounting hardware: (not included w/shield)
-11	211-0504-00			2	SCREW, 6-32 x 1/4 inch, PHS
	210-0802-00			2	WASHER, flat, 0.150 ID x 5/16 inch OD
-12	348-0055-00			1	GROMMET, plastic, 1/4 inch diameter
-13	175-0586-00			1	WIRE, CRT lead, striped brown
	175-0592-00			1	WIRE, CRT lead, striped green
	175-0594-00			1	WIRE, CRT lead, striped blue
	175-0595-00			1	WIRE, CRT lead, striped red
	------			-	each wire includes:
-14	131-0049-00			1	CONNECTOR, cable
-15	348-0085-00			1	GROMMET, plastic
-16	352-0123-01			2	HOLDER, CRT retainer
	------			-	mounting hardware for each: (not included w/holder)
-17	211-0590-00			2	SCREW, 6-32 x 5/16 inch, PHS
-18	343-0138-00			1	RETAINER, CRT, plastic
	------			-	mounting hardware: (not included w/retainer)
-19	211-0599-00			2	SCREW, 6-32 x 3/4 inch, Fil HS
-20	211-0146-00			1	SCREW, 4-40 x 1.312 inches, Socket HS
-21	343-0123-01			1	CLAMP, CRT retainer
-22	343-0171-01			1	CLAMP, CRT retainer
-23	220-0444-00			2	NUT, square, 6-32 x 1/4 inch

FIG. 5 CRT & REAR *(Cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
5-	136-0334-00			1	ASSEMBLY, CRT socket
	- - - - - -			-	assembly includes:
-24	136-0304-00			1	SOCKET, CRT
	131-0371-00			5	CONNECTOR, single contact
-25	200-0917-00			1	COVER, CRT socket
-26	337-1046-01			1	SHIELD, CRT socket
-27	367-0095-00			1	HANDLE, CRT socket
-28	386-1524-00			1	SUPPORT, chassis
	- - - - - -			-	mounting hardware: (not included w/support)
-29	211-0507-00			4	SCREW, 6-32 x 5/16 inch, PHS
-30	343-0089-00			2	CLAMP, cable, plastic, large
-31	348-0055-00			1	GROMMET, plastic, 1/4 inch diameter
-32	358-0215-00			2	BUSHING, plastic, black
-33	343-0013-00			1	CLAMP, cable, plastic
	- - - - - -			-	mounting hardware: (not included w/clamp)
-34	211-0510-00			1	SCREW, 6-32 x 3/8 inch, PHS
	210-0863-00			1	WASHER, D shape, 0.191 ID x 33/64 x 33/64 inch long
-35	210-0457-00			1	NUT, keps, 6-32 x 5/16 inch
-36	441-0856-00			1	CHASSIS, high voltage
	- - - - - -			-	mounting hardware: (not included w/chassis)
-37	212-0039-00			2	SCREW, 6-32 x 3/8 inch, THS
-38	- - - - - -			1	CAPACITOR
	- - - - - -			-	mounting hardware: (not included w/capacitor)
-39	211-0534-00			2	SCREW, sems, 6-32 x 5/16 inch, PHS
-40	386-0253-00			1	PLATE, metal, small
-41	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch
-42	136-0270-00			1	SOCKET, transistor
	- - - - - -			-	mounting hardware: (not included w/socket)
-43	213-0088-00			2	SCREW, thread forming, #4 x 1/4 inch, PHS
-44	- - - - - -			1	TRANSISTOR
	- - - - - -			-	mounting hardware: (not included w/transistor)
-45	213-0104-00			2	SCREW, thread forming, #6 x 3/8 inch, THS
-46	386-0143-00			1	PLATE, insulating, mica
-47	- - - - - -			1	TRANSFORMER
	- - - - - -			-	mounting hardware: (not included w/transformer)
-48	346-0001-00			1	STRAP, mounting
	162-0004-00			FT	TUBING, plastic, black, 4 1/2 inches long
-49	210-0586-00			2	NUT, keps, 4-40 x 1/4 inch

FIG. 5 CRT & REAR *(Cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	1 2 3 4 5 Description
5-50	670-1022-00			1	ASSEMBLY, circuit board—H V POWER SUPPLY
	- - - - - -			-	assembly includes:
	388-1117-00			1	BOARD, circuit
-51	131-0633-00			9	TERMINAL, pin
-52	136-0183-00			1	SOCKET, transistor, 3 pin
-53	136-0220-00			3	SOCKET, transistor, 3 pin
-54	343-0043-00	XB020000		2	CLAMP, bulb
-55	- - - - - -			3	CAPACITOR
	- - - - - -			-	mounting hardware: (not included w/capacitor)
	210-0966-00			2	WASHER, rubber, 5/16 ID x 7/8 inch OD
-56	346-0032-00			1	STRAP, mouse tail, rubber
	- - - - - -			-	mounting hardware: (not included w/assembly)
-57	211-0116-00			4	SCREW, sems, 4-40 x 5/16 inch, PHB
-58	129-0212-00			3	POST, plastic
-59	211-0008-00			3	SCREW, 4-40 x 1/4 inch, PHS
-60	337-1123-00			1	SHIELD, high voltage
	- - - - - -			-	mounting hardware: (not included w/shield)
-61	211-0504-00			4	SCREW, 6-32 x 1/4 inch, PHS
-62	129-0224-00			1	POST, terminal
	- - - - - -			-	mounting hardware: (not included w/post)
-63	211-0504-00			1	SCREW, 6-32 x 1/4 inch, PHS
-64	426-0471-01			1	FRAME-PANEL, cabinet, rear
	- - - - - -			-	mounting hardware: (not included w/frame-panel)
-65	212-0039-00			4	SCREW, 8-32 x 3/8 inch, THS
-66	220-0536-00			2	NUT, saddle, plastic
	- - - - - -			-	mounting hardware for each: (not included w/nut)
	210-0802-00			1	WASHER, flat, 0.150 ID x 5/16 inch OD
-67	211-0575-00			1	SCREW, 6-32 x 1/2 inch, HHS
-68	136-0270-00			1	SOCKET, transistor
	- - - - - -			-	mounting hardware: (not included w/socket)
	211-0062-00			2	SCREW, 2-56 x 5/16 inch, RHS
	210-0001-00			2	LOCKWASHER, internal, #2
-69	210-0405-00			2	NUT, hex., 2-56 x 3/16 inch
-70	136-0135-00			5	SOCKET, transistor
	- - - - - -			-	mounting hardware: (not included w/socket)
-71	211-0034-00			2	SCREW, 2-56 x 1/2 inch, RHS
	210-0001-00			2	LOCKWASHER, internal, #2
-72	210-0405-00			2	NUT, hex., 2-56 x 3/16 inch

FIG. 5 CRT & REAR *(Cont)*

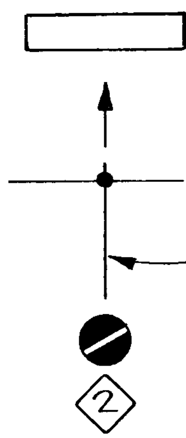
Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
5-73	- - - - - -			1	TRANSISTOR
	- - - - - -			-	mounting hardware: (not included w/transistor)
	213-0183-00			1	SCREW, thread forming, # 6x 0.500 inch, PHS
	213-0185-00			1	SCREW, thread forming, #6 x 0.625 inch, PHS
-74	200-0669-00			1	COVER, plastic, black
-75	386-0143-00			1	PLATE, insulating, mica
-76	- - - - - -			5	TRANSISTOR
	- - - - - -			-	mounting hardware for each: (not included w/transistor)
-77	211-0514-00			1	SCREW, 6-32 x 3/4 inch, PHS
-78	200-0692-00			1	COVER, plastic, black
-79	211-0513-00			1	SCREW, 6-32 x 5/8 inch, PHS
-80	386-0978-00			1	PLATE, insulating, mica
-81	260-0675-01			1	SWITCH, slide—50Hz 60Hz
	- - - - - -			-	switch includes:
	260-0675-00			1	SWITCH, slide
-82	337-1036-00			1	SHIELD, solder
	- - - - - -			-	mounting hardware: (not included w/switch)
-83	211-0008-00			2	SCREW, 4-40 x 1/4 inch, PHS
-84	210-0406-00			2	NUT, hex., 4-40 x 3/16 inch
-85	204-0279-00			1	BODY, line voltage selector
	- - - - - -			-	mounting hardware: (not included w/body)
	210-0006-00			2	LOCKWASHER, internal, #6
-86	210-0407-00			2	NUT, hex., 6-32 x 1/4 inch
-87	200-0762-00			1	COVER, line voltage selector
	- - - - - -			-	cover includes:
-88	352-0102-00			2	HOLDER, fuse
	- - - - - -			-	mounting hardware for each: (not included w/holder)
-89	213-0088-00			2	SCREW, thread forming, #4 x 1/4 inch, PHS
-90	358-0025-00			1	BUSHING, plastic
-91	161-0017-00			1	CORD, power
-92	386-1512-00			1	PLATE, retaining, power cord
	- - - - - -			-	mounting hardware: (not included w/plate)
-93	211-0565-00			4	SCREW, 6-32 x 1/4 inch, THS
-94	124-0100-00			1	STRIP, ceramic, 3/4 inch h, w/1 notch
	- - - - - -			-	strip includes:
	355-0046-00			1	STUD, plastic
	- - - - - -			-	mounting hardware: (not included w/strip)
	361-0008-00			1	SPACER, plastic, 0.281 inch long
-95	179-1372-00			1	CABLE HARNESS, AC
	- - - - - -			-	cable harness includes:
-96	214-0768-00			8	CONTACT, electrical
-97	348-0197-00			1	GASKET, light seal

FIG. 6 CABINET

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
6-	367-0073-03			1	ASSEMBLY, handle-frame section
	- - - - - -			-	assembly includes:
-1	124-0218-00			1	STRIP, trim
-2	386-1283-01			2	PLATE, handle
-3	367-0073-01			1	HANDLE, carrying
	- - - - - -			-	mounting hardware: (not included w/handle)
-4	212-0559-00			4	SCREW, 10-32 x $^5/_8$ inch, 100° csk, FHS
-5	386-1601-00			2	PLATE, handle
-6	358-0369-00			4	BUSHING, sleeve
-7	200-0728-00			2	COVER, handle
-8	426-0481-00			1	FRAME SECTION
	- - - - - -			-	mounting hardware: (not included w/assembly)
-9	212-0002-00			4	SCREW, 8-32 x $^1/_4$ inch, 100° csk, FHS
-10	390-0088-00			2	CABINET SIDE
	- - - - - -			-	each cabinet side includes:
	214-0812-00			2	ASSEMBLY, latch
	- - - - - -			-	each assembly includes:
-11	214-0603-01			1	PIN, securing
	214-0604-00			1	SPRING
	386-0227-00			1	PLATE, index, plastic
-12	386-0226-00			1	PLATE, locking
-13	390-0087-00			1	CABINET BOTTOM
	- - - - - -			-	cabinet bottom includes:
-14	348-0177-00			4	PAD, cushioning
-15	348-0178-00			4	FOOT, cabinet
	- - - - - -			-	mounting hardware for each: (not included w/foot)
	210-0803-00			2	WASHER, flat, 0.150 ID x $^3/_8$ inch OD
-16	213-0054-00			2	SCREW, thread cutting, 6-32 x $^5/_{16}$ inch, PHS
	- - - - - -			-	mounting hardware: (not included w/cabinet bottom)
-17	211-0504-00			14	SCREW, 6-32 x $^1/_4$ inch, PHS
-18	212-0004-00			2	SCREW, 8-32 x $^5/_{16}$ inch, PHS
	210-0802-00			4	WASHER, flat, 0.150 ID x $^5/_{16}$ inch OD (not shown)
-19	426-0472-01			1	FRAME SECTION, cabinet, bottom left
-20	426-0473-01			1	FRAME SECTION, cabinet, bottom right

SECTION 8
DIAGRAMS

Reference standards for the diagrams are Graphic Symbols standards USAS &32.2-1967 and ASA Y32.14-1966. The following special symbols are also used.



Identification of front-panel control or connector.

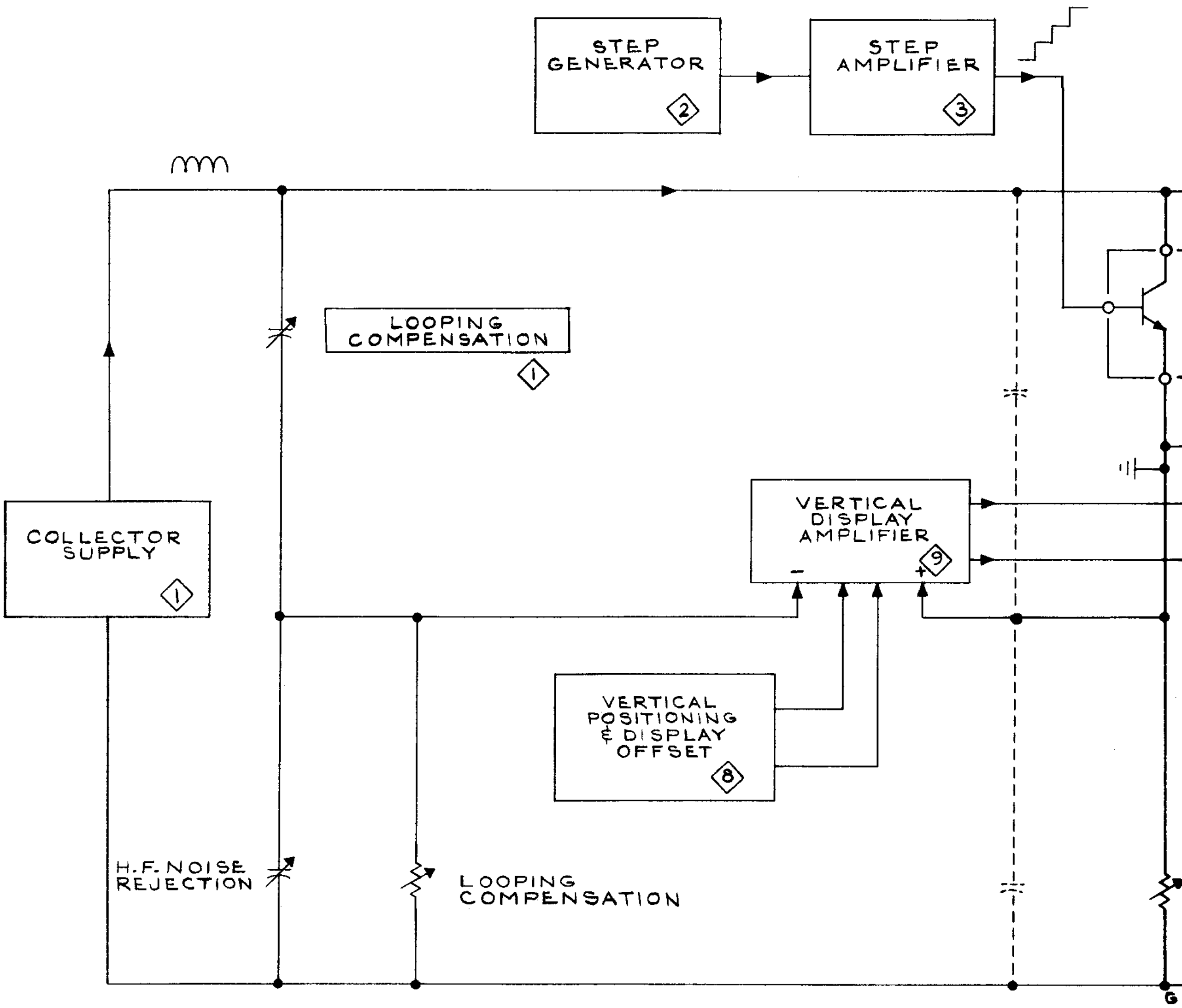
Connection and voltage source

Connection soldered to circuit board.

Blue line encloses components located on circuit board.

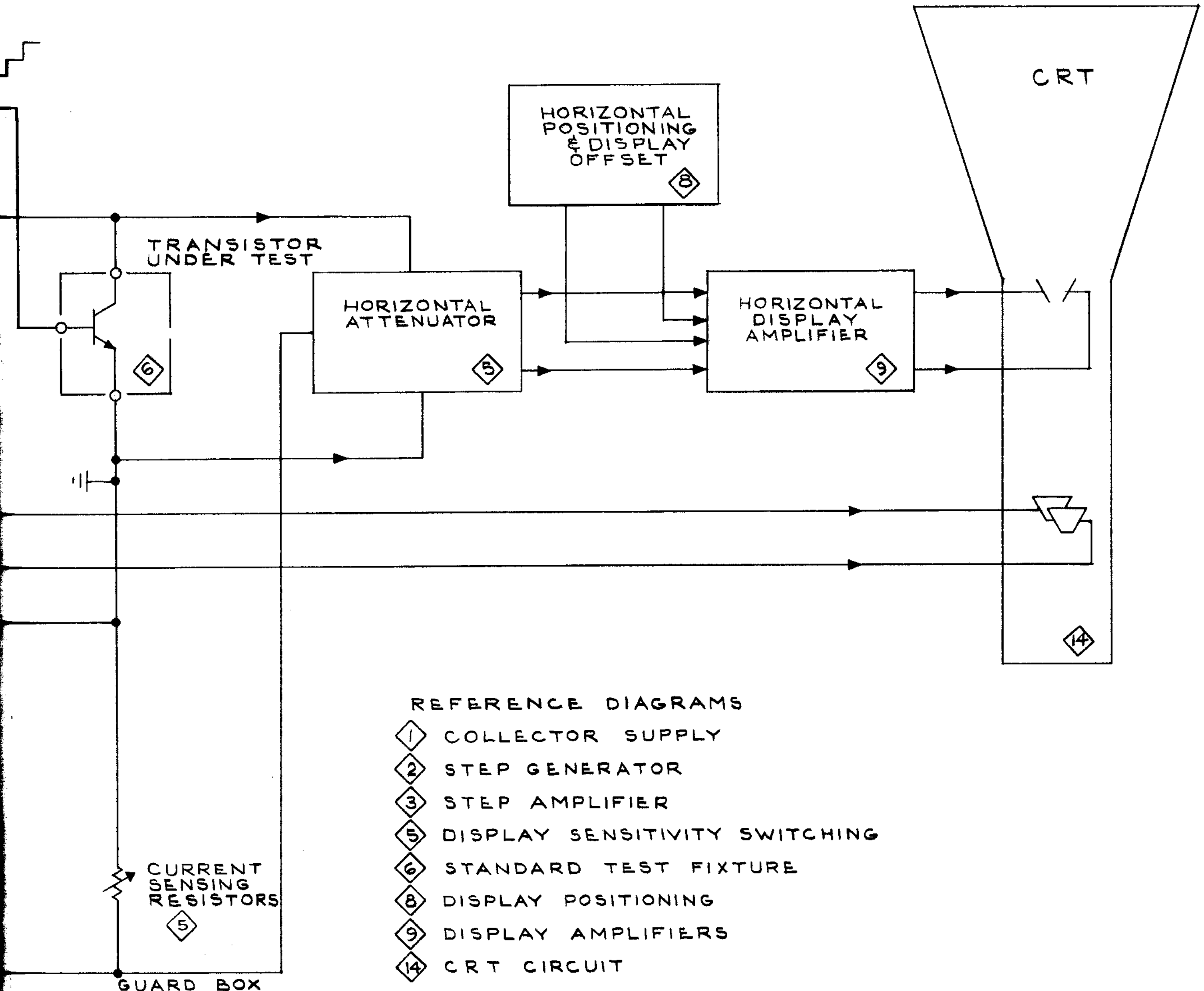
Screwdriver adjustment.

Diagram identification number.


STEP GENERATOR
2
STEP AMPLIFIER
3
LOOPING COMPENSATION
1
COLLECTOR SUPPLY
1
VERTICAL DISPLAY AMPLIFIER
9
VERTICAL POSITIONING & DISPLAY OFFSET
8
H.F. NOISE REJECTION
LOOPING COMPENSATION
G

TYPE 576

Ⓐ



REFERENCE DIAGRAMS

- 1 COLLECTOR SUPPLY
- 2 STEP GENERATOR
- 3 STEP AMPLIFIER
- 5 DISPLAY SENSITIVITY SWITCHING
- 6 STANDARD TEST FIXTURE
- 8 DISPLAY POSITIONING
- 9 DISPLAY AMPLIFIERS
- 14 CRT CIRCUIT

FUNCTIONAL BLOCK DIAGRAM

Ⓐ

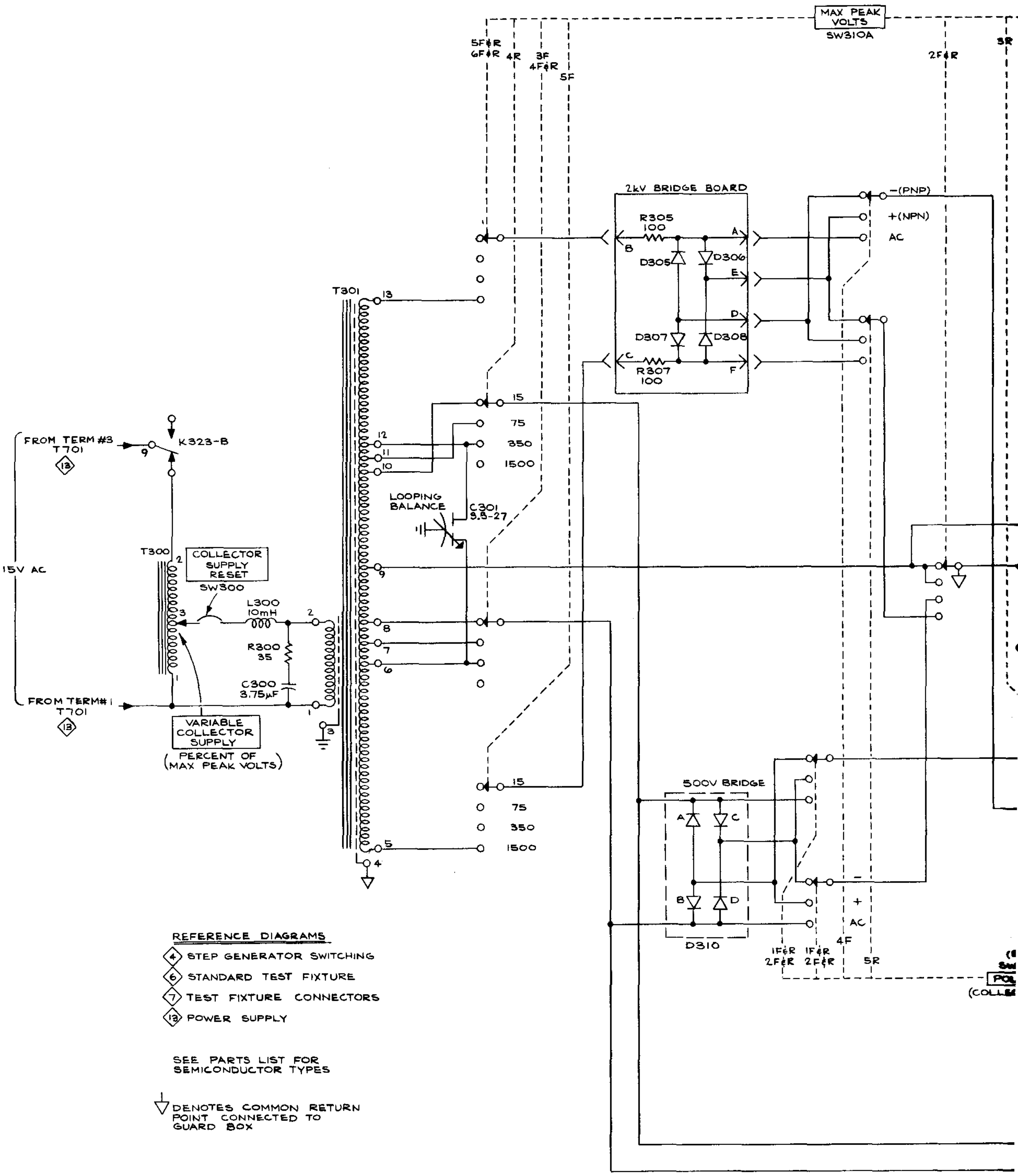
VOLTAGE AND WAVEFORM TEST CONDITIONS

Voltages and waveforms on the diagrams (shown in blue) are not absolute and may vary between instruments because of differing component tolera nces, internal calibration or front-panel control settings.

Typical voltage measurements and waveform photographs were obtained under the following conditions unless noted otherwise on the individual diagrams:

Test Oscilloscope (with 10X Probe)	
Frequency Response	DC to 50 MHz
Deflection factor (with probe)	100 millivolts to 5 volts/division
Input impedance	10 Megohms, 7.5 picofarads
Probe ground	Type 576 chassis ground
Recommended type (as used for waveforms on diagrams)	Tektronix Type 547 with Type 1A1 plug in unit
Voltmeter	
Type	Infinite-resistance DC digital Voltmeter
Range	0 to ±500 volts
Reference voltage	Type 576 chassis ground
Type 576	
GRATICULE ILLUM	Graticule Lines Visible
READOUT ILLUM	Readout Visible
INTENSITY	Display Visible
FOCUS	Maximum Display Definition
VERTICAL	1 mA
DISPLAY OFFSET Selector	NORM (OFF)
CENTERLINE VALUE	0
HORIZONTAL	2 V
POSITION (Vertical and Horizontal)	Controls Centered
FINE POSITION (Vertical and Horizontal)	Controls Centered
ZERO	Released
CAL	Released
DISPLAY INVERT	Released
MAX PEAK VOLTS	15
PEAK POWER WATTS	220
VARIABLE COLLECTOR SUPPLY	Fully Clockwise
POLARITY	+(NPN)
MODE	NORM
LOOPING COMPENSATION	As Is
NUMBER OF STEPS	10
CURRENT LIMIT	20 mA
AMPLITUDE	1 V
OFFSET ZERO	ZERO
OFFSET MULT	0.00

(CONT ON DIAGRAM ⟨2⟩)



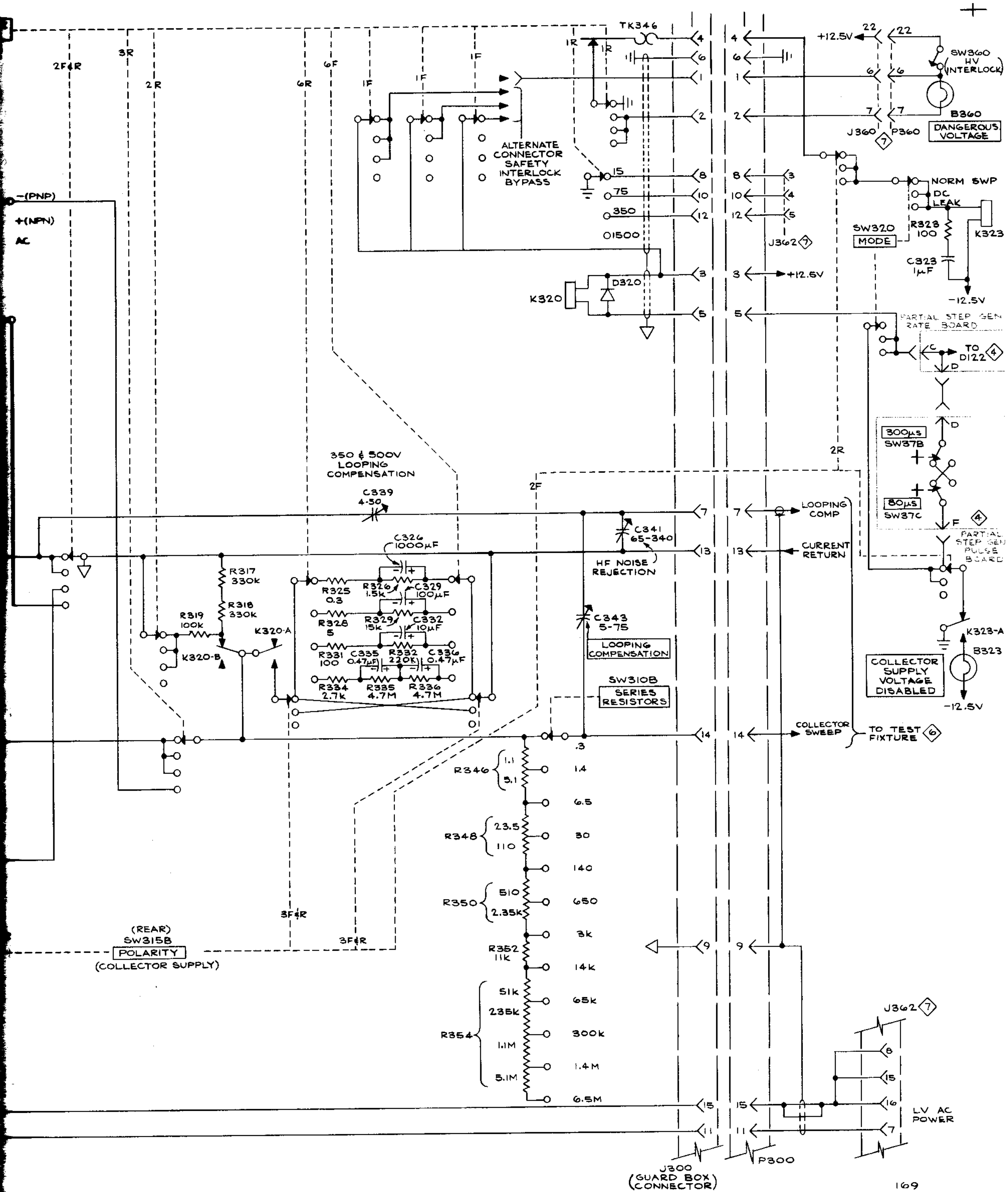
REFERENCE DIAGRAMS

- ⟨4⟩ STEP GENERATOR SWITCHING
- ⟨6⟩ STANDARD TEST FIXTURE
- ⟨7⟩ TEST FIXTURE CONNECTORS
- ⟨13⟩ POWER SUPPLY

SEE PARTS LIST FOR SEMICONDUCTOR TYPES

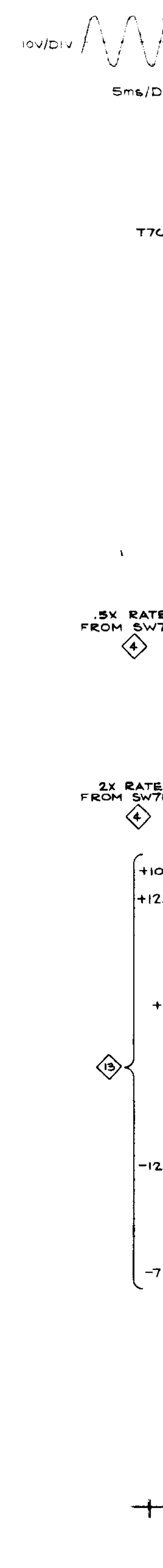
▽ DENOTES COMMON RETURN POINT CONNECTED TO GUARD BOX

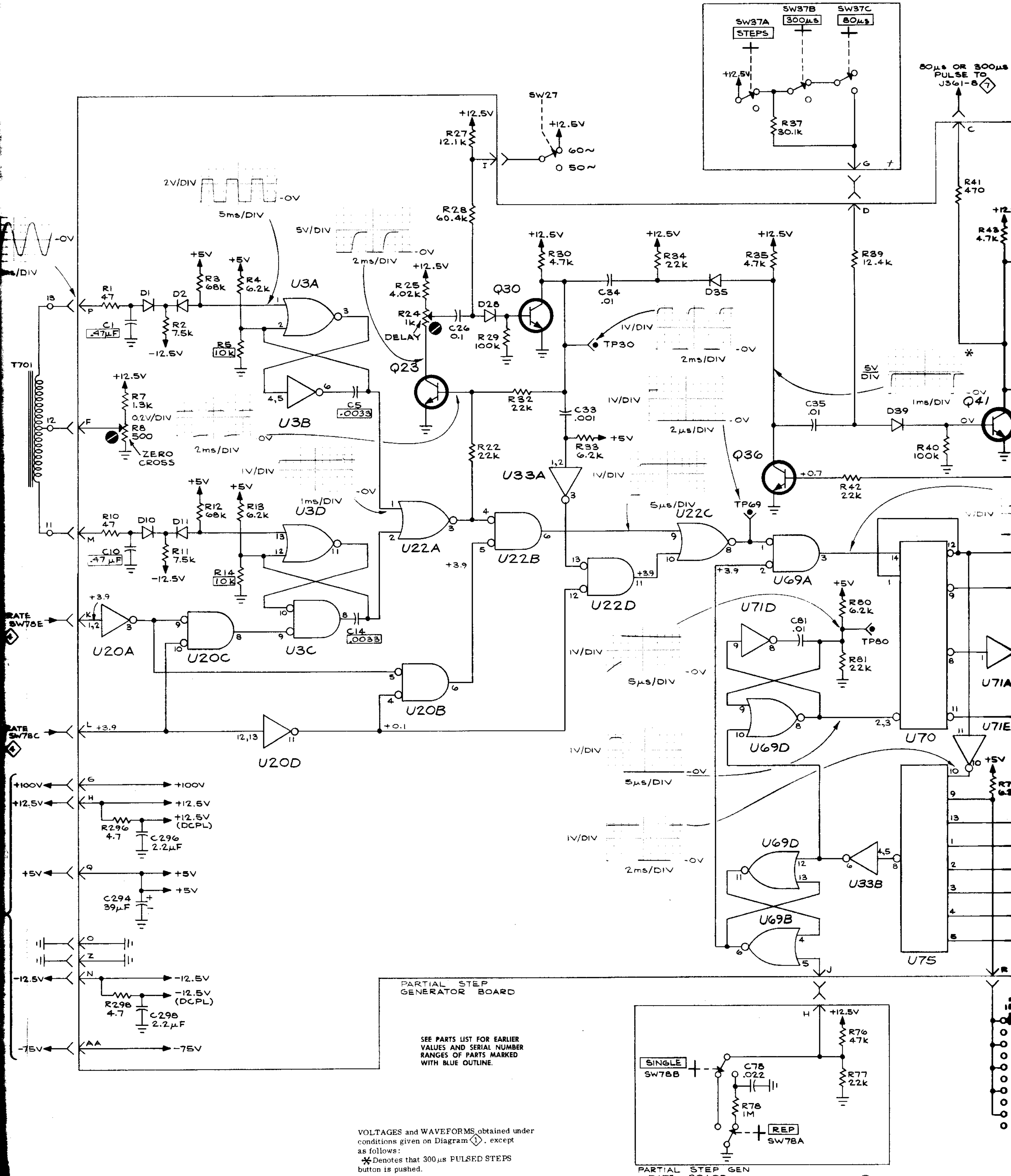
Ⓐ1



COLLECTOR SUPPLY ⟨1⟩

STEPS	Pressed
PULSED STEPS	Released
STEP FAMILY	REP
RATE	NORM
POLARITY INVERT	Released
STEP MULT .1X	Released

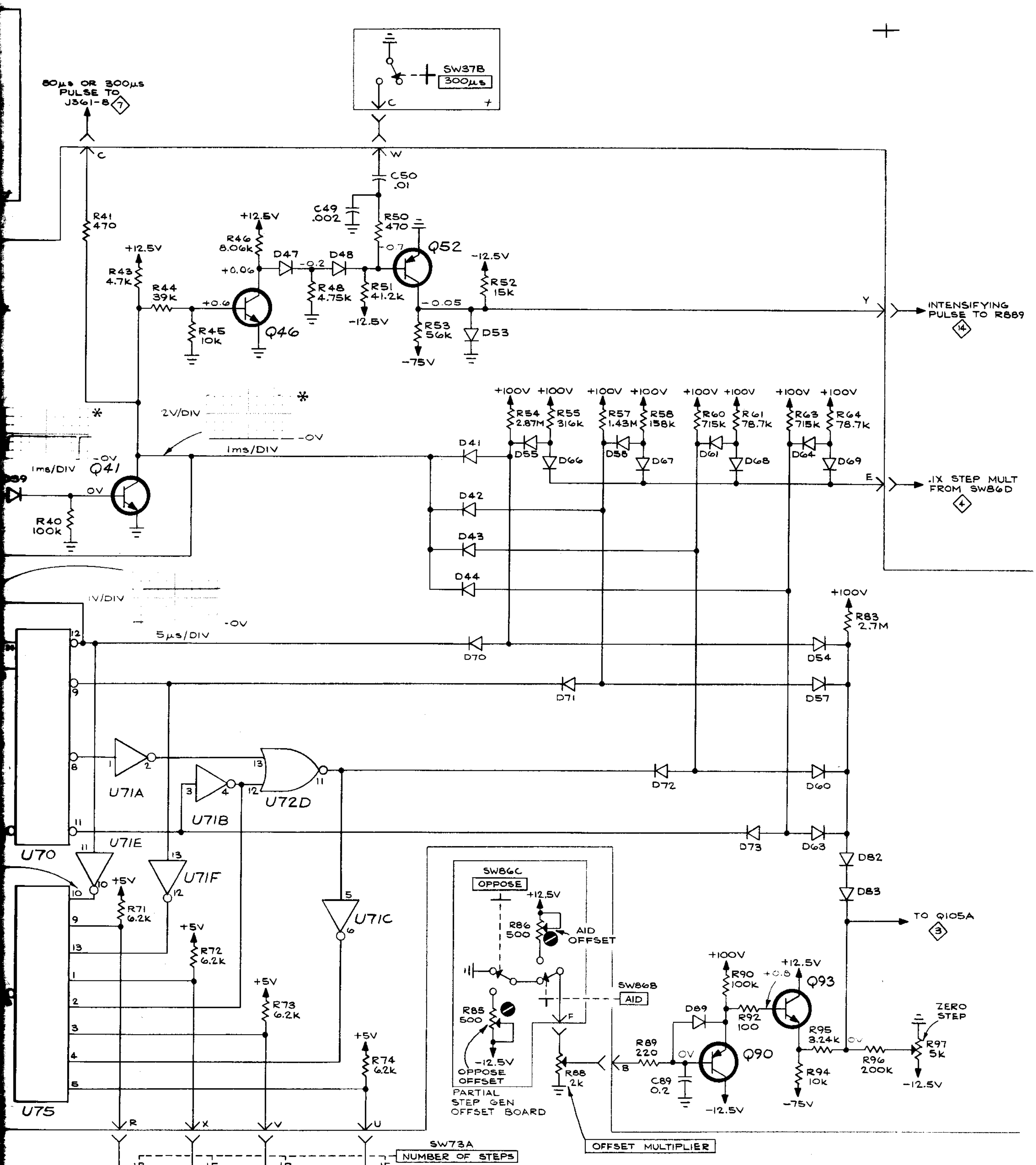




SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

VOLTAGES and WAVEFORMS obtained under conditions given on Diagram 1, except as follows:
*Denotes that 300μs PULSED STEPS button is pushed.

TYPE 576



REFERENCE DIAGRAMS

- 3 STEP AMPLIFIER
- 4 STEP GENERATOR SWITCHING
- 7 TEST FIXTURE CONNECTIONS
- 13 POWER SUPPLY
- 14 CRT CIRCUIT

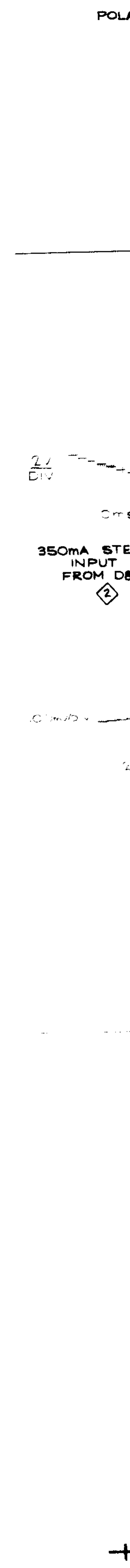
SEE PARTS LIST FOR SEMICONDUCTOR TYPES

† PARTIAL STEP GEN PULSE BOARD

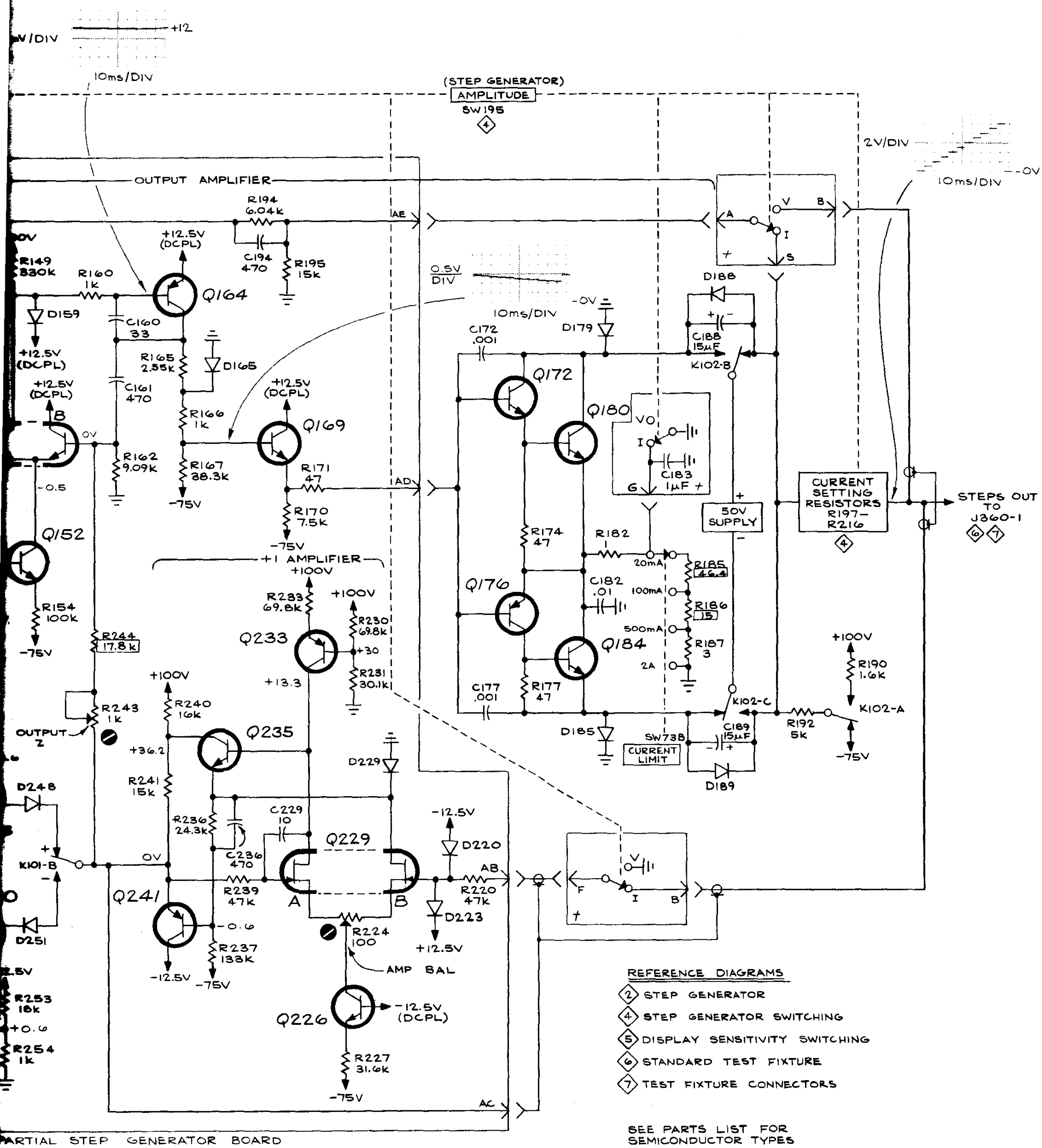
1269

STEP GENERATOR 2

STEP GENERATOR 2



POL
2V
DIV
350mA STE
INPUT
FROM D8
2



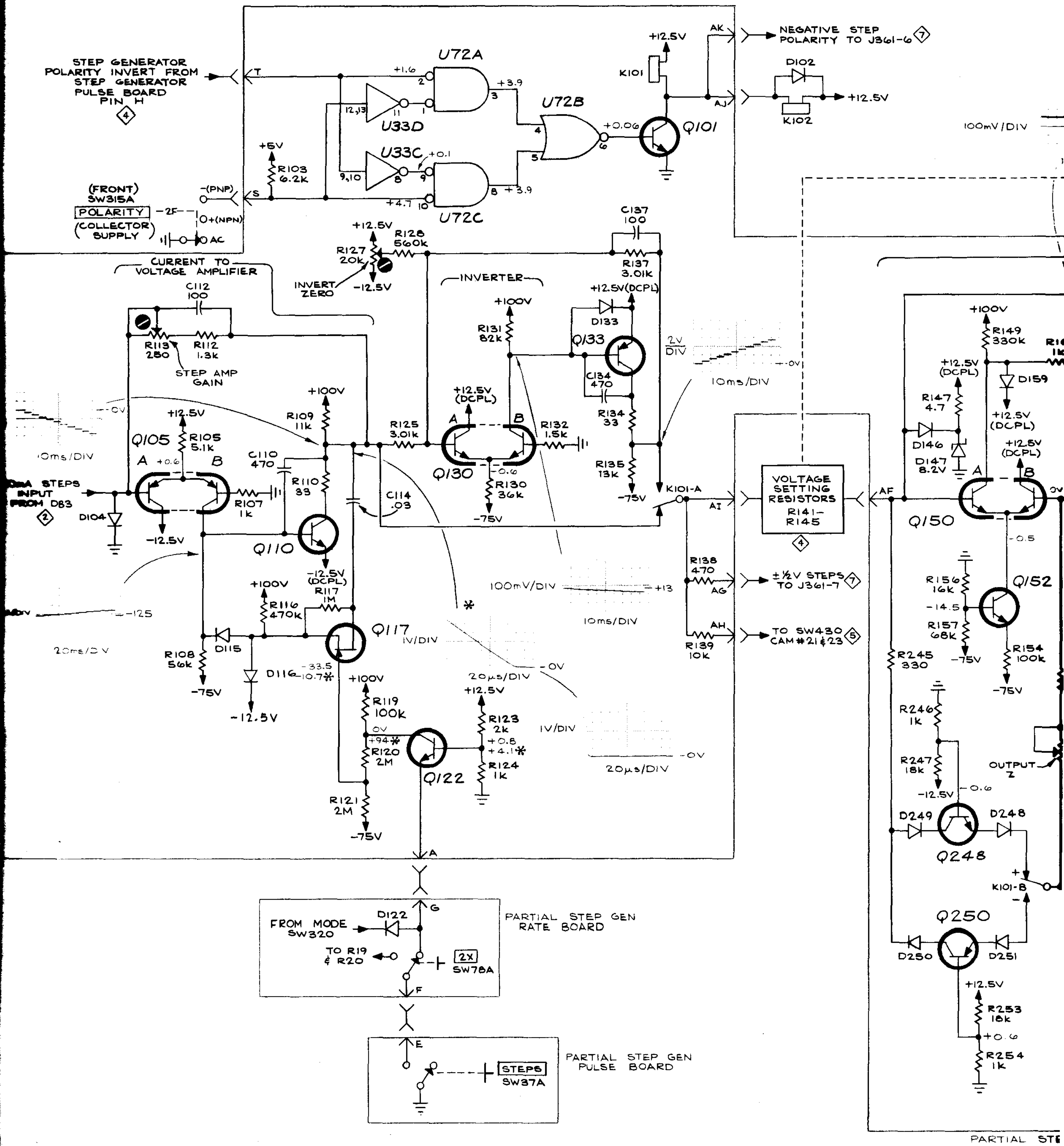
REFERENCE DIAGRAMS

2 STEP GENERATOR
4 STEP GENERATOR SWITCHING
5 DISPLAY SENSITIVITY SWITCHING
6 STANDARD TEST FIXTURE
7 TEST FIXTURE CONNECTORS

SEE PARTS LIST FOR SEMICONDUCTOR TYPES

† DENOTES PARTIAL STEP GEN AMPLITUDE BOARD

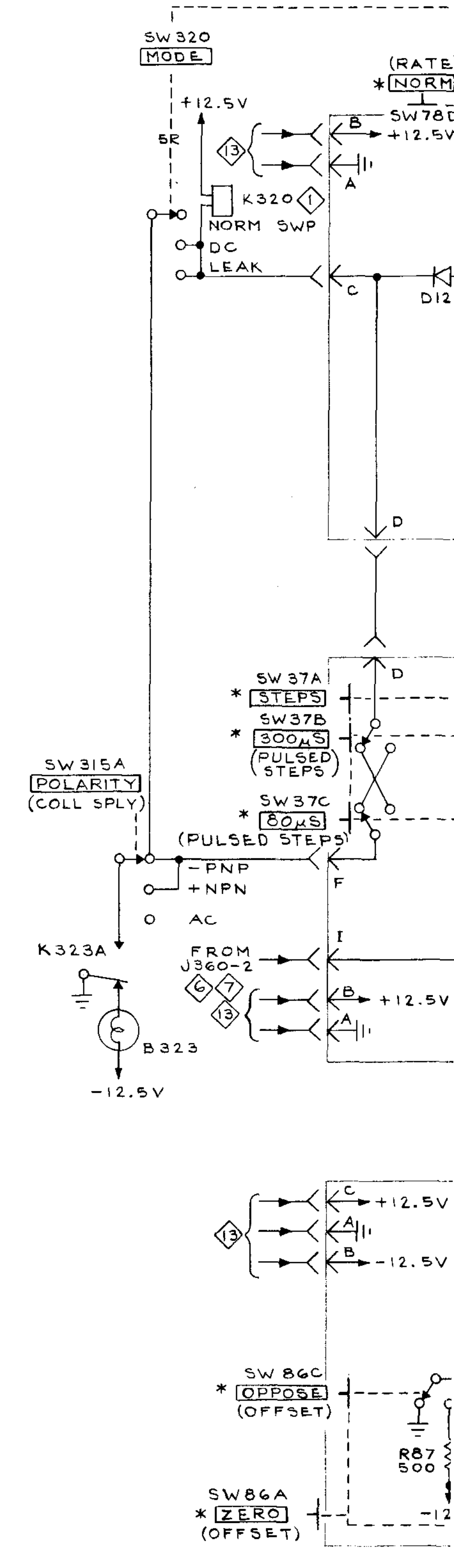
VOLTAGES and WAVEFORMS obtained under conditions given on Diagram 1, except as follows:
✱ Denotes that 2X RATE button is pressed.



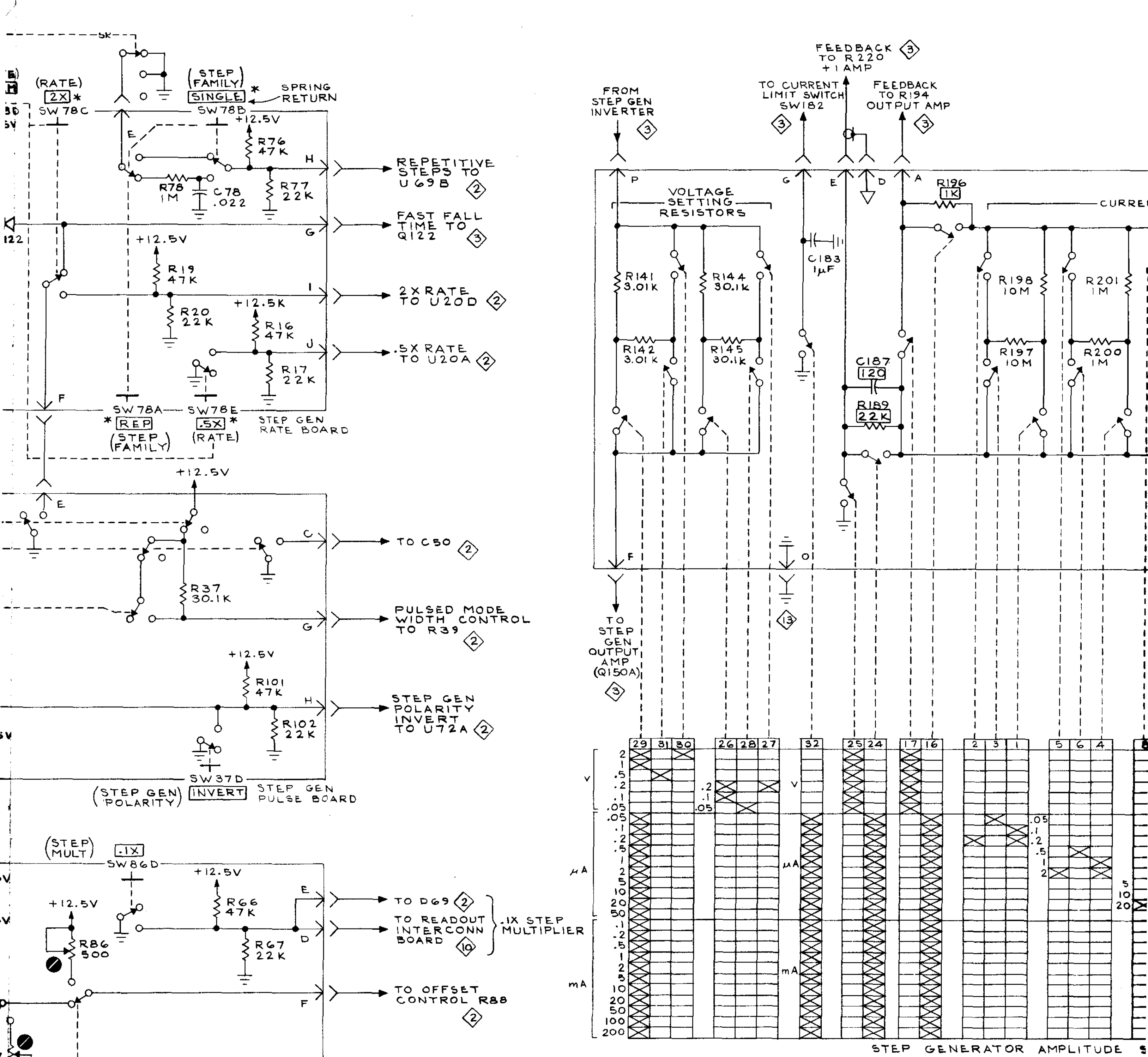
TYPE 576

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

(A)2


SW 320
MODE
(RATE
* NORM
SW78D
+12.5V
5R
13
B
A
K320
1
NORM SWP
DC
LEAK
C
D12
D
SW 37A
* STEPS
SW37B
* 300μS
(PULSED STEPS)
SW 315A
POLARITY
(COLL SPLY)
SW 37C
* 80μS
(PULSED STEPS)
−PNP
+NPN
AC
F
I
K323A
FROM J360-2
6
7
13
B323
−12.5V
+12.5V
−12.5V
SW 86C
* OPPOSE
(OFFSET)
R87
500
SW86A
* ZERO
(OFFSET)

TYPE 576



SEE PARTS LIST FOR SEMICONDUCTOR TYPES

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

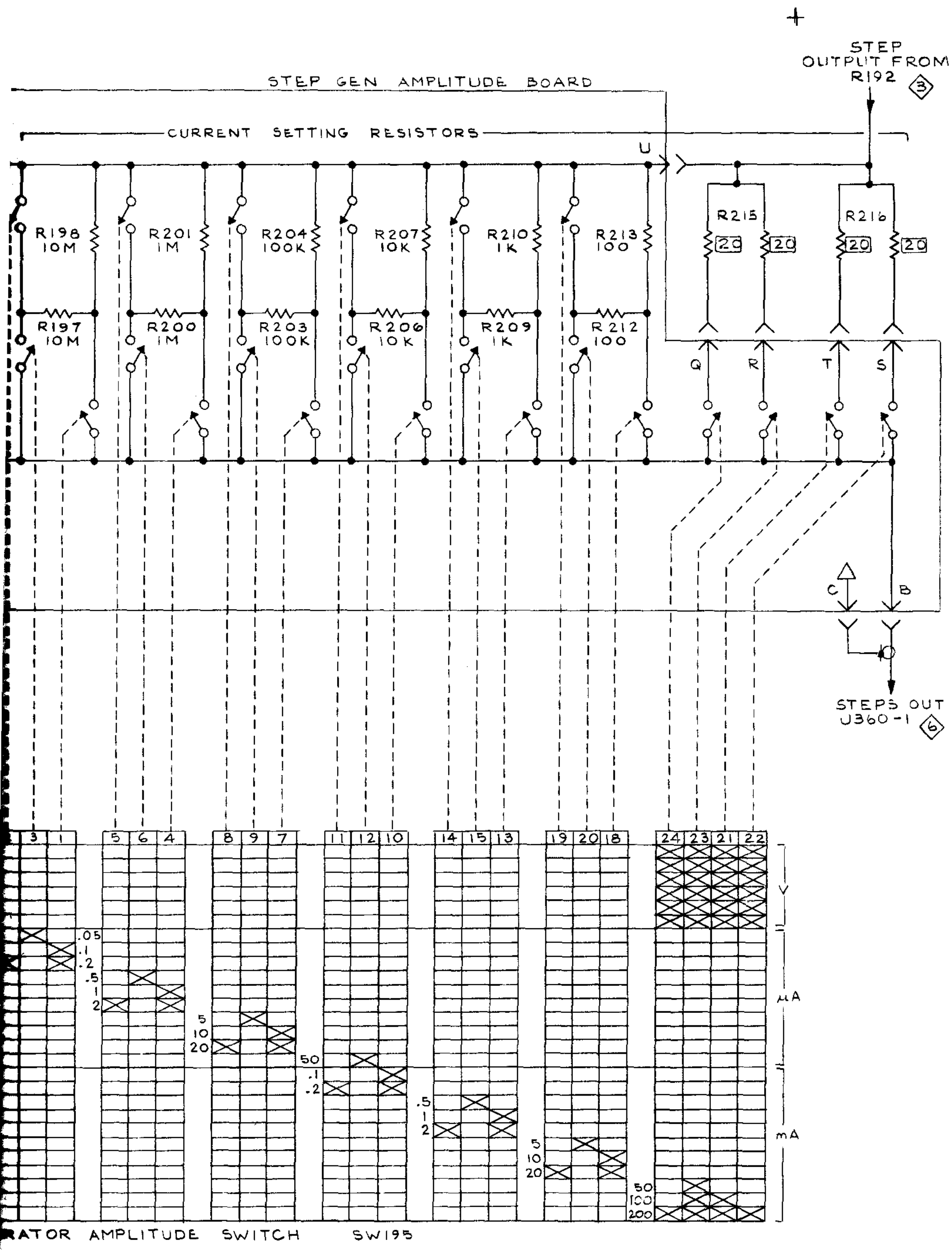
* DENOTES SELF CANCELLING SWITCH

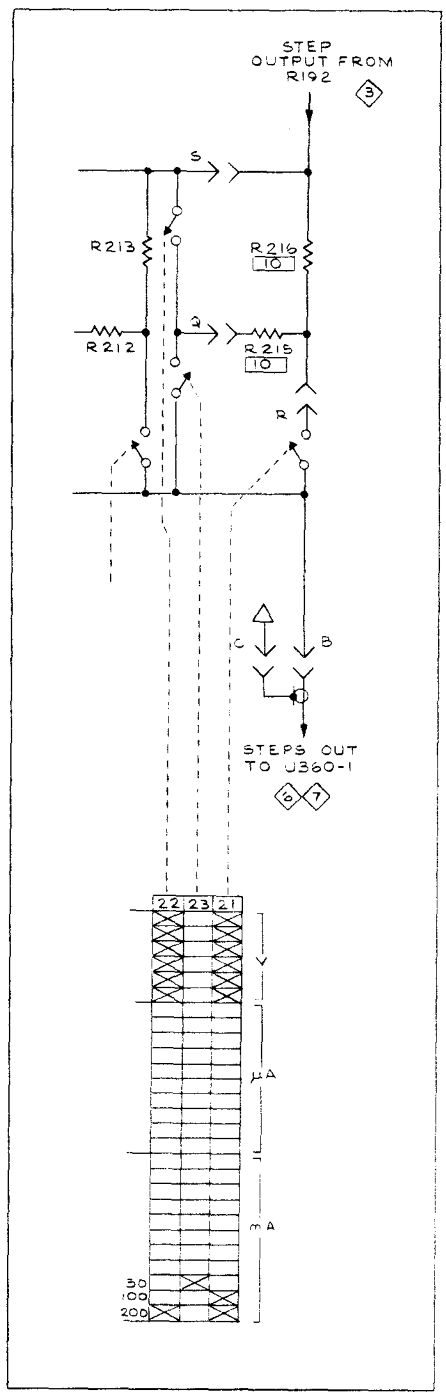
COMMON RETURN POINT CONNECTED TO GUARD BOX

RE

(B)

STEP (





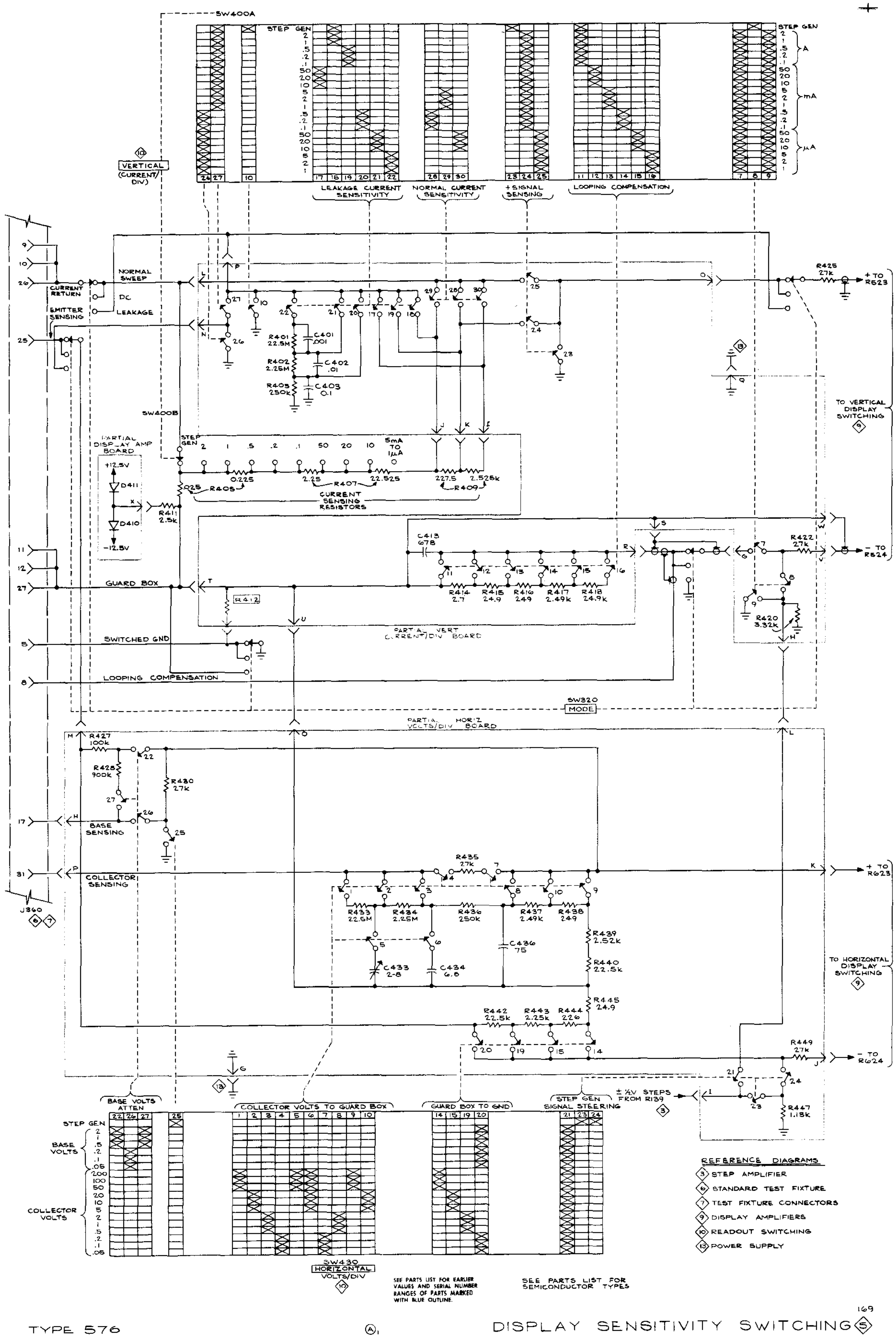
EFF. SN. B010100-B099999

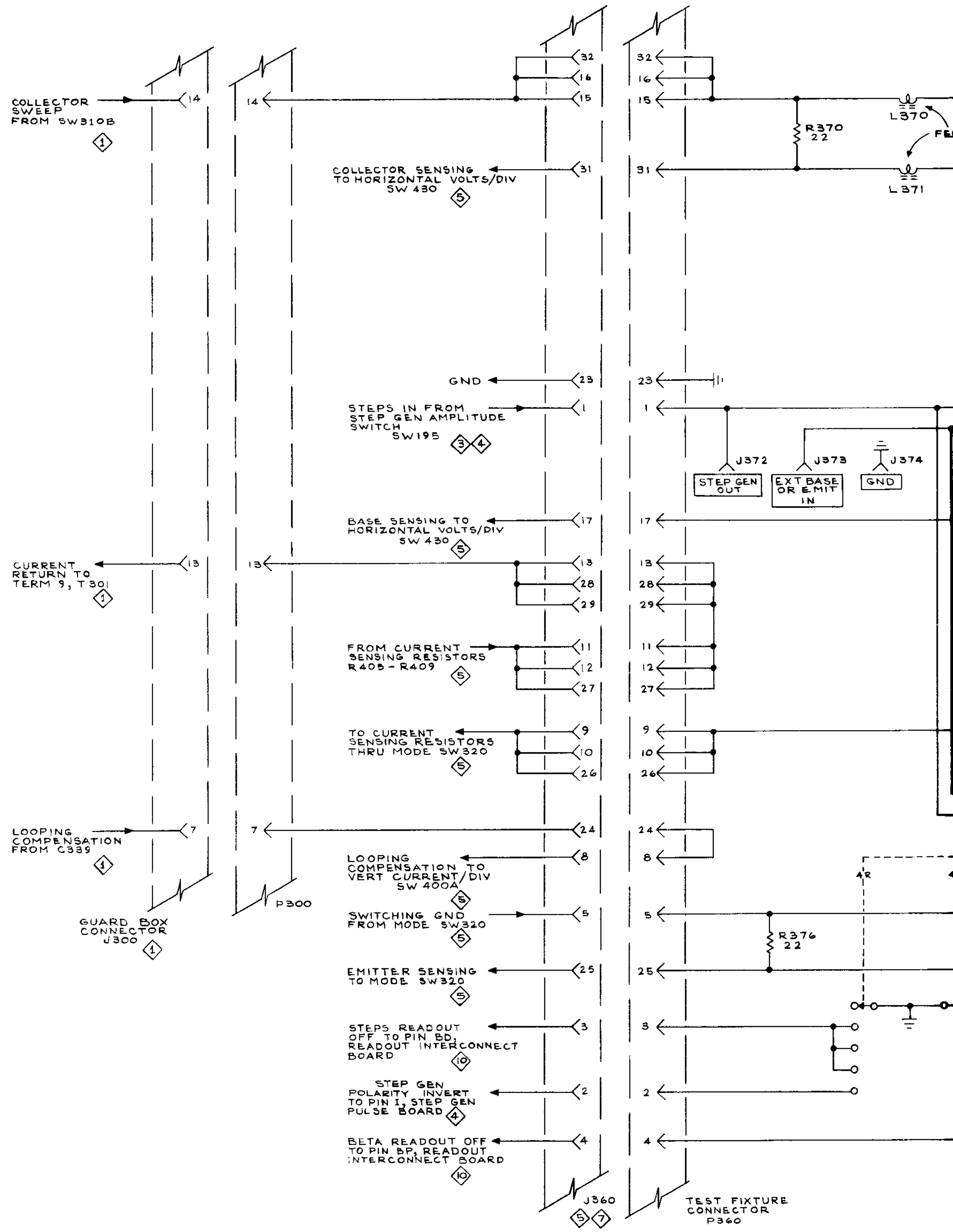
REFERENCE DIAGRAMS

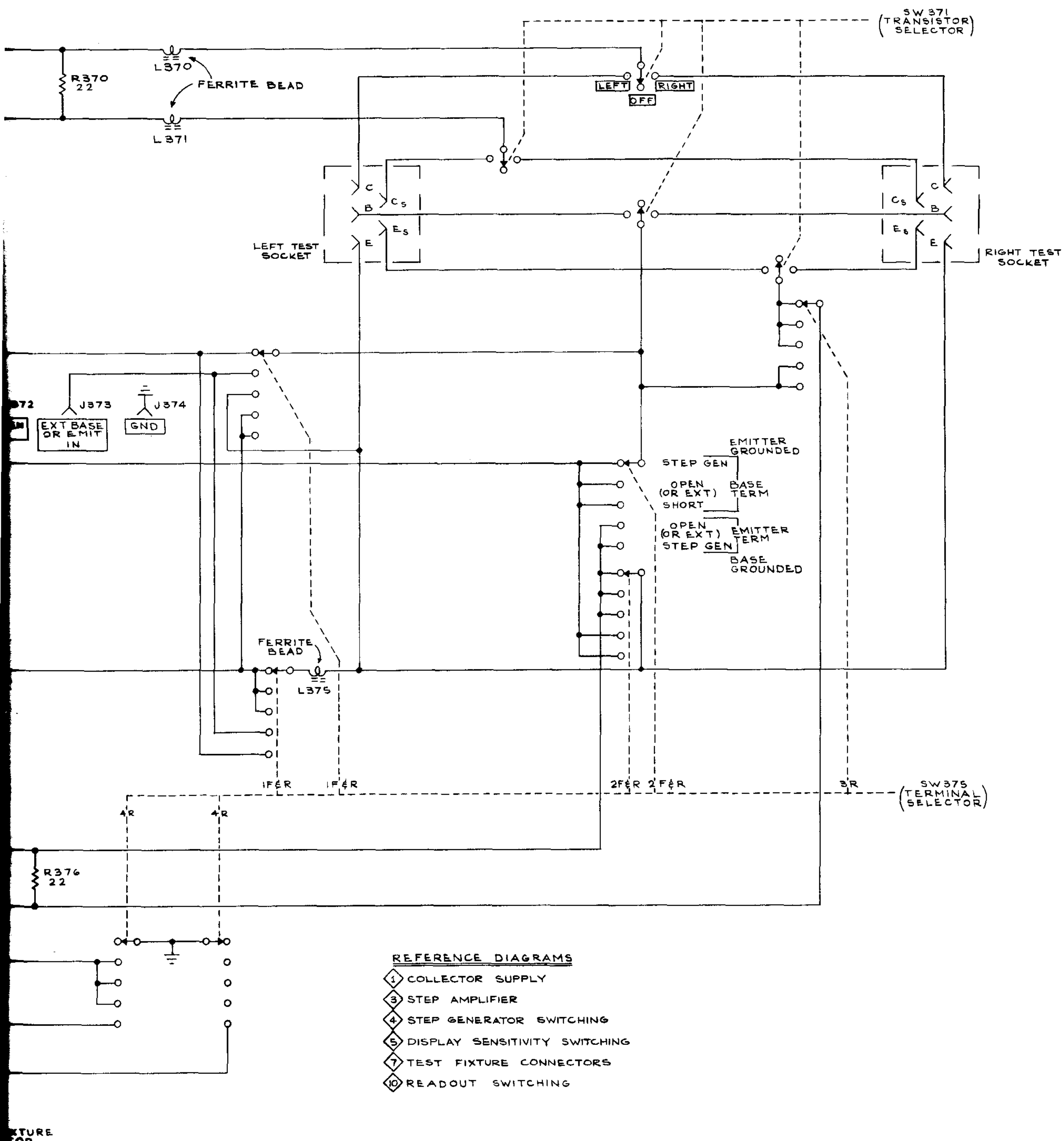
1. COLLECTOR SUPPLY
2. STEP GENERATOR
3. STEP AMPLIFIER
6. STANDARD TEST FIXTURE
7. TEST FIXTURE CONNECTIONS
10. READOUT SWITCHING & INTERCONNECTIONS
13. POWER SUPPLY

0270

STEP GENERATOR SWITCHING 4

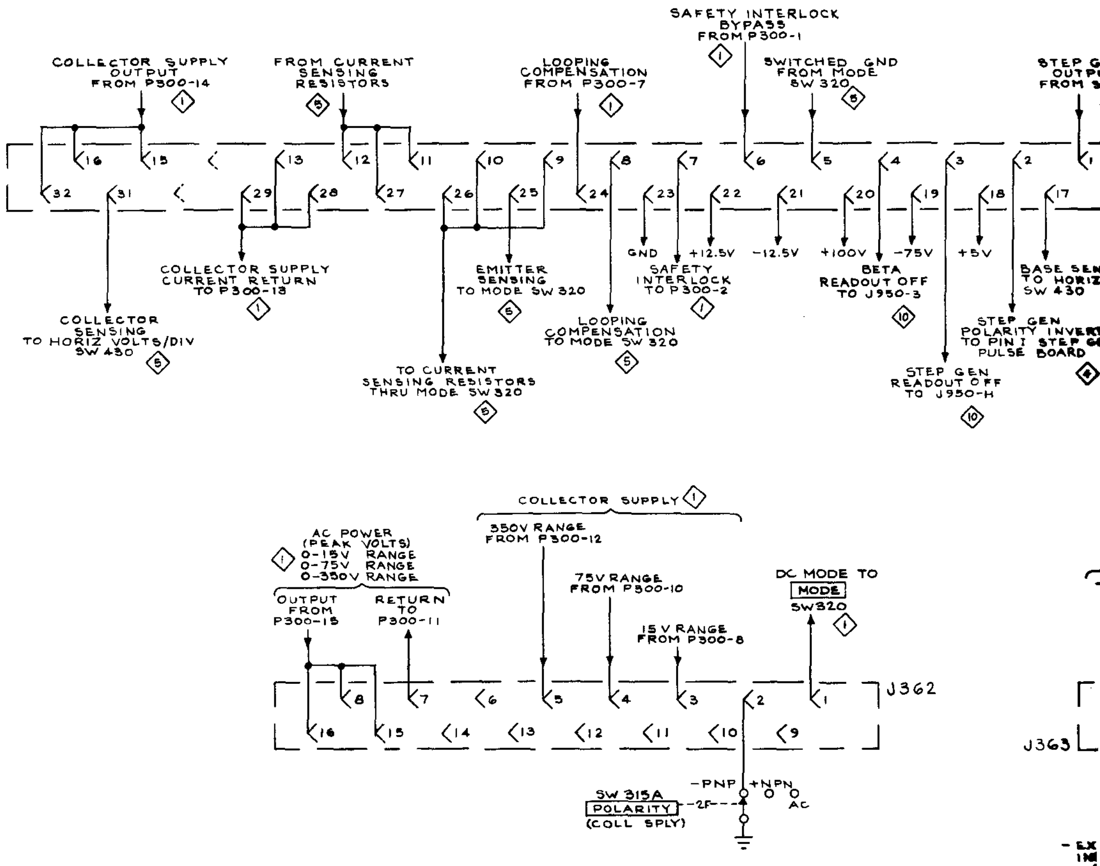

SW400A
VERTICAL (CURRENT/DIV)
LEAKAGE CURRENT SENSITIVITY
NORMAL CURRENT SENSITIVITY
+SIGNAL SENSING
LOOPING COMPENSATION
NORMAL SWEEP
CURRENT RETURN
D.C.
LEAKAGE
EMITTER SENSING
SW400B
PARTIAL DISPLAY AMP BOARD
CURRENT SENSING RESISTORS
GUARD BOX
SWITCHED GND
LOOPING COMPENSATION
PARTIAL VERT CURRENT/DIV BOARD
SW320 MODE
TO VERTICAL DISPLAY SWITCHING
PARTIAL HORIZ VOLTS/DIV BOARD
BASE SENSING
COLLECTOR SENSING
TO HORIZONTAL DISPLAY SWITCHING
J360
± ½V STEPS FROM R139
BASE VOLTS ATTEN
COLLECTOR VOLTS TO GUARD BOX
GUARD BOX TO GND
STEP GEN SIGNAL STEERING
SW430 HORIZONTAL VOLTS/DIV
REFERENCE DIAGRAMS
3 STEP AMPLIFIER
6 STANDARD TEST FIXTURE
7 TEST FIXTURE CONNECTORS
9 DISPLAY AMPLIFIERS
10 READOUT SWITCHING
13 POWER SUPPLY
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.
SEE PARTS LIST FOR SEMICONDUCTOR TYPES


COLLECTOR SWEEP FROM SW310B
COLLECTOR SENSING TO HORIZONTAL VOLTS/DIV SW 430
GND
STEPS IN FROM STEP GEN AMPLITUDE SWITCH SW195
J372
J373
J374
STEP GEN OUT
EXT BASE OR EMIT IN
GND
BASE SENSING TO HORIZONTAL VOLTS/DIV SW 430
CURRENT RETURN TO TERM 9, T301
FROM CURRENT SENSING RESISTORS R405-R409
TO CURRENT SENSING RESISTORS THRU MODE SW320
LOOPING COMPENSATION FROM C339
LOOPING COMPENSATION TO VERT CURRENT/DIV SW 400A
SWITCHING GND FROM MODE SW320
EMITTER SENSING TO MODE SW320
STEPS READOUT OFF TO PIN BD, READOUT INTERCONNECT BOARD
STEP GEN POLARITY INVERT TO PIN I, STEP GEN PULSE BOARD
BETA READOUT OFF TO PIN BP, READOUT INTERCONNECT BOARD
R370 22
R376 22
L370
L371
P300
GUARD BOX CONNECTOR J300
J360
TEST FIXTURE CONNECTOR P360



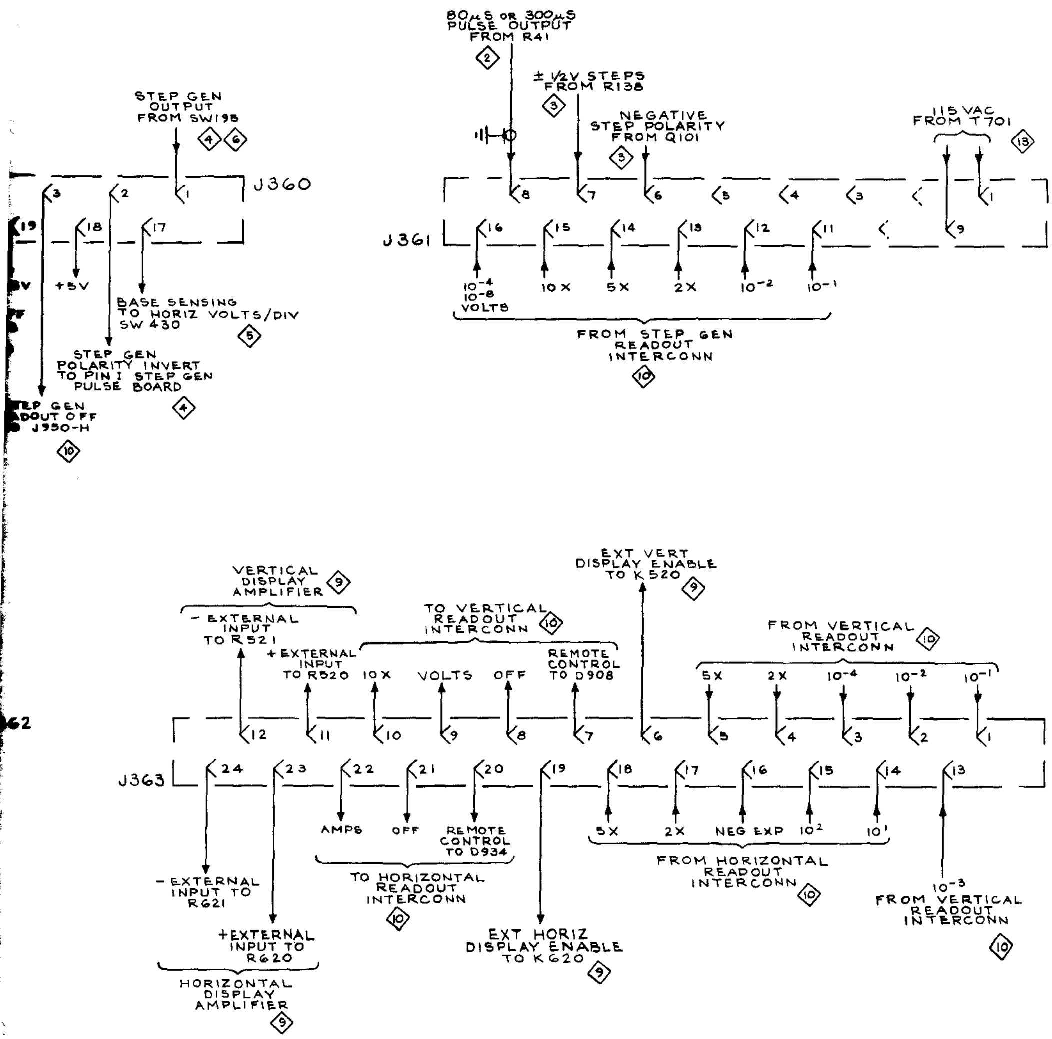
Ⓐ

STANDARD TEST FIXTURE ⑥



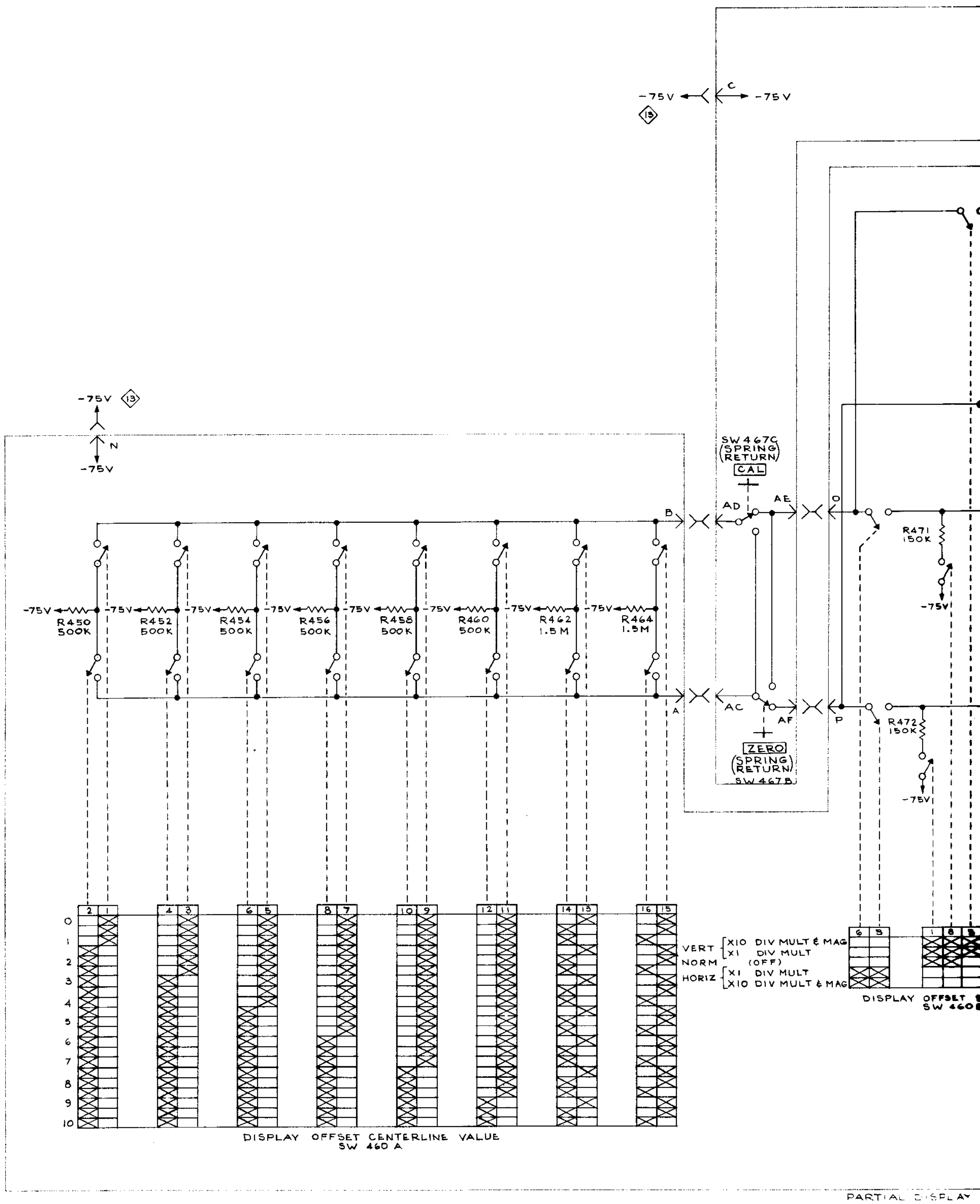
REFERENCE DIAGRAMS

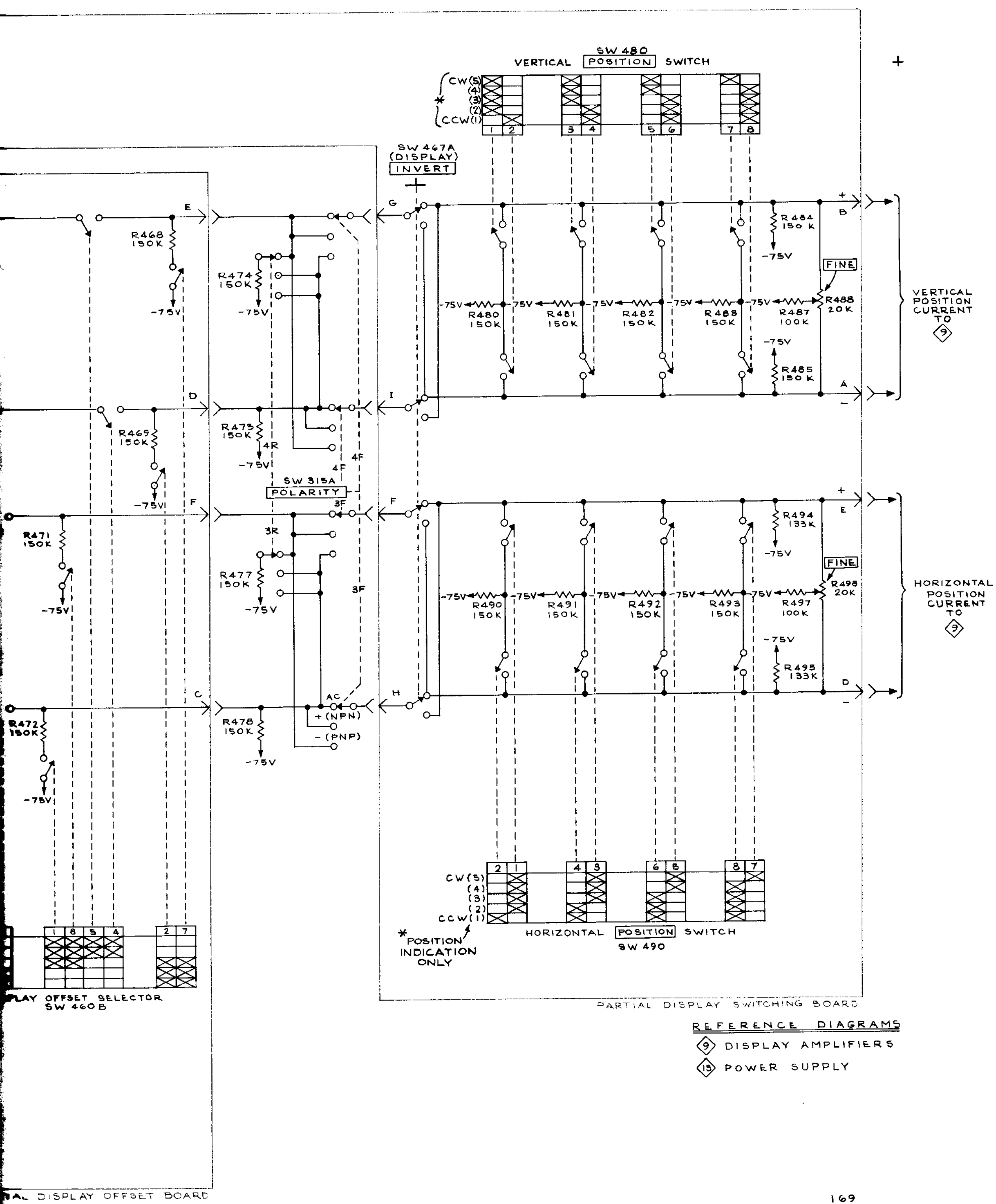
1. COLLECTOR SUPPLY
2. STEP GENERATOR
3. STEP AMPLIFIER
4. STEP GENERATOR SWITCHING
5. DISPLAY SENSITIVITY SWITCHING
6. STANDARD TEST FIXTURE
9. DISPLAY AMPLIFIERS
10. READOUT SWITCHING INTERCONNECTIONS
13. POWER SUPPLY



Ⓐ TEST FIXTURE CONNECTORS 169 ⑦

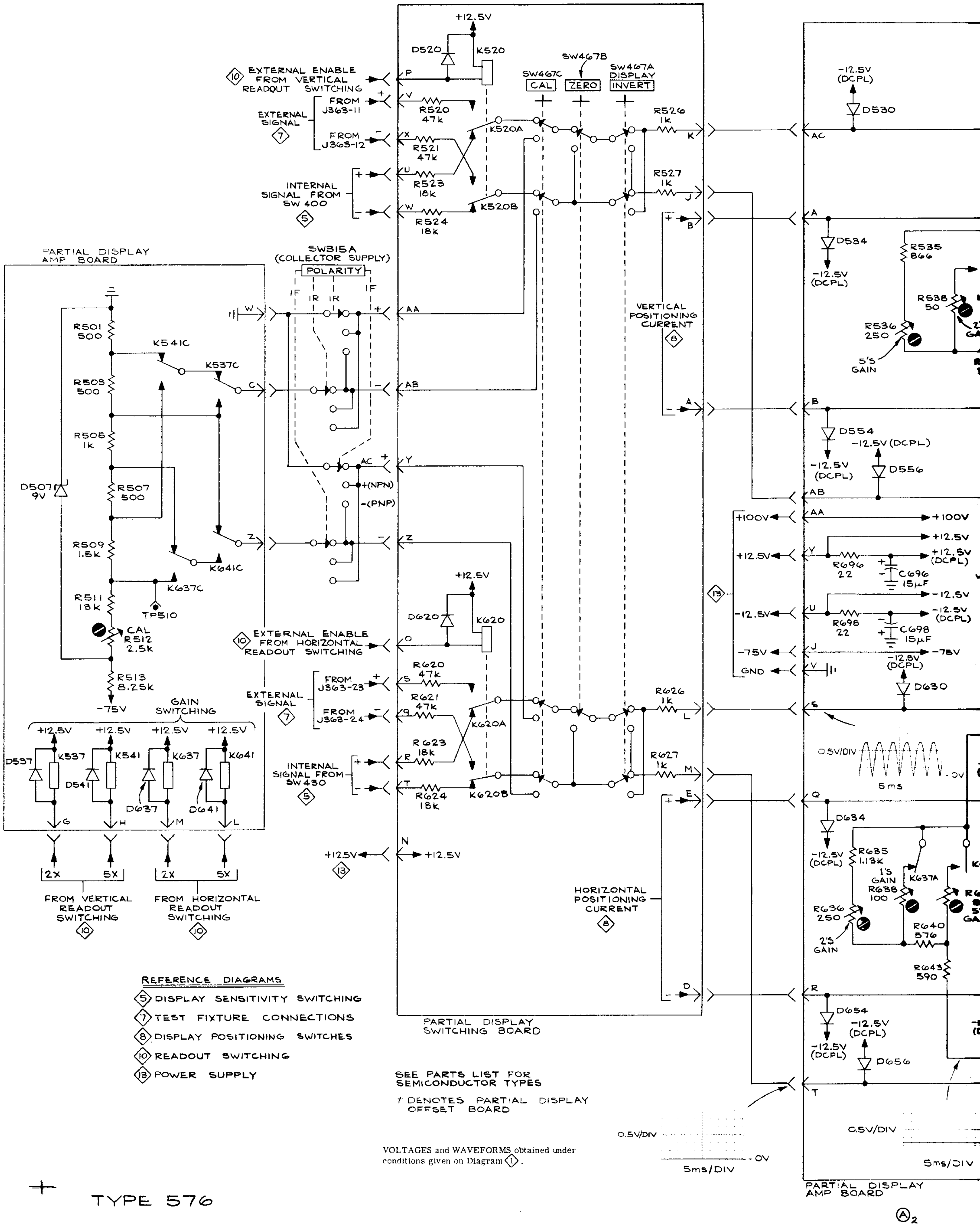
TEST FIXTURE CONNECTORS ⑦


-75V
C
-75V
-75V
N
-75V
SW 467C (SPRING RETURN)
CAL
AD
AE
O
B
R450 500K
R452 500K
R454 500K
R456 500K
R458 500K
R460 500K
R462 1.5M
R464 1.5M
R471 150K
R472 150K
AC
AF
P
A
ZERO
(SPRING RETURN)
SW 467B
VERT [X10 DIV MULT & MAG / X1 DIV MULT]
NORM (OFF)
HORIZ [X1 DIV MULT / X10 DIV MULT & MAG]
DISPLAY OFFSET CENTERLINE VALUE
SW 460 A
PARTIAL DISPLAY



REFERENCE DIAGRAMS
9 DISPLAY AMPLIFIERS
13 POWER SUPPLY

DISPLAY POSITIONING SWITCHES 8



REFERENCE DIAGRAMS

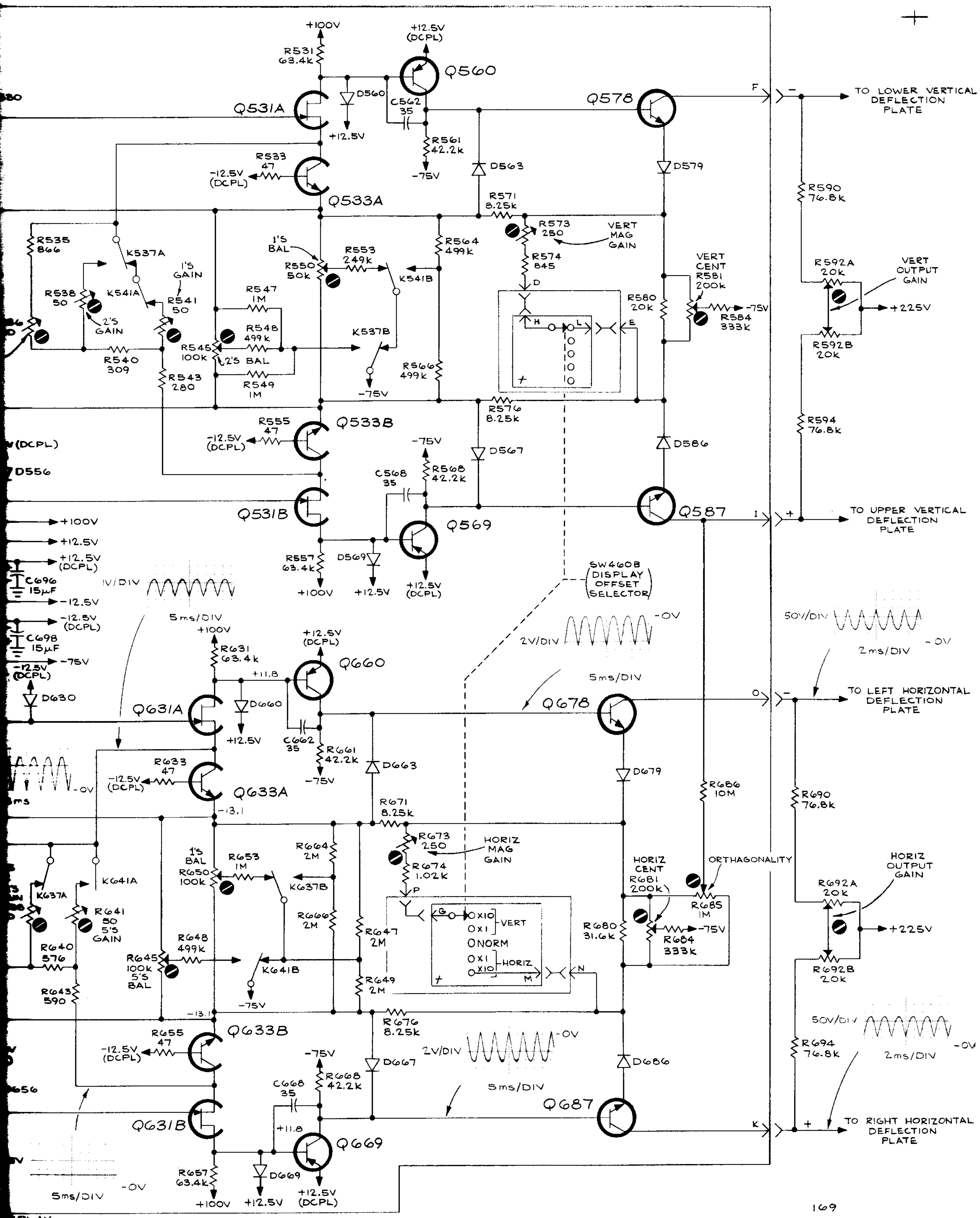
- ⑤ DISPLAY SENSITIVITY SWITCHING
- ⑦ TEST FIXTURE CONNECTIONS
- ⑧ DISPLAY POSITIONING SWITCHES
- ⑩ READOUT SWITCHING
- ⑬ POWER SUPPLY

SEE PARTS LIST FOR SEMICONDUCTOR TYPES

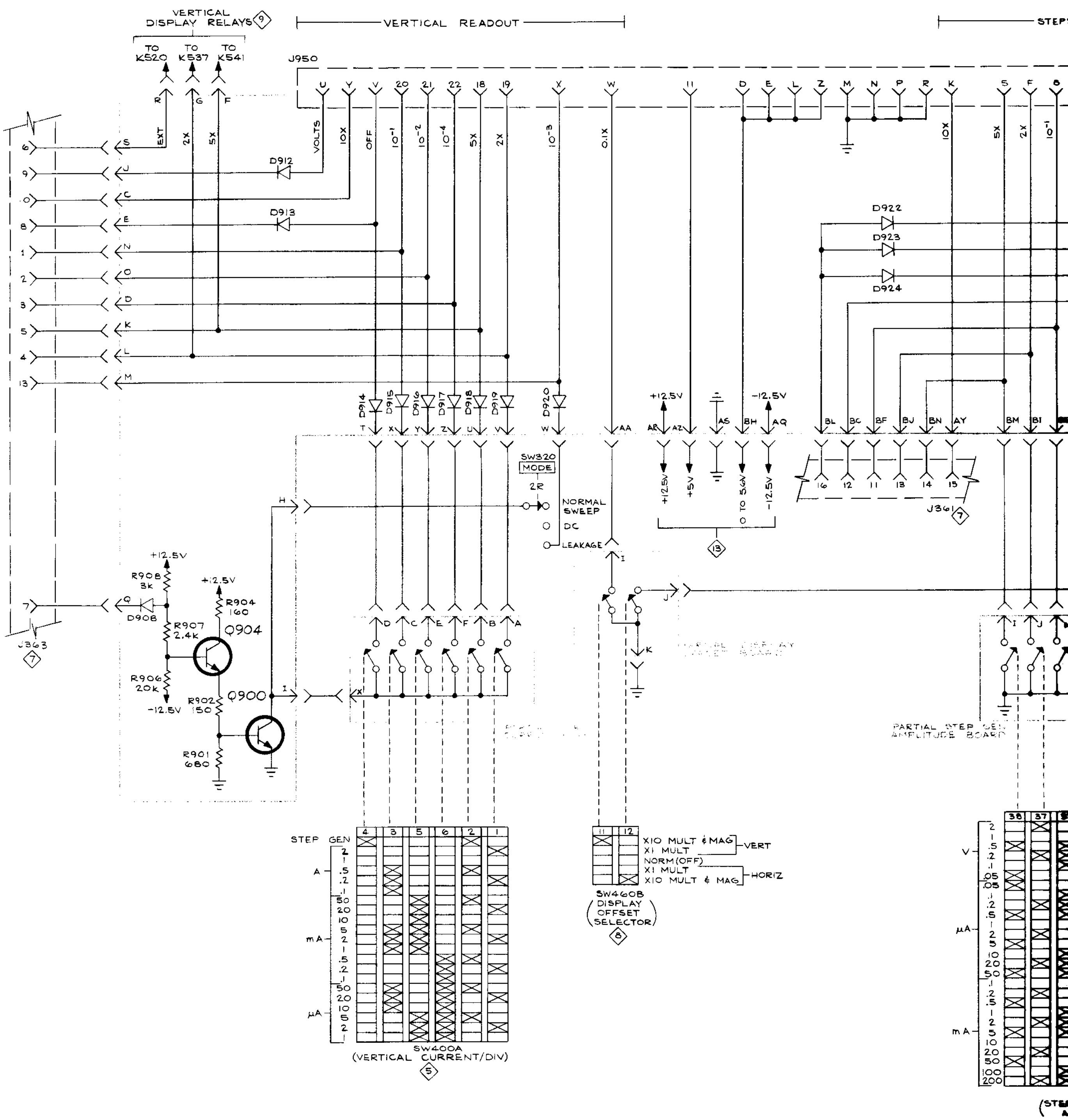
† DENOTES PARTIAL DISPLAY OFFSET BOARD

VOLTAGES and WAVEFORMS obtained under conditions given on Diagram ①.

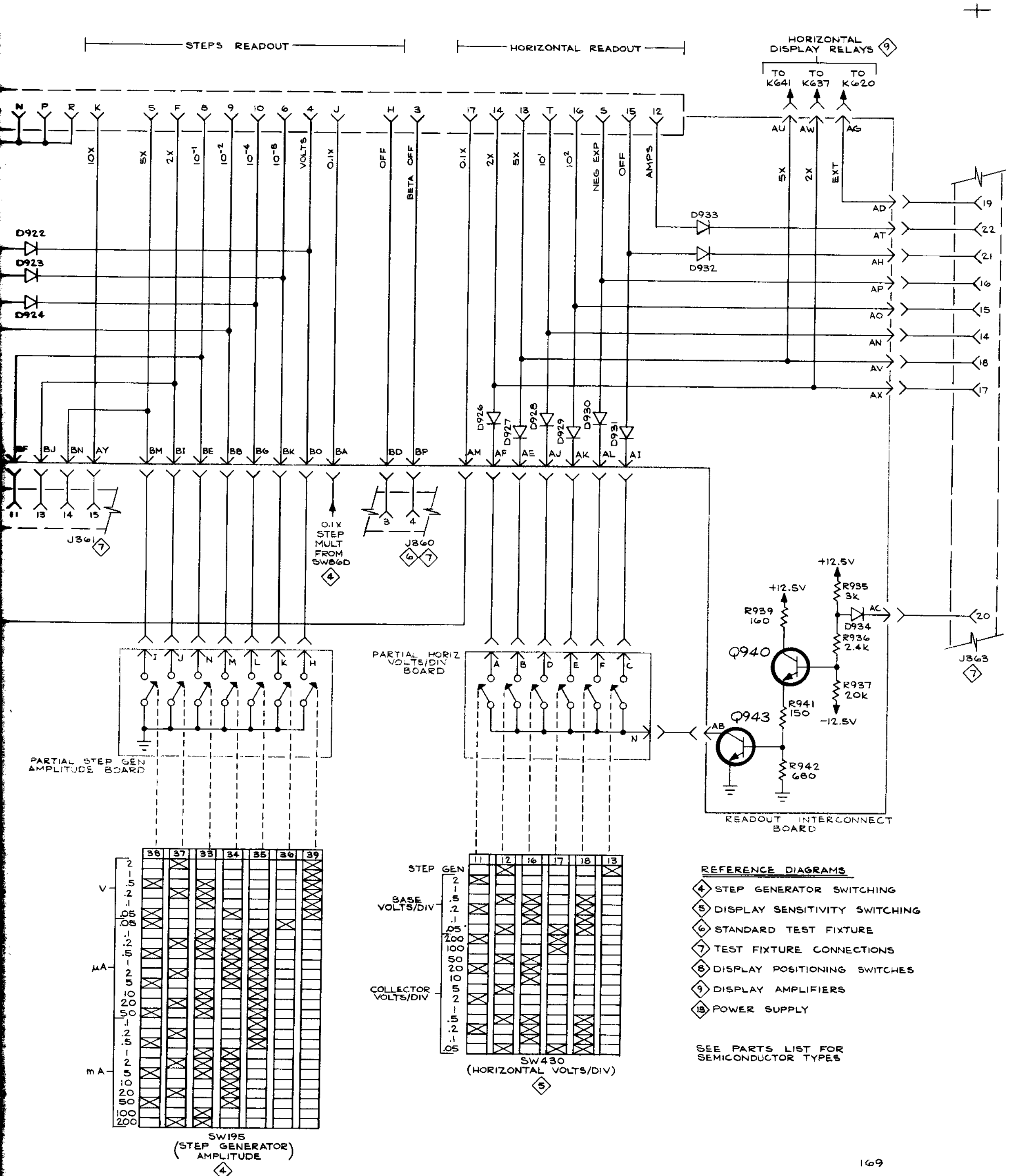
TYPE 576



DISPLAY AMPLIFIERS ⑨


VERTICAL DISPLAY RELAYS
TO K520
TO K537
TO K541
VERTICAL READOUT
J950
J363
D912
D913
D914
D915
D916
D917
D918
D919
D920
D922
D923
D924
SW320 MODE
NORMAL SWEEP
DC
LEAKAGE
+12.5V
-12.5V
+5V
R908 3k
R907 2.4k
R904 160
R906 20k
R902 150
R901 680
Q904
Q900
D908
J361
PARTIAL STEP GEN AMPLITUDE BOARD
STEP GEN
SW400A (VERTICAL CURRENT/DIV)
X10 MULT & MAG
X1 MULT
NORM (OFF)
VERT
HORIZ
SW460B DISPLAY OFFSET SELECTOR

Ⓐ



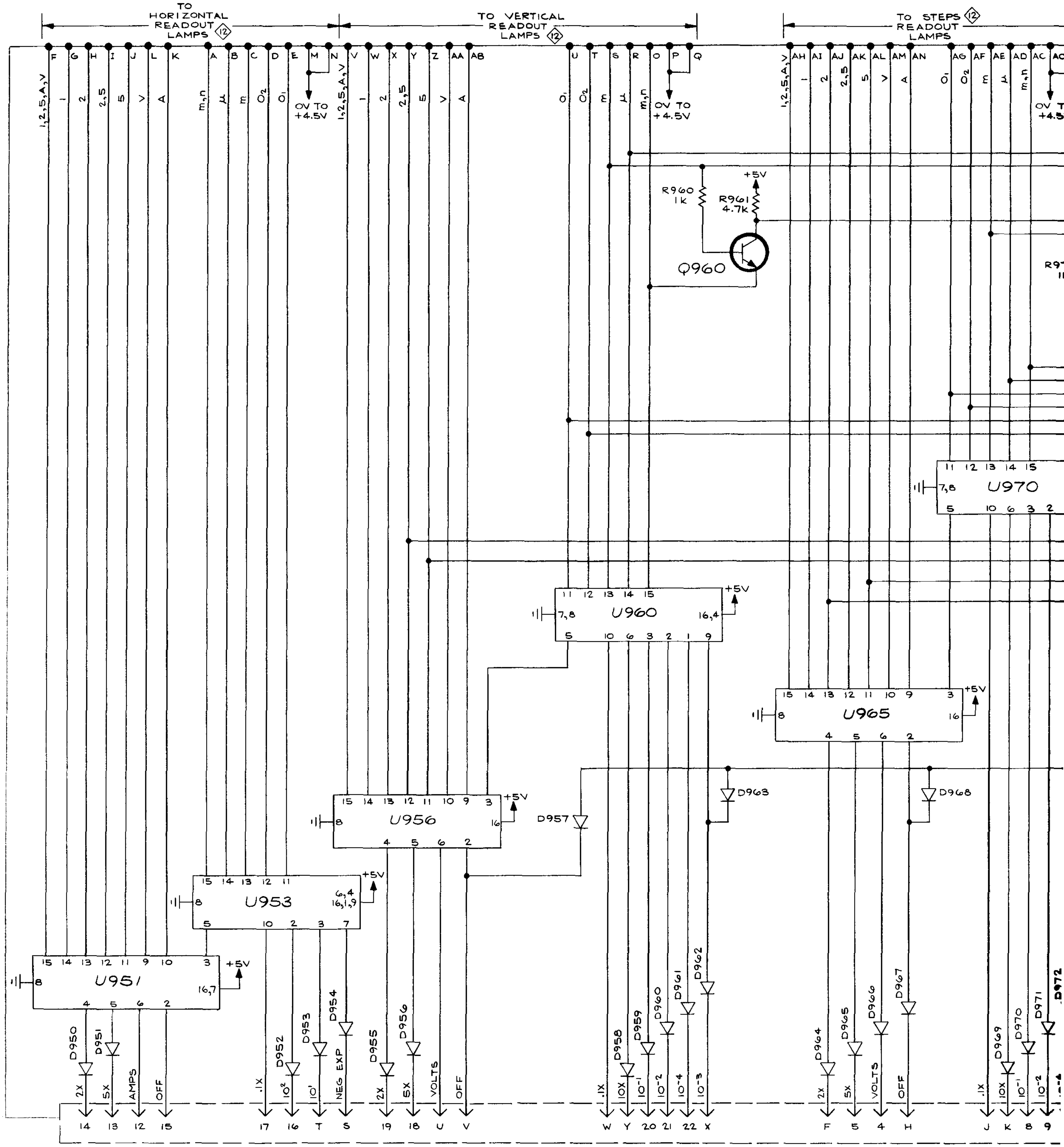
REFERENCE DIAGRAMS

- 4 STEP GENERATOR SWITCHING
- 5 DISPLAY SENSITIVITY SWITCHING
- 6 STANDARD TEST FIXTURE
- 7 TEST FIXTURE CONNECTIONS
- 8 DISPLAY POSITIONING SWITCHES
- 9 DISPLAY AMPLIFIERS
- 18 POWER SUPPLY

SEE PARTS LIST FOR SEMICONDUCTOR TYPES

READOUT SWITCHING & INTERCONNECTIONS 10

A

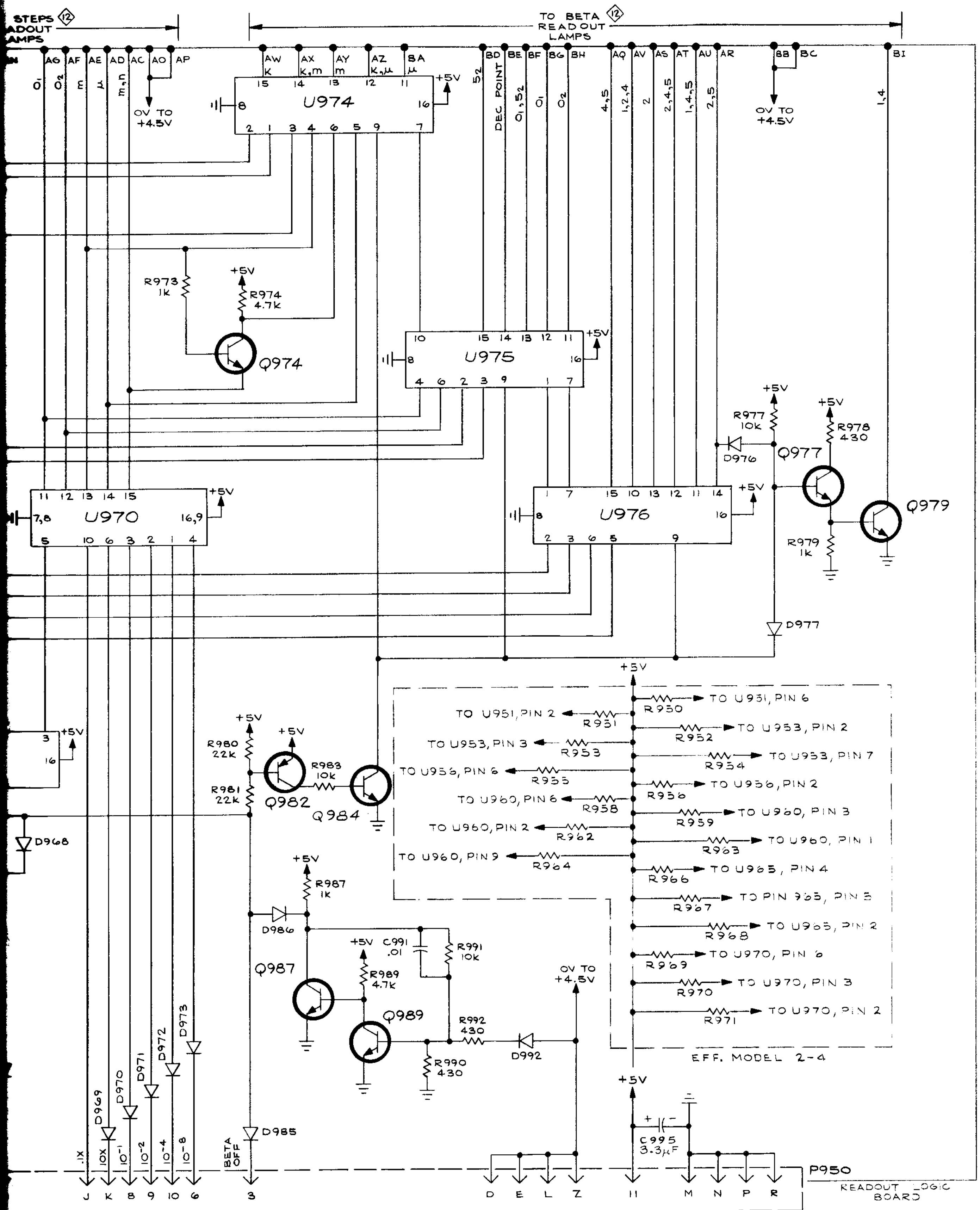


REFERENCE DIAGRAM

12 READOUT LAMPS

TYPE 576

©



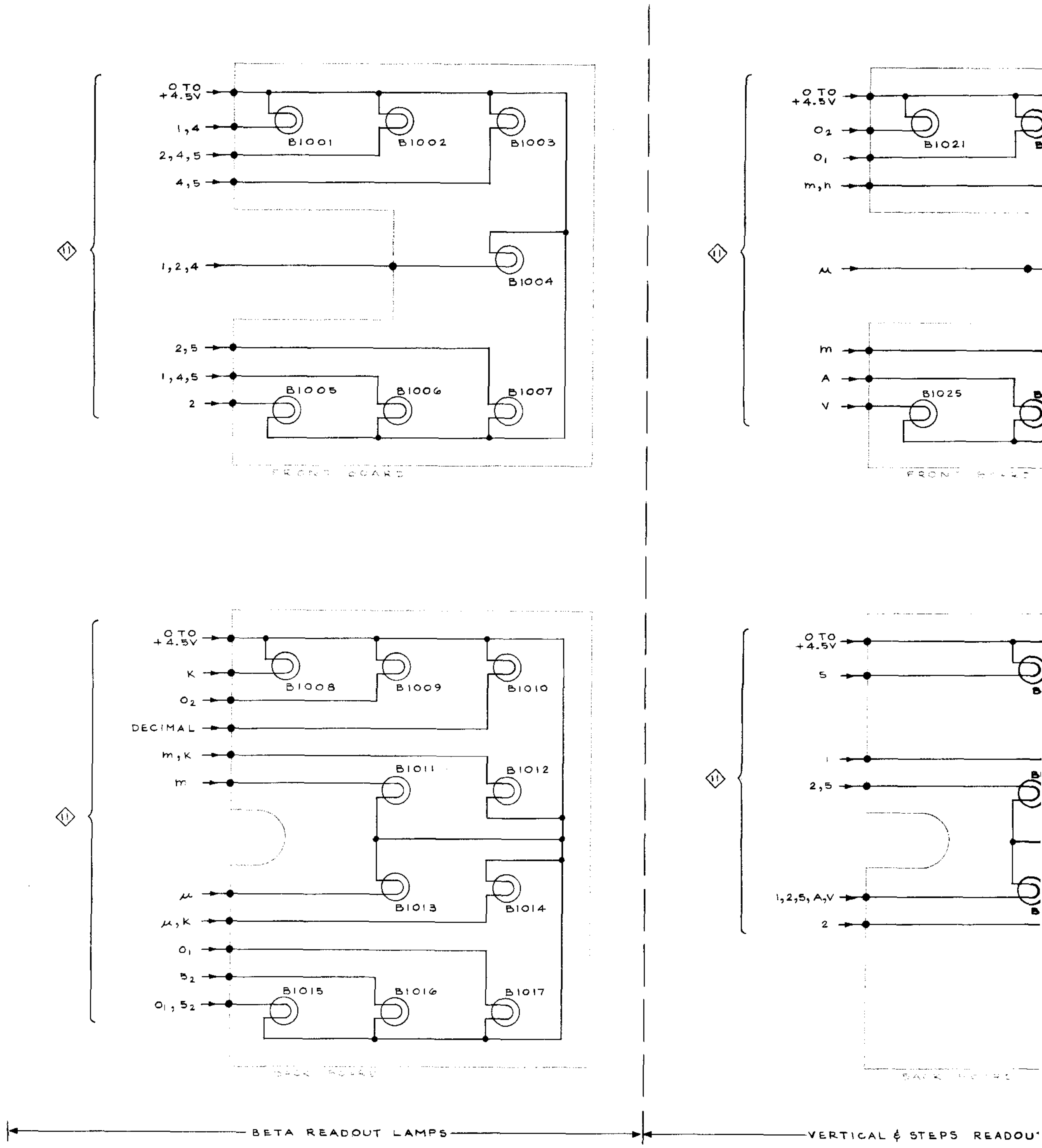
SEE PARTS LIST FOR SEMICONDUCTOR TYPES

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

0270

READOUT LOGIC ⑪

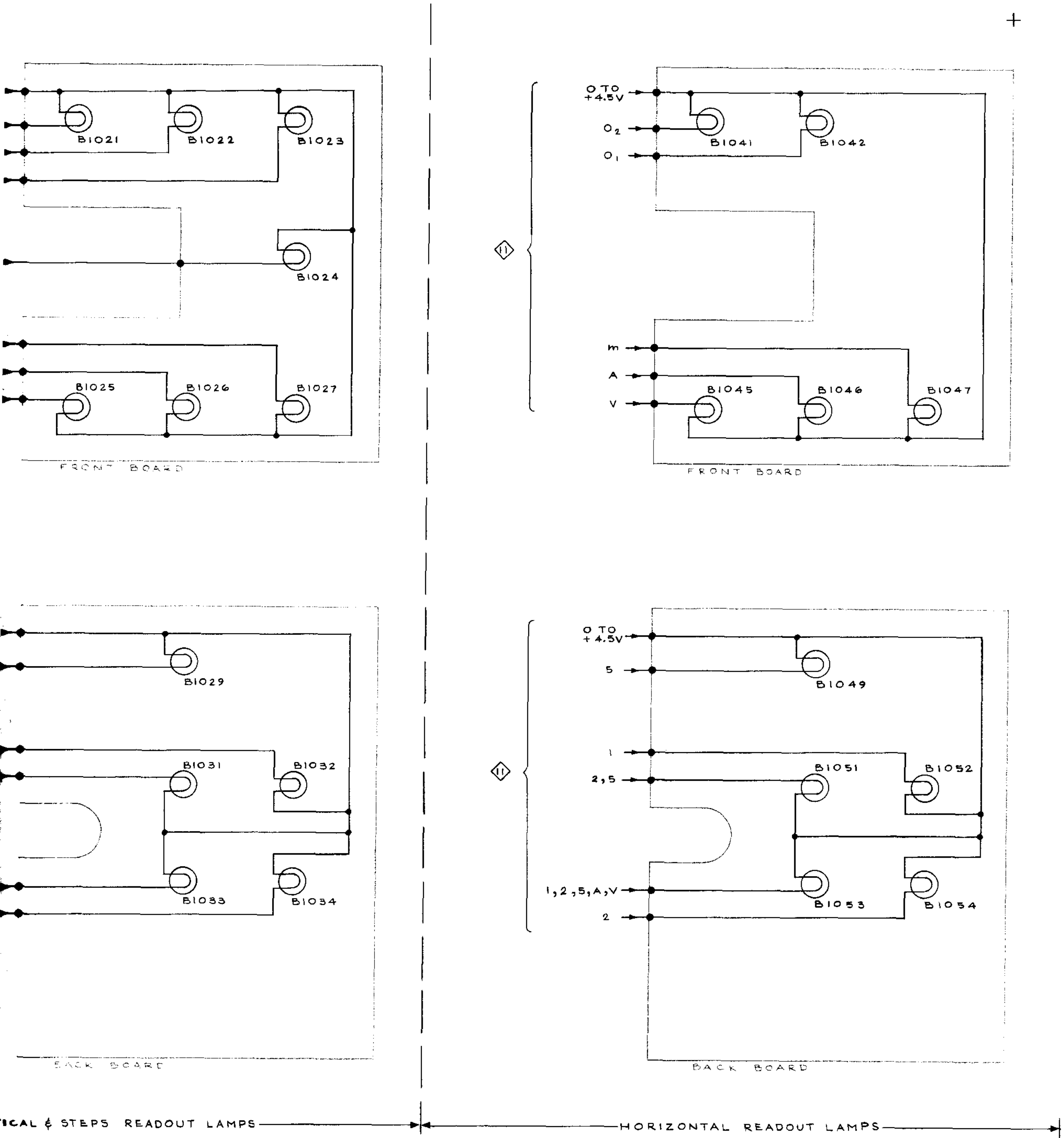
©



0 TO +4.5V
1,4
2,4,5
4,5
1,2,4
2,5
1,4,5
2
B1001
B1002
B1003
B1004
B1005
B1006
B1007
K
O2
DECIMAL
m,K
m
μ
μ,K
O1
S2
O1,S2
B1008
B1009
B1010
B1011
B1012
B1013
B1014
B1015
B1016
B1017
O1
m,n
μ
A
V
B1021
B1025
5
1
1,2,5,A,V
BETA READOUT LAMPS
VERTICAL & STEPS READOU

TYPE 576

Ⓐ

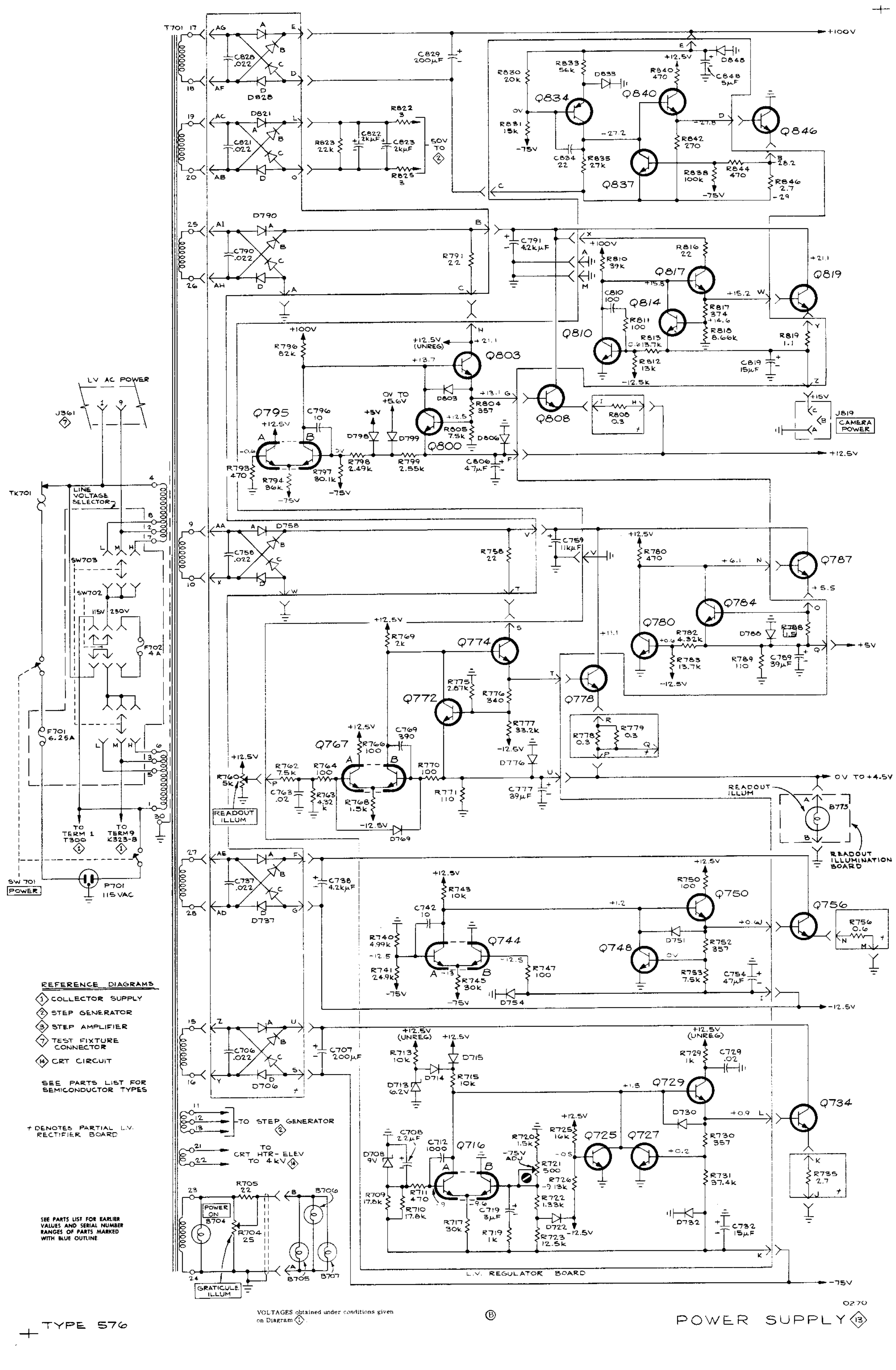


REFERENCE DIAGRAM
11 READOUT LOGIC

Ⓐ

169

READOUT LAMPS 12



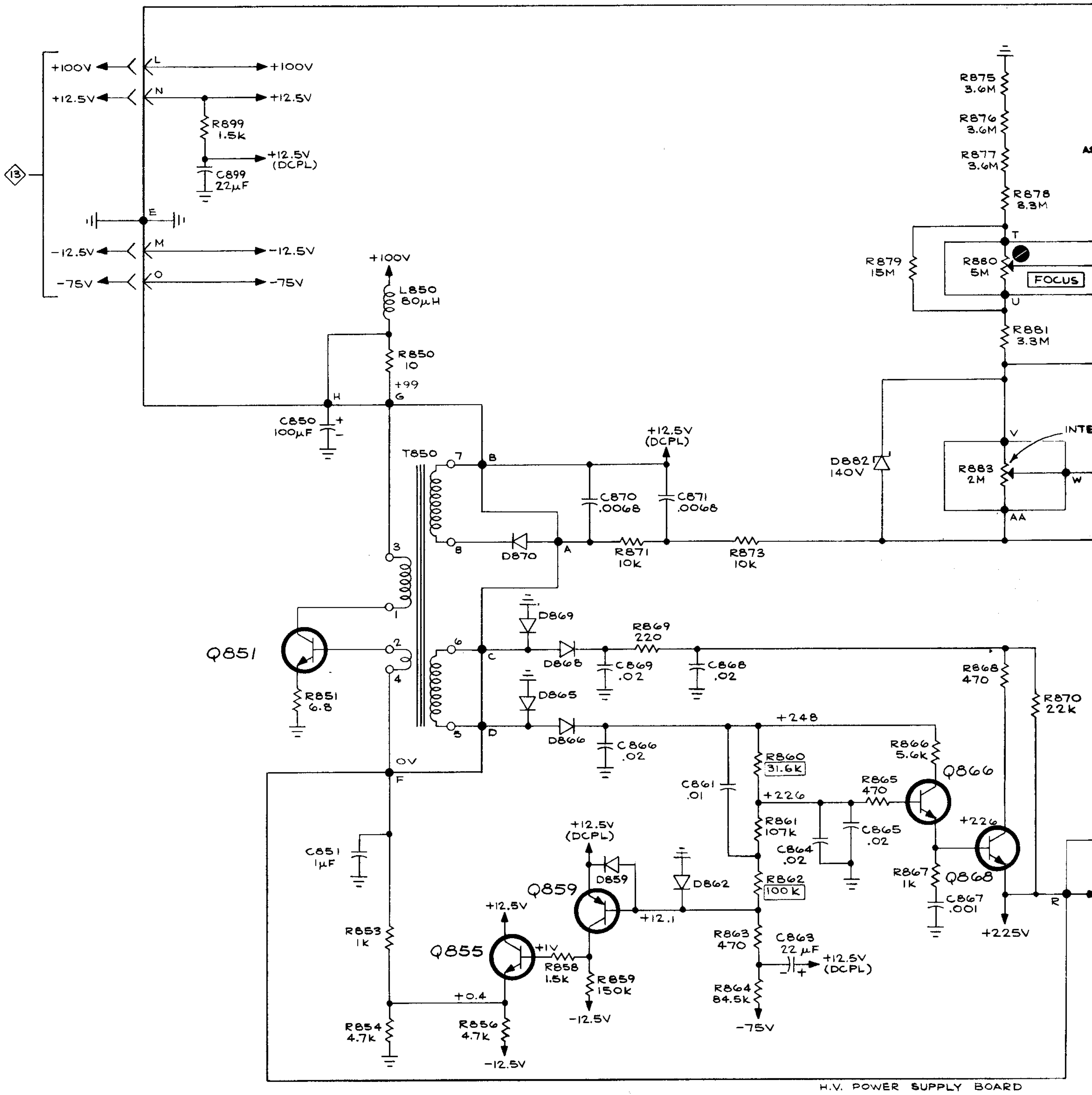
TYPE 576

VOLTAGES obtained under conditions given on Diagram 1.

B

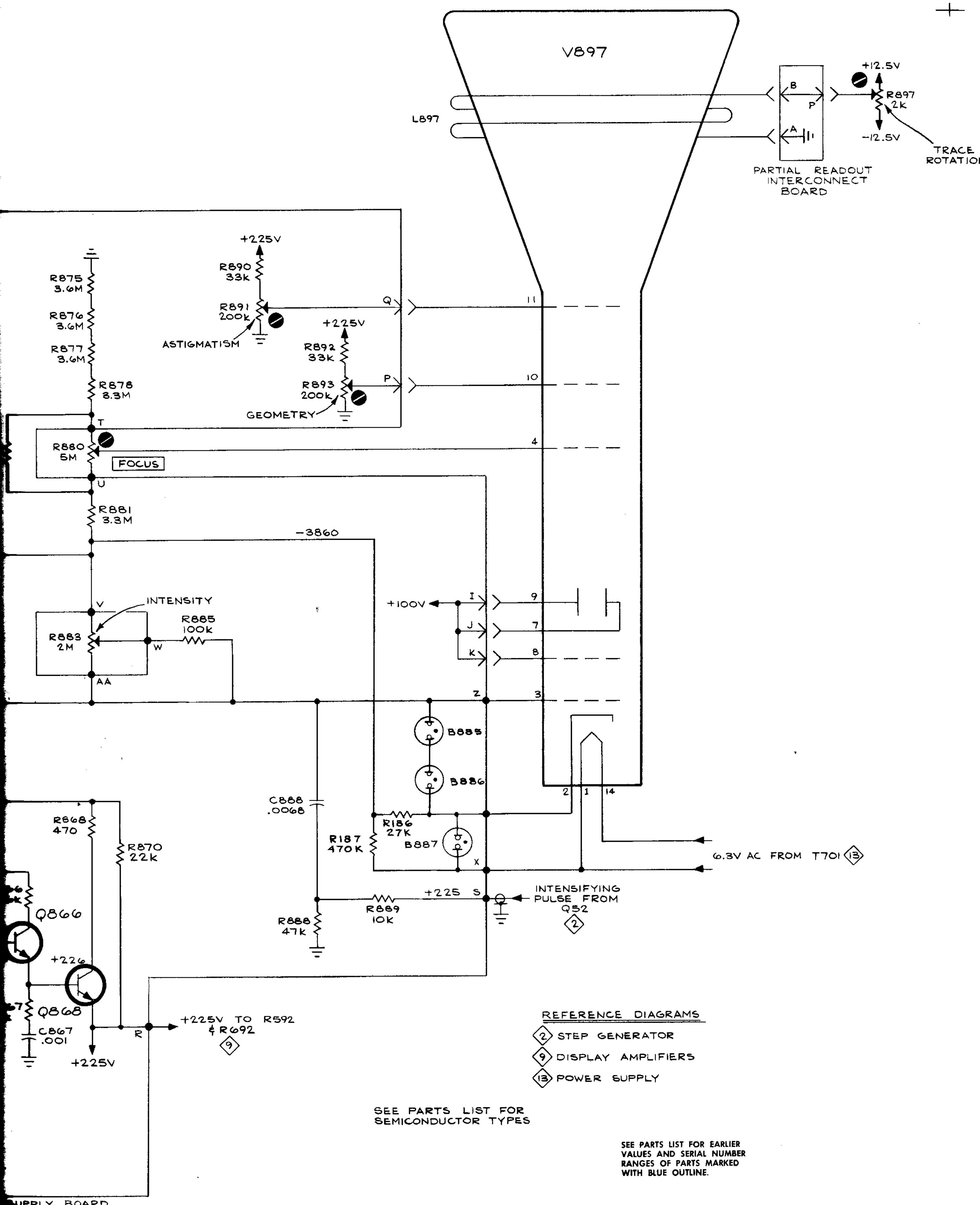
0270

POWER SUPPLY 13


+100V
+12.5V
+12.5V (DCPL)
-12.5V
-75V
13
R899 1.5k
C899 22µF
L850 80µH
R850 10
+99
C850 100µF
T850
Q851
R851 6.8
D870
C870 .0068
C871 .0068
R871 10k
R873 10k
D869
D868
D865
D866
R869 220
C869 .02
C868 .02
C866 .02
+248
+226
R860 31.6k
R861 107k
R862 100k
R863 470
R864 84.5k
C861 .01
C864 .02
C865 .02
C863 22 µF
R865 470
R866 5.6k
R867 1k
C867 .001
Q866
Q868
+225V
R868 470
R870 22k
C851 1µF
R853 1k
R854 4.7k
R856 4.7k
Q855
Q859
D859
D862
R858 1.5k
R859 150k
+12.1
+1V
+0.4
0V
R875 3.6M
R876 3.6M
R877 3.6M
R878 8.3M
R879 15M
R880 5M
FOCUS
R881 3.3M
D882 140V
R883 2M
H.V. POWER SUPPLY BOARD

TYPE 576

Ⓑ



REFERENCE DIAGRAMS
(2) STEP GENERATOR
(9) DISPLAY AMPLIFIERS
(13) POWER SUPPLY

SEE PARTS LIST FOR SEMICONDUCTOR TYPES

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

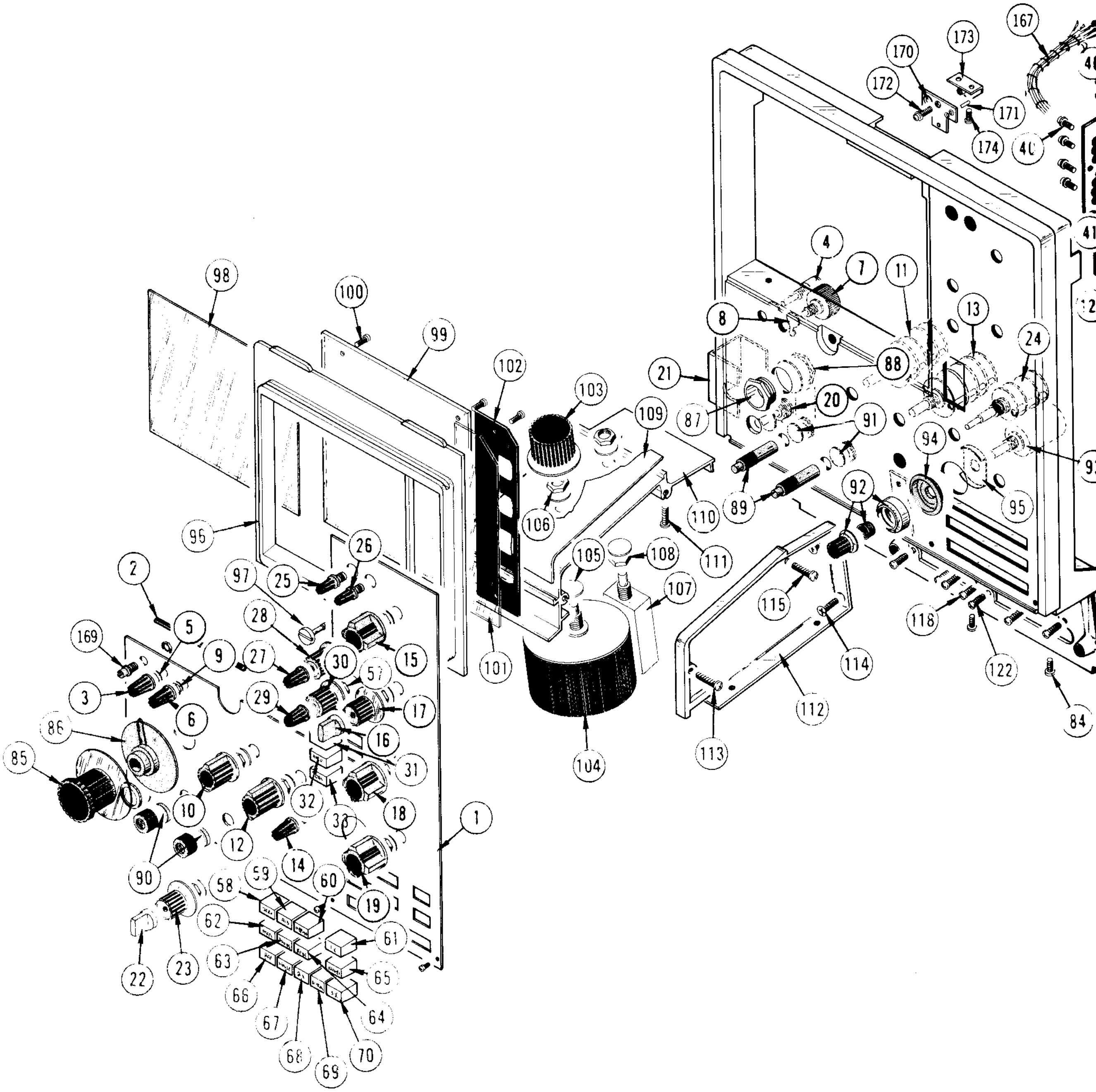
VOLTAGES obtained under conditions given on Diagram (1).

1269

CRT CIRCUIT (14)

(B)

FIG. 1 FRONT



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(B)

FIG. 1 FRONT

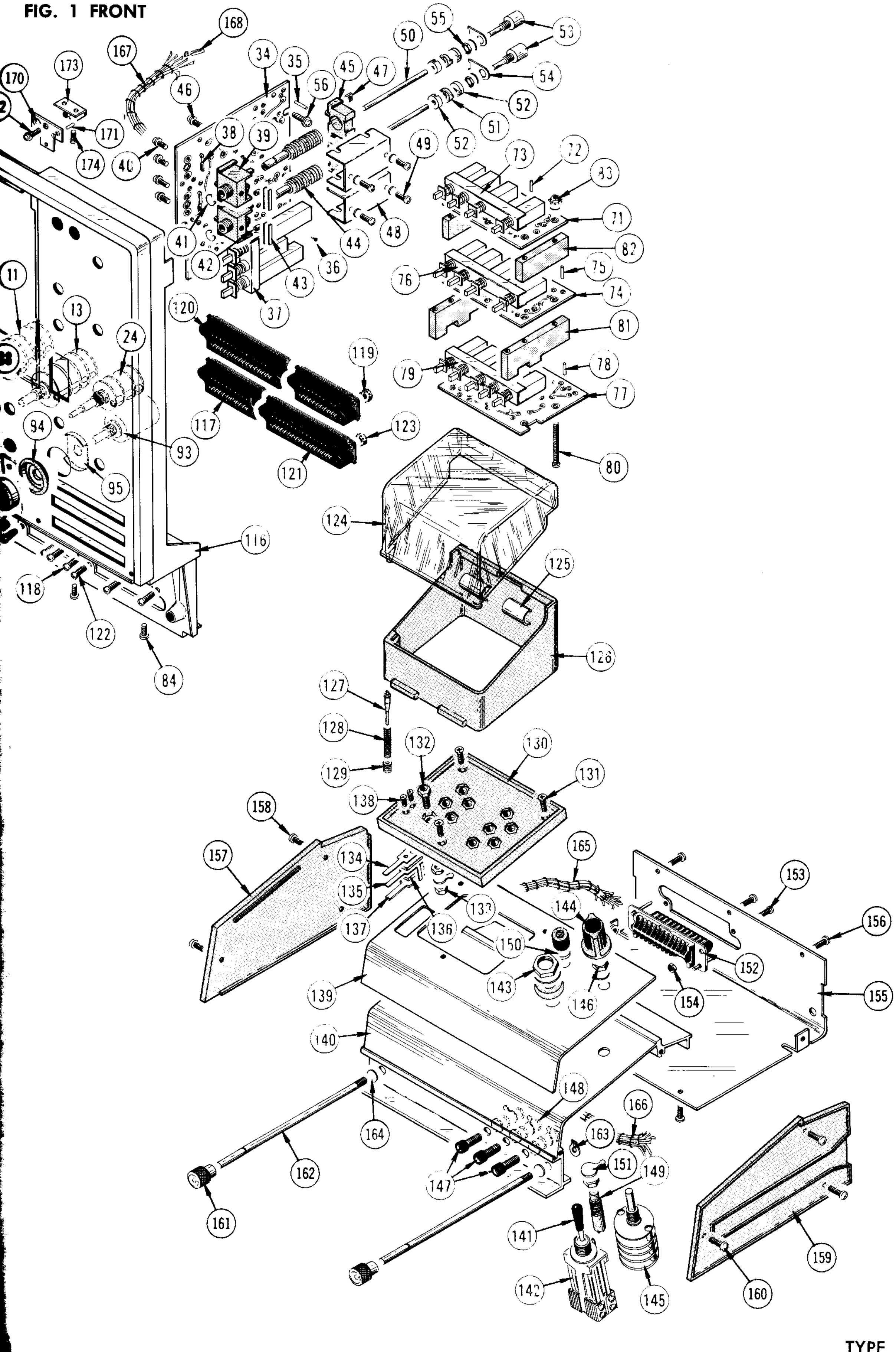
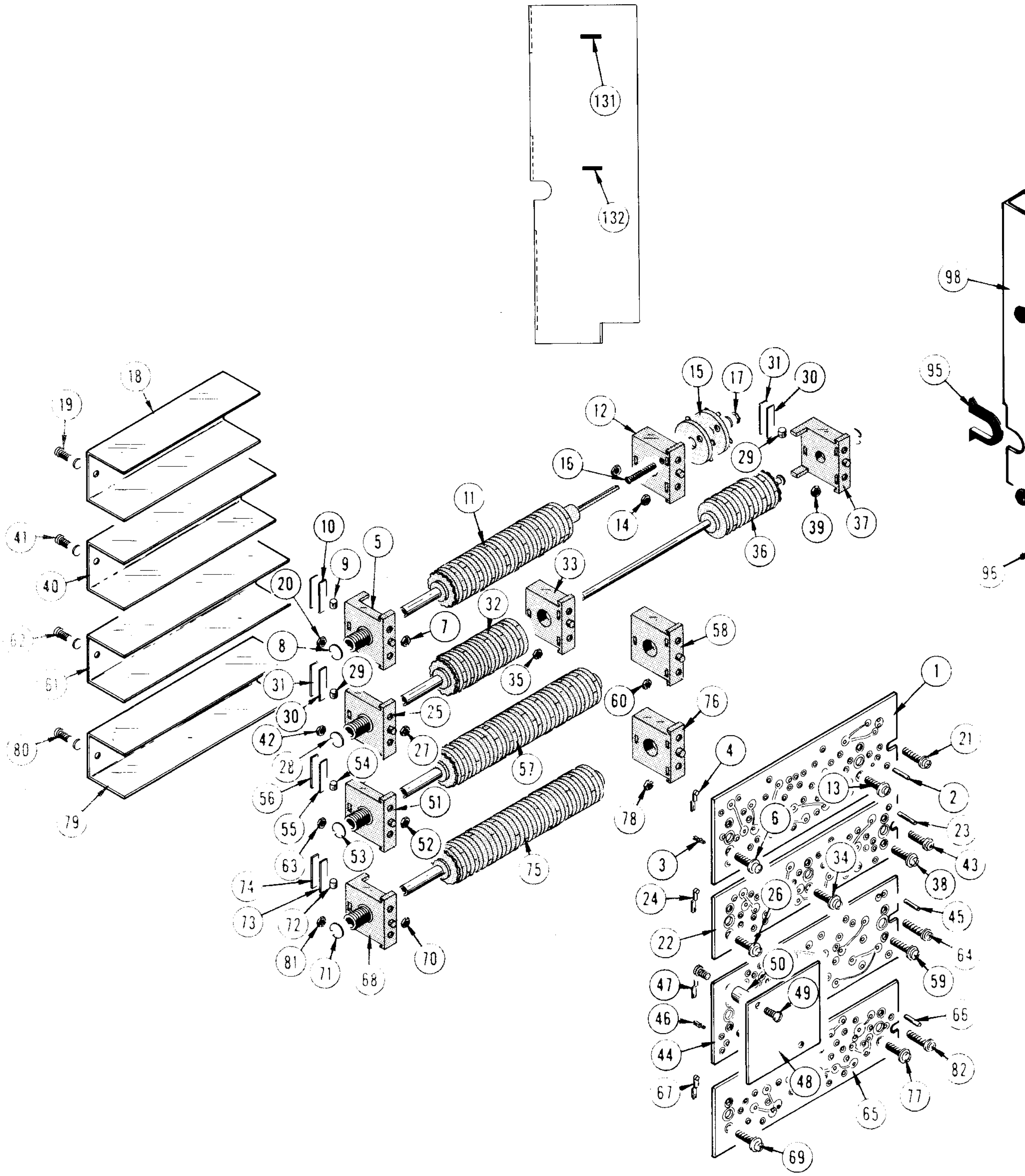


FIG. 1

TYPE 576 CURVE TRACER


131
132
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10
9
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33
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20
32
7
8
58
62
61
31
29
35
1
30
25
60
76
80
42
27
21
28
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57
4
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51
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2
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52
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72
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B

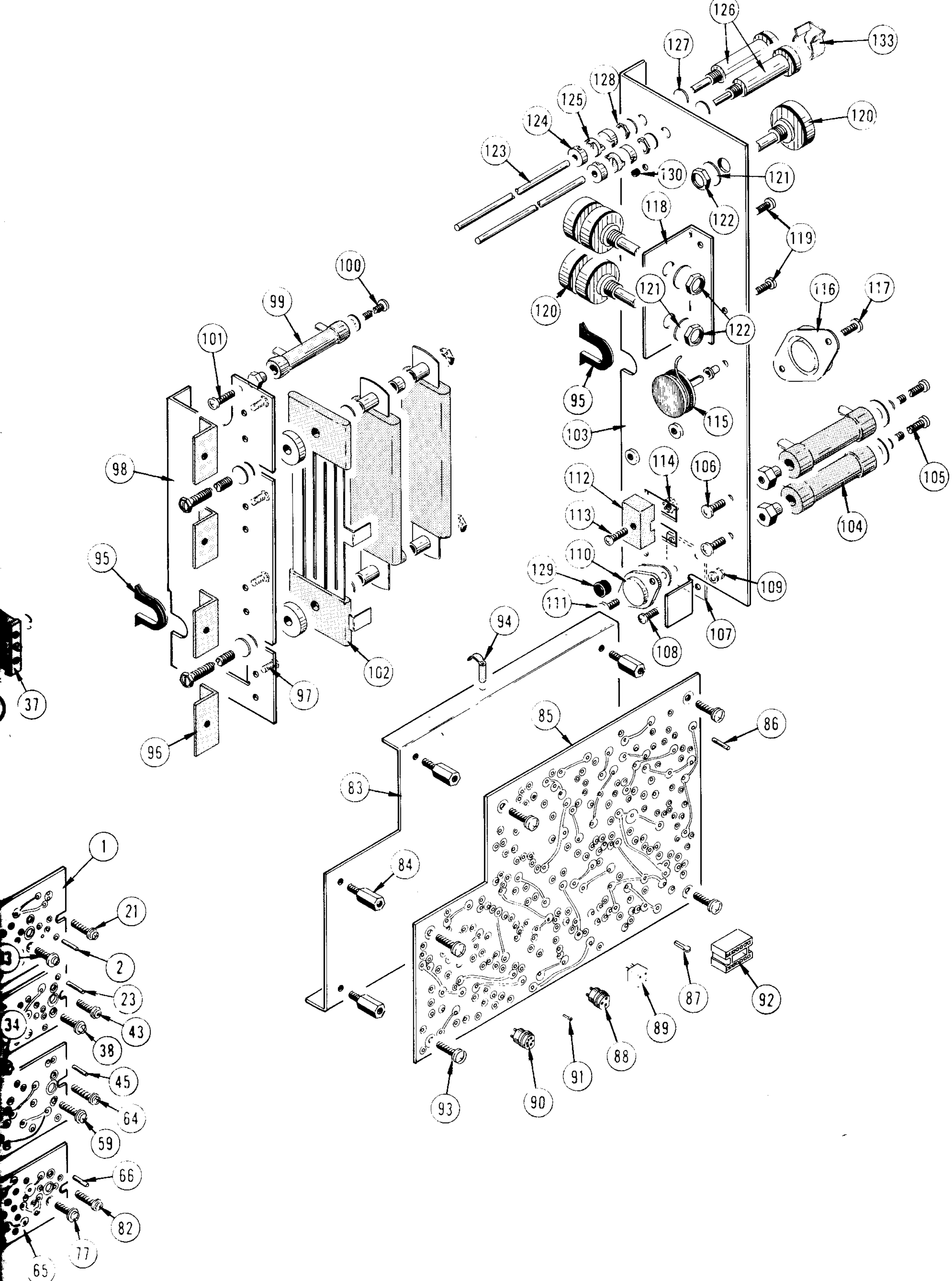
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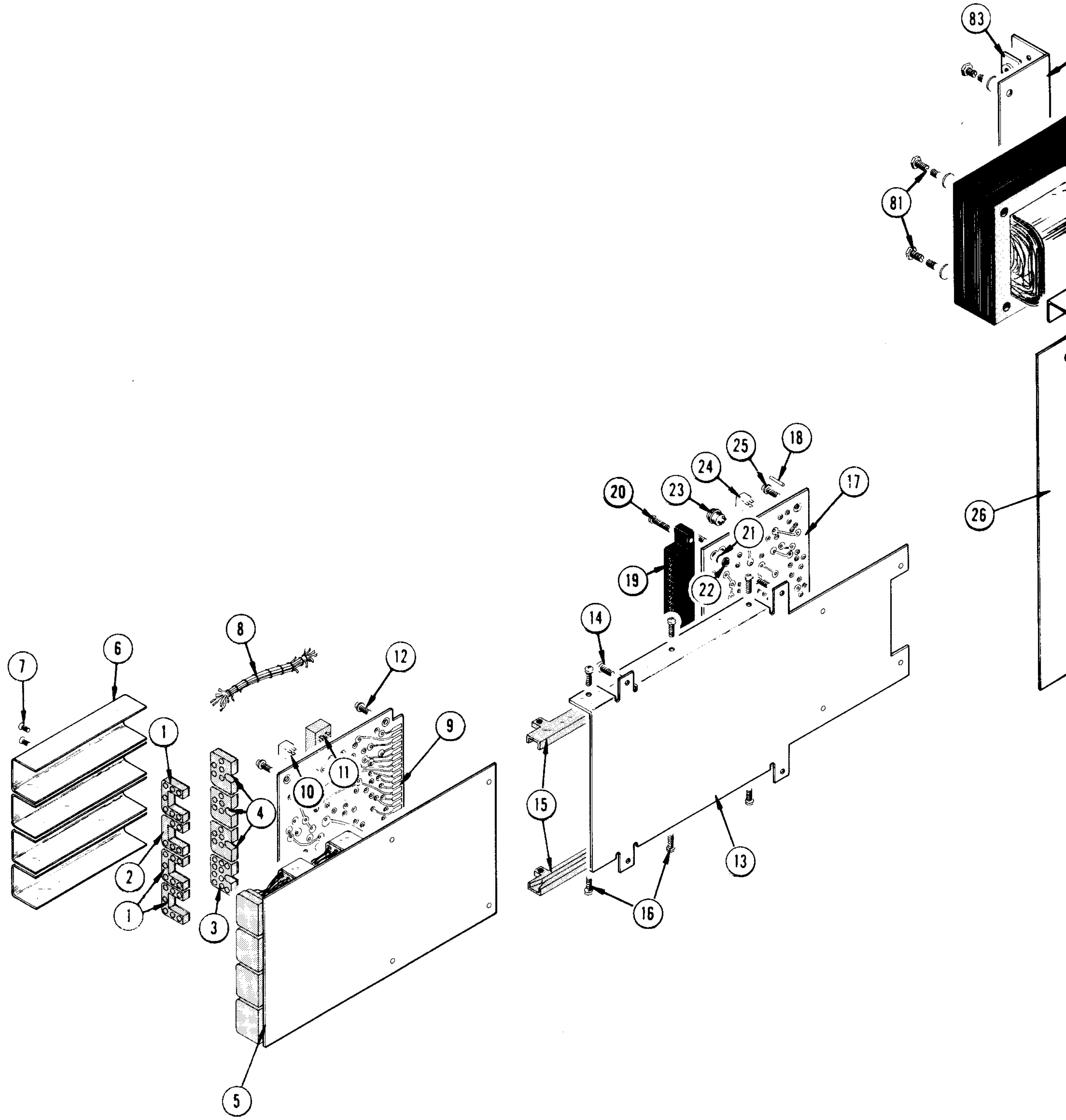
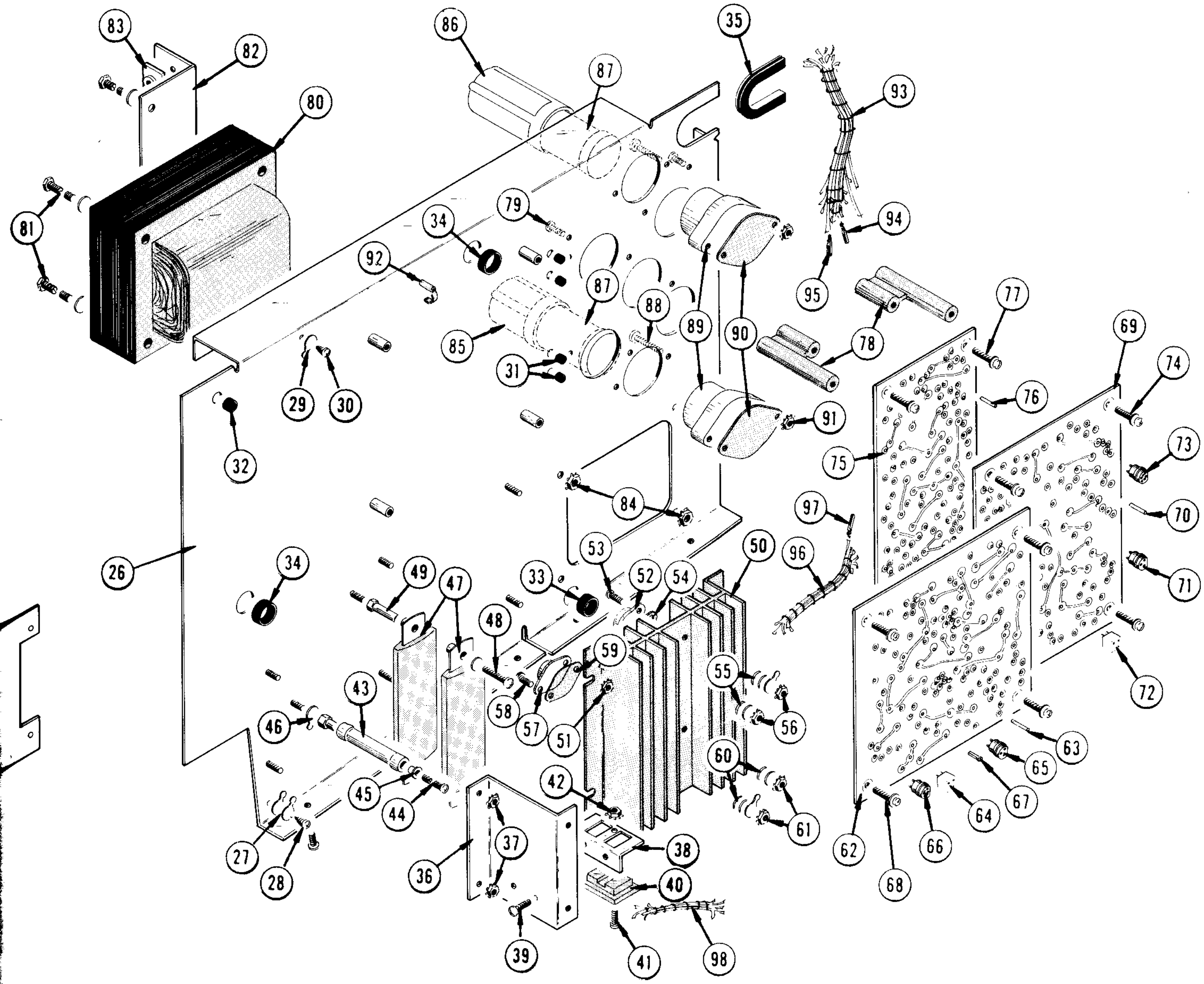
FIG. 3 CHASSIS



+Ⓐ

FIG. 3 CHASSIS



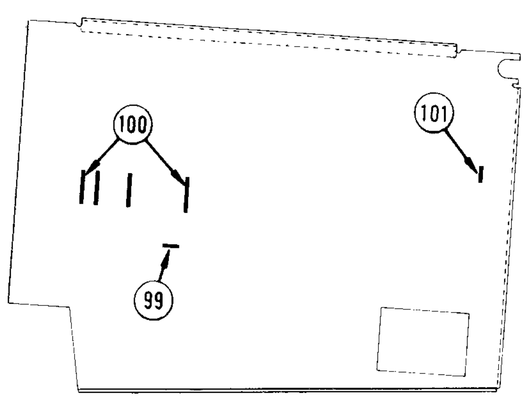
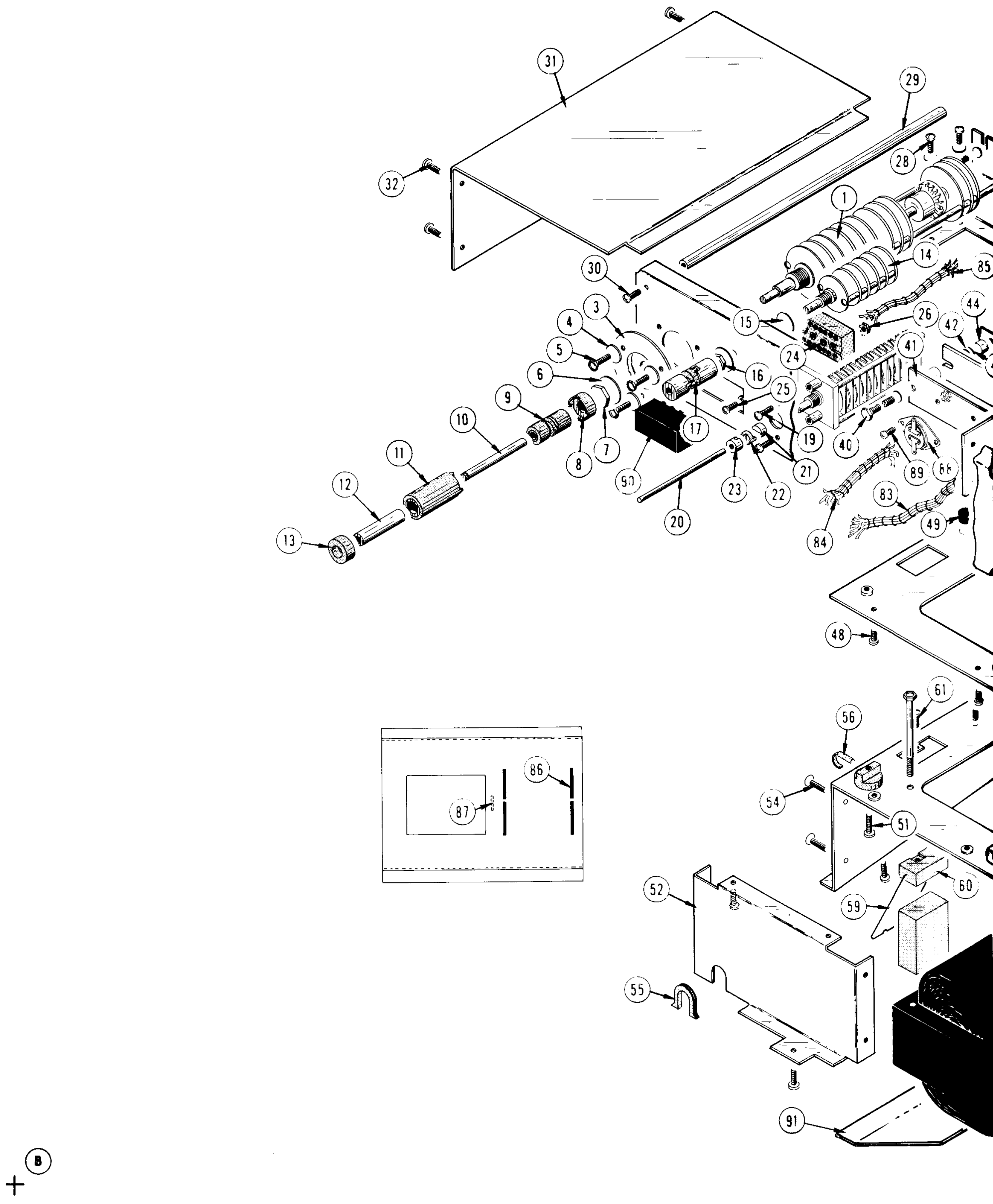


FIG. 3

FIG. 4 COLLECTOR SUPP



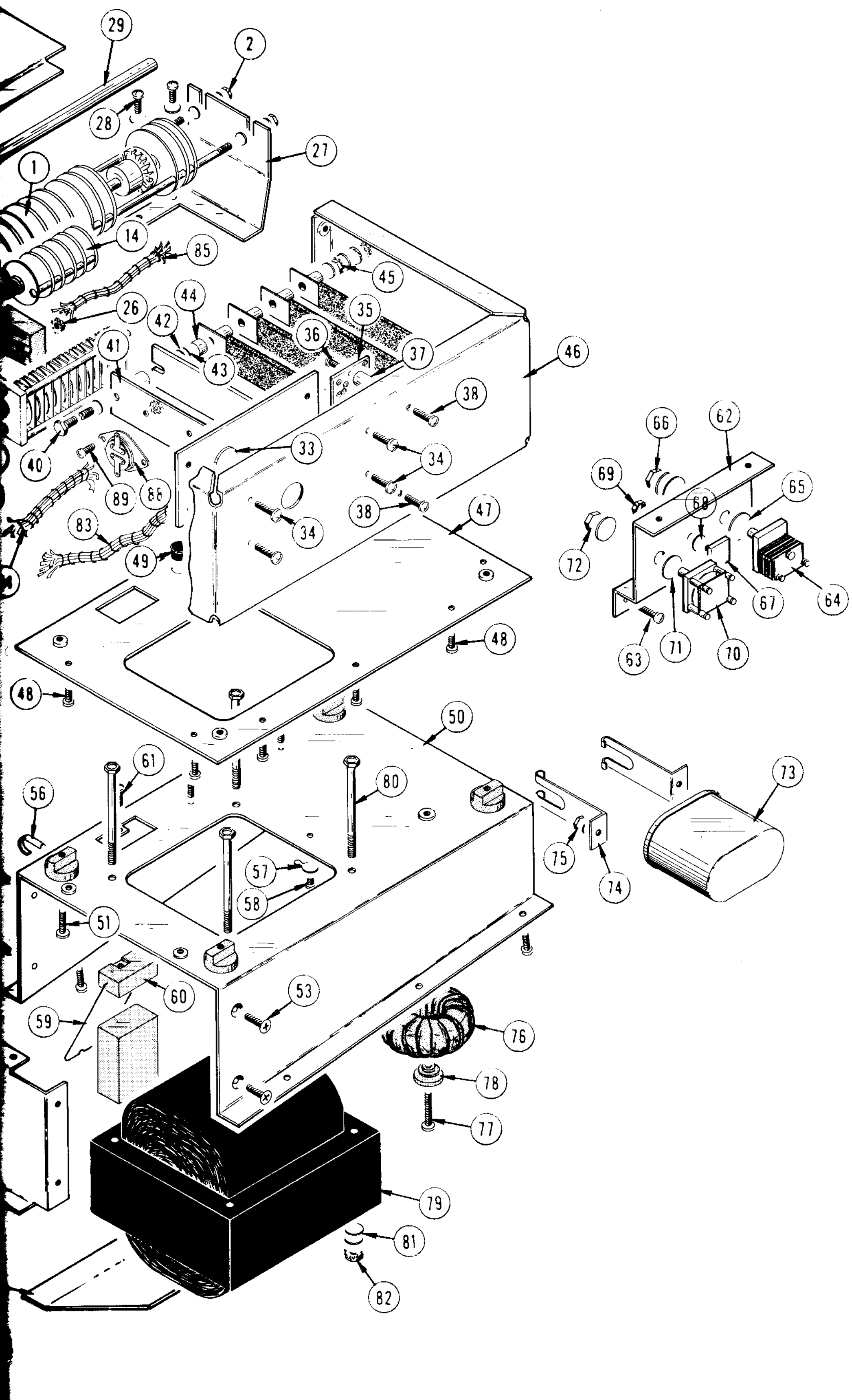

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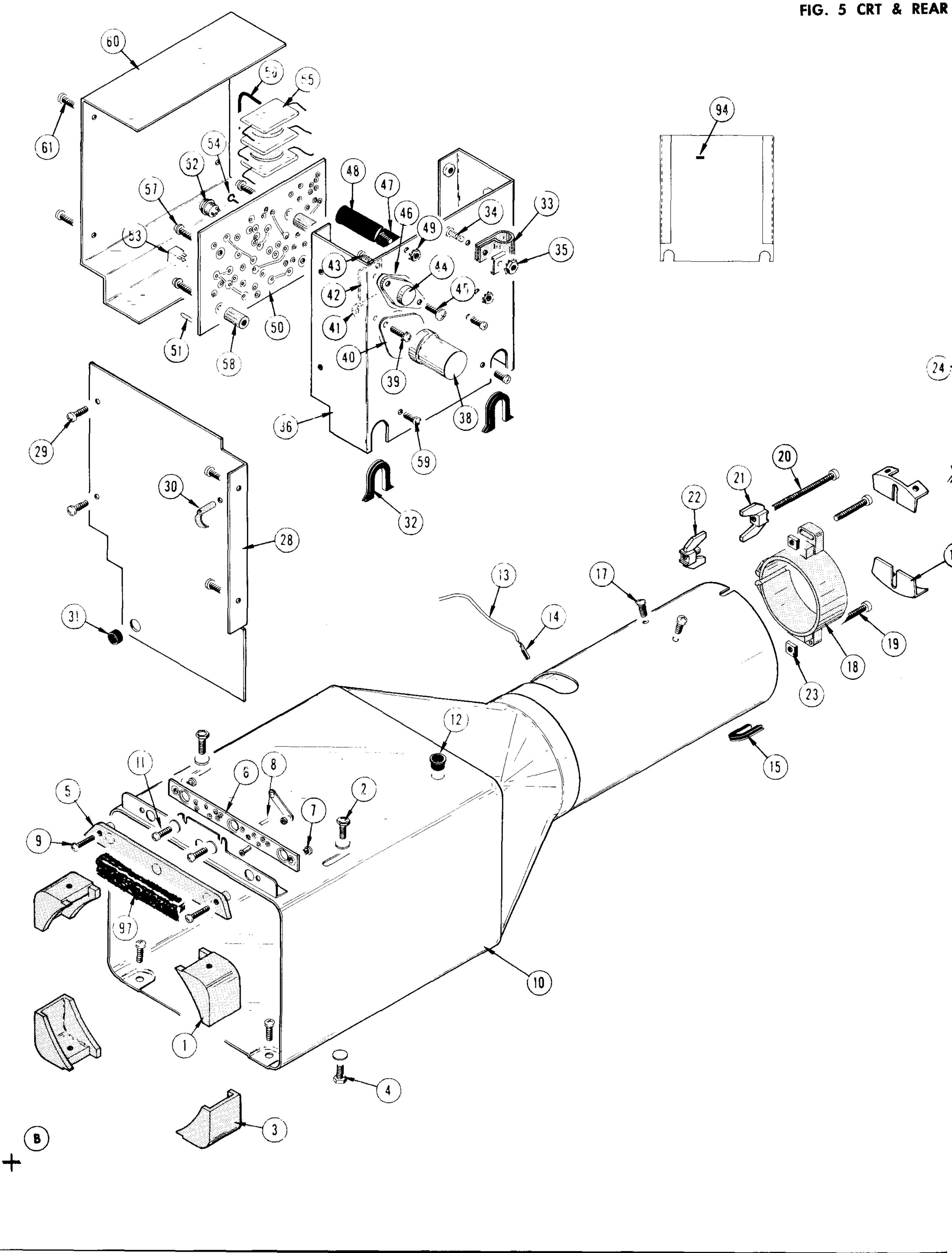
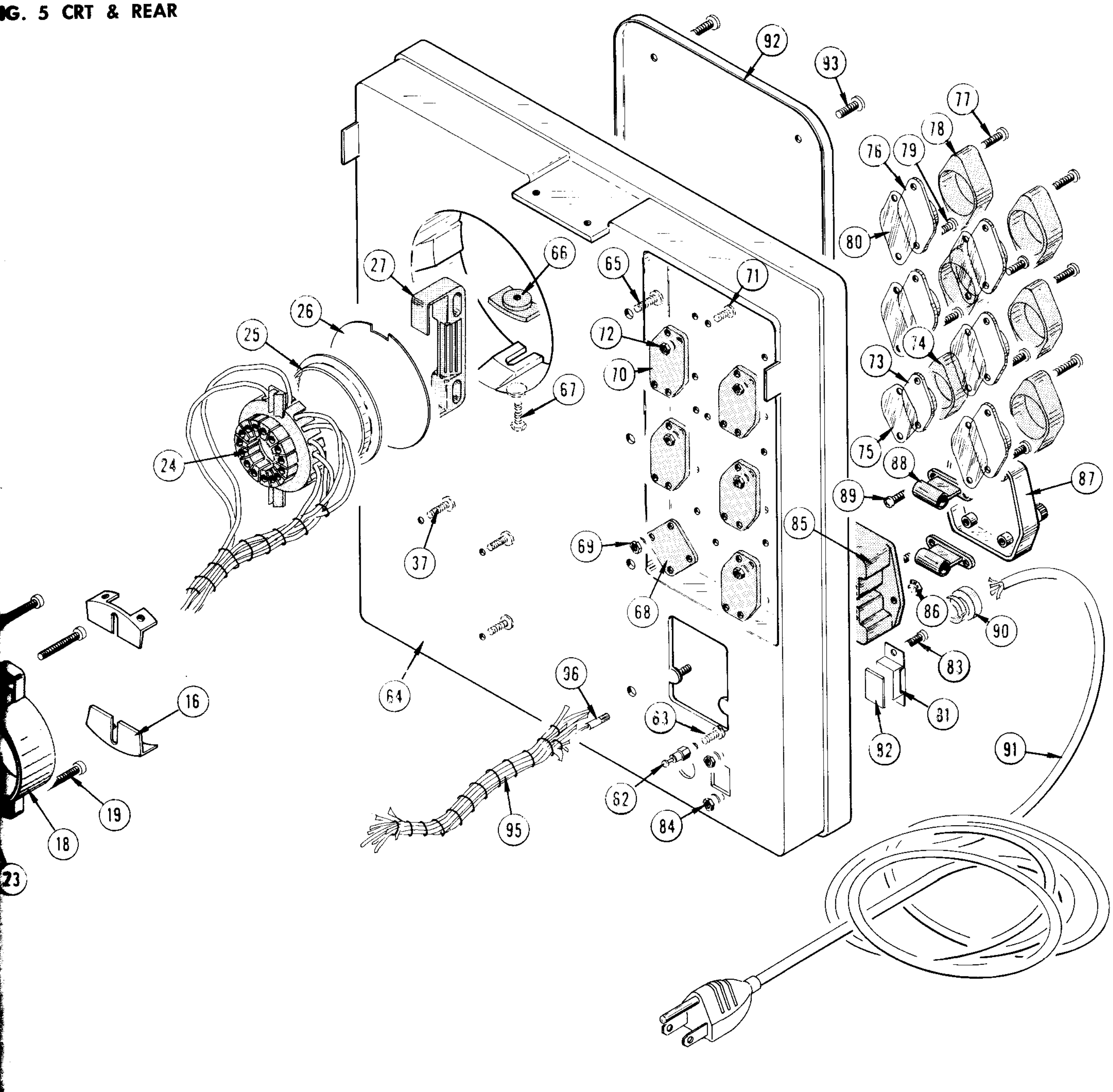
FIG. 5 CRT & REAR

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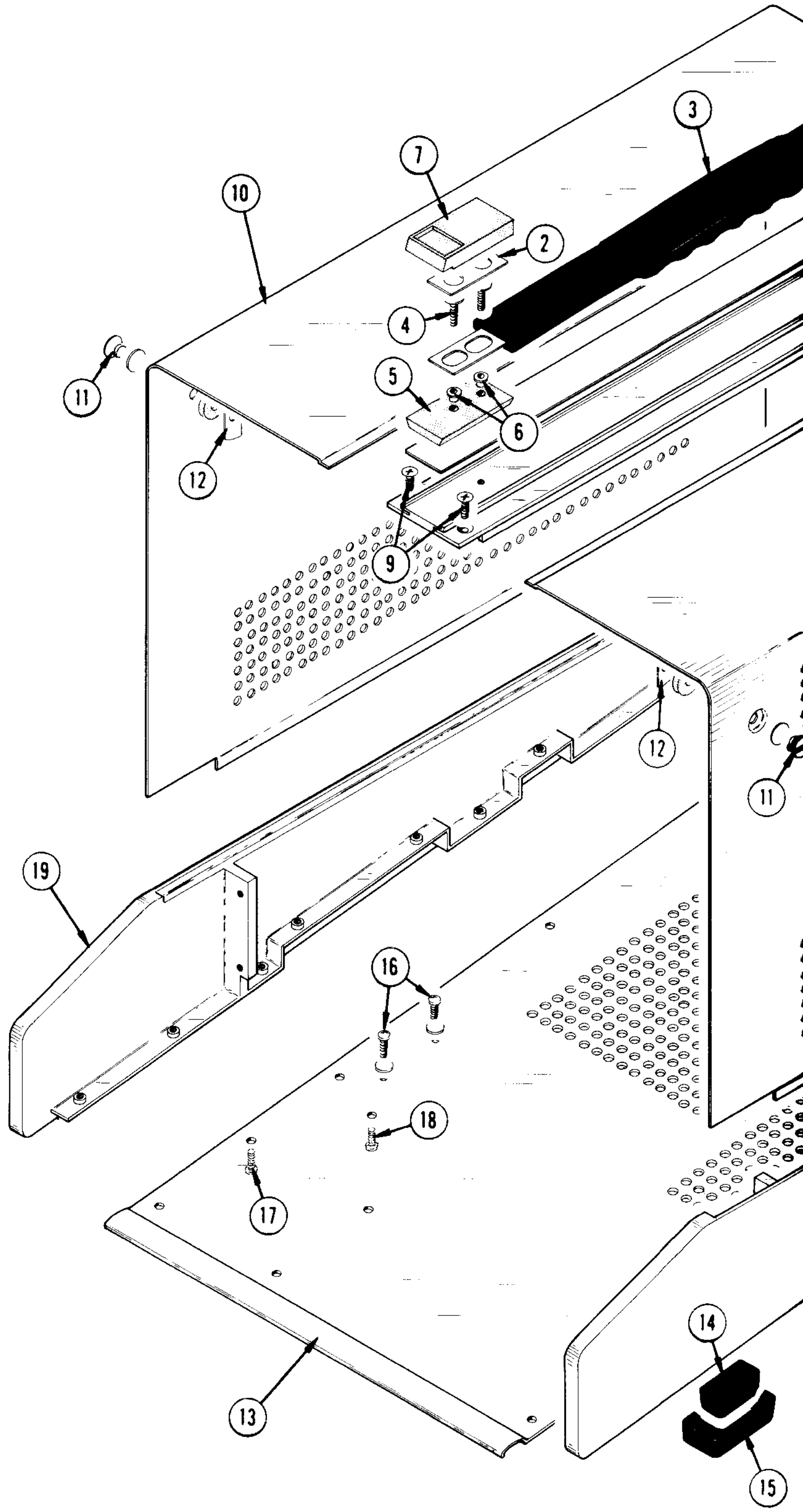
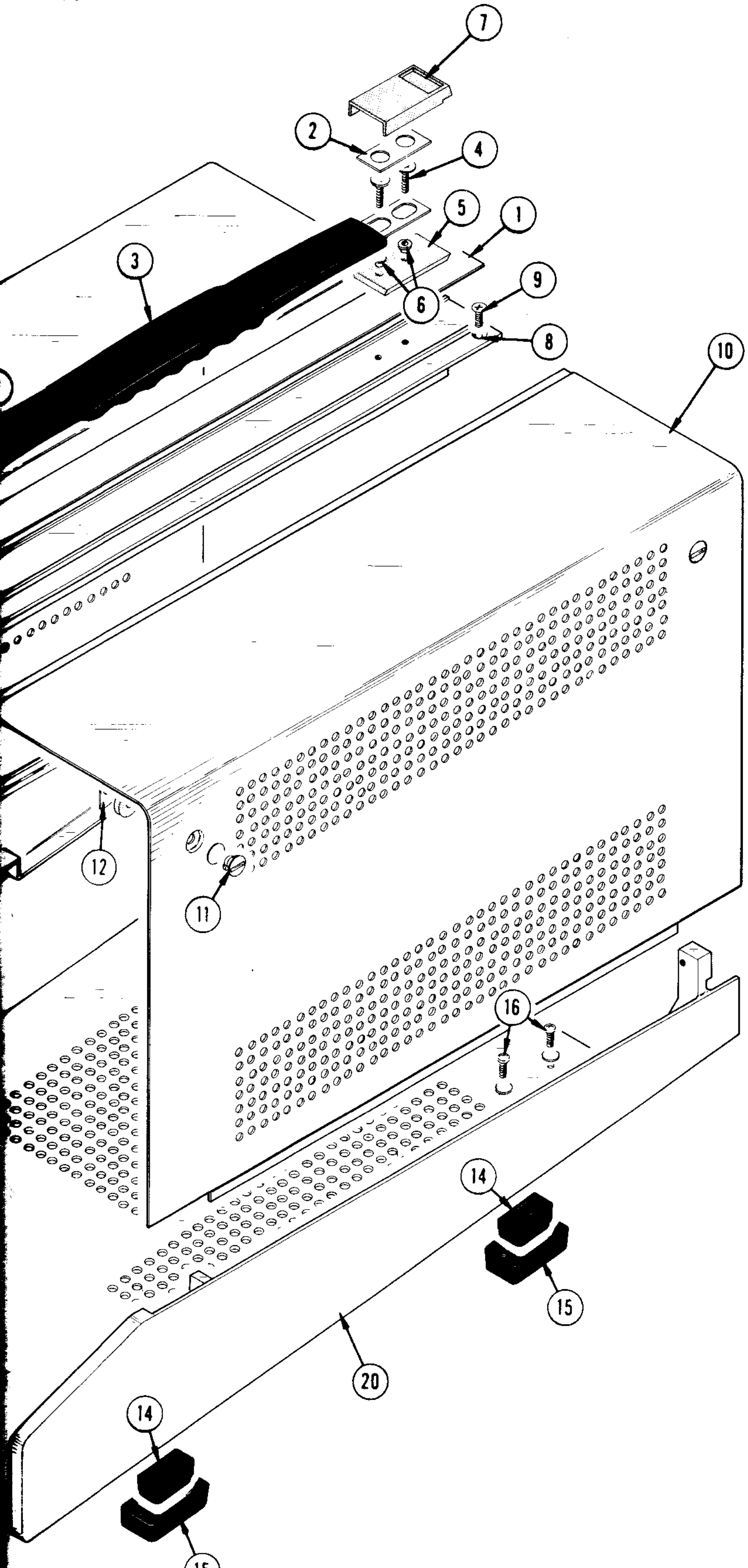


⊕(A)

FIG. 6 CABINET



OPTIONAL ACCESSORIES (not shown)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	1 2 3 4 5 Description
	013-0102-00			1	TEST ADAPTER, transistor
	013-0103-00			1	TEST ADAPTER, FET
	013-0104-00			1	TEST ADAPTER, blank

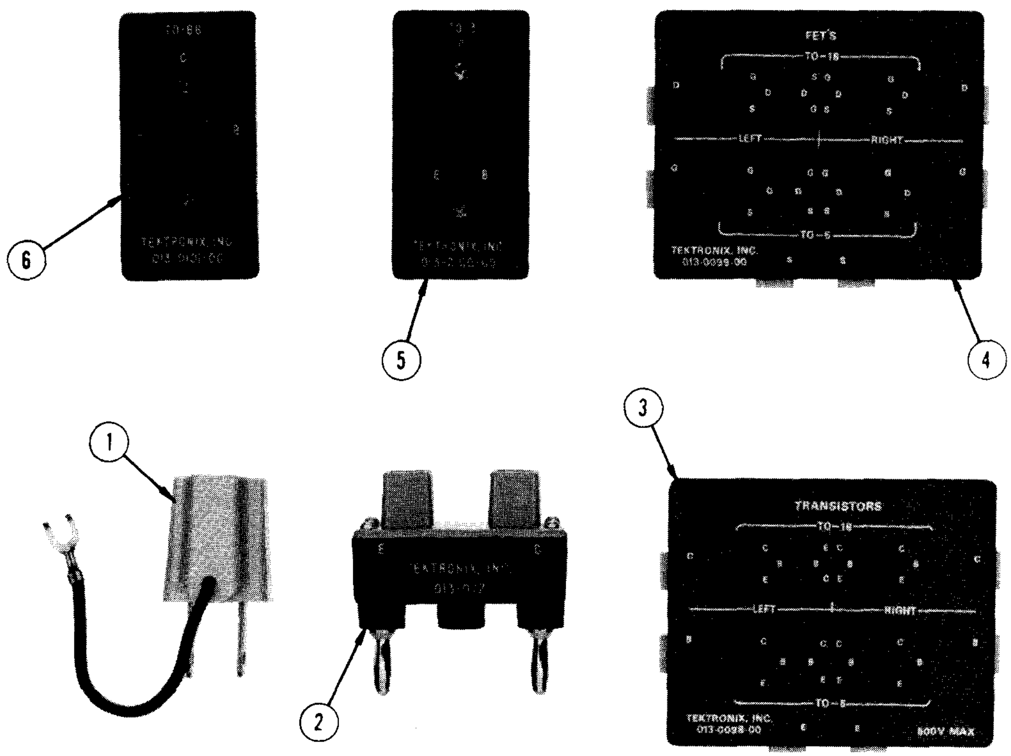
MOD 301 W

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	1 2 3 4 5 Description
	672-0405-00			1	ASSEMBLY, circuit board—READOUT (remove)
	670-0778-00			1	ASSEMBLY, circuit board—READOUT ILLUM (remove)
	386-1598-00			1	LIGHT CONDUCTOR, readout illum (remove)
	331-0230-00			1	MASK, readout (remove)
	331-0246-00			1	MASK, readout, blank (add)

(A)

Fig. & Index No.	T… P…
7-1	10
-2	01
-3	01
-4	01
-5	01
-6	01
	43
	43
	06
	07

FIG. 7 STANDARD ACCESSORIES



Ⓐ

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
7-1	103-0013-00			1	ADAPTER, power cord, 2 to 3 wire
-2	013-0072-00			2	TEST FIXTURE, diode
-3	013-0098-00			1	TEST ADAPTER, transistor
-4	013-0099-00			1	TEST ADAPTER, FET
-5	013-0100-00			2	TEST ADAPTER, transistor
-6	013-0101-00			2	TEST ADAPTER, transistor
	436-0089-00			1	TRAY, test adapter top (not shown)
	436-0090-00			1	TRAY, test adapter bottom (not shown)
	062-1009-00			1	BOOKLET, semiconductor device measurements (not shown)
	070-0905-00			2	MANUAL, instruction (not shown)

MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages.

A single change may affect several sections. Sections of the manual are often printed at different times, so some of the information on the change pages may already be in your manual. Since the change information sheets are carried in the manual until ALL changes are permanently entered, some duplication may occur. If no such change pages appear in this section, your manual is correct as printed.

ELECTRICAL PARTS LIST CORRECTION

CHANGE TO:

R27	321-0298-00	12.4 kΩ	1/8 W	Prec	1%
R28	321-0365-00	61.9 kΩ	1/8 W	Prec	1%

SCHEMATIC CORRECTIONS

CRT CIRCUIT ⟨14⟩

CHANGE: R186 to R886 and R187 to R887.

TEXT CORRECTION

Section 4   Maintenance

Page 4-41   Fig. 4-26

CHANGE: callouts 'I', 'J' and 'K' to read as follows:

'I' Grn on wht

'J' Blk-vio on wht

'K' Blk-gry on wht

TEXT CORRECTION

Section 3 Circuit Description

Page 3-3 Interlock

ADD: to the end of the second paragraph:

The COLLECTOR SUPPLY VOLTAGE DISABLED light may also be turned on if thermal cutout TK346 becomes open. TK346 opens whenever the internal heat in the instrument becomes hot enough to damage the collector supply or the readout.

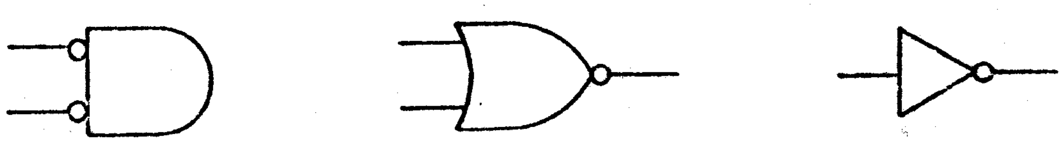
Page 3-4 Fig. 3-3

CHANGE: Callout in picture in Fig. 3-3 which reads 1F20 (75 and 350 Bypass) to read:

1F2 (75 to 350 Bypass)

Page 3-5 Fig. 3-4

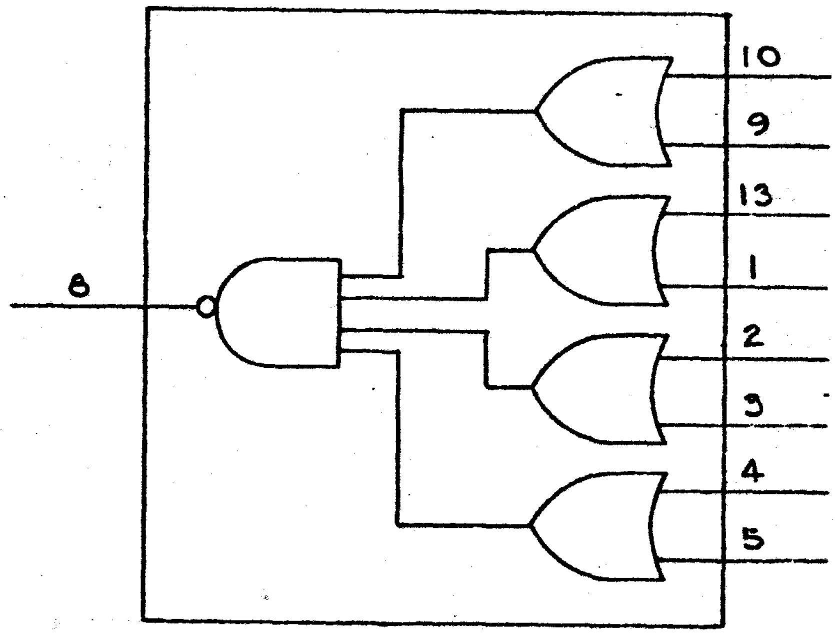
ADD: The logic symbols used to describe the operation of the clock circuit are defined as:



Negative Input AND NOR Inverter

Page 3-7 Fig. 3-5

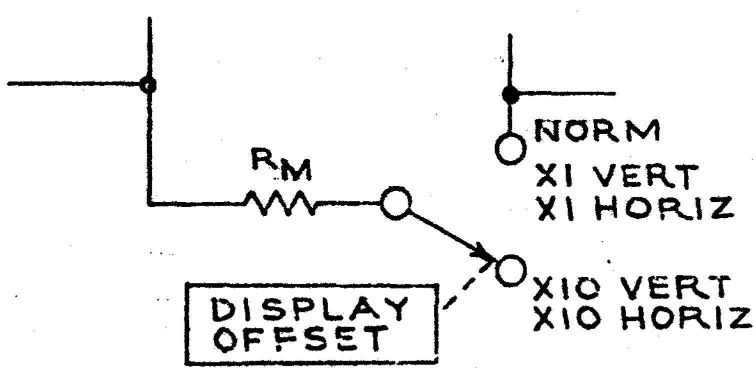
CHANGE: Internal logic diagram of U75 to:



U75

Page 3-19 Fig. 3-12

CHANGE: representation of DISPLAY OFFSET Selector switch to be:



Section 4 Maintenance

Page 4-13 Fig. 4-5

CHANGE: callout on 'B' to read:

'B' Brn on wht

Pages 4-14 through 4-17 Table 4-11

CHANGE: all references to +3 V found under Performance, False to read:

+4 V

Page 4-25 Fig. 4-10

CHANGE: figure title to read:

Fig. 4-10A. Component locations and wiring color codes on Step Gen Pulse circuit board (SN B010100 to B010129).

ADD: the following Fig. 4-10B.

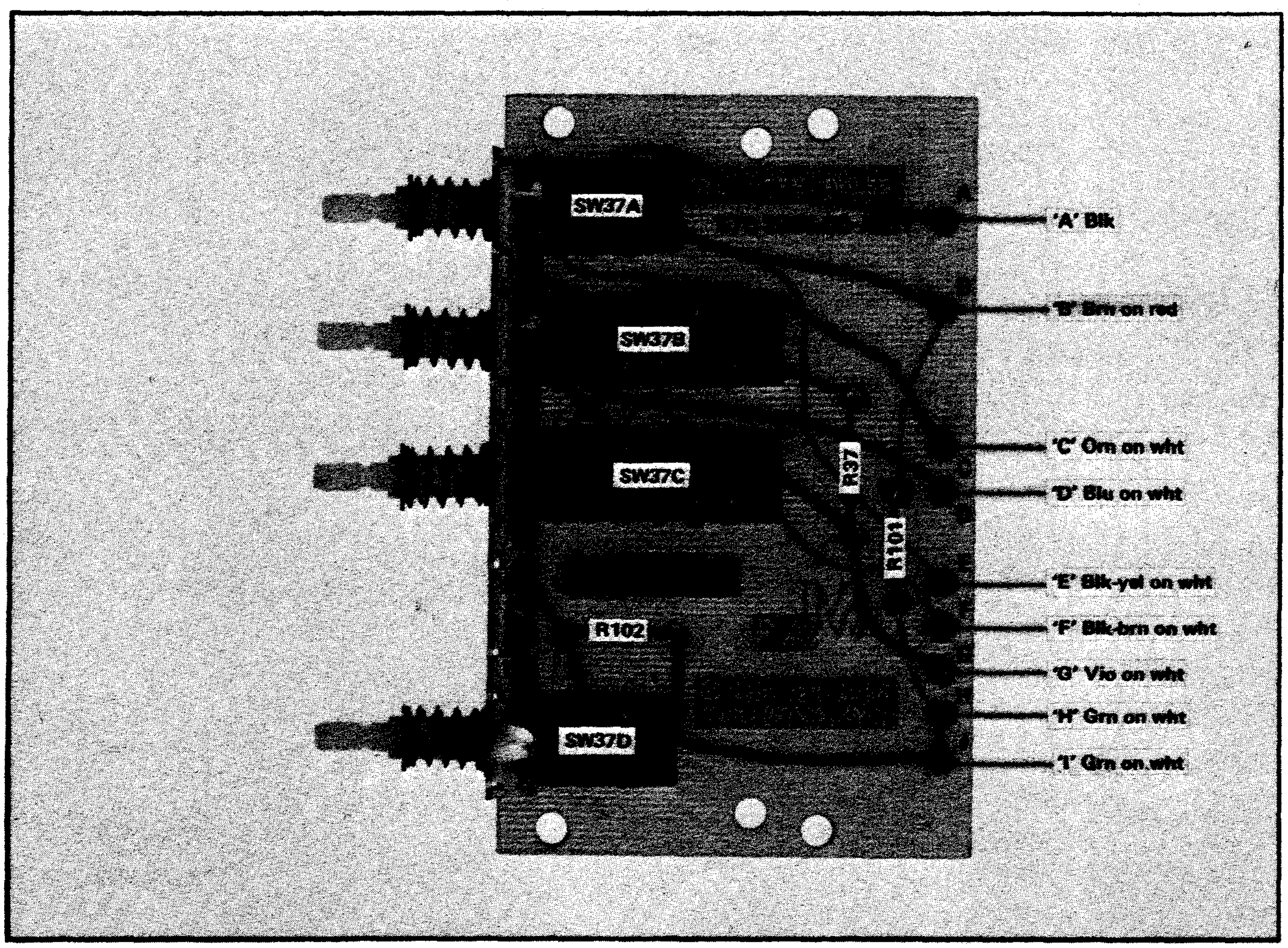


Fig. 4-10B. Component locations and wiring color codes on Step Gen Pulse circuit board (SN B010130 - up).

Page 4-27 Fig. 4-12

CHANGE: callouts on 'X' and 'T' to read:

'X' Orn on wht, 'T' Blu on wht

REMOVE: R412 and pin M.

Page 4-29 Fig. 4-14

CHANGE: callout on 'J' to read:

'J' Blk on wht

Page 4-32 Fig. 4-17

CHANGE: callouts on 'AB', 'Y', 'R' and 'Q' to read:

'AB' Blk on wht, 'Y' Brn on red, 'R' Blk-orn on wht, 'Q' Blk-yel on wht

Page 4-34 Fig. 4-19

CHANGE: callouts on 'H', 'I', 'AB' and 'AY' to read:

'H' Blk-grn on wht, 'I' Orn on wht, 'AB' Blu on wht, 'AY' Blk-yel on wht

Page 4-38 Fig. 4-23

CHANGE: callout on 'O' to read:

'O' Brn-red on vio

Page 4-39 Fig. 4-24

CHANGE: callout on 'F' to read:

'F' Brn on red

Section 5 Performance Check/Calibration

Page 5-5 Fig. 5-2

CHANGE: callout which reads Pin 'R' +5 V to read:

Pin 'Q' +5 V

TEXT CORRECTION

Section 1 Specification
Page 1-2 Step Generator Table
CHANGE TO:

Current Mode Ripple Plus Noise	0.5% or less of AMPLITUDE switch setting or 1 nA, peak to peak.

TEXT CORRECTION

Section 1 Specification

Page 1-2 Column 2

CHANGE TO:

Voltage Mode Maximum Opposing Current	Limited between 5 mA and 20 mA

TEXT CORRECTION

REPLACE: the present Fig. 4-13 with the one below:

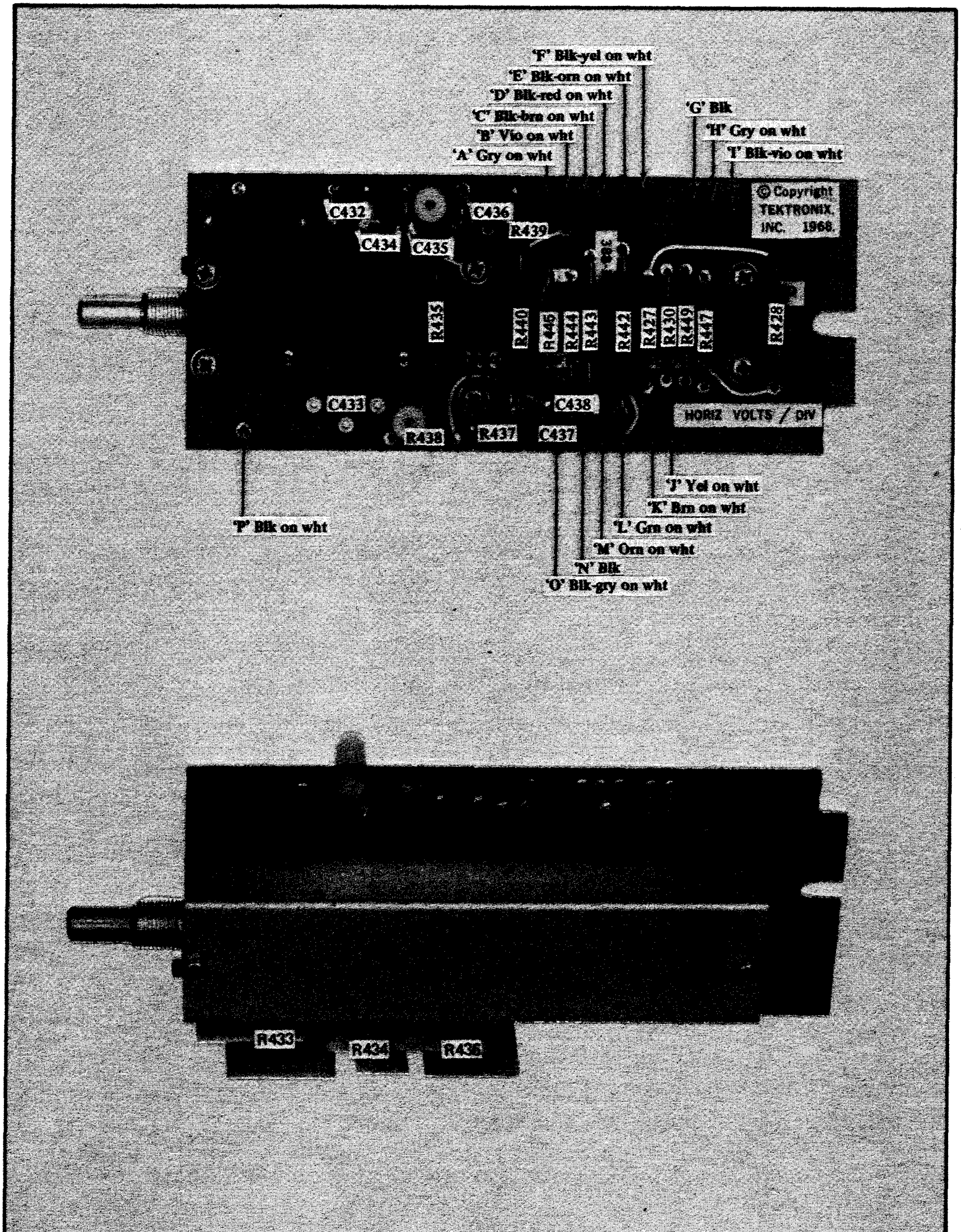


Fig. 4-13. Component locations and wiring color codes on Horiz Volts/Div circuit board. (SN B091250-up)

ELECTRICAL PARTS LIST AND SCHEMATIC CORRECTIONS

CHANGE:

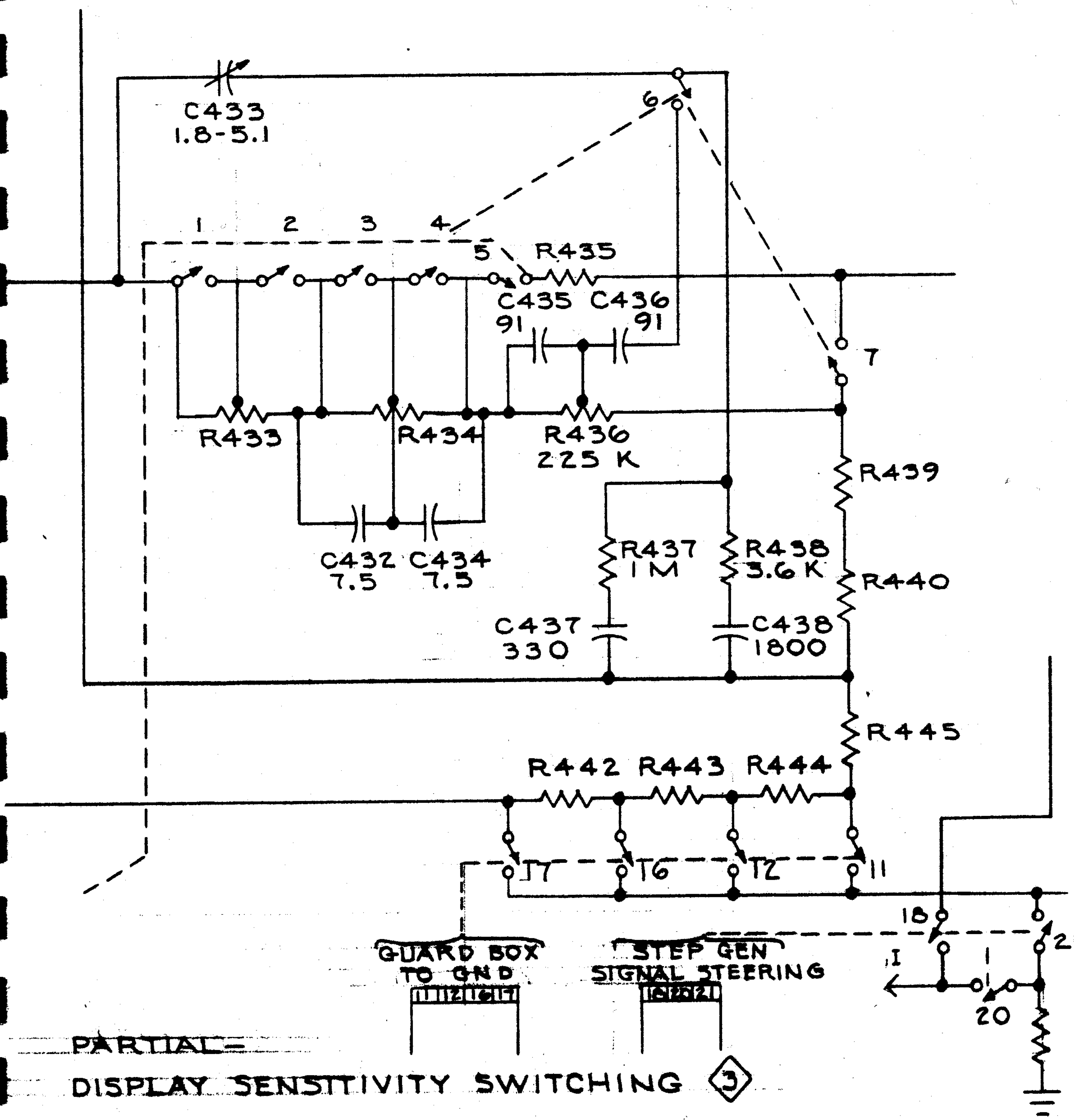
C433	281-0159-00	1.8-5.1 pF, Var			
C434	281-0601-00	7.5 pF	Cer	500 V	
C436	281-0637-00	91 pF	Cer	500 V	
R436	312-0661-00	225 kΩ	matched pair		
R437	301-0105-00	1 MΩ	1/2 W		5%
R438	301-0362-00	3.6 kΩ	1/2 W		5%
SW430	670-1027-01	Cam	HORIZONTAL VOLTS/DIV		

ADD:

C432	281-0601-00	7.5 pF	Cer	500 V
C435	281-0637-00	91 pF	Cer	500 V
C437	281-0546-00	330 pF	Cer	500 V
C438	283-0626-00	1800 pF	Mica	500 V

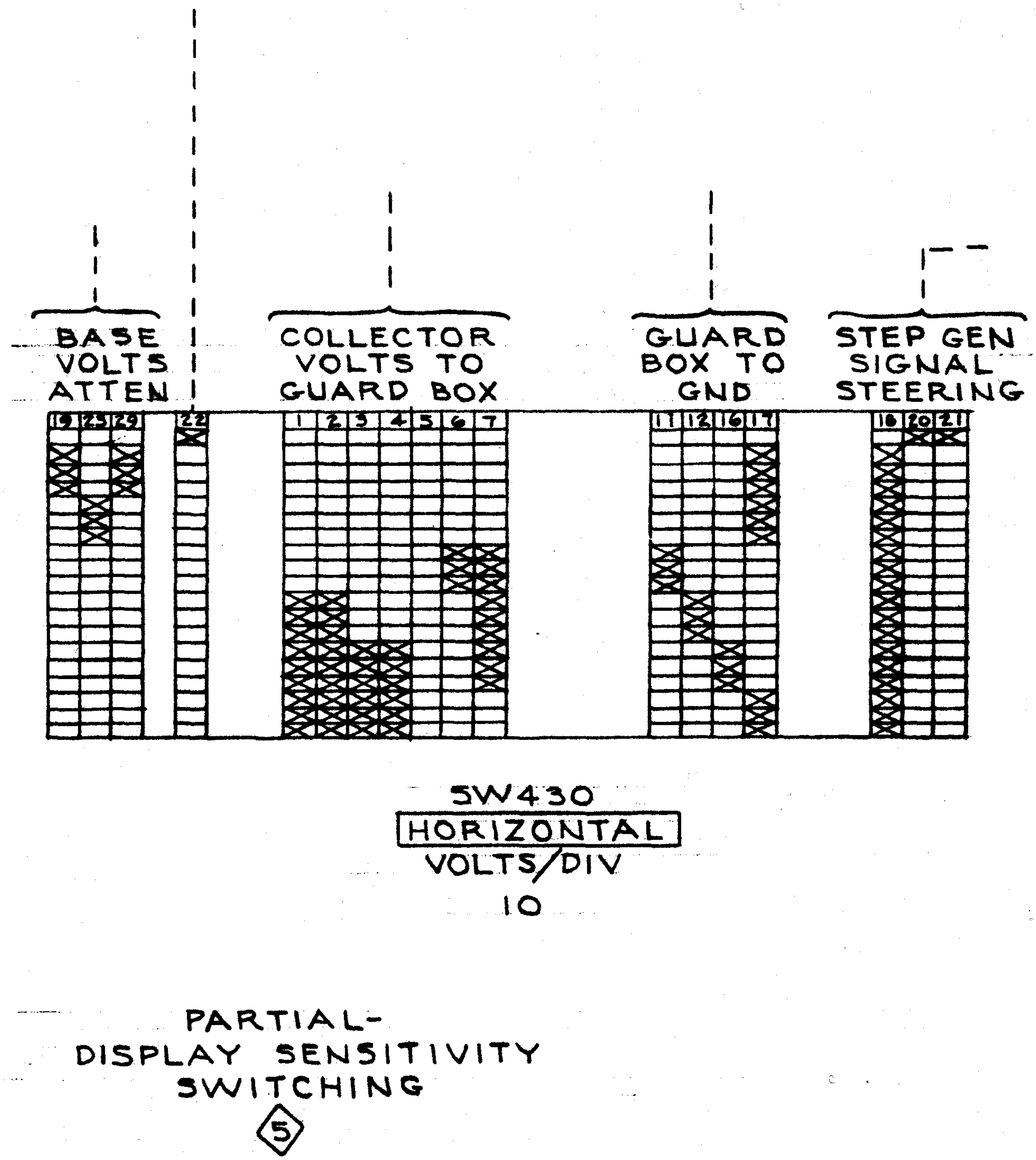
Readout Switching & Interconnections ⟨10⟩

CHANGE: The cams which are operating contacts A, B, D, E, F and C on the HORIZ VOLTS/DIV circuit board have been changed from 11, 12, 16, 17, 18, 13 to 8, 9, 13, 14, 15 and 10 respectively.



PARTIAL–
DISPLAY SENSTTIVITY SWITCHING ③

SCHEMATIC CORRECTION



TYPE 576 TENT SN B091240

ELECTRICAL PARTS LIST CORRECTION

CHANGE TO:

R860	321-0337-00	31.6 kΩ	1/8 W	Prec	1%
R862	323-0385-00	100 kΩ	1/2 W	Prec	1%
T850	120-0612-02		H. V. Power		

M15,592/1069

ELECTRICAL PARTS LIST CORRECTION

READOUT CIRCUIT CARD ASSEMBLY

CHANGE: the description for all the Bulbs to read:

150-0048-01	Incandescent, #638, 5V	Model 5-up

TYPE 576 TENT SN B081240

ELECTRICAL PARTS LIST CORRECTION

CHANGE TO:

C1	283-0203-00	0.47 µF	Cer	50 V
C10	283-0203-00	0.47 µF	Cer	50 V

M15.624/969

TYPE 576   TENT SN B131870

ELECTRICAL PARTS LIST CORRECTION

CHANGE TO:

K323	148-0047-00	Relay, Armature

M16,026/270