

INSTRUCTION MANUAL

Serial Number _____



7CT1N
CURVE TRACER



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TABLE OF CONTENTS

SECTION 1	OPERATING INSTRUCTIONS	Page
	General Description	1-1
	Installation	1-1
	Controls and Connectors	1-1
	Basic Operation	1-3
	Applications	1-5
	Specification	1-11
	Supplementary Information	1-12
SECTION 2	CIRCUIT DESCRIPTION	
	Block Diagram Description	2-1
	Circuit Description	2-2
SECTION 3	PERFORMANCE CHECK/ADJUSTMENT PROCEDURE	
	Services Available	3-1
	Test Equipment	3-1
	Performance Check/Adjustment Procedure	3-2
SECTION 4	DIAGRAMS AND PARTS LISTS	
	Block Diagram	
	Electrical Parts List	
	Component Board Locations	
	Schematic Diagram	
	Mechanical Parts List	

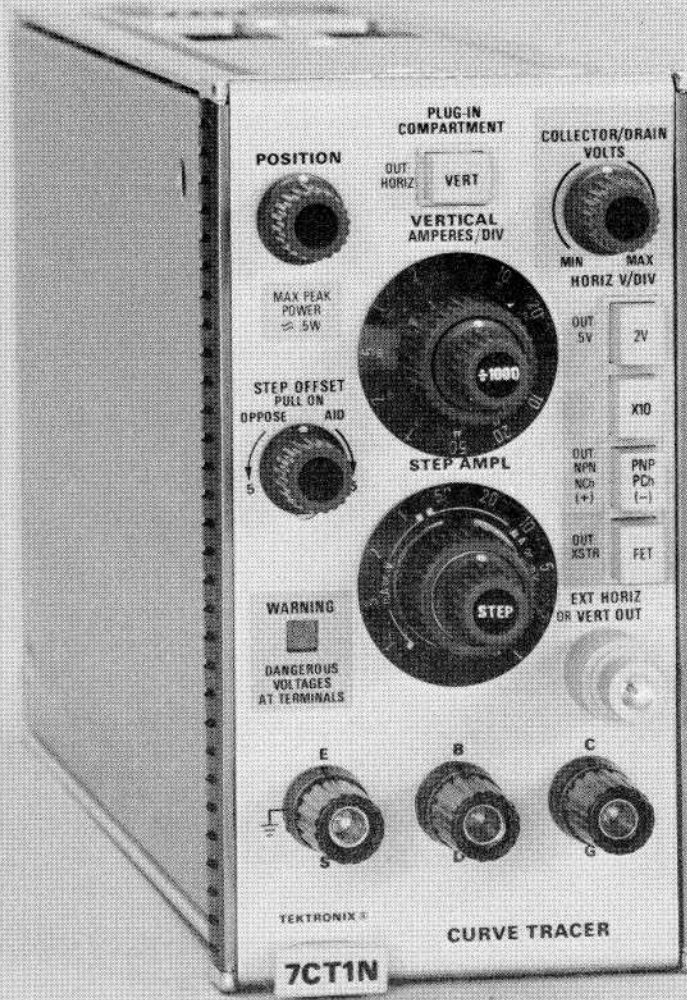


Fig. 1-1. 7CT1N Curve Tracer.

SECTION 1

OPERATING INSTRUCTIONS

Introduction

This section of the manual gives a general description of the 7CT1N, installation instructions, a functional description of the front-panel controls and connectors, a basic operation procedure, application notes and the instrument characteristics.

GENERAL DESCRIPTION

The 7CT1N is a curve tracer plug-in unit for the 7000-Series Oscilloscope System (see Fig. 1-1). It is to be used to make quick checks of the operation of small-signal semiconductor devices, particularly transistors and FET's. It features a variable collector or drain voltage supply with a maximum peak voltage of at least 240 volts and a base or gate step generator which produces calibrated current of voltage steps. The ranges of step amplitudes available are from 1 μ A/step to 1 mA/step for current steps, and from 1 mV/step to 1 V/step for voltage steps. The maximum power which can be supplied to a device is limited to about 0.5 watt. In addition, the unit has a vertical display amplifier for measuring collector or drain currents from about 5 nA to 160 mA and a horizontal display amplifier for measuring collector-emitter or drain-source voltages ranging from about 0.2 V to 200 V.

INSTALLATION

The 7CT1N is calibrated and ready for use upon arrival. It can be operated in either a vertical or horizontal plug-in compartment in any of the 7000-Series Oscilloscope mainframes. It is suggested that the plug-in be installed in a center compartment.

To install, align the upper and lower tracks of the 7CT1N with the guides of the desired plug-in compartment in the mainframe and slide it in until its front panel is flush with the mainframe front panel. To remove, pull the release latch (labeled 7CT1N) to disengage the 7CT1N from the mainframe and pull the instrument out.

To operate the 7CT1N, its horizontal or vertical output must be connected to another plug-in in the oscilloscope system, through the EXT HORIZ OR VERT OUT cable. If the 7CT1N is in a vertical compartment, connect the cable to a plug-in in a horizontal compartment; if the 7CT1N is in a horizontal compartment, connect the cable to a plug-in in

a vertical compartment. The plug-in to which the cable is connected should have an external input with a deflection factor of 100 mV/division. At the time of printing of this manual, all the 7000-Series amplifier plug-ins and all the time-base plug-ins except the delaying time bases meet this qualification (see Table 1-1). The deflection factor of the external input to some of the time bases must be set using a variable control.

Also, after the 7CT1N has been installed, set the PLUG-IN COMPARTMENT pushbutton according to the location of the 7CT1N in the mainframe. The pushbutton must be out if the plug-in is in a horizontal compartment, and in if the plug-in is in a vertical compartment. See the beginning of the Familiarization Procedure for other initial control settings for the 7CT1N and oscilloscope system.

Table 1-1

7000-Series Plug-Ins Which Can Be Used with the 7CT1N

Amplifiers	Time Bases
7A11	7B50
7A12	7B52
7A13 ✓	7B53N
7A15	7B70
7A16	
7A18	
7A22	

CONTROLS AND CONNECTORS

This is a description of the function and operation of the front-panel controls and connectors. More information is given under Basic Operation.

PLUG-IN COMPARTMENT Push-button	Determines the output of the EXT HORIZ OR VERT OUT cable, according to the location of the 7CT1N in the mainframe.
POSITION	Positions the display vertically or horizontally depending on the setting of the PLUG-IN COMPARTMENT pushbutton.

Operating Instructions—7CT1N

COLLECTOR/DRAIN VOLTS Varies the collector-drain supply output voltage within the range set by the .5 V - 2 V and X10 push-buttons.

.5 V - 2 V and X10 Pushbuttons Selects the horizontal deflection factor and the range of the collector-drain supply output. Table 1-2 shows the deflection factors and voltage ranges for the various states of the pushbuttons.

TABLE 1-2

**Collector-Drain Supply Output Ranges
and
Horizontal Deflection Factors**

X10 Pushbutton	.5 V - 2 V Pushbutton	Collector-Drain Supply Range	Horizontal Deflection Factor
Out	Out	0 V to 7.5 V	0.5 V/Div
Out	In	0 V to 30 V	2 V/Div
In	Out	0 V to 75 V	5 V/Div
In	In	0 V to 300 V	20 V/Div

VERTICAL Selects the vertical deflection factor. The range of the switch is from 10 μ A/division to 20 mA/division in a 1-2-5 sequence, with the \div 1000 pushbutton in; and from 10 nA/division to 20 μ A/division in a 1-2-5 sequence with the pushbutton out.

\div 1000 When out, the sensitivity of the vertical display amplifier is increased 1000 times for making leakage current measurements. Also, when out, the collector-drain supply is changed from a sweeping output to a DC (non-looping) output.

STEP AMPL Selects the step amplitude of the base-gate step generator output. When the XSTR-FET pushbutton is out, the step amplitude range is from 1 μ A/step to 1 mA/step in a 1-2-5 sequence; when the pushbutton is in, the step amplitude range is from 1mV/step to 1 V/step in a 1-2-5 sequence.

STEP Continuously variable control which determines the number of steps in the base-gate step generator output. The number of steps ranges from 0 to at least 10 steps.

STEP OFFSET When pulled out, the control provides continuously variable offset of the base-gate step generator output from at least 5 steps of opposing offset (control fully counterclockwise) to at least 5 steps of aiding offset (control fully clockwise). When the control is pushed in, zero offset is obtained.

NPN, N CH - PNP, P CH Pushbutton Selects the polarity of the collector-drain supply output and the base-gate step generator output. When the pushbutton is out, the collector-drain supply output is positive and the base-gate step generator steps are either positive-going for current steps or negative-going for voltage steps. When the pushbutton is in, the collector-drain supply output is negative and the base-gate step generator steps are negative-going for current steps and positive-going for voltage steps. The XSTR-FET pushbutton determines whether the base-gate step generator output is current or voltage steps. The NPN, N CH-PNP, P CH pushbutton also determines the position of the display. When the pushbutton is out, the zero position of the display is located in the lower left corner of the display unit CRT; when in, the zero position is in the upper right corner of the CRT. The positioning accuracy is within 0.3 division and may be used to the check calibration accuracy of the system.

XSTR-FET Pushbutton Selects whether the base-gate step generator output is current steps or voltage steps. When the pushbutton is out, the base-gate step generator output is current steps in the same direction as the collector-drain supply output; when the pushbutton is in, the output is voltage steps in the opposite direction to the collector-drain supply output. This pushbutton also selects which

device testing jacks the collector-drain supply output and the base-gate step generator output are connected to (see Table 1-3).

TABLE 1-3

Connection of Collector-Drain Supply Output and Base-Gate Step Generator Output to Device Testing Jacks

B or D	C or G	XSTR-FET
Step Generator	Collector-Drain Supply	Out
Collector-Drain Supply	Step Generator	In

WARNING Light Light flashes when a dangerous voltage is present at the device testing jacks.

Device Testing Jacks Three binding posts on the front of the unit permit connection of devices to be tested to the curve tracer unit. The collector-drain supply output and the base-gate step generator output are connected either to the B or D (base or drain) or C or G (collector or gate) binding post, depending on the state of the XSTR-FET pushbutton (see Table 1-3). The E or S (emitter or source) binding post is always connected to ground.

EXT HORIZ OR VERT OUT Cable Connects the horizontal or vertical signal (depending on the setting of the PLUG-IN COMPARTMENT pushbutton) to another plug-in in the oscilloscope for display on the CRT.

BASIC OPERATION

Familiarization Procedure

This procedure will familiarize the user with the operation of the 7CT1N, and show how to obtain the basic characteristic curves for a diode, bipolar transistor and field effect transistor (FET). Applications are given at the end of this section. This procedure may also be used as an operational check. For a performance check of the instrument, see Section 3.

1. Install the 7CT1N in the mainframe as described in the beginning of this section. Turn on the oscilloscope system and set the mainframe, and time base or amplifier controls as follows:

Mainframe

Horizontal and Vertical Mode Set for location of 7CT1N and for location of plug-in 7CT1N is connected to.

Amplifier

Polarity +Up
Coupling DC
Volts/Div .1

Time Base

Display Mode (7B50 or 7B70) Amplifier
Time/Div or DI'y Time (7B52 or 7B53N) Ampl
Trigger Source Ext
Triggering Coupling DC

DIODE CHECK

2. Set the 7CT1N controls as follows:

POSITION Centered
COLLECTOR/DRAIN
VOLTS Fully counterclockwise
X10 Pushbutton out
.5 V - 2 V Pushbutton out
VERTICAL 1 mA/Div
÷ 1000 Pushbutton in
STEP AMPL No effect for diode check
STEP No effect for diode check
STEP OFFSET No effect for diode check
NPN, N CH - PNP, P CH Pushbutton out
XSTR-FET Pushbutton out

3. Position the spot to the lower left corner of the CRT graticule using the 7CT1N POSITION control and the position control of the plug-in which the EXT HORIZ OR VERT OUT cable is connected to.

CAUTION

Occasionally, a single spot may be displayed on the CRT. In such cases, avoid high spot intensity to prevent burning the CRT phosphor. This precaution is especially important when using a storage oscilloscope.

Operating Instructions—7CT1N

Press the **NPN, N CH—PNP, P CH** pushbutton. Check that the spot moves from the lower left corner of the CRT graticule to the upper right corner. If the mainframe display amplifiers are properly adjusted, the position of the spot should be within 0.3 division of the upper right corner of the CRT graticule. If the spot position is not correct, adjust the Volts/Div Variable (amplifier) or Variable (time base) until the spot deflection is correct between the two settings of the **NPN, N CH—PNP, P CH** pushbutton. Release the **NPN, N CH—PNP, P CH** pushbutton.

4. Connect a silicon diode between the C or G (anode) and E or S (cathode) binding posts of the 7CT1N. The transistor-FET adapter supplied with the 7CT1N may be used for this purpose.

5. Turn the **COLLECTOR/DRAIN VOLTS** control clockwise and obtain a display of the forward current versus voltage characteristic of the diode (see Fig. 1-2A).

6. Press the **NPN, N CH—PNP, P CH** pushbutton. The polarity of the collector-drain supply output voltage is now negative, providing a display of the reverse current versus voltage characteristic of the diode.

7. Turn the **COLLECTOR/DRAIN VOLTS** control fully counterclockwise and set the **.5 V - 2 V** and **X10** pushbuttons for a new collector-drain supply range and horizontal deflection factor (see Table 1-2).

CAUTION

*Always turn the **COLLECTOR/DRAIN VOLTS** control counterclockwise before changing the collector-drain supply range, to avoid damage to the device under test.*

Set the **VERTICAL** switch to $10\mu\text{A}/\text{Div}$ and turn the **COLLECTOR/DRAIN VOLTS** control clockwise until the reverse voltage breakdown of the diode is obtained. If the device does not break down within the display window of the CRT, select a higher collector-drain supply range.

Note that when the collector-drain voltage is above about 50 V, the **WARNING** light flashes.

WARNING

A flashing warning light indicates that a potentially hazardous voltage is present on the device testing terminals.

TRANSISTOR CHECK

8. Set the 7CT1N controls as follows:

POSITION	Centered
COLLECTOR/DRAIN VOLTS	Fully counterclockwise
X10	Pushbutton out
.5 V - 2 V	Pushbutton in
VERTICAL	1 mA/DIV
÷ 1000	Pushbutton in
STEP AMPL	1 $\mu\text{A}/\text{STEP}$
STEP	Fully clockwise
STEP OFFSET	Pull-switch in
NPN, N CH - PNP	
P CH	Pushbutton out
XSTR-FET	Pushbutton out

9. Position the spot to the lower left corner of the CRT graticule.

10. Connect the transistor-FET adapter, which is supplied with the 7CT1N, to the device testing jacks. Install an NPN transistor (with the following suggested characteristics: β of 50 to 100, BV_{CEO} at least 30 V, I_{Cmax} at least 20 mA) in one of the test sockets.

11. Turn the **COLLECTOR/DRAIN VOLTS** control clockwise until a trace of about 5 divisions ($V_{CE} = 10\text{ V}$) is obtained. Turn the **STEP AMPL** switch clockwise until a family of curves similar to that shown in Fig. 1-2B is obtained. This set of curves is a display of the I_C vs. V_{CE} for a transistor operated in a common-emitter configuration. With the **XSTR-FET** pushbutton out, the step generator output is current steps. The setting of the **STEP AMPL** switch indicates the increment of current added to each step (or the step amplitude).

12. Turn the **VERTICAL** switch throughout its range and note the change in vertical deflection factor.

13. Turn the **STEP** control fully counterclockwise. Note that the number of steps decreases to zero. With the **STEP** control fully counterclockwise, the base current of the transistor is essentially zero. (For a true open base condition, disconnect the base lead from the test socket.)

14. Release the $\div 1000$ pushbutton and note that the collector-drain supply output becomes a DC voltage (a spot) rather than a sweeping voltage (a trace). Turn the **VERTICAL** switch clockwise to obtain a measurable display of leakage current (in this case I_{CEO}). The vertical deflection factor with the $\div 1000$ pushbutton out is the setting of the **VERTICAL** switch divided by 1000. Before

measuring leakage current, remove the transistor from the test socket and vertically position the spot to the bottom horizontal graticule line (top line for PNP transistor). Repositioning of the spot compensates for leakage current in the transistor-FET adapter and 7CT1N. (As is mentioned in part 13, the best measurement of I_{CEO} is obtained when the base lead is disconnected from the test socket).

FIELD EFFECT TRANSISTOR CHECK

15. Set the 7CT1N controls as follows:

POSITION	Centered
COLLECTOR/DRAIN VOLTS	Fully counterclockwise
X10	Pushbutton out
.5 V - 2 V	Pushbutton in
VERTICAL	1 mA/DIV
÷ 1000	Pushbutton in
STEP AMPL	1 mV/STEP
STEP	Fully clockwise
STEP OFFSET	Pull-Switch in
NPN, N CH - PNP, P CH	Pushbutton out
XSTR-FET	Pushbutton in

16. Position the spot to the lower left corner of the CRT graticule.

17. Install an N channel FET in one of the test sockets. The lead configuration of most FET's should match the sockets on the transistor-FET adapter. Information on the side of the adapter indicates which terminals of the socket the leads of the FET should be connected to.

18. Turn the COLLECTOR/DRAIN VOLTS control and the STEP AMPL switch clockwise until a family of curves similar to those shown in Fig. 1-2C is obtained. (The VERTICAL switch may have to be reset to obtain this display.) This set of curves is a display of I_C vs. V_{DS} for an FET operated in the depletion region. With the XSTR-FET pushbutton in, the step generator output is voltage steps. The setting of the STEP AMPL switch indicates the increment of voltage added to each step (or the step amplitude). Turn the STEPS control fully counterclockwise. The step generator output is now zero volts and the curve displayed on the CRT is the zero gate-voltage curve.

19. Turn the STEP control clockwise and pull the STEP OFFSET control out. Turn the STEP OFFSET control fully clockwise and note that the curves are offset further into the depletion region of the device toward pinch-off. Turn the control fully counterclockwise and note that the family of curves is offset into the enhancement region of the device. When an FET is operated in its enhancement region, the 1 kΩ output impedance of the step generator

protects the device by causing the voltage steps to be compressed as gate current increases. Push in the STEP OFFSET control to obtain the zero offset condition.

Device Adapters

A transistor-FET device testing adapter (Tektronix Part No. 013-0128-00) for TO-5 and TO-18 type cases is supplied as a standard accessory with the 7CT1N. A number of other adapters, which may be used with the 7CT1N, are available from Tektronix. Table 1-4 lists the adapters available at the time of printing of this manual and their uses.

TABLE 1-4

Test Fixture Adapters Which May Be Used With the 7CT1N

Tektronix Part Number	Case Type
013-0072-00	Diodes with axial leads
013-0069-00	Devices with long leads
013-0070-01	TO-3 and TO-66
013-0163-00	Transistors with stud leads
013-0110-00	Diodes with stud leads; DO-4/DO-5
013-0112-00	TO-36

APPLICATIONS

The following section describes how to use the 7CT1N to make some common checks and measurements of diodes, transistors and FET's. These checks may range from checking if a device is operating or not (go, no-go) to checking manufacturer-specified parameters. Before reading this section, it is suggested that a user go through the preceding Familiarization Procedure to acquaint himself with the 7CT1N.

Diodes

General. Most signal, Zener and tunnel diodes can be tested with the 7CT1N. The maximum I_F which can be measured is about 160 mA and the maximum V_R is about 200 V. Care should be taken when testing diodes which are sensitive to current, especially tunnel diodes.

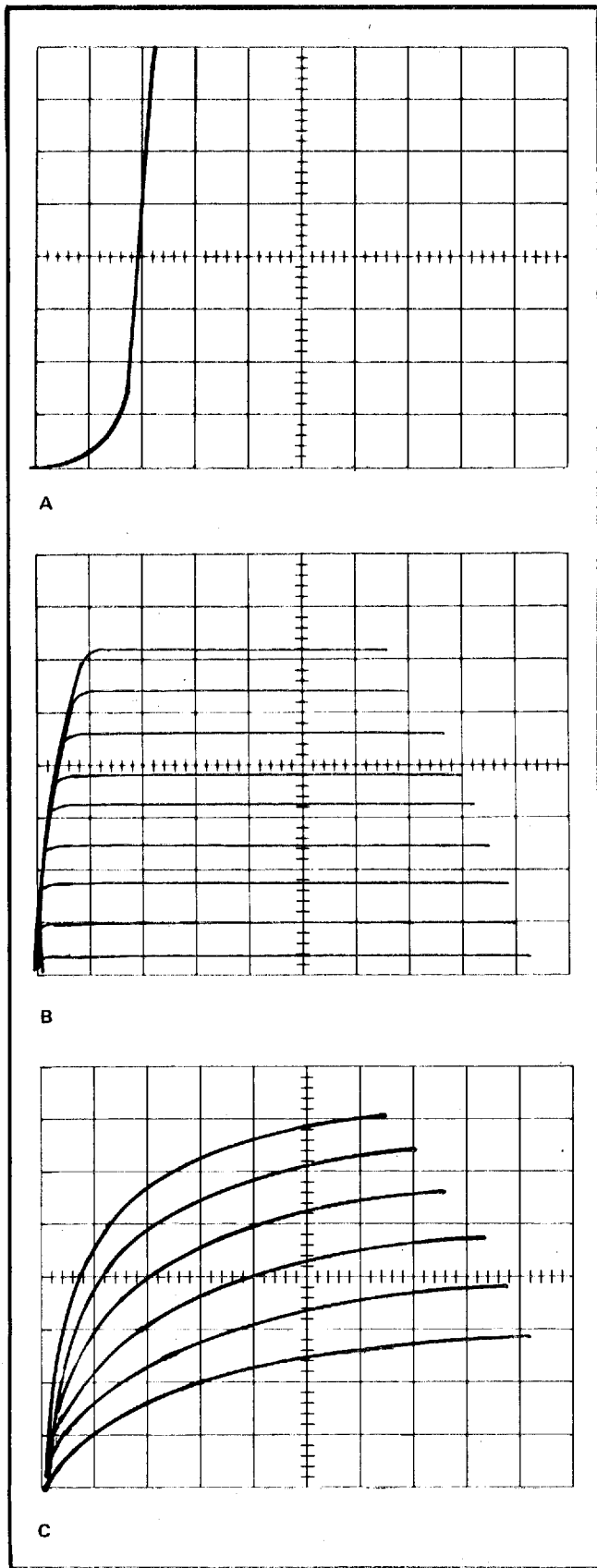


Fig. 1-2. Characteristic curves: (A) Diode; (B) Bipolar transistor; (C) Field effect transistor.

Controls Settings. Set the 7CT1N controls initially as follows:

POSITION	Centered
COLLECTOR/DRAIN VOLTS	Fully counterclockwise
X10	Pushbutton out
.5 V - 2 V	Pushbutton out
VERTICAL	As desired
÷ 1000	Pushbutton in
STEP AMPL	No effect for Diode Check
STEP	No effect for Diode Check
STEP OFFSET	No effect for Diode Check
NPN, N CH - PNP, P CH	Pushbutton out
XSTR-FET	Pushbutton out

Installation. Connect the diode to the device testing jacks as shown in Fig. 1-3. The device may be connected either directly to the jacks or through the transistor-FET adapter included with the 7CT1N. Special diode adapters are also available from Tektronix (see Table 1-4).

Checks and Measurements. Use the following instructions to make checks and measurements of a diode once the controls have been set and the diode has been installed as described previously.

Go, No-Go Turn the COLLECTOR/DRAIN VOLTS control clockwise to obtain a display of the forward conduction characteristic of the diode. Fig. 1-3 shows typical displays for a rectifier type diode and a tunnel diode.

I_F and V_F Turn the COLLECTOR/DRAIN VOLTS control clockwise to obtain a display of the forward conduction characteristic of the diode. Measure the turn-on voltage on the horizontal axis of the CRT graticule and measure the forward current on the vertical axis. Measure the peak and valley currents and voltages of a tunnel diode in the same manner.

I_R (leakage) and V_R or V_Z Press the NPN, N CH - PNP, P CH pushbutton. Turn the COLLECTOR/DRAIN VOLTS control clockwise until Zener or avalanche breakdown voltage is obtained. If breakdown is not obtained, select a higher collector-drain supply output voltage. Measure V_R or V_Z on the hori-

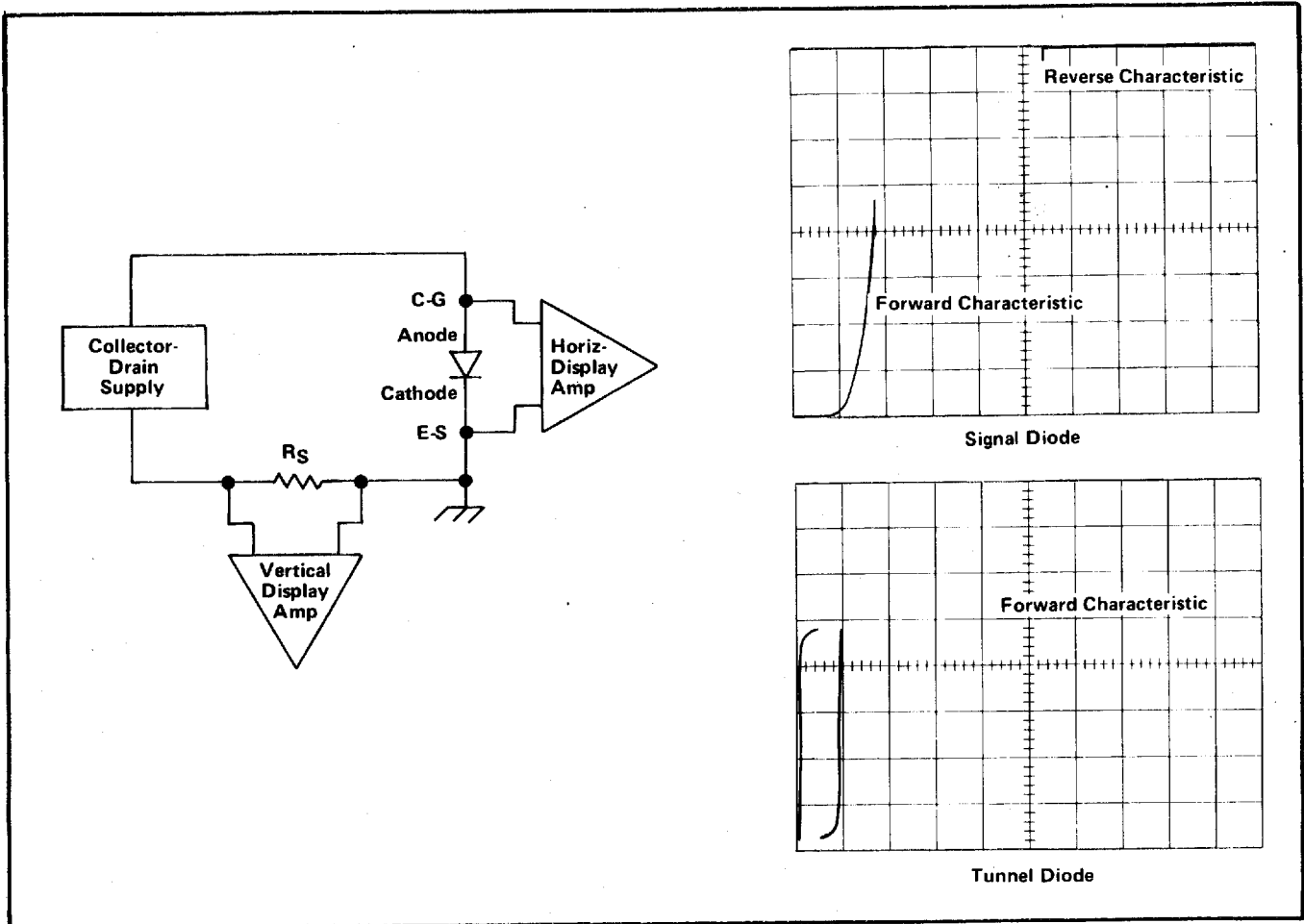


Fig. 1-3. Simplified diagram showing the connection of a diode to the 7CT1N and some typical displays.

zontal axis. Release the $\div 1000$ pushbutton to measure leakage current. With the $\div 1000$ pushbutton out, divide the VERTICAL switch setting by 1000 to obtain the vertical deflection factor. Before measuring leakage current, momentarily disconnect the diode from the test socket and vertically position the spot to the zero current line (normally the top horizontal graticule line).

X10
 .5 V - 2 V
 VERTICAL
 $\div 1000$
 STEP AMPL
 STEP
 STEP OFFSET
 NPN, N CH - PNP,
 P CH

Pushbutton out
 Pushbutton in
 As desired
 Pushbutton in
 1 μ A/DIV
 Fully clockwise
 Pull-Switch in

Pushbutton out
 (NPN Devices)
 Pushbutton in (PNP Devices)
 Pushbutton out

XSTR-FET

Bipolar Transistors

General. All bipolar transistors can be tested with the 7CT1N. The maximum I_C which can be measured is 160 mA.

Controls Settings. Set the 7CT1N controls initially as follows:

POSITION	Centered
COLLECTOR/DRAIN VOLTS	Fully counterclockwise

Installation. Connect the transistor to the device testing jacks through the transistor-FET adapter which is included with the 7CT1N. This adapter accepts TO-5 and TO-18 type cases. For devices which do not match this adapter, connect the leads to the jacks as shown in Fig. 1-4.

Checks and Measurements. Use the following instructions to make checks and measurements of a transistor once the controls have been set and the diode has been installed as described previously.

age with the base open is measured on the horizontal axis. Collector-emitter leakage current with the base open is measured on the vertical axis. To make this measurement, release the $\div 1000$ pushbutton and adjust the COLLECTOR/DRAIN VOLTS control for the V_{CE} at which the leakage current is specified. Before measuring I_{CEO} momentarily disconnect the transistor from the test socket and position the spot to the zero current line (the bottom horizontal graticule line for NPN transistors, and the top horizontal graticule line for PNP transistors).

to the C or G terminal, the base lead is connected to the E or S terminal, and the collector lead is left open (or connected to the B or D terminal).

Field Effect Transistors

General. All Field Effect Transistors including junction FET's and MOS-FET's can be tested with the 7CT1N.

Control Settings. Set the 7CT1N controls initially as follows:

POSITION	Centered
COLLECTOR/DRAIN VOLTS	Fully counterclockwise
X10	Pushbutton out
.5 V - 2 V	Pushbutton in
VERTICAL	As desired
$\div 1000$	Pushbutton in
STEP AMPL	1 mV/STEP
STEP	Fully clockwise
STEP OFFSET	Pull-Switch in
NPN, N CH - PNP, P CH	Pushbutton out (N channel) Pushbutton in (P channel)
XSTR-FET	Pushbutton in

Installation. Connect the FET to the device testing jacks through the transistor-FET adapter which is included with the 7CT1N. This adapter is wired to accept devices with gate-drain-source configurations. If the adapter can not be conveniently used, connect the leads directly to the device testing jacks as shown in Fig. 1-5.

Checks and Measurements. Use the following instructions to make checks and measurements of an FET once the controls have been set and the FET has been installed as previously described.

Go, No-Go Turn the COLLECTOR/DRAIN VOLTS control clockwise to obtain a horizontal trace of about 5 divisions. Turn the STEP AMPL switch clockwise until a display similar to that shown in Fig. 1-5 is obtained.

g_m (small-signal) The small-signal transconductance (source grounded) is $\Delta I_D / \Delta V_{GS}$. To measure g_m , obtain a display of I_D vs. V_{DS} as is described for the go, no-go check. Set the STEP AMPL switch and VERTICAL switch for the I_D at which g_m is specified. I_D is measured on the vertical axis. The VERTICAL switch sets the deflection factor. When the desired display is

I_{CES} and BV_{CES}

Collector-emitter leakage current and collector-emitter breakdown voltage (base shorted to emitter) are measured the same as I_{CEO} and BV_{CEO} , except that the base lead of the device is shorted to the emitter lead.

I_{CER} and BV_{CER}

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

α (small-signal)

The small-signal short-circuit forward current transfer ratio (base grounded), h_{fb} , cannot be measured conveniently with the 7CT1N. It can, however, be calculated from β with the following equation: $\alpha = \beta / (1 + \beta)$.

I_{CBO} and BV_{CBO}

Collector-base leakage current and collector-base breakdown voltage (emitter open) is measured the same as I_{CEO} and BV_{CEO} , except that the base lead is connected to the E or S terminal, and the emitter lead is left open (or connected to the B or D terminal).

I_{EBO} and BV_{EBO}

Emitter-base leakage current and emitter-base breakdown voltage (collector open) are measured the same as I_{CEO} and BV_{CEO} , except that the emitter lead is connected

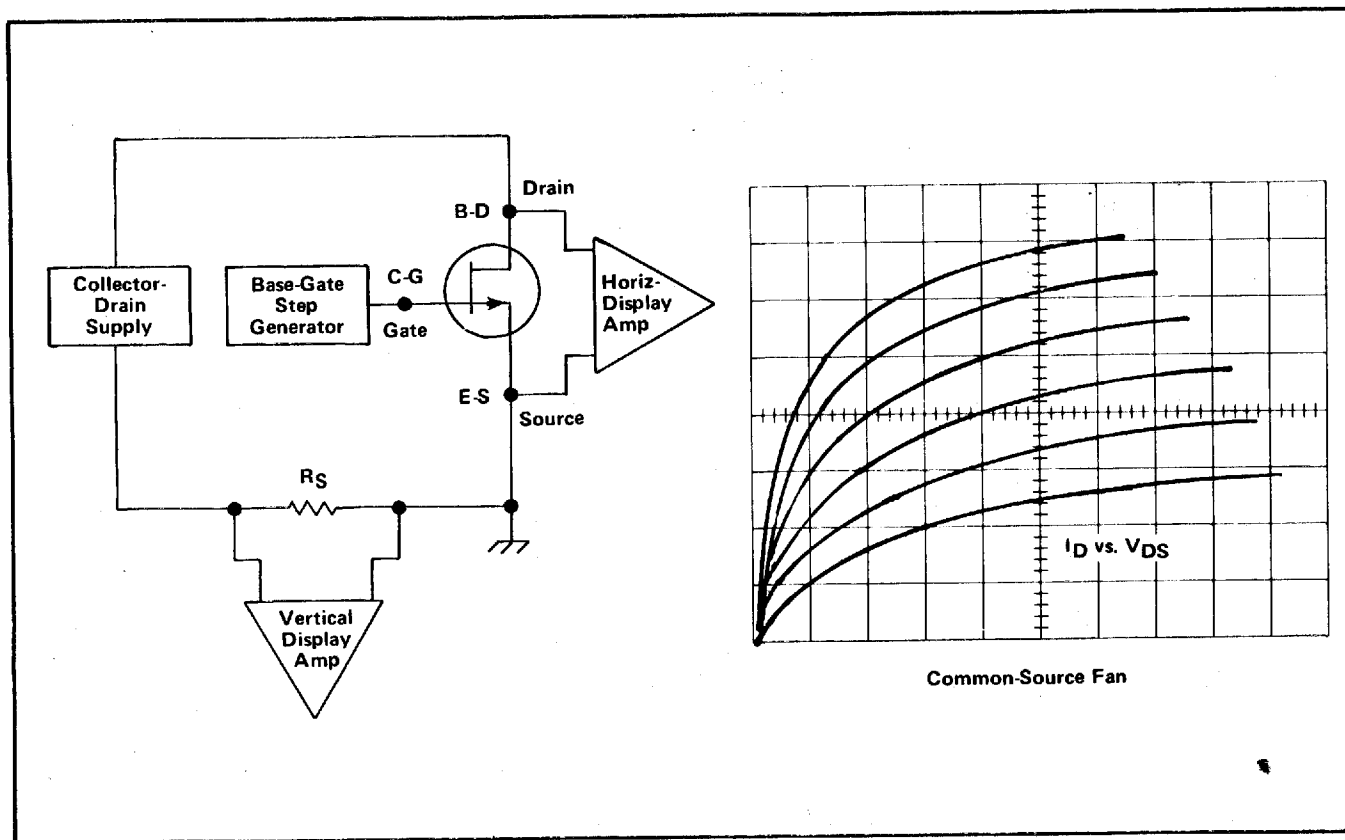


Fig. 1-5. Simplified diagram showing the connection of an FET to the 7CT1N and a typical display.

obtained, calculate a value of g_m /division by dividing the VERTICAL switch setting by the setting of the STEP AMPL switch. Next measure the vertical distance between two curves in the vicinity of the I_D at which g_m is specified. Offset may be used to position the curves for convenient measurement. Multiply this distance by the g_m /division previously calculated to determine g_m .

obtained. V_p is then the gate-source voltage required to reach pinch-off current. Multiply the number of steps required to reach pinch-off current by the setting of the STEP AMPL switch to obtain a value for V_p . For a more accurate measurement of V_p , use the STEP OFFSET control. Since the STEP OFFSET control is not calibrated, some reference point must be established on the CRT graticule. For example, the level of the 10th step could be marked on the CRT graticule before the STEP OFFSET control is pulled out.

I_{DSS}

Obtain a display of I_D vs. V_{DS} as described for the go, no-go check. Turn the STEPS control fully counterclockwise. Drain-source current with zero V_{GS} is the current level of the single curve measured above the knee.

BV_{GSS}

Install the device in the test socket with the gate lead connected to the E or S jack and the source and drain leads shorted together and connected to the B or D jack. Turn the COLLECTOR/DRAIN VOLTS control clockwise until the gate-source breakdown voltage is obtained. **This measurement should not be made on insulated gate devices.**

Pinch-Off Voltage (V_p)

Obtain the display of I_D vs. V_{DS} as described for the go, no-go check. Pinch-off voltage is measured by increasing the gate-source depletion voltage, using the STEP AMPL switch and the STEPS control, until the specified pinch-off current is

SPECIFICATION

This specification lists the electrical performance limits and physical requirements of the 7CT1N. A procedure for checking the electrical performance limits is given in the Performance Check/Adjust section.

Collector-Drain Supply

Polarity: + or —.

Voltage Ranges: (No Load)

0 V to 7.5 V.

0 V to 30 V.

0 V to 75 V.

0 V to 300 V.

Maximum Voltage Limit: Within 20%

Peak Current: (Short Circuit)

240 mA in 7.5 V range.

60 mA in 30 V range.

24 mA in 75 V range.

6 mA in 300 V range.

Peak Current Limit: Within 30%

Base-Gate Step Generator

Step Polarity: Positive-going or negative-going

Number of Steps: From 0 to at least 10.

Step Accuracy:

Absolute: (Eighth step) within 5%.

Incremental: Within 3%

Zero Step Level: Within 0.3 step.

Step Offset:

Aiding: At least 5 steps (or 13 V total step generator output for voltage steps).

Opposing: At least 5 steps.

Display Amplifiers

Vertical:

Ranges: Normal and Leakage.

Accuracy: Within 5% + 0.2 nA/V.

Horizontal Accuracy: Within 5%.

Positioning Accuracy: Within 3% using NPN, N CH - PNP, P CH pushbutton.

General

Temperature:

Operating: 0° C to +50° C.

Storage: -40° C to +70° C.

Altitude:

Operating: To 15,000 feet.

Storage: To 50,000 feet.

Vibration Range: To 0.015 inch total displacement at 50 Hz.

Shock Range: 30 g's, 1/2 sine, 11 ms duration.

Transportation: Qualified under National Safe Transit Committee Test Procedure 1A, Category II.

Standard Accessories:

1 Instruction Manual 070-1247-00

1 Transistor, FET Adapter, TO-5 and TO-18.

SUPPLEMENTARY INFORMATION

This section lists additional information about the 7CT1N which may be useful in using or maintaining the instrument.

Collector-Drain Supply

Modes: Normal sweeping output or DC output (for leakage current measurements).

Sweep Waveform: Triangular.

Sweep Frequency: ≈ 110 Hz.

Peak Power: ≈ 0.5 watt. Limited by internal series resistors. Reduced in higher sensitivity positions of VERTICAL switch.

Warning Light: Flashes when collector-drain supply is set above about 50 volts open circuit to indicate a dangerous voltage at the device testing terminals.

Base-Gate Step Generator

Modes: Current steps for testing bipolar transistors, and voltage steps for testing field effect transistors.

Step Rate: 1 step per cycle of the collector-drain supply.

Ranges:

Current Mode: $1 \mu\text{A}/\text{step}$ to $1 \text{ mA}/\text{step}$ in a 1-2-5 sequence.

Voltage Mode: $1 \text{ mV}/\text{step}$ to $1 \text{ V}/\text{step}$ in a 1-2-5 sequence.

Limits—Current Mode:

Maximum Current:

With Aiding Offset: 15 times the STEP AMPL switch setting.

With Opposing Offset: 5 times the STEP AMPL switch setting.

Maximum Voltage:

With Aiding Offset: $\pm 13 \text{ V}$.

With Opposing Offset: $\pm 15 \text{ V}$.

Limits—Voltage Mode:

Maximum Voltage:

With Aiding Offset: 15 times the STEP AMPL switch setting or $\pm 13 \text{ V}$, whichever is less.

With Opposing Offset: 5 times STEP AMPL switch setting.

Maximum Current: Limited by output impedance of $1 \text{ k}\Omega$ (aiding or opposing offset).

Display Amplifiers

Vertical Ranges:

Normal: $10 \mu\text{A}/\text{division}$ to $20 \text{ mA}/\text{division}$ in 1-2-5 sequence.

Leakage: $10 \text{ nA}/\text{division}$ to $20 \mu\text{A}/\text{division}$ in 1-2-5 sequence.

Horizontal Ranges: $.5 \text{ V}/\text{division}$, $2 \text{ V}/\text{division}$, $5 \text{ V}/\text{division}$ and $20 \text{ V}/\text{division}$ through plug-in with $100 \text{ mV}/\text{division}$ deflection factor.

Repackaging for Shipment

If the Tektronix instrument is to be shipped to a Tektronix Service Center for service or repair, attach a tag showing: owner (with address) and the name of an individual at your firm that can be contacted, complete instrument serial number and a description of the service required.

Save and re-use the package in which your instrument was shipped. If the original packaging is unfit for use or not available, repackage the instrument as follows:

Surround the instrument with polyethylene sheeting to protect the finish of the instrument. Obtain a carton of corrugated cardboard of the correct carton strength and having inside dimensions of no less than six inches more than the instrument dimensions. Cushion the instrument by tightly packing three inches of dunnage or urethane foam between carton and instrument, on all sides. Seal carton with shipping tape or industrial stapler.

The carton test strength for your instrument is 200 pounds.

Circuit Description—7CT1N

steps for application to the gate of an FET. The steps occur at a rate of one step per cycle of the collector-drain supply.

The vertical display amplifier measures current for display on the vertical axis of the CRT. A resistor in the return path to the collector-drain supply is used to sense current.

The horizontal display amplifier measures voltage for display on the horizontal axis of the CRT. The voltage measured is V_{CE} for a bipolar transistor, V_{DS} for an FET or an anode-cathode voltage for a diode.

CIRCUIT DESCRIPTION

Collector-Drain Supply

The sweep generator (see the Block Diagram in the diagrams section) produces a triangular waveform which is the basis for the collector-drain supply output. The signal is generated at a rate of about 55 Hz with a peak-to-peak amplitude of about 10 V. To produce the triangular waveform (see the circuit diagram), C11 is charged and discharged with constant current conducted through R11. Q2 and Q4 form a Schmitt trigger circuit which determines when C11 is charged and discharged.

The sweep generator output is transmitted through variable attenuator R20, the COLLECTOR/DRAIN VOLTS control, to the sweep amplifier. The sweep amplifier amplifies the triangular waveform about five times.

From the sweep amplifier, the triangular waveform is transmitted through collector supply transformer T39. T39 has four taps which determine the four ranges of the collector-drain supply. CR52 full-wave rectifies the output of the transformer secondary, producing the collector-drain sweep output. The sweep output is thus a positive or negative triangular waveform produced at twice the rate of the unrectified waveform, or 110 Hz.

The collector-drain supply voltage is applied to the device under test through S70C, controlled by the PNP, P CH pushbutton, and S75B, controlled by the FET pushbutton. The path of collector or drain current (see the Block Diagram) is from one side of the rectifier, through the device under test, through the current sensing resistor, and back to the other side of the rectifier. S70C determines the polarity of the collector-drain supply sweep applied to the device under test, and thus the direction of current through the device under test.

R56 and R57 are series limiting resistors which limit the power dissipated by the device under test. The VERTICAL switch determines when these resistors are in the circuit.

C52 and C53, or C54 are connected between the two outputs of the collector-drain supply rectifier when the ÷ 1000 pushbutton is released. These capacitors filter the collector-drain sweep voltage, producing a DC voltage.

Q208 performs two functions; it turns off the collector-drain supply when the 7TC1N is installed in the oscilloscope system, but not in use, and it helps limit beam intensity when the collector-drain supply voltage is low. A6, connected to the emitter of Q204, is a common. A16 and B7 are logic lines which indicate whether the plug-in is in use or not. When the plug-in is not being used, A16 and B7 are either both high or both low. In this case, Q208 is off and Q210 and Q212 are on, holding the output of the sweep generator at ground.

When the plug-in is in use, the logic levels on A16 and B7 are opposite one another, and Q208 is on. In this case, the amount of current conducted by Q208 controls the beam intensity. As current increases through Q208, the beam intensity decreases. The voltage across C214, which is controlled by the negative portion of the sweep amplifier output, determines the amount of current Q208 conducts. As the collector-drain supply voltage decreases, the voltage across C214 decreases. This causes the current conducted by R214 to decrease, which increases the current through Q208 and reduces the beam intensity.

The voltage across C214 controls the WARNING HIGH VOLTAGE light. When the voltage across C214 gets higher than 5 V or 24 V, depending on the position of S45C, multivibrator Q226 and Q228 is allowed to free run causing the warning light to flash. 5 V and 25 V across C214 correspond to about 50 V at the output of the collector-drain supply.

Base-Gate Step Generator

The zero crossing detector produces a positive-going pulse each time the output of the sweep generator crosses 0 volts. When the sweep generator output crosses 0 volts going positive, Q82 is turned on and Q84 is turned off, causing a positive pulse to be transmitted through CR86 to the base of Q92. When the output crosses zero going negative, Q84 turns on, Q82 turns off and a positive pulse is transmitted through CR88 to the base of Q92.

The step generator produces a DC voltage which increases by one increment (or step) each time the zero crossing detector produces a positive pulse. The output of the step generator is, thus, a positive-going staircase. The staircase voltage increases until it reaches a level set by the STEP control. At this time, the step generator output returns to 0 volts and a new staircase begins.

C114 is charged in increments to produce the step generator output voltage. Quiescently, C96 is charged to about 5 volts as set by R90, the V/STEP CAL adjustment. When a positive-going pulse from the zero crossing detector is applied to the base of Q92, its collector goes to ground, causing a negative-going pulse to be conducted through CR97. This negative pulse causes C114 to be charged by an amount proportional to the initial charge on C96. R90 thus determines the step amplitude at the step generator output. When C96 has discharged, CR97 turns off, holding the charge on C114 constant.

C114 will continue to charge in this manner until the step generator output voltage becomes high enough to turn on Q104. R100, the STEP control, determines the voltage required to turn on Q104. When Q104 turns on, Q108 turns on, which turns on Q114. With Q114 on, C114 is discharged. When Q108 turns on, Q92 is also turned on, keeping C96 discharged until the step generator output returns to 0 volts.

The offset circuit allows the DC level of the step generator staircase to be shifted either positive (aiding) or negative (opposing). R120, the STEP OFFSET control, controls the output voltage of the offset circuit.

The step amplifier amplifies the step generator output 1.5 times and converts the voltage steps into current steps. Q132 and Q136 form an emitter-coupled amplifier. The output of this amplifier is at the collector of Q132. Q142 and Q148 conduct constant current. Q144 and Q146 conduct varying current as determined by the collector of Q132. To obtain positive current steps (current steps conducted into the device under test), the base of Q136 is grounded and positive-going voltage steps from the step generator are applied to the base of Q132. The resulting negative-going voltage steps at the collector of Q132 cause the current conducted by Q144 and Q146 to increase in step increments. Since Q142 and Q148 conduct constant current, the additional current conducted by Q144 and Q146 is conducted into the device under test.

To obtain negative-going current steps (current steps conducted out of the device under test), the base of Q132 is grounded and the step generator output is applied to the base of Q136. In this case, the voltage steps at the collector of Q132 are positive-going, causing the current conducted by Q144 and Q146 to be reduced in step increments. Since Q142 and Q148 are still conducting constant current, current will have to be conducted out of the device under test to make up for the reduced current conducted by Q144 and Q146.

When voltage steps are desired, R169 is switched into the circuit. The current produced by the step amplifier is then conducted through R169 to produce voltage steps. The accuracy of the voltage steps is dependent on the amount of current R169 conducts. If the voltage steps are

applied to the gate of an FET being operated in its enhancement region, the steps will be compressed due to the gate current conducted by the device. This voltage limiting protects the gate from excessive current in such cases.

R139, the 1.5 μA BAL adjustment sets the current conducted by emitter-coupled amplifier Q132 and Q136. It thus sets the overall balance of the step amplifier. R158, R155, and R152 (the 10-50 μA , 100-500 μA , and 1 mA BAL adjustment, respectively) set the balance of the step amplifier for their respective positions of the STEP AMPL switch. These four controls are adjusted for zero current when no steps are being generated.

Display Amplifiers

The vertical display amplifier measures the current supplied to the device by the collector-drain supply, by measuring the voltage across a current sensing resistor in the return path to the supply. The size of the current sensing resistor is changed to obtain the decade ranges of the vertical deflection factor. The size of the feedback resistor across the vertical amplifier determines the 1-2-5 multiplier of the vertical deflection factor. When the \div 1000 pushbutton is released, a different set of current sensing resistors is used to increase the sensitivity of the vertical amplifier and allow leakage currents to be measured. R194, the VERT AMP BAL adjustment, adjusts the balance of U194 so that there is no DC shift in the output when the VERTICAL AMPERES/DIV switch position is changed. U232 is an amplifier which provides a voltage gain of 2.

The horizontal display amplifier measures the output voltage of the collector-drain supply, which is essentially the voltage between the C-G and E-S jacks, when the XSTR-FET pushbutton is out, and the B-D and E-S jacks, when the pushbutton is in. Since the current sensing resistors are in series with the device under test (see Fig. 2-1), the voltage measured by the horizontal display amplifier is not exactly the voltage across the device under test. This error is only significant for the 0.5 V/div horizontal deflection factor. In this case, divider R171-R172 compensates for the error introduced by the current sensing resistor.

The 7CT1N transmits the output of one display amplifier to the mainframe through push-pull amplifier Q252 and Q262, and the output of the other amplifier through the EXT HORIZ OR VERT OUT cable. From this cable the signal is transmitted to the mainframe through an amplifier in another plug-in in the oscilloscope system. The position of VERT pushbutton S230 determines which signal is transmitted through the EXT HORIZ OR VERT OUT cable. If the 7CT1N is in a vertical compartment, the VERT pushbutton is pressed and the horizontal signal is transmitted through the EXT HORIZ OR VERT OUT cable; if the 7CT1N is in a horizontal compartment, the VERT pushbutton is left out and the vertical signal is transmitted through the cable.

SECTION 3

PERFORMANCE CHECK / ADJUSTMENT PROCEDURE

GENERAL

Introduction

This section contains a procedure for checking the performance capabilities of the 7CT1N and, when necessary, for making internal adjustments to bring the instrument performance within specified limits. The basic operation procedure in Section 1 verifies instrument operation, but does not check its performance to specified limits.

Services Available

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

TEST EQUIPMENT REQUIRED

General

The following test equipment and accessories, or the equivalent, are required for complete calibration of the 7CT1N. Specifications given for the test equipment are the minimum necessary for accurate calibration. Therefore, some of the specifications listed here may be less rigorous than the performance capabilities of the test equipment. All test equipment is assumed to be operating within the listed specifications.

Special Calibration Fixtures

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

Calibration Equipment Alternatives

If other test equipment is substituted, control settings or calibration setups may need altering to meet the requirements of the equipment used. Detailed operating instruc-

tions for the test equipment are not given in this procedure. Refer to the instruction manual for the test equipment if more information is needed.

Test Equipment

1. 7000-Series Oscilloscope System, including a mainframe, one vertical amplifier and one time-base. The measurement accuracies of the vertical amplifier and time-base must be within 3%.

2. Voltage Source. A voltage source with DC voltages (or pulse amplitudes) of 500 mV, 5 V, 20 V, 50 V and 100 V, accuracy within 1%. A Tektronix Standard Amplitude Calibrator is suggested (Tektronix Part No. 067-0502-01).

3. The following precision resistors checked to within 1/2% accuracy, 100 Ω , 1 k Ω , 10 k Ω , 20 k Ω , 50 k Ω , 100 k Ω , 200 k Ω , 2 M Ω and 20 M Ω (all 1/8 watt or greater).

Accessories

1. Patch cords (2). 12 to 18 inches long with standard banana plug connectors. (Tektronix Part No. 012-0031-00 or 012-0039-00.)

2. Connector adapter. BNC male-to-dual binding post (Tektronix Part No. 103-0035-00).

3. Plug-in extender (optional). Tektronix Part No. 067-0616-00. Used for adjustments only.

NOTE

The display amplifiers in the oscilloscope mainframe should be calibrated before performing this procedure.

TABLE 3-1
Check/Adjust Procedure Index and Record

Step	Title	Adjustments	Page
1	Check Horizontal Display Amplifier		3-2
2	Check/Adjust Vertical Display Amplifier	R194	3-3
3	Check Collector-Drain Supply		3-4
4	Check/Adjust Base-Gate Step Generator	R139, R152, R155, R158, R100	3-5

Performance Check/Adjustment Procedure—7CT1N

Preliminary Procedure

1. Install the 7CT1N and amplifier plug-ins in the 7000-series oscilloscope system.

a. (Performance Check Only)—Install the 7CT1N in the Right plug-in compartment and the amplifier plug-in in the A compartment.

b. (Performance Check and/or Adjustment)—Remove the left dust cover from the 7CT1N and install the plug-in in the Right plug-in compartment through a plug-in extender. Install the amplifier plug-in in the A compartment. If a plug-in extender is not available, install the 7CT1N in the Left compartment and remove the left dust cover from the mainframe. The plug-in extender is required for rack-mounted oscilloscope systems.

2. Connect the oscilloscope system and Standard Amplitude Calibrator to a suitable power source and turn on the instruments. Allow 5 minutes warmup before starting the procedure.

NOTE

The performance of this instrument can be checked at any ambient temperature within the 0°C to +50°C range. If adjustments are to be made, the ambient temperature should be 25°C ±5°C, for best overall accuracy.

1. Check Horizontal Display Amplifier

a. Set the 7CT1N, oscilloscope system and standard amplitude calibrator controls as follows:

7CT1N	
PLUG-IN COMPARTMENT	VERT
POSITION	Centered
COLLECTOR/ DRAIN VOLTS	Fully counterclockwise
X10	Pushbutton out
.5 V-2 V	Pushbutton out
VERTICAL	20 mA/DIV
÷1000	Pushbutton in
STEP AMPL	1 mA/STEP

STEP	Fully counterclockwise
STEP OFFSET	Pull-switch in
NPN, N CH -	
PNP, P CH	Pushbutton out
XSTR-FET	Pushbutton out

Oscilloscope System

Vertical Mode	Location of 7CT1N
Horizontal Mode	A
Amplifier	
Position	Centered
Polarity	+Up
Coupling	DC
Volts/Div	.1 (Cal)

Standard Amplitude Calibrator

Mode	Square Wave
Amplitude	5 Volts

CAUTION

Occasionally while using this procedure, a single spot will be displayed on the CRT. In such cases, avoid high spot intensity to prevent burning the CRT phosphor. This precaution is especially important when using a storage oscilloscope.

b. Connect the 7CT1N EXT HORIZ OR VERT OUT cable to an input to the amplifier plug-in. Connect the square wave output of the Standard Amplitude Calibrator to the C or G jack on the 7CT1N and the ground to the E or S jack. It is suggested that a BNC male to dual binding post adapter and two patch cords with banana plug connectors be used.

c. Position the display so that both spots are visible on the CRT graticule.

d. CHECK FOR—Horizontal separation of spots as shown in Table 3-2 ±0.5 division (±0.25 division for the 20 V/div deflection factor) for all the settings of the .5 V-2 V and X10 pushbuttons. Note that for the 0.5 V/div, 2 V/div and 5 V/div deflection factors, the 7CT1N loads the Standard Amplitude Calibrator, causing the spot separation to be reduced 0.2 division.

TABLE 3-2

Check Horizontal Display Amplifier Accuracy

X10 Pushbutton	.5 V-2 V Pushbutton	Horizontal Deflection Factor	Standard Amplitude Calibrator	Horizontal Separation
Out	Out	.5 V/Div	5 V	9.8 divisions
Out	In	2 V/Div	20 V	9.8 divisions
In	Out	5 V/Div	50 V	9.8 divisions
In	In	20 V/Div	100 V	5.0 divisions

e. Calibrate the CRT horizontal deflection for 5 V over the center 8 divisions. This is done by setting the Standard Amplitude Calibrator for 5 V and the 7CT1N horizontal deflection factor for 0.5 V/division. Then release the amplifier volts/div variable control and adjust it for a spot separation of 7.8 divisions.

f. Disconnect the Standard Amplitude Calibrator from the 7CT1N.

2. Check/Adjust Vertical Display Amplifier

a. Set the 7CT1N and Oscilloscope System controls as follows:

7CT1N

PLUG-IN COMPARTMENT POSITION	VERT Centered
COLLECTOR/DRAIN VOLTS X10	Fully counterclockwise
.5 V-2 V	Pushbutton out
VERTICAL ÷1000	Pushbutton out
STEP AMPL STEP	50 μ A/DIV
	Pushbutton in
	1 mA/STEP
	Fully counterclockwise

STEP OFFSET	Pull-switch in
NPN, N CH-	
PNP, P CH	Pushbutton out
XSTR-FET	Pushbutton out

Oscilloscope System

Vertical Mode	Location of 7CT1N
Horizontal Mode	A
Amplifier	
Position	Centered
Polarity	+Up
Coupling	DC
Volts/Div	Use setting determined in step 1e.

b. Center the spot on the CRT both horizontally and vertically.

c. Switch the VERTICAL switch back and forth between the 50 μ A/DIV and 100 μ A/DIV positions.

d. ADJUST—R194, the VERT AMPL BAL adjustment (see Fig. 3-1), for no vertical shift in spot between the two positions of the VERTICAL switch.

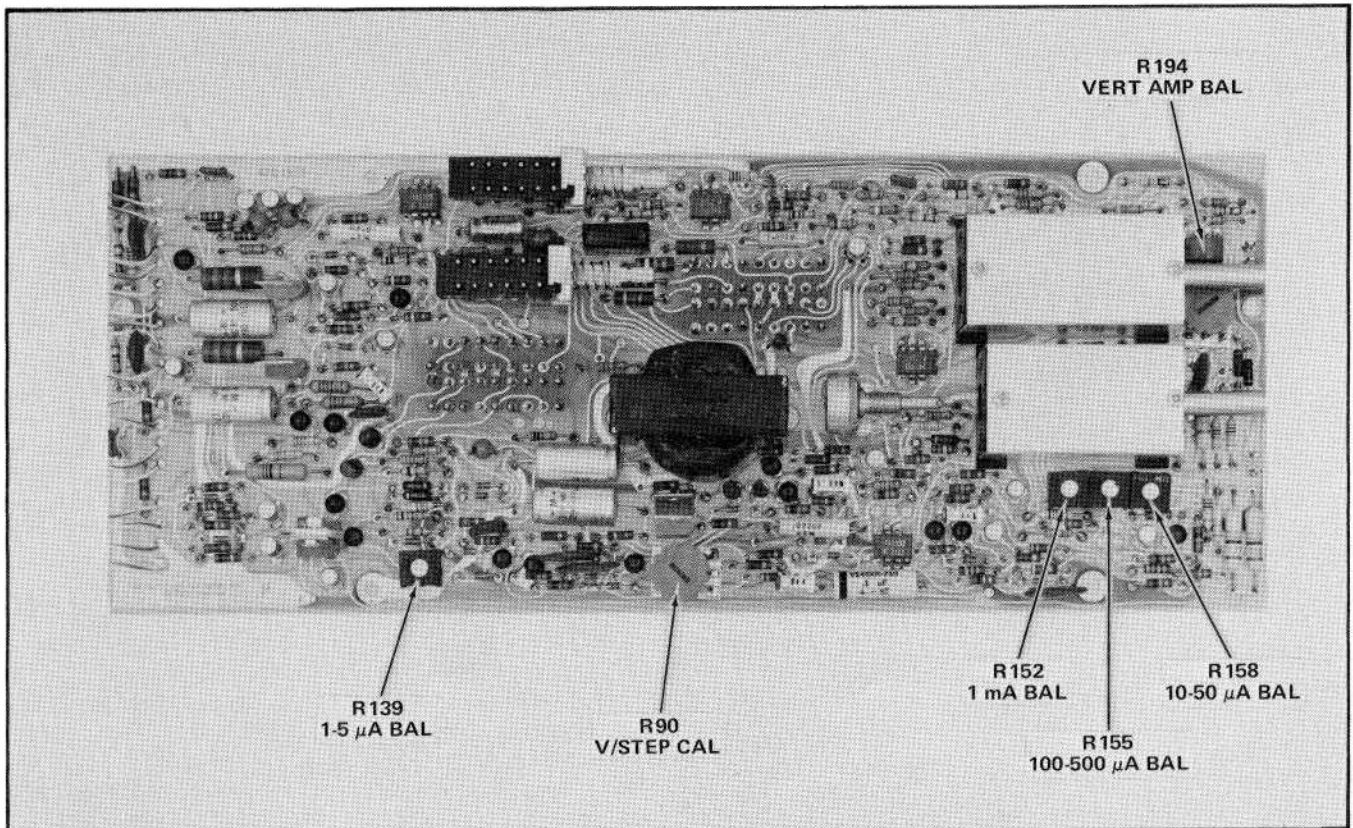


Fig. 3-1. Location of internal adjustments for the 7CT1N.

Performance Check/Adjustment Procedure—7CT1N

e. Turn the COLLECTOR/DRAIN VOLTS control fully clockwise and set the VERTICAL switch to one of the positions shown in Table 3-3. Connect the resistor shown in the table for that switch position between the C or G and the E or S jacks. Position the left end of the trace at the intersection of the second vertical graticule line on the left of the CRT and the second horizontal graticule line from the bottom of the CRT.

TABLE 3-3

Check Vertical Display Amplifier Accuracy

VERTICAL	÷1000	Resistor Value
10 mA/DIV	In	100 Ω
1 mA/DIV	In	1 kΩ
0.1 mA/DIV	In	10 kΩ
50 μA/DIV	In	20 kΩ
20 μA/DIV	In	50 kΩ
10 mA/DIV (10 μA/DIV)	Out	100 kΩ
5 mA/DIV (5 μA/DIV)	Out	200 kΩ
0.5 mA/DIV (500 nA/DIV)	Out	2 MΩ
50 μA/DIV (50 nA/DIV)	Out	20 MΩ

f. CHECK FOR—Trace slope, 5 divisions ±0.25 division ±1 nA, for 8 divisions (5 volts) of horizontal movement. The top of the trace should intersect the second vertical graticule line from the right and the third horizontal graticule line from the top.

g. Repeat parts e and f for all the non-leakage (÷1000 pushbutton in) positions of the VERTICAL switch.

h. Release the ÷1000 pushbutton and repeat parts e and f for all the leakage positions of the VERTICAL switch. When measuring leakage current, a spot is displayed, rather than a trace. The COLLECTOR/DRAIN VOLTS control must, therefore, be turned counterclockwise until the spot can be positioned onto the intersection of the second vertical and horizontal graticule lines from the left and bottom, respectively. Once the position of the spot has been established, the COLLECTOR/DRAIN VOLTS can be turned clockwise to obtain the current at 5 volts. The spot may be shaped like an X. In such cases, make measurements from the top right of the display.

i. Remove the resistor connected to the device testing jacks.

3. Check Collector-Drain Supply

a. Set the 7CT1N and Oscilloscope System controls as follows:

7CT1N

POSITION	Centered
COLLECTOR/ DRAIN VOLTS	Fully counterclockwise
X10	Pushbutton out
.5 V-2 V	Pushbutton out
VERTICAL	20 mA/DIV
÷1000	Pushbutton in
STEP AMPL	1 mA/STEP
STEP	Fully counterclockwise
STEP OFFSET	Pull-switch in
NPN, N CH-	
PNP, P CH	Pushbutton out
XSTR-FET	Pushbutton out

Oscilloscope System

Vertical Mode	Location of 7CT1N
Horizontal Mode	A
Amplifier	
Position	Centered
Polarity	+Up
Coupling	DC
Volts/Div	.1 (Cal)

b. Position the spot to the first vertical graticule line on the left. Turn the COLLECTOR/DRAIN VOLTS control clockwise to obtain a trace 10 divisions long, then release the amplifier volts/div variable control and adjust it to reduce the trace length to 5 divisions. (Reposition the left end of the trace to the left of the CRT graticule.) Turn the COLLECTOR/DRAIN VOLTS control fully clockwise.

c. CHECK FOR—Trace length of 7.5 divisions ±1.5 divisions (±20%).

(The display may be offset up to 30 nA vertically when the ÷ 1000 pushbutton is released. The vertical position control can be used to reposition the trace.)

d. Set the .5 V-2 V and X10 pushbuttons for the other 3 collector-drain supply ranges and repeat part c for each range.

e. Reset the following 7CT1N controls as follows:

COLLECTOR/ DRAIN VOLTS	Fully Counterclockwise
.5 V-2 V	Pushbutton Out
X10	Pushbutton Out

f. Connect a short between the C or G and the E or S jacks. Position the spot to the center of the bottom horizontal graticule line. Turn the COLLECTOR/DRAIN VOLTS control clockwise to obtain a vertical trace of 8 divisions.

g. CHECK FOR—Trace tilt less than 0.2 division horizontally, over total length of trace.

h. Vertically position the top of the trace to the bottom horizontal graticule line and turn the COLLECTOR/DRAIN VOLTS control fully clockwise.

i. CHECK FOR—End of trace on the center horizontal graticule line ± 3.6 divisions ($\pm 30\%$).

j. Set the .5 V-2 V and X10 pushbuttons and the VERTICAL switch as shown in Table 3-4 for the other 3 collector-drain supply ranges. Repeat parts i for each range.

TABLE 3-4

Check Collector-Drain Supply Peak Current

X10 Pushbutton	.5 V-2 V Pushbutton	VERTICAL Switch
Out	In	5 mA/DIV
In	Out	2 mA/DIV
In	In	.5 mA/DIV

k. Turn the COLLECTOR/DRAIN VOLTS control fully counterclockwise, remove the short and reposition the spot to the lower left corner of the CRT graticule. (Reset the amplifier variable control to its calibrated position.) Press the NPN, N CH-PNP, P CH pushbutton.

l. CHECK FOR—Spot moving to the top right corner of the CRT graticule within 0.3 division vertically and horizontally. (The display amplifiers in the oscilloscope mainframe must be properly adjusted to perform this check.)

m. Turn the COLLECTOR/DRAIN VOLTS control fully clockwise.

n. CHECK FOR—Trace extending right to left, indicating that the polarity of the collector-drain supply voltage has been switched to negative.

4. Check/Adjust Base-Gate Step Generator

a. Disconnect the EXT HORIZ OR VERT OUT cable from the amplifier plug-in, remove the amplifier from its horizontal location and install it in the vertical compartment not being used by the 7CT1N. Install the time base plug-in in a horizontal compartment. Set the 7CT1N and Oscilloscope System controls as follows:

7CT1N

PLUG-IN COMPARTMENT POSITION	VERT Fully Clockwise
COLLECTOR/DRAIN VOLTS	Fully Counterclockwise
X10	Pushbutton Out
.5 V-2 V	Pushbutton Out
VERTICAL	20 mA/DIV
$\div 1000$	Pushbutton In
STEP AMPL STEPS	5 mV/STEP
STEP OFFSET	Fully counterclockwise
NPN, N CH-PNP, P CH	Pull-switch In
XSTR-FET	Pushbutton In

Oscilloscope System

Vertical Mode	Chop
Horizontal Mode	Location of Time-Base
Trigger Source	Location of Amplifier
Amplifier Position	Centered
Polarity	+Up
Coupling	Gnd
Volts/Div	5 mV (Cal)
Time Base Display Mode (7B50 or 7B70)	Time Base
Position	Centered
Triggering	Norm, +Slope, Int
Time/Div	10 ms (Cal, X1 Mag)

b. Connect a cable between the C or G jack of the 7CT1N and the external input to the amplifier plug-in.

c. Vertically position the trace to the center horizontal graticule line and release the ground pushbutton on the amplifier.

d. CHECK FOR—Vertical shift in the trace within ± 0.3 division. If noise makes this check difficult, a probe or coaxial cable can be used in place of the patch cord.

e. ADJUST—R139, the 1-5 μ A BAL adjustment (see Fig. 3-1), to move the trace to the center horizontal graticule line.

f. Press the ground pushbutton on the amplifier and repeat parts c through e for the other adjustments in Table 3-5. Note that the 7CT1N STEP AMPL switch and the amplifier volts/div switch will have to be changed for each adjustment.

TABLE 3-5
Adjust Zero Step Level

STEP AMPL	Volts/Div	Adjustment
50 mV/STEP	50 mV/Div	R 158 (10-50 μ A BAL)
.5 V/STEP	0.5 V/Div	R 155 (100-500 μ A BAL)
1 V/STEP	1 V/Div	R 152 (1 mA BAL)

g. Turn the 7CT1N STEP control fully clockwise. Trigger the display and position the zero step to the bottom horizontal graticule line.

h. CHECK FOR—Eighth step on the top horizontal graticule line ± 0.4 division (one step per vertical division).

i. ADJUST—R90, the V/STEP CAL adjustment (see Fig. 3-1), so that the eighth step is on the top horizontal graticule line.

j. Set the amplifier volts/div switch to .2 volt/div.

k. CHECK FOR—Step increments of 5 divisions ± 0.15 division for the first three steps. (Additional steps can be checked by using the STEP OFFSET control.)

l. Set the 7CT1N STEP AMPL and amplifier volts/div switch as shown in Table 3-6. For each setting of the STEP AMPL switch, position the zero step on the bottom horizontal graticule line.

m. CHECK FOR—Eighth step on the top horizontal graticule line ± 0.4 division for each setting on the STEP AMPL switch in Table 3-6. Noise received through the unshielded patch cord may cause measurement difficulty for the lower voltage steps. In such cases, replace the patch cord with a shielded cable.

TABLE 3-6

Check Step Amplitude Accuracy

STEP AMPL	Volts/Div
1 mV/STEP	1 mV/Div
2 mV/STEP	2 mV/Div
5 mV/STEP	5 mV/Div
10 mV/STEP	10 mV/Div
20 mV/STEP	20 mV/Div
50 mV/STEP	50 mV/Div
.1 V/STEP	0.1 V/Div
.2 V/STEP	0.2 V/Div
.5 V/STEP	0.5 V/Div

n. Set the 7CT1N STEP AMPL switch to 0.5 volt/step and the amplifier volts/div switch to 1 volt. Vertically center the zero step on the CRT graticule. Pull the 7CT1N STEP OFFSET pull-switch and turn it throughout its range.

o. CHECK FOR—At least 2.5 divisions of offset both above and below the center horizontal graticule line.

p. CHECK FOR—At least 10 steps in the display. (Use STEP OFFSET control to position display to bottom of graticule.)

q. Push in the 7CT1N STEP OFFSET pull-switch and release the NPN, N CH-PNP, P CH pushbutton.

r. CHECK FOR—Negative-going steps (the Oscilloscope System may have to be retriggered).

s. Disconnect the 7CT1N from the input to the amplifier.

This completes the 7CT1N Check/Adjust procedure.

SECTION 4

DIAGRAMS AND PARTS LISTS

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

General

The following section contains a complete electrical and mechanical parts lists, a block diagram, a schematic diagram, typical waveforms and a circuit board picture with the electrical components labeled by circuit number.

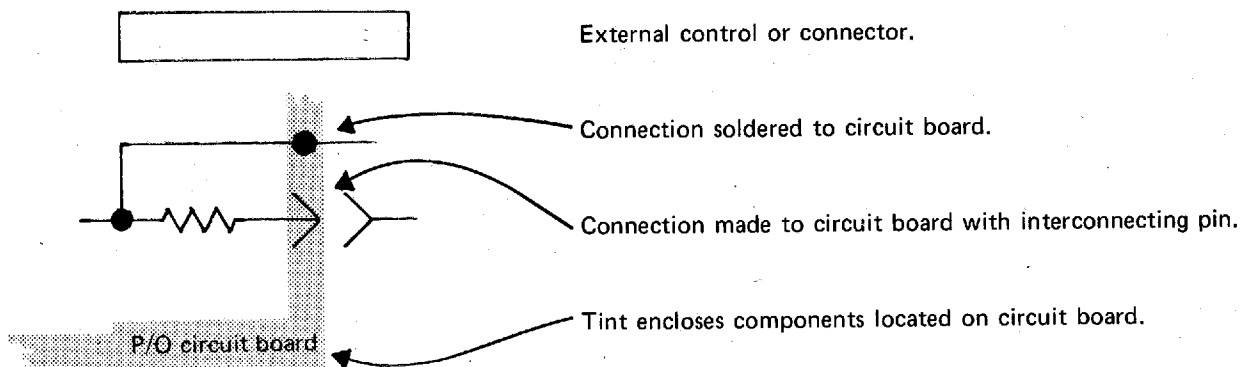
Diagram Symbols

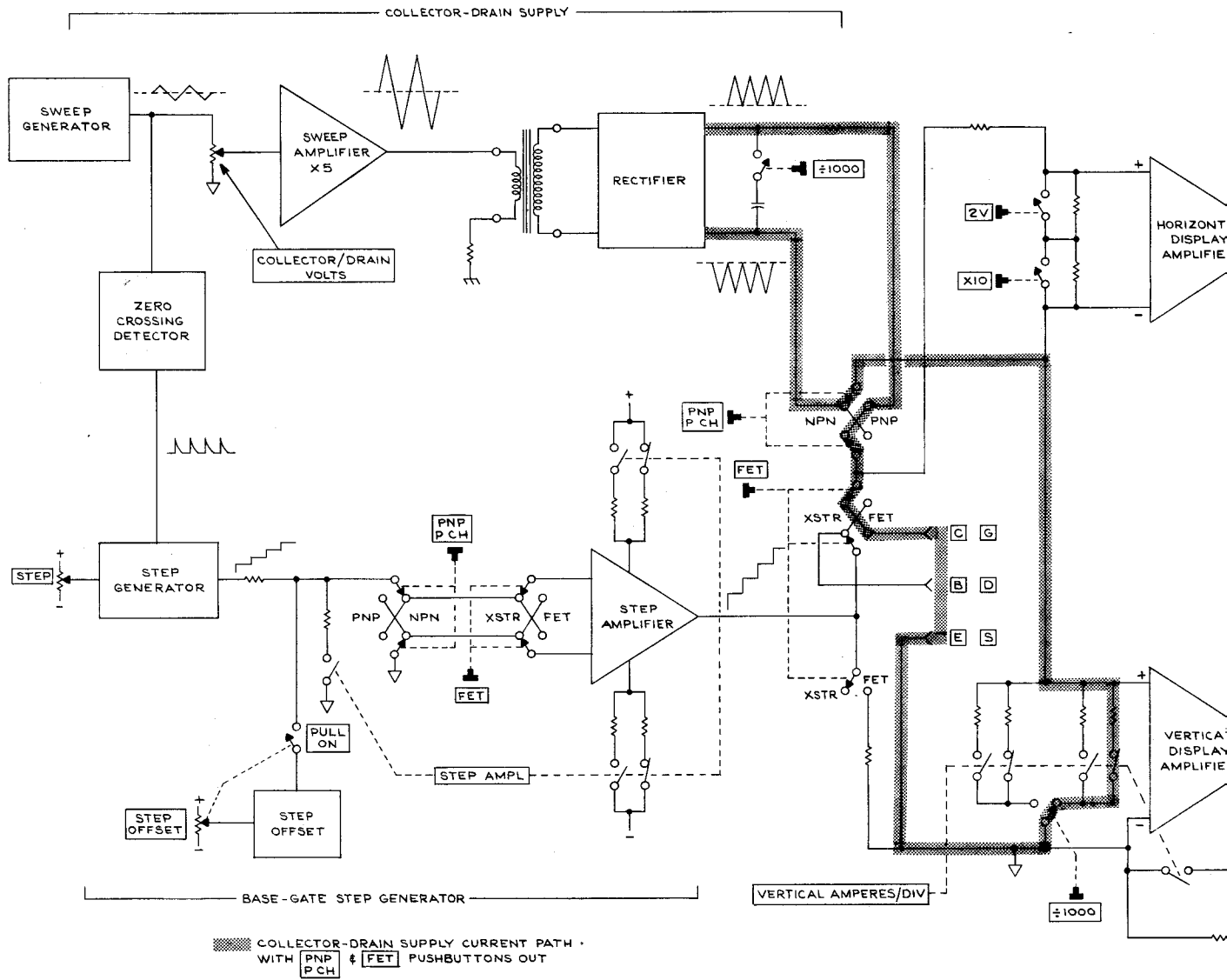
Electrical components shown on the diagrams are in the following units unless noted otherwise:

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

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

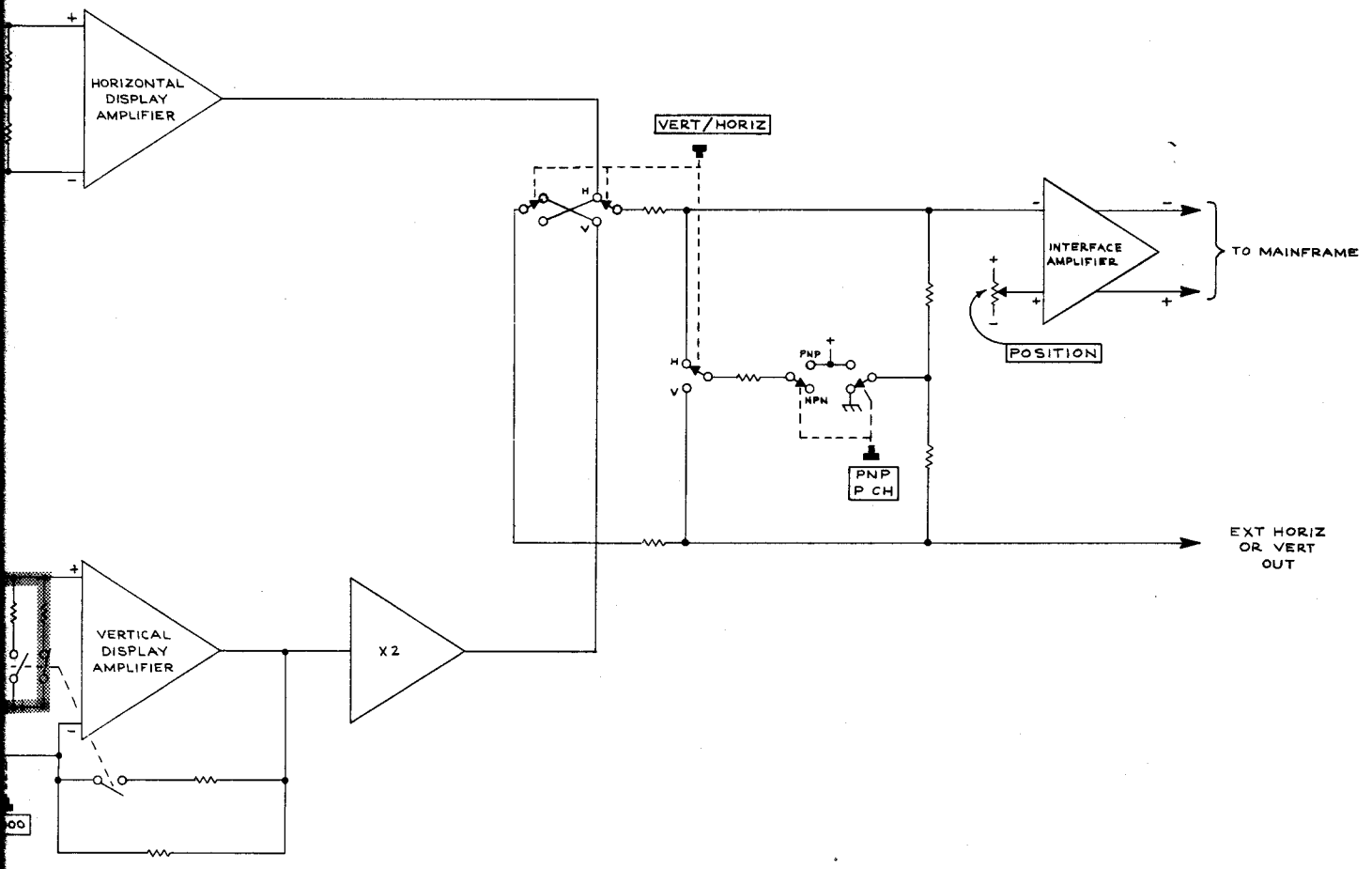
The following special symbols are used on the diagrams:





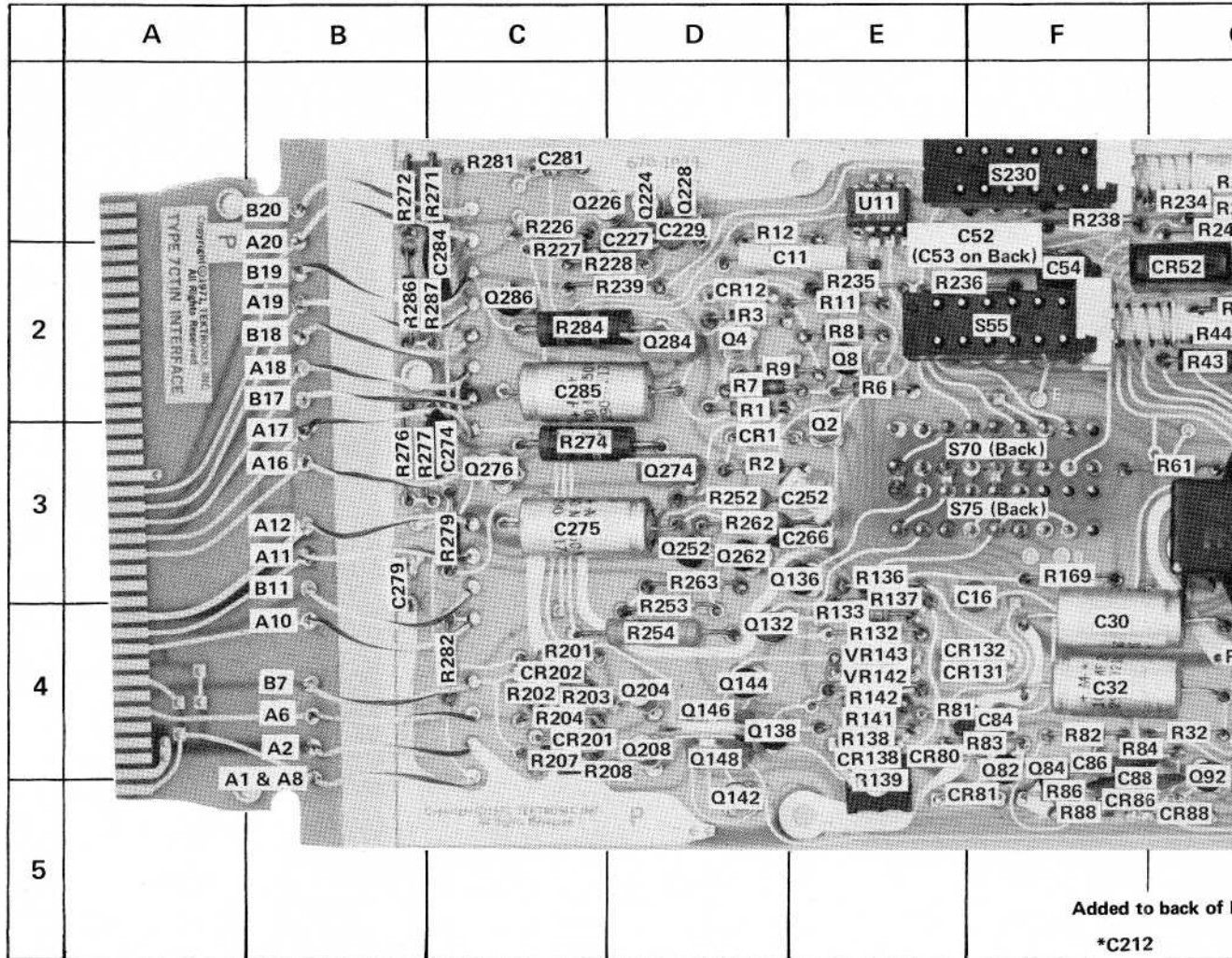
7CT1N

(A)



(A)

BLOCK DIAGRAM DEM 1271



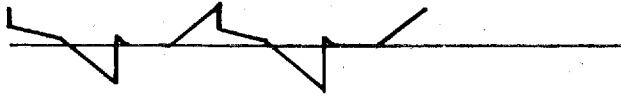
Added to back of

*C212

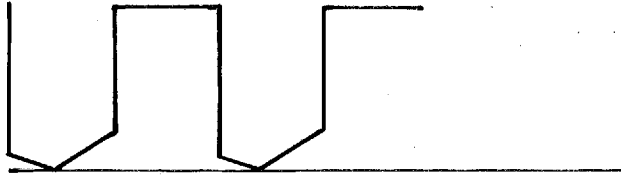
*C12

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C11	E2	C266	E3	CR1	D3	Q2	E3	Q204	D4	R1	D2	R57	I2
C16	F3	C248	L3	CR12	D2	Q4	D2	Q208	D4	R2	D3	R61	G
C26	I4	C252	E3	CR28	H4	Q8	E2	Q210	J4	R3	D2	R62	H
C30	F4	C274	C3	CR52	G2	Q22	H4	Q212	I4	R6	E2	R63	H
C32	F4	C275	C3	CR80	E4	Q24	H4	Q224	D1	R7	D2	R64	I2
C52	F2	C279	B3	CR81	F5	Q26	H4	Q226	C1	R8	E2	R69	I1
C53	F2	C281	C1	CR86	F5	Q28	H4	Q228	D1	R9	D2	R71	I2
C54	F2	C284	C2	CR88	G5	Q30	G4	Q252	D3	R11	E2	R72	I2
C84	F4	C285	C2	CR96	H4	Q32	G4	Q262	D3	R12	D2	R74	I2
C86	F4			CR97	I4	Q70A,B	I2	Q274	D3	R21	I3	R75	I2
C88	F5			CR105	J4	Q82	F4	Q276	C3	R22	H4	R76	I2
C94	H4			CR111	J5	Q84	F4	Q284	D2	R23	H4	R77	I2
C96	H4			CR131	F4	Q92	G4	Q286	C2	R24	G3	R81	E
C108	J4			CR132	F4	Q104	I4			R25	H4	R82	F
C111	J5			CR138	E4	Q108	J4			R26	H4	R83	F
C112	I4			CR191	L3	Q114	J4			R28	H4	R84	F
C113	H5			CR192	L3	Q124	L4			R30	G4	R86	F
C114	I5			CR201	C4	Q126	K4			R32	G4	R88	F
C179	I1			CR202	C4	Q132	D4			R33	H3	R90	G
C197	G1			CR214	J3	Q136	E3			R39	G4	R91	H
C214	H3			CR224	H1	Q138	D4			R41	G2	R92	H
C227	D2			VR142	E4	Q142	D5			R42	G2	R94	H
C229	D1			VR143	E4	Q144	D4			R43	G2	R100	I3
						Q146	D4			R44	G2	R101	I3
						Q148	D4			R56	I2	R102	J3

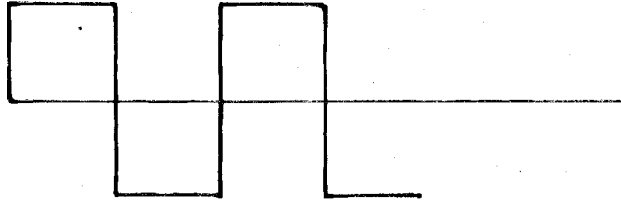
Base
of Q4



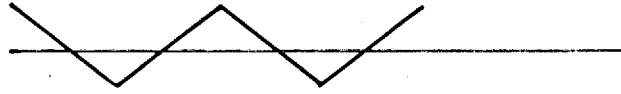
Emitter
of Q4



Junction
of
R8 and R9



Pin 6
of U11



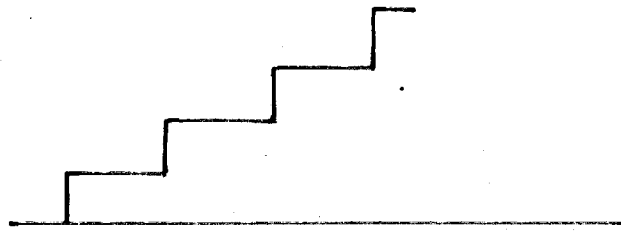
Base
of Q92

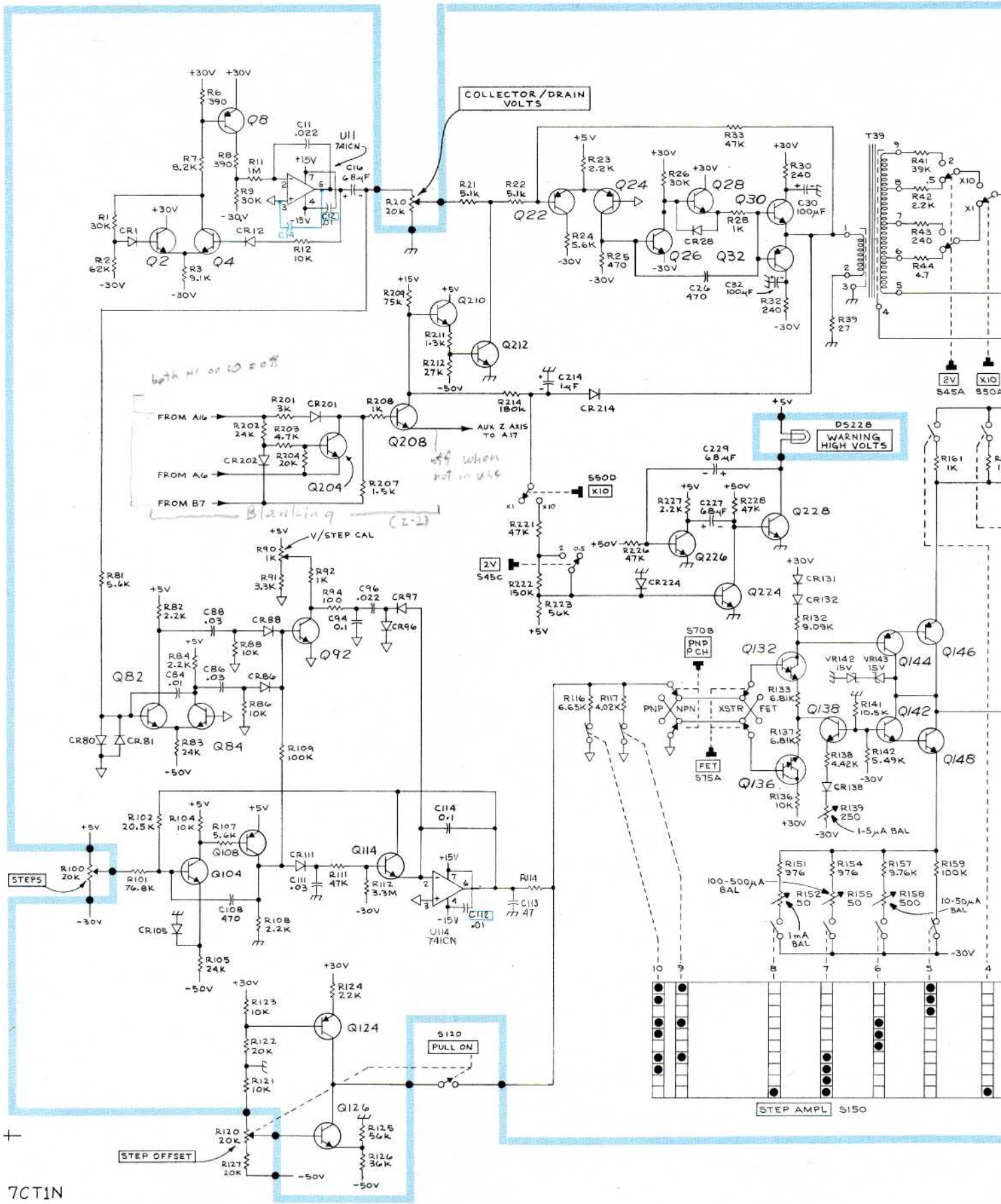


Junction
of C96
and CR97

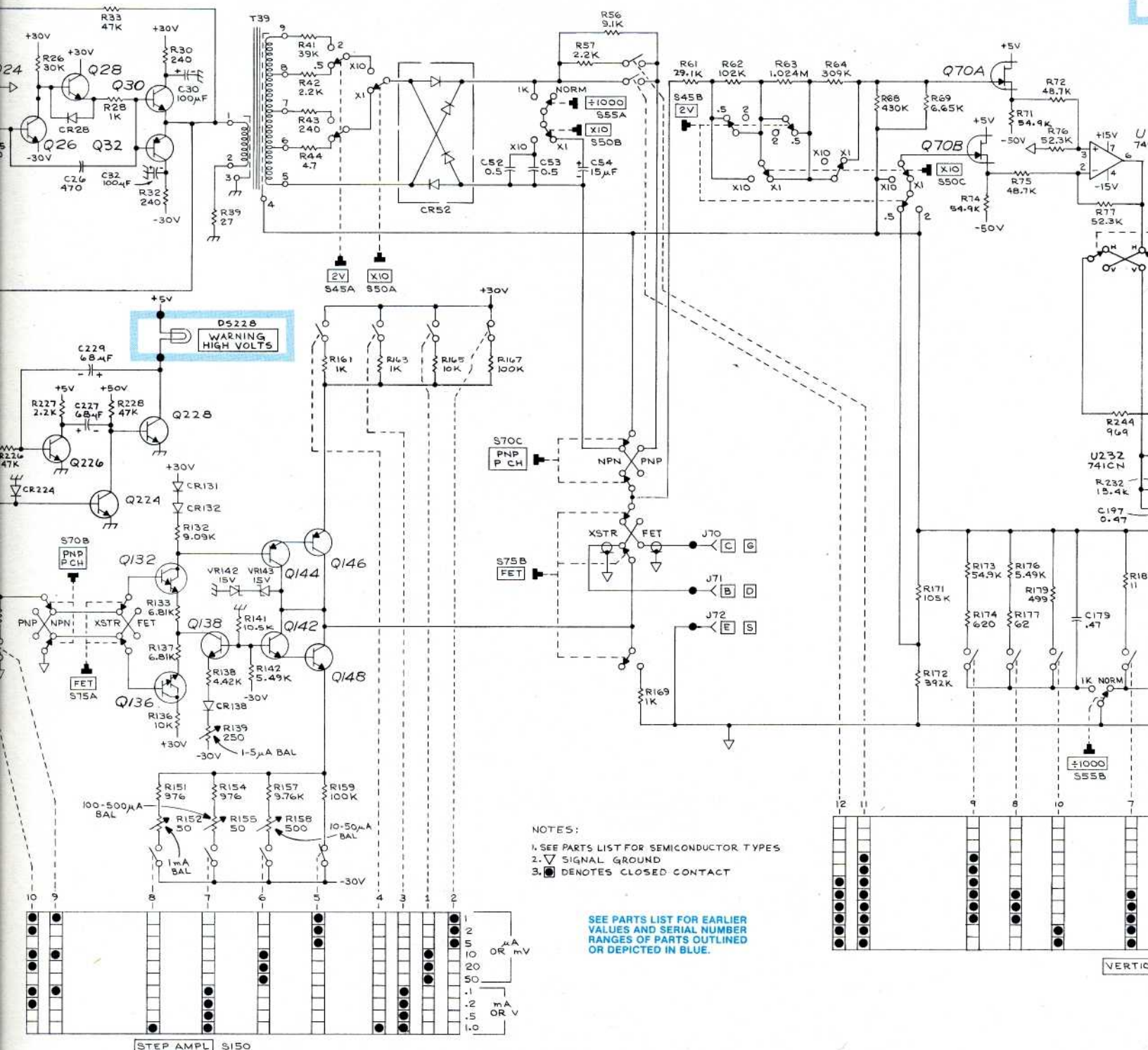


Pin 6
of U114



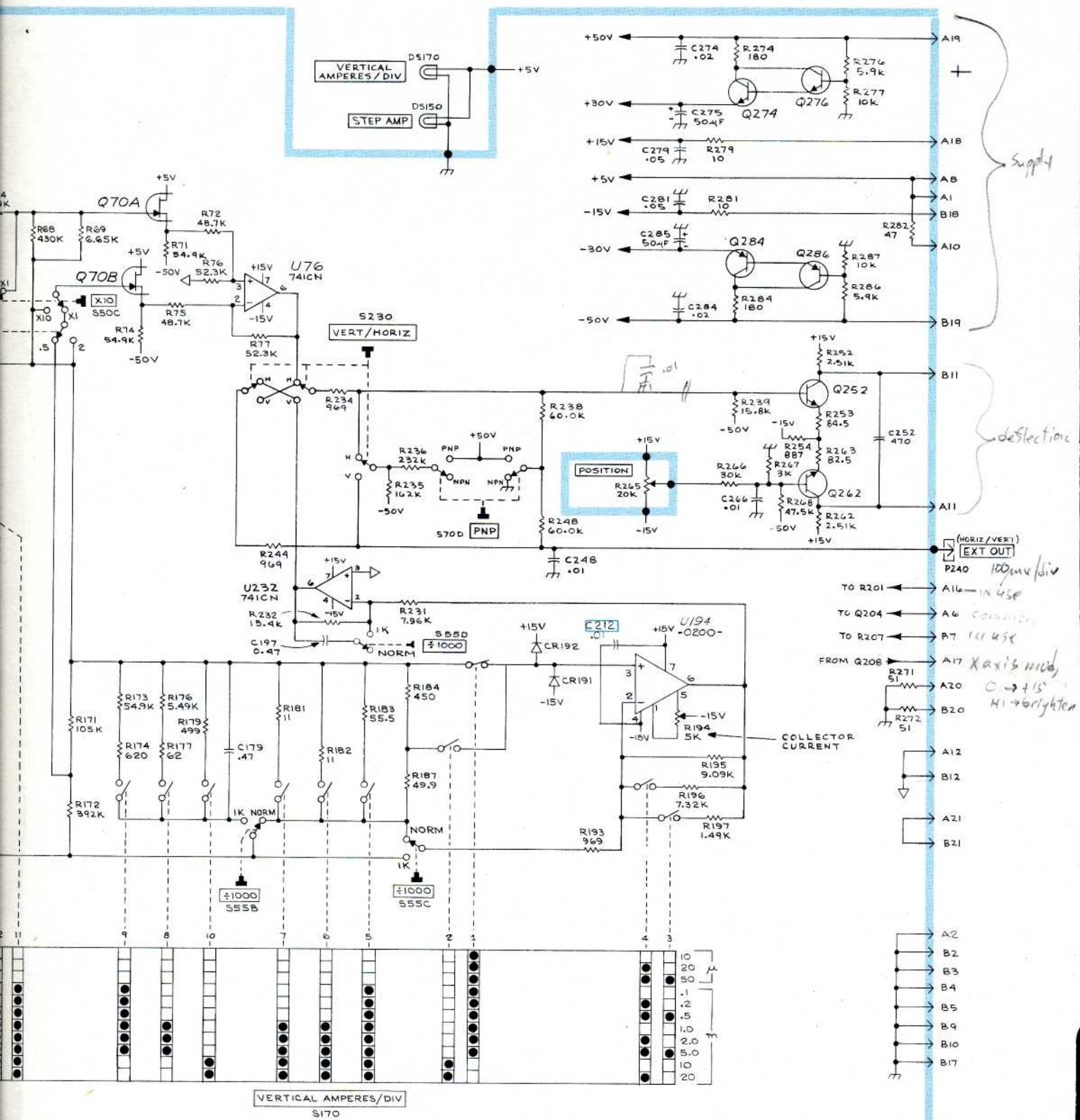


7CT1N



- NOTES:
1. SEE PARTS LIST FOR SEMICONDUCTOR TYPES
 2. ▽ SIGNAL GROUND
 3. ■ DENOTES CLOSED CONTACT

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN BLUE.



CURVE TRACER

REPLACEABLE ELECTRICAL PARTS

PARTS ORDERING INFORMATION

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

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

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

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

SPECIAL NOTES AND SYMBOLS

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

ITEM NAME

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

ABBREVIATIONS

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

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
04222	AVX CERAMICS, DIVISION OF AVX CORP.	P O BOX 867, 19TH AVE. SOUTH	MYRTLE BEACH, SC 29577
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD, PO BOX 20923	PHOENIX, AZ 85036
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS STREET	MOUNTAIN VIEW, CA 94042
08806	GENERAL ELECTRIC CO., MINIATURE LAMP PRODUCTS DEPARTMENT	NELA PARK 2830 F FAIRVIEW ST.	CLEVELAND, OH 44112 SANTA ANA, CA 92704
14552	MICRO SEMICONDUCTOR CORP.	550 HIGH STREET	BRADFORD, PA 16701
24546	CORNING GLASS WORKS, ELECTRONIC COMPONENTS DIVISION	1200 COLUMBIA AVE.	RIVERSIDE, CA 92507
32997	BOURNS, INC., TRIMPOT PRODUCTS DIV.	905 N. WEST BLVD	NORTH ADAMS, MA 01247
56289	SPRAGUE ELECTRIC CO.	644 W. 12TH ST.	ELKHART, IN 46514
71450	CTS CORP.	2500 HARBOR BLVD.	ERIE, PA 16512
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	401 N. BROAD ST.	FULLERTON, CA 92634
73138	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.	P O BOX 500	PHILADELPHIA, PA 19108
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	3029 E. WASHINGTON STREET P. O. BOX 372	BEAVERTON, OR 97077
80009	TEKTRONIX, INC.	4242 W BRYN MAWR	INDIANAPOLIS, IN 46206
90201	MALLORY CAPACITOR CO., DIV. OF P. R. MALLORY AND CO., INC.	P. O. BOX 609	CHICAGO, IL 60646
91418	RADIO MATERIALS COMPANY, DIV. OF P.R. MALLORY AND COMPANY, INC.		COLUMBUS, NE 68601
91637	DALE ELECTRONICS, INC.		

Replaceable Electrical Parts—7CTIN

Kct No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1	670-1933-00	B010100	B049999	CKT BOARD ASSY:MAIN	80009	670-1933-00
A1	670-1933-01	B050000		CKT BOARD ASSY:MAIN	80009	670-1933-01
C11	285-0683-00			CAP., FXD, PLSTC:0.022UF, 5%, 100V	56289	410P22351
C12	283-0003-00	XB050000		CAP., FXD, CER DI:0.01UF, +80-20%, 150V	72982	855-558Z5U-103Z
C16	290-0530-00			CAP., FXD, ELCTLT:68UF, 20%, 6V	90201	TDC686M006NLF
C26	281-0525-00			CAP., FXD, CER DI:470PF, +/-94PF, 500V	04222	7001-1364
C30	290-0215-00			CAP., FXD, ELCTLT:100UF, +75-10%, 25V	56289	30D107G025DD9
C32	290-0215-00			CAP., FXD, ELCTLT:100UF, +75-10%, 25V	56289	30D107G025DD9
C52	290-0480-00			CAP., FXD, ELCTLT:0.5UF, +50-10%, 200V	80009	290-0480-00
C53	290-0480-00			CAP., FXD, ELCTLT:0.5UF, +50-10%, 200V	80009	290-0480-00
C54	290-0528-00			CAP., FXD, ELCTLT:15UF, 20%, 50V	90201	TDC156M050WLC
C84	283-0003-00			CAP., FXD, CER DI:0.01UF, +80-20%, 150V	72982	855-558Z5U-103Z
C86	283-0092-00			CAP., FXD, CER DI:0.03UF, +80-20%, 200V	72982	845-534E303Z
C88	283-0092-00			CAP., FXD, CER DI:0.03UF, +80-20%, 200V	72982	845-534E303Z
C94	283-0023-00			CAP., FXD, CER DI:0.1UF, +80-20%, 12V	91418	MX0104Z1205R5
C96	285-0683-00			CAP., FXD, PLSTC:0.022UF, 5%, 100V	56289	410P22351
C108	281-0525-00			CAP., FXD, CER DI:470PF, +/-94PF, 500V	04222	7001-1364
C111	283-0092-00			CAP., FXD, CER DI:0.03UF, +80-20%, 200V	72982	845-534E303Z
C112	283-0003-00	XB050000		CAP., FXD, CER DI:0.01UF, +80-20%, 150V	72982	855-558Z5U-103Z
C113	281-0518-00			CAP., FXD, CER DI:47PF, +/-9.4PF, 500V	72982	301-000U2J0470M
C114	285-0703-00			CAP., FXD, PLSTC:0.1UF, 5%, 100V	56289	410P10451
C179	283-0203-00			CAP., FXD, CER DI:0.47UF, 20%, 50V	72982	8131N075 E474M
C197	283-0203-00			CAP., FXD, CER DI:0.47UF, 20%, 50V	72982	8131N075 E474M
C212	283-0003-00	XB050000		CAP., FXD, CER DI:0.01UF, +80-20%, 150V	72982	855-558Z5U-103Z
C214	290-0522-00			CAP., FXD, ELCTLT:1UF, 20%, 50V	56289	196D105X0050HA1
C227	290-0530-00			CAP., FXD, ELCTLT:68UF, 20%, 6V	90201	TDC686M006NLF
C229	290-0530-00			CAP., FXD, ELCTLT:68UF, 20%, 6V	90201	TDC686M006NLF
C248	283-0003-00			CAP., FXD, CER DI:0.01UF, +80-20%, 150V	72982	855-558Z5U-103Z
C252	281-0525-00			CAP., FXD, CER DI:470PF, +/-94PF, 500V	04222	7001-1364
C266	283-0003-00			CAP., FXD, CER DI:0.01UF, +80-20%, 150V	72982	855-558Z5U-103Z
C274	283-0004-00			CAP., FXD, CER DI:0.02UF, +80-20%, 150V	72982	855-558Z5V0203Z
C275	290-0117-00			CAP., FXD, ELCTLT:50UF, +75-10%, 50V	56289	30D506G050DD9
C279	283-0010-00			CAP., FXD, CER DI:0.05UF, +100-20%, 50V	56289	273C20
C281	283-0010-00			CAP., FXD, CER DI:0.05UF, +100-20%, 50V	56289	273C20
C284	283-0004-00			CAP., FXD, CER DI:0.02UF, +80-20%, 150V	72982	855-558Z5V0203Z
C285	290-0117-00			CAP., FXD, ELCTLT:50UF, +75-10%, 50V	56289	30D506G050DD9
CR1	152-0141-02			SEMICONV DEVICE:SILICON, 30V, 50NA	80009	152-0141-02
CR12	152-0141-02			SEMICONV DEVICE:SILICON, 30V, 50NA	80009	152-0141-02
CR28	152-0141-02			SEMICONV DEVICE:SILICON, 30V, 50NA	80009	152-0141-02
CR52	152-0488-00			SEMICONV DEVICE:SILICON, 200V, 1500MA	80009	152-0488-00
CR80	152-0141-02			SEMICONV DEVICE:SILICON, 30V, 50NA	80009	152-0141-02
CR81	152-0141-02			SEMICONV DEVICE:SILICON, 30V, 50NA	80009	152-0141-02
CR86	152-0141-02			SEMICONV DEVICE:SILICON, 30V, 50NA	80009	152-0141-02
CR88	152-0141-02			SEMICONV DEVICE:SILICON, 30V, 50NA	80009	152-0141-02
CR96	152-0141-02			SEMICONV DEVICE:SILICON, 30V, 50NA	80009	152-0141-02
CR97	152-0141-02			SEMICONV DEVICE:SILICON, 30V, 50NA	80009	152-0141-02
CR105	152-0141-02			SEMICONV DEVICE:SILICON, 30V, 50NA	80009	152-0141-02
CR111	152-0141-02			SEMICONV DEVICE:SILICON, 30V, 50NA	80009	152-0141-02
CR131	152-0141-02			SEMICONV DEVICE:SILICON, 30V, 50NA	80009	152-0141-02
CR132	152-0141-02			SEMICONV DEVICE:SILICON, 30V, 50NA	80009	152-0141-02
CR138	152-0141-02			SEMICONV DEVICE:SILICON, 30V, 50NA	80009	152-0141-02
CR191	152-0246-00			SEMICONV DEVICE:SILICON, 40V, 200MA	80009	152-0246-00
CR192	152-0246-00			SEMICONV DEVICE:SILICON, 40V, 200MA	80009	152-0246-00
CR201	152-0141-02			SEMICONV DEVICE:SILICON, 30V, 50NA	80009	152-0141-02
CR202	152-0141-02			SEMICONV DEVICE:SILICON, 30V, 50NA	80009	152-0141-02
CR214	152-0107-00			SEMICONV DEVICE:SILICON, 400V, 400MA	80009	152-0107-00

Replaceable Electrical Parts—7CTIN

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CR224	152-0141-02			SEMICON D DEVICE: SILICON, 30V, 50NA	80009	152-0141-02
DS150	150-0048-01			LAMP, INCAND: 5V, 0.06A, SEL	08806	683AS15
DS170	150-0048-01			LAMP, INCAND: 5V, 0.06A, SEL	08806	683AS15
DS228	150-0048-01			LAMP, INCAND: 5V, 0.06A, SEL	08806	683AS15
Q2	151-0302-00			TRANSISTOR: SILICON, NPN	07263	S038487
Q4	151-0302-00			TRANSISTOR: SILICON, NPN	07263	S038487
Q8	151-0342-00			TRANSISTOR: SILICON, PNP	80009	151-0342-00
Q22	151-0342-00			TRANSISTOR: SILICON, PNP	80009	151-0342-00
Q24	151-0342-00			TRANSISTOR: SILICON, PNP	80009	151-0342-00
Q26	151-0347-00			TRANSISTOR: SILICON, NPN	80009	151-0347-00
Q28	151-0347-00			TRANSISTOR: SILICON, NPN	80009	151-0347-00
Q30	151-0365-00			TRANSISTOR: SILICON, NPN	80009	151-0365-00
Q32	151-0364-00			TRANSISTOR: SILICON, PNP	80009	151-0364-00
Q70A, B	151-1054-00			TRANSISTOR: SILICON, JFE, N-CHANNEL, DUAL	80009	151-1054-00
Q82	151-0341-00			TRANSISTOR: SILICON, NPN	80009	151-0341-00
Q84	151-0341-00			TRANSISTOR: SILICON, NPN	80009	151-0341-00
Q92	151-0341-00			TRANSISTOR: SILICON, NPN	80009	151-0341-00
Q104	151-0341-00			TRANSISTOR: SILICON, NPN	80009	151-0341-00
Q108	151-0342-00			TRANSISTOR: SILICON, PNP	80009	151-0342-00
Q114	151-0302-00			TRANSISTOR: SILICON, NPN	07263	S038487
Q124	151-0342-00			TRANSISTOR: SILICON, PNP	80009	151-0342-00
Q126	151-0302-00			TRANSISTOR: SILICON, NPN	07263	S038487
Q132	151-0254-00			TRANSISTOR: SILICON, NPN	80009	151-0254-00
Q136	151-0254-00			TRANSISTOR: SILICON, NPN	80009	151-0254-00
Q138	151-0341-00			TRANSISTOR: SILICON, NPN	80009	151-0341-00
Q142	151-0302-00			TRANSISTOR: SILICON, NPN	07263	S038487
Q144	151-0342-00			TRANSISTOR: SILICON, PNP	80009	151-0342-00
Q146	151-0364-00			TRANSISTOR: SILICON, PNP	80009	151-0364-00
Q148	151-0365-00			TRANSISTOR: SILICON, NPN	80009	151-0365-00
Q204	151-0302-00			TRANSISTOR: SILICON, NPN	07263	S038487
Q208	151-0302-00			TRANSISTOR: SILICON, NPN	07263	S038487
Q210	151-0302-00			TRANSISTOR: SILICON, NPN	07263	S038487
Q212	151-0302-00			TRANSISTOR: SILICON, NPN	07263	S038487
Q224	151-0302-00			TRANSISTOR: SILICON, NPN	07263	S038487
Q226	151-0302-00			TRANSISTOR: SILICON, NPN	07263	S038487
Q228	151-0302-00			TRANSISTOR: SILICON, NPN	07263	S038487
Q252	151-0192-00			TRANSISTOR: SILICON, NPN, SEL FROM MPS6521	04713	SPS8801
Q262	151-0192-00			TRANSISTOR: SILICON, NPN, SEL FROM MPS6521	04713	SPS8801
Q274	151-0365-00			TRANSISTOR: SILICON, NPN	80009	151-0365-00
Q276	151-0302-00			TRANSISTOR: SILICON, NPN	07263	S038487
Q284	151-0364-00			TRANSISTOR: SILICON, PNP	80009	151-0364-00
Q286	151-0342-00			TRANSISTOR: SILICON, PNP	80009	151-0342-00
R1	315-0303-00			RES., FXD, CMPSN: 30K OHM, 5%, 0.25W	01121	CB3035
R2	315-0623-00			RES., FXD, CMPSN: 62K OHM, 5%, 0.25W	01121	CB6235
R3	315-0912-00			RES., FXD, CMPSN: 9.1K OHM, 5%, 0.25W	01121	CB9125
R6	315-0391-00			RES., FXD, CMPSN: 390 OHM, 5%, 0.25W	01121	CB3915
R7	315-0822-00			RES., FXD, CMPSN: 8.2K OHM, 5%, 0.25W	01121	CB8225
R8	315-0391-00			RES., FXD, CMPSN: 390 OHM, 5%, 0.25W	01121	CB3915
R9	315-0303-00			RES., FXD, CMPSN: 30K OHM, 5%, 0.25W	01121	CB3035
R11	321-0481-00			RES., FXD, FILM: 1M OHM, 1%, 0.125W	91637	MFF1816G10003F
R12	315-0103-00			RES., FXD, CMPSN: 10K OHM, 5%, 0.25W	01121	CB1035
R20	311-1220-00			RES., VAR, NONWIR: 20K OHM, 30%, 0.25W	71450	OB
R21	315-0512-00			RES., FXD, CMPSN: 5.1K OHM, 5%, 0.25W	01121	CB5125
R22	315-0512-00			RES., FXD, CMPSN: 5.1K OHM, 5%, 0.25W	01121	CB5125
R23	316-0222-00			RES., FXD, CMPSN: 2.2K OHM, 10%, 0.25W	01121	CB2221

Replaceable Electrical Parts—7CTIN

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R24	316-0562-00			RES., FXD, CMPSN: 5.6K OHM, 10%, 0.25W	01121	CB5621
R25	315-0471-00			RES., FXD, CMPSN: 470 OHM, 5%, 0.25W	01121	GB4715
R26	315-0303-00			RES., FXD, CMPSN: 30K OHM, 5%, 0.25W	01121	CB3035
R28	316-0102-00			RES., FXD, CMPSN: 1K OHM, 10%, 0.25W	01121	CB1021
R30	315-0241-00			RES., FXD, CMPSN: 240 OHM, 5%, 0.25W	01121	CB2415
R32	315-0241-00			RES., FXD, CMPSN: 240 OHM, 5%, 0.25W	01121	CB2415
R33	316-0473-00			RES., FXD, CMPSN: 47K OHM, 10%, 0.25W	01121	CB4731
R39	316-0270-00			RES., FXD, CMPSN: 27 OHM, 10%, 0.25W	01121	CB2701
R41	301-0393-00			RES., FXD, CMPSN: 39K OHM, 5%, 0.50W	01121	EB3935
R42	301-0222-00			RES., FXD, CMPSN: 2.2K OHM, 5%, 0.50W	01121	EB2225
R43	301-0241-00			RES., FXD, CMPSN: 240 OHM, 5%, 0.50W	01121	EB2415
R44	307-0023-00			RES., FXD, CMPSN: 4.7 OHM, 10%, 0.50W	01121	EB47G1
R56	315-0912-00			RES., FXD, CMPSN: 9.1K OHM, 5%, 0.25W	01121	CB9125
R57	316-0222-00			RES., FXD, CMPSN: 2.2K OHM, 10%, 0.25W	01121	CB2221
R61	321-1330-02			RES., FXD, FILM: 27.1K OHM, 0.5%, 0.125W	24546	NC55C2712D
R62	321-0386-00			RES., FXD, FILM: 102K OHM, 1%, 0.125W	91637	MFF1816G10202F
R63	322-0684-09			RES., FXD, FILM: 1.024M OHM, 1%, 0.25W	91637	MFF1412G10243F
R64	321-0432-00			RES., FXD, FILM: 309K OHM, 1%, 0.125W	91637	MFF1816G30902F
R68	315-0434-00			RES., FXD, CMPSN: 430K OHM, 5%, 0.25W	01121	CB4345
R69	321-0272-00			RES., FXD, FILM: 6.65K OHM, 1%, 0.125W	91637	MFF1816G66500F
R71	321-0360-00			RES., FXD, FILM: 54.9K OHM, 1%, 0.125W	91637	MFF1816G54901F
R72	321-0355-00			RES., FXD, FILM: 48.7K OHM, 1%, 0.125W	91637	MFF1816G48701F
R74	321-0360-00			RES., FXD, FILM: 54.9K OHM, 1%, 0.125W	91637	MFF1816G54901F
R75	321-0355-00			RES., FXD, FILM: 48.7K OHM, 1%, 0.125W	91637	MFF1816G48701F
R76	321-0358-00			RES., FXD, FILM: 52.3K OHM, 1%, 0.125W	91637	MFF1816G52301F
R77	321-0358-00			RES., FXD, FILM: 52.3K OHM, 1%, 0.125W	91637	MFF1816G52301F
R81	316-0562-00			RES., FXD, CMPSN: 5.6K OHM, 10%, 0.25W	01121	CB5621
R82	316-0222-00			RES., FXD, CMPSN: 2.2K OHM, 10%, 0.25W	01121	CB2221
R83	315-0243-00			RES., FXD, CMPSN: 24K OHM, 5%, 0.25W	01121	CB2435
R84	316-0222-00			RES., FXD, CMPSN: 2.2K OHM, 10%, 0.25W	01121	CB2221
R86	315-0103-00			RES., FXD, CMPSN: 10K OHM, 5%, 0.25W	01121	CB1035
R88	315-0103-00			RES., FXD, CMPSN: 10K OHM, 5%, 0.25W	01121	CB1035
R90	311-1154-00			RES., VAR, NONWIR: TRMR, 1K OHM, 0.50W	73138	91D-R1K
R91	316-0332-00	B010100	B010199	RES., FXD, CMPSN: 3.3K OHM, 10%, 0.25W	01121	CB3321
R91	315-0202-00	B010200		RES., FXD, CMPSN: 2K OHM, 5%, 0.25W	01121	CB2025
R92	316-0102-00			RES., FXD, CMPSN: 1K OHM, 10%, 0.25W	01121	CB1021
R94	316-0101-00			RES., FXD, CMPSN: 100 OHM, 10%, 0.25W	01121	CB1011
R100	311-1220-00			RES., VAR, NONWIR: 20K OHM, 30%, 0.25W	71450	0BD
R101	321-0374-00			RES., FXD, FILM: 76.8K OHM, 1%, 0.125W	91637	MFF1816G76801F
R102	321-0319-00			RES., FXD, FILM: 20.5K OHM, 1%, 0.125W	91637	MFF1816G20501F
R104	315-0103-00			RES., FXD, CMPSN: 10K OHM, 5%, 0.25W	01121	CB1035
R105	315-0243-00			RES., FXD, CMPSN: 24K OHM, 5%, 0.25W	01121	CB2435
R107	316-0562-00			RES., FXD, CMPSN: 5.6K OHM, 10%, 0.25W	01121	CB5621
R108	316-0222-00			RES., FXD, CMPSN: 2.2K OHM, 10%, 0.25W	01121	CB2221
R109	316-0104-00			RES., FXD, CMPSN: 100K OHM, 10%, 0.25W	01121	CB1041
R111	316-0473-00			RES., FXD, CMPSN: 47K OHM, 10%, 0.25W	01121	CB4731
R112	316-0335-00			RES., FXD, CMPSN: 3.3M OHM, 10%, 0.25W	01121	CB3351
R114	321-0289-00			RES., FXD, FILM: 10K OHM, 1%, 0.125W	91637	MFF1816G10001F
R116	321-0272-00			RES., FXD, FILM: 6.65K OHM, 1%, 0.125W	91637	MFF1816G66500F
R120	311-1310-00			RES., VAR, NONWIR: 20K OHM, 20%, 1W (FURNISHED AS A UNIT WITH S120)	01121	10M654
R121	315-0103-00			RES., FXD, CMPSN: 10K OHM, 5%, 0.25W	01121	CB1035
R122	315-0203-00			RES., FXD, CMPSN: 20K OHM, 5%, 0.25W	01121	CB2035
R123	315-0103-00			RES., FXD, CMPSN: 10K OHM, 5%, 0.25W	01121	CB1035
R124	315-0223-00			RES., FXD, CMPSN: 22K OHM, 5%, 0.25W	01121	CB2235
R125	315-0563-00			RES., FXD, CMPSN: 56K OHM, 5%, 0.25W	01121	CB5635
R126	315-0363-00			RES., FXD, CMPSN: 36K OHM, 5%, 0.25W	01121	CB3635

Replaceable Electrical Parts--7CTIN

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R127	315-0203-00			RES., FXD, CMPSN: 20K OHM, 5%, 0.25W	01121	CB2035
R132	321-0285-00			RES., FXD, FILM: 9.09K OHM, 1%, 0.125W	91637	MFF1816G90900F
R133	321-0273-00			RES., FXD, FILM: 6.81K OHM, 1%, 0.125W	91637	MFF1816G68100F
R136	315-0103-00			RES., FXD, CMPSN: 10K OHM, 5%, 0.25W	01121	CB1035
R137	321-0273-00			RES., FXD, FILM: 6.81K OHM, 1%, 0.125W	91637	MFF1816G68100F
R138	321-0255-00			RES., FXD, FILM: 4.42K OHM, 1%, 0.125W	91637	MFF1816G44200F
R139	311-1223-00			RES., VAR, NONWIR: 250 OHM, 10%, 0.50W	32997	3386F-T04-251
R141	321-0291-00			RES., FXD, FILM: 10.5K OHM, 1%, 0.125W	91637	MFF1816G10501F
R142	321-0264-00			RES., FXD, FILM: 5.49K OHM, 1%, 0.125W	91637	MFF1816G54900F
R151	323-0192-00			RES., FXD, FILM: 976 OHM, 1%, 0.50W	75042	CECT0-9760F
R152	311-1221-00			RES., VAR, NONWIR: 50 OHM, 20%, 0.50W	32997	3386F-T04-500
R154	323-0192-00			RES., FXD, FILM: 976 OHM, 1%, 0.50W	75042	CECT0-9760F
R155	311-1221-00			RES., VAR, NONWIR: 50 OHM, 20%, 0.50W	32997	3386F-T04-500
R157	321-0288-00			RES., FXD, FILM: 9.76K OHM, 1%, 0.125W	91637	MFF1816G97600F
R158	311-1224-00			RES., VAR, NONWIR: 500 OHM, 20%, 0.50W	32997	3386F-T04-501
R159	321-0645-00			RES., FXD, FILM: 100K OHM, 0.5%, 0.125W	91637	MFF1816D10002D
R161	323-0193-01			RES., FXD, FILM: 1K OHM, 0.5%, 0.50W	75042	CECT0-1001D
R163	323-0193-01			RES., FXD, FILM: 1K OHM, 0.5%, 0.50W	75042	CECT0-1001D
R165	321-0289-01			RES., FXD, FILM: 10K OHM, 0.5%, 0.125W	91637	MFF1816G10001D
R167	321-0645-00			RES., FXD, FILM: 100K OHM, 0.5%, 0.125W	91637	MFF1816D10002D
R169	321-0193-00			RES., FXD, FILM: 1K OHM, 1%, 0.125W	91637	MFF1816G10000F
R171	321-0387-00			RES., FXD, FILM: 105K OHM, 1%, 0.125W	91637	MFF1816G10502F
R172	321-0442-00			RES., FXD, FILM: 392K OHM, 1%, 0.125W	91637	MFF1816G39202F
R173	321-0360-00			RES., FXD, FILM: 54.9K OHM, 1%, 0.125W	91637	MFF1816G54901F
R174	315-0621-00			RES., FXD, CMPSN: 620 OHM, 5%, 0.25W	01121	CB6215
R176	321-0264-00			RES., FXD, FILM: 5.49K OHM, 1%, 0.125W	91637	MFF1816G54900F
R177	315-0620-00			RES., FXD, CMPSN: 62 OHM, 5%, 0.25W	01121	CB6205
R179	321-0164-00			RES., FXD, FILM: 499 OHM, 1%, 0.125W	91637	MFF1816G4990R0F
R181	321-0005-00			RES., FXD, FILM: 11 OHM, 1%, 0.125W	75042	CEAT0-11R0F
R182	321-0005-00			RES., FXD, FILM: 11 OHM, 1%, 0.125W	75042	CEAT0-11R0F
R183	321-0750-06			RES., FXD, FILM: 55.5 OHM, 0.25%, 0.125W	91637	MFF1816G55R50C
R184	321-0749-06			RES., FXD, FILM: 450 OHM, 0.25%, 0.125W	91637	MFF1816G450R0C
R187	321-0068-03			RES., FXD, FILM: 49.9 OHM, 0.25%, 0.125W	75042	CEAT2-49R90C
R193	321-0765-01			RES., FXD, FILM: 969 OHM, 0.5%, 0.125W	91637	MFF1816G969R0D
R194	311-1153-00			RES., VAR, NONWIR: TRMR, 5K OHM, 0.50W	73138	91-69-0
R195	321-0285-00			RES., FXD, FILM: 9.09K OHM, 1%, 0.125W	91637	MFF1816G90900F
R196	321-0276-00			RES., FXD, FILM: 7.32K OHM, 1%, 0.125W	91637	MFF1816G73200F
R197	321-0207-00			RES., FXD, FILM: 1.4K OHM, 1%, 0.125W	91637	MFF1816G14000F
R201	315-0302-00			RES., FXD, CMPSN: 3K OHM, 5%, 0.25W	01121	CB3025
R202	315-0243-00			RES., FXD, CMPSN: 24K OHM, 5%, 0.25W	01121	CB2435
R203	315-0472-00			RES., FXD, CMPSN: 4.7K OHM, 5%, 0.25W	01121	CB4725
R204	315-0203-00			RES., FXD, CMPSN: 20K OHM, 5%, 0.25W	01121	CB2035
R207	315-0152-00			RES., FXD, CMPSN: 1.5K OHM, 5%, 0.25W	01121	CB1525
R208	316-0102-00			RES., FXD, CMPSN: 1K OHM, 10%, 0.25W	01121	CB1021
R209	315-0753-00			RES., FXD, CMPSN: 75K OHM, 5%, 0.25W	01121	CB7535
R211	315-0132-00			RES., FXD, CMPSN: 1.3K OHM, 5%, 0.25W	01121	CB1325
R212	315-0273-00			RES., FXD, CMPSN: 27K OHM, 5%, 0.25W	01121	CB2735
R214	315-0184-00			RES., FXD, CMPSN: 180K OHM, 5%, 0.25W	01121	CB1845
R221	316-0473-00			RES., FXD, CMPSN: 47K OHM, 10%, 0.25W	01121	CB4731
R222	315-0154-00			RES., FXD, CMPSN: 150K OHM, 5%, 0.25W	01121	CB1545
R223	315-0563-00			RES., FXD, CMPSN: 56K OHM, 5%, 0.25W	01121	CB5635
R226	316-0473-00			RES., FXD, CMPSN: 47K OHM, 10%, 0.25W	01121	CB4731
R227	316-0222-00			RES., FXD, CMPSN: 2.2K OHM, 10%, 0.25W	01121	CB2221
R228	316-0473-00			RES., FXD, CMPSN: 47K OHM, 10%, 0.25W	01121	CB4731
R231	321-0638-00			RES., FXD, FILM: 7.96K OHM, 1%, 0.125W	24546	NA55D7961F
R232	321-0307-00			RES., FXD, FILM: 15.4K OHM, 1%, 0.125W	91637	MFF1816G15401F
R234	321-0765-01			RES., FXD, FILM: 969 OHM, 0.5%, 0.125W	91637	MFF1816G969R0D

Replaceable Electrical Parts—7CTIN

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R235	321-0405-00			RES., FXD, FILM: 162K OHM, 1%, 0.125W	91637	MFF1816G16202F
R236	321-0420-00			RES., FXD, FILM: 232K OHM, 1%, 0.125W	91637	MFF1816G23202F
R238	321-0720-01			RES., FXD, FILM: 60K OHM, 0.5%, 0.125W	91637	MFF1816G60001D
R239	321-0308-00			RES., FXD, FILM: 15.8K OHM, 1%, 0.125W	91637	MFF1816G15801F
R244	321-0765-01			RES., FXD, FILM: 969 OHM, 0.5%, 0.125W	91637	MFF1816G969R0D
R248	321-0720-01			RES., FXD, FILM: 60K OHM, 0.5%, 0.125W	91637	MFF1816G60001D
R252	322-0603-00			RES., FXD, FILM: 2.51K OHM, 1%, 0.25W	75042	CEBTO-2511F
R253	321-0090-00			RES., FXD, FILM: 84.5 OHM, 1%, 0.125W	91637	MFF1816G84R50F
R254	323-0188-00			RES., FXD, FILM: 887 OHM, 1%, 0.50W	75042	CECTO-8870F
R262	322-0603-00			RES., FXD, FILM: 2.51K OHM, 1%, 0.25W	75042	CEBTO-2511F
R263	321-0089-00			RES., FXD, FILM: 82.5 OHM, 1%, 0.125W	91637	MFF1816G82R50F
R265	311-1220-00			RES., VAR, NONWIR: 20K OHM, 30%, 0.25W	71450	OBD
R266	315-0303-00			RES., FXD, CMPSN: 30K OHM, 5%, 0.25W	01121	CB3035
R267	315-0302-00			RES., FXD, CMPSN: 3K OHM, 5%, 0.25W	01121	CB3025
R268	321-0354-00			RES., FXD, FILM: 47.5K OHM, 1%, 0.125W	91637	MFF1816G47501F
R271	315-0510-00			RES., FXD, CMPSN: 51 OHM, 5%, 0.25W	01121	CB5105
R272	315-0510-00			RES., FXD, CMPSN: 51 OHM, 5%, 0.25W	01121	CB5105
R274	304-0181-00			RES., FXD, CMPSN: 180 OHM, 10%, 1W	01121	GB1811
R276	321-0267-00			RES., FXD, FILM: 5.9K OHM, 1%, 0.125W	91637	MFF1816G59000F
R277	321-0289-00			RES., FXD, FILM: 10K OHM, 1%, 0.125W	91637	MFF1816G10001F
R279	315-0100-00			RES., FXD, CMPSN: 10 OHM, 5%, 0.25W	01121	CB1005
R281	315-0100-00			RES., FXD, CMPSN: 10 OHM, 5%, 0.25W	01121	CB1005
R282	315-0470-00			RES., FXD, CMPSN: 47 OHM, 5%, 0.25W	01121	CB4705
R284	304-0181-00			RES., FXD, CMPSN: 180 OHM, 10%, 1W	01121	GB1811
R286	321-0267-00			RES., FXD, FILM: 5.9K OHM, 1%, 0.125W	91637	MFF1816G59000F
R287	321-0289-00			RES., FXD, FILM: 10K OHM, 1%, 0.125W	91637	MFF1816G10001F
S45)	260-1356-00			SWITCH, PUSH: 6PDT, 2 BUTTON, PUSH-PUSH	80009	260-1356-00
S50)						
S55	260-1209-00			SWITCH, PUSH: 4PDT, 1A, 25VDC	80009	260-1209-00
S70)						
S75)	260-1356-00			SWITCH, PUSH: 6PDT, 2 BUTTON, PUSH-PUSH	80009	260-1356-00
S120	311-1310-00			RES., VAR, NONWIR: 20K OHM, 20%, 1W (FURNISHED AS A UNIT WITH R120)	01121	10M654
S150	105-0308-00			ACTR ASSY, CAM S:	80009	105-0308-00
S170	105-0307-00			ACTR ASSY, CAM S:	80009	105-0307-00
S230	260-1209-00			SWITCH, PUSH: UPDT, 1A, 25VDC	80009	260-1209-00
T39	120-0756-00			XFMR, PWR, SDN&SU: COLLECTOR SWEEP	80009	120-0756-00
U11	156-0067-00			MICROCIRCUIT, LI: OPERATIONAL AMPLIFIER	80009	156-0067-00
U76	156-0067-00			MICROCIRCUIT, LI: OPERATIONAL AMPLIFIER	80009	156-0067-00
U114	156-0067-00			MICROCIRCUIT, LI: OPERATIONAL AMPLIFIER	80009	156-0067-00
U194	156-0200-00			MICROCIRCUIT, LI: LOW INPUT/OFFSET CURRENT	80009	156-0200-00
U232	156-0067-00			MICROCIRCUIT, LI: OPERATIONAL AMPLIFIER	80009	156-0067-00
VR142	152-0243-00			SEMICONV DEVICE: ZENER, 0.4W, 15V, 5%	14552	1N965B
VR143	152-0243-00			SEMICONV DEVICE: ZENER, 0.4W, 15V, 5%	14552	1N965B

REPLACEABLE MECHANICAL PARTS

PARTS ORDERING INFORMATION

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

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

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

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

SPECIAL NOTES AND SYMBOLS

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

FIGURE AND INDEX NUMBERS

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

INDENTATION SYSTEM

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

```

1 2 3 4 5           Name & Description
Assembly and/or Component
Attaching parts for Assembly and/or Component
-----
Detail Part of Assembly and/or Component
Attaching parts for Detail Part
-----
Parts of Detail Part
Attaching parts for Parts of Detail Part
-----

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

Attaching parts must be purchased separately, unless otherwise specified.

ITEM NAME

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

ABBREVIATIONS

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

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
000BK	STAUFFER SUPPLY	105 SE TAYLOR	PORTLAND, OR 97214
000CY	NORTHWEST FASTENER SALES, INC.	7923 SW CIRRUS DRIVE	BEAVERTON, OREGON 97005
08261	SPECTRA-STRIP CORP.	7100 LAMPSON AVE.	GARDEN GROVE, CA 92642
12327	FREEWAY CORPORATION	9301 ALLEN DRIVE	CLEVELAND, OH 44125
13257	AMERACE, LTD.	10 ESNA PARK DRIVE	MARKHAM, ONTARIO, CANADA
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
58474	SUPERIOR ELECTRIC CO.	383 MIDDLE ST.	BRISTOL, CT 06010
71785	TRW, CINCH CONNECTORS	1501 MORSE AVENUE	ELK GROVE VILLAGE, IL 60007
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
73803	TEXAS INSTRUMENTS, INC., METALLURGICAL MATERIALS DIV.	34 FOREST STREET	ATTLEBORO, MA 02703
74445	HOLO-KROME CO.	31 BROOK ST. WEST	HARTFORD, CT 06110
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
78471	TILLEY MFG. CO.	900 INDUSTRIAL RD.	SAN CARLOS, CA 94070
79136	WALDES, KOHINOOR, INC.	47-16 AUSTEL PLACE	LONG ISLAND CITY, NY 11101
79807	WROUGHT WASHER MFG. CO.	2100 S. O BAY ST.	MILWAUKEE, WI 53207
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
87308	N. L. INDUSTRIES, INC., SOUTHERN SCREW DIV.	P. O. BOX 1360	STATESVILLE, NC 28677
95987	WECKESSER CO., INC.	4444 WEST IRVING PARK RD.	CHICAGO, IL 60641

Replaceable Mechanical Parts—7CTIN

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Qty	1	2	3	4	5	Name & Description	Mfr Code	Mfr Part Number
1-1	337-1064-04		2						SHIELD,ELEC:SIDE PLUG-IN UNITS	80009	337-1064-00
-2	366-0494-00		1						KNOB:GRAY WITH SETSCREW	80009	366-0494-00
	213-0153-00		1						. SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-3	366-1376-00		1						KNOB:GY,0.252 ID X1.125 X 0.6 H	80009	366-1376-00
	213-0153-00		2						. SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-4	366-1382-00		1						KNOB:GY,0.128 ID X 0.5 OD X 0.26H	80009	366-1382-00
	213-0153-00		1						. SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-5	366-1375-00		1						KNOB:GY,0.252 ID X0.125 OD X 0.52H	80009	366-1375-00
	213-0153-00		2						. SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-6	366-0494-00		1						KNOB:GRAY WITH SETSCREW	80009	366-0494-00
	213-0153-00		1						. SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-7	366-0494-00		1						KNOB:GRAY WITH SETSCREW	80009	366-0494-00
	213-0153-00		1						. SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-8	366-0494-02		1						KNOB:CHARCOAL,STEP OFFSET	80009	366-0494-02
	213-0153-00		1						. SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-9	366-1058-38		1						KNOB:LATCH		
									(ATTACHING PARTS)		
-10	214-1095-00		1						PIN,SPG,SPLIT:0.094 OD X 0.187 INCH LONG	13257	52-022-094-0187
									- - - * - - -		
-11	105-0076-02		1						REL BAR,LATCH:PLUG-IN UNIT	80009	105-0076-02
-12	214-1280-00		1						SPRING,HLCPS:0.14 OD X 1.126"L,0.16"DIA W	80009	214-1280-00
-13	214-1054-00		1						SPRING,FLAT:0.825 X 0.322,SST	80009	214-1054-00
-14	105-0075-00		1						BOLT,LATCH:7A & 7B SER PL-IN	80009	105-0075-00
-15	366-1257-95		1						PUSHBUTTON:VERT		
-16	366-1257-88		1						PUSH BUTTON:SIL GY,2V	80009	366-1257-88
-17	366-1257-87		1						PUSH BUTTON:SIL GY,X 10	80009	366-1257-87
-18	366-1257-76		1						PUSH BUTTON:SIL GY,PNP PCH	80009	366-1257-76
-19	366-1257-86		1						PUSHBUTTON:FET		
-20	426-0681-00		5						FR,PUSH BUTTON:GRAY PLASTIC	80009	426-0681-00
-21	195-0095-00		1						LEAD,TEST:BNC	80009	195-0095-00
-22	348-0301-00		1						GROMMET:PLASTIC,0.312 ID X 0.43 INCH OD		
-23	343-0144-00		1						CLAMP,LOOP:0.125 INCH ID,BLK NYLON	95987	1-8-2
									(ATTACHING PARTS)		
-24	211-0121-00		1						SCR,ASSEM WSHR:4-40 X 0.438 INCH,PNH BRS	83385	OBD
									- - - * - - -		
-25	129-0064-00		3						POST,BDG,ELEC:CHARCOAL,5-WAY MINIATURE	58474	BINP BB10167G13T
									(ATTACHING PARTS)		
-26	210-0457-00		1						NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
-27	358-0181-00		1						INSULATOR,BSHG:CHARCOAL	58474	BB10166G13BX
									- - - * - - -		
-28	358-0029-00		2						BSHG,MACH.THD:HEX,0.375-32 X 0.438"LONG	80009	358-0029-00
									(ATTACHING PARTS)		
-29	210-0590-00		1						NUT,PLAIN,HEX.:0.375 X 0.438 INCH,STL	73743	2X28269-402
-30	210-0978-00		1						WASHER,FLAT:0.375 ID X 0.50 INCH OD,STL	78471	OBD
-31	210-0012-00		1						WASHER,LOCK:INTL,0.375 ID X 0.50" OD STL	78189	1220-02-00-0541C
									- - - * - - -		
-32	-----		2						RESISTOR,VARIABLE:(SEE R20 & R265 EPL)		
									(ATTACHING PARTS)		
-33	210-0583-00		1						NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-34	210-0940-00		1						WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
									- - - * - - -		
-35	-----		1						RESISTOR,VARIABLE:(SEE R120 & S120 EPL)		
									(ATTACHING PARTS)		
-36	210-0583-00		1						NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-37	210-0940-00		1						WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
									- - - * - - -		
-38	333-1553-00		1						PANEL:FRONT		
-39	348-0235-00		2						SHLD GSKT,ELEC:4.734 INCH LONG	80009	348-0235-00
-40	200-0935-00		3						BASE,LAMPHOLDER:0.29 OD X 0.19 CASE	80009	200-0935-00
-41	331-0262-00	B010100 B030870X	2						DIFFUSER,LIGHT:INDICATOR LIGHTS	80009	331-0262-00
-42	378-0635-00		2						LENS,LIGHT:WHITE	80009	378-0635-00
-43	378-0602-02		1						LENS,LIGHT:RED	80009	378-0602-02
-44	352-0157-01		1						LAMPHOLDER:BLACK PLASTIC	80009	352-0157-01



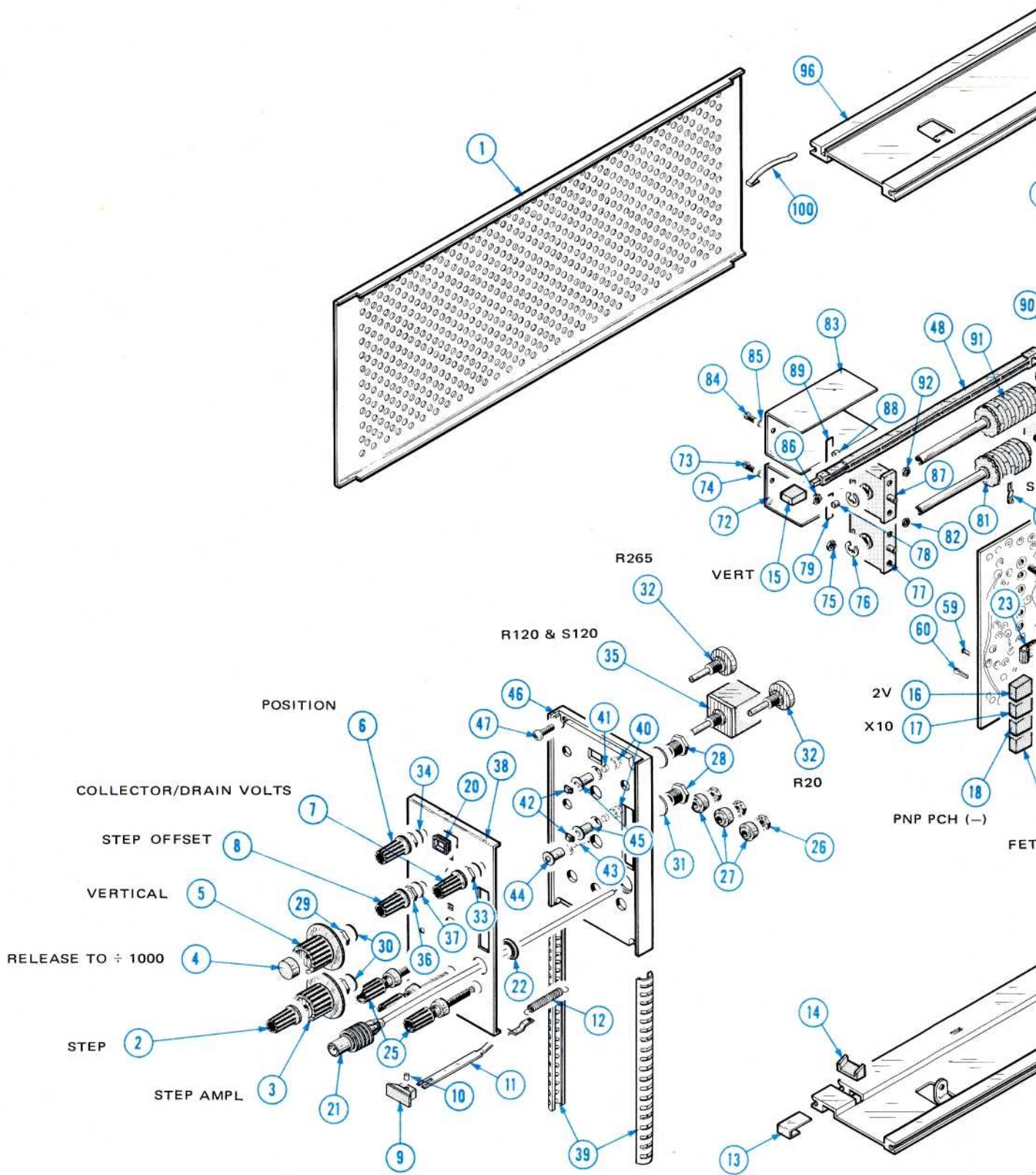
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Replaceable Mechanical Parts—7CTIN

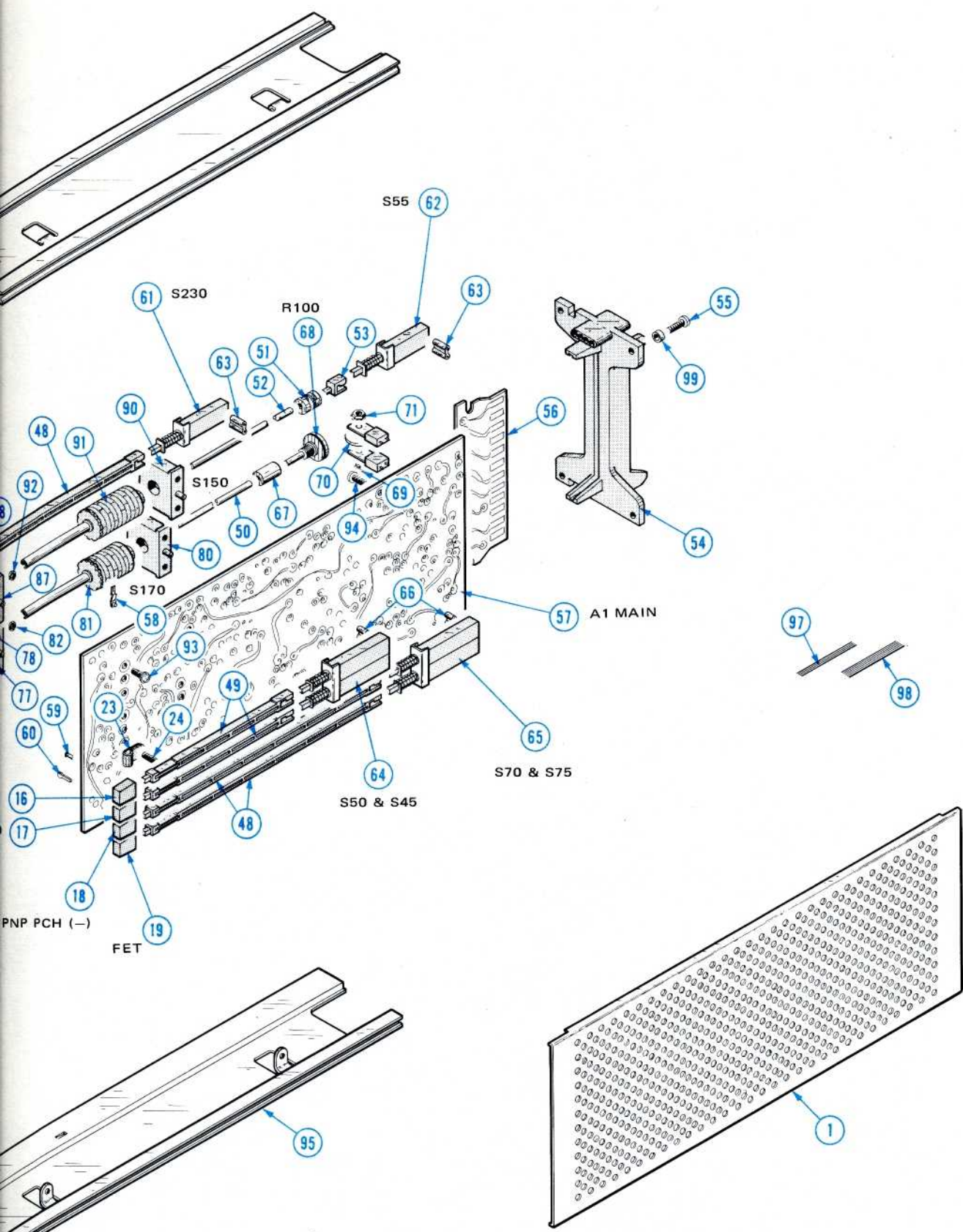
Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-45	352-0157-00		2		LAMPHOLDER:WHITE PLASTIC	80009	352-0157-00
-46	386-1447-62		1		SUBPANEL:FRONT		
					(ATTACHING PARTS)		
-47	213-0192-00		4		SCR,TPG,THD FOR:6-32 X 0.50 INCH,PNH STL	87308	OBD
					-----*		
-48	384-1059-00		3		EXTENSION SHAFT:6.58 INCH LONG	80009	384-1059-00
-49	384-1061-00		2		EXTENSION SHAFT:3.981 INCH LONG	80009	384-1061-00
-50	384-0496-00		1		EXTENSION SHAFT:4.82 L X 0.123 OD EPOXY-GL	80009	384-0496-00
-51	376-0051-00		1		CPLG,SHAFT,FLEX:FOR 0.125 INCH DIA SHAFTS	80009	376-0051-00
	213-0022-00		4		. SETSCREW:4-40 X 0.188 INCH,HEX SOC STL	74445	OBD
	376-0049-00		1		. CPLG,SHAFT,FLEX:PLASTIC	80009	376-0049-00
	354-0251-00		2		. RING,COUPLING:0.251 ID X 0.375 INCH OD,AL	80009	354-0251-00
-52	384-1125-00		1		EXTENSION SHAFT:7.15 L X 0.125 OD AL	80009	384-1125-00
-53	103-0161-00		1		ADPTR PB TO COU:0.125 SQ TO 0.125 ID	80009	103-0161-00
-54	386-1402-00		1		PANEL,REAR:	80009	386-1402-00
					(ATTACHING PARTS)		
-55	213-0192-00		4		SCR,TPG,THD FOR:6-32 X 0.50 INCH,PNH STL	87308	OBD
					-----*		
-56	388-2485-00		1		CIRCUIT BOARD:INTERFACE		
-57	-----		1		CKT BOARD ASSEMBLY:MAIN(SEE A1 EPL)		
	388-2486-00		1		. CIRCUIT BOARD		
-58	131-0604-00		22		. CONTACT,ELEC:CKT BD SW,SPR,CU BE	80009	131-0604-00
-59	136-0252-04	B010100 B030779	93		. SOCKET,PIN TERM:U/W 0.016-0.018 DIA PINS	22526	75060-007
	136-0220-00	B030780 B051549	31		. SKT,PL-IN ELEC:TRANSISTOR 3 CONTACT,PCB MT	71785	133-23-11-034
	136-0220-00	B051550	2		. SKT,PL-IN ELEC:TRANSISTOR 3 CONTACT,PCB MT	71785	133-23-11-034
	136-0252-07	B051550	87		. SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
	136-0235-00	B030780	1		. SOCKET,PLUG-IN:6 CONTACT,ROUND	71785	133-96-12-062
	136-0514-00	B030780	5		. SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	73803	CS9002-8
-60	214-0579-00		6		. TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-61	260-1209-00		1		. SWITCH,PUSH:4PDT,1A,25VDC	80009	260-1209-00
-62	260-1209-00		1		. SWITCH,PUSH:4PDT,1A,25VDC	80009	260-1209-00
-63	361-0383-00		4		. SPACER,PB SW:CHARCOAL,0.33 INCH LONG	80009	361-0383-00
-64	-----		1		. SWITCH,PUSH:(SEE S45,S50 EPL)		
-65	-----		1		. SWITCH,PUSH:(SEE S70,S75 EPL)		
-66	361-0385-00		8		. SPACER,PB SW:0.164 INCH LONG	80009	361-0385-00
-67	376-0029-00		1		. CPLG,SHAFT,RGD:0.128 ID X 0.312 OD X 0.5" L	80009	376-0029-00
	213-0075-00		2		. SETSCREW:4-40 X 0.094 INCH,HEX SOC STL	000BK	OBD
-68	-----		1		. RESISTOR,VARIABLE:(SEE R100 EPL)		
-69	211-0008-00		1		. SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-70	210-1061-00		1		. WASHER,FLAT:0.203 ID X 0.062 THK,STL CD	12327	OBD
-71	210-0586-00		1		. NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	211-041800-00
	105-0308-00		1		. ACTR ASSY,CAM S:	80009	105-0308-00
-72	200-1193-00		1		. COVER,CAM SW:	80009	200-1193-00
					(ATTACHING PARTS)		
-73	211-0022-00		2		. SCREW,MACHINE:2-56 X 0.188 INCH,PNH STL	83385	OBD
-74	210-0001-00		2		. WASHER,LOCK:INTL,0.092 ID X 0.18"OD,STL	78189	1202-00-00-0541C
-75	210-0405-00		2		. NUT,PLAIN,HEX.:2-56 X 0.188 INCH,BRS	73743	2X12157-402
					-----*		
-76	354-0219-00		1		. RING,RETAINING:FOR 0.25 INCH SHAFT	79136	5103-25-MD-R
-77	401-0057-00		1		. BEARING,CAM SW:FRONT	80009	401-0057-00
-78	214-1127-00		1		. ROLLER,DETENT:0.125 DIA X 0.125 INCH L	80009	214-1127-00
-79	214-1139-00		-		. SPRING,FLAT:0.885 X 0.156CU BE GLD CLR	80009	214-1139-00
	214-1139-02		-		. SPRING,FLAT:GREEN COLORED	80009	214-1139-02
	214-1139-03		-		. SPRING,FLAT:RED COLORED	80009	214-1139-03
-80	401-0056-00		1		. BEARING,CAM SW:REAR	80009	401-0056-00
-81	105-0305-00		1		. ACTUATOR,CAM SW:	80009	105-0305-00
-82	210-0406-00		4		. NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
					(ATTACHING PARTS)		
	211-0116-00		3		. SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
					-----*		
	105-0307-00		1		. ACTR ASSY,CAM S:	80009	105-0307-00
-83	200-1010-00		1		. COVER,CAM SW:12 ELEMENT,0.83 INCH DIA	80009	200-1010-01
					(ATTACHING PARTS)		
-84	211-0022-00		2		. SCREW,MACHINE:2-56 X 0.188 INCH,PNH STL	83385	OBD
-85	210-0001-00		2		. WASHER,LOCK:INTL,0.092 ID X 0.18"OD,STL	78189	1202-00-00-0541C
-86	210-0405-00		2		. NUT,PLAIN,HEX.:2-56 X 0.188 INCH,BRS	73743	2X12157-402
					-----*		

Replaceable Mechanical Parts—7CTIN

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Qty	1	2	3	4	5	Name & Description	Mfr Code	Mfr Part Number
1-	354-0219-00		1	.	.	.	.	.	RING,RETAINING:FOR 0.25 INCH SHAFT	79136	5103-25-MD-R
-87	401-0057-00		1	.	.	.	.	.	BEARING,CAM SW:FRONT	80009	401-0057-00
-88	214-1127-00		1	.	.	.	.	.	ROLLER,DETENT:0.125 DIA X 0.125 INCH L	80009	214-1127-00
-89	214-1139-00		-	.	.	.	.	.	SPRING,FLAT:0.885 X 0.156CU BE GLD CLR	80009	214-1139-00
	214-1139-02		-	.	.	.	.	.	SPRING,FLAT:GREEN COLORED	80009	214-1139-02
	214-1139-03		-	.	.	.	.	.	SPRING,FLAT:RED COLORED	80009	214-1139-03
-90	401-0056-00		1	.	.	.	.	.	BEARING,CAM SW:REAR	80009	401-0056-00
-91	105-0306-00		1	.	.	.	.	.	ACTUATOR,CAM SW:	80009	105-0306-00
-92	210-0406-00		4	.	.	.	.	.	NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS (ATTACHING PARTS)	73743	2X12161-402
-93	211-0116-00		4	.	.	.	.	.	SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS (ATTACHING PARTS)	83385	OBD
-94	213-0146-00		4	.	.	.	.	.	SCR,TPG,THD FOR:6-20 X 0.313 INCH,PNH STL	83385	OBD
									* - - -		
-95	426-0499-14		1						FRAME SECTION:BOTTOM		
-96	426-0505-14		1						FRAME SECTION:TOP		
-97	175-0826-00		FT						WIRE,ELECTRICAL:3 WIRE RIBBON	80009	175-0826-00
-98	175-0828-00		FT						WIRE,ELECTRICAL:5 WIRE RIBBON	08261	OBD
-99	361-0326-00		1						SPACER,SLEEVE:0.18 ID X 0.25 OD X 0.10"L	80009	361-0326-00
-100	214-1061-00		1						SPRING,GROUND:FLAT	80009	214-1061-00



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7CT1N CURVE TRACER

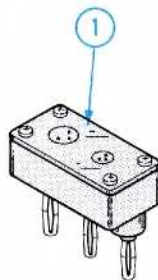


Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Q t y						Description
		Eff	Disc		1	2	3	4	5	
2-1	013-0128-00 070-1247-00			1						TEST ADAPTER, transistor
				1						MANUAL, instruction (not shown)

MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages.

A single change may affect several sections. 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 following this page, your manual is correct as printed.

SERVICE NOTE

Because of the universal parts procurement problem, some electrical parts in your instrument may be different from those described in the Replaceable Electrical Parts List. The parts used will in no way alter or compromise the performance or reliability of this instrument. They are installed when necessary to ensure prompt delivery to the customer. Order replacement parts from the Replaceable Electrical Parts List.

CALIBRATION TEST EQUIPMENT REPLACEMENT

Calibration Test Equipment Chart

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

Comparison of Main Characteristics

DM 501 replaces 7D13		
PG 501 replaces 107 108	PG 501 - Risetime less than 3.5 ns into 50 Ω . PG 501 - 5 V output pulse; 3.5 ns Risetime	107 - Risetime less than 3.0 ns into 50 Ω . 108 - 10 V output pulse 1 ns Risetime
PG 502 replaces 107 108 111	PG 502 - 5 V output PG 502 - Risetime less than 1 ns; 10 ns Pretrigger pulse delay	108 - 10 V output 111 - Risetime 0.5 ns; 30 to 250 ns Pretrigger pulse delay
PG 508 replaces 114 115 2101	Performance of replacement equipment is the same or better than equipment being replaced.	
PG 506 replaces 106 067-0502-01	PG 506 - Positive-going trigger output signal at least 1 V; High Amplitude output, 60 V. PG 506 - Does not have chopped feature.	106 - Positive and Negative-going trigger output signal, 50 ns and 1 V; High Amplitude output, 100 V. 0502-01 - Comparator output can be alternately chopped to a reference voltage.
SG 503 replaces 190, 190A, 190B 191 067-0532-01	SG 503 - Amplitude range 5 mV to 5.5 V p-p. SG 503 - Frequency range 250 kHz to 250 MHz.	190B - Amplitude range 40 mV to 10 V p-p. 0532-01 - Frequency range 65 MHz to 500 MHz.
SG 504 replaces 067-0532-01 067-0650-00	SG 504 - Frequency range 245 MHz to 1050 MHz.	0532-01 - Frequency range 65 MHz to 500 MHz.
TG 501 replaces 180, 180A 181 184 2901	TG 501 - Trigger output-slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time. TG 501 - Trigger output-slaved to market output from 5 sec through 100 ns. One time-mark can be generated at a time. TG 501 - Trigger output-slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	180A - Trigger pulses 1, 10, 100 Hz; 1, 10, and 100 kHz. Multiple time-marks can be generated simultaneously. 181 - Multiple time-marks 184 - Separate trigger pulses of 1 and 0.1 sec; 10, 1, and 0.1 ms; 10 and 1 μ s. 2901 - Separate trigger pulses, from 5 sec to 0.1 μ s. Multiple time-marks can be generated simultaneously.

NOTE: All TM 500 generator outputs are short-proof. All TM 500 plug-in instruments require TM 500-Series Power Module.