INSTRUCTION MANUAL

Serial Number ____________

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172 PROGRAMMABLE TEST FIXTURE

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

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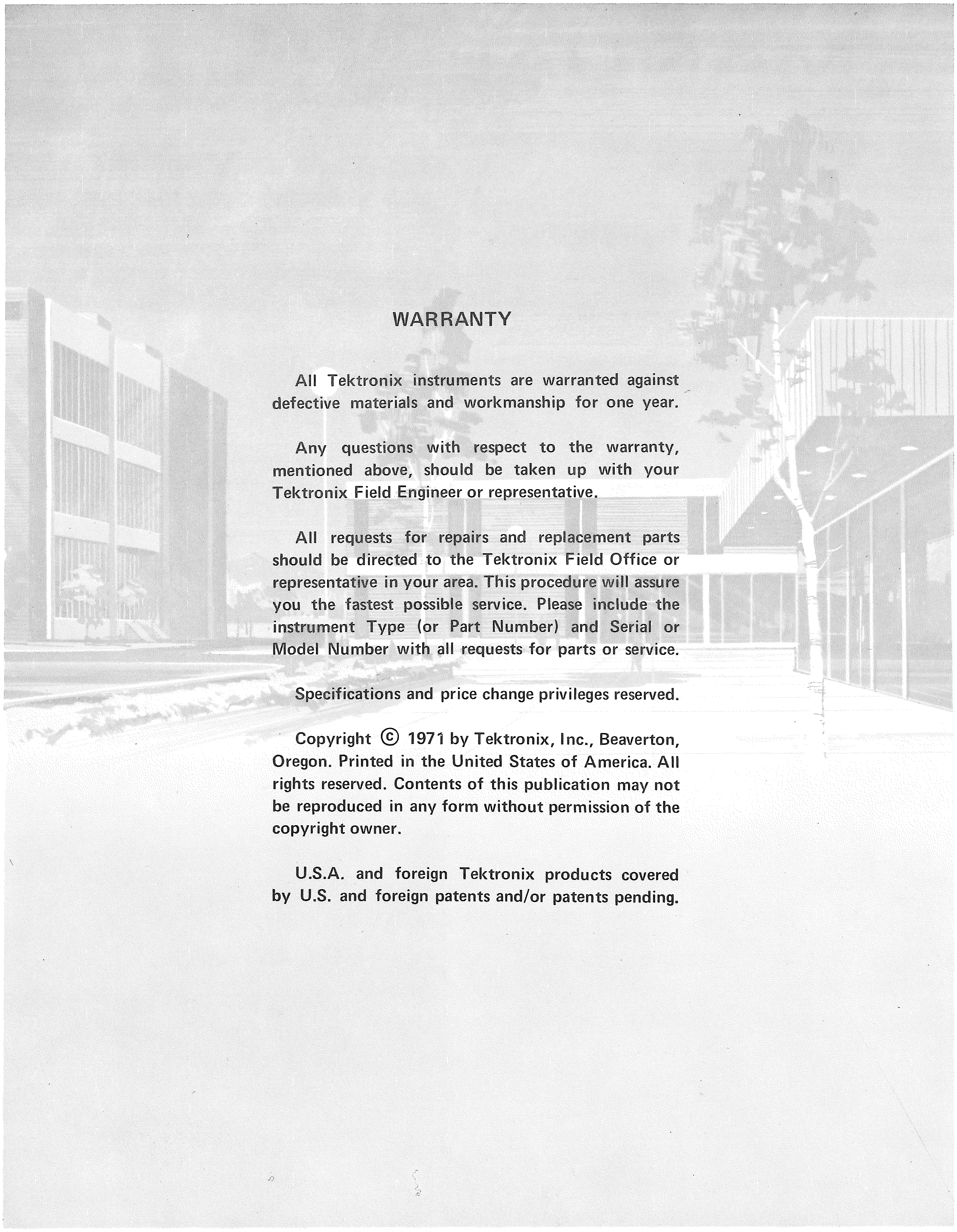

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Any questions with respect to the warranty, mentioned above, should be taken up with your Tektronix Field Engineer or representative.

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Fig. 1-1. 172 Programmable Test Fixture

SECTION 1
SPECIFICATION

Introduction

The 172 Programmable Test Fixture is used with the Type 576 Curve Tracer. It may be programmed to perform up to eleven different transistor, JFET, or diode tests without manipulating any of the controls. The 172 advances from test to test, either automatically or manually. The AUTOMATIC test rate is set by the variable RATE control; it is adjustable from 0.3 Sec/test to 2.0 Sec/test. When the AUTO-MANUAL switch is in MANUAL, the test sequence is advanced by pressing the ADVANCE button or the optional foot switch. A row of eleven lamps shows which test is being performed.

CAUTION

Special care should be taken not to exceed 10A from the Type 576 during tests 1 and 2, to avoid damaging the Type 576. MOSFETS should not be checked with the 172. The 172 switching transients can destroy MOSFETS.

TABLE 1-1

ELECTRICAL CHARACTERISTICS

The following characteristics are valid for instruments operated at an ambient temperature between +10°C and +40°C after a warmup period of 5 minutes.

The Display Amplifier specifications are for the combination of the 172 attenuators and the Type 576 display amplifiers, since the Type 576 is used as the readout for the 172.

Display Accuracies (% of Highest On-Screen Value)	Offset and Magnified, with centerline value from:			NORM, Unmagnified
	100 to 40 Div	35 to 15 Div	10 to 0 Div	
Normal Display Modes				
Vertical Current	2%	3%	4%	3%
Horizontal Base Volts	2%	3%	4%	3%
Horizontal Volts	2%	3%	4%	3%

TABLE 1-1 (cont)

Leakage Display Modes	100 to 40 Div	35 to 15 Div	10 to 0 Div	NORM Unmagnified
Vertical CURRENT				
10 nA to 0.5 A/Div				3% ±1 nA
1 nA to 50 mA/Div (Magnified)	2% ±1 nA	3% ±1 nA	4% ±1 nA	
5, 2, & 1 nA/Div				5% ±1 nA
Horizontal Volts (Vertical CURRENT of 1 μA/Div or more)	2%	3%	4%	3%

Horizontal Volts With Vertical CURRENT of	
100, 10, or 1 nA/Div	3% plus 0.025 V for each vertical division in NORM, unmagnified mode
200, 20, or 2 nA/Div	3% plus 0.050 V for each vertical division in NORM, unmagnified mode
500, 50, or 5 nA/Div	3% plus 0.125 V for each vertical division in NORM, unmagnified mode
Deflection Factor	
Vertical	
Test 1 (Collector or Emitter Current)	I_c; 1 μA to 2 A/div in 20 steps (1, 2, 5 sequence) I_e: 1 nA to 2 mA/div in 20 steps (1, 2, 5 sequence)

TABLE 1-1 (cont)

Test 2 (Collector Current)	I_C: 1 μA/div to 2 A/div in 17 steps (1, 2, 5 sequence)
Tests 3, 4, and 8 through 11 (Collector or Breakdown Current)	1 μA to 0.5 A/div in 18 steps (1, 2, 5 sequence)
Tests 5 through 7 (Leakage Current)	1 nA to 0.5 A/div in 27 steps (1, 2, 5 sequence)
Horizontal	
Test 1	0.05 V/div to 200 V/div in 12 steps (1, 2, 5 sequence)
Test 2 (Base Voltage)	100 mV/div to 2 V/div in 5 steps (1, 2, 5 sequence)
Input Z	At least 100 MΩ at 100 mV/div and 200 mV/div, 1 MΩ (within 2%) at 0.5 V/div, 1 V/div, and 2 V/div
Tests 3 and 4 (Collector Voltage)	100 mV/div to 2 V/div in 5 steps (1, 2, 5 sequence)
Tests 5 through 11 (Breakdown or Leakage Voltage)	100 mV/div to 50 V/div in 9 steps (1, 2, 5 sequence)

TABLE 1-1 (cont)

Voltage and Current Sources	
Collector Sweep Voltage at Low Line	
100 mV/Div to 200 mV/Div	At least 2 V open circuit, or 1.5 A short circuit
500 mV/Div	At least 5 V open circuit, or 2 A short circuit
1 V/Div to 2 V/Div	At least 20 V open circuit, or 150 mA short circuit
Test Display Time (Automatic)	
Range	At least 400 ms to 1.5 s
Current Supply	
0.1 μA to 11 mA	Within 2% ±30 nA ±1/50 of the least significant program pin (i.e., 1/50 of 0.1) with up to 500 V compliance.
10 mA to 110 mA	Within 2% ±1/50 of the least significant program pin (i.e., 1/50 of 0.1) with up to 50 V compliance.
Voltage Supply	
1 V to 500 V	Within 3% ±300 mV with at least 0.5 mA compliance

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TABLE 1-2

Test Number	Tests That Can Be Performed On:			Limitations
	Transistors	FET's	Diodes	
1	[1] H_{FE}, V_{CE}(sat)	[1] V_P	[1] V_F	MAX PEAK VOLTS has no 1500 V range
2	V_{BE}			Horizontal D.F. range is 100 mV/div to 2 V/div. (Other test conditions are the same as Test 1)
3	H_{FE}, V_{CE}(sat)	I_{DSS}, R_{DS}(on)		Base Drive: 100 nA to 110 mA Collector Sweep: 2 V to 20 V peak Vert. D.F.: 1 µA/div to 0.5 A/div Horiz. D.F.: 0.1 V/div to 2 V/div
4	Same as 3			
5	I_{CEO} or I_{CES}, I_{CER} with external short or resistor			Voltage Supply: 1 V to 500 VDC Vert. D.F.: 1 nA/div to 0.5 A/div Horiz. D.F.: 0.1 V/div to 50 V/div
6	I_{CBO}	I_{GSS}		Same as 5
7	I_{EBO}		I_R	Same as 5
8	BV_{CEO} or BV_{CER} with external resistor		V_F	Current Supply: 100 nA to 110 mA DC Vert. D.F.: 1 µA/div to 0.5 A/div Horiz. D.F.; 0.1 V/div to 50 V/div
9	BV_{CES}			Same as 8
10	BV_{CBO}	BV_{GSS}		Same as 8
11	BV_{EBO}		V_R	Same as 8

[1] These are the usual tests performed because of the higher current capability and pulse mode operation. However, other tests could be performed as well.

TABLE 1-3

ENVIRONMENTAL CHARACTERISTICS

Temperature	
Storage	−40°C to +65°C
Operating	+10°C to +40°C
Altitude	
Storage	To 50,000 feet
Operating	To 10,000 feet
Transportation	Qualified under National Safe Transit Committee Test Procedure 1A

TABLE 1-4

MECHANICAL CHARACTERISTICS

Dimensions	
Height (with cover)	6 1/2 inches
Width	7 3/4 inches
Depth	12 3/8 inches
Weight	
Net	11.5 pounds
Domestic Shipping	16.0 pounds
Export Packed	23.0 pounds

NOTES

SECTION 2
OPERATING INSTRUCTIONS

General Information

This section discusses Installation; Function of controls, connectors, and indicators; Programming the 172; First-time operation of the 172; and use of the Limit Cards.

Installation

Turn off the Type 576 Power switch. Loosen the retainer capscrews on the Type 576 standard test fixture. Install the 172 in place of the standard test fixture, and secure the retainer capscrews.

Function of Controls, Connectors, and Indicators

LEFT-OFF-RIGHT Switch. Selects device to be tested; left or right.

AUTO-MANUAL Switch. Chooses automatic or manual sequencing of the programmed tests.

ADVANCE Switch. Starts the test cycle, or advances the 172 to the next programmed test. The choice is made by the AUTO-MANUAL switch.

RATE Control. Adjusts the display time of each programmed test when the 172 is in the AUTO mode.

Foot Switch Connector. Allows connection of optional foot switch which provides the same function as the ADVANCE switch.

Yellow Indicator. Indicates that the high-voltage supply is disabled.

Red Indicator/Switch. Indicates high-voltage supply is enabled and dangerous voltage may appear at device terminals. Depressing the switch enables the high voltage supply.

Test Indicators. Indicates which test (1 through 11) is being performed.

BASE and EMITTER TERMINALS (TEST 5). Provides means of connecting a resistor (or short) between base and emitter for I_{CES} or I_{CER} tests.

GND Connector. Provides external access to ground reference.

BASE TERM (Test 8). Provides means of connecting a resistor from the base to ground for BV_{CER} tests.

Device Testing 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. Sensing terminals allow Kelvin sensing of voltage on the emitter and collector terminals.

PROGRAMMING

General

The 172 is programmed by use of a plastic programming card (Fig. 2-1). Specific parameters for testing a device are programmed by putting plastic programming pins in the programming card holes.

When the programming card is programmed as desired, the card is put in the card reader (Fig. 2-2). The card reader cover is then closed. Pressure from the card reader cover actuates the switch matrix via the programming pins, establishing a test program.

Specific

The 172 programming card has five distinct areas:

1. The test selection holes.
2. The drive programming holes.
3. Horizontal deflection factor.
4. Vertical deflection factor.
5. JFET or diode selection.

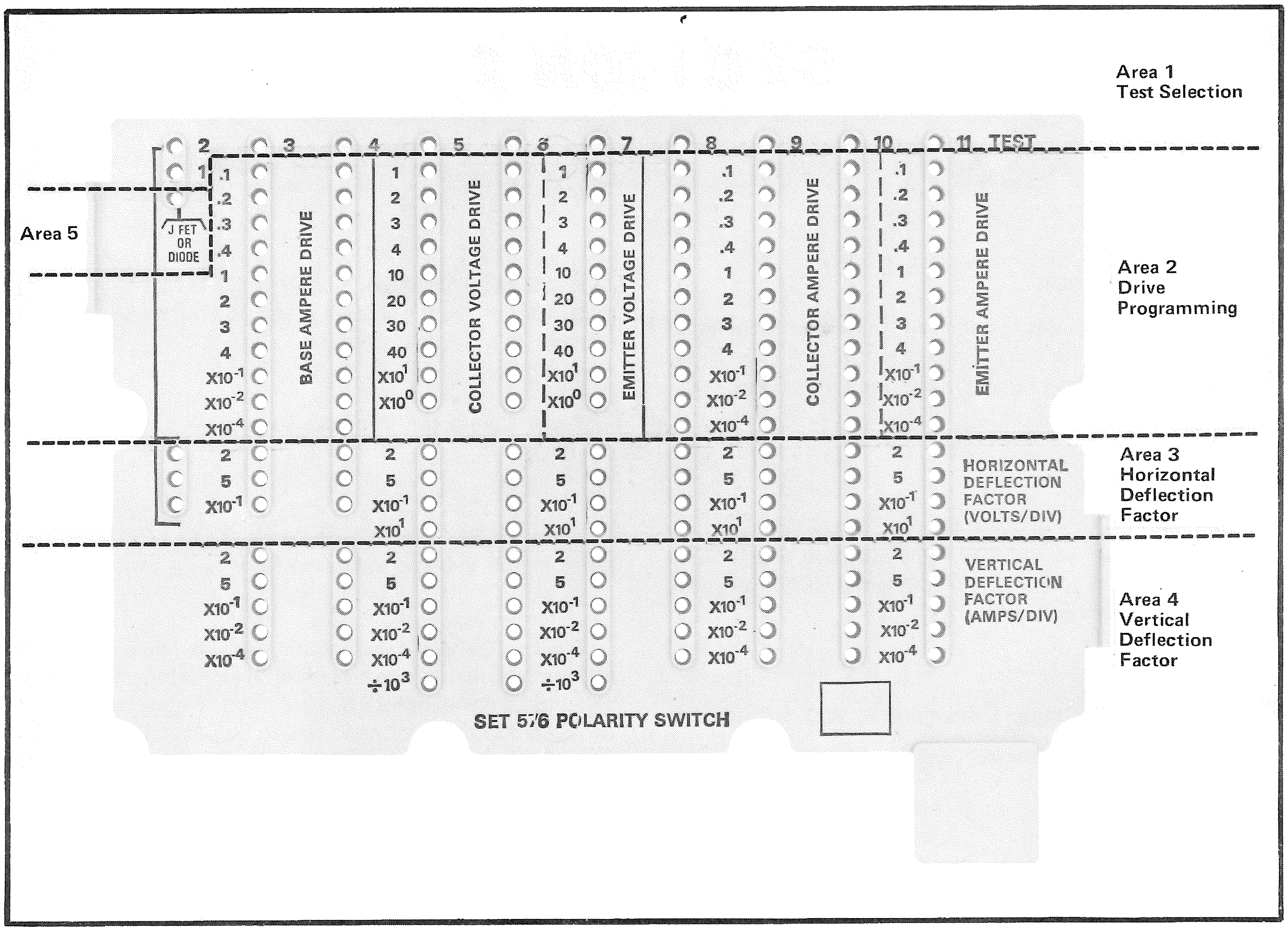

Fig. 2-1. 172 Programming card and its program areas.

Figure 2-1 illustrates the five programming card areas.

Each of the eleven possible tests is included in a test sequence by placing a programming pin in the appropriate test hole (Area 1, Fig. 2-1). Omitting a programming pin from a test hole excludes that particular test from the test sequence.

Tests 1 and 2 use the Type 576 to drive the device under test (DUT). Test parameters are set by the Type 576 front panel controls.

The remaining tests (3-11) use a DUT drive current or voltage furnished by the 172. A specific drive value is selected by the program pins in area 2. Both a characteristic and a multiplier must be programmed in the drive area. Any combination of characteristic value may be chosen, but greater accuracy is afforded by the larger digits. The multiplier may be any value from 10^{-2} through 10^{-6}, for AMPERE DRIVE (tests 3, 4, and 8-11). For VOLTAGE DRIVE (tests 5, 6, and 7), the multiplier values are 10^{-1} or 10^{0}.

Area 3 programming holes set the horizontal deflection factor. The 2 and 5 values should not be simultaneously programmed. When neither 2 nor 5 is programmed, the horizontal deflection value is 1. If neither 10^{-1} nor 10^{1} is programmed, the value is 10^{0} or 1. Therefore, if a test has no pins in the horizontal deflection factor programming holes, the horizontal deflection factor is 1 V/div.

Area 4 programming holes determine the vertical deflection factor. As for the horizontal deflection factor, the 2 and 5 should not be simultaneously programmed, and when neither 2 nor 5 is programmed, a 1 is the vertical deflection multiplier (VDM). The VDM has a range of 10^{-1} to 10^{-6}, programmed by combinations of 10^{-1}, 10^{-2}, and 10^{-4}. Tests 5, 6, and 7 also provide a 10^{3} exponent. To program vertical sensitivity of 10^{-7}, 10^{-8}, or 10^{-9} for tests 5, 6, and 7, $\div 10^{3}$ should be used with the other appropriate exponents. The $\div 10^{3}$ programming hole is not used alone, so if 10^{-3} is desired, 10^{-1} and 10^{-2} should be programmed, not $\div 10^{3}$.

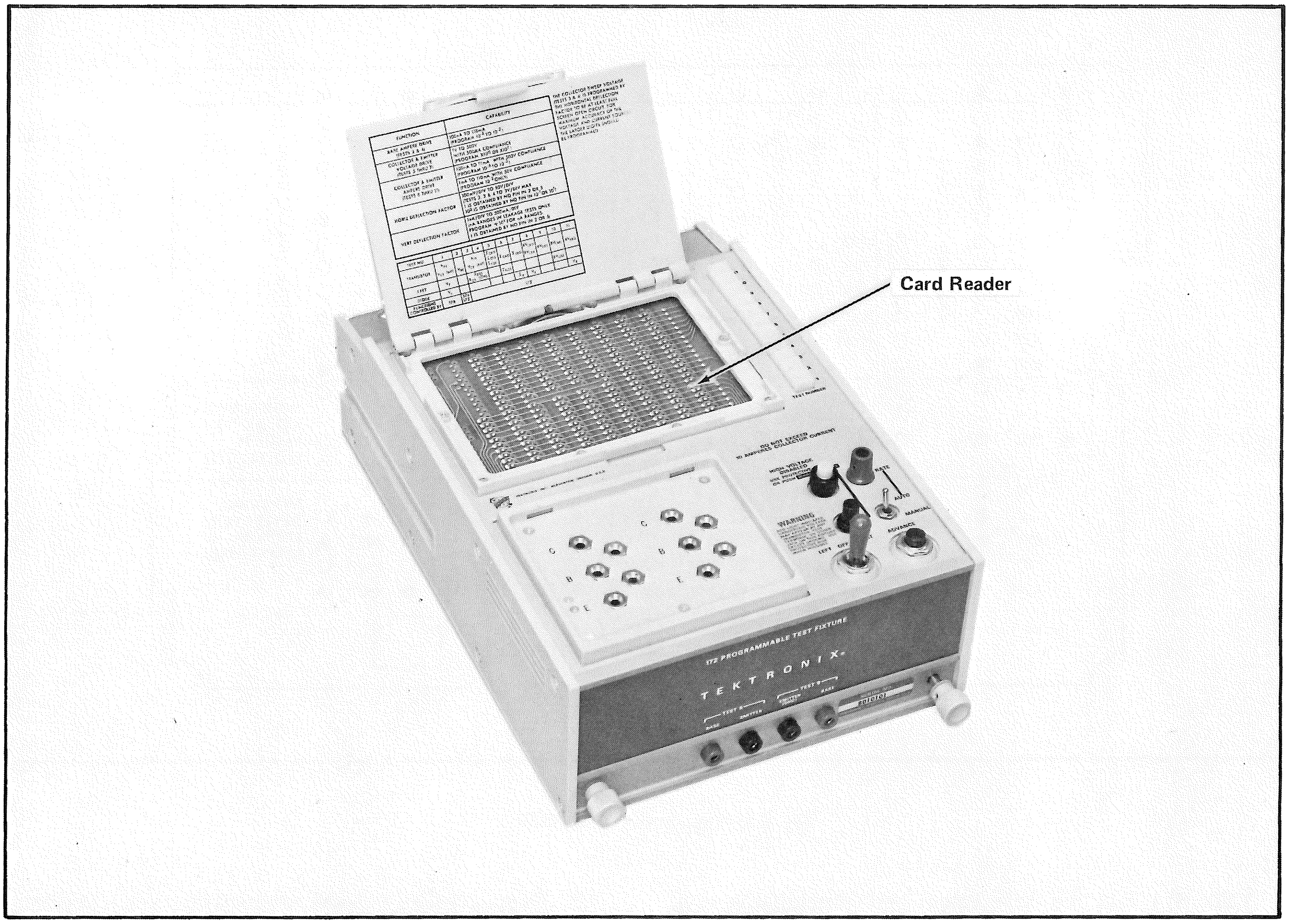

Fig. 2-2. 172 Card Reader

172 FIRST TIME OPERATION

A sample bipolar transistor test sequence will be programmed and illustrated here. The transistor is an NPN silicon device (2N4275) with parameters as follows:

V_{CE} (sat)	0.2 V max	I_C = 10 mA I_b = 1 mA
V_{BE} (sat)	0.85 V max	I_C = 10 mA I_b = 1 mA
H_{FE}	35 min	I_C = 10 mA, V_{CE} = 1 V
I_{CES}	0.4 μA max	V_{CE} = 20 V
BV_{CES}	40 V min	I_C = 10 μA
BV_{CBO}	40 V min	I_C = 10 μA
BV_{EBO}	4.5 V min	I_E = 10 μA

Test numbers 1, 2, 3, 5, 9, 10, and 11 [V_{CE}(sat), V_{BE}(sat), H_{FE}, I_{CES}, BV_{CES}, BV_{CBO}, BV_{EBO}] will test these parameters.

Set the Type 576 and 172 controls as follows:

VERTICAL	2 mA COLLECTOR
HORIZONTAL	0.1 V COLLECTOR
STEP GENERATOR AMPLITUDE	1 mA
VARIABLE COLLECTOR SUPPLY	CCW
MODE	NORM
POLARITY	+(NPN)
MAX PEAK VOLTS	15
NUMBER OF STEPS	1
OFFSET	0
SERIES RESISTORS	0.3
LEFT-OFF-RIGHT	RIGHT
AUTO-MANUAL	MANUAL
TEST 5 [BASE-EMITTER]	Shorted

Figure 2-3 shows the programming for tests 2, 3, 5, 9, 10, and 11.

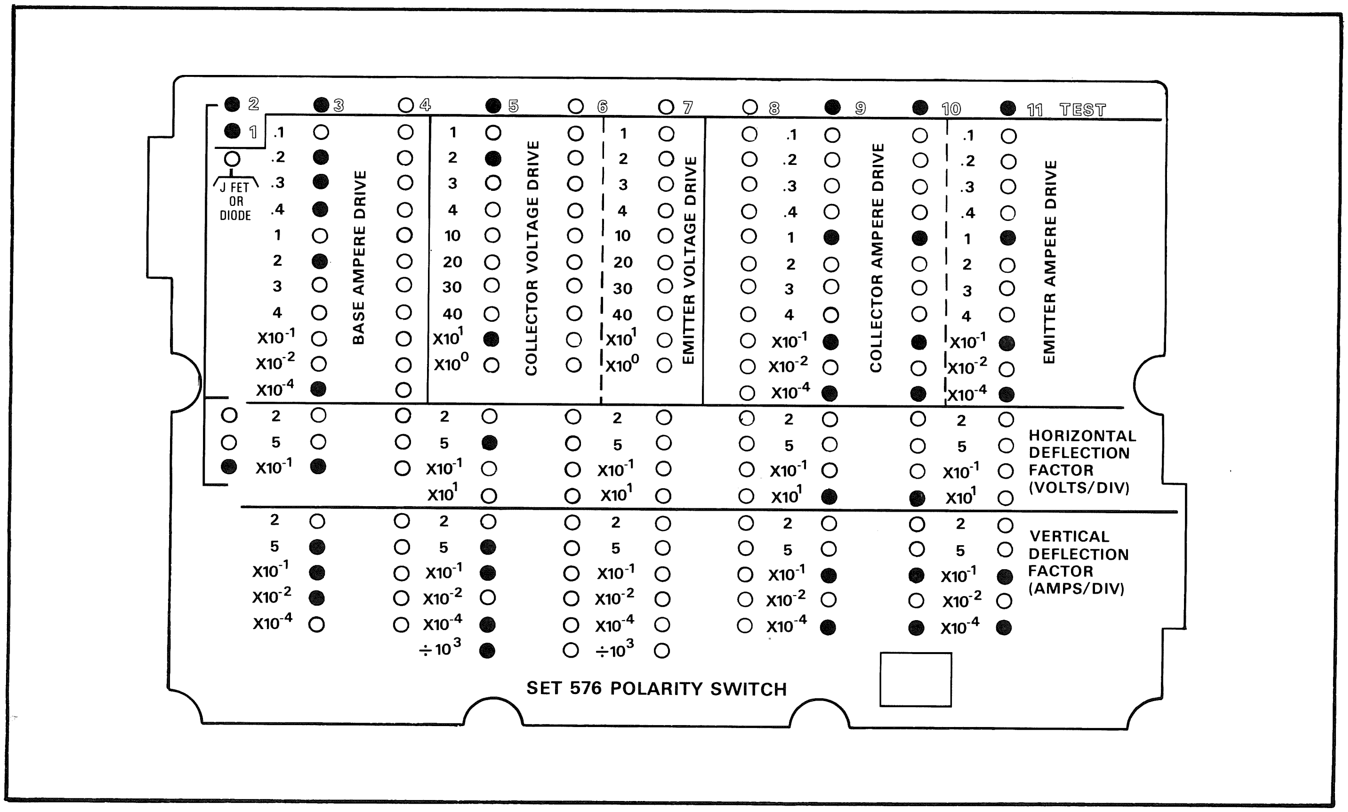

Fig. 2-3. Program to test 2N4275

Table 2-1 lists the drive values and horizontal/vertical sensitivities programmed for this test sequence. Drives are the magnitudes called for in the 2N4275 specification sheet (listed previously).

TABLE 2-1

Test Number	Drive	Horiz. Sens.	Vert. Sens.
2	— — —	100 mV/div	— — —
3	0.29 mA	100 mV/div	5 mA/div
5	20 V	5 V/div	50 nA/div
9	10 μA	10 V/div	10 μA/div
10	10 μA	10 V/div	10 μA/div
11	10 μA	1 V/div	10 μA/div

1. Put the programming card in the 172 card reader and close the card reader lid.

2. Install a transistor adapter (Tektronix Part No. 013-0098-00) and a protective cover (Tektronix Part No. 337-1194-00) in the 172.

3. Plug a 2N4275 into the adapter (right side), and close the lid of the protective cover.

4. Press the 172 ADVANCE button. The 172 will switch to Test 1 [(V_{CE} (sat)] and indicator lamp number 1 will be lit.

5. Adjust the INTENSITY control for a visible display. (Assure that the spot is zeroed.)

6. Advance the VARIABLE COLLECTOR SUPPLY so that I_C reaches 10 mA. (The fifth vertical division, at 2 mA/div).

7. The horizontal deflection at 10 mA (180 mV) is V_{CE} (sat). See Fig. 2-4.

8. Press the 172 ADVANCE button. The 172 will switch to Test 2, V_{BE} (sat). V_{BE} (sat) is that voltage (800 mV) at which I_C is 10 mA. See Fig. 2-5.

9. Press the ADVANCE button. The 172 will now be performing Test 3, H_{FE}. See Fig. 2-6. H_{FE} will be I_C/I_B or

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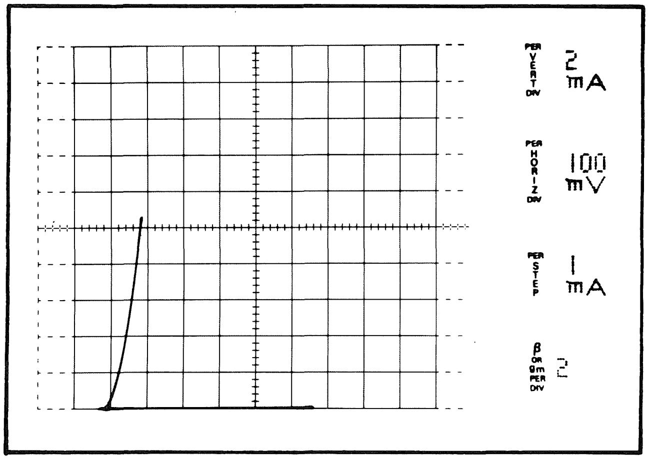


Fig. 2-4. Test 1, V_{CE} (sat)

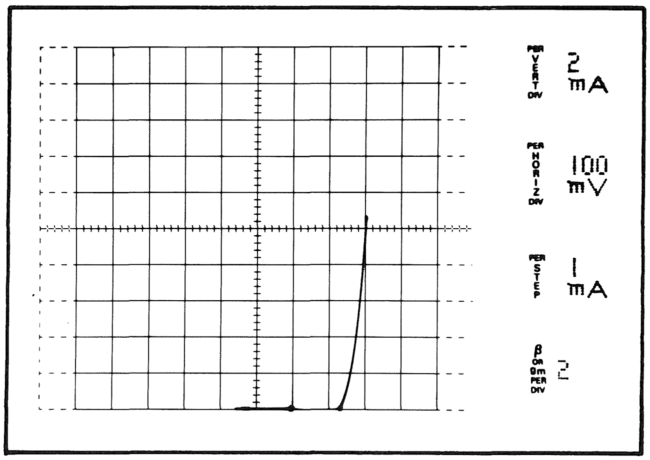


Fig. 2-5. Test 2, V_{BE} (sat)

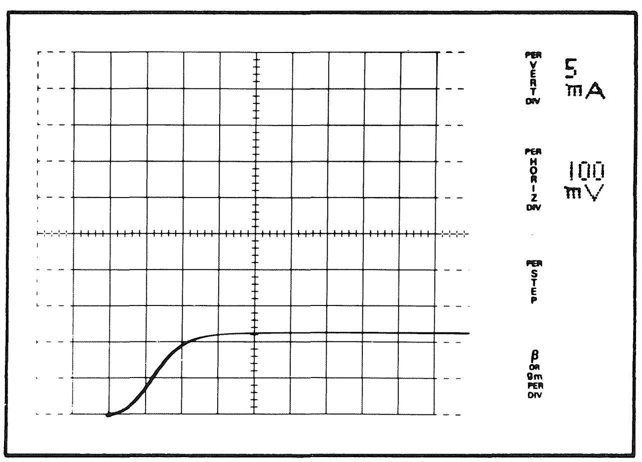


Fig. 2-6. Test 3, H_{FE}

11 mA/0.29 mA = 38 for this sample. 0.29 mA drive was programmed to cause an I_C of about 10 mA.

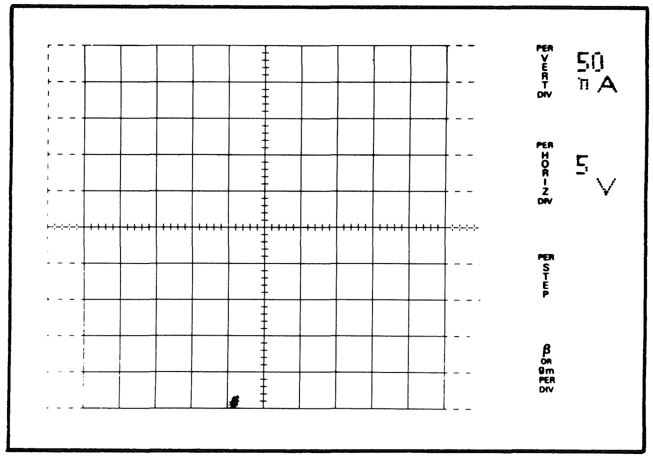


Fig. 2-7. Test 5, I_{CES}

10. ADVANCE the 172 to Test 5, the I_{CES} test. Verify that the leakage at the specified voltage is within limits. For the sample transistor (2N4275), I_{CES} was 5 nA at 20 V (Fig. 2-7).

11. Press the ADVANCE button. The 172 will switch to Test 9, BV_{CES}. Check the display to see that the programmed drive current (10 μA) is flowing and that BV_{CES} is at least 40 V. See Fig. 2-8.

12. ADVANCE the 172 to Test 10, BV_{CBO}. Verify that the programmed drive current (10 μA) is flowing and that BV_{CBO} is at least 40 V. See Fig. 2-8. Tests 9 and 10 displays are in the same place. They may be separated (for easier use) by programming different vertical deflection factors.

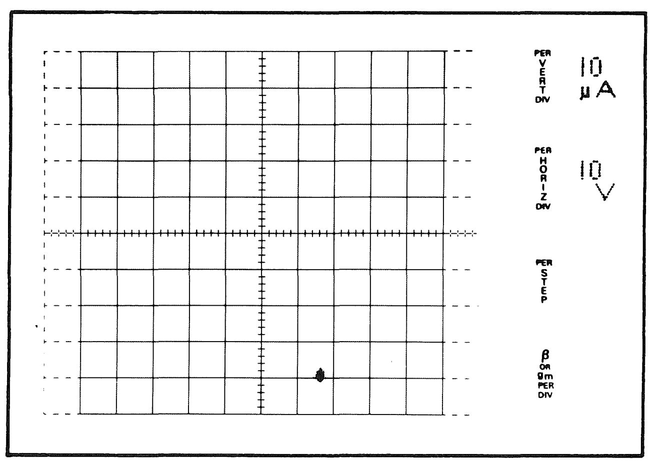


Fig. 2-8. BV_{CES}, Test 9; and BV_{CBO}, Test 10.

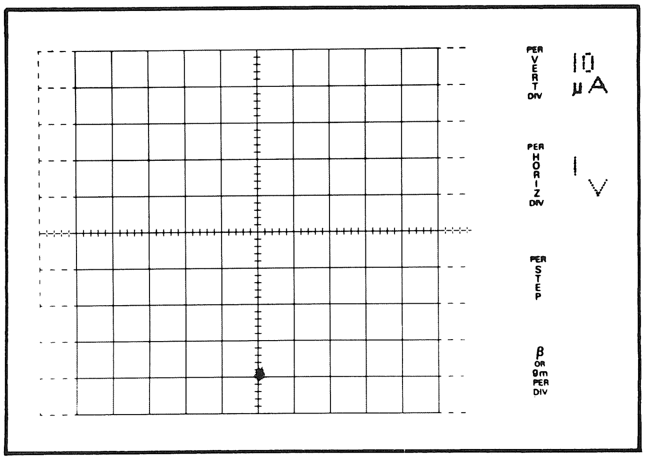


Fig. 2-9. Test 11, BV_{EBO}.

13. ADVANCE the 172 to Test 11, BV_{EBO}. This test calls for 10 μA drive and a BV_{EBO} of at least 4.5 V. See Fig. 2-9.

14. Press the ADVANCE button. The 172 will go to "Rest" condition and await an ADVANCE command.

15. Set the AUTO-MANUAL switch to AUTO and press the ADVANCE button. The 172 will perform one test sequence and then go to the "Rest" condition.

16. Lift the protective cover lid. Press the ADVANCE button and verify that the automatic sequence stops when the 172 yellow HIGH VOLTAGE DISABLED light is lit.

Use of the Limit Cards

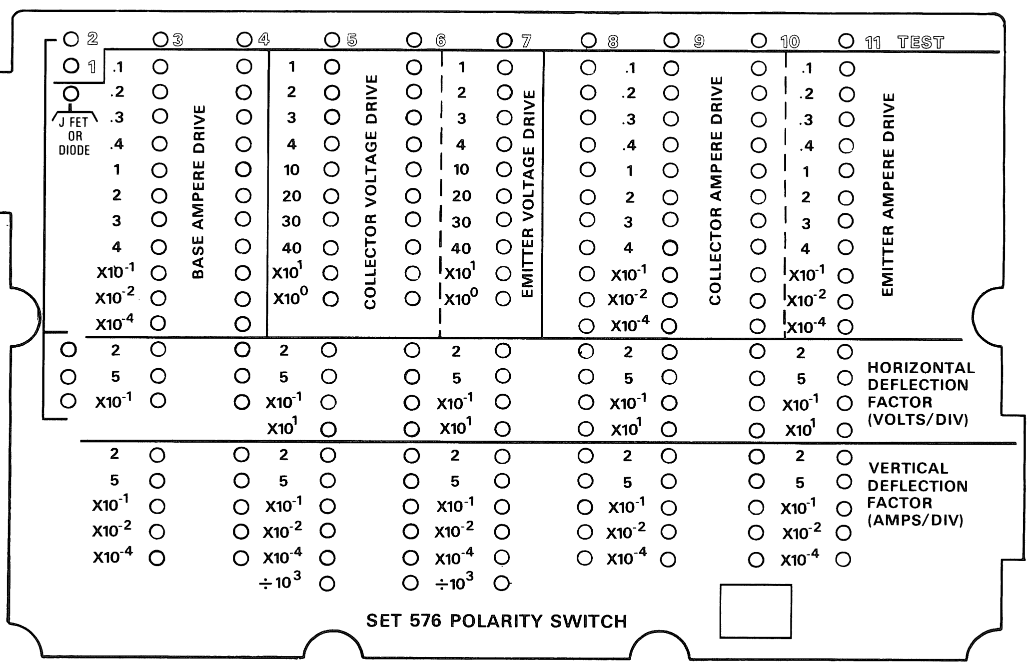
Five Limit Cards are supplied, and may be used for marking parameter ranges of specific devices. The Limit Cards may be kept and re-used to speed testing.

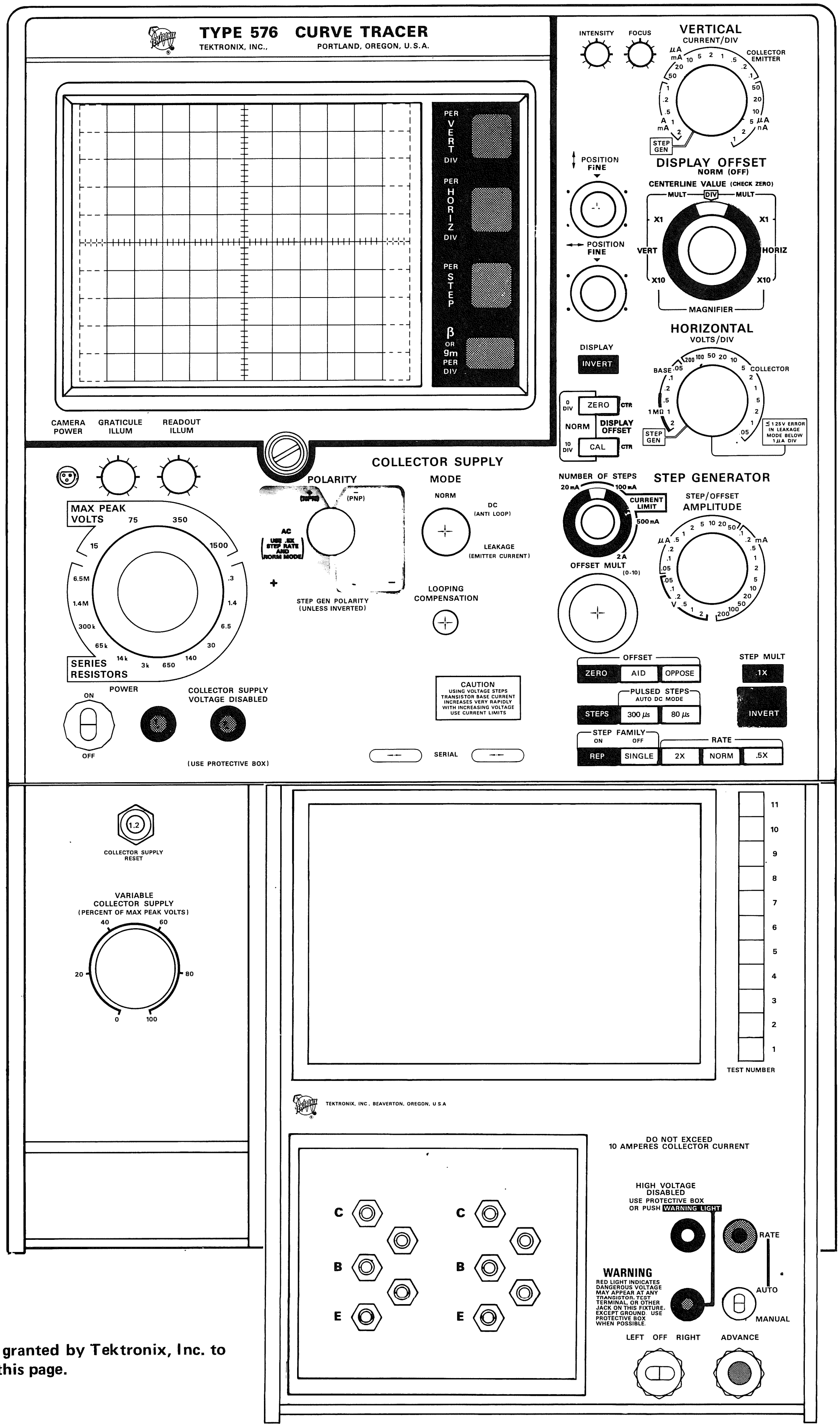
Several commercially available pencils make clear markings on the Limit Cards. Three of them are: Staedtler Lumocolor, Audiovisual Projection, and grease pencils.

FUNCTION	CAPABILITY
BASE AMPERE DRIVE (TESTS 3 & 4)	100nA TO 110mA (PROGRAM 10^{-6} TO 10^{-2})
COLLECTOR & EMITTER VOLTAGE DRIVE (TESTS 5 THRU 7)	1V TO 500V WITH 500µA COMPLIANCE (PROGRAM $X10^0$ OR $X10^1$)
COLLECTOR & EMITTER AMPERE DRIVE (TESTS 8 THRU 11)	100nA TO 11mA WITH 500V COMPLIANCE (PROGRAM 10^{-6} TO 10^{-3})
	1mA TO 110mA WITH 50V COMPLIANCE (PROGRAM 10^{-2} ONLY)
HORIZ DEFLECTION FACTOR	100mV/DIV TO 50V/DIV (TESTS 2, 3 & 4 TO 2V/DIV MAX 1 IS OBTAINED BY NO PIN IN 2 OR 5 10^0 IS OBTAINED BY NO PIN IN 10^{-1} OR 10^1)
VERT DEFLECTION FACTOR	1nA/DIV TO 500mA/DIV (nA RANGES IN LEAKAGE TESTS ONLY. PROGRAM $\div 10^3$ FOR nA RANGES. 1 IS OBTAINED BY NO PIN IN 2 OR 5)

THE COLLECTOR SWEEP VOLTAGE (TESTS 3 & 4) IS PROGRAMMED BY THE HORIZONTAL DEFLECTION FACTOR TO BE AT LEAST FULL SCREEN OPEN CIRCUIT. FOR MAXIMUM ACCURACY OF THE VOLTAGE AND CURRENT SOURCES THE LARGER DIGITS SHOULD BE PROGRAMMED.

TEST NO	1	2	3	4	5	6	7	8	9	10	11
TRANSISTOR	h_{FE} V_{CE} (sat)	V_{BE}	h_{FE} V_{CE} (sat)		I_{CEO} I_{CES} I_{CER}	I_{CBO}	I_{EBO}	BV_{CEO} BV_{CER}	BV_{CES}	BV_{CBO}	BV_{EBO}
J FET	V_P		I_{DSS} R_{DS} (ON)			I_{GSS}				BV_{GSS}	
DIODE	V_F						I_R	V_F			V_R
FUNCTIONS CONTROLLED BY	576	576 172	172								





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SECTION 3
CIRCUIT DESCRIPTION

Introduction

This section contains a description of the 172 circuitry. Refer to the Diagrams section (Section 7) for specific circuitry details.

CURRENT SUPPLY

The Current Supply drives the base of a transistor during a Beta test, supplies a reference current for the voltage supply, and forces a current during voltage breakdown tests. Current value for any particular test is set by the programming for that test.

A 1 mA reference current (I_{ref}) is established by the zener voltage of VR725 across R728 and R729. I_{ref} polarity is reversed by K725S1 and K725S2 as necessary for NPN or PNP devices.

Figure 3-1 is a simplified schematic of the current supply. I_{ref} generates a drive voltage for U740 in passing through R_c (R731-R738). The value of R_c is changed as directed by the test programming. Q60 supplies drive current output as directed by U740. Q60 acts as a series "pass" element for NPN devices, and as a shunt regulator for PNP devices. Q61 is used as a current source. U740, Q60, and Q61 apply the same voltage to R_c (U740 and U760 are both used as voltage followers, an amplifier arrangement having high input impedance, unity gain, and no signal inversion), causing a current $\frac{I_{ref}(R_c)}{R_c'}$.

This current then completes its circuit through one of four paths:

1. The base-emitter junction of the Device Under Test for tests 3, 4, or 11.

2. The collector-emitter DUT terminals, tests 8 and 9.

3. The collector-base DUT terminals, for test 10.

4. R758-R759 when the voltage source is used (tests 5, 6, and 7).

Some devices may oscillate during breakdown voltage tests (tests 8 through 11). An oscillating device causes the 172 to deliver a current much greater than the programmed current. Therefore, circuitry to limit current supply output curing device oscillation is incorporated.

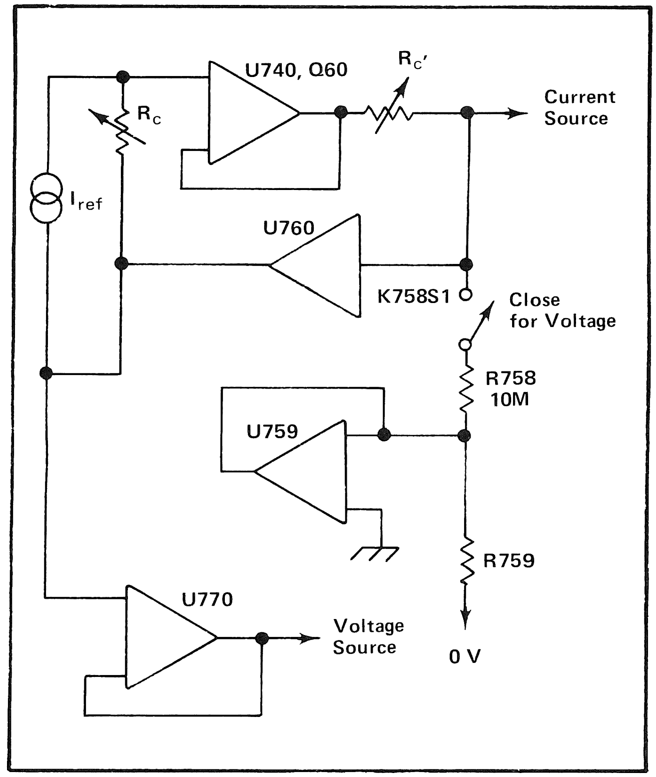

Fig. 3-1. Current supply, simplified schematic.

When a device starts oscillation, its voltage drops sharply. This voltage drop appears at the R771/R772 junction, and is applied via R771 and CR772/CR773 to VR731 and VR732. When the voltage drop between the R771/R772 junction and U740 pin 3 exceeds about 12 V, the reverse-biased zener conducts, charging C729. Current is then diverted from the R731/R738 string to discharge C729. As long as C729 is charged the voltage drive to U740 is reduced, which in turn decreases the output current to a safe level. R739 conducts the VR731/VR732 leakage current during normal operation; CR772/CR773 blocks that leakage current from the output.

Leakage tests (I_{CEO}, I_{CBO}, I_{EBO}) are performed by applying a voltage to the DUT. The voltage is generated by forcing a current (the current supply output) into R758, and then applying the resultant voltage via voltage followers (U760, U770) and switches, to the DUT terminals.

Should the DUT current exceed 0.5 mA, Q775 (Q776 for PNP devices) conducts, reducing the voltage drive to U760 and preventing any further DUT current increase.

SEQUENCER

The sequencer controls the 172 test selection and test performance rate. Eleven test lines are driven by the sequencer. The test lines operate the test parameter switch matrix. Two multivibrators (Automatic and Start/Advance), a pulse delay circuit, a four-bit binary counter, and a binary-coded-decimal (BCD) to decimal decoder comprise the sequencer.

R441, C441, R444, R427, and Q440 form the Start/Advance multivibrator (multi). Q440 is an anode-gated unijunction transistor. Q440 conducts when the anode-gate diode is forward-biased, i.e., when the anode is 0.6 V more positive than the gate. C441 charges toward +12.5 V until Q440 anode reaches +5.6 V, switching Q440 to its conductive state. C441 then discharges through Q440. Q440 stops conducting and switches back to its "off" state when C441 is discharged.

The Auto multi is similar to the Start/Advance multi with the addition of the variable RATE control.

Before an automatic test sequence is started, the sequencer is in a quiescent condition. U461 pin 3 is low (U460 is in "zero" state), disabling U578B, and saturating Q430. The Start/Advance multi is thereby held off. All test lines are high, saturating Q410 and holding the Auto multi off.

A test sequence is initiated by pressing either the ADVANCE switch (S21) or the foot switch. A negative pulse from S21 or the foot switch then back-biases CR437, which turns off Q430 and allows C441 to charge toward +12.5 V until it is about 0.6 V more positive than Q440 gate. At this point, Q440 conducts and the Start/Advance multi sends a positive pulse to the pulse delay circuit (Q450/Q457). About 5 ms later, the pulse delay circuit triggers the binary counter U459, which switches to count number 1.

U459 output is a binary number representing the number of clock pulses it has received. U459 drives U460, the BCD to decimal decoder. U460 has sixteen output lines. The first twelve (0-11) lines control the sequencer.

The sequencer will operate whether or not every test is programmed. Each of the eleven test lines has a switch connecting it to R1 which is tied to +5 V. When a test is not programmed, the decoder cannot pull that particular test line low, since the absence of the Test Number programming pin has left the switch closed and the line is held up near +3 V by R1.

If test 1 is not programmed, test line 1 is held high when the counter/decoder switches to count 1, and the Auto multi is held off. U578B is enabled now (and whenever any unprogrammed test is reached), turning Q430 off and allowing the Start/Advance multi to fire. The binary counter and decoder then advance to the next count (2).

If test 2 is programmed, test line 2 is pulled low, establishing the following conditions:

1. U578B is disabled.

2. Q430 is saturated and holds the Start/Advance multi off.

3. Q410 is turned off, allowing the Auto multi to start running at some rate set by the RATE control.

All eleven counts are sequenced through in the aforementioned fashion, each being performed or omitted as called for by the programming card.

After the decoder (U460) has received the twelfth pulse (for test line 11), the succeeding four pulses have no meaning. During the 13th, 14th, 15th, and 16th pulses the "rest" line and the eleven test lines are all high. This causes the Start/Advance multi to cycle four times (just as if there were unprogrammed tests) and return the binary counter to count zero, the "rest" state. The sequencer then awaits for a "start" command from S21 or the foot switch before commencing another test sequence.

Should a Manual sequence be desired, S20 is closed, holding the Auto multi off and requiring a pulse from S21 or the foot switch to start the Start/Advance multi to perform each test.

CONTROL LOGIC

The vertical and horizontal display sensitivities are controlled by reed switches. Reed switch selection is performed by the horizontal and vertical decoders.

The vertical sensitivity decoder is a BCD to decimal IC (U590) whose output lines drive the vertical attenuator reed switches.

Ten gates (U570A, B, C; U574A, B; U578A; U572A, B; U576A, B) form the horizontal sensitivity decoder. Table 3-1 lists the deflection factor, the programming, and the reed relays activated.

TABLE 3-1

Horizontal Sensitivity 1 = pin in; 0 = pin out					Reed Relays Conditions 1 = high = off; 0 = low = on				
V/div	2	5	10^{-1}	10^{1}	K635	K634	K633	K632	K636
1	0	0	0	0	1	0	1	0	1
10	0	0	0	1	1	1	0	0	1
0.1	0	0	1	0	0	1	1	1	1
5	0	1	0	0	1	1	0	0	1
50	0	1	0	1	1	1	1	0	0
0.5	0	1	1	0	1	0	1	0	1
2	1	0	0	0	1	0	1	0	1
20	1	0	0	1	1	1	0	0	1
0.2	1	0	1	0	0	1	1	1	1

SIGNAL SENSING AND DISPLAY SENSITIVITY

When the collector supply and the base drive have been applied to the device under test (DUT), measurements of the DUT voltages and currents may be displayed on the vertical and horizontal axes of the Type 576 CRT. The measurements are made by sensing the current or voltage with current sensing resistors or voltage dividers, and amplifying the resulting voltage in the display amplifiers. The display amplifier outputs drive the CRT deflection plates to form a display.

Current Sensing (⩾1 μA/div)

Current is sensed in a resistance (R_B) connected between ground and the current return to the supply. By changing the value of R_B, the CRT deflection factor is changed.

Leakage Current Sensing (⩽1 μA/div)

Leakage current is sensed by a resistance (R_A) connected between the emitter or base DUT terminal and ground. Display deflection factor is changed by switching in different values of R_E. Leakage current sensing is employed for tests 5, 6, and 7.

Voltage Sensing

In tests 1, 2, 3, and 4, either collector or base voltage is measured on the horizontal axis of the CRT, depending on which test is being performed.

Test 1 sensing is done in the Type 576 (see Fig. 3-2). Test 2 vertical sensing also takes place in the Type 576, and Test 2 horizontal sensing occurs in the voltage divider R_A. See Fig. 3-3.

Tests 3, 4, 5, 6, and 7 use R_A for voltage sensing. See Figs. 3-4, 3-5, 3-6, and 3-7.

Breakdown Voltage Tests

During breakdown voltage tests (numbers 8, 9, 10, and 11) a current is forced through the DUT. The voltage developed in the DUT is sensed by the horizontal sensing resistors (R_A). This forced durrent completes its circuit through the vertical sensing resistance, R_B.

Figs. 3-6, 3-8, and 3-9 are simplified schematics of each test arrangement.

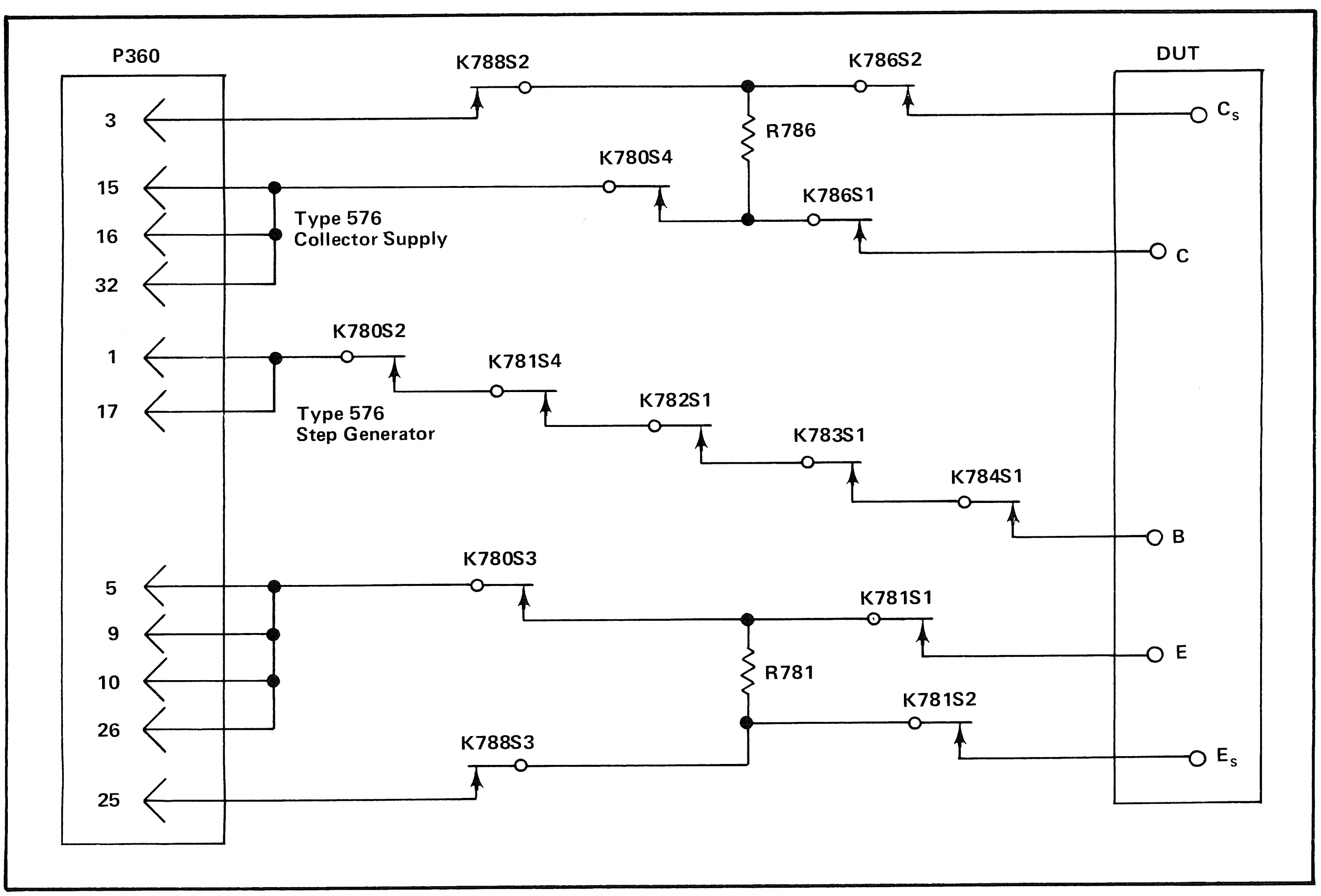

Fig. 3-2. Test 1; B, V_{CE} (sat).

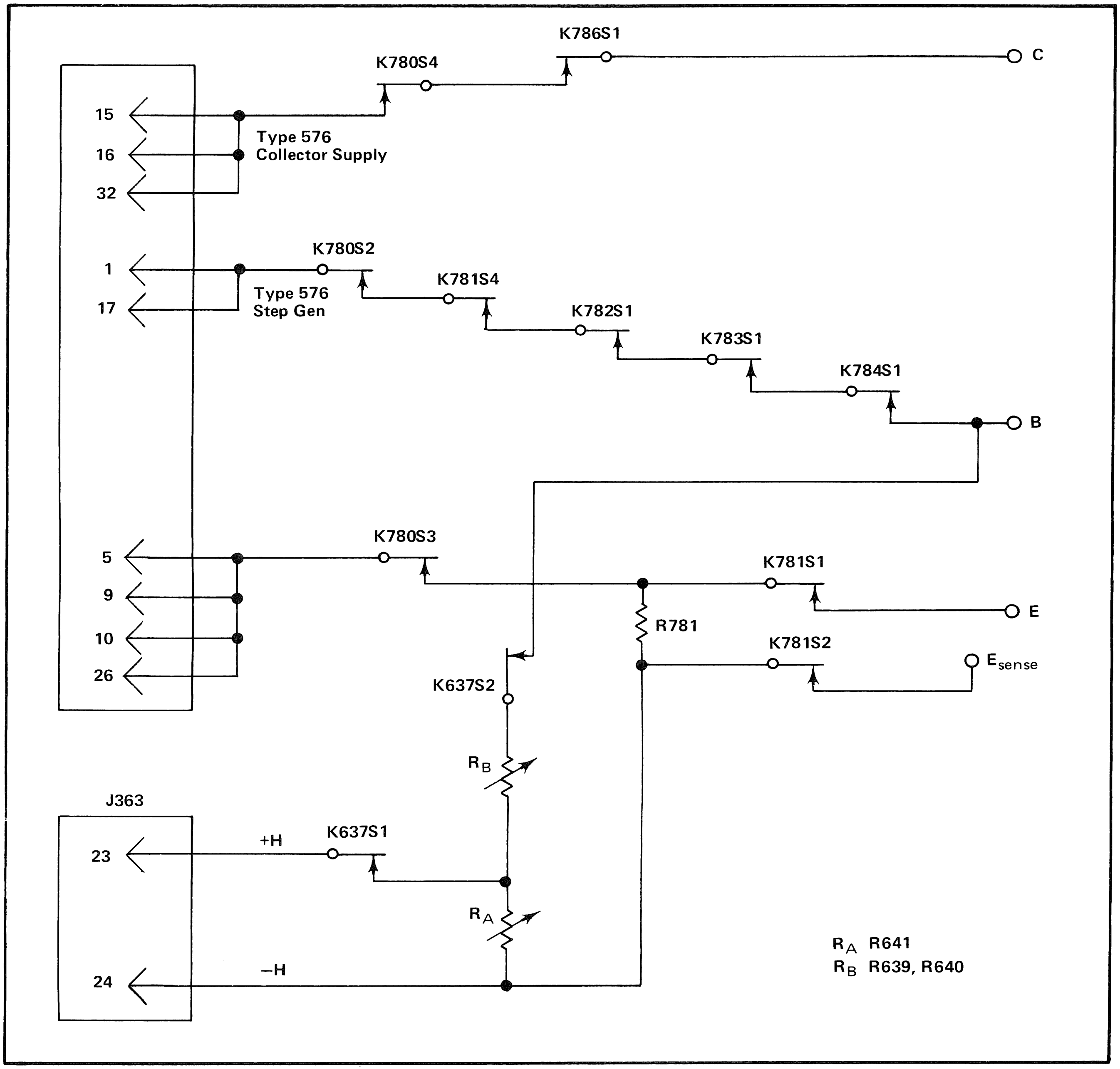

Fig. 3-3. Test 2, V_{BE}

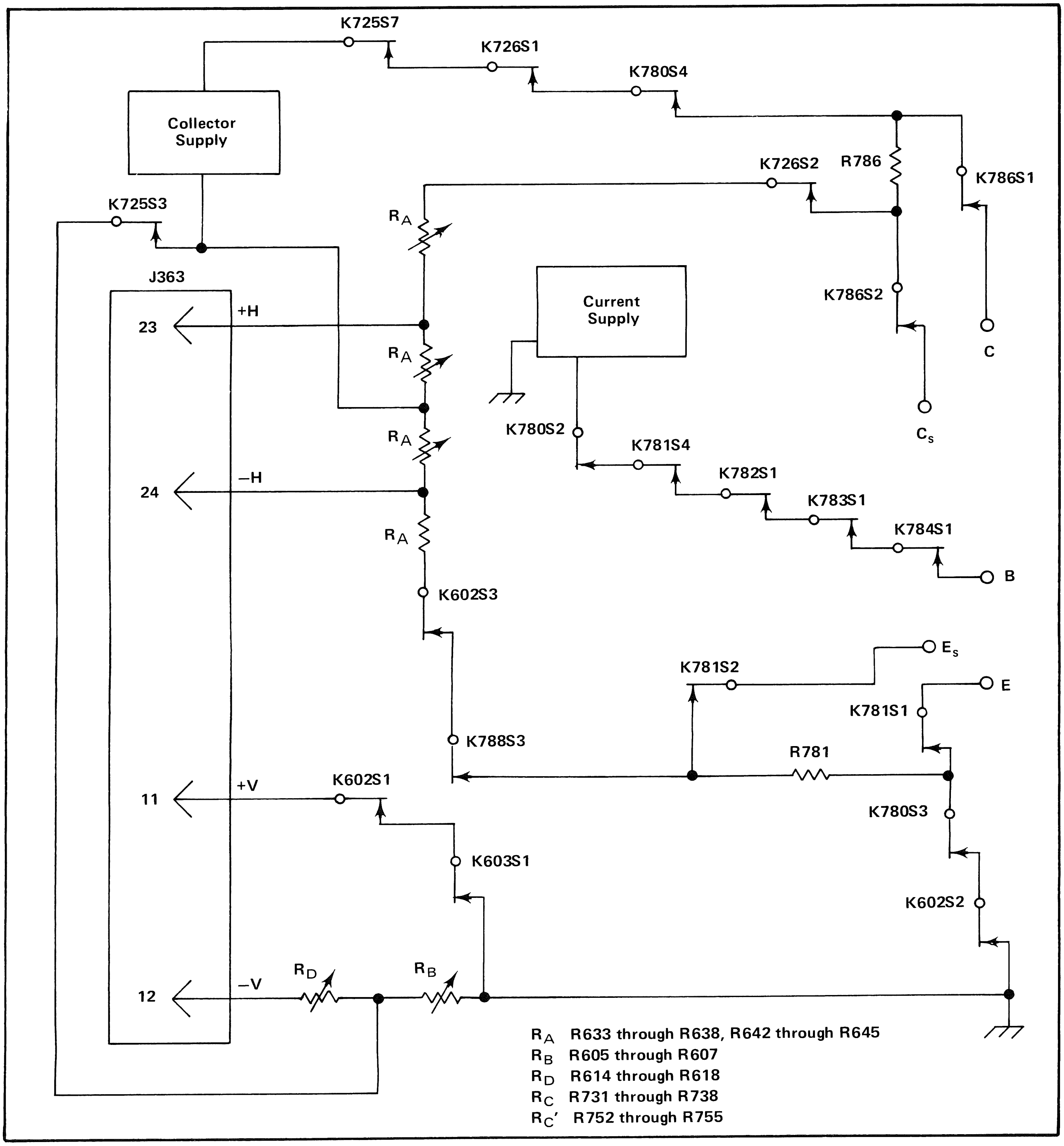

Fig. 3-4. Test 3, B; and Test 4, V_{CE} (sat)

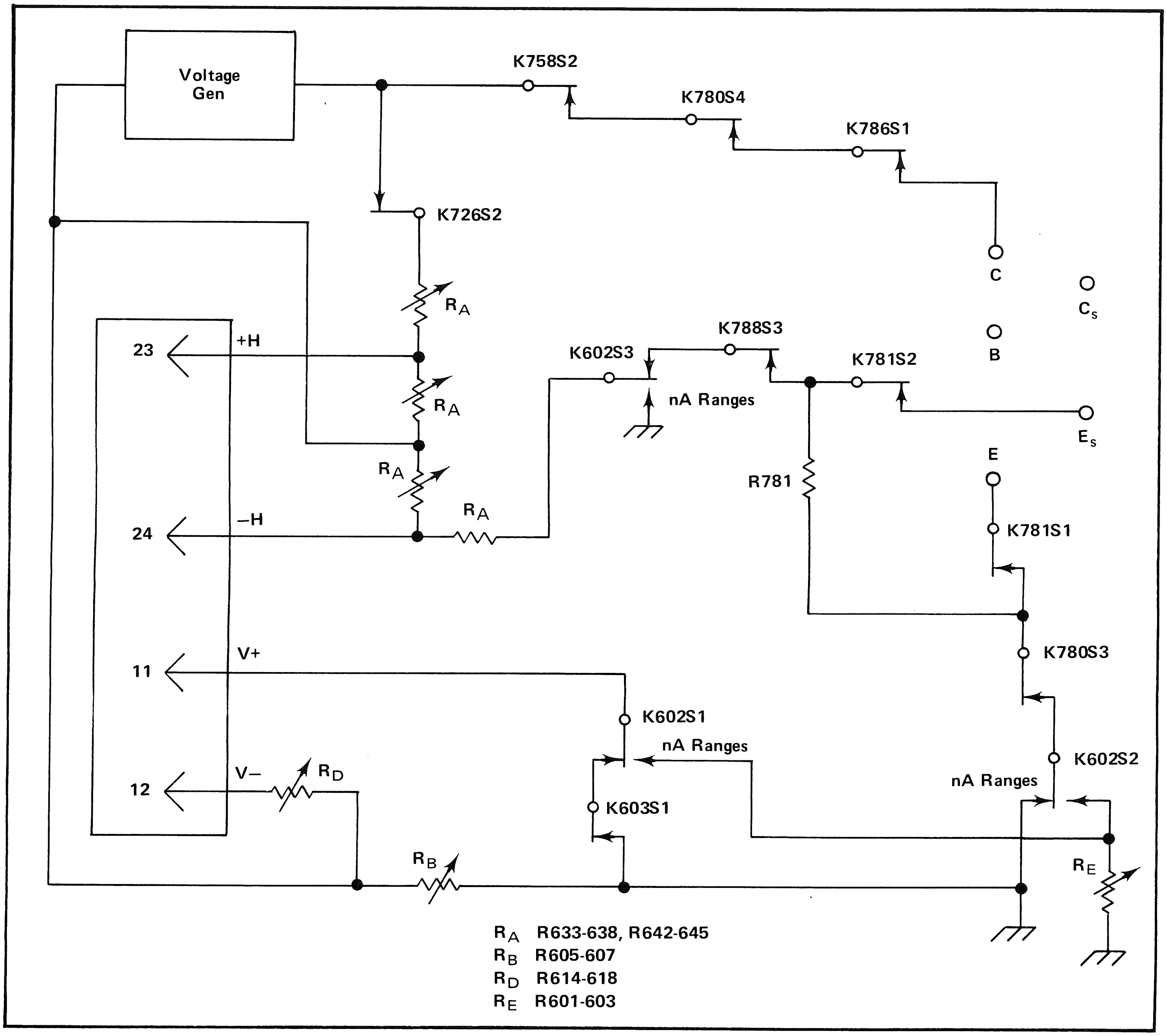

Fig. 3-5. Test 5, I_{CEO}

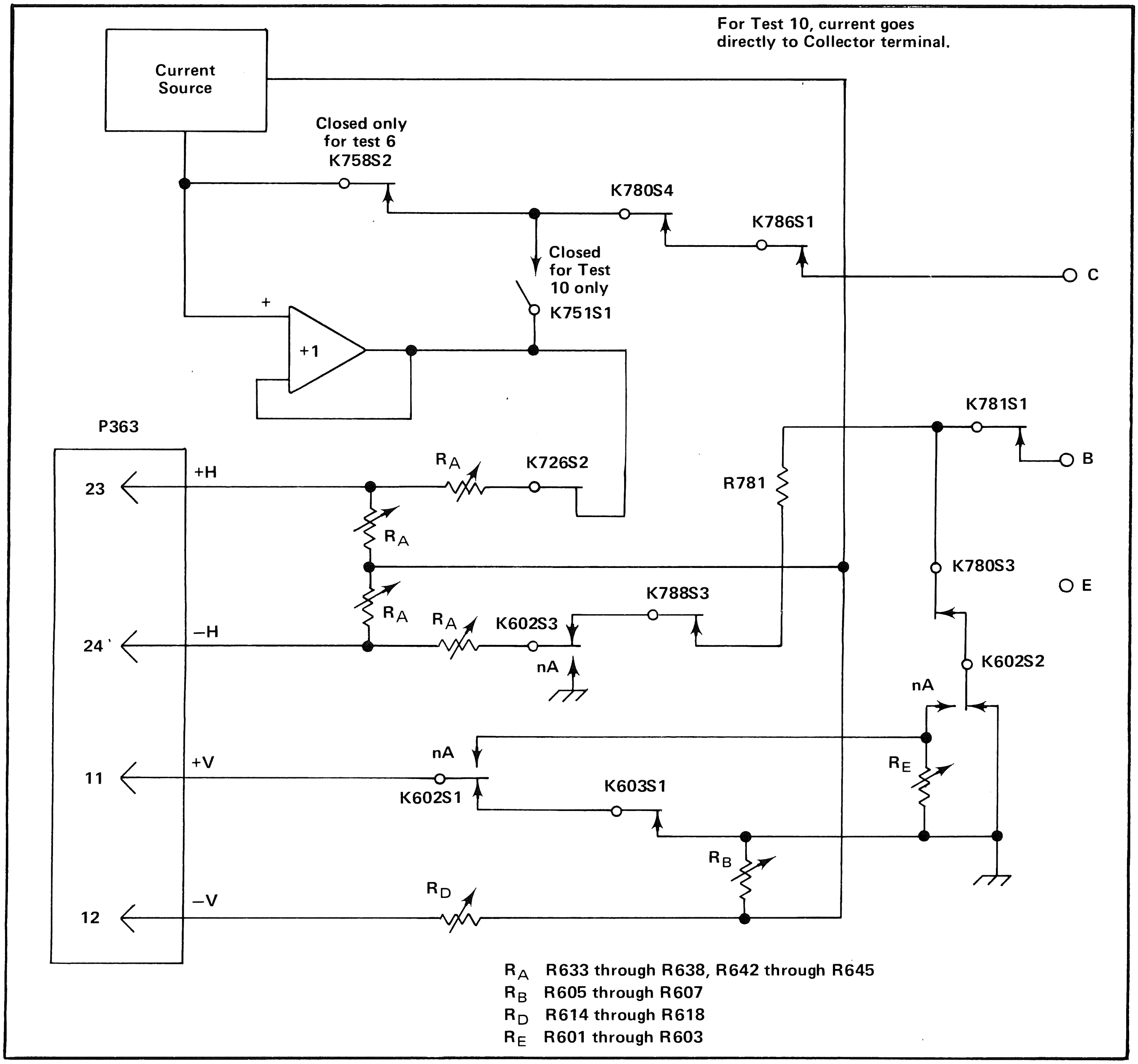

Fig. 3-6. Test 6, I_{CBO}; and Test 10, BV_{CBO}

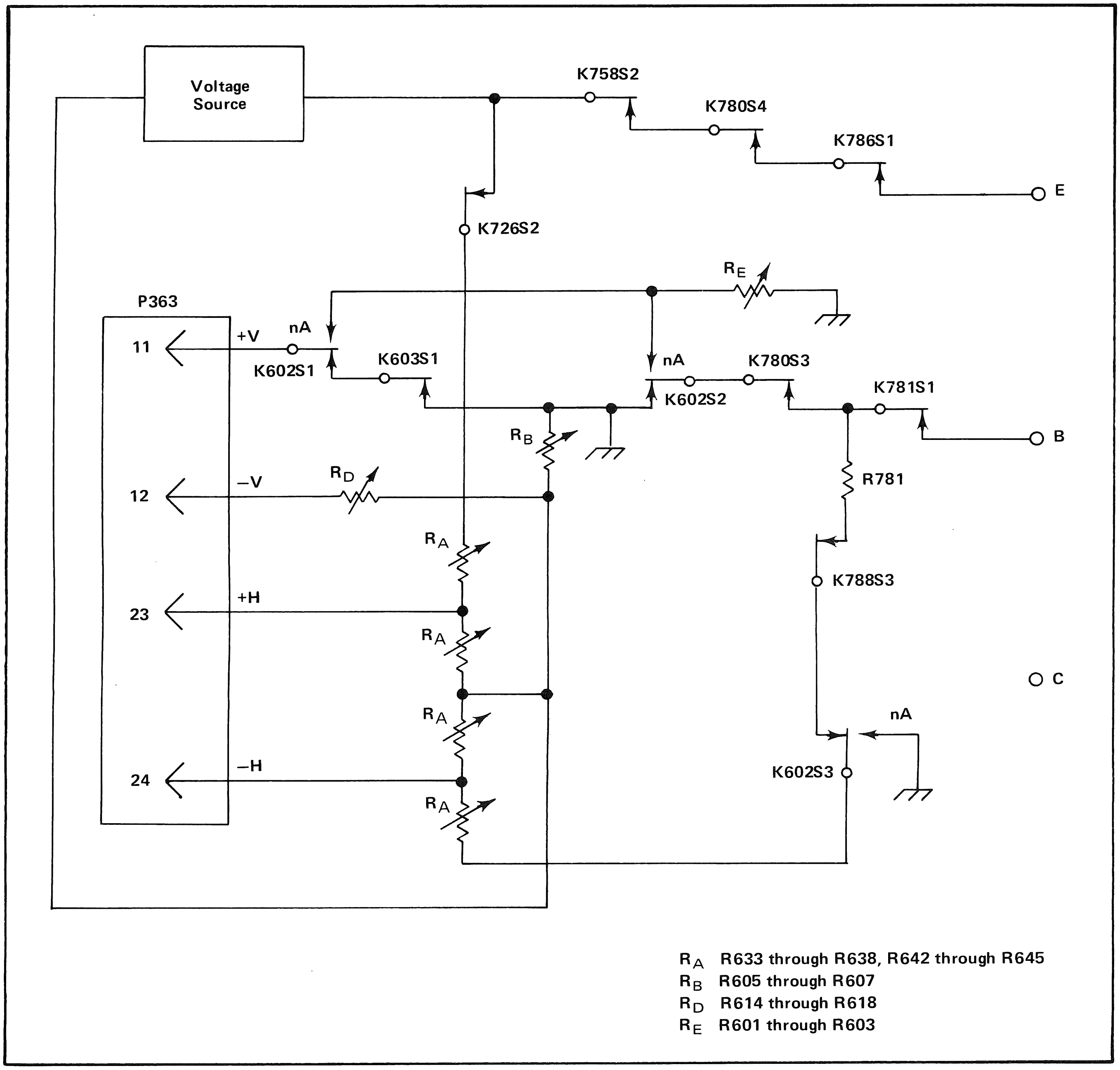

Fig. 3-7. Test 7, I_{EBO}

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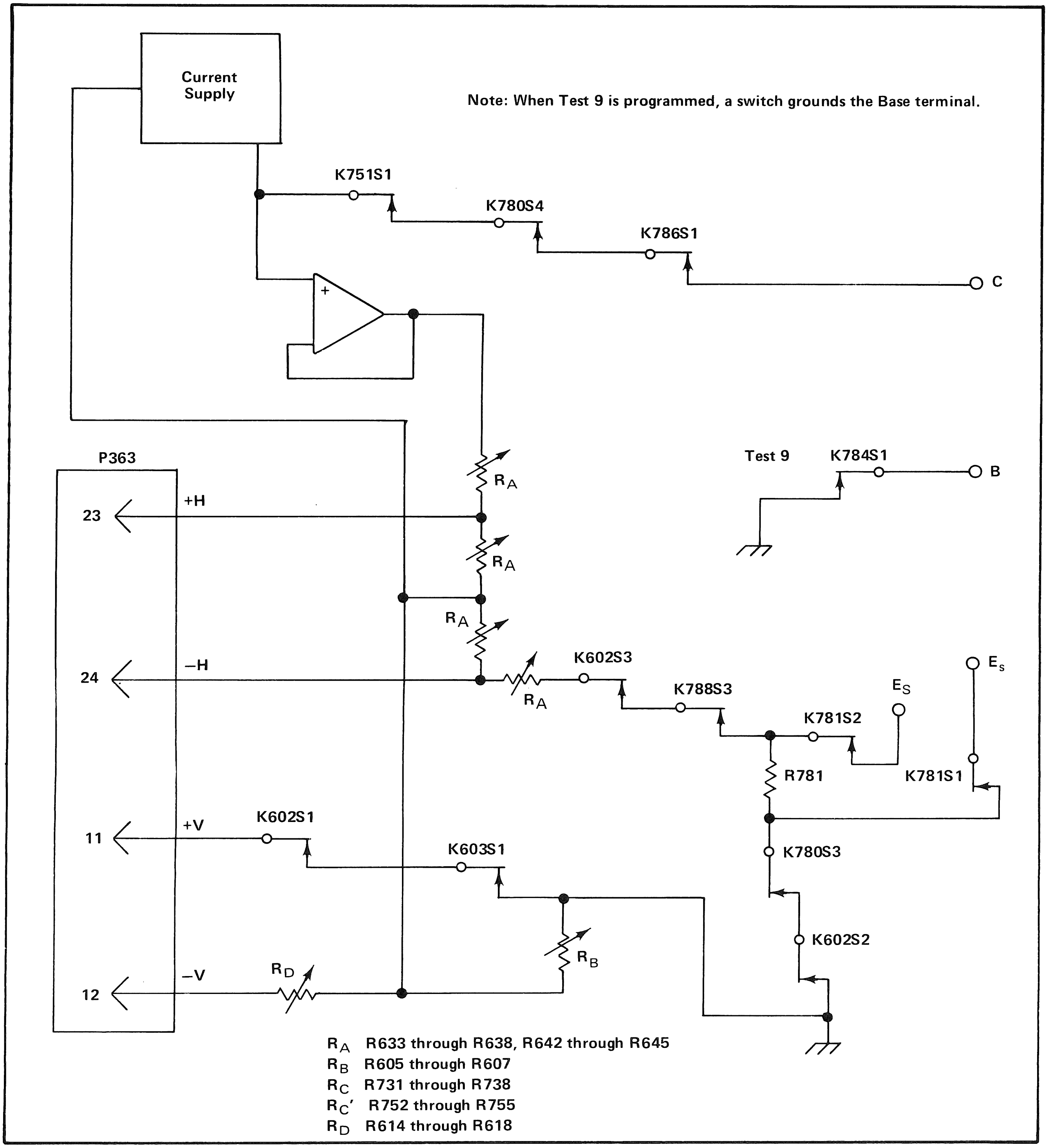

Fig. 3-8. Test 8, BV_{CEO}; and Test 9, BV_{CES}

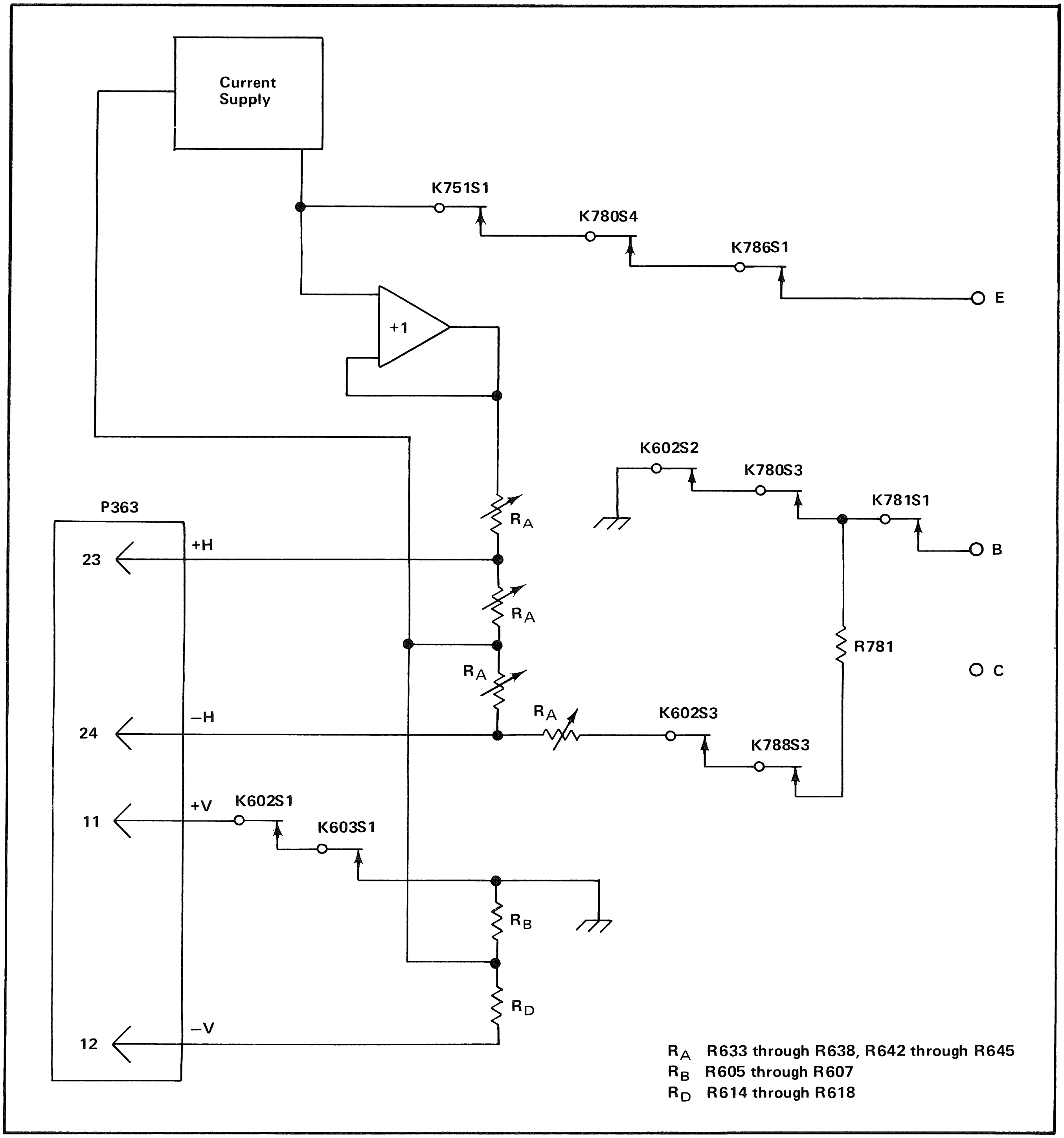

Fig. 3-9. Test 11, BV_{EBO}

Tables 3-2 and 3-3 list the relays activated by the vertical/horizontal sensitivity programmer.

An isolation amplifier (U760/U770) is used during voltage breakdown tests to prevent the horizontal attenuator from loading down the current supply. This assures that the DUT voltage and the horizontal attenuator voltage are the same.

TABLE 3-2

Vert Atten Programmed	Relay(s) Activated
1×10^{-9}	K602
2	
5	
1×10^{-8}	K604
2	
5	
1×10^{-7}	K605
2	
5	
1×10^{-6}	K603
2	
5	
1×10^{-5}	K604
2	
5	
1×10^{-4}	K605
2	
5	
1×10^{-3}	K606
2	
5	
1×10^{-2}	K607
2	
5	
1×10^{-1}	K608
2	
5	

TABLE 3-3

Horiz Atten (Collector or Emitter Sensing) (Base Sensing)

Programmed	Relay(s) Activated
1×10^{-1}	K635 K637
2×10^{-1}	K635
5×10^{-1}	K634 K636
1×10^{0}	
2×10^{0}	
5×10^{0}	K633
1×10^{1}	
2×10^{1}	
5×10^{1}	K632

INTERLOCK

An interlock circuit is used to assure that high voltage is applied to the DUT terminals only when certain conditions are satisfied.

Those conditions are:

1. S31 must be in LEFT or RIGHT.

2. 172 must be on tests number 1, 2, or 5 through 11.

3. Either the INTERLOCK or the INTERLOCK DEFEAT must be closed.

4. The Type 576 MAX PEAK VOLTS switch must be in either the 75 or 350 positions, during tests 1 and 2.

Conversely, if S31 is in OFF, if the 172 is on tests number 3 or 4, if the Type 576 MAX PEAK VOLTS switch is in the 15 V or 1500 V position (during tests 1 and 2), or if the INTERLOCK and INTERLOCK DEFEAT are open, no high voltage can be applied to the DUT terminals.

Seven transistors (Q480, Q487, Q489, Q490, Q494, Q496, and Q498) and their associated components form the interlock circuitry.

While the 172 is performing tests 1 or 2, Q494 base is connected to +12.5 V through R493 and K520 of the Type 576. Q494 emitter will be grounded when the Type 576 MAX PEAK VOLTS switch (S310) is in the 75 V or 350 V position. These conditions cause Q494 to conduct and to turn on Q496. Q946 collector current (I_C) has two possible paths:

1. If the INTERLOCK (S26) or INTERLOCK DEFEAT (S25) is closed, I_C goes through Q490. Q490 I_C is then directed by K520 to K320 (the Type 576 high voltage control relay) or to K716 (during tests 5-11), the 172 high-voltage control relay.

When either K320 or K716 is energized, sufficient current is drawn to light DS11, the high-voltage indicator lamp.

2. If both INTERLOCK DEFEAT and the INTERLOCK are open, Q496 I_C goes to ground via CR497, R497, and R498. Q498 is forward-biased by Q496 I_C. Q498 then conducts and lights DS26, indicating that the HV supply is disabled.

Q487 is reverse-biased when S1 is in the OFF position and forward-biased when S31 is in Left or Right. Q487 conduction turns on Q489, whose I_C will forward bias Q490 if either the INTERLOCK or INTERLOCK DEFEAT switch is closed.

For the other tests (3 through 11), Q494 is reverse-biased. This removes the base drive for Q496 during tests 3 and 4; consequently, there can be no high voltage for those tests. Relay K520 is turned on during tests 5 through 11. Turning on K520 also forward-biases CR494 and Q496, whose I_c drives K716 to connect the 172 high voltage to the DUT terminals.

INTERLOCK SHUTOFF

Q480, Q487, and associated components are connected to form a one-shot multivibrator (multi). The multi is functional only when 31 is in Left or Right, and has a pulse width of 40 ms. In the absence of a sequencer pulse, Q480 is reverse biased by the R428, R427 combination. Q487 base drive is furnished via R482 from −12.5 V.

When a sequencer pulse occurs, it forward-biases Q480. Q480 then shuts off Q487, which remains off after the sequencer pulse until C482 has discharged from +4 V to −0.6 V, a period of 40 ms. See Fig. 3-10(A).

A shutoff pulse is used to turn off Q490 after each sequencer pulse to assure that no high voltage is applied to the DUT terminals while the 172 switches are switching for the next test. If the next test is not programmed, another sequencer pulse will occur 7 ms afterward. Further unprogrammed tests keep the Start/Advance multi cycling at its period of 1 pulse/7 ms. When there are two or more successive unprogrammed tests, the one-shot timing capacitor (C482) is recharged each time the sequencer pulses. This moves the conclusion of the shutoff pulse to 40 ms from the last unprogrammed test. See Fig. 3-10(B).

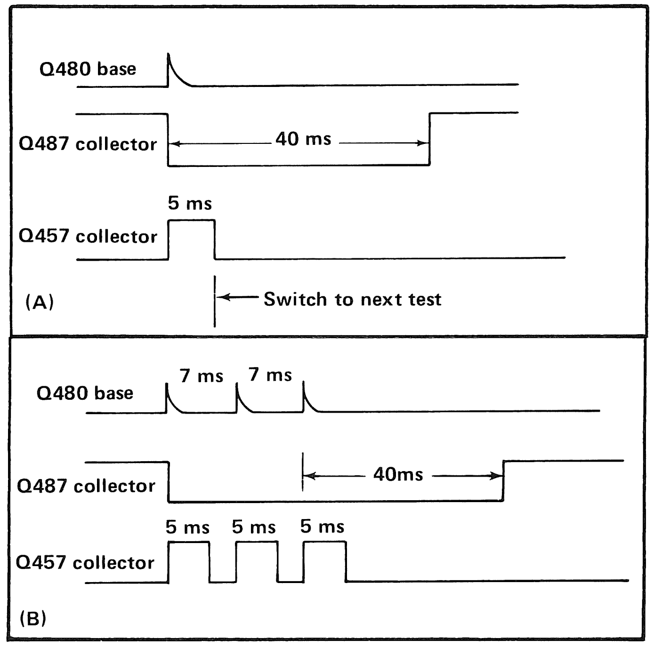

Fig. 3-10. Interlock Shutoff Timing

POWER SUPPLY

Power to operate the 172 is furnished by two bridge rectifiers (CR720, CR705) whose outputs are +15 V, −15 V, +19 V, and −19 V, and by the +12.5 V −12.5 V and +5 V Type 576 power supplies.

When voltages greater than 12 V are needed for Q60 and Q61 (current supply), ±50 V or ±500 V is provided by two bridge rectifiers (CR715, ±50 V; and CR710-CR713, ±500 V).

DUT COLLECTOR SUPPLY

The DUT Collector Supply is a bridge rectifier that may be switched to any of three transformer taps to provide three open-circuit voltages of 2, 5, or 20 volts.

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SECTION 4
MAINTENANCE

Introduction

This section of the manual contains maintenance information for use in preventive maintenance, corrective maintenance or troubleshooting of these instruments.

PREVENTIVE MAINTENANCE

General

The instrument covers protect against dust in the interior. Leave panels in place except when working on the instrument.

CAUTION

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

Exterior. Remove loose dust on the outside of the instrument with a soft cloth or small paint brush. Use the paint brush to dislodge dirt on and around the front. Remove the remaining dirt with a soft cloth dampened in a mild detergent and water solution. Do not use abrasive cleaners.

Interior. Keep the interior of the instrument free of dust, since a heavy dust layer combined with high-humidity conditions can cause failure. Clean the interior by blowing off the accumulated dust with dry, low-pressure air. Remove any remaining dirt with a soft paint brush or a cloth dampened with a mild detergent and water solution. Use a cotton-tipped applicator to clean circuit boards.

Lubrication

General. Proper lubrication increases the reliability of potentiometers, switches and other moving parts. Do not use too much lubrication. A lubrication kit containing the necessary lubricants and instructions is available from Tektronix, Inc. Order Tektronix Part No. 003-0342-01.

Visual Inspection

Occasionally inspect the instrument for defects, such as broken connections, damaged or improperly installed circuit boards, and heat-damaged parts.

If you can see the trouble, the repair procedure is usually obvious. If heat-damaged components are found, be sure to locate and correct the cause of heat damage before replacing the component.

Semiconductor Checks

We do not recommend periodic checks or replacement of semiconductors. The best semiconductor performance check is under instrument operation. See the discussion on troubleshooting for more details.

Recalibration

Check the calibration of the instrument after 1000 hours of operation or every six months, whichever occurs first. If a component is replaced you may have to recalibrate the affected circuit. Also, while recalibrating the instrument, otherwise unseen problems may be discovered and repaired.

TROUBLESHOOTING

Introduction

While troubleshooting the instrument, consult other sections of this manual in addition to the following information.

Diagrams. The circuit numbers, electrical values and connections of all components are shown on the diagrams at the rear of this manual. Important voltages and waveforms also appear.

Parts List. Part replacements are available through your local Tektronix Field Office or representative. However, many electrical parts are available locally. Before purchasing or ordering replacement parts, consult the Parts List for value, tolerance and rating.

Calibration Procedure. Use the calibration procedure to locate instrument problems. Recalibration may reveal and correct minor problems not apparent during normal use.

Circuit Description. Knowing circuit operation can help locate the trouble.

Circuit Board Replacement. If a circuit board is damaged beyond repair, either the entire assembly 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.

Resistor Color Code. In addition to the composition resistors, some metal-film resistors are used in the instrument. Nearly all resistors are color-coded for resistance value and tolerance using EIA color code (a metal-film resistor may have the value printed on the body). Composition resistors have four stripes which represent two significant figures, the multiplier and the tolerance value (see Fig. 4-1). Metal-film resistors have five stripes which represent three significant figures, the multiplier and the tolerance value.

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

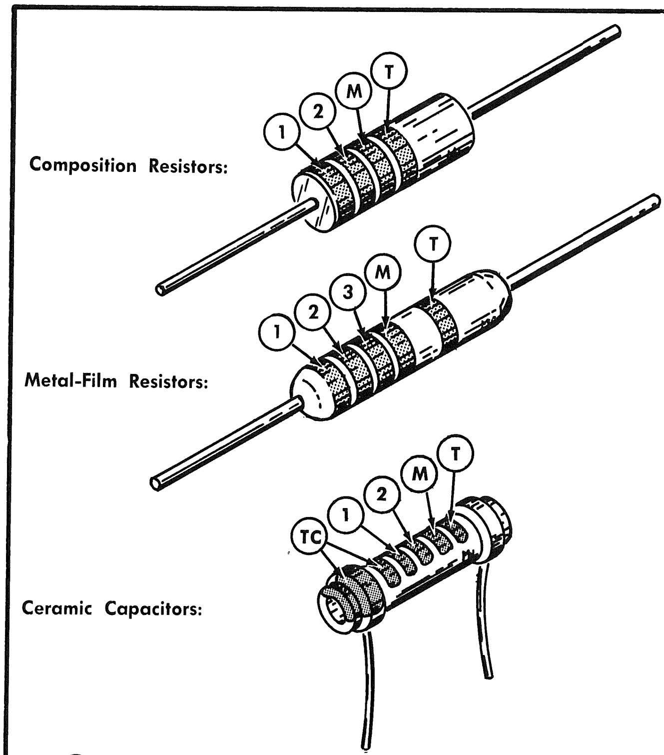
Diode Color Code. The cathode end of each glass-encased diode is indicated by a stripe, a series of stripes or a dot. For most striped diodes, the color code identifies the unique portion of the Tektronix Part Number using the EIA color-code system (e.g., a diode color-coded pink-, or blue-, brown-gray-green indicates Tektronix Part Number 152-0185-00).

Semiconductor Lead Configuration. Fig. 4-2 shows the lead configurations of semiconductors used in this instrument. This view is from the bottom of the semiconductors.

Troubleshooting Techniques

The following steps aid in locating the defective component. When the defective component is located, it should be replaced following the replacement procedures given under Corrective Maintenance.

1. Check Control Settings. Incorrect control settings can mislead the troubleshooter. If there is doubt about a



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: Resistors	Multiplier: Capacitors	Tolerance: Resistors	Tolerance: 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. Standard EIA color coding for resistors and capacitors.

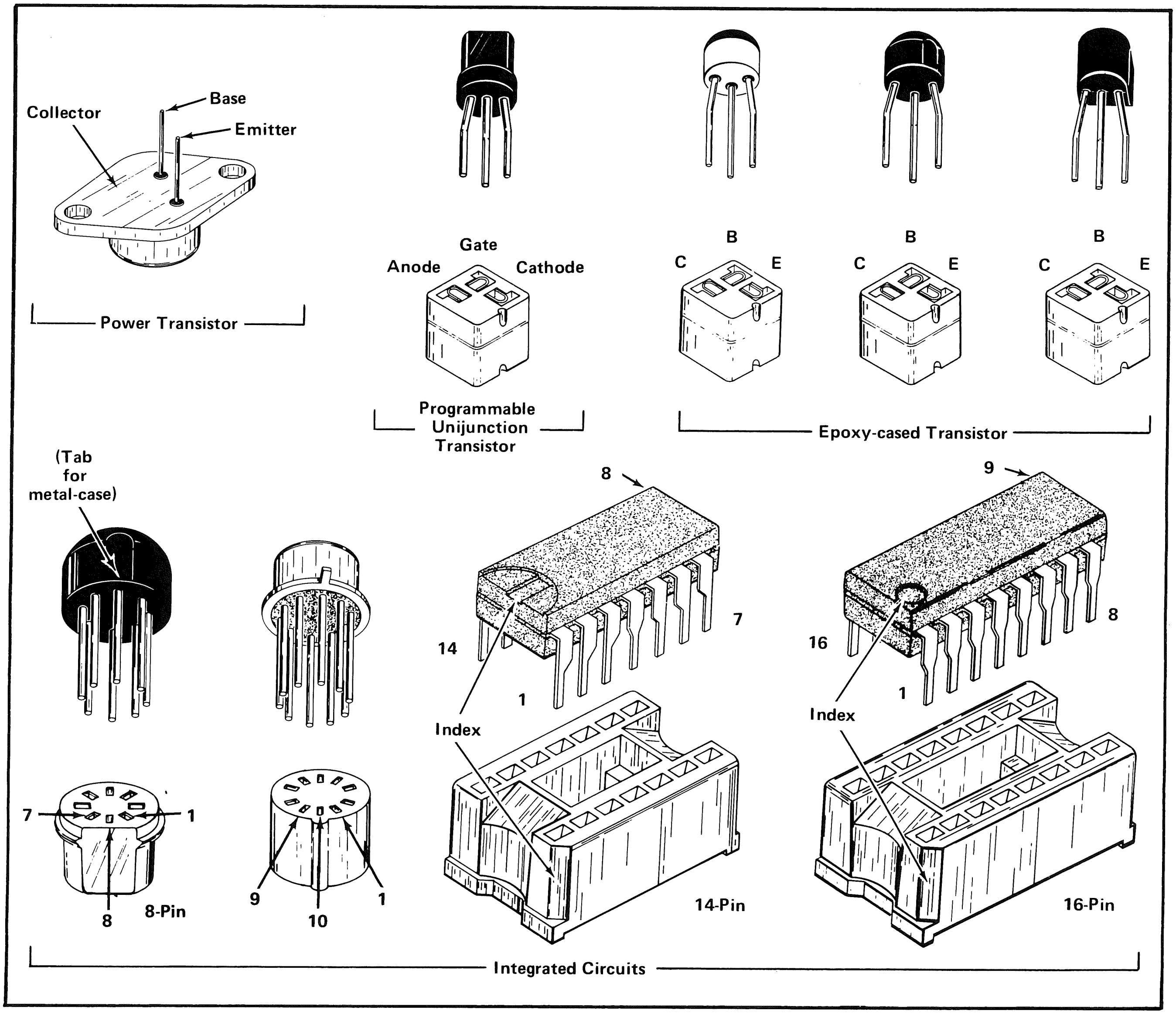


Fig. 4-2. Semiconductor installation information.

control, see the Programming and Operating Instructions section.

2. Check Associated Equipment. Before going further, check that the equipment used with the instrument is operating correctly. Also, check the power source.

3. Visual Check. Inspect the suspected trouble area. Possible troubles include unsoldered connections, broken wires, damaged circuit boards, damaged components, etc.

4. Isolate Trouble to a Circuit. The symptom often identifies the circuit in which the trouble is located. When trouble symptoms appear in more than one circuit, check affected circuits by taking voltage and waveform readings. If the signal is correct, the circuit is working correctly up to that point.

5. Check Voltages and Waveforms. The defective component can often be located by checking for the correct voltage or waveform in the circuit. Typical voltages and waveforms are given on the diagrams.

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.

6. Check Individual Components. The following procedures describe methods of checking components. Components which are soldered in place should first be isolated by disconnecting one end.

A. Semiconductors

CAUTION

Power switch must be turned off before removing or replacing semiconductors.

To check a transistor, substitute another which is known to be good. If substitute transistors are not available, use a dynamic tester. Static-type testers are not recommended, since they do not check for dynamic operation.

B. Diodes

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

CAUTION

Do not use an ohmmeter scale that involves the supply of large internal current to the diode. (For this use, avoid the lower ranges, such as RX1 and RX10.)

C. Resistors

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

D. Capacitors

Use an ohmmeter (high resistance scale) to check a capacitor for leakage or short-circuit. Do not exceed the voltage rating of the capacitor. The resistance reading should be high after initial charge of the capacitor. An open capacitor can best be detected with a capacitance meter or by checking whether the capacitor passes AC signals.

7. 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.

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 replacement parts for the instrument 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, remember that the physical size and shape of a component may affect its performance in the instrument, particularly at high frequenices. 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 components are used in the instrument. These components are manufactured or selected by Tektronix, Inc. to meet specific performance requirements, or are manufactured for Tektronix, Inc. in accordance with our specifications. 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 technique should be used to replace a component on a circuit board. Use the procedures given under Component Replacement to remove the boards from the instrument before soldering.

1. Grip the component lead with long-nose pliers. Touch the soldering iron to the lead at the solder connections. 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, insert 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. Insert the leads into the holes in the boards so the component is firmly seated against the board, or as positioned originally. If it does not seat properly, heat the solder and gently press the component into place.

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

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

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

Metal Terminals. When soldering metal terminals (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 metal terminals:

1. Apply only enough heat to make the solder flow freely. Use a heat sink to protect heat-sensitive components.

2. Apply only enough solder to form a solid connection. Excess solder may impair the function of the part.

3. If a wire extends beyond the solder joint, clip off the excess.

4. Clean the flux from the solder joint with a flux-remover solvent.

Component Replacement

WARNING

Disconnect the instrument from the power source before replacing components.

General. The exploded-view drawings associated with the Mechanical Parts List may be helpful in the removal or disassembly of components or subassemblies.

To open the 172, remove the three screws at the front of the bottom plate and the two bottom-center screws from each side-panel.

Circuit Board Replacement. If a circuit board is damaged beyond repair, either the entire assembly including all soldered 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.

NOTES

SECTION 5
PERFORMANCE CHECK/CALIBRATION

GENERAL

Introduction

The 172 should be checked and, if necessary, recalibrated after each 1000 hours of operation or at least once every six months, to ensure that it is operating properly. In addition, portions of the instrument may require recalibration if components are replaced or other electrical repairs are made. This procedure provides instructions for adjusting the 172 internal adjustments and checking the performance of the 172 against the electrical characteristics listed in Section 1.

Maintenance

Any maintenance required on the 172 should be completed before starting this procedure. If instrument troubles occur while using this procedure, they should be corrected before proceeding. Repair and servicing information is given in the Maintenance Section.

Equipment List

The following equipment list shows the required test equipment ranges and tolerances and suggests particular test instruments. For accurate measurement, the tolerances required for each piece of test equipment must be more rigorous than the measured tolerance by at least 4 times. For measured tolerances of less than 1%, the accuracy of the test equipment must be more rigorous than that tolerance by at least 10 times.

I. Type 576 Curve Tracer.

2. DC Voltmeter—Requirements: range of 0.1 V to ±500 V, basic accuracy of ±0.1%, input impedance of at least 500 MΩ. Fluke Model 801B differential voltmeter suggested. A digital voltmeter can be used if its input impedance is accurately known, If the meter chosen has an input impedance of less than 500 MΩ, the voltages measured in steps 5 and 8 will not coincide with those shown in Tables 5-2 and 5-4. Instructions for calculating the proper voltages are given in those steps.

3. Continuity Checker—Requirements: Measure 0 Ω and ∞.

4. Variable Autotransformer (e.g., General Radio, Variac Type W10MT3W for 115-volt operation, or Type W20HMT3A for 230-volt operation). Minimum Requirements: Output voltage variable from 90 V to 136 VAC RMS for 115-volt operation or from 180 V to 272 VAC RMS for 230-volt operation; power output of at least 305 watts. If a monitor voltmeter is not included, a separate AC voltmeter is required.

5. DC Ammeter or Shunt Resistors—The DC voltmeter (Item 1) and a group of shunt resistors (see Table 5-1) are used to measure the accuracy of the collector current portion of the VERTICAL switch and the current portion of the AMPLITUDE switch. The more convenient but more expensive method of checking these switches is to use a DC ammeter with the following range and accuracy: range from 0.50 μA to 1.0 A, accuracy within 0.5%. If such an ammeter is available, the first 7 resistors in Table 5-1 are not needed.

6. Shunt Resistors—The DC voltmeter (Item 1) and a group of shunt resistors ranging from 25 kΩ to 25 MΩ (see Table 5-1) are used to measure the accuracy of the emitter current portion of the VERTICAL DEFLECTION FACTOR.

7. Miscellaneous Resistors—Some other resistors and a capacitor not mentioned in items 5 or 7 or this list are also required See Table 5-1.

TABLE 5-1

Resistors and Capacitor[1]

	Value	Watts	Accuracy
1	10 Ω	3	1/4%
2	100 Ω	1/2	
3	1 kΩ	1/4	
4	10 kΩ	1/4	
5	100 kΩ	1/8	
6	1 MΩ	1/8	
7	25 kΩ	1/8	1/4%
8	2.5 MΩ	1/8	
9	25 MΩ	1/8	
*	0.1 μF, 25 V		
10	454.5 Ω	11	1/4%
11	45.45 kΩ	11	

[1]These resistors are available from Tektronix, Inc. in a kit (Tektronix Part No. 067-0652-00).

8. NPN transistor with BV_{CEO} of 50 volts or more, h_{FE} of 50-200.

9. Twelve-inch patch cord with standard banana plugs.

10. Two very short patch cords with banana plug to alligator clip connectors.

11. Small screwdriver.

Use of the Procedure

The following procedure is arranged to allow either:

a. Adjustment of the 172.

b. A performance check of the 172 with respect to the electrical characteristics is given in Section 1.

To perform any of these operations, use one of the following methods.

ADJUSTMENT ONLY. Start with the Calibration Procedure and perform steps 1 through 4.

PERFORMANCE CHECK ONLY. Start with step 1 and perform the remaining steps. Sixteen programs, as shown in Figures 5-1 through 5-16 (pages 5-8 through 5-15), are used in the PERFORMANCE CHECK.

Control Settings

A complete list of initial control settings for the Type 576/172 and significant control settings for the test instruments precedes Step 1 of this procedure. In addition, partial lists of control settings are provided in various places throughout the procedures. Any control setting not listed in a partial list should be set as designated in the initial list of control settings for the respective procedure. If adjustments and/or checks are made without following one of the three procedures, start with the list of control settings preceding the desired adjustment or check and follow the sequency up to the desired step, making changes in control settings as indicated.

CALIBRATION

Preliminary

1. Plug the 172 into the Type 576.

2. Plug the Type 576 into the variable autotransformer. Adjust the autotransformer to nominal Type 576 line voltage.

3. Turn on the Type 576. Preset the controls as follows:

Initial Control Settings

Type 576/172

GRATICULE ILLUM	Graticule Lines Visible
INTENSITY	CCW
FOCUS	Centered
VERTICAL	2 mA COLLECTOR
DISPLAY OFFSET Selector	NORM (OFF)
CENTERLINE VALUE	0
HORIZONTAL	2 V COLLECTOR
Vertical POSITION	Control Centered
Vertical FINE POSITION	Control Centered
Horizontal POSITION	Control Centered
Horizontal FINE POSITION	Control Centered
DISPLAY INVERT	Not Pressed
ZERO	Not Pressed
CAL	Not Pressed
MAX PEAK VOLTS	15
PEAK POWER WATTS	0.1
VARIABLE COLLECTOR SUPPLY	Fully Counterclockwise
POLARITY	+ (NPN)
MODE	NORM
LOOPING COMPENSATION	As is
NUMBER OF STEPS	5
CURRENT LIMIT	2 A
AMPLITUDE	20 μA
OFFSET	ZERO
OFFSET MULT	0.00 (fully counterclockwise)
STEPS	Pressed
PULSED STEPS	Released
STEP FAMILY	REP
RATE	NORM
POLARITY INVERT	Released
STEP MULT .1X	Released
LEFT-OFF-RIGHT	RIGHT
AUTO-MANUAL	MANUAL
RATE	Centered

Adjustment

4. Adjust the 172 as follows:

a. Install a card containing program 1 (Fig. 5-1) in the card reader.

b. ADVANCE the 172 to test 3.

c. Place a 10 kΩ, 0.1% resistor and 10 μF 10 V capacitor in parallel between the RIGHT B and E terminals. Connect the voltmeter from the B terminal to TEST 8 EMITTER (GND). (Remove the Type 576 bottom cover to perform step d.)

d. Adjust R761 so that the B voltage is 0 V ±0.001 V. Replace the Type 576 bottom cover.

e. ADVANCE the 172 to Test 4.

f. Adjust R729 so that the voltage across the 10 kΩ is 1.1 V ±2%. Check in −(PNP) for −1.1 V ±2%.

PERFORMANCE CHECK

1. Sequencer/Readout

a. Install a card containing program 2 (Fig. 5-2) in the card reader. Place a protective cover (Tektronix Part No. 337-1194-00) on the 172, and close the lid.

b. Press the ADVANCE button. The 172 should switch to test 1, and indicator lamp 1 should light. Adjust READOUT ILLUMINATION, manually sequence the 172 through tests 2-11 by pressing the ADVANCE button. Each test should be indicated by its test number lamp. Check an NPN transistor (item 8, Equipment List) to verify proper test 1 operation.

c. Switch the AUTO-MANUAL switch to AUTO. Press the ADVANCE switch. The 172 will automatically sequence through tests 2-11 and then stop with no test number lamp lit. This is the "rest" condition.

d. Check RATE control range. A complete sequence (all 11 tests) should take >16.5 s with RATE CCW, and <4.5 s with RATE CW.

MANUAL POS.

e. Open the protective cover lid, ADVANCE the 172 to test 5 and verify that the yellow HIGH VOLTAGE DISABLED lamp lights. Press the red WARNING LIGHT. The yellow light will go out and the WARNING LIGHT will come on, while it is depressed. Close the protective cover lid.

f. Move the AUTO-MANUAL switch to MANUAL. ADVANCE the 172 through tests 1-11, and verify that the readouts are as listed:

	Deflection Factor	
Test	Vertical	Horizontal
1	2 mA/Div	2 V/Div
2	2 mA/Div	500 mV/Div
3,4	500 μA/Div	500 mV/Div
5-7	500 nA/Div	500 mV/Div
8-11	500 μA/Div	500 mV/Div

g. Install a card containing program 3 (Fig 5-3) in the card reader.

h. ADVANCE the 172 through test 2-11, and check that the readouts are as listed:

Test	Deflection Factor	Horizontal
2	2 mA/Div	2 V/Div
3,4	2 mA/Div	2 V/Div
5-11	2 mA/Div	20 V/Div

2. Sweep Voltages

a. Set the autotransformer for the lowest voltage within the voltage range selected by the Line Voltage Selector assembly on the rear panel of the Type 576.

b. Use patch cords to short the C and E terminals, the E and E sense terminals, and the C and C sense terminals.

c. Install a card containing program 4 (Fig. 5-4) in the card reader.

d. ADVANCE the 172 to test 3. Adjust INTENSITY. Verify that the short circuit exceeds 150 mA, and that the open circuit voltage (when LEFT-OFF-RIGHT is OFF) is more than 10 divisions in length.

e. Test the following parameters as performed in step d.

Program	Test	Horizontal Deflection	Current (Short Circuit)	Sweep Voltage (Open Circuit)
4	3	2 V	>150 mA	>10 Horiz. div.
(Fig. 5-4)	4	1 V	>150 mA	>10 Horiz. div.
5 (Fig. 5-5)	3	500 mV	>2 A	>10 Horiz. div.
1	3	100 mV	>1.5 A	>10 Horiz. div.
(Fig. 5-1)	4	200 mV	>1.5 A	>10 Horiz. div.

3. Check Kelvin Sensing Resistors

a. Leave the card containing program 1 (test 3 only is used) (Fig. 5-1) in the card reader.

b. ADVANCE the 172 to test 3, and move the MAGNIFIER to HORIZ X10.

LEFT-OFF, RIGHT switch in Right.

c. Observe a trace extending more than 3 divisions vertically and about 1 division horizontally.

d. Remove the patch cord between the E and E sense terminals. The horizontal deflection should increase by about 0.5 to 1 division. The change is caused by the voltage developed in the emitter sensing resistor.

e. Repeat step d with C and C sense patch cord.

f. Repeat steps b through e on the LEFT test terminals.

4. JFET, Diode Relays, and Front Panel Connectors

a. Install a card containing program 5 (Fig. 5-5) in the card reader.

b. Move the LEFT-OFF-RIGHT switch to RIGHT.

c. ADVANCE the 172 to test 3; verify that the Base terminal has 0 Ω with respect to the front panel TEST 8 EMITTER (GND) connector.

d. ADVANCE the 172 to test 5. Short the front panel TEST 5 BASE and EMITTER terminals.

e. Check that there is 0 Ω between the B and E terminals (RIGHT side).

f. ADVANCE the 172 to test 8. Move patch cord to TEST 8 EMITTER (GND) and BASE terminals.

g. Check that there is 0 Ω resistance between the RIGHT B and E terminals. Remove patch cord.

h. ADVANCE the 172 to test 10. Check that the C and E terminals are connected. check with a meter

i. ADVANCE the 172 to test 11. Check that the C and B terminals are connected.

● 5. Vertical Display Accuracy (3% ±1 nA unmagnified; 2% ±1 nA magnified)

Various precision resistances will be connected to the terminals to conduct drive current. Deflection and attenuator accuracy will be checked by this means. Table 5-2 lists the pertinent information.

a. Install a card containing program 6 (Fig. 5-6) in the card reader.

b. Connect a 100 kΩ resistor between the C and E terminals, RIGHT side.

c. Connect the voltmeter from the C terminal end of the 100 kΩ to the front panel TEST 8 EMITTER (GND) connector.

d. ADVANCE the 172 to test 8.

e. Press WARNING LIGHT, or close the protective cover lid in order to make the measurement.

WARNING

Enabling the Collector Supply without the use of the protective box, as described in step e, presents a potential hazard to the person checking the instrument. 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.

TABLE 5-2

Program Number	Test	Resistor	Connect Resistor From[3]	Vert. Defl. (A/DIV)	Programmed Drive	Approx. Resistor Voltage	Approx. Resistor Current	Magnified Accuracy Tolerance[2]
6	8	100 kΩ	C-E	1 μ	10 μA	1 V	10 μA	2%
	9	10 kΩ	C-E	10 μ	100 μA	1 V	100 μA	2%
	10	1 kΩ	C-B	100 μ	1 mA	1 V	1 mA	2%
	11	100 Ω	E-B	1 m	10 mA	1 V	10 mA	2%
7	[1]5	25 MΩ	C-E	5 n	1 V	1 V	40 nA	±3.5 minor div. Scope
	[1]6	2.5 MΩ	C-B	50 n	1 V	1 V	400 nA	±2.0 minor div. "
	[1]7	2.50 kΩ	E-B	500 n	1 V	1 V	4 μA	±2.0 minor div. "
	8	10 Ω	C-E	10 m	100 mA	1 V	100 mA	±1.5 minor div. "
	9	10 Ω	C-E	100 m	100 mA	1 V	100 mA	±1.5 minor div. "

[1] These resistors are internally wired.
[2] Program 7 is checked UNMAGNIFIED.
[3] The voltmeter should be connected to the first-mentioned terminal.

f. The 172 is now driving 10 μA through the 100 kΩ resistor. The resistor voltage is 1 V. A spot appears at the intersection of the first vertical graticule line and the tenth horizontal graticule line.

g. Switch the Type 576 magnifier to VERT X10. Now the voltage is causing about 100 divisions of vertical deflection. Set the DISPLAY OFFSET to 10 to return the display to the CRT center. Press the Type 576 CAL button and adjust the vertical FINE POSITION to bring the spot to the center horizontal graticule line. This line now represents 1 volt, and each vertical division represents 100 nA (100 kΩ) = 10 mV.

h. Measure the resistor voltage. This voltage is the reference for an accuracy check. For example, if the actual resistor voltage is 990 mV, then the proper reference for an accuracy check is 1 division below the center horizontal line. 2% of the total display size (100 div) is 2 divisions, so if the spot is within ±2 divisions of the resistor voltage line, the vertical deflection is within specified tolerance.

i. Using the procedure of steps g and h, check tests 9, 10, and 11 of program 6. When the yellow lamp lights, the red WARNING LIGHT must be pressed to apply voltage to the test terminals.

j. Install a card containing program 7 (Fig. 5-7) in the card reader.

k. Short the RIGHT side E and C terminals with a patch cord. Connect the voltmeter from the C terminal to TEST 8 EMITTER (GND). Move the LEFT-OFF-RIGHT switch to RIGHT.

l. ADVANCE the 172 to test 5.

m. Calculate the current from the reference voltage and resistance (internal for test 5, 6, and 7) value. Verify that the actual current as measured with the Type 576 readout is within ±3.5 minor divisions of the calculated reference current.

n. Check tests 6, 7, 8, and 9 as described in Table 5-2. Use the tolerances given there.

If a DC voltmeter with an input impedance of less than 500 MΩ is used to measure the voltage across the 25 MΩ 100 kΩ and 10 kΩ resistors, an error in the voltage reading may be noticed. To calculate the correct voltage under these conditions (V_2), multiply the voltage in the Resistor Voltage column of Table 5-2 (V_1) by the input impedance of the DC voltmeter (R_m) divided by the current sensing resistor (R_s) plus R_m:

$$V_2 = V_1 \frac{R_m}{R_m + R_s}$$

6. Horizontal Display Accuracy (±3% unmagnified, ±2% magnified)

Tests 5, 6, and 7 are used to supply drive voltages, which are measured with a voltmeter and used as a reference to check the horizontal display accuracy. Table 5-3 lists the pertinent information.

a. Install a card containing program 8 (Fig. 5-8) in the card reader.

b. Connect the voltmeter from the RIGHT C terminal to the front panel TEST 8 EMITTER (GND) connector.

c. ADVANCE the 172 to test 5.

d. Switch the MAGNIFIER to X10 HORIZ. Move the DISPLAY OFFSET to 10 to return the display to the CRT.

e. Press the CAL button and adjust the horizontal FINE to bring the spot to the center vertical graticule line. Read the drive voltage from the voltmeter, and verify that the display is within 2.0 major divisions (2%) of the drive voltage.

f. Using the procedure of steps d and e, check tests 6 and 7 of program 8, and test 5 of program 9 (Fig. 5-9).

7. Horizontal Base Attenuator (±2%)

Set the 576 controls as follows:

VERTICAL	1 mA
STEP GENERATOR	1 V
OFFSET	AID
OFFSET MULT	1.00
STEP FAMILY	SINGLE

a. Install a card containing program 10 (Fig. 5-10) in the card reader.

TABLE 5-3

Program	Test	Driven Terminal	Drive Voltage	Horiz. Defl. Factor	Divisions of Deflection	Accuracy Tolerance
8	5	C	1 V	100 mV	10	2%
	6	C	10 V	1 V	10	2%
Close Lid →	7	E	100 V	10 V	10	2%
" 9	5	C	500 V	50 V	10	2%

b. Monitor the B terminal voltage (RIGHT side) with the voltmeter.

c. ADVANCE the 172 to test 2. The spot will appear at (or near) the 10th division.

d. Move the MAGNIFIER to HORIZ X10. Set the DISPLAY OFFSET to 10 to return the spot to the screen. Press the CAL button and adjust the horizontal FINE to bring the spot to the center vertical graticule line. Read the base voltage from the voltmeter, and check that the spot is within 2.0 major divisions (2%) of the base voltage.

e. Install a program card containing program 11 (Fig. 5-11) in the card reader.

f. Move the OFFSET MULT to 10.00. Repeat steps b (base voltage is now 10 V), c, and d.

8. Current Supply

The current supply is tested by sending various programmed currents through precision resistors, and checking the resistor voltage to ascertain the current magnitude. Table 5-4 lists the tests.

a. Install a card containing program 12 (Fig. 5-12) in the card reader.

b. Connect a 1 MΩ resistor (and 0.1 μF capacitor, if needed) between the B and E terminals, RIGHT side. Move the LEFT-OFF-RIGHT switch to RIGHT. (Use the capacitor as necessary for noise reduction.)

c. Connect the voltmeter between the B terminal and TEST 8 EMITTER (GND). First terminal

d. ADVANCE the 172 to test 3 and check that the voltage is 0.1 V ±0.033 V.

e. Check the remainder of program 12 voltages as listed in TABLE 5-4.

f. Install a card containing program 13 (Fig. 5-13) in the card reader. Program 13 tests should be made four times, at

TABLE 5-4

Program	Test	Connect Resistor from	Resistor	Current Drive	DC Voltage	DC Current
12	3	B-E	1 MΩ	.1 μA	.1 V ±.033 V	.1 μA ±.033 μA
	4	B-E	1 MΩ	.2 μA	.2 V ±.036 V	.2 μA ±.018 μA
	8	C-E	1 MΩ	.3 μA	.3 V ±.039 V	.3 μA ±.013 μA
	9	C-E	1 MΩ	.4 μA	.4 V ±.040 V	.4 μA ±.010 μA
	10	C-B	1 MΩ	1.0 μA	1 V ±.05 V	1.0 μA ±.05 μA
	11	E-B	1 MΩ	2.0 μA	2 V ±.06 V	2.0 μA ±.03 μA
13	3	B-E	1 MΩ	3.0 μA	3 V ±.09 V	3.0 μA ±.03 μA
	4	B-E	1 MΩ	4.0 μA	4 V ±.108 V	4.0 μA ±.027 μA
	8	C-E	10 kΩ	110 μA	1.1 V ±.0022 V	110 μA ±.22 μA
	9	C-E	1 kΩ	1.1 mA	1.1 V ±.022 V	1.1 mA ±22 μA
close lid →	10	C-B	45.45 kΩ	11 mA	500 V ±10 V	11 mA ±.22 mA
close lid →	11	E-B	454.5 Ω	110 mA	50 V ±1 V	110 mA ±2.2 mA

high line and low line in both +(NPN) and −(PNP) polarities.

g. Perform the specified voltage tests, using the listed resistors.

9. Voltage Supply (3% ±300 mV)

The voltage supply output is checked under load at high line and low line in both +(NPN) and −(PNP) polarities. High line tests are made using program 14 (Fig. 5-14); low line tests use program 15 (Fig. 5-15). Table 5-5 lists the test information.

a. Install a card containing program 14 (Fig. 5-14) in the card reader.

b. Connect a 2 kΩ 5% resistor (not included in kit of Table 5-1) between the C and E terminals. Connect the +voltmeter lead to the C terminal. Adjust the variable autotransformer to high line.

c. ADVANCE the 172 to test 5, and check that the resistor voltage is within specifications.

d. Check the voltage supply in tests 6 and 7, using the listed resistors.

e. Move the Type 576 POLARITY switch to −(PNP) and repeat steps c and d.

f. Install a card containing program 15 (Fig. 5-15) in the card reader.

g. Adjust the variable autotransformer to low line.

h. Connect a 2.5 MΩ resistor between the C and E terminals. Monitor the C terminal voltage with the voltmeter.

i. ADVANCE the 172 to test 5, and check that the resistor voltage is within specifications.

j. Repeat step d for tests 6 and 7, program 15.

k. Move the Type 576 POLARITY switch to +(NPN) and repeat steps i and j.

TABLE 5-5

Program	Test	Resistor	Connect Resistor	Voltage Drive	Vertical Current Compliance	Voltage Tolerance	Note
14	5	2 k ±5%	C-E	1 V	0.5 mA	±0.33 V	High line
	6	25 k	C-B	10 V	0.4 mA	±0.6 V	
close lid	7	100 k	E-B	50 V	0.5 mA	±1.8 V	
15	5	2.5 M	C-E	1 V	0.4 μA	±0.33 V	Low line
	6	25 M	C-B	10 V	0.4 μA	±0.6 V	
Close Lid	7	1 M	E-B	500 V	0.5 mA	±15.3 V	

10. Voltage Supply Current Limiting

This check tests the current-limiting circuitry of the 172 voltage supply. 100 V and 400 V are programmed. The 172 should NOT supply 100 V or 400 V. Table 5-6 lists the tests.

a. Install a card containing program 16 (Fig. 5-16) in the card reader.

Perform these checks in both +(NPN) and −(PNP) polarities.

This concludes the 172 Calibration Procedure.

TABLE 5-6

Program	Test	Resistor	Connect Resistor	Voltage Program	Voltage Out
Close 16 Lid	5	100 k	C-E	100 V	≈85 V
Close Lid	6	100 k	C-B	400 V	≈110 V

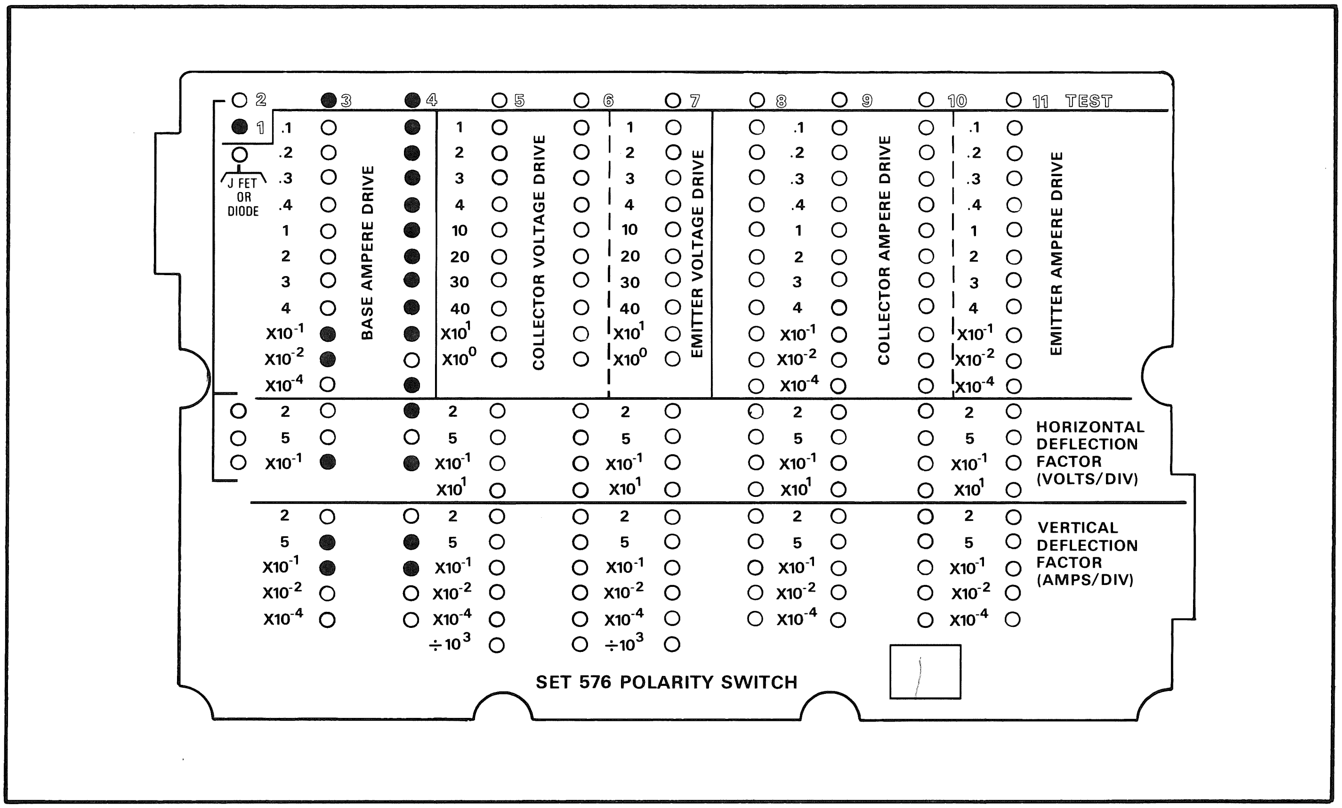


Fig. 5-1. Program 1.

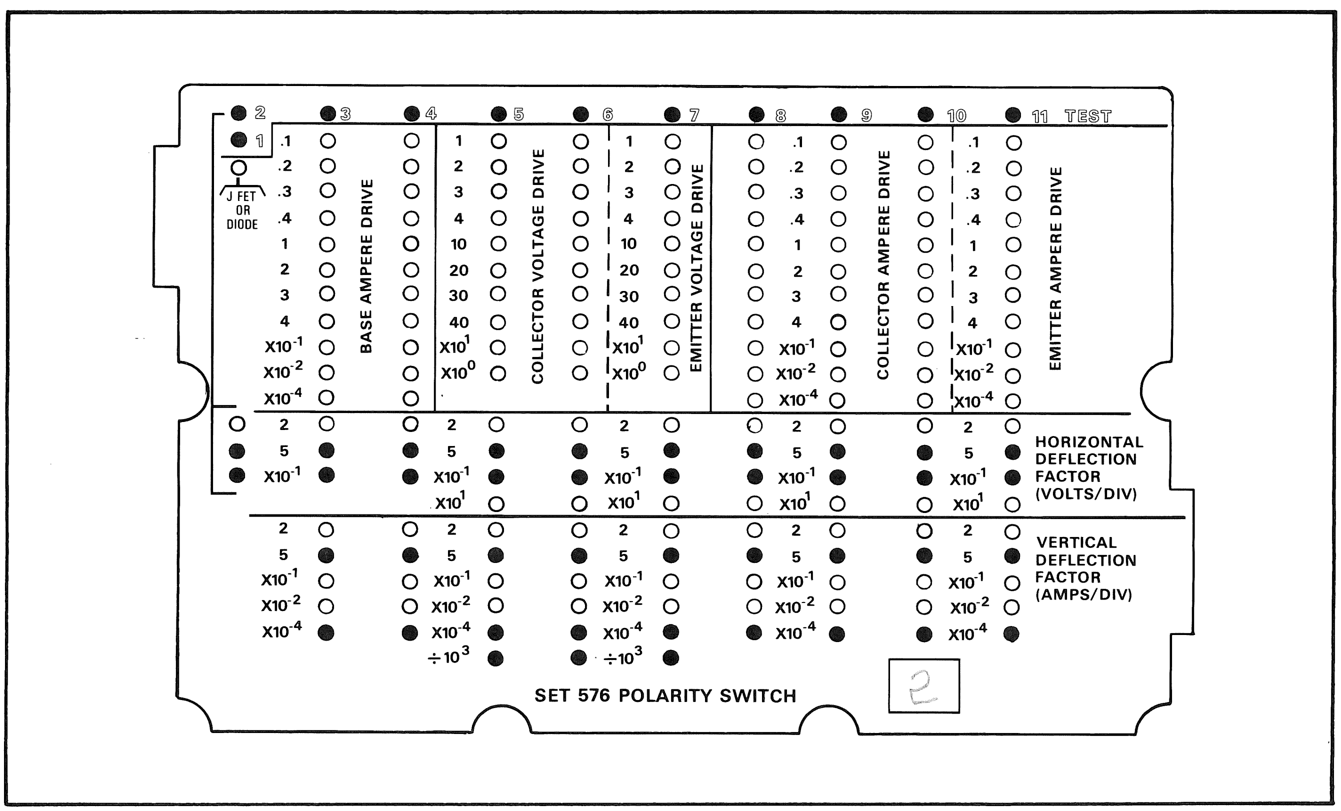


Fig. 5-2. Program 2.

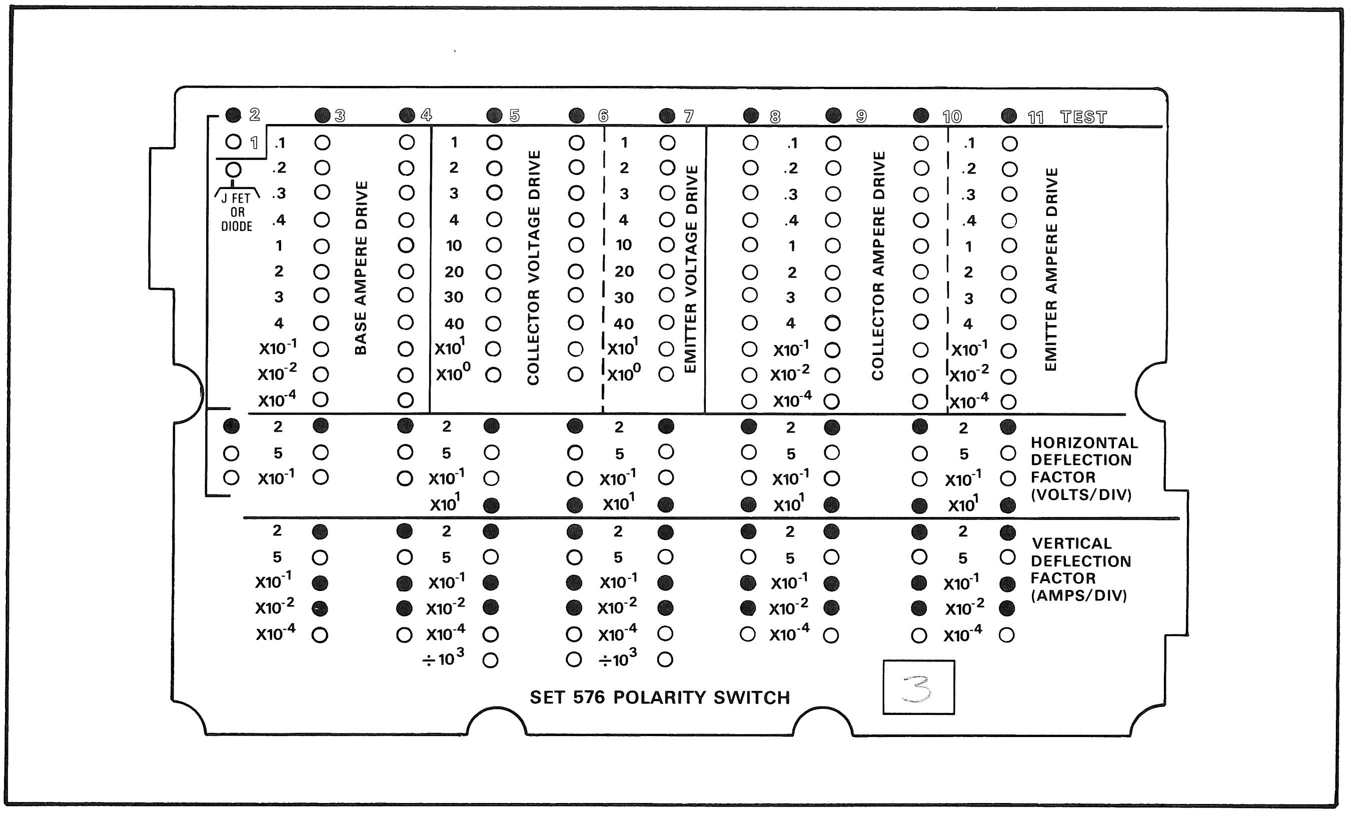


Fig. 5-3. Program 3.

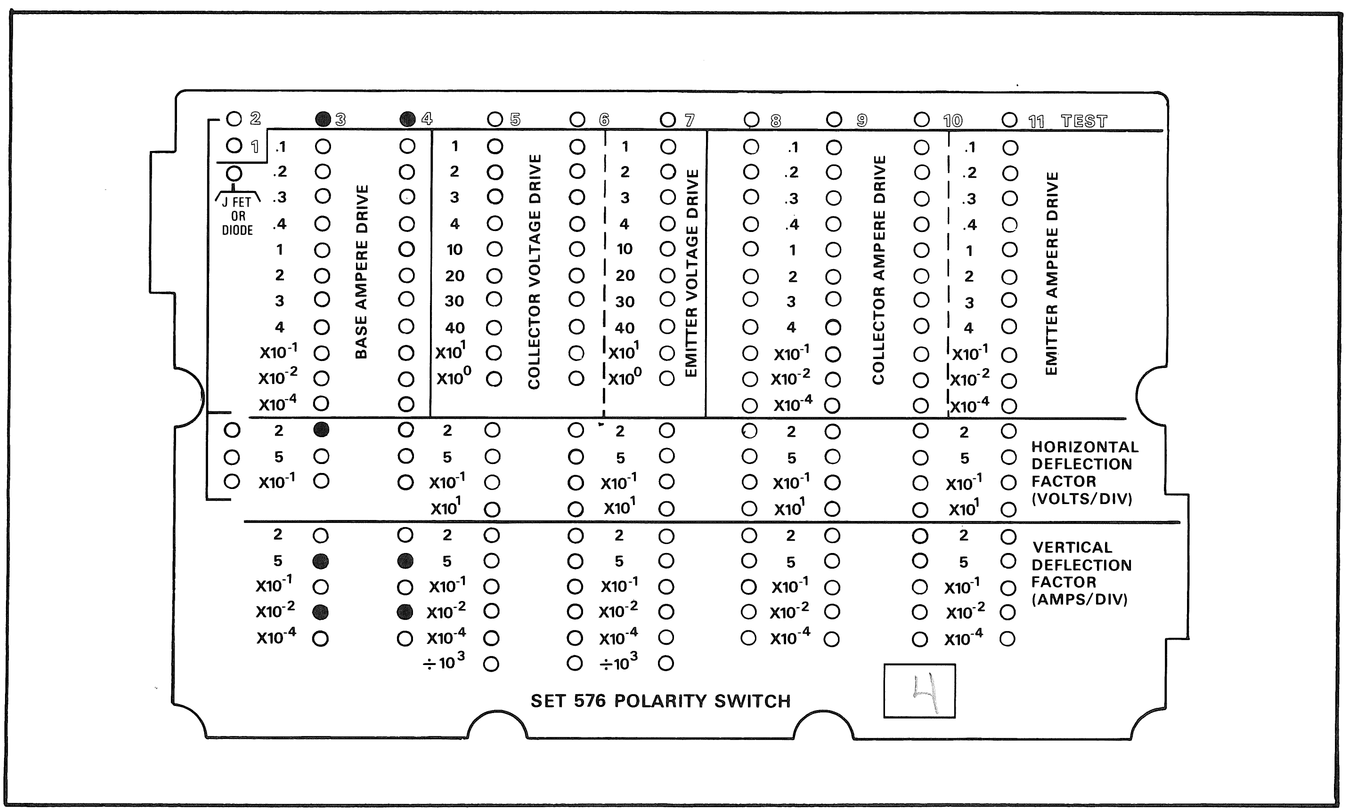


Fig. 5-4. Program 4.

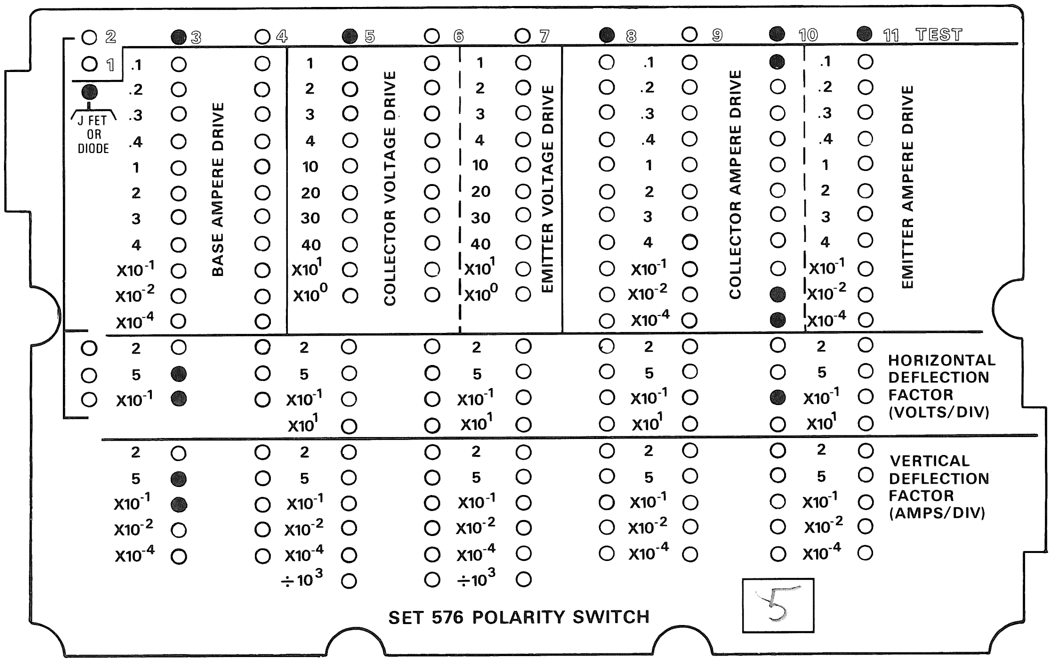


Fig. 5-5. Program 5.

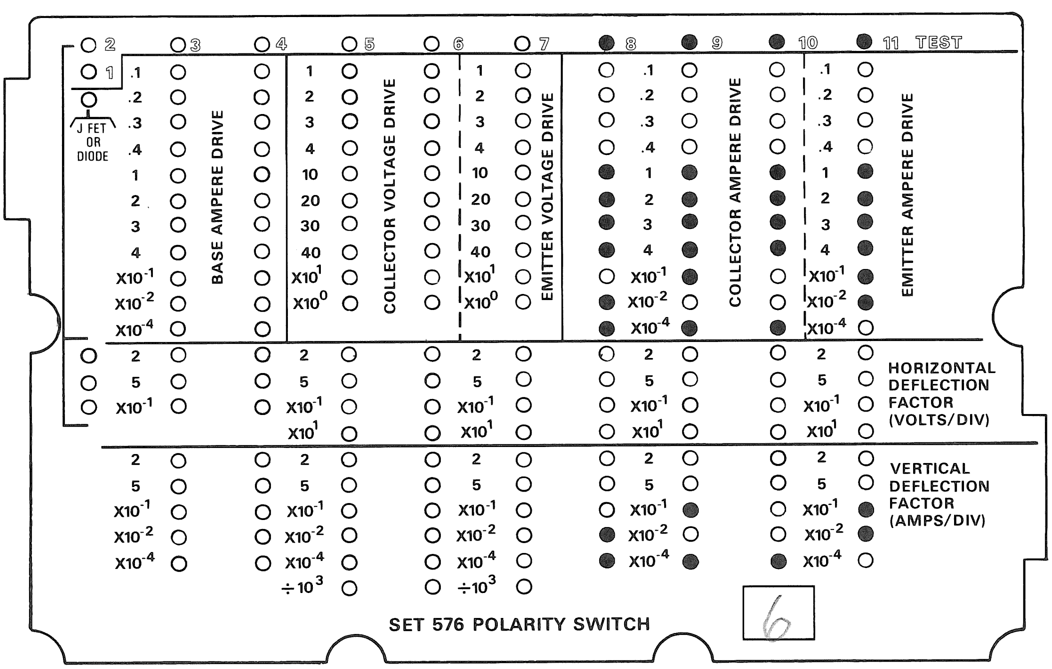


Fig. 5-6. Program 6.

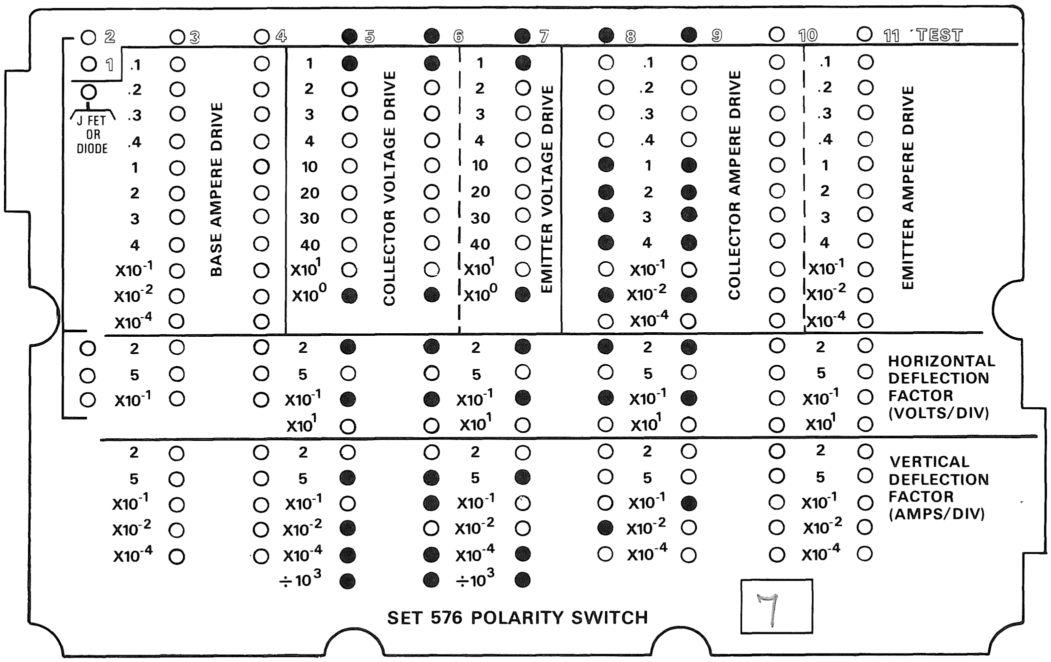


Fig. 5-7. Program 7.

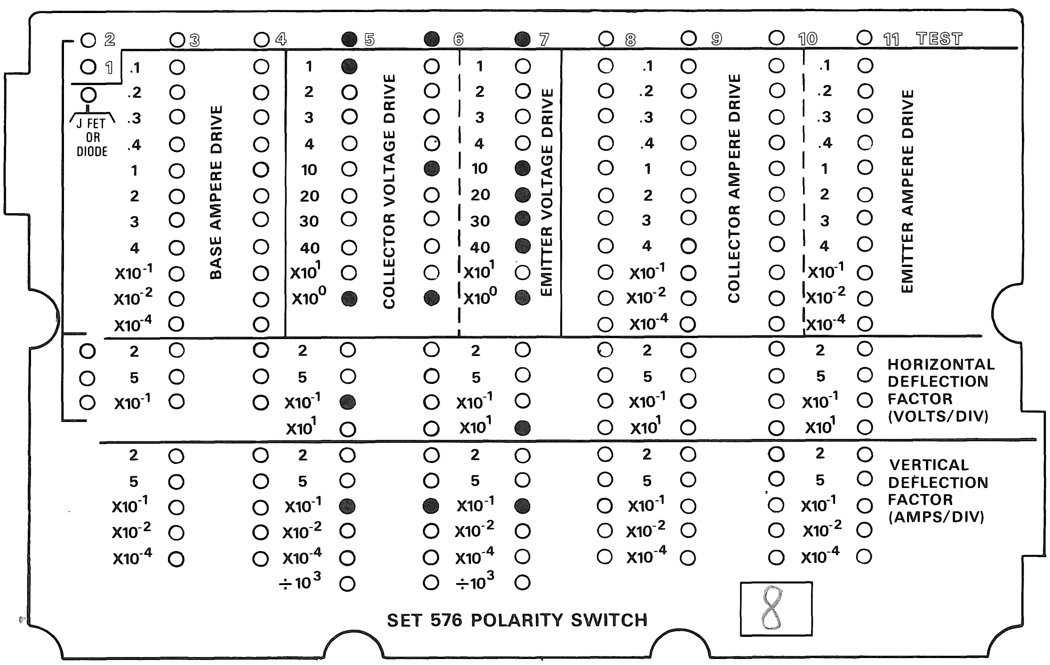


Fig. 5-8. Program 8.

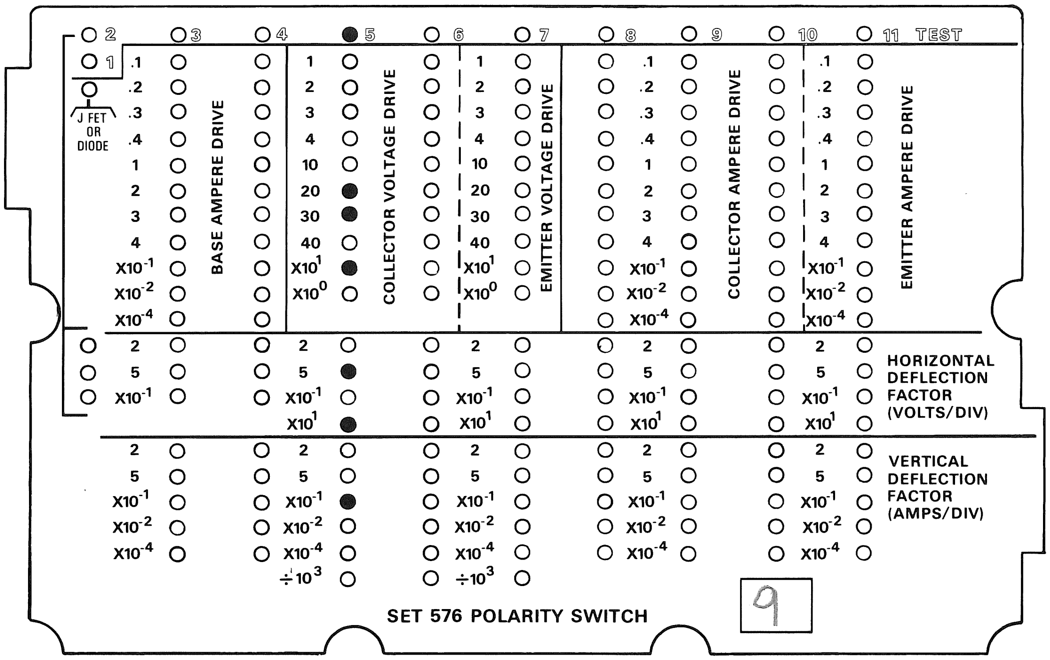


Fig. 5-9. Program 9.

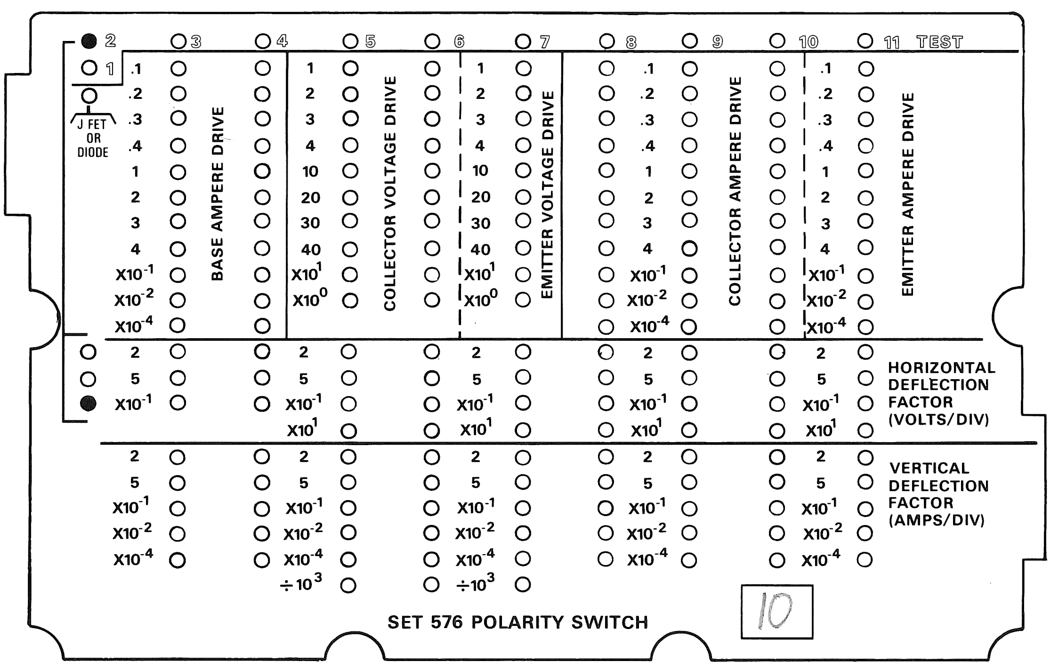


Fig. 5-10. Program 10.

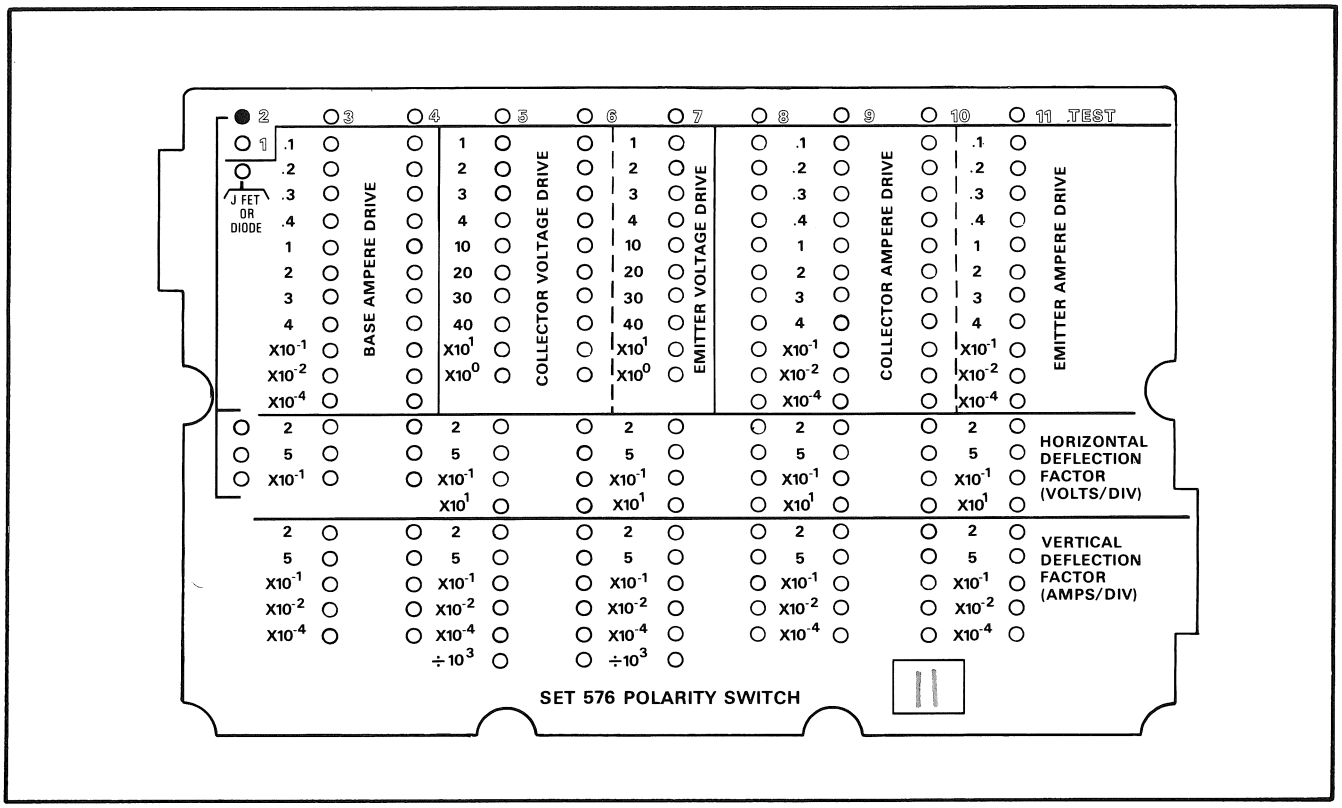


Fig. 5-11. Program 11.

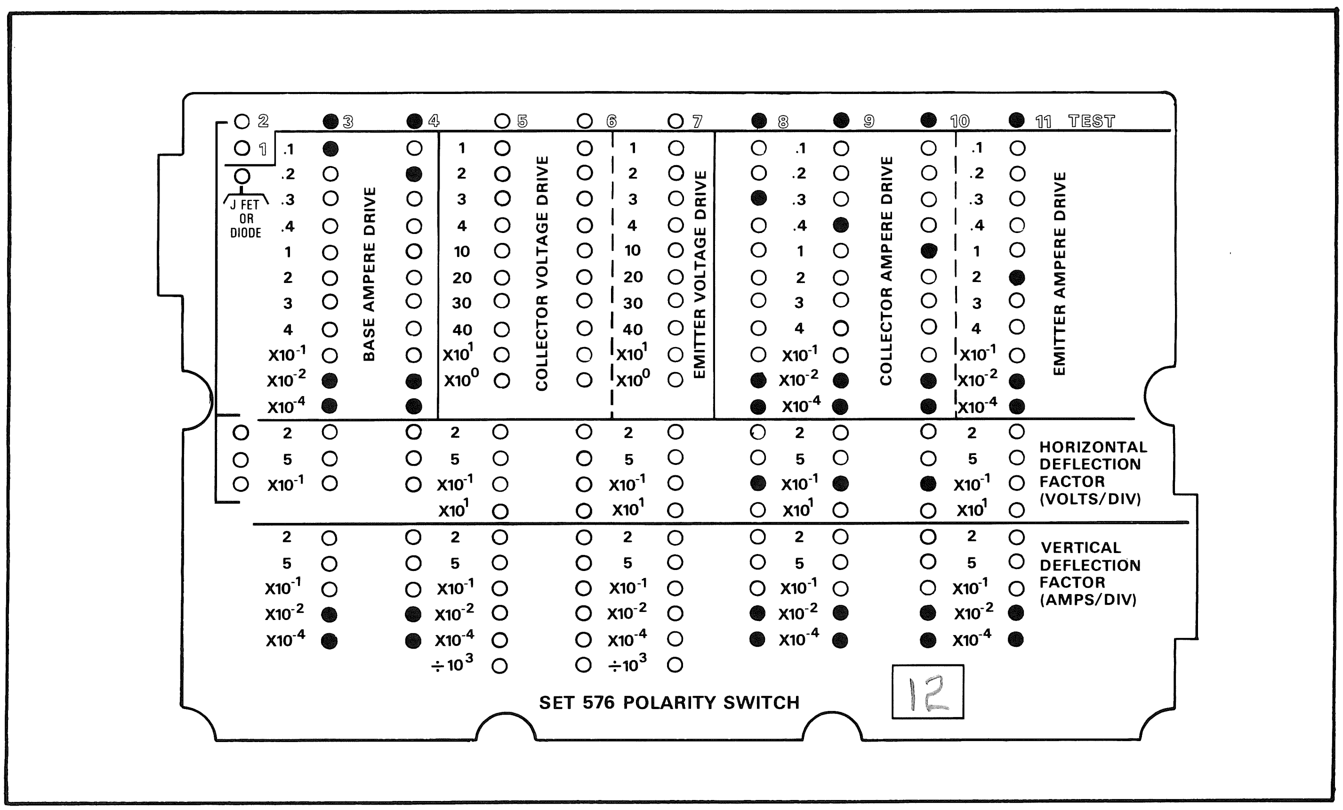


Fig. 5-12. Program 12.

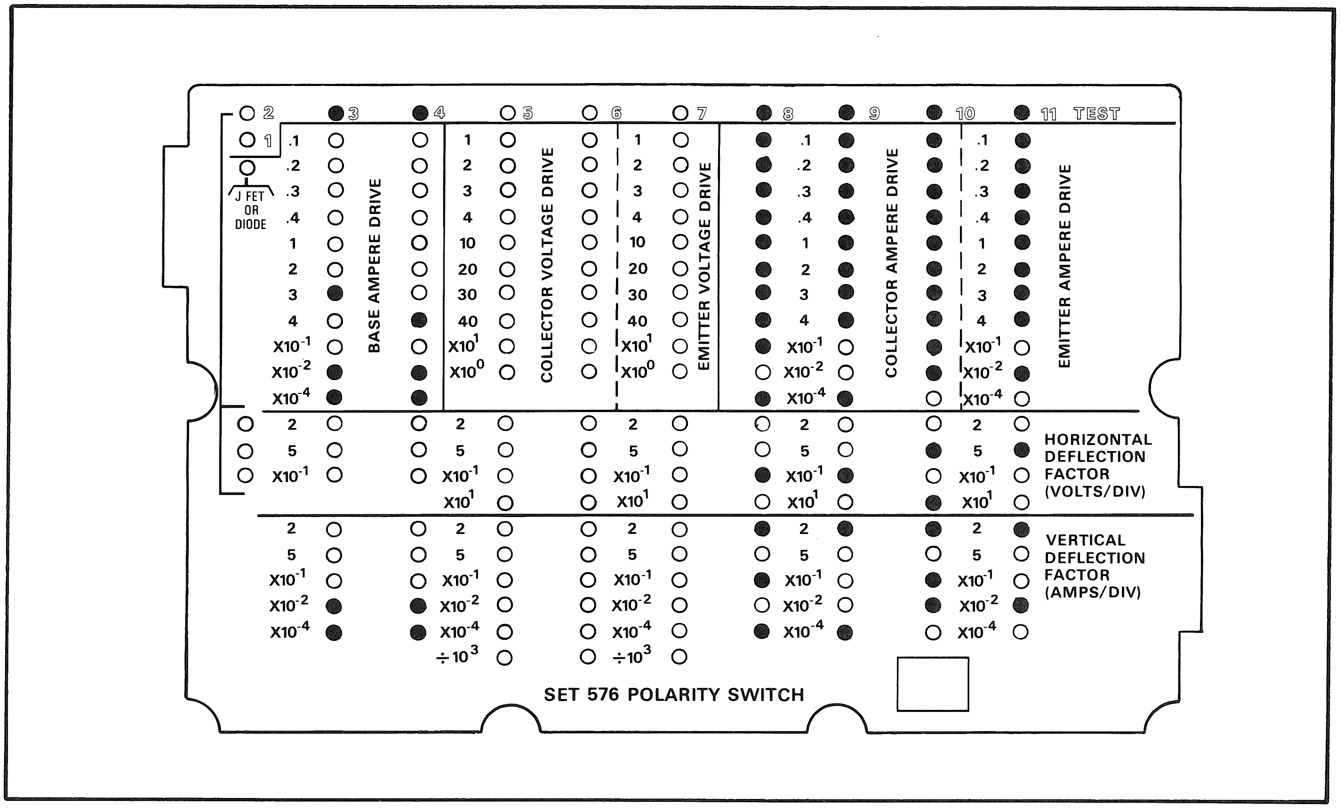


Fig. 5-13. Program 13.

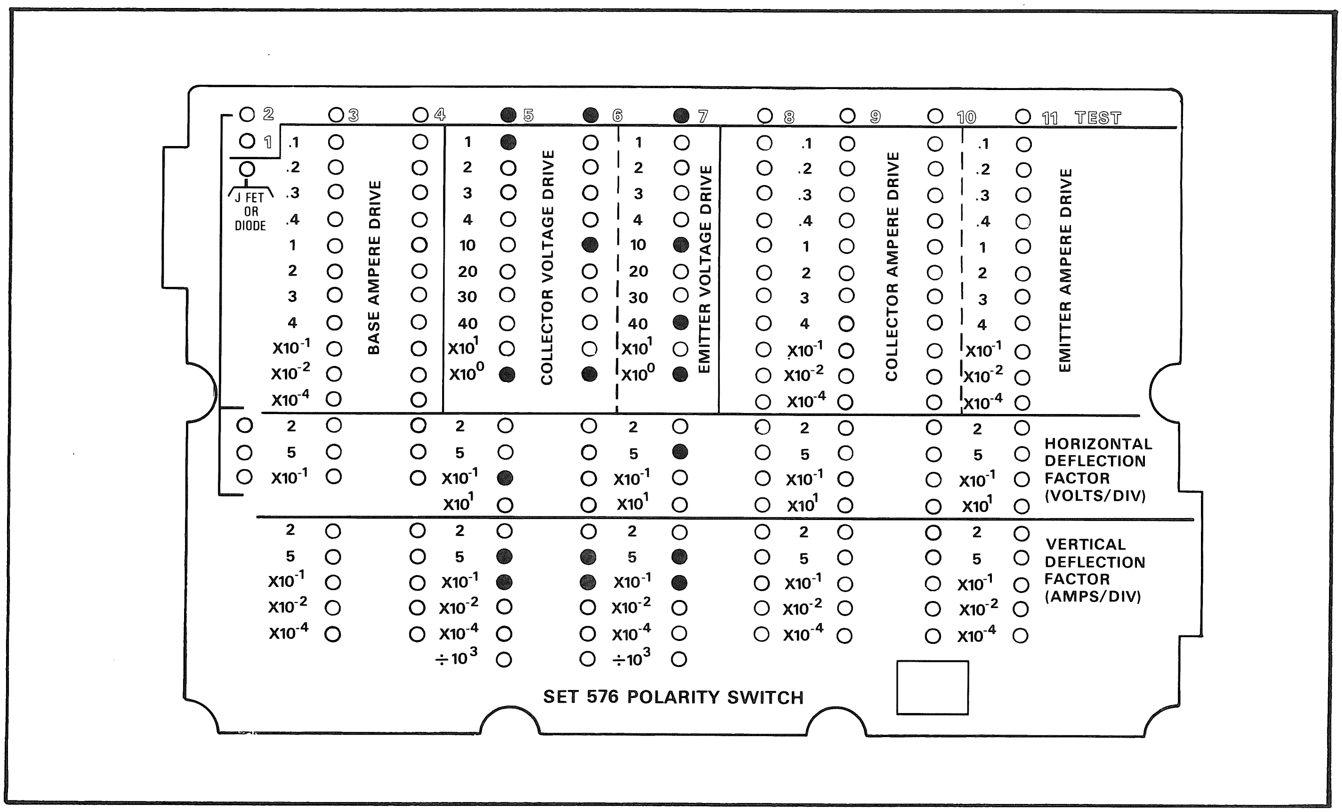


Fig. 5-14. Program 14.

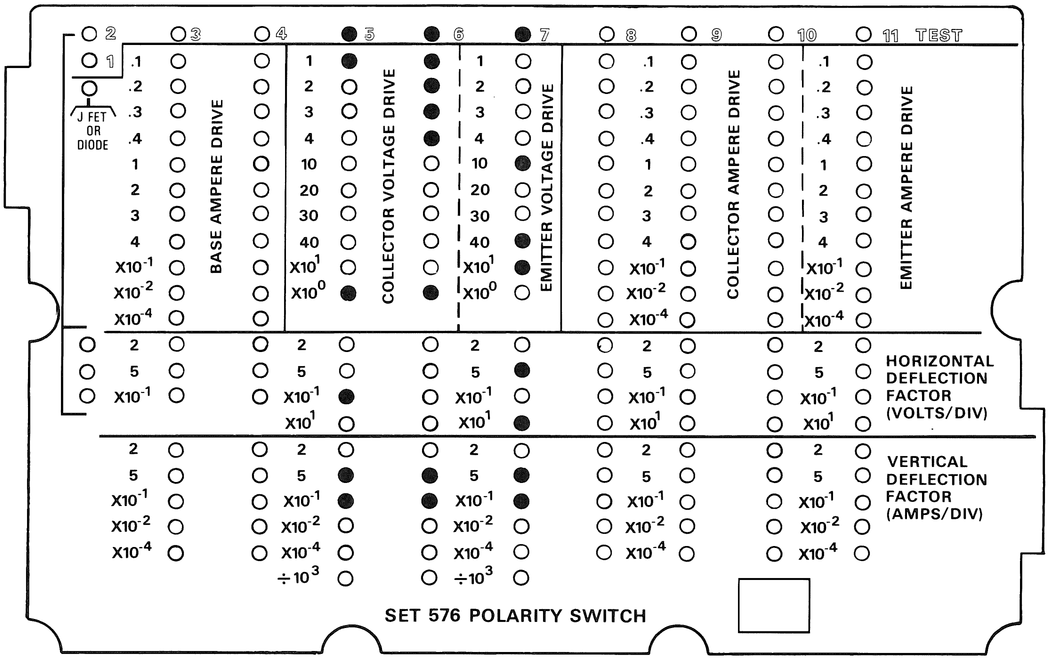


Fig. 5-15. Program 15.

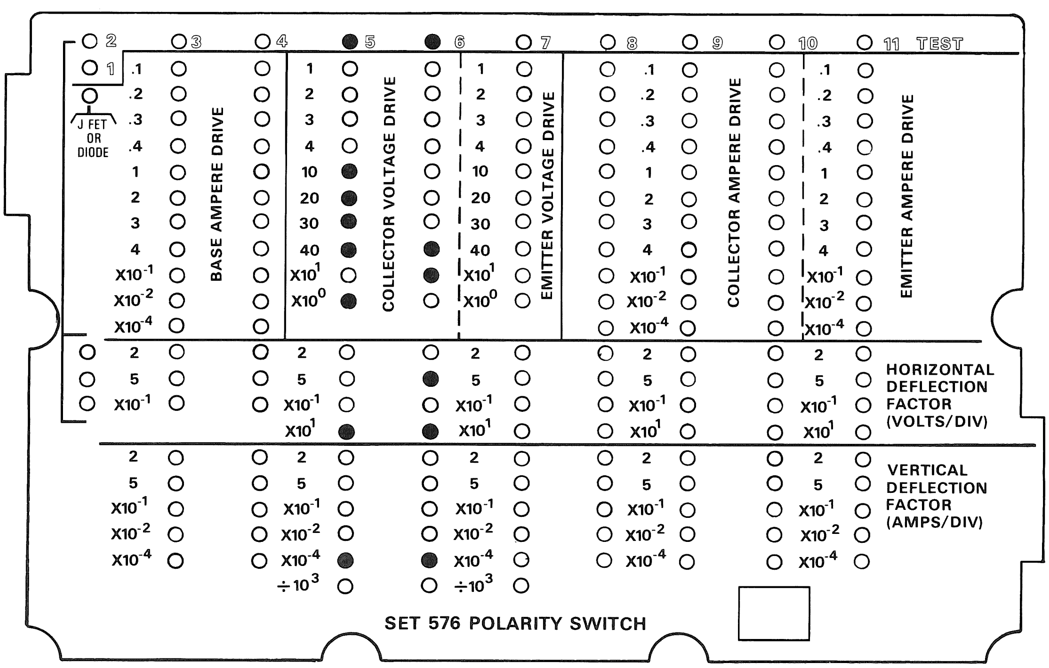


Fig. 5-16. Program 16.

NOTES

SECTION 6
ELECTRICAL PARTS LIST

Replacement parts should be ordered from the Tektronix Field Office or Representative in your area. Changes to Tektronix products give you the benefit of improved circuits and components. Please include the instrument type number and serial number with each order for parts or service.

ABBREVIATIONS AND REFERENCE DESIGNATORS

A	Assembly, separable or repairable	FL	Filter	PTM	paper or plastic, tubular molded
AT	Attenuator, fixed or variable	H	Heat dissipating device (heat sink, etc.)	R	Resistor, fixed or variable
B	Motor	HR	Heater	RT	Thermistor
BT	Battery	J	Connector, stationary portion	S	Switch
C	Capacitor, fixed or variable	K	Relay	T	Transformer
Cer	Ceramic	L	Inductor, fixed or variable	TP	Test point
CR	Diode, signal or rectifier	LR	Inductor/resistor combination	U	Assembly, inseparable or non-repairable
CRT	cathode-ray tube	M	Meter	V	Electron tube
DL	Delay line	Q	Transistor or silicon-controlled rectifier	Var	Variable
DS	Indicating device (lamp)	P	Connector, movable portion	VR	Voltage regulator (zener diode, etc.)
Elect.	Electrolytic	PMC	Paper, metal cased	WW	wire-wound
EMC	electrolytic, metal cased	PT	paper, tubular	Y	Crystal
EMT	electrolytic, metal tubular				
F	Fuse				

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
ASSEMBLIES				
A1	670-1654-00			UPPER MAIN Circuit Board Assembly
A2	670-1653-00			LOWER MAIN Circuit Board Assembly
A3	670-1652-00			DIODE MATRIX Circuit Board Assembly
CAPACITORS				
C51	285-0925-00			3 µF, PTM, 200 V, 10%
C410	281-0523-00			100 pF, Cer, 350 V, 20%
C421	290-0183-00			1 µF, Elect., 35 V, 10%
C433	283-0081-00			0.1 µF, Cer, 25 V, +80%-20%
C435	285-0719-00			0.015 µF, PTM, 100 V, 5%
C441	285-0702-00			0.033 µF, PTM, 100 V, 5%
C455	283-0198-00			0.22 µF, Cer, 50 V, 20%
C458	290-0526-00			6.8 µF, Elect., 6 V, 20%
C459	283-0081-00			0.1 µF, Cer, 25 V, +80%-20%
C482	283-0167-00			0.1 µF, Cer, 200 V, 10%
C600	283-0000-00			0.001 µF, Cer, 500 V, +100%-0%
C601	283-0041-00			0.0033 µF, Cer, 500 V, 5%
C602	283-0068-00			0.01 µF, Cer, 500 V, +100%-0%
C613	283-0626-00			1800 pF, Mica, 5%
C618	281-0580-00			470 pF, Cer, 500 V, 10%
C700	281-0638-00			240 pF, Cer, 500 V, 5%
C707	290-0513-00			510 µF, Elect., 25 V, +75%-10%
C708	290-0513-00			510 µF, Elect., 25 V, +75%-10%
C709	283-0059-00			1 µF, Cer, 25 V, +80%-20%
C712	290-0370-00			25 µF, Elect., 350 V, +50%-10%
C713	290-0370-00			25 µF, Elect., 350 V, +50%-10%
C717	290-0442-00			120 µF, Elect., 150 V, +75%-10%
C718	283-0013-00			0.1 µF, Cer, 1000 V
C720	290-0519-00			100 µF, Elect., 20 V, 20%
C721	290-0519-00			100 µF, Elect., 20 V, 20%
C743	283-0008-00			0.1 µF, Cer, 500 V
C747	283-0000-00			0.001 µF, Cer, 500 V, +100%-0%
C758	283-0104-00			2000 pF, Cer, 500 V
C780	281-0524-00			150 pF, Cer, 500 V, 20%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
SCD, DIODES				
CR1M-X	152-0141-02			Silicon, replaceable by 1N4152
CR2M-X	152-0141-02			Silicon, replaceable by 1N4152
CR3A-X	152-0141-02			Silicon, replaceable by 1N4152
CR4A-X	152-0141-02			Silicon, replaceable by 1N4152
CR5A-X	152-0141-02			Silicon, replaceable by 1N4152
CR6A-X	152-0141-02			Silicon, replaceable by 1N4152
CR7A-X	152-0141-02			Silicon, replaceable by 1N4152
CR8A-X	152-0141-02			Silicon, replaceable by 1N4152
CR9A-X	152-0141-02			Silicon, replaceable by 1N4152
CR10A-X	152-0141-02			Silicon, replaceable by 1N4152
CR11A-X	152-0141-02			Silicon, replaceable by 1N4152
CR410-CR639	152-0141-02			Silicon, replaceable by 1N4152
CR640	152-0107-00			Silicon, replaceable by T160 or 1N647
CR641	152-0107-00			Silicon, replaceable by T160 or 1N647
CR642	152-0141-02			Silicon, replaceable by 1N4152
CR700	152-0406-00			Silicon, selected from W601
CR701	152-0141-02			Silicon, replaceable by 1N4152
CR702	152-0141-02			Silicon, replaceable by 1N4152
CR705	152-0488-00			Silicon, rectifier bridge
CR710	152-0331-00			Silicon, replaceable by 1S1592
CR711	152-0331-00			Silicon, replaceable by 1S1592
CR712	152-0331-00			Silicon, replaceable by 1S1592
CR713	152-0331-00			Silicon, replaceable by 1S1592
CR714	152-0141-02			Silicon, replaceable by 1N4152
CR715	152-0488-00			Silicon, rectifier bridge
CR717	152-0066-00			Silicon, selected from 1N3194
CR718	152-0066-01			Silicon, selected from 1N3194
CR720	152-0488-00			Silicon, rectifier bridge
CR721	152-0141-02			Silicon, replaceable by 1N4152
CR725	152-0141-02			Silicon, replaceable by 1N4152
CR727	152-0141-02			Silicon, replaceable by 1N4152
CR731	152-0141-02			Silicon, replaceable by 1N4152
CR732	152-0141-02			Silicon, replaceable by 1N4152
CR733	152-0141-02			Silicon, replaceable by 1N4152
CR734	152-0141-02			Silicon, replaceable by 1N4152
CR735	152-0141-02			Silicon, replaceable by 1N4152
CR736	152-0141-02			Silicon, replaceable by 1N4152
CR737	152-0141-02			Silicon, replaceable by 1N4152
CR738	152-0141-02			Silicon, replaceable by 1N4152
CR739	152-0141-02			Silicon, replaceable by 1N4152
CR740	152-0141-02			Silicon, replaceable by 1N4152
CR741	152-0141-02			Silicon, replaceable by 1N4152
CR742	152-0066-01			Silicon, selected from 1N3194
CR743	152-0066-01			Silicon, selected from 1N3194
CR744	152-0066-01			Silicon, selected from 1N3194
CR745	152-0066-01			Silicon, selected from 1N3194
CR746	152-0066-01			Silicon, selected from 1N3194
CR747	152-0066-01			Silicon, selected from 1N3194
CR748	152-0066-01			Silicon, selected from 1N3194
CR749	152-0066-01			Silicon, selected from 1N3194

ELECTRICAL PARTS LIST (cont0

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
SCD, DIODES (cont)				
CR752	152-0141-02			Silicon, replaceable by 1N4152
CR753	152-0141-02			Silicon, replaceable by 1N4152
CR754	152-0141-02			Silicon, replaceable by 1N4152
CR755	152-0141-02			Silicon, replaceable by 1N4152
CR758	152-0141-02			Silicon, replaceable by 1N4152
CR760	152-0141-02			Silicon, replaceable by 1N4152
CR761	152-0141-02			Silicon, replaceable by 1N4152
CR770	152-0141-02			Silicon, replaceable by 1N4152
CR771	152-0141-02			Silicon, replaceable by 1N4152
CR772	152-0141-02			Silicon, replaceable by 1N4152
CR773	152-0141-02			Silicon, replaceable by 1N4152
CR780	152-0141-02			Silicon, replaceable by 1N4152
CR781	152-0141-02			Silicon, replaceable by 1N4152
CR782	152-0141-02			Silicon, replaceable by 1N4152
CR783	152-0141-02			Silicon, replaceable by 1N4152
CR784	152-0141-02			Silicon, replaceable by 1N4152
CR786	152-0141-02			Silicon, replaceable by 1N4152
CR787	152-0141-02			Silicon, replaceable by 1N4152
CR788	152-0141-02			Silicon, replaceable by 1N4152
CR790	152-0141-02			Silicon, replaceable by 1N4152
VR723	152-0168-00			Zener, replaceable by 1N963B, 400 mW, 12 V, 5%
VR725	152-0461-00			Zener, replaceable by 1N821, 400 mW, 6.2 V, 5%
VR731	152-0055-00			Zener, replaceable by 1N962B, 400 mW, 11 V, 5%
VR732	152-0055-00			Zener, replaceable by 1N962B, 400 mW, 11 V, 5%
BULBS				
DS1-DS11 DS25[1]	150-0075-00			Incandescent, T 1 3/4
DS26	150-0089-00			Incandescent, 14 V, 80 mA, yellow lens
FUSE				
F50	159-0032-00			1/2 A, 3 AG, slo-blo
CONNECTORS				
J21	131-0267-00			Phone jack
P360	131-0096-00			32 contact, male
P361	131-0017-00			Receptacle, electrical, 16 contact, male
P362	131-0017-00			Receptacle, electrical, 16 contact, male
P363	131-0149-00			24 contact, male
RELAYS				
K500	108-0340-00			Coil, reed drive, double
K500S1	260-0552-00			Switch, reed
K500S2	260-0552-00			Switch, reed
K520	108-0405-00			Coil, reed drive
K520S1	260-0817-00			Switch, mag reed, SPDT
K602	148-0083-00			Armature, 12V DC, 1000 Ω, 4PDT
K603	108-0405-00			Coil, reed drive
K603S1	260-0817-00			Coil, mag reed, SPDT
K604	108-0404-00			Coil, reed drive
K604S1	260-0722-00			Switch, reed, SPST

[1] Furnished as a unit with S25.

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RELAYS				
K604S2	260-0552-00			Switch, reed
K604S3	260-0552-00			Switch, reed
K605	108-0404-00			Coil, reed drive
K605S1	260-0722-00			Switch, reed, SPST
K605S2	260-0552-00			Switch, reed
K605S3	260-0552-00			Switch, reed
K606	108-0340-00			Coil, reed drive, double
K606S1	260-0552-00			Switch, reed
K606S2	260-0552-00			Switch, reed
K607	108-0340-00			Coil, reed drive, double
K607S1	260-0552-00			Switch, reed
K607S2	260-0552-00			Switch, reed
K608	108-0664-00			Coil, mag reed
K608S1	260-1305-00			Switch, mag reed
K608S2	260-1305-00			Switch, mag reed
K632	148-0076-00			Mag reed, 500 Ω coil
K633	108-0340-00			Coil, reed drive, double
K633S1	260-0722-00			Switch, reed, SPST
K633S2	260-0552-00			Switch, reed
K634	108-0404-00			Coil reed drive
K634S1	260-0722-00			Switch, mag reed, SPST
K634S2	260-0817-00			Switch, mag reed, SPDT
K634S3	260-0552-00			Switch, reed
K635	108-0404-00			Coil, reed drive
K635S1	260-0722-00			Switch, reed, SPST
K635S2	260-0817-00			Switch, mag reed, SPDT
K635S3	260-0552-00			Switch, reed
K637	108-0340-00			Coil, reed drive, double
K637S1	260-0817-00			Switch, mag reed, SPDT
K637S2	260-0722-00			Switch, reed, SPST
K701	148-0081-00			Armature, 12V DC, 1000 Ω, DPDT
K702	148-0081-00			Armature, 12V DC, 1000 Ω, DPDT
K714	148-0082-00			Armature, 12V DC, 1000 Ω, 4PDT
K716	108-0664-00			Coil, mag reed
K716S1	260-1304-00			Switch, mag reed
K716S2	260-1305-00			Switch, mag reed
K725	148-0085-00			Armature, 12V DC, 200 Ω, 8PDT
K726	108-0664-00			Coil, mag reed
K726S1	260-1304-00			Switch, mag reed
K726S2	260-1305-00			Switch, mag reed
K727	108-0405-00			Coil, reed drive
K727S1	260-0817-00			Switch, mag reed, SPDT
K731	148-0076-00			Mag reed, 500 Ω coil
K732	148-0076-00			Mag reed, 500 Ω coil
K733	148-0076-00			Mag reed, 500 Ω coil
K734	148-0076-00			Mag reed, 500 Ω coil
K735	148-0076-00			Mag,reed, 500 Ω coil
K736	148-0076-00			Mag reed, 500 Ω coil
K737	148-0076-00			Mag reed, 500 Ω coil
K738	148-0076-00			Mag reed, 500 Ω coil

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RELAYS				
K751	108-0405-00			Coil, reed drive
K751S1	260-0722-00			Switch, reed, SPST
K752	148-0076-00			Mag reed, 500 Ω coil
K753	148-0076-00			Mag reed, 500 Ω coil
K754	148-0076-00			Mag reed, 500 Ω coil
K755	148-0076-00			Mag reed, 500 Ω coil
K758	108-0340-00			Coil, reed drive, double
K758S1	260-0722-00			Switch, reed, SPST
K758S2	260-0722-00			Switch, reed, SPST
K780	148-0084-00			Armature, 12V DC, 1000 Ω, 4PDT
K781	148-0084-00			Armature, 12V DC, 1000 Ω, 4PDT
K782	108-0663-00			Coil, mag reed, 600 Ω
K782S1	260-1305-00			Switch, mag reed
K783	108-0663-00			Coil mag reed, 600 Ω
K783S1	260-1305-00			Switch, mag reed
K784	108-0663-00			Coil, mag reed, 600 Ω
K784S1	260-1305-00			Switch, mag reed
K786	148-0081-00			Armature, 12V DC, 1000 Ω, DPDT
K787	108-0405-00			Coil, reed drive
K787S1	260-0722-00			Switch, reed, SPST
K788	148-0082-00			Armature, 12V DC, 1000 Ω, 4PDT
INDUCTOR				
L50	108-0674-00			Toroid, 10 μH
TRANSISTORS				
Q60	151-0355-00			Silicon, NPN, replaceable by 2SC642A
Q61	151-0355-00			Silicon, NPN, replaceable by 2SC642A
Q410	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q420	151-0508-00			Silicon, unijunction, replaceable by X13T520 or selected from D13T1
Q430	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q440	151-0508-00			Silicon, unijunction, replaceable by X13T520 or selected from D13T1
Q450	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q457	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q480	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q487	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q489	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q490	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q494	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q496	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q498	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q500	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q542	151-0190-00			Silicon, replaceable by 2N3904 or TE3904
Q548	151-0190-00			Silicon, replaceable by 2N3904 or TE3904
Q582	151-0190-00			Silicon, replaceable by 2N3904 or TE3904
Q585	151-0190-00			Silicon, replaceable by 2N3904 or TE3904
Q598	151-0190-00			Silicon, replaceable by 2N3904 or TE3904
Q748	151-0190-00			Silicon, replaceable by 2N3904 or TE3904
Q775	151-0190-00			Silicon, replaceable by 2N3904 or TE3904
Q776	151-0188-00			Silicon, ~~NPN~~, replaceable by 2N3906 PNP

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS				
R1	316-0271-00			270 Ω, 1/4 W, 10%
R2	316-0472-00			4.7 kΩ, 1/4 W, 10%
R3	316-0121-00			120 Ω, 1/4 W, 10%
R20	311-0075-00			5 MΩ, Var
R31	316-0471-00			470 Ω, 1/4 W, 10%
R32	316-0220-00			22 Ω, 1/4 W, 10%
R33	316-0220-00			22 Ω, 1/4 W, 10%
R34	307-0103-00			2.7 Ω, 1/4 W, 5%
R35	307-0103-00			2.7 Ω, 1/4 W, 5%
R51	308-0223-00			35 Ω, 3 W, WW, 5%
R410	315-0242-00			2.4 kΩ, 1/4 W, 5%
R411	315-0622-00			6.2 kΩ, 1/4 W, 5%
R412	316-0103-00			10 kΩ, 1/4 W, 10%
R413	316-0222-00			2.2 kΩ, 1/4 W, 10%
R420	316-0106-00			10 MΩ, 1/4 W, 10%
R421	315-0274-00			270 kΩ, 1/4 W, 5%
R422	316-0470-00			47 Ω, 1/4 W, 10%
R424	316-0103-00			10 kΩ, 1/4 W, 10%
R427	316-0102-00			1 kΩ, 1/4 W, 10%
R428	316-0103-00			10 kΩ, 1/4 W, 10%
R430	316-0153-00			15 kΩ, 1/4 W, 10%
R433	315-0220-00			22 Ω, 1/4 W, 5%
R435	315-0275-00			2.7 MΩ, 1/4 W, 5%
R436	316-0682-00			6.8 kΩ, 1/4 W, 10%
R441	316-0564-00			560 kΩ, 1/4 W, 5%
R444	316-0103-00			10 kΩ, 1/4 W, 10%
R450	316-0222-00			2.2 kΩ, 1/4 W, 10%
R453	316-0472-00			4.7 kΩ, 1/4 W, 10%
R455	315-0273-00			27 kΩ, 1/4 W, 5%
R457	316-0472-00			4.7 kΩ, 1/4 W, 10%
R458	316-0182-00			1.8 kΩ, 1/4 W, 10%
R459	315-0220-00			22 Ω, 1/4 W, 5%
R461	315-0241-00			240 Ω, 1/4 W, 5%
R462	315-0241-00			240 Ω, 1/4 W, 5%
R463	315-0241-00			240 Ω, 1/4 W, 5%
R464	315-0241-00			240 Ω, 1/4 W, 5%
R465	315-0241-00			240 Ω, 1/4 W, 5%
R466	315-0241-00			240 Ω, 1/4 W, 5%
R467	315-0241-00			240 Ω, 1/4 W, 5%
R468	315-0241-00			240 Ω, 1/4 W, 5%
R470	315-0241-00			240 Ω, 1/4 W, 5%
R471	315-0241-00			240 Ω, 1/4 W, 5%
R482	315-0125-00			1.2 MΩ, 1/4 W, 5%
R483	316-0222-00			2.2 kΩ, 1/4 W, 10%
R486	316-0103-00			10 kΩ, 1/4 W, 10%
R487	316-0103-00			10 kΩ, 1/4 W, 10%
R489	316-0152-00			1.5 kΩ, 1/4 W, 10%
R490	316-0103-00			10 kΩ, 1/4 W, 10%
R491	304-0331-00			330 Ω, 1 W, 10%
R493	316-0153-00			15 kΩ, 1/4 W, 10%
R494	316-0152-00			1.5 kΩ, 1/4 W, 10%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R495	316-0103-00			10 kΩ, 1/4 W, 10%
R497	316-0152-00			1.5 kΩ, 1/4 W, 10%
R498	316-0103-00			10 kΩ, 1/4 W, 10%
R501	316-0153-00			15 kΩ, 1/4 W, 10%
R531	315-0392-00			3.9 kΩ, 1/4 W, 5%
R532	315-0622-00			6.2 kΩ, 1/4 W, 5%
R534	315-0392-00			3.9 kΩ, 1/4 W, 5%
R535	315-0622-00			6.2 kΩ, 1/4 W, 5%
R537	315-0392-00			3.9 kΩ, 1/4 W, 5%
R538	315-0622-00			6.2 kΩ, 1/4 W, 5%
R541	316-0272-00			2.7 kΩ, 1/4 W, 10%
R543	316-0153-00			15 kΩ, 1/4 W, 10%
R546	315-0122-00			1.2 kΩ, 1/4 W, 5%
R547	315-0222-00			2.2 kΩ, 1/4 W, 5%
R549	316-0153-00			15 kΩ, 1/4 W, 10%
R556	315-0122-00			1.2 kΩ, 1/4 W, 5%
R557	315-0222-00			2.2 kΩ, 1/4 W, 5%
R566	315-0122-00			1.2 kΩ, 1/4 W, 5%
R567	315-0222-00			2.2 kΩ, 1/4 W, 5%
R581	316-0272-00			2.7 kΩ, 1/4 W, 10%
R584	316-0272-00			2.7 kΩ, 1/4 W, 10%
R587	315-0242-00			2.4 kΩ, 1/4 W, 5%
R588	315-0392-00			3.9 kΩ, 1/4 W, 5%
R591	315-0242-00			2.4 kΩ, 1/4 W, 5%
R592	315-0392-00			3.9 kΩ, 1/4 W, 5%
R594	315-0242-00			2.4 kΩ, 1/4 W, 5%
R595	315-0392-00			3.9 kΩ, 1/4 W, 5%
R597	316-0103-00			10 kΩ, 1/4 W, 10%
R600	302-0105-00			1 MΩ, 1/2 W, 10%
R601	325-0112-00			22.5 MΩ, 1/2 W, 1/2%
R602	325-0109-00			2.25 MΩ, 1/2 W, 1/2%
R603	325-0111-00			250 kΩ, 1/2 W, 1/2%
R605	310-0696-00			2.525 kΩ, 3 W, WW, 1/2%
R606	310-0697-00			227.5 Ω, 3 W, WW, 1/2%
R607	307-0295-00			25.025 Ω, 0.25 Ω, 2.25 Ω w/taps
R614	307-0103-00			2.7 Ω, 1/4 W, 5%
R615	321-0039-00			24.9 Ω, 1/8 W, 1%
R616	321-0135-00			249 Ω, 1/8 W, 1%
R617	321-0231-00			2.49 kΩ, 1/8 W, 1%
R618	321-0327-00			24.9 kΩ, 1/8 W, 1%
R631	316-0681-00			680 Ω, 1/4 W, 10%
R633	325-0112-00			22.5 MΩ, 1/2 W, 1/2%
R634	325-0109-00			2.25 MΩ, 1/2 W, 1/2%
R635	302-0273-00			27 kΩ, 1/2 W, 10%
R636	325-0110-00			225 kΩ, 1/2 W, 1/2%
R637	308-0397-00			12.5 kΩ, 3 W, WW, 1/2%
R638	308-0397-00			12.5 kΩ, 3 W, WW, 1/25
R639	316-0273-00			27 kΩ, 1/4 W, 10%
R640	322-0621-01			900 kΩ, 1/4 W, 1/2%
R641	321-0645-00			100 kΩ, 1/8 W, 1/2%
R642	308-0544-00			22.5 kΩ, 5 W, WW, 1/4%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R643	308-0539-00			2.25 kΩ, 3 W, WW, 1/2%
R644	321-0131-00			226 Ω, 1/8 W, 1%
R645	321-0039-00			24.9 Ω, 1/8 W, 1%
R646	321-0689-00			24.9 kΩ, 1/8 W, 1/2%
R647	315-0566-00			56 MΩ, 1/4 W, 5%
R648	316-0125-00			1.2 MΩ, 1/4 W, 10%
R649	316-0474-00			470 kΩ, 1/4 W, 10%
R691	308-0223-00			35 Ω, 3 W, WW, 5%
R701	308-0459-00			1.1 Ω, 3 W, WW, 5%
R702	308-0079-00			117 Ω, 5 W, WW, 5%
R704	302-0152-00			1.5 kΩ, 1/2 W, 10%
R705	307-0103-00			2.7 Ω, 1/4 W, 5%
R706	307-0103-00			2.7 Ω, 1/4 W, 5%
R709	315-0100-00			10 Ω, 1/4 W, 5%
R712	302-0684-00			680 kΩ, 1/2 W, 10%
R713	302-0684-00			680 kΩ, 1/2 W, 10%
R714	304-0102-00			1 kΩ, 1 W, 10%
R717	302-0224-00			220 kΩ, 1/2 W, 10%
R718	308-0248-00			150 Ω, 5 W, WW, 1%
R720	307-0103-00			2.7 Ω, 1/4 W, 5%
R721	307-0103-00			2.7 Ω, 1/4 W, 5%
R723	315-0112-00			1.1 kΩ, 1/4 W, 5%
R724	315-0112-00			1.1 kΩ, 1/4 W, 5%
R725	315-0391-00			390 Ω, 1/4 W, 5%
R726	315-0391-00			390 Ω, 1/4 W, 5%
R728	321-0266-00			5.76 kΩ, 1/8 W, 1%
R729	311-1123-00			1 kΩ, Var
R730	316-0471-00			470 Ω, 1/4 W, 10%
R731	321-0093-01			90.9 Ω, 1/8 W, 1/2%
R732	321-1121-01			180 Ω, 1/8 W, 1/2%
R733	321-0843-01			270 Ω, 1/8 W, 1/2%
R744	301-0562-00			5.6 kΩ, 1/2 W, 5%
R734	321-0857-01			360 Ω, 1/8 W, 1/2%
R735	321-1188-06			898 Ω, 1/8 W, 1/4%
R736	321-0641-01			1.8 kΩ, 1/8 W, 1/2%
R737	321-1234-02			2.71 kΩ, 1/8 W, 1/2%
R738	321-0827-03			3.61 kΩ, 1/8 W, 1/4%
R739	316-0273-00			27 kΩ, 1/4 W, 10%
R741	302-0182-00			1.8 kΩ, 1/2 W, 10%
R742	306-0334-00			330 kΩ, 2 W, 10%
R743	302-0391-00			390 Ω, 1/2 W, 10%
R745	306-0334-00			330 kΩ, 2 W, 10%
R746	308-0319-00			4.5 kΩ, 3 W, WW, 1%
R747	321-0089-00			82.5 Ω, 1/8 W, 1%
R748	321-0012-00			143 Ω, 1/8 W, 1%
R749	321-0008-00			11.8 Ω, 1/8 W, 1%
R750	321-0008-00			11.8 Ω, 1/8 W, 1%
R751	322-0621-01			900 kΩ, 1/4 W, 1/2%
R752	321-0645-00			100 kΩ, 1/8 W, 1/2%
R753	321-0285-01			9.09 kΩ, 1/8 W, 1/2%
R754	323-0729-01			900 Ω, 1/2 W, 1/2%
R755	308-0696-00			90 Ω, 3 W, WW, 1/2%
R758	325-0071-00			10 MΩ, 1 W, 1/2%
R759	316-0103-00			10 kΩ, 1/4 W, 10%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R760	315-0222-00			2.2 kΩ, 1/4 W, 5%
R761	311-1123-00			1 kΩ, Var
R765	316-0102-00			1 kΩ, 1/4 W, 10%
R766	316-0153-00			15 kΩ, 1/4 W, 10%
R767	316-0102-00			1 kΩ, 1/4 W, 10%
R771	316-0103-00			10 kΩ, 1/4 W, 10%
R772	316-0103-00			10 kΩ, 1/4 W, 10%
R773	316-0331-00			330 Ω, 1/4 W, 10%
R774	316-0181-00			180 Ω, 1/4 W, 10%
R775	316-0470-00			47 Ω, 1/4 W, 10%
R781	315-0220-00			22 Ω, 1/4 W, 5%
R790	316-0681-00			680 Ω, 1/4 W, 10%
R791	316-0681-00			680 Ω, 1/4 W, 10%
R792	316-0681-00			680 Ω, 1/4 W, 10%
R793	316-0681-00			680 Ω, 1/4 W, 10%
R794	316-0681-00			680 Ω, 1/4 W, 10%
R795	316-0681-00			680 Ω, 1/4 W, 10%
R796	316-0681-00			680 Ω, 1/4 W, 10%
R797	316-0681-00			680 Ω, 1/4 W, 10%
R798	316-0681-00			680 Ω, 1/4 W, 10%
SWITCHES				
S20	260-0613-00			Toggle, AUTO-MAN
S21	260-0574-01			Push, ADVANCE
S25[1]	260-1323-00			Push, INTERLOCK DEFEAT
S31	260-1303-00			Lever, LEFT-OFF-RIGHT
TRANSFORMER				
T50	120-0739-00			Power
INTEGRATED CIRCUITS				
U459	156-0101-00			Single 3 MHz 1 & 3-bit binary ripple counter-low power, replaceable by SN74L93N
U460	156-0078-00			Single 1-out-of-16-line decoder multiplexer, replaceable by SN74154N
U461	156-0094-00			Dual peripheral driver, replaceable by SN75451P
U463	156-0094-00			Dual peripheral driver, replaceable by SN75451P
U465	156-0094-00			Dual peripheral driver, replaceable by SN75451P
U467	156-0094-00			Dual peripheral driver, replaceable by SN75451P
U469	156-0094-00			Dual peripheral driver, replaceable by SN75451P
U471	156-0094-00			Dual peripheral driver, replaceable by SN75451P
U530	156-0111-00			Single BCD-to-decimal decoder/driver, replaceable by SN74145N
U560	156-0058-00			Hex. inverter, replaceable by SN7404N

[1]Furnished as a unit with DS25.

ELECTRICAL PARTS LISTS (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
INTEGRATED CIRCUITS (cont)				
U570A	156-0047-00			Triple 3-input positive nand gate, replaceable by SN7410N
U572	156-0094-00			Dual peripheral driver, replaceable by SN75451P
U574A	156-0034-00			Dual 4-input postivie nand gate, replaceable by SN7420N
U576	156-0094-00			Dual peripheral driver, replaceable by SN75451P
U578A	156-0034-00			Dual 4-input positive nand gate, replaceable by SN7420N
U590	156-0111-00			Single BCD-to-decimal decoder/driver, replaceable by SN74145N
U740	156-0067-00			Operational amplifier, replaceable by UA741C
U759	156-0067-00			Operational amplifier, replaceable by UA741C
U760	156-0060-00			Voltage follower, replaceable by LM302
U770	156-0067-00			Operational amplifier, replaceable by UA741C

SECTION 7

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols and Reference Designators

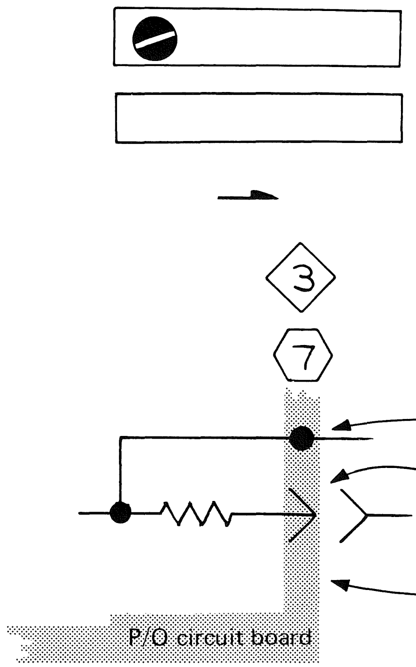
Electrical components shown on the diagrams are in the following units unless noted otherwise:

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

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

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

The following special symbols are used on the diagrams:



External Screwdriver adjustment.

External control or connector.

Clockwise control rotation in direction of arrow.

Refer to diagram number indicated in diamond.

Refer to waveform number indicated in hexagon.

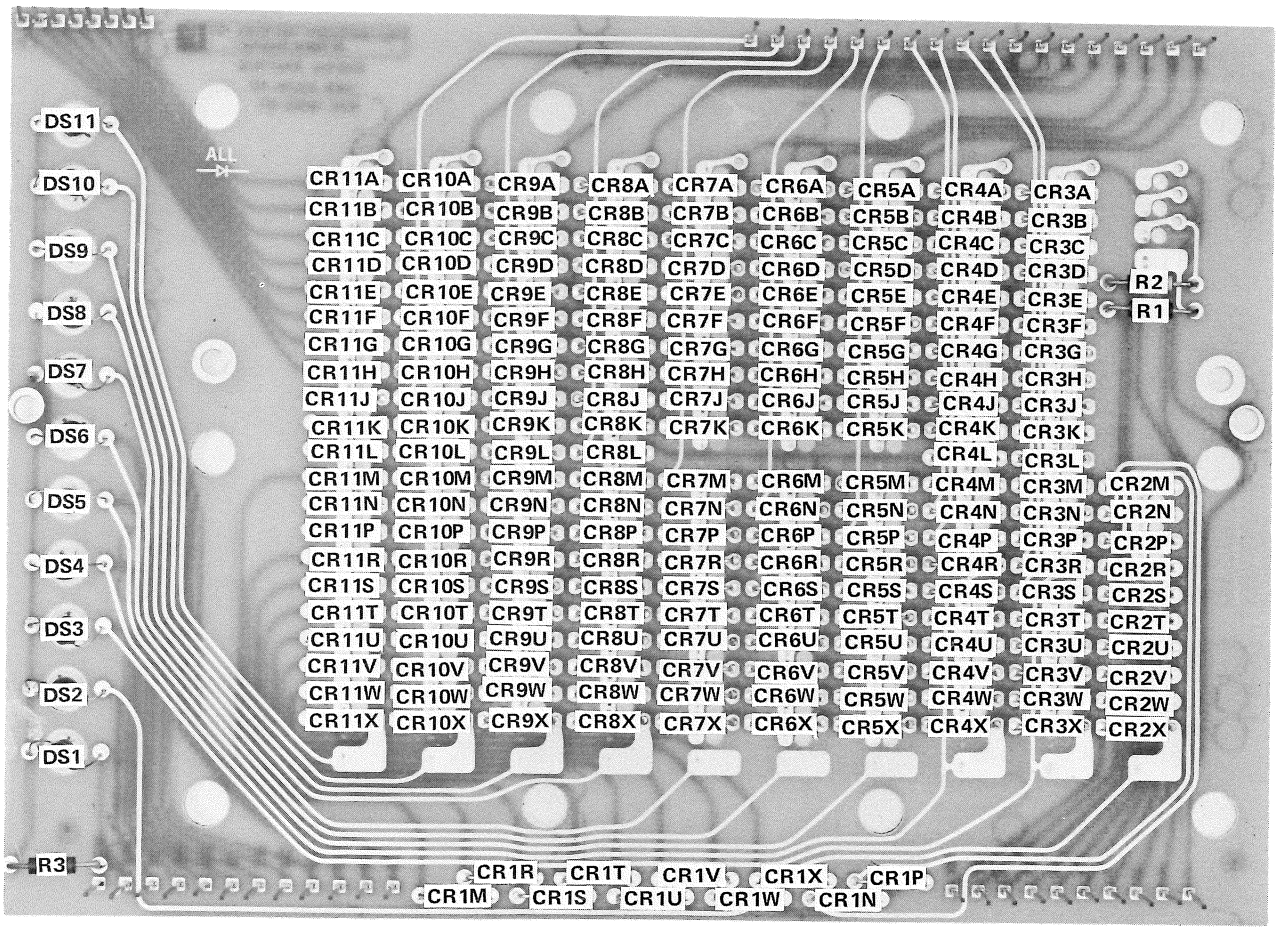
Connection soldered to circuit board.

Connection made to circuit board with interconnecting pin.

Blue tint encloses components located on circuit board.

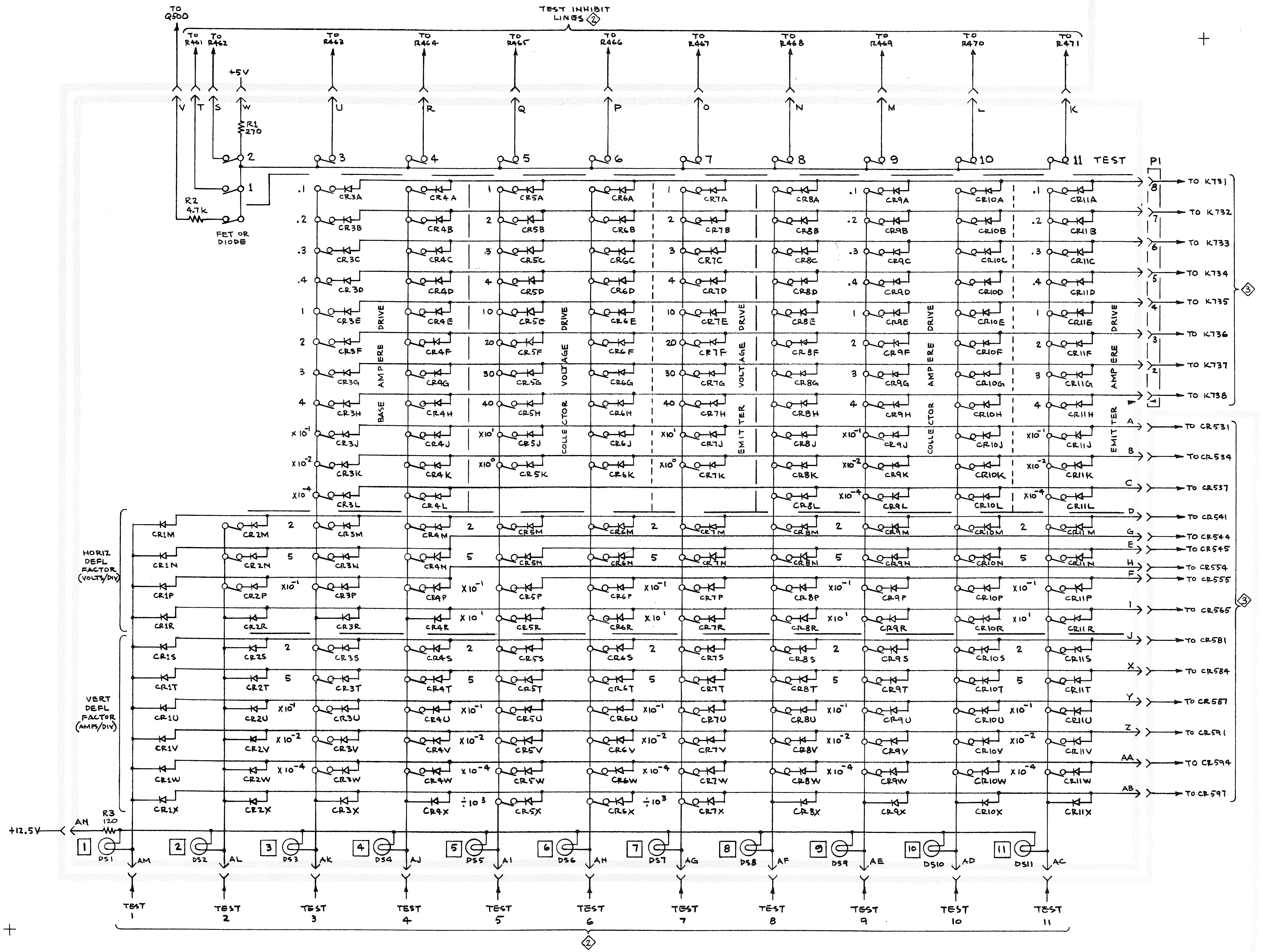
The following prefix letters are used as reference designators to identify components or assemblies on the diagrams.

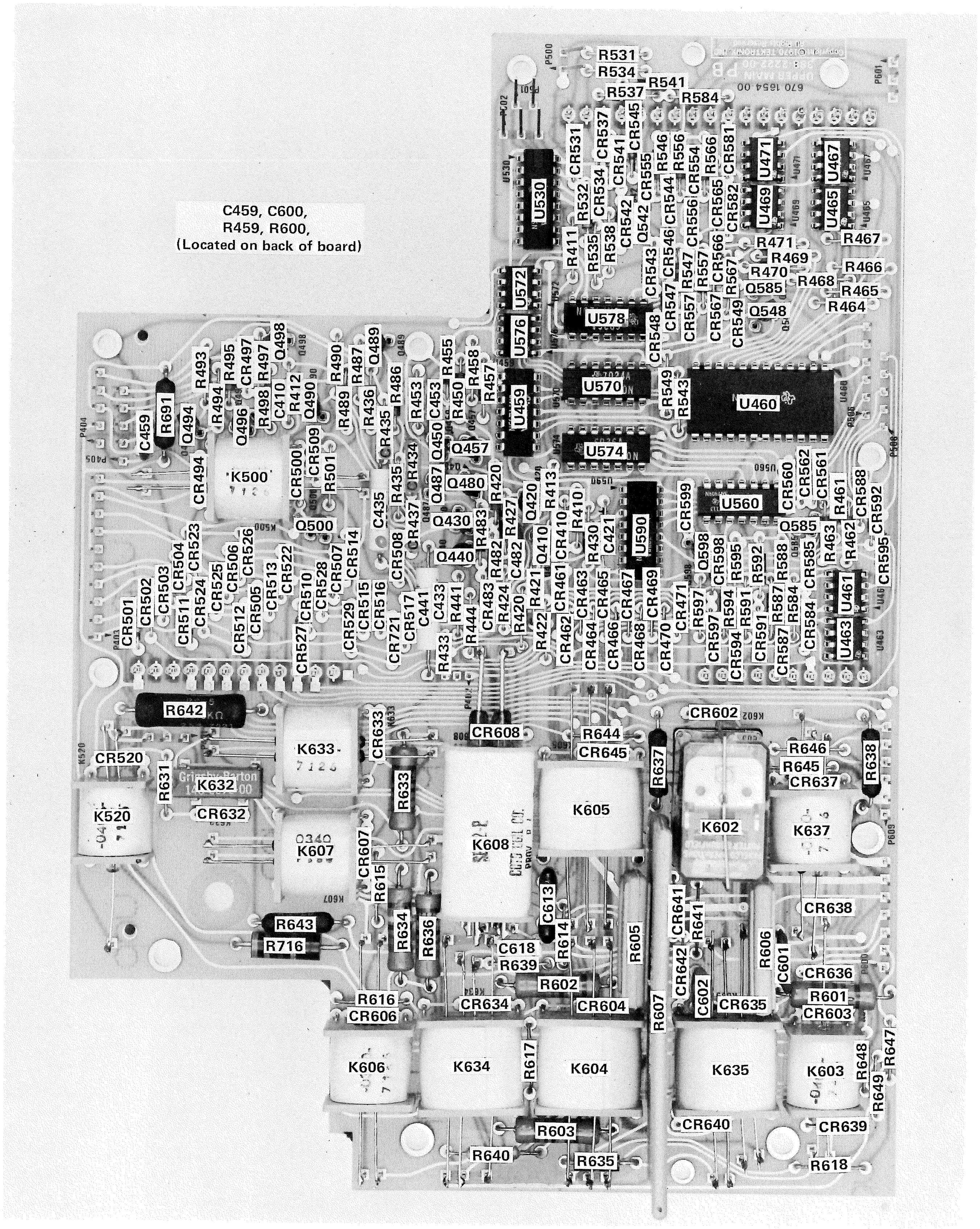
A	Assembly, separable or repairable (circuit board, etc.)
AT	Attenuator, fixed or variable
B	Motor
BT	Battery
C	Capacitor, fixed or variable
CR	Diode, signal or rectifier
DL	Delay line
DS	Indicating device (lamp)
F	Fuse
FL	Filter
H	Heat dissipating device (heat sink, heat radiator, etc.)
HR	Heater
J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



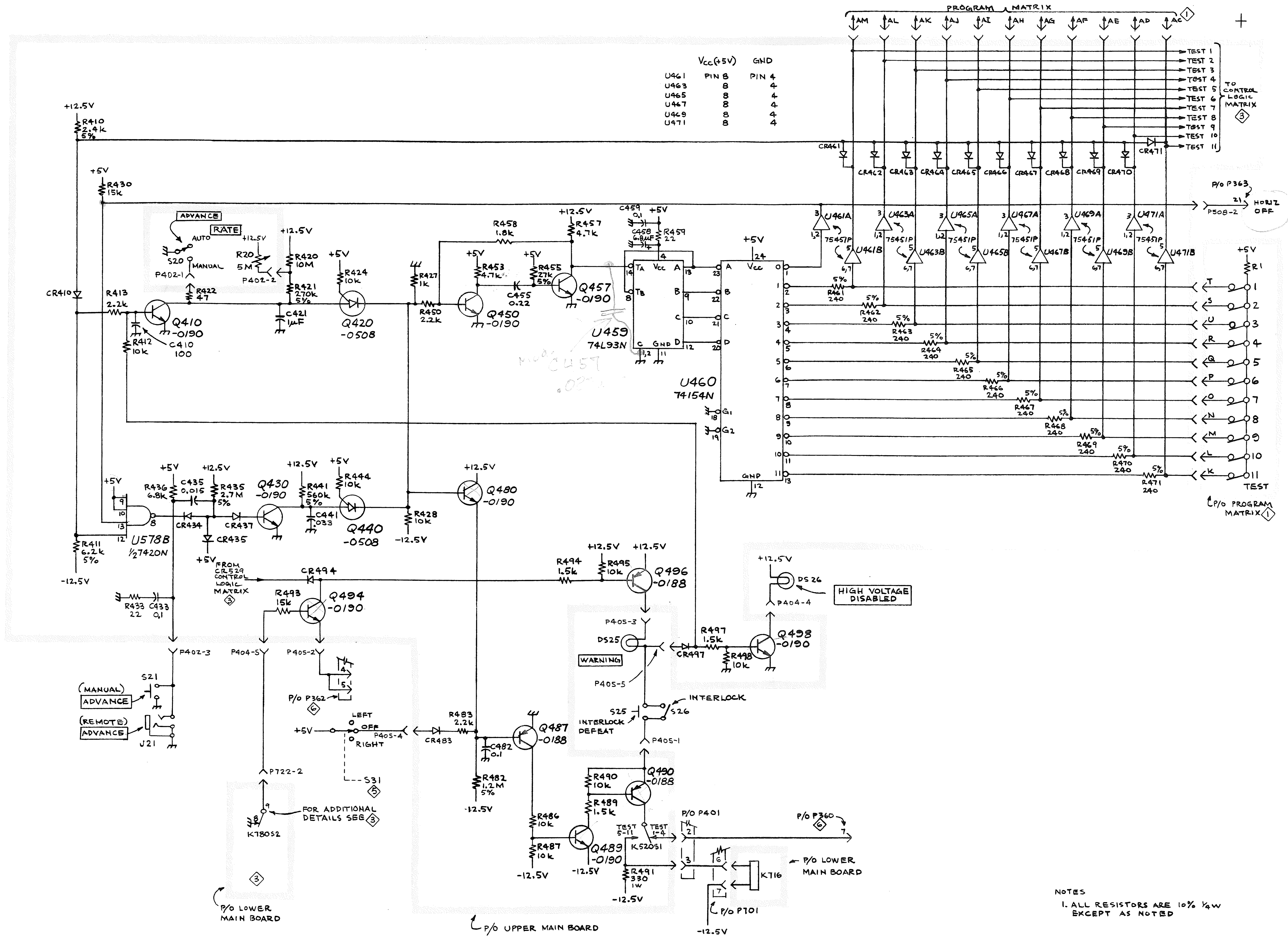
Diode Matrix Board

PROGRAM MATRIX 1



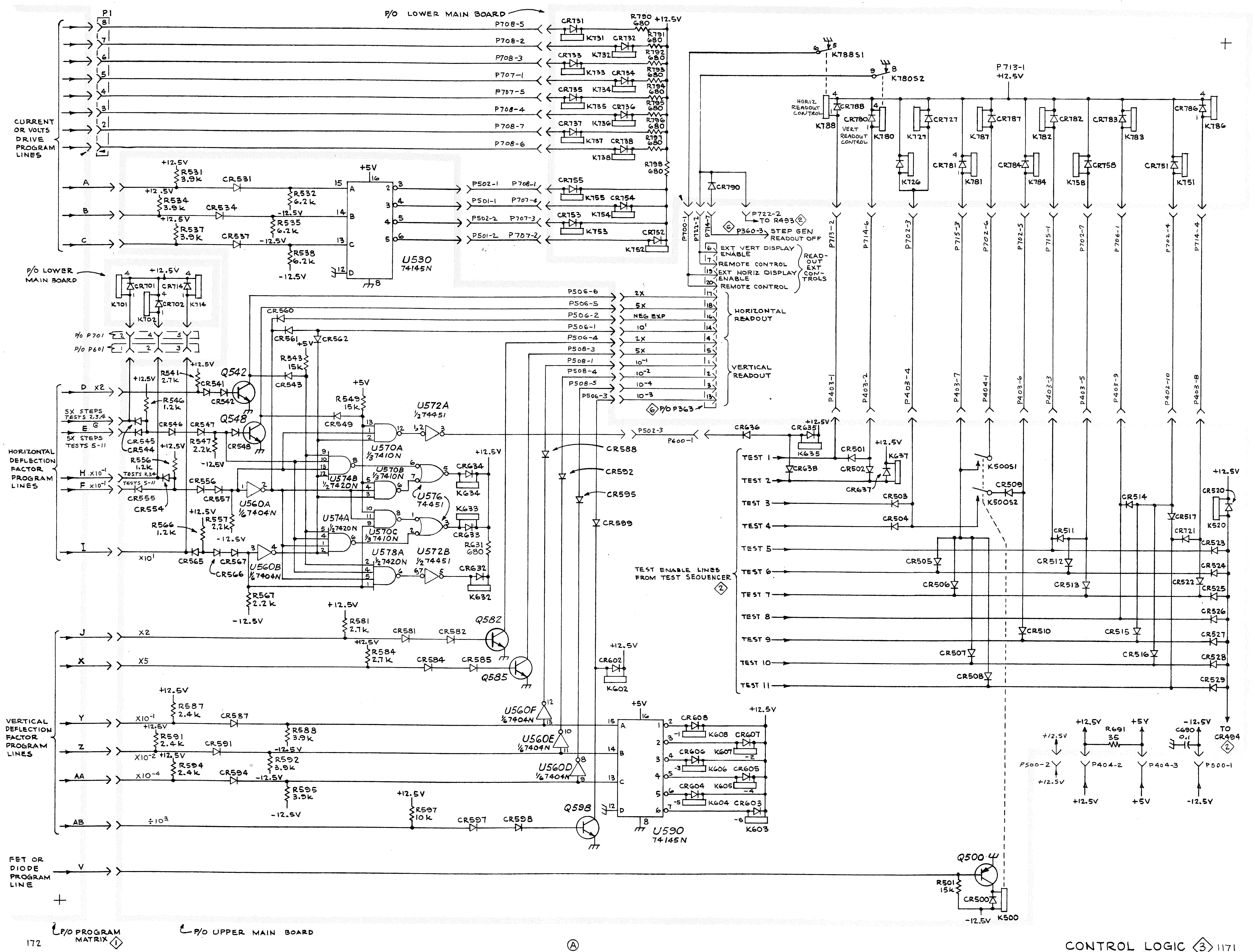


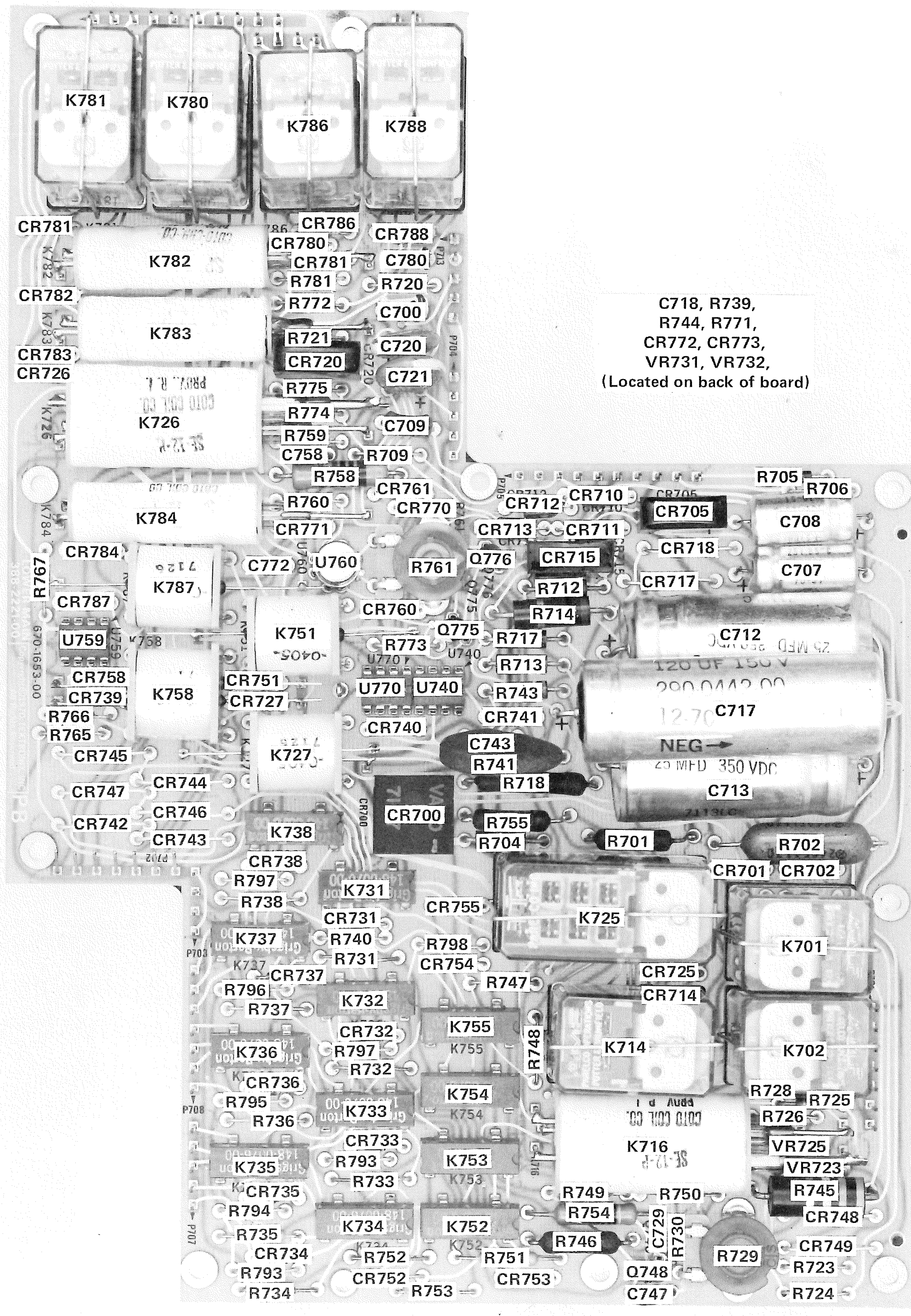
Upper Main Board



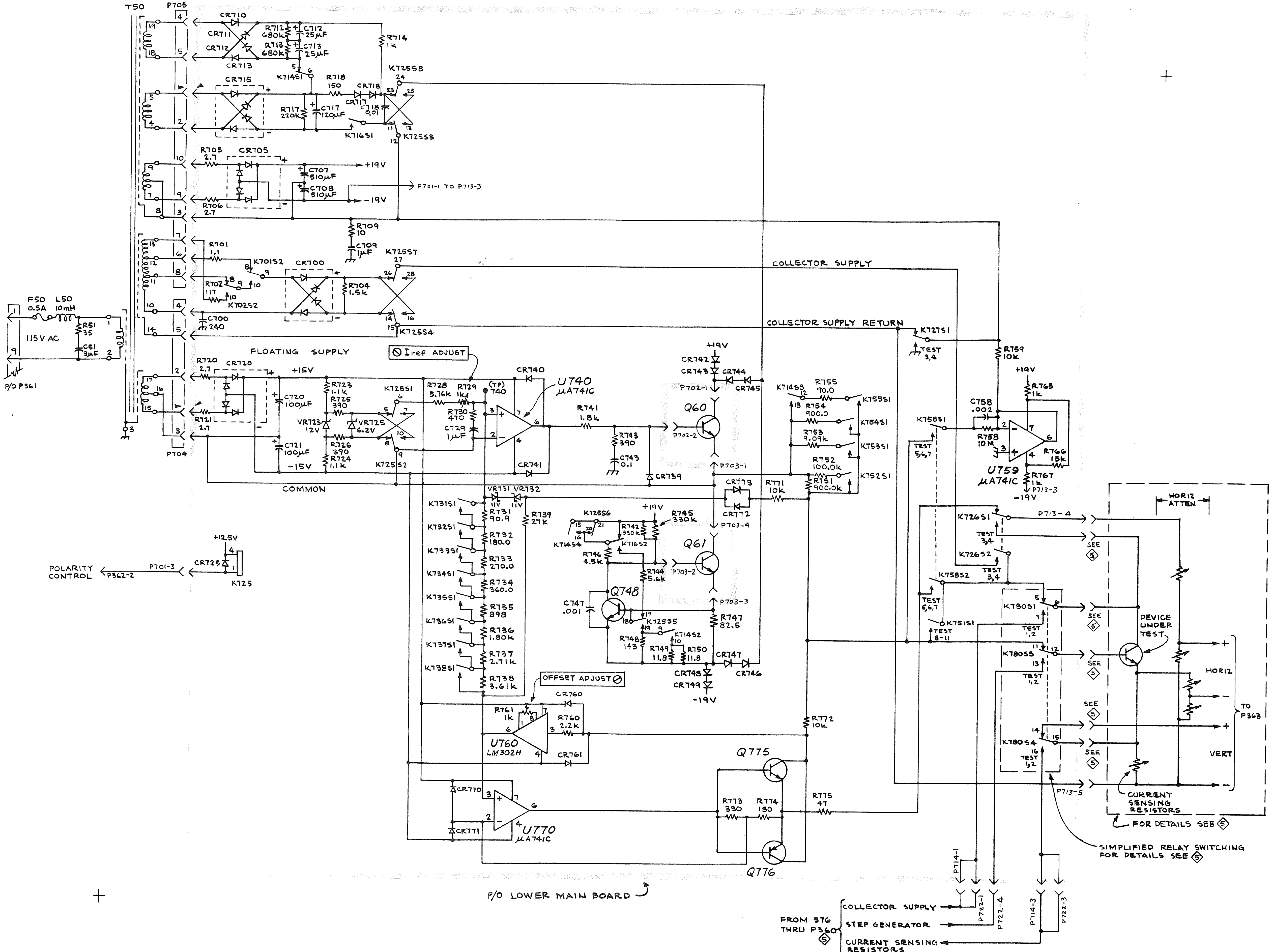
NOTES
1. ALL RESISTORS ARE 10% 1/4W EXCEPT AS NOTED

TEST SEQUENCER 2


P/O LOWER MAIN BOARD
CURRENT OR VOLTS DRIVE PROGRAM LINES
HORIZONTAL DEFLECTION FACTOR PROGRAM LINES
VERTICAL DEFLECTION FACTOR PROGRAM LINES
FET OR DIODE PROGRAM LINE
P/O PROGRAM MATRIX 1
P/O UPPER MAIN BOARD
U530 74145N
U590 74145N
U570A 1/3 7410N
U572A 1/2 74451
U576 74451
U560A 1/6 7404N
U560B 1/6 7404N
U574A 1/2 7420N
U574B 1/2 7420N
U578A 1/2 7420N
U572B 1/2 74451
HORIZONTAL READOUT
VERTICAL READOUT
EXT VERT DISPLAY ENABLE
REMOTE CONTROL
EXT HORIZ DISPLAY ENABLE
READ-OUT EXT CON-TROLS
STEP GEN READOUT OFF
TEST ENABLE LINES FROM TEST SEQUENCER 2
HORIZ READOUT CONTROL
VERT READOUT CONTROL
TO CR494 2

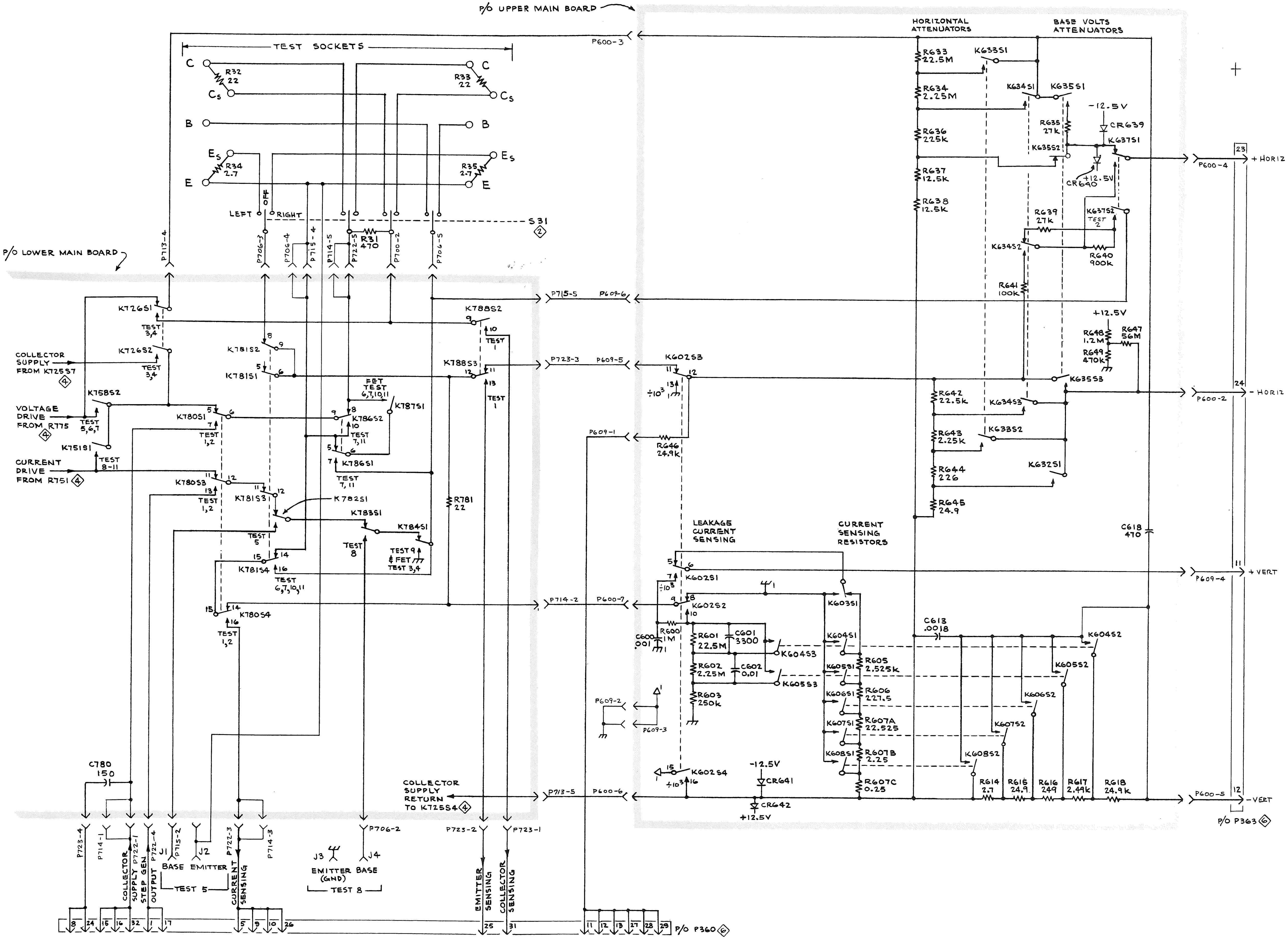


Lower Main Board



T50
P705
P704
F50 0.5A
L50 10mH
115 V AC
R51 35
C51 3µF
P/O P361
FLOATING SUPPLY
COLLECTOR SUPPLY
COLLECTOR SUPPLY RETURN
COMMON
+19V
-19V
+15V
-15V
P701-1 TO P713-3
Iref ADJUST
OFFSET ADJUST
U740 µA741C
U759 µA741C
U760 LM302H
U770 µA741C
Q60
Q61
Q748
Q775
Q776
POLARITY CONTROL
P362-2
P701-3
CR725
K725
+12.5V
DEVICE UNDER TEST
HORIZ ATTEN
HORIZ
VERT
TO P363
CURRENT SENSING RESISTORS
FOR DETAILS SEE ⑤
SIMPLIFIED RELAY SWITCHING FOR DETAILS SEE ⑤
P/O LOWER MAIN BOARD
FROM 576 THRU P360 ⑤
COLLECTOR SUPPLY
STEP GENERATOR
CURRENT SENSING RESISTORS
P714-1
P722-1
P722-4
P714-3
P722-3
P713-4
P713-5

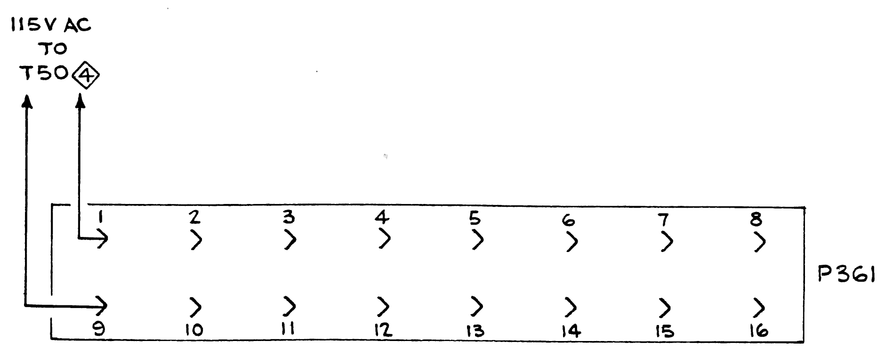
Ⓐ

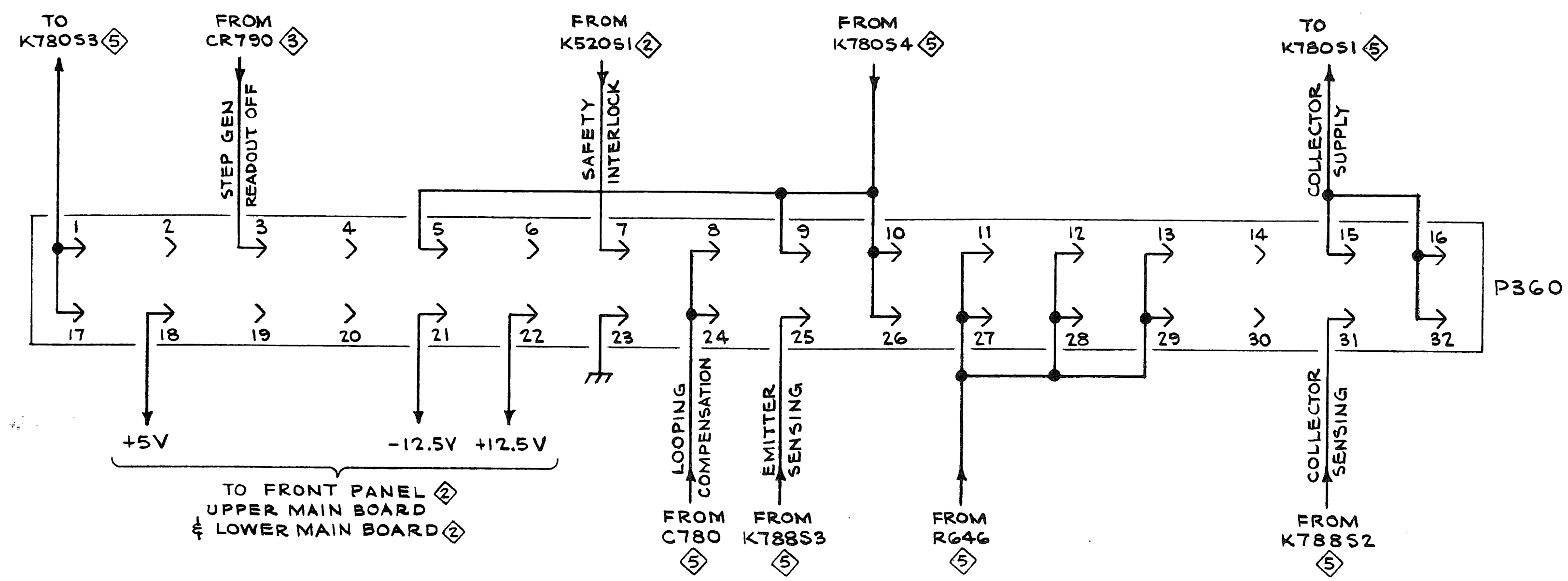


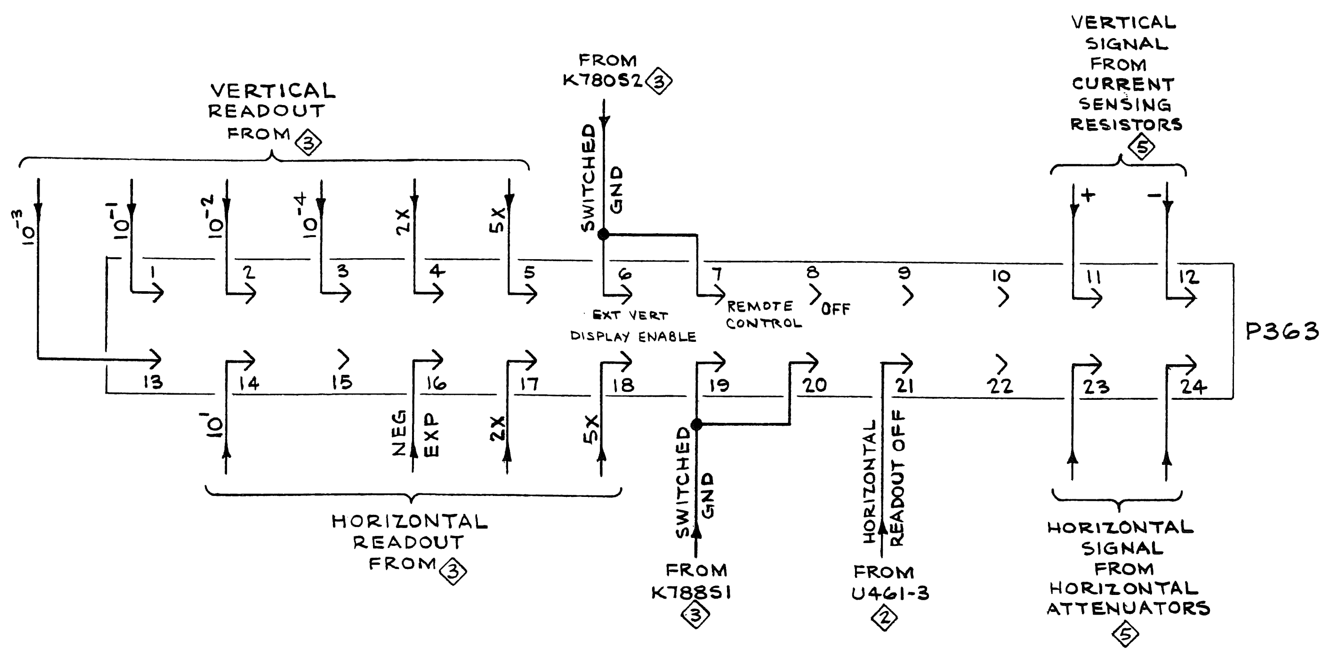
A

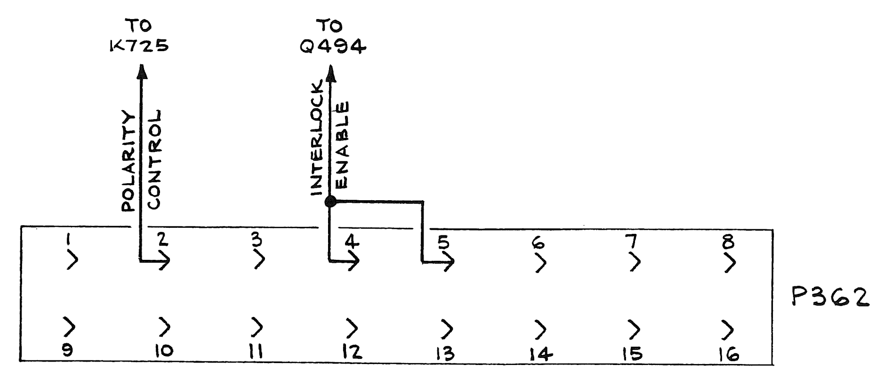
1171

TEST SWITCHING & ATTENUATORS (5)


115V AC
TO
T50 4
P361
1 2 3 4 5 6 7 8
9 10 11 12 13 14 15 16


TO
K780S3 5
FROM
CR790 3
FROM
K520S1 2
FROM
K780S4 5
TO
K780S1 5
STEP GEN
READOUT OFF
SAFETY
INTERLOCK
COLLECTOR
SUPPLY
P360
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32
+5V
-12.5V +12.5V
TO FRONT PANEL 2
UPPER MAIN BOARD
& LOWER MAIN BOARD 2
LOOPING
COMPENSATION
EMITTER
SENSING
COLLECTOR
SENSING
FROM
C780
5
FROM
K788S3
5
FROM
R646
5
FROM
K788S2
5


VERTICAL
READOUT
FROM 3
FROM
K780S2 3
VERTICAL
SIGNAL
FROM
CURRENT
SENSING
RESISTORS
5
10^{-3} 10^{-1} 10^{-2} 10^{-4} 2X 5X
SWITCHED
GND
+ −
1 2 3 4 5 6 7 8 9 10 11 12
EXT VERT
DISPLAY ENABLE
REMOTE
CONTROL
OFF
P363
13 14 15 16 17 18 19 20 21 22 23 24
10^{1} NEG
EXP 2X 5X
SWITCHED
GND
HORIZONTAL
READOUT OFF
HORIZONTAL
READOUT
FROM 3
FROM
K788S1
3
FROM
U461-3
2
HORIZONTAL
SIGNAL
FROM
HORIZONTAL
ATTENUATORS
5


TO
K725
TO
Q494
POLARITY
CONTROL
INTERLOCK
ENABLE
1 2 3 4 5 6 7 8
P362
9 10 11 12 13 14 15 16

SECTION 8
MECHANICAL PARTS LIST

Replacement parts should be ordered from the Tektronix Field Office or Representative in your area. Changes to Tektronix products give you the benefit of improved circuits and components. Please include the instrument type number and serial number with each order for parts or service.

ABBREVIATIONS

BHB	binding head brass	h	height or high	OHB	oval head brass
BHS	binding head steel	hex.	hexagonal	OHS	oval head steel
CRT	cathode-ray tube	HHB	hex head brass	PHB	pan head brass
csk	countersunk	HHS	hex head steel	PHS	pan head steel
DE	double end	HSB	hex socket brass	RHS	round head steel
FHB	flat head brass	HSS	hex socket steel	SE	single end
FHS	flat head steel	ID	inside diameter	THB	truss head brass
Fil HB	fillister head brass	lg	length or long	THS	truss head steel
Fil HS	fillister head steel	OD	outside diameter	w	wide or width

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
1-1	390-0223-00			1	CABINET TOP
	- - - - - -			-	mounting hardware: (not included w/cabinet top)
-2	211-0565-00			3	SCREW, 6-32 x 0.25 inch, THS
-3	200-1244-00			1	LID, matrix
	- - - - - -			-	mounting hardware: (not included w/lid)
-4	213-0020-00			2	SETSCREW, 6-32 x 0.125 inch, HSS
-5	214-1604-00			1	PIN, hinge, 5.63 inches long
-6	214-1646-00			1	SPRING, flat
-7	105-0286-00			1	LATCH, matrix lid
	- - - - - -			-	mounting hardware: (not included w/latch)
-8	211-0007-00			2	SCREW, 4-40 x 0.188 inch, PHS
	210-0003-00			2	WASHER, lock, internal, 0.12 ID x 0.25 inch OD
-9	426-0780-00			1	FRAME, matrix
	- - - - - -			-	mounting hardware: (not included w/frame)
-10	211-0106-00			4	SCREW, 4-40 x 0.625 inch, 100° csk, FHS
-11	211-0086-00			6	SCREW, 4-40 x 0.75 inch, 100° csk. FHS
	210-1011-00			20	WASHER, plastic, 0.13 ID x 0.375 inch OD
-12	378-0689-01			1	LENS, indicator light
-13	670-1652-00			1	CIRCUIT BOARD ASSEMBLY--DIODE MATRIX A3
	- - - - - -			-	circuit board assembly includes:
	388-2220-00			1	CIRCUIT BOARD
-14	131-0608-00			8	TERMINAL, pin, 0.365 inch long
-15	131-0592-00			40	TERMINAL, pin, 0.885 inch long
-16	131-1181-00			1	CONTACT-HOLDER ASSEMBLY
	- - - - - -			-	contact-holder assembly includes:
	131-1113-00			9	CONTACT SET
	131-1150-00			1	CONTACT SET, 0-1 tests
	343-0327-00			11	RETAINER, contacts
	210-0702-00			55	EYELET
	352-0280-00			1	HOLDER, contacts
-17	333-1457-00			1	PANEL, front
-18	441-1016-00			1	CHASSIS, main
	- - - - - -			-	mounting hardware: (not included w/chassis)
-19	211-0538-00			3	SCREW, 6-32 x 0.312 inch, 100° csk, FHS
-20	211-0559-00			1	SCREW, 6-32 x 0.375 inch, 100° csk, FHS
-21	210-0202-00			1	LUG, solder, SE #6
-22	210-0457-00			1	NUT, keps, 6-32 x 0.312 inch
	211-0541-00			2	SCREW, 6-32 x 0.25 inch, 100° csk, FHS

FIGURE 1 EXPLODED (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
1-23	131-0031-00			10	CONNECTOR, banana jack
	- - - - - -			-	mounting hardware for each: (not included w/connector)
-24	210-0455-00			2	NUT, hex., 0.25-28 x 0.375 inch
-25	210-0223-00			1	TERMINAL, lug, 0.25 inch diameter, SE
-26	337-1152-00			1	SHIELD, push switch, 1.20 inches long
	- - - - - -			-	mounting hardware: (not included w/shield)
-27	211-0112-00			2	SCREW, 2-56 x 0.375 inch, 100° csk, FHS
-28	210-0405-00			2	NUT, hex., 2-56 x 0.188 inch
-29	131-0748-00			1	CONTACT, electrical lower
-30	361-0259-00			1	SPACER, contact, plastic
-31	131-0749-00			1	CONTACT, upper
-32	386-1544-00			1	PLATE, plastic, test adapter mounting
	- - - - - -			-	mounting hardware: (not included w/plate)
-33	211-0038-00			3	SCREW, 4-40 x 0.312 inch, 100° csk, FHS
-34	670-1654-00			1	CIRCUIT BOARD ASSEMBLY--UPPER MAIN A1
	- - - - - -			-	circuit board assembly includes:
	388-2222-00			1	CIRCUIT BOARD
-35	131-0589-00			116	TERMINAL, pin, 0.50 inch long
-36	131-0608-00			3	TERMINAL, pin, 0.365 inch long
-37	136-0252-04			247	SOCKET, connector pin
-38	136-0263-03			40	SOCKET, pin terminal
-39	136-0393-00			1	SOCKET, relay, 16 pin
	- - - - - -			-	mounting hardware: (not included w/circuit board assembly)
-40	211-0601-00			4	SCREW, sems, 6-32 x 0.312 inch, PHB
-41	384-0519-00			4	ROD, spacing, hex., 6-32 x 0.25 inch
-42	211-0116-00			6	SCREW, sems, 4-40 x 0.312 inch, PHB
-43	260-1303-00			1	SWITCH, lever--LEFT-OFF-RIGHT
	- - - - - -			-	mounting hardware: (not included w/switch)
-44	210-0473-00			1	NUT, dodecagon, 0.469-32 x 0.638 inch
-45	210-0902-00			1	WASHER, flat, 0.47 ID x 0.656 inch OD
-46	361-0262-00			1	SPACER, ring, lever switch
-47	354-0055-00			1	WASHER, key 0.469 ID x 0.719 inch OD
-48	366-1126-00			1	KNOB, gray--LEFT-OFF-RIGHT
-49	366-0494-00			1	KNOB, charcoal--RATE
	- - - - - -			-	knob includes:
	213-0125-00			1	SETSCREW, 5-40 x 0.125 inch, HSS

FIGURE 1 EXPLODED (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	1 2 3 4 5 Description
1-50	260-0574-01			1	SWITCH, pushbutton--ADVANCE
	- - - - - -			-	mounting hardware: (not included w/switch)
-51	210-0473-00			1	NUT, dodecagon, 0.469-32 x 0.638 inch
	210-0902-00			1	WASHER, flat, 0.47 ID x 0.656 inch OD
	361-0262-00			1	SPACER, ring, lever switch
-52	354-0055-00			1	WASHER, key 0.469 ID x 0.719 inch OD
-53	210-0414-00			1	NUT, hex., 0.469-32 x 0.562 inch
-54	260-0613-00			1	SWITCH, toggle--AUTO-MANUAL
	- - - - - -			-	mounting hardware: (not included w/switch)
-55	210-0562-00			2	NUT, hex., 0.25-40 x 0.312 inch
	210-0940-00			1	WASHER, flat, 0.25 ID x 0.375 inch OD
	210-0046-00			1	WASHER, lock, internal, 0.261 ID x 0.40 inch OD
-56	260-1323-00			1	SWITCH, push--INTERLOCK DEFEAT
	- - - - - -			-	mounting hardware: (not included w/switch)
-57	220-0480-02			1	NUT, dodecagon, 0.375-32 x 0.438 inch
	210-0978-00			1	WASHER, flat, 0.375 ID x 0.50 inch OD
-58	210-0046-00			1	WASHER, lock, internal, 0.261 ID x 0.40 inch OD
-59	136-0164-00			1	SOCKET, lamp
	- - - - - -			-	mounting hardware: (not included w/socket)
-60	220-0480-02			1	NUT, dodecagon, 0.375-32 x 0.438 inch
	210-0978-00			1	WASHER, flat, 0.375 ID x 0.50 inch OD
-61	210-0012-00			1	WASHER, lock, internal, 0.375 ID x 0.50 inch OD
-62	210-0413-00			1	NUT, hex., 0.375 ID x 0.50 inch OD
-63	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
-64	210-0583-00			1	NUT, hex., 0.25-32 x 0.312 inch
-65	210-0940-00			1	WASHER, flat, 0.25 ID x 0.375 inch OD
-66	210-0046-00			1	WASHER, lock, internal, 0.261 ID x 0.40 inch OD
-67	343-0003-00			1	CLAMP, cable, 0.25 inch diameter
	- - - - - -			-	mounting hardware: (not included w/clamp)
-68	211-0507-00			1	SCREW, 6-32 x 0.312 inch, PHS
-69	210-0863-00			1	WASHER, D-shape, 0.191 ID x 0.515 inch
-70	210-0457-00			1	NUT, keps, 6-32 x 0.312 inch
-71	136-0139-00			2	SOCKET, banana jack, red
	- - - - - -			-	mounting hardware for each: (not included w/socket)
-72	210-0465-00			2	NUT, hex., 0.25-32 x 0.375 inch
-73	210-0223-00			1	TERMINAL, lug, 0.25 inch diameter, SE
-74	210-0898-00			1	WASHER, insulating, red plastic

FIGURE 1 EXPLODED (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
1-75	136-0140-00			2	SOCKET, banana jack, charcoal
	- - - - - - -			-	mounting hardware for each: (not included w/socket)
-76	210-0465-00			2	NUT, hex., 0.25-32 x 0.375 inch
-77	210-0223-00			1	TERMINAL, lug, 0.25 inch diameter, SE
-78	210-0895-00			1	WASHER, insulating, gray plastic
-79	366-0125-00			2	KNOB, plug-in securing
	- - - - - - -			-	each knob includes:
	210-0894-00			1	SETSCREW, 6-32 x 0.188 inch, HSS
-80	384-0805-00			2	ROD, securing
	- - - - - - -			-	each rod includes:
-81	354-0025-00			1	RING, retaining
-82	210-0894-00			2	WASHER, plastic, 0.19 ID x 0.438 inch OD
-83	131-0267-00			1	CONNECTOR, phone jack
	- - - - - - -			-	mounting hardware: (not included w/connector)
-84	210-0590-00			1	NUT, hex., 0.375-32 x 0.438 inch
-85	210-0978-00			1	WASHER, flat, 0.375 ID x 0.50 inch OD
-86	210-0012-00			1	WASHER, lock, internal, 0.375 ID x 0.50 inch OD
-87	407-0984-00			1	BRACKET, angle
	- - - - - - -			-	mounting hardware: (not included w/bracket)
-88	211-0538-00			2	SCREW, 6-32 x 0.312 inch, 100° csk, FHS
-89	426-0773-00			1	FRAME-PANEL, front
-90	131-0942-00			1	CONTACT, electrical grounding
	- - - - - - -			-	mounting hardware: (not included w/contact)
-91	213-0138-00			1	SCREW, thread forming, 4-24 x 0.188 inch, PHS
-92	390-0228-00			1	CABINET SIDE, left
	- - - - - - -			-	mounting hardware: (not included w/cabinet side)
-93	211-0504-00			5	SCREW, 6-32 x 0.25 inch, PHS
-94	213-0146-00			3	SCREW, thread forming, 6-32 x 0.312 inch, PHS
-95	390-0227-01			1	CABINET SIDE, right
	- - - - - - -			-	mounting hardware: (not included w/cabinet side)
-96	211-0504-00			5	SCREW, 6-32 x 0.25 inch, PHS
-97	213-0146-00			3	SCREW, thread forming, 6-32 x 0.312 inch, PHS
-98	426-0772-00			1	FRAME-PANEL, rear
	- - - - - - -			-	mounting hardware: (not included w/frame)
-99	214-1605-00			1	PIN, hinge, 6.90 inches long

FIGURE 1 EXPLODED (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
1-100	131-0096-00			1	CONNECTOR, receptacle, 32 pin
	- - - - - - -			-	mounting hardware: (not included w/connector)
-101	211-0008-00			2	SCREW, 4-40 x 0.25 inch, PHS
-102	210-0586-00			2	NUT, keps, 4-40 x 0.25 inch
-103	131-0017-00			2	CONNECTOR, receptacle, 16 pin
	- - - - - - -			-	mounting hardware for each: (not included w/connector)
-104	211-0008-00			2	SCREW, 4-40 x 0.25 inch, PHS
-105	210-0586-00			2	NUT, keps, 4-40 x 0.25 inch
-106	131-0149-00			1	CONNECTOR, receptacle, 24 pin
	- - - - - - -			-	mounting hardware: (not included w/connector)
-107	211-0008-00			2	SCREW, 4-40 x 0.25 inch, PHS
-108	210-0201-00			1	LUG, solder, SE #4
-109	210-0586-00			2	NUT, keps, 4-40 x 0.25 inch
-110	- - - - - - -			2	TRANSISTOR
	- - - - - - -			-	mounting hardware for each: (not included w/transistor)
-111	210-0457-00			2	NUT, keps, 6-32 x 0.312 inch
-112	386-0978-00			2	PLATE, mica, insulating
-113	210-0967-00			2	WASHER, plastic, shouldered, 0.157 ID x 0.375 inch OD
-114	210-0803-00			2	WASHER, flat, 0.15 ID x 0.375 inch OD
-115	210-0202-00			1	LUG, solder, SE #6
-116	211-0511-00			2	SCREW, 6-32 x 0.50 inch, PHS
-117	214-1599-00			1	HEATSINK, transistor
	- - - - - - -			-	mounting hardware: (not included w/heatsink)
-118	210-0457-00			2	NUT, keps, 6-32 x 0.312 inch
-119	- - - - - - -			1	TRANSFORMER
	- - - - - - -			-	mounting hardware: (not included w/transformer)
-120	210-0457-00			2	NUT, keps, 6-32 x 0.312 inch
-121	210-0202-00			1	LUG, solder, SE #6
-122	211-0502-00			2	SCREW, 6-32 x 0.188 inch, 100° csk, FHS
-123	212-0516-00			2	SCREW, 10-32 x 2 inches, HHS
-124	166-0227-00			2	TUBE, insulating, 0.188 ID x 1.50 inches long
-125	210-0812-00			2	WASHER, fiber, 0.188 ID x 0.375 inch OD
-126	407-0946-00			1	BRACKET, angle, transformer front
-127	407-0947-00			1	BRACKET, transformer rear
-128	- - - - - - -			1	COIL
	- - - - - - -			-	mounting hardware: (not included w/coil)
-129	210-0586-00			1	NUT, keps, 4-40 x 0.25 inch
-130	210-0958-00			1	WASHER, flat, 0.115 ID x 0.469 inch OD
-131	210-0810-00			1	WASHER, fiber, 0.125 ID x 0.50 inch OD

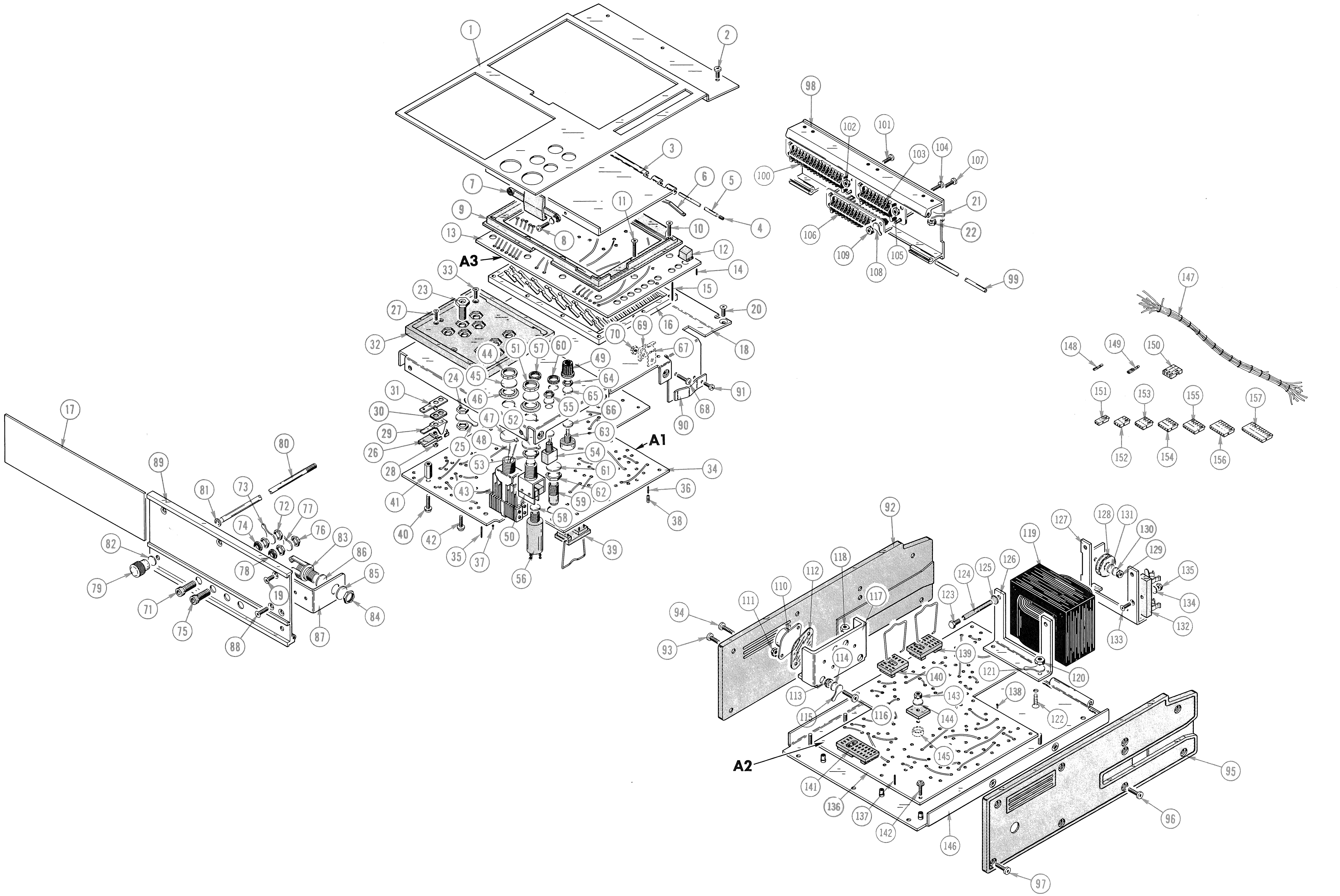
FIGURE 1 EXPLODED (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	1 2 3 4 5 Description
1-132	352-0031-00			1	FUSEHOLDER
	- - - - - -			-	mounting hardware: (not included w/fuseholder)
-133	211-0038-00			1	SCREW, 4-40 x 0.312 inch, 100° csk, FHS
-134	210-0004-00			1	WASHER, lock, internal, 0.12 ID x 0.26 inch OD
-135	210-0406-00			1	NUT, hex., 4-40 x 0.188 inch
-136	670-1653-00			1	CIRCUIT BOARD ASSEMBLY--LOWER MAIN A2
	- - - - - -			-	circuit board assembly includes:
	388-2221-00			1	CIRCUIT BOARD
-137	131-0591-00			108	TERMINAL, pin 0.835 inch long
-138	136-0252-04			41	SOCKET, connector pin
-139	136-0393-00			4	SOCKET, relay, 16 pin
-140	136-0394-00			3	SOCKET, relay, 10 pin
-141	136-0468-00			1	SOCKET, relay, 28 pin
	214-0579-00			1	PIN, test point
	- - - - - -			-	mounting hardware: (not included w/circuit board assembly)
-142	211-0116-00			10	SCREW, sems, 4-40 x 0.312 inch, PHB
-143	210-0586-00			1	NUT, keps, 4-40 x 0.312 inch, PHB
-144	210-0851-00			1	WASHER, flat, 0.119 ID x 0.375 inch OD
-145	214-1614-00			1	HEAT SINK, diode bridge
-146	390-0221-00			1	CABINET BOTTOM
-147	179-1698-00			1	WIRING HARNESS, main
	- - - - - -			-	wiring harness includes:
-149	131-0707-00			10	CONNECTOR, terminal
	131-0792-00			10	CONNECTOR, terminal
-149	131-0621-00			110	CONNECTOR, terminal
-150	352-0161-02			1	HOLDER, terminal connector, 3 wire (red)
	352-0166-01			1	HOLDER, terminal connector, 8 wire (brown)
-151	352-0198-00			2	HOLDER, terminal connector, 2 wire (black)
	352-0198-01			1	HOLDER, terminal connector, 2 wire (brown)
-152	352-0199-01			2	HOLDER, terminal connector, 3 wire (brown)
	352-0199-06			1	HOLDER, terminal connector, 3 wire (red)
-153	352-0200-03			2	HOLDER, terminal connector, 4 wire (orange)
-154	352-0201-02			1	HOLDER, terminal connector, 5 wire (red)
	352-0201-03			1	HOLDER, terminal connector, 5 wire (orange)
	352-0201-04			1	HOLDER, terminal connector, 5 wire (yellow)
	352-0201-05			2	HOLDER, terminal connector, 5 wire (green)
	352-0201-06			1	HOLDER, terminal connector, 5 wire (blue)
	352-0201-07			1	HOLDER, terminal connector, 5 wire (violet)
	352-0201-08			1	HOLDER, terminal connector, 5 wire (gray)
-155	352-0202-06			1	HOLDER, terminal connector, 6 wire (blue)
	352-0202-09			1	HOLDER, terminal connector, 6 wire (white)
-156	352-0203-00			1	HOLDER, terminal connector, 7 wire (black)
	352-0203-01			1	HOLDER, terminal connector, 7 wire (brown)
	352-0203-02			1	HOLDER, terminal connector, 7 wire (red)
	352-0203-04			1	HOLDER, terminal connector, 7 wire (yellow)
	352-0203-08			1	HOLDER, terminal connector, 7 wire (gray)
-157	352-0206-03			1	HOLDER, terminal connector, 10 wire (orange)

FIGURE 1 EXPLODED (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
1-	179-1699-00			1	WIRING HARNESS, AC
	- - - - - -			-	wiring harness includes:
	131-0621-00			12	CONNECTOR, terminal
	131-0792-00			3	CONNECTOR, terminal
	352-0201-04			1	HOLDER, terminal connector, 5 wire (yellow)
	352-0206-05			1	HOLDER, terminal connecotr, 10 wire (green)

FIG. 1 EXPLODED



172 PROGRAMMABLE TEST FIXTURE

STANDARD ACCESSORIES

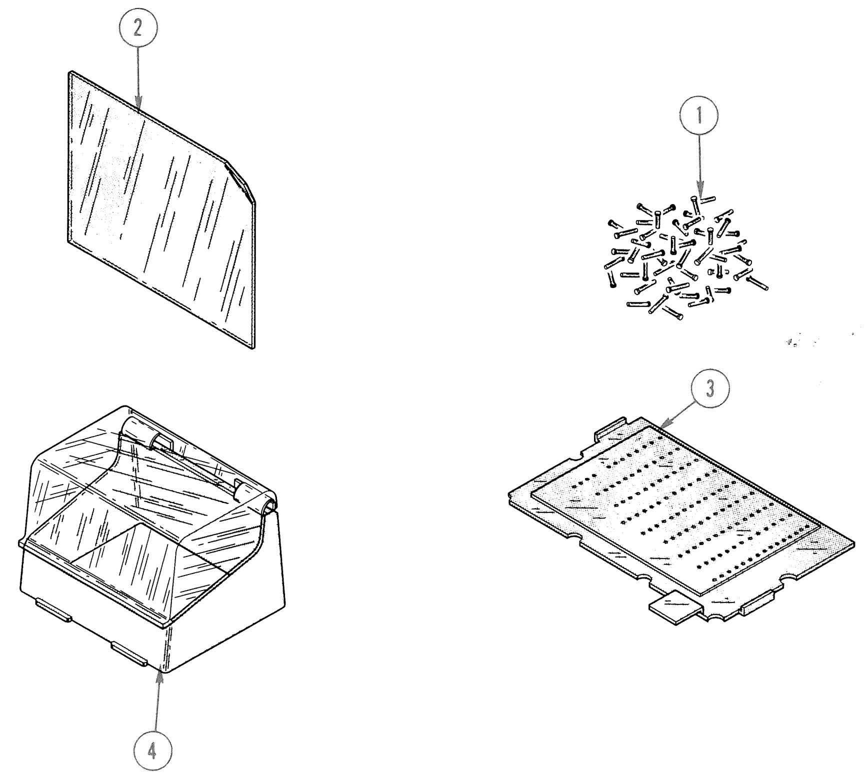


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	1 2 3 4 5 Description
2-1	214-1633-00			250	PROGRAMMING CARD PIN
-2	016-0510-00			5	LIMIT CARD
-3	016-0198-00			5	PROGRAMMING CARD
-4	337-1194-00			1	SHIELD, transistor
	070-1170-00			1	MANUAL, instruction (not shown)

OPTIONAL ACCESSORIES

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	1 2 3 4 5 Description
	016-0518-00			1	ACCESSORY PACKAGE (not shown)

CARTON ASSEMBLY
(Part No. 065-0160-00)

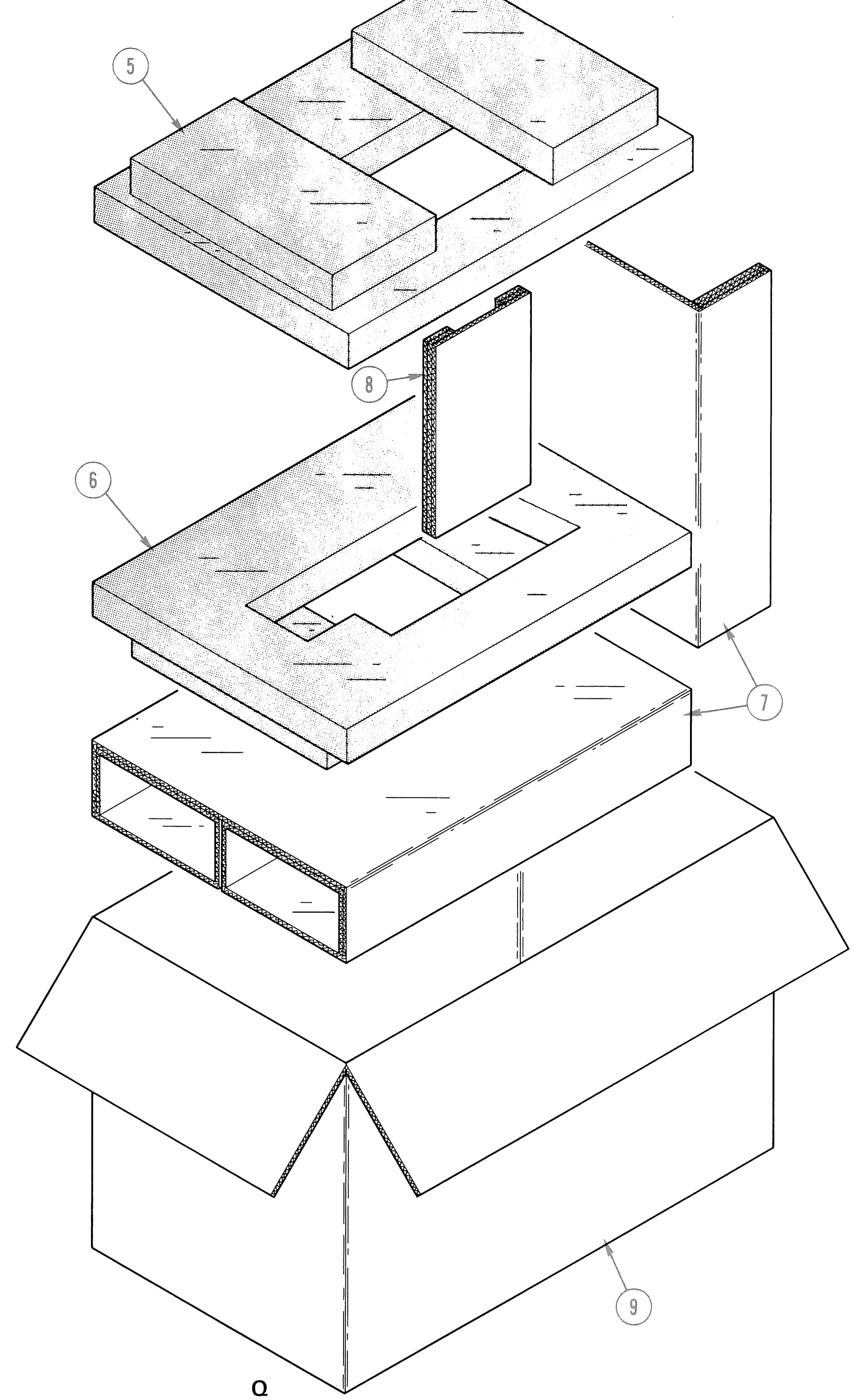


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	1 2 3 4 5 Description
2-	065-0160-00			1	CARTON ASSEMBLY
	- - - - - - - - - -			-	carton assembly includes:
-5	004-0263-00			1	ETHA-FRAME, top
-6	004-0264-00			1	ETHA-FRAME, bottom
-7	004-1076-00			1	PAD SET, 2 pieces
-8	004-1109-00			1	PAD
-9	004-0628-00			1	CARTON

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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 AND SCHEMATIC CORRECTION

CHANGE TO:

A2	670-1653-01	Eff. B030000-up	LOWER MAIN CIRCUIT BOARD ASSEMBLY
C780	283-0084-00	Eff. B020000-up	270 pF, Cer, Disc, 1000V

MECHANICAL PARTS LIST CORRECTION

Page 8-6

CHANGE TO:

Fig.	-136	670-1653-00	B010100	B029999	1	CIRCUIT BOARD ASSEMBLY-LOWER MAIN A2
		670-1653-01	B030000		1	CIRCUIT BOARD ASSEMBLY-LOWER MAIN A2
		- - - - - -			-	circuit board assembly includes:
		388-2221-00	B010100	B029999	1	CIRCUIT BOARD
		388-2221-01	B030000		1	CIRCUIT BOARD
	-137	131-0591-00	B010100	B029999	108	TERMINAL, pin, 0.835 inch long
		131-0591-00	B030000		104	TERMINAL, pin, 0.835 inch long
		131-0608-00	XB030000		23	TERMINAL, pin, 0.365 inch long
	-147	179-1698-00	B010100	B019999	1	WIRING HARNESS, main
		179-1698-01	B020000	B029999	1	WIRING HARNESS, main
		179-1698-02	B030000		1	WIRING HARNESS, main

ELECTRICAL PARTS LIST AND SCHEMATIC CORRECTION

ADD:

C457	283-0058-00	0.027 μF, Cer, 100 V, 10%