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INSTRUCTION MANUAL

7CT1N CURVE TRACER

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<p>THE FOLLOWING SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID PERSONAL INJURY, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.</p>		
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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 main-frames. 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.

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 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.

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

VOLTS

.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

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

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 AMPPL

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 1 mV/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, NCH - PNP, PCH 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, NCH-PNP, PCH 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

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

Operating Instructions—7CT1N

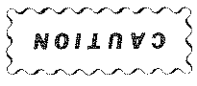
1. Install the 7CT1N in the mainframe as described in the beginning of this section. Turn on the oscilloscope system and set the mainframe, and time base or amplifier controls as follows:

Mainframe	
Set for location of 7CT1N and for location of plug-in 7CT1N is connected to.	Horizontal and Vertical Mode
	Display Mode (7B50 or 7B70)
	Time/Div or Div (7B52 or 7B53N)
	Amplifier
	Time Base
	DC
	Amplifier
	Time/Div or Div (7B52 or 7B53N)
	Amplifier
	DC
	Triggering Coupling
	DC
	Ext
	DC

2. Set the 7CT1N controls as follows:

DIODE CHECK	
Position	Centered
Collector/Drain	Position
VOLTS	X 10
VERTICAL	Pushbutton out
÷ 1000	Pushbutton out
STEP AMPL	Pushbutton in
STEP OFFSET	No effect for diode check
NPV, N CH - PNP, P CH	No effect for diode check
XSTR-FET	Pushbutton out

3. Position the spot to the lower left corner of the CRT graphic using the 7CT1N POSITION control and the VERT OUT cable is connected to.



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.

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

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

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.)

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

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).

10. Connect the transistor-FET adapter, which is supplied with the ZCT1N, 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.

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

POSITION	Centered
COLLECTOR/DRAIN VOLTS	Fully counterclockwise
X10	Pushbutton out
.5 V - 2 V	Pushbutton in
VERTICAL	1 mA/DIV
$\div 1000$	Pushbutton in
STEP AMPL	1 μ A/STEP
STEP	Fully clockwise
STEP OFFSET	Full-switch in
NPN, NCH - PNP	Pushbutton out
PCH	Pushbutton out
XSTR-FET	Pushbutton out

8. Set the ZCT1N controls as follows:

TRANSISTOR CHECK

Press the NPN, NCH-PNP, PCH pushbutton. Check that the spot moves from the lower left corner of the CRT graphicule 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 graphicule. 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, NCH-PNP, PCH pushbutton. Release the NPN, NCH-PNP, PCH pushbutton.

4. Connect a silicon diode between the C or G (anode) and E or S (cathode) binding posts of the ZCT1N. The transistor-FET adapter supplied with the ZCT1N 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, NCH-PNP, PCH 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 μ A/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.

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 ZCT1N. A number of other adapters, which may be used with the ZCT1N, 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 ZCT1N

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 ZCT1N 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 ZCT1N.

Diodes

General. Most signal, Zener and tunnel diodes can be tested with the ZCT1N. 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.

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 ZCT1N. (As is mentioned in part 13, the best measurement of I_{CE0} is obtained when the base lead is disconnected from the test socket).

FIELD EFFECT TRANSISTOR CHECK

15. Set the ZCT1N controls as follows:

- POSITION Centered
- COLLECTOR/DRAIN 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, NCH - PNP, PCH 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.

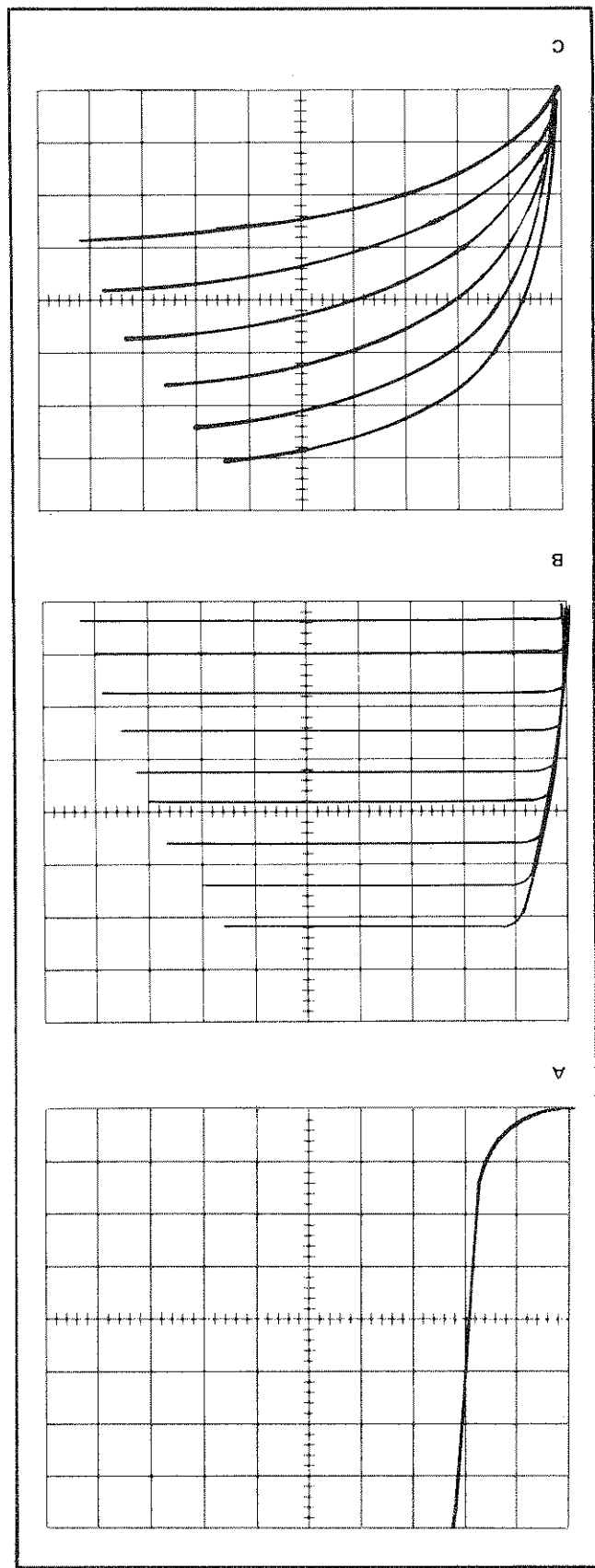
18. Turn the COLLECTOR/DRAIN VOLTS control

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 k Ω output impedance of the step generator

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



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

- POSITION
- COLLECTOR/DRAIN
- VOLTS
- X 10
- .5 V - 2 V
- Pushbutton out
- As desired
- Pushbutton in
- No effect for Diode Check
- STEP AMPL
- STEP
- STEP OFFSET
- NPN, NCH - PNP,
- P CH
- XSTR-FET
- Pushbutton out
- Pushbutton out
- Centered
- Fully counterclockwise
- Pushbutton out
- Pushbutton out
- Pushbutton out
- No effect for Diode Check
- No effect for Diode Check
- No effect for Diode Check
- 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.

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.

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.

Press the NPN, NCH - PNP, PCH pushbutton. Turn the COLLECTOR/DRAIN VOLTS control clockwise until Zener or avalanche breakdown voltage is not obtained. If breakdown is not obtained, select a higher collector-drain supply output voltage. Measure V_R or V_Z on the horizontal axis.

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.

Installation. Connect the transistor to the device testing jacks through the transistor-FET adapter which is included with the ZCT1N. 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.

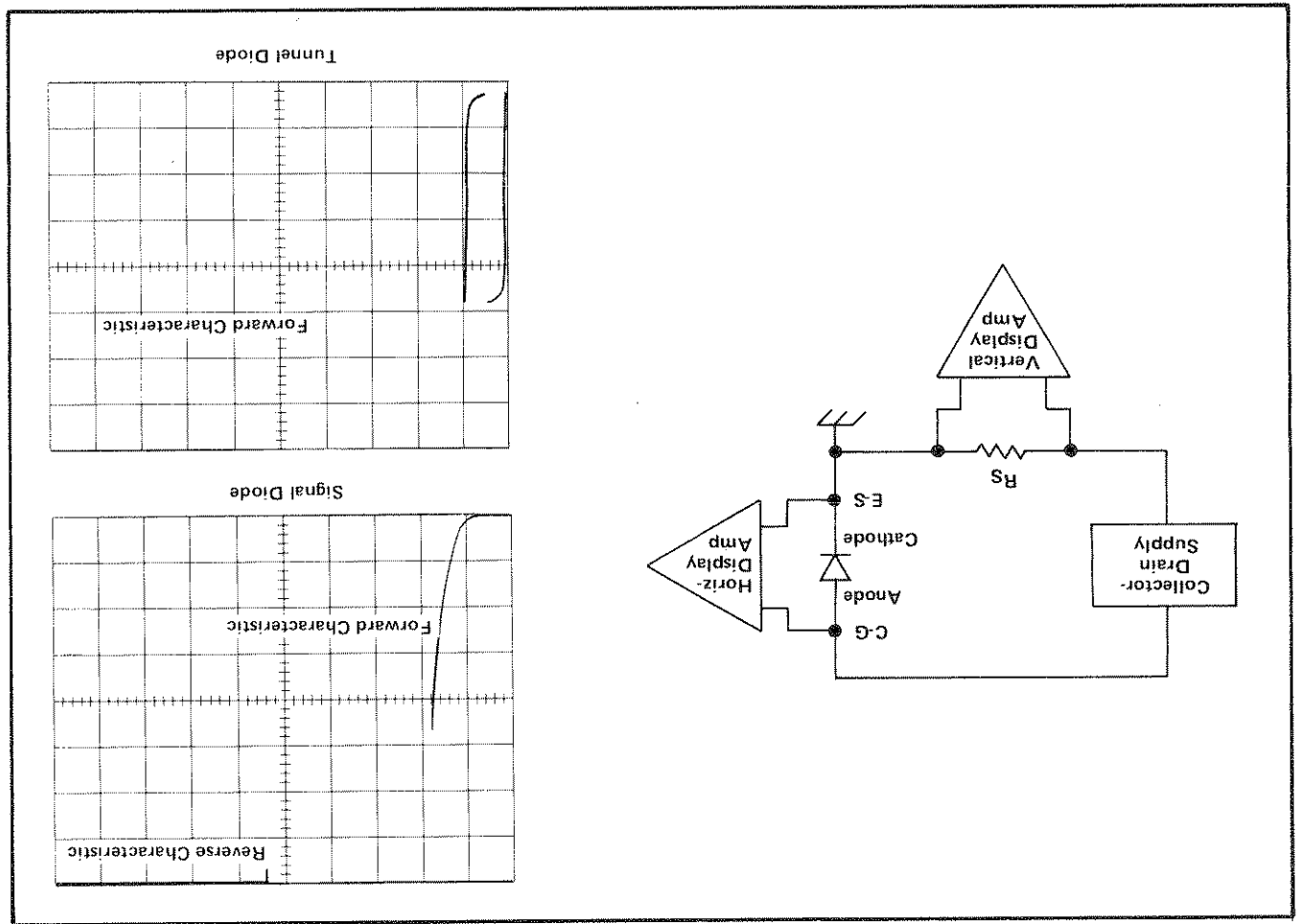
Pushbutton out	X 10	Pushbutton out	XSTR-FET
Pushbutton in	.5 V . 2 V	Pushbutton in (PNP Devices)	P CH
As desired	VERTICAL	Pushbutton out (NPN Devices)	NPN, N CH - PNP,
Pushbutton in	÷ 1000	Pushbutton in	STEP OFFSET
Pushbutton in	STEP AMPL	Pushbutton in	STEP
1 μ A/DIV	STEP	Pushbutton in	STEP OFFSET
Fully clockwise	STEP OFFSET	Pushbutton in	P CH
Pull-Switch in	NPV, N CH - PNP,	Pushbutton out	XSTR-FET

Bipolar Transistors
General. All bipolar transistors can be tested with the ZCT1N. The maximum I_c which can be measured is 160 mA.
Controls Settings. Set the ZCT1N controls initially as follows:

- POSITION COLLECTOR/DRAIN VOLTS
- Centered
- Fully counterclockwise

Release the ÷ 1000 pushbutton to measure leakage current. With the ÷ 1000 pushbutton out, divide the VERTICAL 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).

Fig. 1-3. Simplified diagram showing the connection of a diode to the ZCT1N and some typical displays.



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. 1-4 is obtained.

β (small-signal)

The small-signal short-circuit forward current transfer ratio (emitter grounded), β or h_{fe} , is $\Delta I_C / \Delta I_B$. To measure β , obtain a display of I_C vs. V_{CE} as described for the go, no-go check. Set the STEP AMPL switch and VERTICAL switch for the I_C at which β is specified. I_C is measured on the vertical axis. The VERTICAL switch sets the deflection factor. When the desired display is obtained, calculate a value for β /division by dividing the setting of the STEP AMPL switch. Next, measure the vertical distance between two curves in the vicinity of the I_C at which β is specified. Offset may be used to position the curves for more convenient

measurement. Multiply this distance by the β /division previously calculated to determine β .

Obtain a display of I_C vs. V_{CE} as described for the go, no-go check. Release the .5 V - 2 V pushbutton and adjust the COLLECTOR/DRAIN VOLTS control for a display of the saturation region of the curves. The saturation region is usually defined as the non-linear or "knee" region of a curve.

Obtain a display of V_{CE} (Sat.) and measure the base voltage on the device, using a probe from a vertical unit in the oscilloscope system.

Disconnect the base lead from the test socket. Turn the COLLECTOR/DRAIN VOLTS control clockwise until the transistor breaks down. If breakdown does not occur, select a higher collector-drain supply range. Collector-emitter breakdown volt-

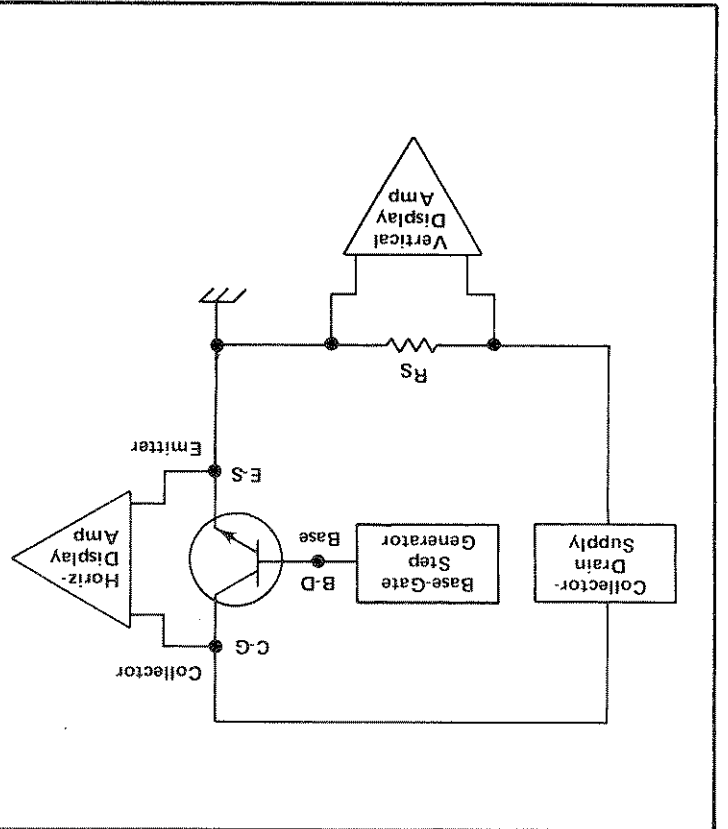
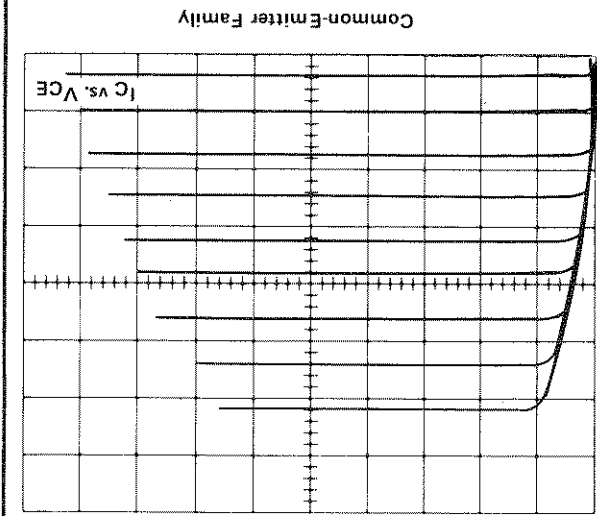


Fig. 1-4. Simplified diagram showing the connection of a bipolar transistor to the ZCT1N and a typical display.



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 ZCT1N.

Control Settings. Set the ZCT1N controls initially as follows:

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

Installation. Connect the FET to the device testing jacks through the transistor-FET adapter which is included with the ZCT1N. 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.

The small-signal transconductance g_m (small-signal)

To measure g_m , obtain a display of I_D vs. V_{DS} as is described for the 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

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 ÷ 1000 push-

button and adjust the COLLECTOR/DRAIN VOLTS control for the V_{CE} at which the

leakage current is specified. Before measuring I_{CEO} momentarily dis-

connect 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

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.

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.

The small-signal short-circuit forward current transfer ratio (base

grounded), h_{fb} , cannot be measured conveniently with the

ZCT1N. It can, however, be calculated from β with the following

equation: $\alpha = \beta / (1 + \beta)$.

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).

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

I_{CES} and BV_{CES}

I_{CER} and BV_{CER}

α (small-signal)

I_{CBO} and BV_{CBO}

I_{EBO} and BV_{EBO}

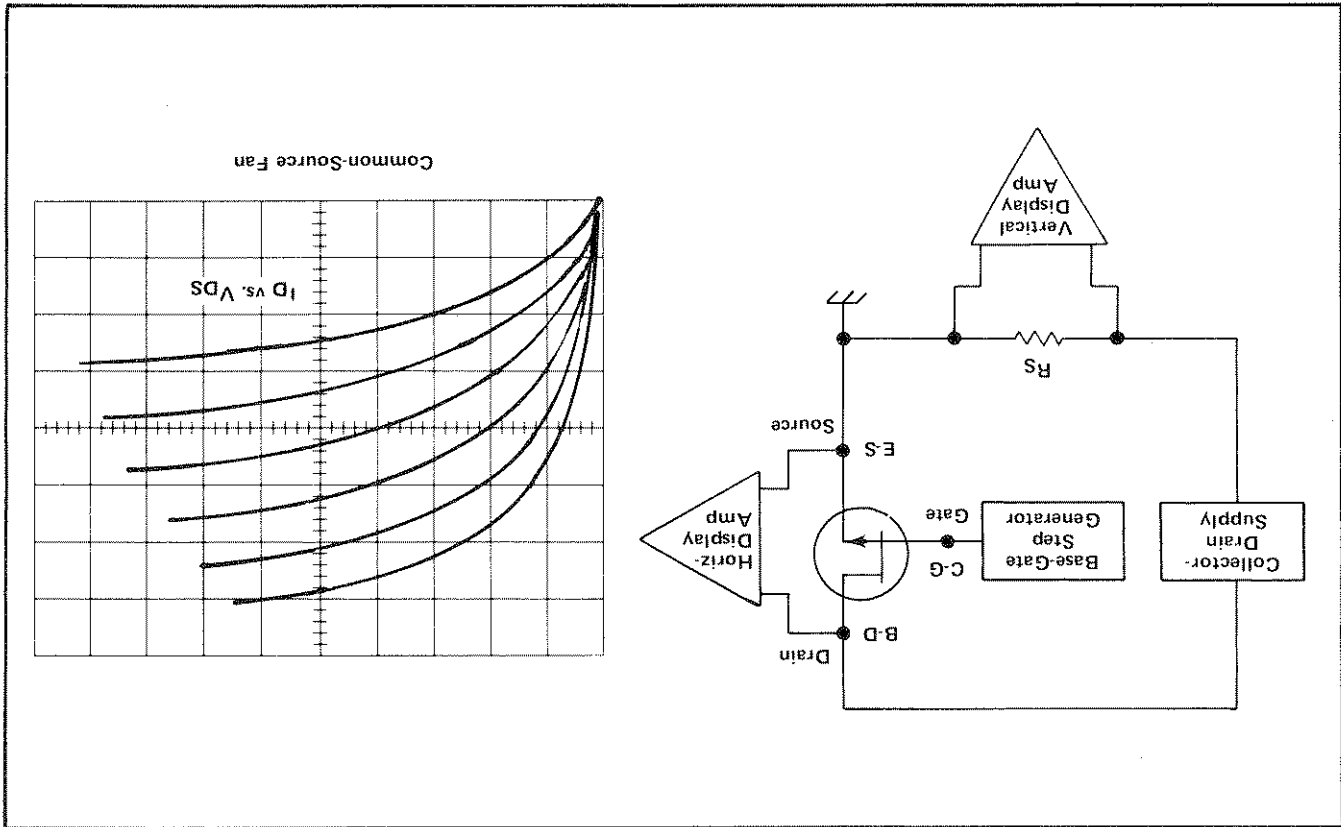


Fig. 1-5. Simplified diagram showing the connection of an FET to the ZCT1N and a typical display.

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 AMP 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.

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.

BV_{GSS}

obtained, calculate a value of g_m /division by dividing the VERTI-CAL switch setting by the setting of the STEP AMP 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 .

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.

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 AMP switch and the STEPS control, until the specified pinch-off current is

Operating Instructions-7CT1N

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 - NPN, 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 Waveshape: 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: $\pm 15 \text{ V}$.

Display Amplifiers

Vertical Ranges:

Normal: $10 \mu\text{A}/\text{divisions}$ 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.

SECTION 2 CIRCUIT DESCRIPTION

BLOCK DIAGRAM DESCRIPTION

The ZCT1N is divided into a stimulus section which provides voltages and currents for application to the device under test, and a measurement section which measures the effects of the stimulus. The stimulus section consists of the collector-drain supply (see Fig. 2-1) and the base gate step generator. The measurement section consists of the vertical and horizontal display amplifiers.

The collector-drain supply produces a voltage which is connected to the collector of a bipolar transistor, the drain of an FET, or either lead of a diode. This voltage can be either a sweeping voltage or a DC voltage. The sweeping voltage has a triangular waveshape.

The base-gate step generator produces current steps for application to the base of a bipolar transistor or voltage

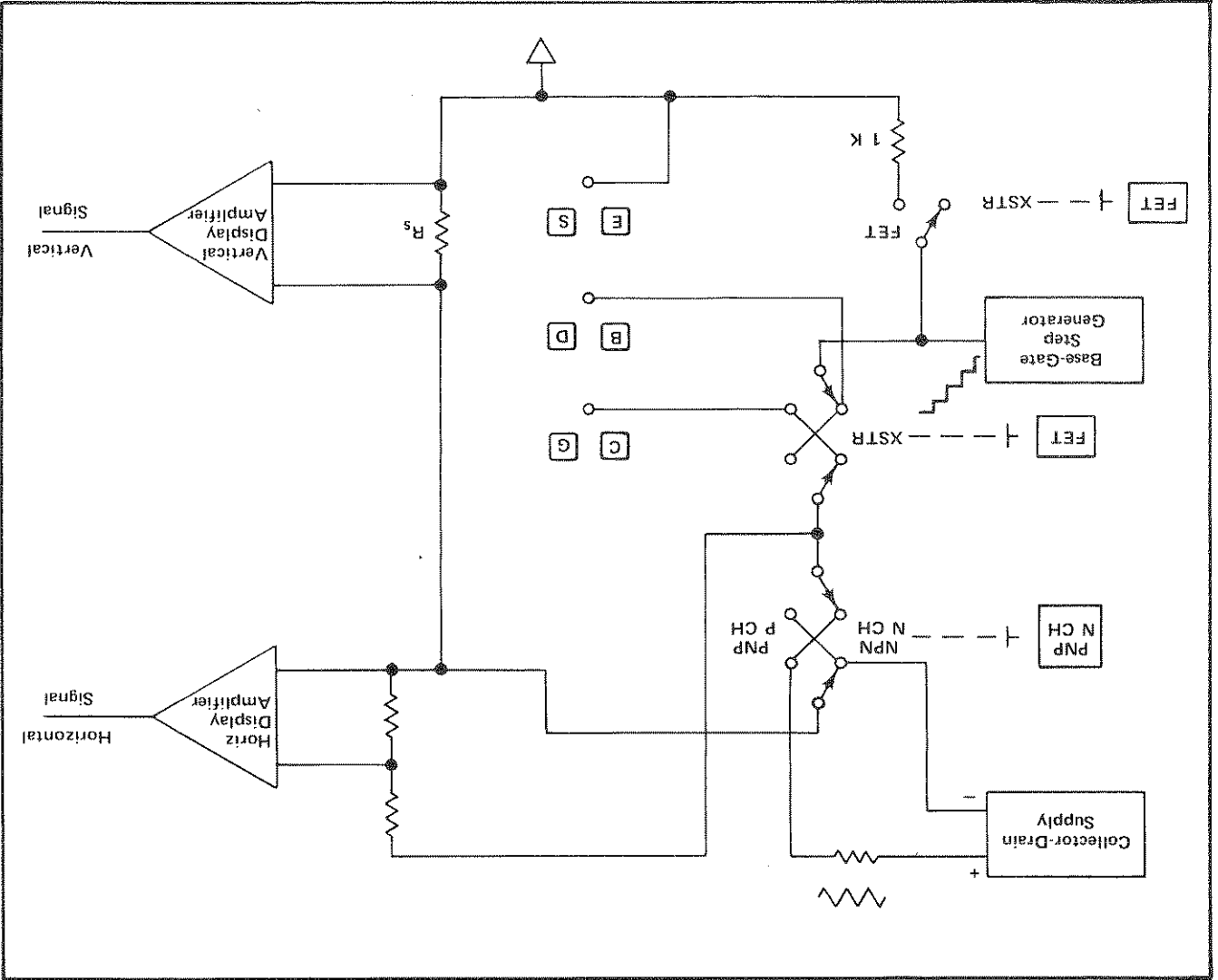


Fig. 2-1. Simplified block diagram of the ZCT1N.

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, PCH pushbutton, and S75B, controlled by the FET push-button. 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.

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

R139, the 1.5 μ A 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 μ A, 100.500 μ A, 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 push-button 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 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.

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 grounded 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 grounded 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



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NOTES

SECTION 3 PERFORMANCE CHECK/ ADJUSTMENT PROCEDURE

GENERAL

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 main-frame, one vertical amplifier and one time-base. The measurement accuracies of the vertical amplifier and time-base must be within 3%.

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 instructions

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

NOTE

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.

Accessories

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).

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

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

Check Horizontal Display Amplifier Accuracy

If you use 33056m you have to plug in 10V offsets

d. CHECK FOR—Horizontal separation of spots as shown in Table 3-2 ± 0.5 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.

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

connectors be used.

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

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.

CAUTION

Vertical Mode	Horizontal Mode	Amplitude	Mode
Location of 7CT1N	A	5 Volts	Square Wave
Vertical Mode	Horizontal Mode	Amplitude	Mode
Amplifier	Position	Amplitude	Mode
Centered	Position	Amplitude	Mode
+Up	Position	Amplitude	Mode
DC	Position	Amplitude	Mode
.1 (Call)	Position	Amplitude	Mode

Oscilloscope System

STEP	STEP OFFSET	STEP OFFSET	STEP OFFSET
Fully counterclockwise	Pull-switch in	PNP, NCH	PNP, PCH
		Pushbutton out	Pushbutton out

7CT1N

PLUG-IN COMPARTMENT VERT POSITION Centered

DRAIN VOLTS FULLY counterclockwise

Pushbutton out

Pushbutton out

20 mA/DIV

Pushbutton in

1 mA/STEP

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

1. Check Horizontal Display Amplifier

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 $\pm 5^\circ$ C, for best overall accuracy.

NOTE

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.

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.

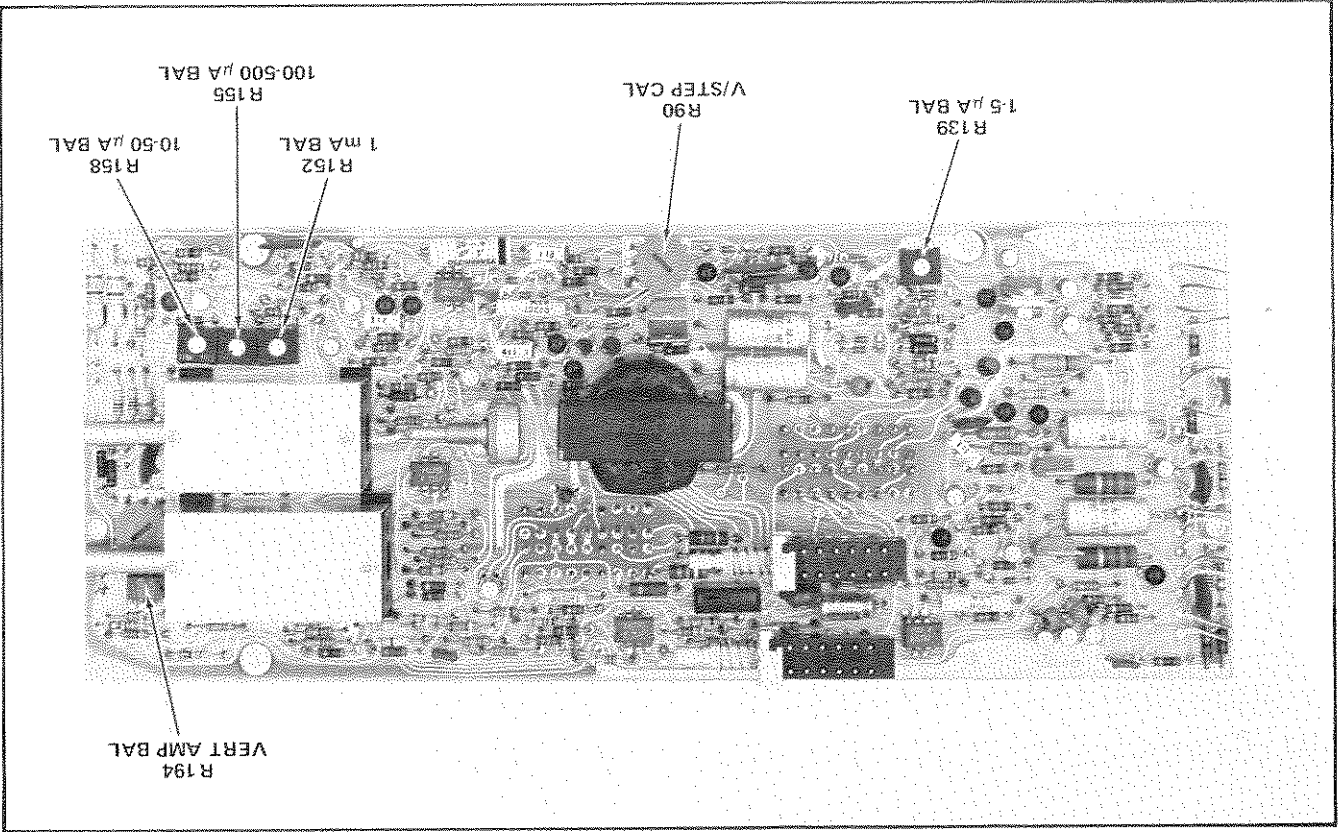
a. (Performance Check Only)—Install the 7CT1N in the Right plug-in compartment and the amplifier plug-in in the A compartment.

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

Preliminary Procedure

Performance Check/Adjustment Procedure—7CT1N

Fig. 3-1. Location of internal adjustments for the ZCT1N.



- 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 ZCT1N 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 ZCT1N.
- ### 2. Check/Adjust Vertical Display Amplifier
- a. Set the ZCT1N and Oscilloscope System controls as follows:
- | | |
|-----------------------------------|------------------------|
| PLUG-IN COMPARTMENT VERT POSITION | Centered |
| COLLECTOR/ DRAIN VOLTS | 5 V-2 V |
| X10 | Pushbutton out |
| VERTICAL | 50 μA/DIV |
| ÷1000 | Pushbutton in |
| STEP AMPL | 1 mA/STEP |
| STEP | Fully counterclockwise |

- b. Center the spot on the CRT both horizontally and vertically.
- c. Switch the VERTICAL switch back and forth between the 50 μA/DIV and 100 μA/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.

Oscilloscope System	Location of ZCT1N	A
Vertical Mode	Horizontal Mode	Amplifier
Vertical Mode	Horizontal Mode	Position
Vertical Mode	Horizontal Mode	Polarity
Vertical Mode	Horizontal Mode	Coupling
Vertical Mode	Horizontal Mode	Volts/Div

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

7CT1N

- PLUG-IN COMPARTMENT VERT POSITION Fully Clockwise
- COLLECTOR/DRAIN VOLTS Fully Counterclockwise
- X10 Pushbutton Out
- .5 V-2 V Pushbutton Out
- VERTICAL 20 mA/DIV Pushbutton In
- ÷1000 Pushbutton In
- STEP AMPL 5 mV/STEP Fully counterclockwise
- STEP OFFSET Pull-switch In
- NPN, NCH- PNP, PCH Pushbutton In
- XSTR-FET Pushbutton In

TABLE 3-4

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

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

Check Collector-Drain Supply Peak Current

VERTICAL Switch	Pushbutton	Pushbutton
	.5 V-2 V	.5 mA/DIV
In	Out	2 mA/DIV
	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, NCH-PNP, PCH 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:

- 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.

Adjust Zero Step Level

STEP AMPL	Volts/Div	Adjustment
50 mV/STEP	50 mV/Div	R158 (10-50 μ A BAL)
5 V/STEP	0.5 V/Div	R155 (100-500 μ A BAL)
1 V/STEP	1 V/Div	R152 (1 mA BAL)

TABLE 3-5

g. Turn the ZCT1N 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 ZCT1N 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.

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

TABLE 3-6

n. Set the ZCT1N 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 ZCT1N 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 ZCT1N 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 ZCT1N from the input to the amplifier.

This completes the ZCT1N Check/Adjust procedure.

SECTION 4 DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols and Reference Designators

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

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

Resistors = Ohms (Ω).

Graphic symbols and class designation letters are based on ANSI Standard Y32.2-1975.

Logic symbology is based on ANSI Y32.14-1973 in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

The overline on a signal name indicates that the signal performs its intended function when it goes to the low state.

Abbreviations are based on ANSI Y1.1-1972.

Other ANSI standards that are used in the preparation of diagrams by Tektronix, Inc. are:

Y14.15, 1966 Drafting Practices.

Y14.2, 1973 Line Conventions and Lettering.

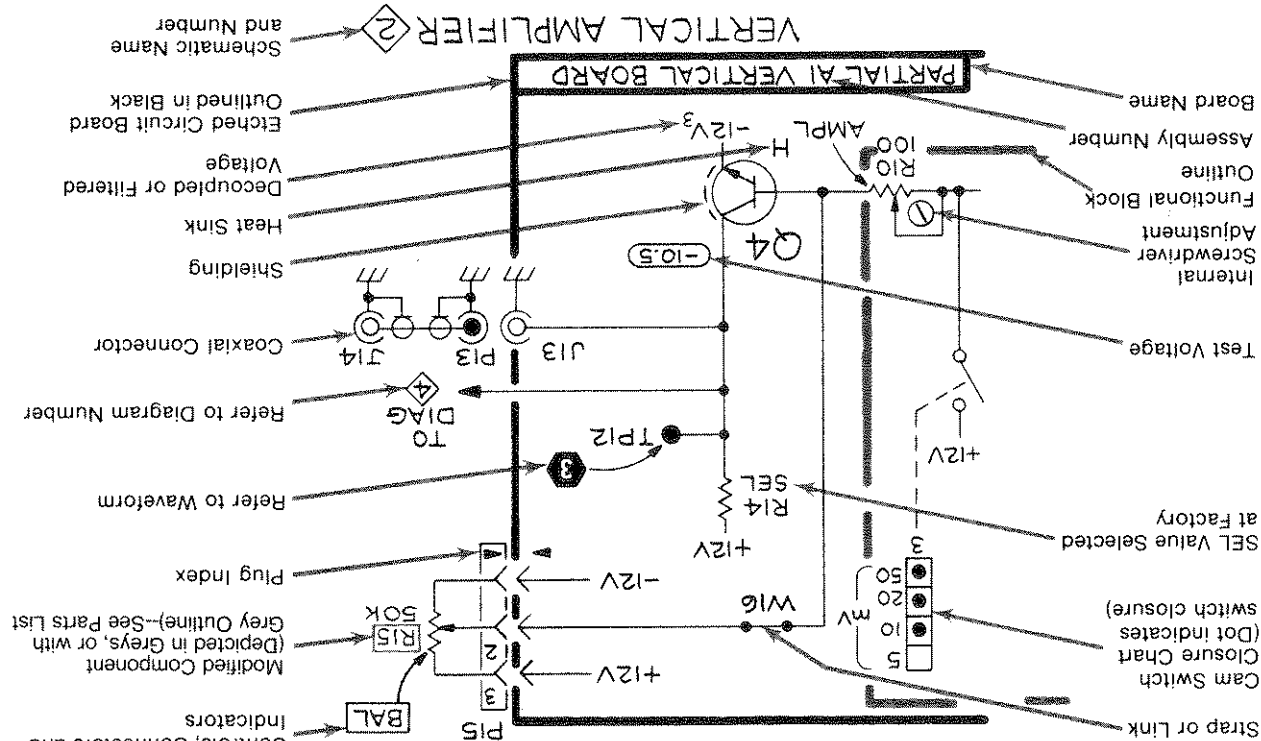
Y10.5, 1968 Letter Symbols for Quantities Used in Electrical Science and

Electrical Engineering.

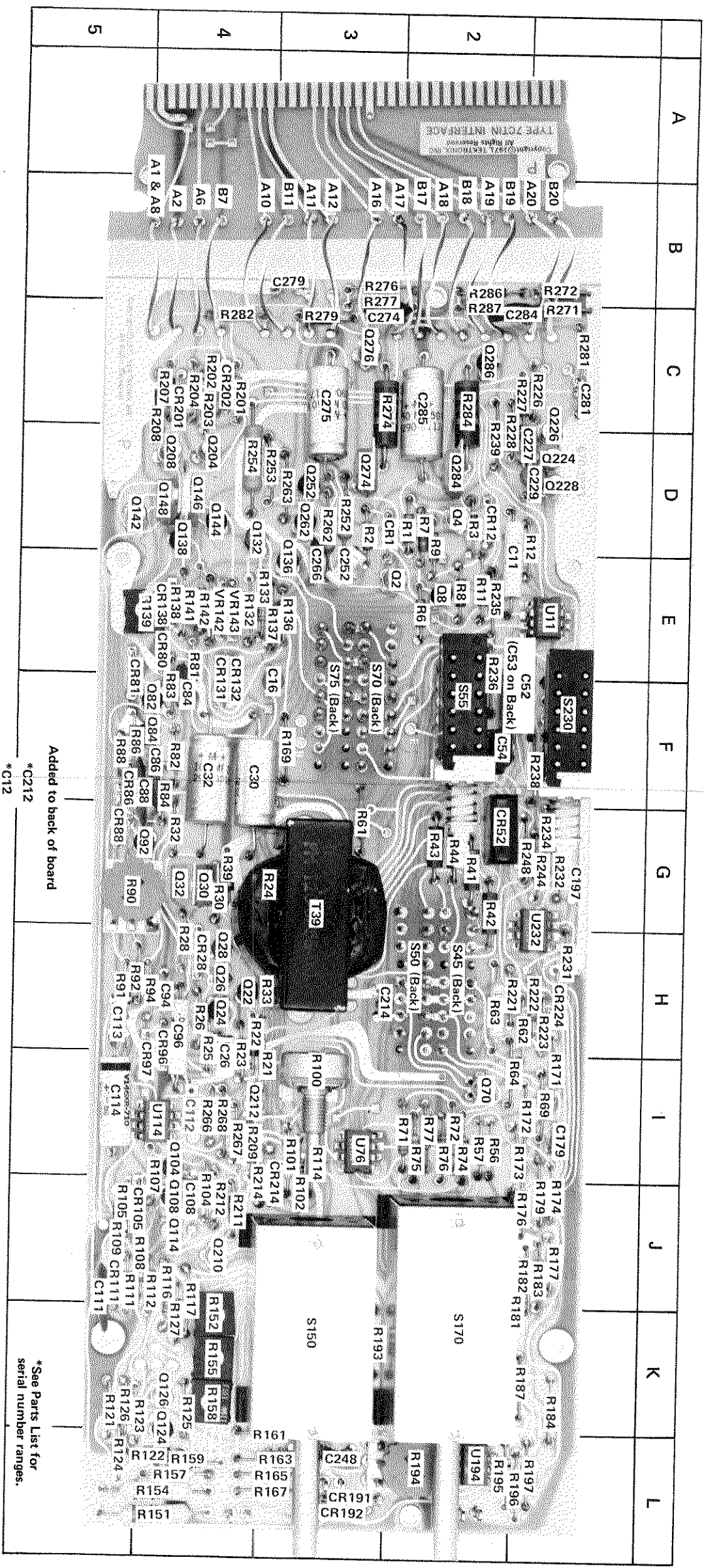
The following prefix letters are used as reference designators to identify components or assemblies on the diagrams.

A	Assembly, separable or repairable	H	Heat dissipating device (heat sink).
AT	Attenuator, fixed or variable	HR	Heater
B	Motor	HY	Hybrid circuit
BT	Battery	J	Connector, stationary portion
C	Capacitor, fixed or variable	K	Relay
CB	Circuit breaker	L	Inductor, fixed or variable
CR	Diode, signal or rectifier	M	Meter
DL	Delay line	P	Connector, movable portion
DS	Indicating device (lamp)	Q	Transistor or silicon-controlled rectifier
E	Spark Cap, Ferrite bead	R	Resistor, fixed or variable
F	Fuse	RT	Thermistor
FL	Filter		

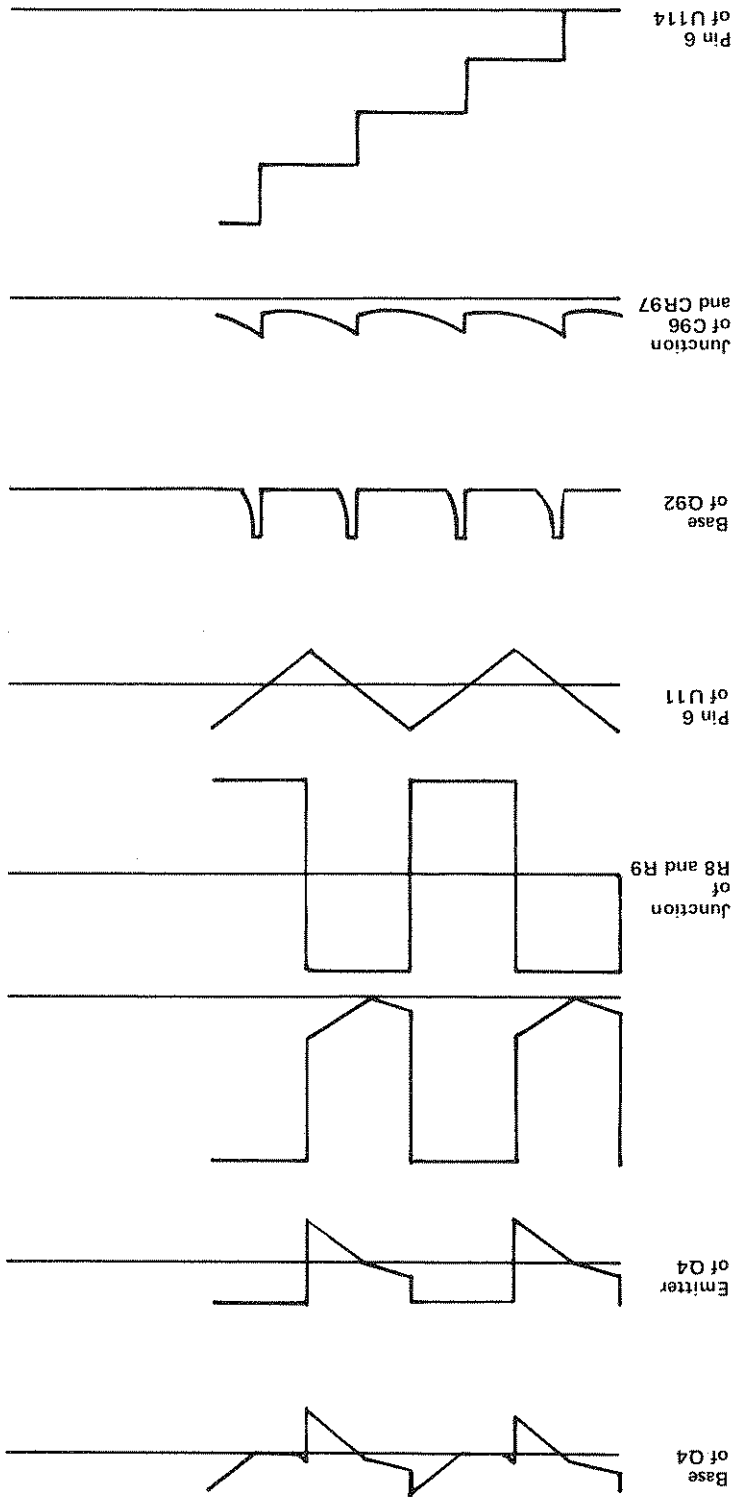
The following special symbols may appear on the diagrams:



MAIN CIRCUIT BOARD LOCATION GRID



CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC				
C111	E2	C266	E3	CR1	D3	Q2	E3	Q204	D4	R1	D3	R57	L2	R104	J4	R151	L4	R194	L2	R238	F1	S45	H2
C116	F3	C248	L3	CR12	D2	Q4	D2	Q208	D4	R2	D2	R62	G3	R105	J5	R152	K4	R195	L2	R239	D2	S50	H2
C26	I4	C252	E3	CR28	H4	O8	E2	Q210	J4	R3	D2	R107	H1	R107	J4	R154	L4	R196	L1	R244	G1	S55	F2
C30	F4	CR52	C3	CR52	H4	O22	H4	Q22	I4	R6	E2	R63	H2	R108	J4	R155	K4	R197	L1	R248	G1	S70	F3
C32	F2	C274	C3	CR80	E4	O24	H4	Q24	D1	R7	D2	R64	I2	R109	J5	R157	L4	R201	C4	R252	D3	S75	F3
C52	F2	C275	C3	CR81	F5	O26	H4	Q26	C1	R8	E2	R69	I1	R111	J5	R158	L4	R202	C4	R253	D4	S150	F3
C53	F2	C279	B3	CR86	F5	O28	H4	Q28	D1	R9	E2	R71	I2	R112	J5	R159	L4	R203	C4	R254	D4	S170	F3
C54	F2	C281	C1	CR88	G5	O30	H4	Q30	D3	R8	D2	R72	I2	R114	J3	R161	L3	R204	C4	R262	D3	S230	F1
C84	F4	C281	C1	CR96	H4	O32	G4	Q32	D3	R11	E2	R74	I2	R116	J4	R163	L3	R207	C4	R263	D3	S230	F1
C88	F4	C284	C2	CR97	H4	O32	G4	Q32	D3	R12	D2	R75	I2	R117	J4	R164	L3	R208	C4	R266	D3	S230	F1
C94	F5	C285	C2	CR105	H4	O82	I2	Q274	D3	R21	D2	R76	I2	R121	J4	R165	L3	R209	C4	R267	D3	S230	F1
C98	F4	C285	C2	CR111	H4	O84	F4	Q276	D3	R22	D2	R77	I2	R122	J4	R167	L3	R210	C4	R268	D3	S230	F1
C99	H4	C285	C2	CR111	H4	O84	F4	Q276	D3	R23	D2	R78	I2	R123	J4	R168	L3	R211	C4	R269	D3	S230	F1
C108	H4	C285	C2	CR131	F4	O92	F4	Q284	D2	R24	H4	R81	I2	R124	J4	R169	L4	R212	C4	R270	D3	S230	F1
C111	J4	C285	C2	CR132	F4	O92	F4	Q284	D2	R25	H4	R82	I2	R125	J4	R171	L4	R213	C4	R271	D3	S230	F1
C112	J4	C285	C2	CR138	F4	O104	F4	Q104	J4	R26	H4	R83	I2	R126	J4	R172	L4	R214	C4	R272	D3	S230	F1
C113	I4	C285	C2	CR191	L3	O114	J4	Q114	J4	R28	H4	R84	I2	R128	J4	R174	L4	R216	C4	R274	D3	S230	F1
C114	I4	C285	C2	CR192	L3	O124	L4	Q124	L4	R30	H4	R86	I2	R130	J4	R176	L4	R218	C4	R276	D3	S230	F1
C114	H5	C285	C2	CR201	L3	Q126	L4	Q126	L4	R32	H4	R88	I2	R132	J4	R178	L4	R220	C4	R278	D3	S230	F1
C179	I1	C285	C2	CR202	C4	Q132	D4	Q132	D4	R33	H4	R89	I2	R133	J4	R179	L4	R222	C4	R280	D3	S230	F1
C197	G1	C285	C2	CR224	J3	Q136	E3	Q136	E3	R39	H3	R90	I2	R136	J4	R181	L4	R227	C1	R281	C1	S45	H2
C214	H3	C285	C2	CR224	J3	Q136	E3	Q136	E3	R41	H3	R92	I2	R137	J4	R183	L4	R228	D2	R282	C2	S45	H2
C227	H3	C285	C2	VR142	E4	Q144	D4	Q144	D4	R42	G2	R94	I2	R139	J4	R184	L4	R234	G1	R284	C2	S45	H2
C229	D1	C285	C2	VR143	E4	Q146	D4	Q146	D4	R44	G2	R96	I2	R141	J4	R187	L4	R235	E2	R286	B2	S45	H2
C229	D1	C285	C2	VR143	E4	Q146	D4	Q146	D4	R56	G2	R101	I2	R142	J4	R188	L4	R236	E2	R287	C2	S45	H2



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
ELECTLT	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
03508	GENERAL ELECTRIC COMPANY, SEMI-CONDUCTOR PRODUCTS DEPARTMENT	ELECTRONICS PARK	SYRACUSE, NY 13201
04222	AVX CERAMICS, DIVISION OF AVX CORP.	P O BOX 867	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
12954	SIEMENS CORPORATION, COMPONENTS GROUP	8700 E THOMAS RD, P O BOX 1390	SCOTTSDALE, AZ 85252
12969	UNITRODE CORPORATION	580 PLEASANT STREET	WATERTOWN, MA 02172
14433	ITT SEMICONDUCTORS	3301 ELECTRONICS WAY	WEST PALM BEACH, FL 33402
14552	MICRO SEMICONDUCTOR CORP.	2830 E FAIRVIEW ST.	SANTA ANA, CA 92704
17856	SILICONIX, INC.	2201 LAURELWOOD DRIVE	SANTA CLARA, CA 95054
19701	ELECTRA-MIDLAND CORP., MEPCO ELECTRA INC.	P O BOX 760	MINERAL WELLS, TX 76067
24546	CORNING GLASS WORKS, ELECTRONIC COMPONENTS DIVISION	550 HIGH STREET	BRADFORD, PA 16701
31918	IEE/SCHADOW INC.	8081 WALLACE ROAD	EDEN PRAIRIE, MN 55343
32997	BOURNS, INC., TRIMPOT PRODUCTS DIV.	1200 COLUMBIA AVE.	RIVERSIDE, CA 92507
56289	SPRAGUE ELECTRIC CO.	87 MARSHALL ST.	NORTH ADAMS, MA 01247
57668	R-OMM CORP.	16931 MILLIKEN AVE.	IRVINE, CA 92713
58756	CTS OF ELKHART INC.	1142 W. BEARDSLEY AVE.	ELKHART, IN 46514
59660	TUSONIX INC.	2155 N FORBES BLVD	TUCSON, AZ 85705
59821	CENTRALAB INC	7158 MERCHANT AVE	EL PASO, TX 79915
71590	SUB NORTH AMERICAN PHILIPS CORP CENTRALAB ELECTRONICS, DIV. OF	P O BOX 858	FORT DODGE, IA 50501
73138	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.	2500 HARBOR BLVD.	FULLERTON, CA 92634
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
90201	MALLOY CAPACITOR CO., DIV. OF MALLOY AND CO., INC.	3029 E. WASHINGTON STREET	INDIANAPOLIS, IN 46206
91637	DALE ELECTRONICS, INC.	P. O. BOX 372	COLUMBUS, NE 68601
93774	OSHINO ELECTRIC LAMP WORKS LTD	5 2 MINAMI SHINAGAWA 2 CHORE	TOKYO, JAPAN

CKT No.	Tektronix Part No.	Serial/Model No.	Eff	Discont	Name & Description	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	285-0688-00				CAP.,FXD,PLSTC:0.022UF,5%,100V	56289	192P22352
C12	283-0003-00	B050000			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	D103Z40Z5UJDC EX
C16	290-0530-00				CAP.,FXD,ELCTL:68UF,20%,6V	90201	TD0686M006NLF
C26	281-0525-00				CAP.,FXD,CER DI:470PF,+/-94PF,500V	59660	301000X5U471M
C30	290-0215-00				CAP.,FXD,ELCTL:100UF,+75-10%,25V	56289	30D107G025DD9
C32	290-0480-00				CAP.,FXD,ELCTL:100UF,+75-10%,25V	56289	30D107G025DD9
C52	290-0480-00				CAP.,FXD,ELCTL:0.5UF,+50-10%,200V	80009	290-0480-00
C53	290-0480-00				CAP.,FXD,ELCTL:0.5UF,+50-10%,200V	80009	290-0480-00
C54	290-0528-00				CAP.,FXD,ELCTL:15UF,20%,50V	56289	196D156X0050PE4
C84	283-0003-00				CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	D103Z40Z5UJDC EX
C86	283-0092-00				CAP.,FXD,CER DI:0.03UF,+80-20%,200V	59660	845-534Z5U0303Z
C88	283-0092-00				CAP.,FXD,CER DI:0.03UF,+80-20%,200V	59660	845-534Z5U0303Z
C94	283-0023-00				CAP.,FXD,CER DI:0.1UF,+80-20%,12V	71590	2DDU66B104Z
C96	285-0683-00				CAP.,FXD,PLSTC:0.022UF,5%,100V	56289	192P22352
C108	281-0525-00				CAP.,FXD,CER DI:470PF,+/-94PF,500V	59660	301000X5U471M
C111	283-0092-00				CAP.,FXD,CER DI:0.03UF,+80-20%,200V	59660	845-534Z5U0303Z
C112	283-0003-00	B050000			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	D103Z40Z5UJDC EX
C113	281-0518-00				CAP.,FXD,CER DI:47PF,+/-9.4PF,500V	59660	301-000U2J0470M
C114	285-0703-00				CAP.,FXD,PLSTC:0.1UF,5%,100V	56289	192P10452
C179	283-0203-00				CAP.,FXD,CER DI:0.47UF,20%,50V	04222	5R3055E474MAA
C197	283-0203-00				CAP.,FXD,CER DI:0.47UF,20%,50V	04222	5R3055E474MAA
C212	283-0003-00	B050000			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	D103Z40Z5UJDC EX
C214	290-0522-00				CAP.,FXD,ELCTL:1UF,20%,50V	12954	D1R0G6S3A50M
C227	290-0530-00				CAP.,FXD,ELCTL:68UF,20%,6V	90201	TD0686M006NLF
C229	290-0530-00				CAP.,FXD,ELCTL:68UF,20%,6V	90201	TD0686M006NLF
C248	283-0003-00				CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	D103Z40Z5UJDC EX
C252	281-0525-00				CAP.,FXD,CER DI:470PF,+/-94PF,500V	59660	301000X5U471M
C266	283-0003-00				CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	D103Z40Z5UJDC EX
C274	283-0004-00				CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C275	290-0117-00				CAP.,FXD,ELCTL:50UF,+75-10%,50V	56289	30D506G050DD9
C279	283-0010-00				CAP.,FXD,CER DI:0.05UF,+100-20%,50V	56289	1C10Z5U503Z050B
C281	283-0010-00				CAP.,FXD,CER DI:0.05UF,+100-20%,50V	56289	1C10Z5U503Z050B
C284	283-0004-00				CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C285	290-0117-00				CAP.,FXD,ELCTL:50UF,+75-10%,50V	56289	30D506G050DD9
CR1	152-0141-02				SEMICONV DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR12	152-0141-02				SEMICONV DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR28	152-0141-02				SEMICONV DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR52	152-0488-00				SEMICONV DEVICE:SI,1CON,200V,1500MA	04713	SDA317
CR80	152-0141-02				SEMICONV DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR81	152-0141-02				SEMICONV DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR86	152-0141-02				SEMICONV DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR88	152-0141-02				SEMICONV DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR96	152-0141-02				SEMICONV DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR105	152-0141-02				SEMICONV DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR111	152-0141-02				SEMICONV DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR131	152-0141-02				SEMICONV DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR132	152-0141-02				SEMICONV DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR138	152-0141-02				SEMICONV DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR191	152-0246-00				SEMICONV DEVICE:SW,SI,40V,200MA	14433	WG1537TK
CR192	152-0246-00				SEMICONV DEVICE:SW,SI,40V,200MA	14433	WG1537TK

CKT No.	Telex/Model No.	Serial/Model No.	Eff	Discont	Name & Description	Mfr Code	Mfr Part Number
CR201	152-0141-02	SEMICONV DVC,D:SW,SI,30V,150MA,30V,DC-35				12969	NDP0263 (1N4152)
CR202	152-0141-02	SEMICONV DVC,D:SW,SI,30V,150MA,30V,DC-35				12969	NDP0263 (1N4152)
CR214	152-0107-00	SEMICONV DEVICE:SILICON,400V,400MA				12969	G27
CR224	152-0141-02	SEMICONV DVC,D:SW,SI,30V,150MA,30V,DC-35				12969	NDP0263 (1N4152)
DS150	150-0048-01	LAMP,INCAND:5V,0.06A,#683,AGED & SEL				S3774	OL683AS15 TPL
DS170	150-0048-01	LAMP,INCAND:5V,0.06A,#683,AGED & SEL				S3774	OL683AS15 TPL
DS228	150-0048-01	LAMP,INCAND:5V,0.06A,#683,AGED & SEL				S3774	OL683AS15 TPL
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				07263	S035928
Q22	151-0342-00	TRANSISTOR:SILICON,PNP				07263	S035928
Q24	151-0342-00	TRANSISTOR:SILICON,PNP				07263	S035928
Q26	151-0347-00	TRANSISTOR:SILICON,NPN				56289	T7916
Q28	151-0347-00	TRANSISTOR:SILICON,NPN				56289	T7916
Q30	151-0365-00	TRANSISTOR:SILICON,NPN				03508	X42C182
Q32	151-0364-00	TRANSISTOR:SILICON,PNP				80009	151-0364-00
Q70	151-054-00	TRANSISTOR:SILICON,FE,N-CHANNEL,DUAL				17856	DN1114
Q82	151-0341-00	TRANSISTOR:NPN,SI,TO-106				04713	SPS6919
Q84	151-0341-00	TRANSISTOR:NPN,SI,TO-106				04713	SPS6919
Q92	151-0341-00	TRANSISTOR:NPN,SI,TO-106				04713	SPS6919
Q104	151-0341-00	TRANSISTOR:NPN,SI,TO-106				04713	SPS6919
Q108	151-0342-00	TRANSISTOR:SILICON,PNP				07263	S035928
Q114	151-0302-00	TRANSISTOR:SILICON,NPN				07263	S038487
Q124	151-0342-00	TRANSISTOR:SILICON,PNP				07263	S035928
Q126	151-0302-00	TRANSISTOR:SILICON,NPN				07263	S038487
Q132	151-0254-00	TRANSISTOR:SILICON,NPN				03508	X38L3118
Q136	151-0254-00	TRANSISTOR:SILICON,NPN				03508	X38L3118
Q138	151-0341-00	TRANSISTOR:NPN,SI,TO-106				04713	SPS6919
Q142	151-0302-00	TRANSISTOR:SILICON,NPN				07263	S038487
Q144	151-0342-00	TRANSISTOR:SILICON,PNP				07263	S035928
Q146	151-0364-00	TRANSISTOR:SILICON,PNP				80009	151-0364-00
Q148	151-0365-00	TRANSISTOR:SILICON,NPN				03508	X42C182
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:SELECTED				04713	SPS8801
Q262	151-0192-00	TRANSISTOR:SELECTED				04713	SPS8801
Q274	151-0365-00	TRANSISTOR:SILICON,NPN				03508	X42C182
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				07263	S035928
R1	315-0303-00	RES.,FXD,CMPNSN:30K OHM,5%,0.25W				57668	NTR25J-E 30K
R2	315-0623-00	RES.,FXD,CMPNSN:62K OHM,5%,0.25W				57668	NTR25J-E 62K
R3	315-0912-00	RES.,FXD,CMPNSN:9.1K OHM,5%,0.25W				57668	NTR25J-E09K1
R6	315-0391-00	RES.,FXD,CMPNSN:390 OHM,5%,0.25W				57668	NTR25J-E390E
R7	315-0822-00	RES.,FXD,CMPNSN:8.2K OHM,5%,0.25W				57668	NTR25J-E 8K2
R8	315-0391-00	RES.,FXD,CMPNSN:390 OHM,5%,0.25W				57668	NTR25J-E390E
R9	315-0303-00	RES.,FXD,CMPNSN:30K OHM,5%,0.25W				57668	NTR25J-E 30K
R11	321-0481-00	RES.,FXD,FILM:1M OHM,1%,0.125W				91637	CMF55116G10003F
R12	315-0103-00	RES.,FXD,CMPNSN:10K OHM,5%,0.25W				57668	NTR25J-E10K0

Replaceable Electrical Parts—7CT1N

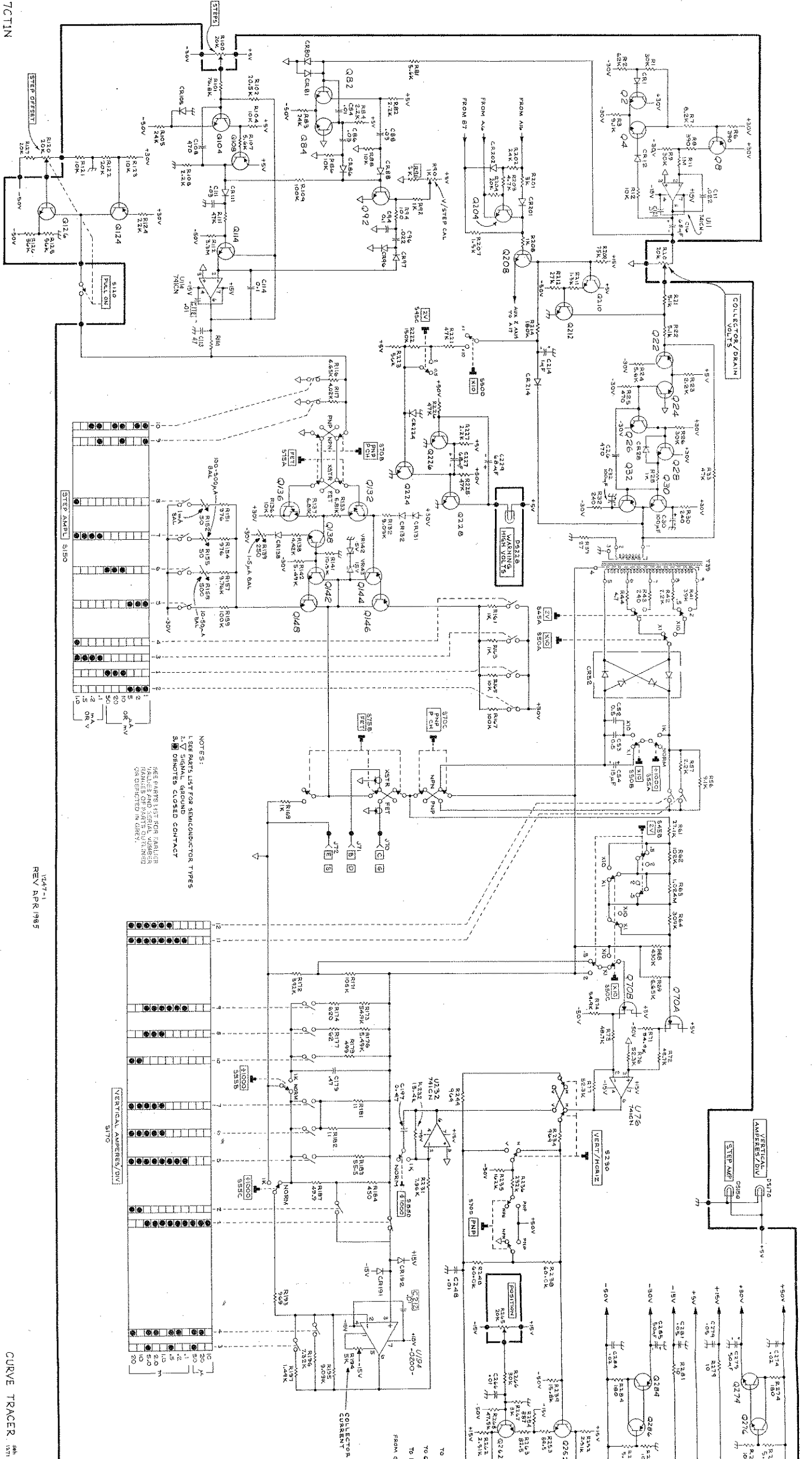
Mfr Part Number Mfr Code Name & Description Mfr Part Number

Ckt No.	Tektronix Part No.	Serial/Model No.	Eff	Discont	Name & Description	Mfr	Code	Mfr Part Number
R20	311-1220-00				RES.,VAR,NONWIR:20K OHM,30%,0.25W	58756	311-1220-00	MFF1816G48701F
R21	315-0512-00				RES.,FXD,CMPNS:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1	MFF1816G54901F
R22	315-0512-00				RES.,FXD,CMPNS:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1	MFF1816G54901F
R23	316-0222-00				RES.,FXD,CMPNS:2.2K OHM,10%,0.25W	01121	CB2221	MFF1816G48701F
R24	316-0562-00				RES.,FXD,CMPNS:5.6K OHM,10%,0.25W	01121	CB5621	MFF1816G52301F
R25	315-0471-00				RES.,FXD,CMPNS:470 OHM,5%,0.25W	57668	NTR25J-E470E	MFF1816G52301F
R26	315-0093-00				RES.,FXD,CMPNS:30K OHM,5%,0.25W	57668	NTR25J-E 30K	MFF1816G54901F
R28	316-0102-00				RES.,FXD,CMPNS:1K OHM,10%,0.25W	01121	CB1021	MFF1816G48701F
R30	315-0241-00				RES.,FXD,CMPNS:240 OHM,5%,0.25W	57668	NTR25J-E 240E	MFF1816G54901F
R32	315-0241-00				RES.,FXD,CMPNS:240 OHM,5%,0.25W	57668	NTR25J-E 240E	MFF1816G54901F
R33	316-0473-00				RES.,FXD,CMPNS:47K OHM,10%,0.25W	01121	CB4731	MFF1816G54901F
R39	316-0270-00				RES.,FXD,CMPNS:27 OHM,10%,0.25W	01121	CB2701	MFF1816G54901F
R41	301-0393-00				RES.,FXD,CMPNS:39K OHM,5%,0.5W	57668	TR50J-E 39K	MFF1816G54901F
R42	301-0222-00				RES.,FXD,CMPNS:2.2K OHM,5%,0.5W	01121	EB2225	MFF1816G54901F
R43	301-0241-00				RES.,FXD,CMPNS:240 OHM,5%,0.5W	01121	EB2415	MFF1816G54901F
R44	307-0023-00				RES.,FXD,CMPNS:4.7 OHM,10%,0.50W	01121	EB47G1	MFF1816G54901F
R56	315-0912-00				RES.,FXD,CMPNS:9.1K OHM,5%,0.25W	57668	NTR25J-E09K1	MFF1816G54901F
R57	316-0222-00				RES.,FXD,CMPNS:2.2K OHM,10%,0.25W	01121	CB2221	MFF1816G54901F
R61	321-1330-02				RES.,FXD,FILM:27.1K OHM,0.5%,0.125W	24546	NC55C2712D	MFF1816G54901F
R62	321-0386-00				RES.,FXD,FILM:102K OHM,1%,0.125W	91637	MFF1816G10202F	MFF1816G54901F
R63	322-0684-09				RES.,FXD,FILM:1.024M OHM,1%,0.25W	91637	CMF60-42C10243F	MFF1816G54901F
R64	321-0434-00				RES.,FXD,FILM:309K OHM,1%,0.125W	91637	MFF1816G30902F	MFF1816G54901F
R68	315-0434-00				RES.,FXD,CMPNS:430K OHM,5%,0.25W	57668	NTR25J-E430K	MFF1816G54901F
R69	321-0272-00				RES.,FXD,FILM:6.65K OHM,1%,0.125W	91637	MFF1816G66500F	MFF1816G54901F
R71	321-0360-00				RES.,FXD,FILM:54.9K OHM,1%,0.125W	91637	MFF1816G54901F	MFF1816G54901F
R72	321-0355-00				RES.,FXD,FILM:48.7K OHM,1%,0.125W	91637	MFF1816G48701F	MFF1816G54901F
R74	321-0360-00				RES.,FXD,FILM:54.9K OHM,1%,0.125W	91637	MFF1816G54901F	MFF1816G54901F
R75	321-0355-00				RES.,FXD,FILM:48.7K OHM,1%,0.125W	91637	MFF1816G48701F	MFF1816G54901F
R76	321-0358-00				RES.,FXD,FILM:52.3K OHM,1%,0.125W	91637	MFF1816G52301F	MFF1816G54901F
R77	321-0358-00				RES.,FXD,FILM:52.3K OHM,1%,0.125W	91637	MFF1816G52301F	MFF1816G54901F
R81	316-0562-00				RES.,FXD,CMPNS:5.6K OHM,10%,0.25W	01121	CB5621	MFF1816G76801F
R82	316-0222-00				RES.,FXD,CMPNS:2.2K OHM,10%,0.25W	01121	CB2221	MFF1816G76801F
R83	315-0243-00				RES.,FXD,CMPNS:24K OHM,5%,0.25W	57668	NTR25J-E24K0	MFF1816G76801F
R84	316-0222-00				RES.,FXD,CMPNS:2.2K OHM,10%,0.25W	01121	CB2221	MFF1816G76801F
R86	315-0103-00				RES.,FXD,CMPNS:10K OHM,5%,0.25W	57668	NTR25J-E10K0	MFF1816G76801F
R88	315-0103-00				RES.,FXD,CMPNS:10K OHM,5%,0.25W	57668	NTR25J-E10K0	MFF1816G76801F
R90	311-1154-00				RES.,VAR,NONWIR:TRMR,1K OHM,0.50W	73138	91DR1K-70A	MFF1816G76801F
R91	316-0332-00	B010100		B010199	RES.,FXD,CMPNS:3.3K OHM,10%,0.25W	01121	CB3321	MFF1816G76801F
R91	315-0202-00	B010200			RES.,FXD,CMPNS:2K OHM,5%,0.25W	01121	CB3321	MFF1816G76801F
R92	316-0102-00				RES.,FXD,CMPNS:1K OHM,10%,0.25W	01121	CB1021	MFF1816G76801F
R94	316-0101-00				RES.,FXD,CMPNS:100 OHM,10%,0.25W	01121	CB1011	MFF1816G76801F
R100	311-1220-00				RES.,VAR,NONWIR:20K OHM,30%,0.25W	58756	311-1220-00	MFF1816G76801F
R101	321-0374-00				RES.,FXD,FILM:76.8K OHM,1%,0.125W	91637	MFF1816G76801F	MFF1816G76801F
R102	321-0319-00				RES.,FXD,FILM:20.5K OHM,1%,0.125W	91637	MFF1816G20501F	MFF1816G76801F
R104	315-0103-00				RES.,FXD,CMPNS:10K OHM,5%,0.25W	57668	NTR25J-E10K0	MFF1816G76801F
R105	315-0243-00				RES.,FXD,CMPNS:24K OHM,5%,0.25W	57668	NTR25J-E24K0	MFF1816G76801F
R107	316-0562-00				RES.,FXD,CMPNS:5.6K OHM,10%,0.25W	01121	CB5621	MFF1816G76801F
R108	316-0222-00				RES.,FXD,CMPNS:2.2K OHM,10%,0.25W	01121	CB2221	MFF1816G76801F
R109	316-0104-00				RES.,FXD,CMPNS:100K OHM,10%,0.25W	01121	CB1041	MFF1816G76801F
R111	316-0473-00				RES.,FXD,CMPNS:47K OHM,10%,0.25W	01121	CB4731	MFF1816G76801F
R112	316-0335-00				RES.,FXD,CMPNS:3.3K OHM,10%,0.25W	01121	CB3351	MFF1816G76801F
R114	321-0289-00				RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F	MFF1816G76801F
R116	321-0272-00				RES.,FXD,FILM:6.65K OHM,1%,0.125W	91637	MFF1816G66500F	MFF1816G76801F
R117	321-0251-00				RES.,FXD,FILM:4.02K OHM,1%,0.125W,TC=TO	19701	5033ED4K020F	MFF1816G76801F

CKI No.	Tektronix Part No.	Serial/Model No.	Eff	Discont	Name & Description	Code	Mfr Part Number
R120	311-1310-00	RES.,VAR,NONWIR,20K OHM,20%,1W				01121	10M654
R121	315-0103-00	RES.,FXD,CMPNS:10K OHM,5%,0.25W				57668	NTR25J-E10K0
R122	315-0203-00	RES.,FXD,CMPNS:20K OHM,5%,0.25W				57668	NTR25J-E20K0
R123	315-0103-00	RES.,FXD,CMPNS:10K OHM,5%,0.25W				57668	NTR25J-E10K0
R124	315-0223-00	RES.,FXD,CMPNS:22K OHM,5%,0.25W				57668	NTR25J-E 22K
R125	315-0563-00	RES.,FXD,CMPNS:56K OHM,5%,0.25W				57668	NTR25J-E 56K
R126	315-0363-00	RES.,FXD,CMPNS:36K OHM,5%,0.25W				57668	NTR25J-E36K0
R127	315-0203-00	RES.,FXD,CMPNS:20K OHM,5%,0.25W				57668	NTR25J-E20K0
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,CMPNS:10K OHM,5%,0.25W				57668	NTR25J-E10K0
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,TRMR,250 OHM,0.5W				73138	72-5-0
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				24546	NA65D9760F
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				24546	NA65D9760F
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				24546	NA65 1001D
R163	323-0193-01	RES.,FXD,FILM:1K OHM,0.5%,0.50W				24546	NA65 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				19701	5043ED1K00F
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,CMPNS:620 OHM,5%,0.25W				57668	NTR25J-E620E
R176	321-0264-00	RES.,FXD,FILM:5.49K OHM,1%,0.125W				91637	MFF1816G54900F
R177	315-0620-00	RES.,FXD,CMPNS:62 OHM,5%,0.25W				57668	NTR25J-E 62E
R179	321-0164-00	RES.,FXD,FILM:499 OHM,1%,0.125W				91637	CMF55116G499R0F
R181	321-0005-00	RES.,FXD,FILM:11 OHM,1%,0.125W				75042	CEAT0-11R0F
R182	321-0750-06	RES.,FXD,FILM:55.5 OHM,0.25%,0.125W				91637	MFF1816C55R50C
R183	321-0749-06	RES.,FXD,FILM:450 OHM,0.25%,0.125W				91637	MFF1816C450R0C
R184	321-0749-06	RES.,FXD,FILM:450 OHM,0.25%,0.125W				91637	MFF1816C450R0C
R187	321-0068-03	RES.,FXD,FILM:49.9 OHM,0.25%,0.125W				24546	NC55C49R9C
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	91DR5K-69A
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	CMF55116G14000F
R201	315-0302-00	RES.,FXD,CMPNS:3K OHM,5%,0.25W				57668	NTR25J-E03K0
R202	315-0243-00	RES.,FXD,CMPNS:24K OHM,5%,0.25W				57668	NTR25J-E24K0
R203	315-0472-00	RES.,FXD,CMPNS:4.7K OHM,5%,0.25W				57668	NTR25J-E04K7
R204	315-0203-00	RES.,FXD,CMPNS:20K OHM,5%,0.25W				57668	NTR25J-E20K0
R207	315-0152-00	RES.,FXD,CMPNS:1.5K OHM,5%,0.25W				57668	NTR25J-E01K5
R208	316-0102-00	RES.,FXD,CMPNS:1K OHM,10%,0.25W				01121	CB1021
R209	315-0753-00	RES.,FXD,CMPNS:75K OHM,5%,0.25W				57668	NTR25J-E75K0
R211	315-0132-00	RES.,FXD,CMPNS:1.3K OHM,5%,0.25W				57668	NTR25J-E01K3

KT No. Tektronix Part No. Eff Serial/Model No. Discont Name & Description Mfr Code Mfr Part Number

R212	315-0273-00	RES.,FXD,CMPNSN:27K OHM,5%,0.25W	57668	NTR25J-E27K0	
R214	315-0184-00	RES.,FXD,CMPNSN:180K OHM,5%,0.25W	57668	NTR25J-E 180K	
R221	316-0473-00	RES.,FXD,CMPNSN:47K OHM,10%,0.25W	01121	CB4731	
R222	315-0154-00	RES.,FXD,CMPNSN:150K OHM,5%,0.25W	57668	NTR25J-E150K	
R223	315-0563-00	RES.,FXD,CMPNSN:56K OHM,5%,0.25W	57668	NTR25J-E 56K	
R226	316-0473-00	RES.,FXD,CMPNSN:47K OHM,10%,0.25W	01121	CB4731	
R227	316-0222-00	RES.,FXD,CMPNSN:2.2K OHM,10%,0.25W	01121	CB2221	
R228	316-0473-00	RES.,FXD,CMPNSN: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	
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	321-0720-01	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	91637	MFF1421G25100F	
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	CECT0-8870F	
R262	322-0603-00	RES.,FXD,FILM:2.51K OHM,1%,0.25W	91637	MFF1421G25100F	
R263	321-0089-00	RES.,FXD,FILM:82.5 OHM,1%,0.125W	91637	CMF55116G82R50F	
R265	311-1220-00	RES.,VAR,NONWIR:20K OHM,30%,0.25W	58756	311-1220-00	
R266	315-0303-00	RES.,FXD,CMPNSN:30K OHM,5%,0.25W	57668	NTR25J-E 30K	
R267	315-0302-00	RES.,FXD,CMPNSN:3K OHM,5%,0.25W	57668	NTR25J-E03K0	
R268	321-0354-00	RES.,FXD,FILM:47.5K OHM,1%,0.125W	91637	CMF55116G47501F	
R271	315-0510-00	RES.,FXD,CMPNSN:51 OHM,5%,0.25W	57668	NTR25J-E51E0	
R272	315-0510-00	RES.,FXD,CMPNSN:51 OHM,5%,0.25W	57668	NTR25J-E51E0	
R274	304-0181-00	RES.,FXD,CMPNSN: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,CMPNSN:10 OHM,5%,0.25W	57668	NTR25J-E 10E0	
R281	315-0100-00	RES.,FXD,CMPNSN:10 OHM,5%,0.25W	57668	NTR25J-E 10E0	
R282	315-0470-00	RES.,FXD,CMPNSN:47 OHM,5%,0.25W	57668	NTR25J-E47E0	
R284	304-0181-00	RES.,FXD,CMPNSN: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	260-1356-00	SWITCH,PUSH:6PDT,2 BUTTON,PUSH-PUSH	80009	260-1356-00	
S55	260-1209-00	SWITCH,PUSH:4PDT,1A,25VDC	31918	601347	
S70	260-1356-00	SWITCH,PUSH:6PDT,2 BUTTON,PUSH-PUSH	80009	260-1356-00	
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 SET WITH R120)	01121	10M654	
S120	-----				
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:4PDT,1A,25VDC	31918	601347	
T39	120-0756-00	XFMR,PWR,SDN&SU:COLLECTOR SWEEP	80009	120-0756-00	
U11	156-0067-00	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	04713	MC1741CP1	
U76	156-0067-00	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	04713	MC1741CP1	
U114	156-0067-00	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	04713	MC1741CP1	
U194	156-0200-00	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	04713	MC1456P1	
U232	156-0067-00	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	04713	MC1741CP1	
VR142	152-0243-00	SEMICOND DEVICE:ZENER,0.4W,15V,5%	14552	TD3810983	
VR143	152-0243-00	SEMICOND DEVICE:ZENER,0.4W,15V,5%	14552	TD3810983	



- NOTES:
1. SEE PARTS LIST FOR SEMICONDUCTOR TYPES
 2. ∇ SIGNAL GROUND
 3. \square DENOTES CLOSED CONTACT
- SEE PARTS LIST FOR EARLIER VARIANTS AND VARIANTS WHICH ARE IDENTIFIED IN WAVEY.

VERTICAL AMPERES/DIV

TO E
TO Q
TO R

5.1
R1
Q274
Q276
Q277

5.1
R1
Q274
Q276
Q277

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Q274
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Q274
Q276
Q277

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Q274
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Q277

5.1
R1
Q274
Q276
Q277

5.1
R1
Q274
Q276
Q277

5.1
R1
Q274
Q276
Q277

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, OR 97005
08261	SPECTRA-STRIP CORP.	7100 LAMPSON AVE.	GARDEN GROVE, CA 92642
09922	BURNBY CORPORATION	RICHARDS AVENUE	NORWALK, CT 06852
12327	FREEWAY CORPORATION	9301 ALLEN DRIVE	CLEVELAND, OH 44125
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
22599	ESNA, DIV. OF AMERACE CORPORATION	16150 STAGG STREET	VAN NUYS, CA 91409
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
74445	HOLO-KROME CO.	31 BROOK ST. WEST	HARTFORD, CT 06110
77900	SHAKEPROOF	SAINT CHARLES RD	ELGIN, IL 60120
78189	DIV OF ILLINOIS TOOL WORKS	ILLINOIS TOOL WORKS, INC.	ELGIN, IL 60120
79136	SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
79136	WALDES, KOHINOR, 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	P. O. BOX 1360	STATESVILLE, NC 28677
92101	SCHULZE MFG. 50 INGOLD RD		
93907	BURLINGAME, CA 94010		
93907	TEXTRON INC. CAMCAR DIV	600 18TH AVE	ROCKFORD, IL 61101
95987	WECKESSER CO., INC.	4444 WEST IRVING PARK RD.	CHICAGO, IL 60641
10435	LEWIS SCREW CO.	4114 SOUTH PERORIA AVE.	CHICAGO, IL 60609

Fig. & Index	Part No.	Serial/Model No.	Eff	Discont	Qty	1	2	3	4	5	Name & Description	Code	Mfr	Mfr Part Number
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1-1	337-1064-04	B010100		B053699	2						SHIELD,ELEC:SIDE PLUG-IN UNITS	80009	337-1064-00	337-1064-12
2	337-1064-12	B053700			2						SHIELD,ELEC:SIDE PLUG-IN UNIT	80009	337-1064-00	337-1064-12
-2	366-0494-00				1						KNOB:GRAY WITH SETSCREW	80009	366-0494-00	366-0494-00
-3	366-1376-00				1						KNOB:GY,0.252 ID X 1.125 X 0.6 H	80009	366-1376-00	366-1376-00
4	213-0153-00				2						SETSCREW:5.40 X 0.125,STL BK OXD,HEX	80009	366-1382-00	366-1382-00
-4	366-1382-00				1						KNOB:GY,0.128 ID X 0.5 OD X 0.2	80009	366-1382-00	366-1382-00
-5	366-1375-00				1						KNOB:GY,0.252 ID X 0.125 OD X 0	80009	366-1375-00	366-1375-00
-6	366-0494-00				2						SETSCREW:5.40 X 0.125,STL BK OXD,HEX	80009	366-0494-00	366-0494-00
-7	366-0494-00				1						KNOB:GRAY WITH SETSCREW	80009	366-0494-00	366-0494-00
-8	366-0494-02				1						SETSCREW:5.40 X 0.125,STL BK OXD,HEX	80009	366-0494-02	366-0494-02
-8	213-0153-00				1						KNOB:GY,STEP,0.127 ID X 0.5 OD X	80009	366-0494-02	366-0494-02
-9	366-1058-38				1						KNOB:GRAY	80009	366-1058-38	366-1058-38
-10	214-1095-00				1						PIN,SPG,SPLT:0.094 OD X 0.187 INCH LONG	22599	52-022-094-0187	52-022-094-0187
-11	105-0076-02	B010100		B053544	1						REL BAR,LATCH:PLUG-IN UNIT	80009	105-0076-02	105-0076-02
-12	214-1280-00				1						RELEASE BAR,LCH:PLUG-IN UNIT	80009	105-0076-04	105-0076-04
-13	214-1054-00				1						SPRING,FLAT:0.825 X 0.322,SST	80009	214-1054-00	214-1054-00
-14	105-0075-00				1						BOLT,LATCH:7A & 7B SER PL-IN	80009	105-0075-00	105-0075-00
-15	366-1257-95				1						PUSHBUTTON:SNL GY,VERT	80009	366-1257-95	366-1257-95
-16	366-1257-88				1						PUSHBUTTON:SNL GY,2V	80009	366-1257-88	366-1257-88
-17	366-1257-87				1						PUSHBUTTON:SNL GY,X 10	80009	366-1257-87	366-1257-87
-18	366-1257-76				1						PUSHBUTTON:SNL GY,PNP PCH	80009	366-1257-76	366-1257-76
-19	426-0681-00				5						FR,PUSH BUTTON:	80009	426-0681-00	426-0681-00
-20	195-0095-00				1						LEAD,TEST:BNC	80009	195-0095-00	195-0095-00
-22	348-0301-00				1						GROMMET,PLASTIC:GRAY,ROUND,0.312 ID	80009	348-0301-00	348-0301-00
-23	343-0144-00				1						CLAMP LOOP:0.125ID,NYLON	95987	1-8-2	1-8-2
-24	211-0121-00				1						SCR,ASSEM WSHR:4.40 X 0.438 INCH,PNH BRS	83385	ORD BY DESCR	A207799-G7
-25	129-0064-00				3						POST,BDG,ELEC:CHARCOAL,5-WAY MINIATURE	58474	ORD BY DESCR	B207516-G7/INSUL
-26	210-0457-00				1						NUT,PLASSEM WA:6-32 X 0.312,STL CD PL	83385	ORD BY DESCR	58474
-27	358-0181-00				1						INSULATOR,BSHG:CHARCOAL	80009	358-0029-00	358-0029-00
-28	358-0029-00				2						BSHG,MACH,THD:HEX,0.375-32 X 0.438,LONG	80009	358-0029-00	358-0029-00
-29	210-0590-00				1						NUT,PLAIN,HEX:0.375-32 X 0.438" BRS	73743	ORD BY DESCR	2X28269-402
-30	210-0978-00				1						WASHER,FLAT:0.375 ID X 0.50 INCH OD,STL	73743	ORD BY DESCR	12227
-31	210-0012-00				1						WASHER,LOCK:INTL,0.384 ID,INTL,0.022 TH	78189	ORD BY DESCR	1220-02-00-0541C
-32	-----				2						RESISTOR,VARIABLE:(SEE R20 & R265 REPL)	73743	ORD BY DESCR	2X20317-402
-33	210-0583-00				1						NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	ORD BY DESCR	2X20317-402
-34	210-0940-00				1						WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	ORD BY DESCR	2X20317-402
-35	-----				1						RESISTOR,VARIABLE:(SEE R120 REPL)	79807	ORD BY DESCR	2X20317-402
-36	210-0583-00				1						NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	ORD BY DESCR	2X20317-402
-37	210-0940-00				1						WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	ORD BY DESCR	2X20317-402
-38	333-1553-00				1						PANEL:FRONT	80009	333-1553-00	333-1553-00
-39	348-0235-00				2						SHLD GSKT,ELEC:4.734 INCH LONG	92101	ORD BY DESCR	200-0935-00
-40	200-0935-00				3						BASE,LAMPHOLDER:0.29 OD X 0.19 CASE	80009	200-0935-00	200-0935-00
-41	331-0262-00				2						DIFFUSER,LIGHT:INDICATOR LIGHTS	80009	331-0262-00	331-0262-00
-42	378-0635-00				2						LENS,LIGHT:WHITE	80009	378-0635-00	378-0635-00
-43	378-0602-02				1						LENS,LIGHT:RED	80009	378-0602-02	378-0602-02
-44	352-0157-01				1						LAMPHOLDER:BLACK PLASTIC	80009	352-0157-01	352-0157-01

Replaceable Mechanical Parts—7CT1N

Fig. & Index

No. Part No.

1-45 352-0157-00

1-46 386-1447-62

-47 213-0192-00

-48 384-1059-00

-49 384-1061-00

-50 384-0496-00

-51 376-0051-00

-52 384-1125-00

-53 103-0161-00

-54 386-1402-00

-55 213-0192-00

-56 388-2485-00

-57 131-0604-00

-58 136-0252-04

-59 136-0252-04

-60 214-0579-00

-61 214-0579-00

-62 361-0383-00

-63 361-0383-00

-64 361-0383-00

-65 361-0385-00

-66 361-0385-00

-67 376-0029-00

-68 213-0075-00

-69 211-0008-00

-70 210-0586-00

-71 210-0586-00

-72 200-1193-00

-73 211-0022-00

-74 210-0001-00

-75 210-0405-00

-76 354-0219-00

-77 401-0057-00

-78 214-1127-00

-79 214-1139-00

-80 401-0056-00

-81 105-0305-00

-82 210-0406-00

211-0116-00

211-0292-00

B010100 B052874

Eff Dscont Qty

1 2 3 4 5

Name & Description

Code Mfr

80009 352-0157-00

80009 386-1447-62

87308 213-0192-00

80009 213-0793-00

80009 384-1059-00

80009 384-1061-00

80009 384-0496-00

80009 376-0051-00

74445 384-1125-00

80009 384-1125-00

80009 103-0161-00

80009 386-1402-00

87308 213-0192-00

93907 213-0793-00

80009 388-2485-00

80009 131-0604-00

80009 136-0252-04

80009 136-0252-04

80009 214-0579-00

80009 214-0579-00

80009 361-0383-00

80009 361-0383-00

80009 361-0385-00

80009 376-0029-00

000BK 213-0075-00

83385 211-0008-00

12227 210-0586-00

10435 210-0586-00

80009 200-1193-00

83385 211-0022-00

77900 210-0001-00

LAMPHOLDER:WHITE PLASTIC

SUBPANEL:FRONT

SCR,TPG,THD FOR:6-32 X 0.50 INCH,PNH STL

SCR,TPG,THD FOR:6-32 X 0.4375,TAPITTE,FIL

EXTENSION SHAFT:6.58 INCH LONG

EXTENSION SHAFT:4.82 L X 0.123 OD EPOXY-GL

EXTENSION SHAFT:1.15 L X 0.125 OD AL

ADPTR PB TO COU:0.125 SQ TO 0.125 ID

PANEL:REAR

SCR,TPG,THD FOR:6-32 X 0.50 INCH,PNH STL

SCR,TPG,TF:6-32 X 0.4375,TAPITTE,FIL

CIRCUIT BOARD:INTERFACE

CKT BOARD ASSEMBLY:MAIN(SEE A1 REPL)

CONTACT,ELEC:CKT BD SW,SPR,CU BE

SKT,PLIN ELEC:TRANSISTOR 3 CONTACT,PCB M

SKT,PLIN ELEC:TRANSISTOR 3 CONTACT,PCB M

SKT,PLIN ELEC:TRANSISTOR 3 CONTACT,PCB M

SKT,PLIN ELEC:TRANSISTOR 3 CONTACT,PCB M

SKT,PLIN ELEC:TRANSISTOR 3 CONTACT,PCB M

SKT,PLIN ELEC:TRANSISTOR 3 CONTACT,PCB M

SKT,PLIN ELEC:TRANSISTOR 3 CONTACT,PCB M

SKT,PLIN ELEC:TRANSISTOR 3 CONTACT,PCB M

SKT,PLIN ELEC:TRANSISTOR 3 CONTACT,PCB M

SKT,PLIN ELEC:TRANSISTOR 3 CONTACT,PCB M

SKT,PLIN ELEC:TRANSISTOR 3 CONTACT,PCB M

SKT,PLIN ELEC:TRANSISTOR 3 CONTACT,PCB M

SKT,PLIN ELEC:TRANSISTOR 3 CONTACT,PCB M

SKT,PLIN ELEC:TRANSISTOR 3 CONTACT,PCB M

SKT,PLIN ELEC:TRANSISTOR 3 CONTACT,PCB M

SKT,PLIN ELEC:TRANSISTOR 3 CONTACT,PCB M

SKT,PLIN ELEC:TRANSISTOR 3 CONTACT,PCB M

SKT,PLIN ELEC:TRANSISTOR 3 CONTACT,PCB M

SKT,PLIN ELEC:TRANSISTOR 3 CONTACT,PCB M

SKT,PLIN ELEC:TRANSISTOR 3 CONTACT,PCB M

SKT,PLIN ELEC:TRANSISTOR 3 CONTACT,PCB M

Mfr Part Number

80009 352-0157-00

80009 386-1447-62

87308 213-0192-00

93907 213-0793-00

80009 384-1059-00

80009 384-1061-00

80009 384-0496-00

80009 376-0051-00

74445 384-1125-00

80009 384-1125-00

80009 103-0161-00

80009 386-1402-00

87308 213-0192-00

93907 213-0793-00

80009 388-2485-00

80009 131-0604-00

80009 136-0252-04

80009 136-0252-04

80009 214-0579-00

80009 214-0579-00

80009 361-0383-00

80009 361-0383-00

80009 361-0385-00

80009 376-0029-00

000BK 213-0075-00

83385 211-0008-00

12227 210-0586-00

10435 210-0586-00

80009 200-1193-00

83385 211-0022-00

77900 210-0001-00

78189 211-0292-00

83385 211-0116-00

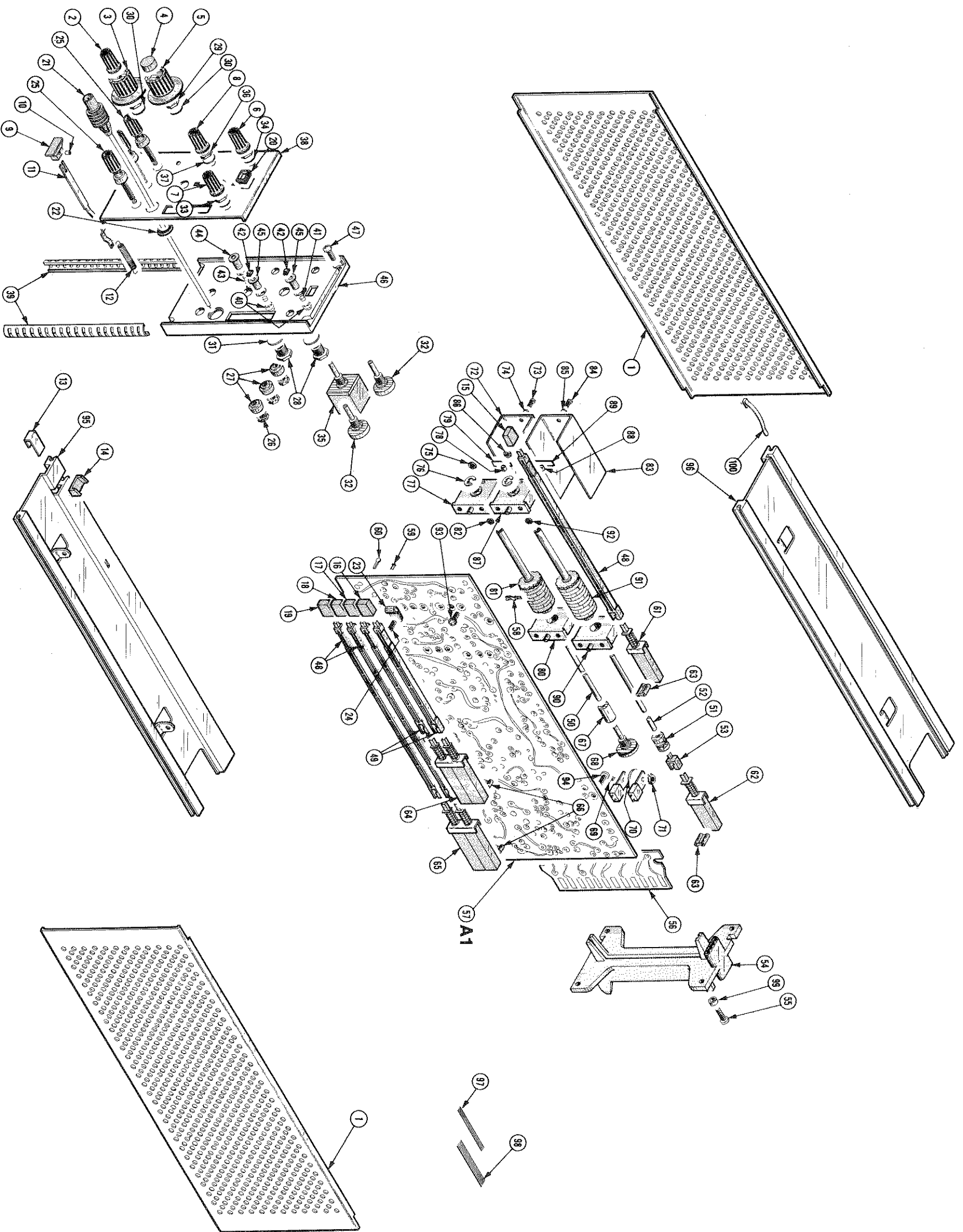
80009 210-0406-00

Replaceable Mechanical Parts—7CT1N

Fig. & Index	Tektronix	Part No.	Serial/Model No.	Discont	Qty	1	2	3	4	5	Name & Description	Mfr Code	Mfr Part Number
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1-		105-0307-00			1						ACTR ASSY,CAM S:	80009	105-0307-00
					1						COVER,CAM SW:12 ELEMENT,0.83 INCH DIA	80009	200-1010-01
					2						SCREW,MACHINE:2.56 X 0.188,PNH,STL,CD PL	83385	ORD BY DESCR
					2						WASHER,LOCK:#2 INTL,0.013 X 0.18 OD,STL	77900	1202-00-00-0541C
					2						NUT,PLAIN,HEX:2.56 X 0.188,BRS,CD PL	73743	12157-50
					1						RING,RETAINING:FOR 0.25 INCH SHAFT	79136	5103-25-MD-R
					1						BEARING,CAM SW:FRONT	80009	401-0057-00
					1						ROLLER,DETENT:0.125 DIA X 0.125,SST	80009	214-1127-00
					-						SPRING,FLAT:0.865 X 0.156 CU BE GLD CLR	80009	214-1139-00
					-						SPRING,FLAT:GREEN COLORED	80009	214-1139-02
					-						SPRING,FLAT:RED COLORED	80009	214-1139-03
					1						BEARING,CAM SW:REAR	80009	401-0056-00
					1						ACTUATOR,CAM SW:	80009	105-0306-00
					4						NUT,PLAIN,HEX:4.40 X 0.188,BRS,CD PL	73743	12161-50
					4						SCR,ASSEM WSHR:4.40 X 0.29,BRS NI PL	83385	ORD BY DESCR
			B052874	B052875	4						SCR,TPG,THD FOR:6-20 X 0.313 INCH,PNH STL	83385	ORD BY DESCR
					4						(ATTACHING PARTS).....		
					4						(END ATTACHING PARTS).....		
					4						FR SECT,PLUG-IN:BOTTOM	80009	426-0499-14
					1						FR SECT,PLUG-IN:TOP	80009	426-0505-14
					FT						WIRE,ELECTRICAL:3 WIRE RIBBON	80009	175-0826-00
					FT						WIRE,ELECTRICAL:5 WIRE RIBBON	80009	111-2699-955
					1						SPACER,SLEEVE:0.18 ID X 0.25 OD X 0.107L	80009	361-0326-00
					1						SPRING,GROUND:FLAT	80009	214-1061-00

FIG. 1 EXPLODED



7CT1N CURVE TRACER

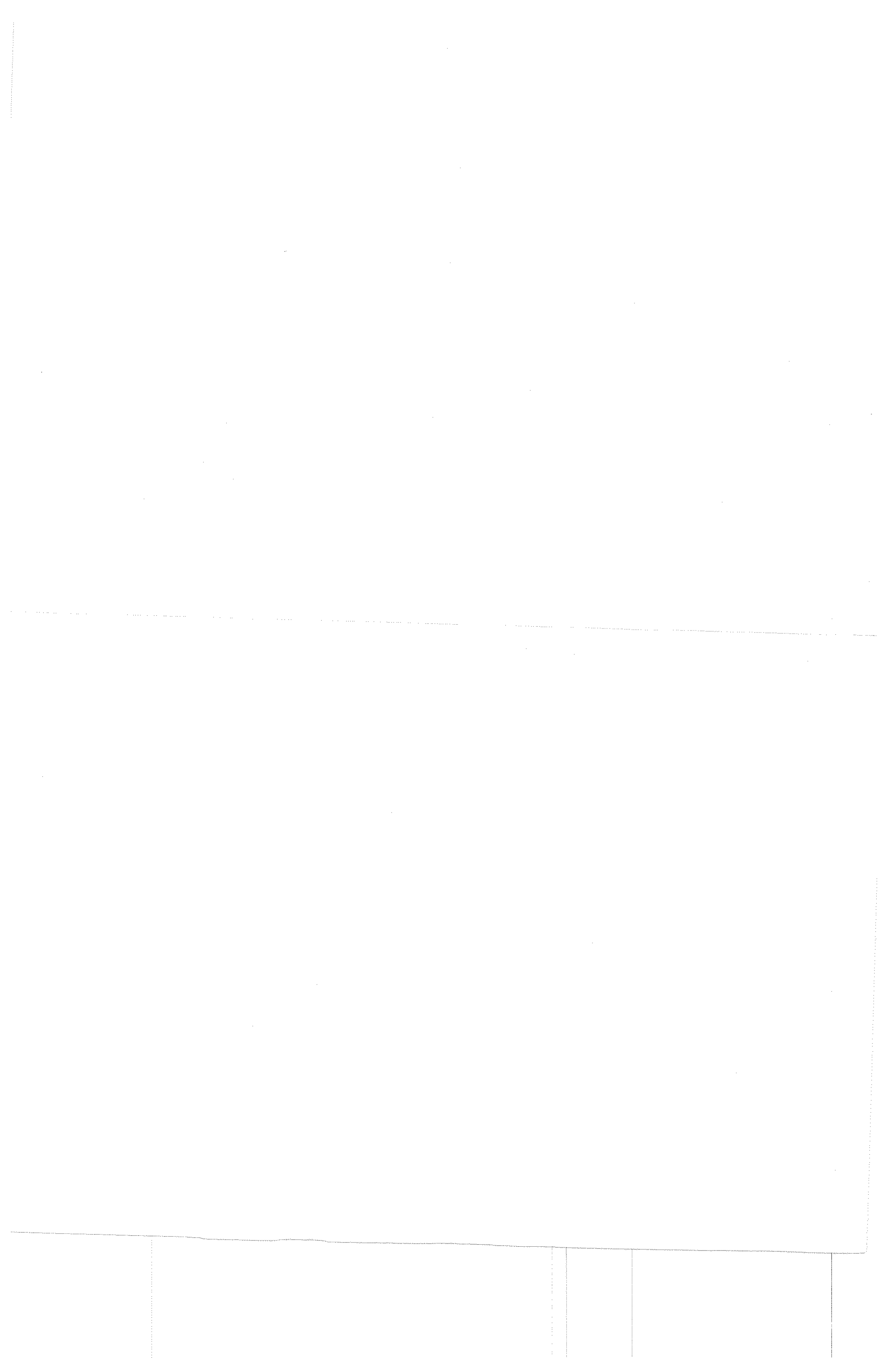
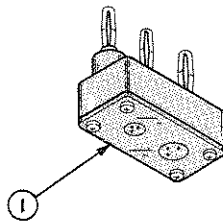


Fig. & Index No.	Tektronix Part No.	Serial/Model No.	Eff	Disc	Y	1	2	3	4	5	Description
2-1	013-0128-00										1 TEST ADAPTER, transistor
	070-1247-00										1 MANUAL, instruction (not shown)



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.

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Product: 7011N Curve Tracer

Date: 8/8/85

Change Reference: M57487

MANUAL CHANGE INFORMATION

Manual Part No.: 070-1247-00

DESCRIPTION Manual Insert for Product Group 42

These changes are effective at serial number B054175.

REPLACEABLE ELECTRICAL PARTS LIST CHANGES

CHANGE TO:

A1	670-1933-02	CKT BOARD ASSY:MAIN
C30	290-0817-00	CAP.,FXD,ELECTLT:100UF,+50-10%,63V
C32	290-0817-00	CAP.,FXD,ELECTLT:100UF,+50-10%,63V

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