Tektronix®

177 STANDARD TEST FIXTURE

SERVICE

INSTRUCTION MANUAL

Tektronix®
COMMITTED TO EXCELLENCE

WARNING

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.

PLEASE CHECK FOR CHANGE INFORMATION AT THE REAR OF THIS MANUAL.

177 STANDARD TEST FIXTURE

SERVICE

INSTRUCTION MANUAL

Tektronix, Inc.
P.O. Box 500
Beaverton, Oregon 97077

070-1472-00
Product Group 48

Serial Number ____________

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INSTRUMENT SERIAL NUMBERS

Each instrument has a serial number on a panel insert, tag, or stamped on the chassis. The first number or letter designates the country of manufacture. The last five digits of the serial number are assigned sequentially and are unique to each instrument. Those manufactured in the United States have six unique digits. The country of manufacture is identified as follows:

B000000	Tektronix, Inc., Beaverton, Oregon, USA
100000	Tektronix Guernsey, Ltd., Channel Islands
200000	Tektronix United Kingdom, Ltd., London
300000	Sony/Tektronix, Japan
700000	Tektronix Holland, NV, Heerenveen, The Netherlands

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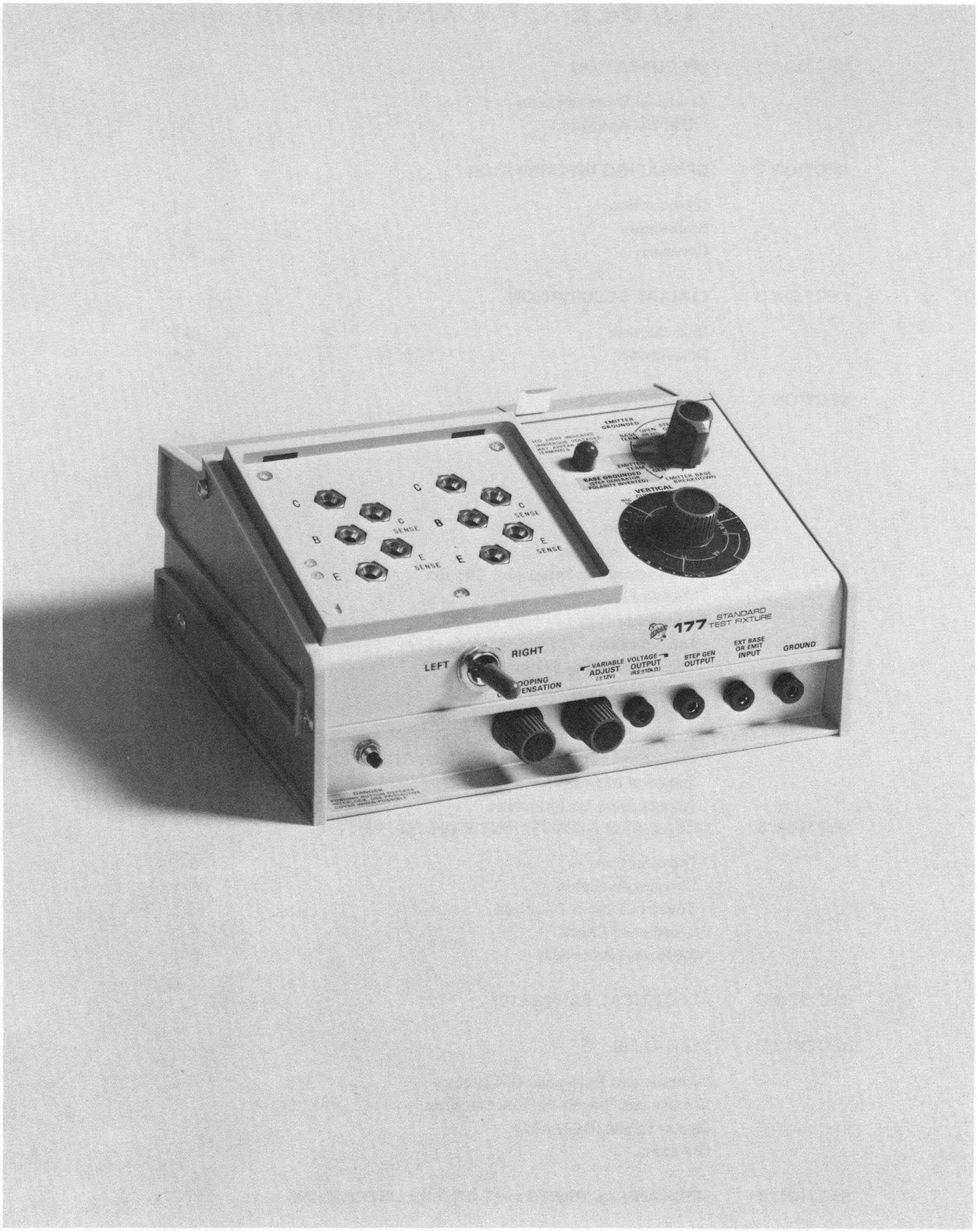


177 Standard Test Fixture.

SPECIFICATION

The 177 is a plug-in test fixture designed to operate with the 577-D1 or D2 Curve Tracer to form a system to measure the characteristics of a variety of two, three, and four terminal devices.

The 177 features:

Two switch-selected sets of test jacks, permitting comparison tests.

Kelvin sensing to provide accurate measurements at high current levels.

A terminal selector switch that permits easy selection of the various test configurations.

Vertical deflection factors ranging from 0.2 nA/DIV to 2 A/DIV.

External front-panel jacks permitting access to the 577 step generator output and device-under-test base (B) and emitter (E) terminals.

A variable −12, 0, +12 volt DC output and a looping compensation control.

The 100 V, 400 V, and 1600 V collector ranges are normally interlocked and are energized by closing the protective box cover or by pushing the interlock defeat button.

Only those voltages that are not interlocked are available for Emitter-Base Leakage or Breakdown tests.

The electrical and environmental characteristics shown are valid for instruments operated in an ambient temperature range from +10°C (+50°F) to +40°C (104°F) after a five-minute warmup, if calibrated at +20°C (+68°F) to +30°C (+86°F).

ELECTRICAL CHARACTERISTICS

Display Amplifier

Accuracy (percent of highest on-screen value)

Vertical Collector Current: Total system accuracy of the 577-177-D1 or D2 is 3%, unmagnified, and 4%, magnified.

Deflection Factor, Vertical

Collector Current: 2 nA/DIV to 2 A/DIV in a 1-2-5 sequence, unmagnified, and 0.2 nA/DIV to 200 mA/DIV, magnified.

OPERATING INFORMATION

Introduction

The 177 Test Fixture operates with a Tektronix 577 Curve Tracer and the D1 or D2 Display Unit as a system.

This section of the manual gives a brief functional description of the front-panel controls of the 177. See the 577-177-D1 or D2 Operators Manual for a complete operating procedure.

Preliminary

For initial preparation, refer to the Operating Instructions section of the 577-177-D1 or D2 Operators Manual. The Operators Manual contains operating instructions, as well as general and specific application information.

Controls

This is a brief description of the functions of the front-panel controls. More detailed information is given in the Operators Manual.

EMITTER GROUNDED MODE (Emitter terminal is grounded; Base terminal is switched as follows):

BASE TERM

STEP GEN

Applies step generator output to the base connections of the test fixture.

OPEN (OR EXT)

Disconnects the base terminal from the step generator output and connects base terminal to the front-panel EXT BASE OR EMIT INPUT Connector.

SHORT

Disconnects the base terminal from the step generator output and grounds the base terminal.

BASE GROUNDED MODE (Base terminal is grounded, step generator polarity is inverted, and the emitter terminal is switched as follows):

EMITTER TERM

OPEN (OR EXT)

Disconnects the emitter terminal from the step generator output and connects the emitter terminal to the front-panel EXT BASE OR EMIT INPUT Connector.

STEP GEN

Applies step generator output to the emitter terminal.

EMITTER-BASE BREAKDOWN

Grounds the base terminal and applies the collector sweep voltage to the emitter terminal. Only the collector-voltage ranges that are not interlocked are available.

STEP GEN OUTPUT Connector

Provides external access to the step generator output.

EXT BASE OR EMIT IN Connector

Provides external access to the base or emitter terminals, depending on the position of the Terminal Selector switch.

GROUND

Provides for external ground connection.

LEFT-RIGHT Switch

Three position toggle switch for applying test signals to either the left or right set of terminal connectors. The center position disconnects all terminals except the emitter terminals. The emitter terminals are always connected together and are connected to either ground, to the step generator, or to the collector sweep depending on the position of the Terminal Selector switch.

Test Adapter Terminal Jacks

Two sets of five recessed jacks accepting various adapters for testing various semiconductor devices.

CIRCUIT DESCRIPTION

Introduction

This section of the manual contains a description of the circuitry in the 177 Standard Test Fixture. Complete schematic diagrams, with component numbers and parts values, are shown on the pullout pages at the rear of this manual.

Description

The Standard Test Fixture contains the vertical preamplifier (variable gain) that measures voltage across a current-sensing resistor.

The entire vertical preamplifier, including its power supply, floats with respect to ground. See Fig. 3-1.

The vertical preamplifier consists of two FET source followers, Q604A and B; a non-inverting feedback amplifier, U616, and an inverting feedback amplifier, U624-Q626-Q628, which provides the 1-2-5 current per division switching. The inverting amplifier output connects to the 577 vertical amplifier.

Current sensing resistors, R630 through R636, are connected between the collector supply and the device under test.

Q604A and B (source followers) are connected across the current-sensing resistors, and the source-follower outputs are fed differentially to U616, the X10 amplifier.

R612 is the input resistor for U616; R616 and R615 (Gain Adj) make up the feedback resistor. The gain is set for slightly more than 10, to compensate for the FET source-follower losses.

C632, LOOPING COMPENSATION (front-panel control), compensates for stray capacitance at Q604B gate and the test adapter, as well as some of the device-under-test capacitance.

C630 and R660 through R665 (ganged with the current-sensing resistors, R630 through R636), compensate for the stray capacitance across the current sensing resistors, keeping the time constant similar to the time constant of the stray capacitance and R630 through R636.

U616 output is connected to a 10:1 divider, R618-R619. This divider output is connected to the horizontal attenuator in the low-current ranges of the VERTICAL CURRENT/DIV switch (2 nA/DIV to 2 mA/DIV). This voltage to the horizontal attenuator is the same as the voltage on the collector of the device under test. This method permits monitoring the collector voltage without drawing current through the current-sensing resistor.

On the high-current ranges (5 mA/DIV to 2 A/DIV) the horizontal attenuator is connected directly to the collector sense terminal of the device under test to permit Kelvin sensing. If Kelvin sensing is not used, the 22 Ω resistor between C and C SENSE terminals connects the horizontal attenuator to the C terminals.

U616 output is connected to the inverting amplifier, U624-Q626-Q628. The input resistance is R621 and the feedback resistance is composed of three resistors, R627 (gain of 5), R627 and R628 in parallel (gain of 2.5), and R627 in parallel with R629 (gain of 1).

The inverting amplifier, U624-Q626-Q628, is connected to pin 21 of J110, to the vertical amplifier via pin 4 of P129. Q626-Q628 provide low-output impedance to prevent signal loading by the chopper circuit.

All power is supplied by the floating Ø+15 and Ø—15-volt supplies. Ø (test fixture common) is connected to the junction of the collector supply and the current sensing resistors.

When using the 177 Test Fixture in the 577, the highest ranges of the MAX PEAK VOLTS switch (100 V, 400 V, and 1600 V) are not enabled unless the protective cover is placed over the test adapter or the interlock defeat button is depressed. When the cover is closed, S626 is closed and permits these three ranges to be enabled.

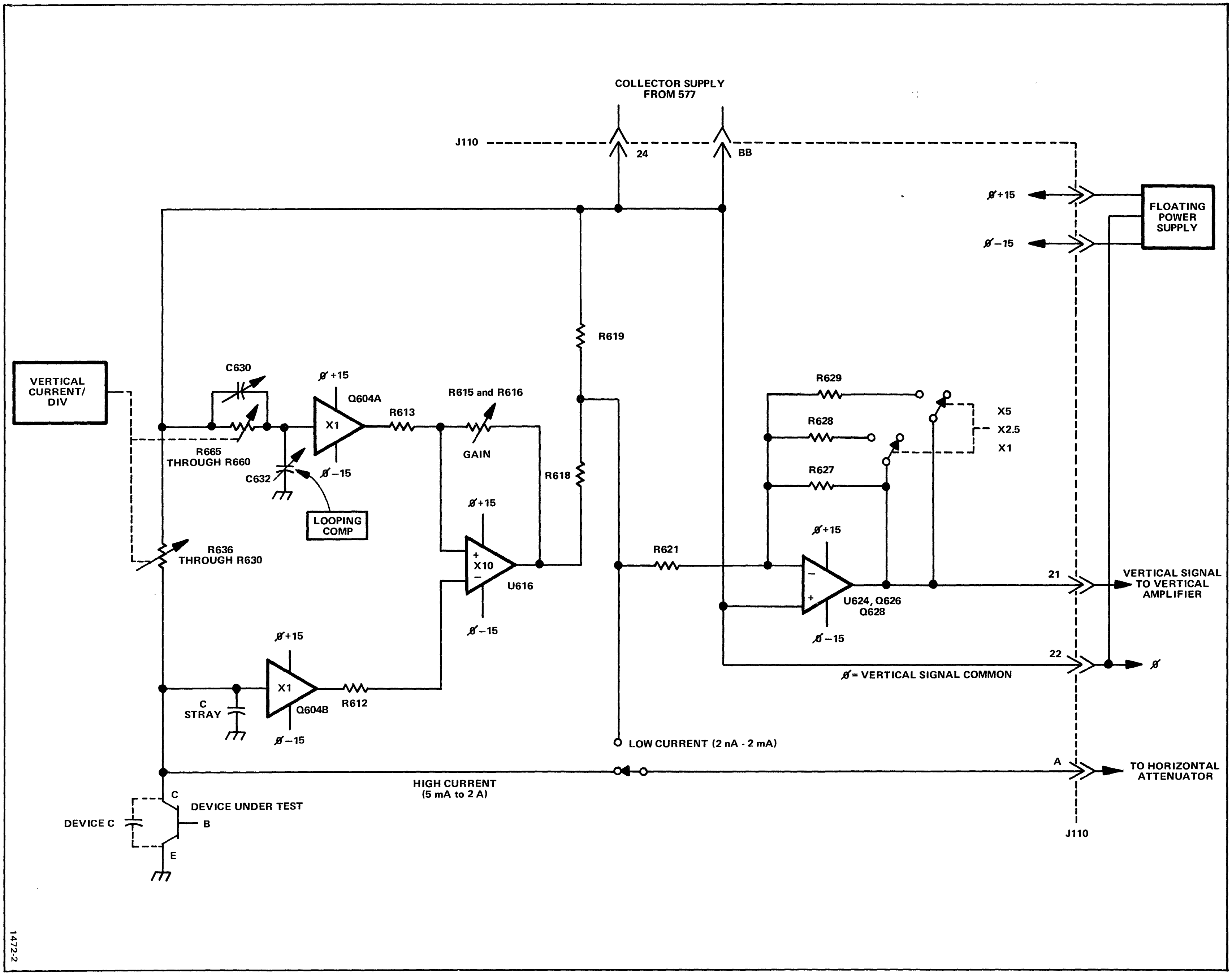


Fig. 3-1. Vertical Preamplifier.

S628, the safety-interlock defeat switch (red button on the 177 front panel) may be pressed to defeat the safety interlock.

The 100 V and 400 V supplies may be enabled without using the protective cover or the defeat switch by a wiring option in the 177 (see Fig. 3-2 for details).

WARNING

This modification is not recommended. The 100 V supply can be lethal and the 400 V supply is very likely lethal. If this modification is made a WARNING note should be permanently attached to the 177.

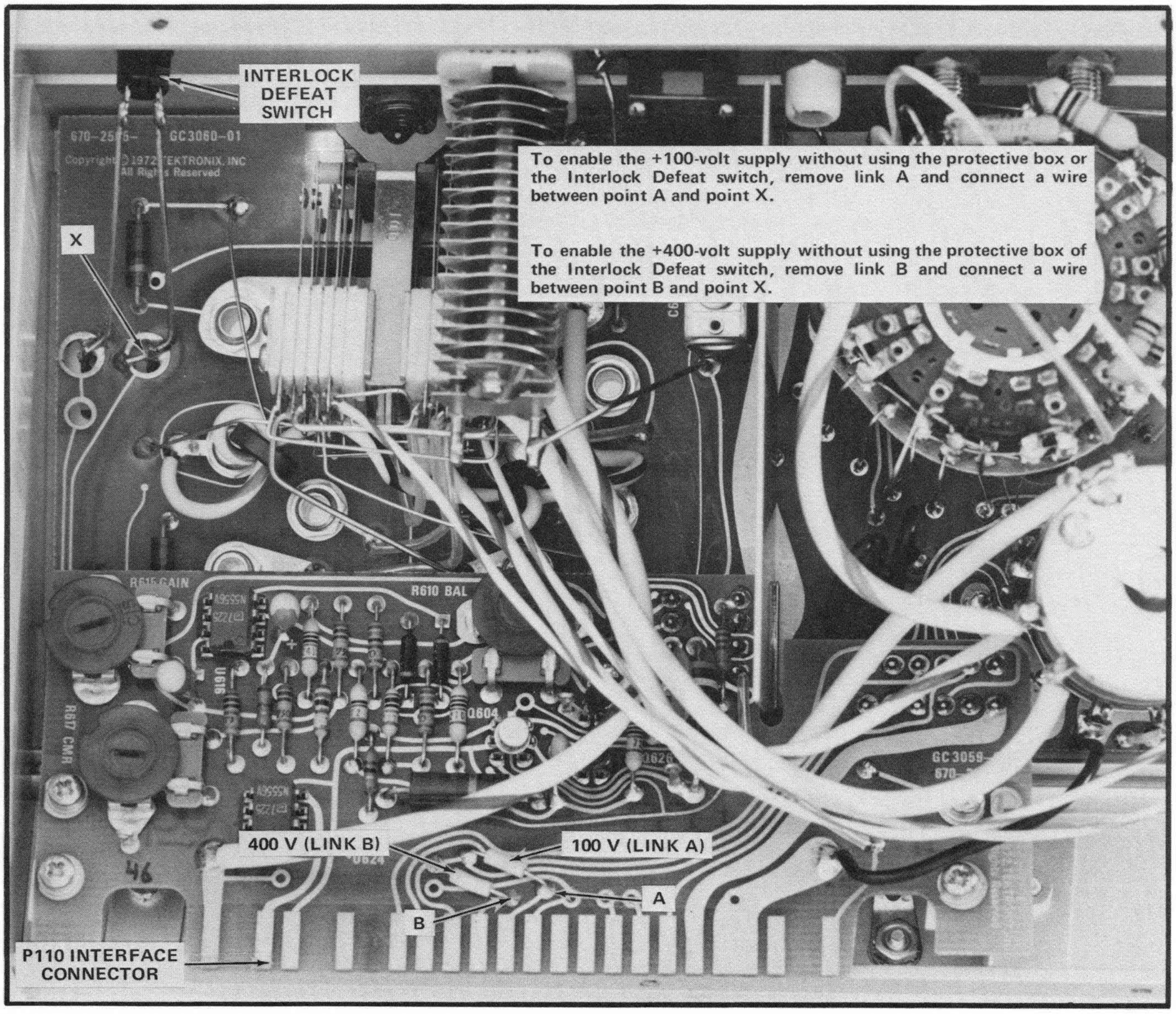


Fig. 3-2. 100 V and 400 V Interlock Defeat bypass option.

MAINTENANCE

Introduction

This section of the manual contains information for use in preventive and corrective maintenance, with some aids to troubleshooting.

PREVENTIVE MAINTENANCE

General

Preventive maintenance consists of cleaning, visual inspection, lubrication, etc. Preventive maintenance performed on a regular basis improves instrument reliability. The severity of the environment in which the instrument is used determines the frequency of maintenance.

Cleaning

The 177 Test Fixture should be cleaned as often as operating conditions require. Accumulation of dirt in the instrument can cause leakage currents and component breakdown, especially in a humid atmosphere.

Exterior. Loose dust accumulated on the outside of the instrument can be removed with a soft cloth or a small paint brush. The paint brush is particularly useful for dislodging loose dust on and around the front-panel controls. Dirt that remains can be removed with a soft cloth dampened in a mild detergent and water solution. Abrasive cleaners should be avoided.

Interior. Dust in the interior of the instrument should be removed occasionally to prevent electrical conduction in high-humidity environments. Blow out accumulated dust using dry, low-velocity air. Remove any remaining dirt with a mild detergent and water solution. A cotton-tipped applicator is useful for cleaning circuit boards.

CAUTION

Avoid the use of chemical cleaning agents that might damage the plastics used in the instrument. Do not use chemicals that contain benzene, toluene, xylene, acetone, or similar solvents.

Lubrication

The reliability of potentiometers, rotary switches, and other moving parts can be maintained if they are kept properly lubricated. Use a cleaning-type lubricant on rotary switch contacts. Lubricate switch detents with heavier grease (such as Tektronix Part No. 006-0219-00).

NOTE

Shaft bushings and potentiometers that are not sealed should be lubricated with a lubricant (such as Tektronix Part No. 006-2574-00) that will not affect the electrical characteristics. Do not over-lubricate. A lubrication kit (Tektronix Part No. 003-0342-01) is available.

Visual Inspection

The 177 Test Fixture should be inspected occasionally for such defects as broken connections, loose pin connections, improperly seated transistors, damaged circuit boards and heat damaged parts.

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

NOTE

Connecting the device under test to the test fixture in a manner that causes current flow in the Kelvin sensing resistors can burn out these resistors. See Fig. 4-1 and the Kelvin Sensing Check in the Troubleshooting section.

The current sensing resistors (R630 through R636) can be damaged if the vertical current over-range disabling circuit in the 577 is not functioning properly. Check the over-range circuit after replacement of a current-sense resistor.

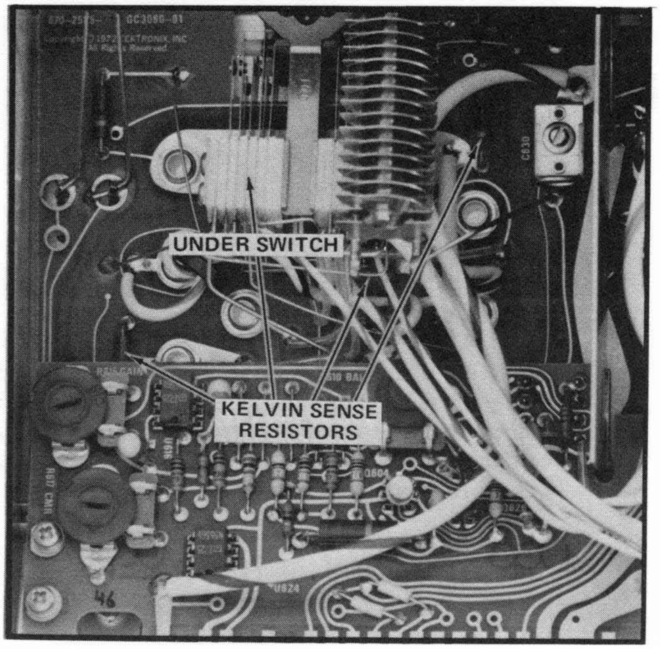


Fig. 4-1. Location of Kelvin sense resistors.

Transistors and Integrated Circuits

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

Recalibration

To ensure accurate measurements, check the instrument calibration after each 1000 hours (approximately) of operation, or if the instrument is used infrequently, every year. Replacement of components may necessitate recalibration of the affected circuits. Complete calibration instructions are given in the Performance Check/ Adjustment section. The Performance Check/Adjustment procedure can also be helpful in locating troubles.

TROUBLESHOOTING

Introduction

The following information is provided to facilitate troubleshooting the 177. Information contained in other sections of this manual should be used with the following information to aid in locating circuit defects (see the Operating and Circuit Description sections).

Troubleshooting Equipment

The following equipment is useful for troubleshooting the 177:

1. Semiconductor Tester. Some means of testing the transistors, diodes, and FETs used in the instrument is helpful. A curve tracer, such as the Tektronix 575, 576, or 577 gives the most complete information.

2. DC Voltmeter and Ohmmeter. A voltmeter for checking circuit voltages and an ohmmeter for checking resistances and diodes are required. For most applications a 20,000 ohms/volt VOM can be used if allowances are made for circuit loading when measuring voltage at high impedance points.

3. Test Oscilloscope. An oscilloscope with a DC to 10 MHz frequency response and 10 mV/Div to 10 V/Div vertical deflection factor is suggested. A 10X probe should be used to reduce circuit loading.

Troubleshooting Aids

Diagrams. Circuit diagrams are given on foldout pages in the Diagrams section. The component number and electrical value of each component are shown. See the first page of the Diagrams section for definition of the symbols used to identify components.

Switch Wafer Identification. Rotary switch wafers shown on the diagrams are coded to indicate the position of each wafer in the switch assembly. The number portion of the code is the wafer number counting from the mounting end of the switch. The letters F and R indicate whether the front or rear of the wafer performs the switching function. For example, a wafer designated 2R indicates the rear of the second wafer.

Circuit Description. The Circuit Description, Section 3, describes each circuit. The section contains a brief description of the theory of circuit operation illustrated by a block diagram of each section of circuitry. Following the Block Diagram description is a detailed description of each circuit that contains unique or complex circuitry.

Transistor and Integrated Circuit Lead Configuration. The lead configurations of the transistors and ICs in the 177 Test Fixture are shown with the circuit board photos on the schematic diagram foldout aprons.

Voltages and Waveforms. Important voltages and waveforms are shown in blue on the diagrams. Portions of the circuits mounted on circuit boards are enclosed by blue lines or boxes.

Capacitor Identification. Capacitor values of disc capacitors are marked on the capacitor body and electrolytic capacitor values are either marked on the capacitor body or are color coded (see Fig. 4-2).

Diode Color Code. The cathode end of each glass-enclosed diode is indicated by a stripe, a series of stripes, or a dot. For diodes using a series of stripes, the color code identifies either the Tektronix part number or the JEDEC number. This code follows the standard color code except that a pink first band indicates a Tektronix part number, i.e., pink—brown—gray—green indicates Tektronix Part Number 152-0185-00.

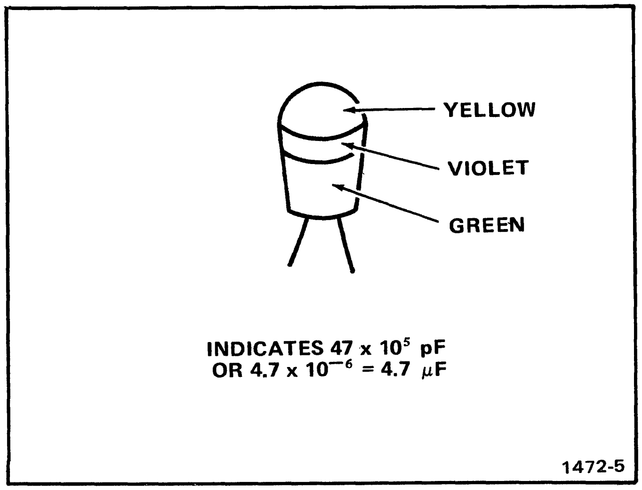


Fig. 4-2. Example of Electrolytic capacitor color code.

Circuit Boards. A photograph of each circuit board, with circuit components identified, is included on the apron of the schematic diagram relating most directly to the circuit board. Some board photos may be placed on the back of the preceding circuit diagram. Each circuit board photo is sectioned by a grid system to facilitate rapid location of components by component number.

COMPONENT REMOVAL AND REPLACEMENT

Removal of the VERTICAL CURRENT/DIV Switch

1. Remove the right-end (viewed from the front) panel of the 177.

Remove the bottom-cover screws (including one from the left-end panel). Note the two types of screws used, to facilitate re-assembly. Machine screws hold the bottom cover and self-threading screws hold the end panels. See Fig. 4-3 for location of screws.

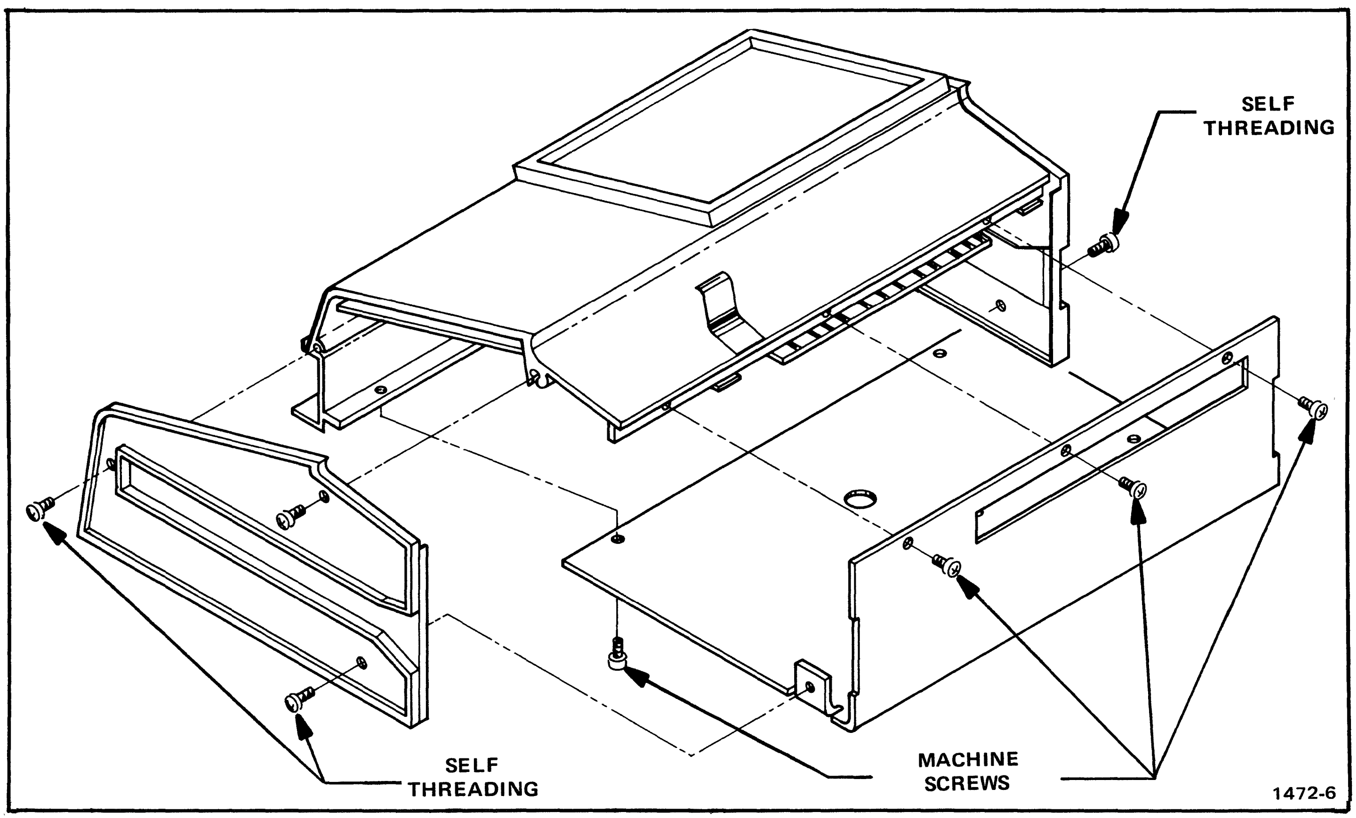


Fig. 4-3. Location of cover screws.

2. Turn the CURRENT/DIV switch to expose one of the two hex socket-head set screws (A in the diagram, Fig. 4-4). Loosen the set screw and turn the CURRENT/DIV knob to make the other set screw accessible.

Note the position of the knob skirt. Loosen the set screw and remove the knob and insulating bushing assembly through the front panel.

WARNING

Do not replace the insulating bushing with an un-insulated bushing, as the switch shaft is elevated to as high as 1900 volts. Since many of the components, including entire switch assemblies, are elevated, replace components and parts with the correct parts.

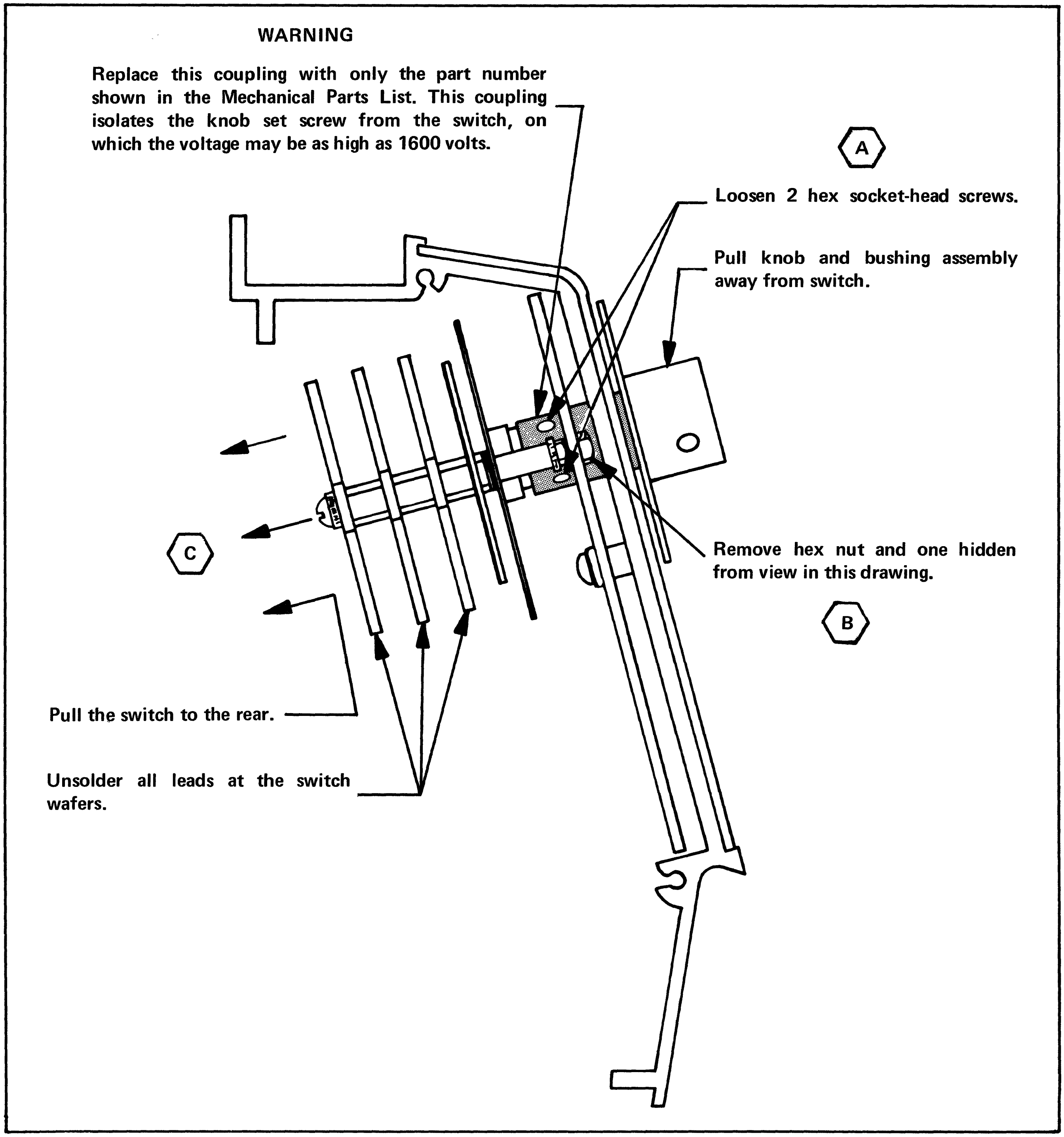


Fig. 4-4. Removal of VERTICAL CURRENT/DIV Switch.

Using a 12-point box-end wrench, or open-end wrench, loosen the two hex nuts (B in the diagram) that hold the switch to the circuit board (hold the screw head, C, while removing the hex nuts).

Refer to Fig. 4-5 (drawing of the leads that must be removed) to faciliate switch replacement.

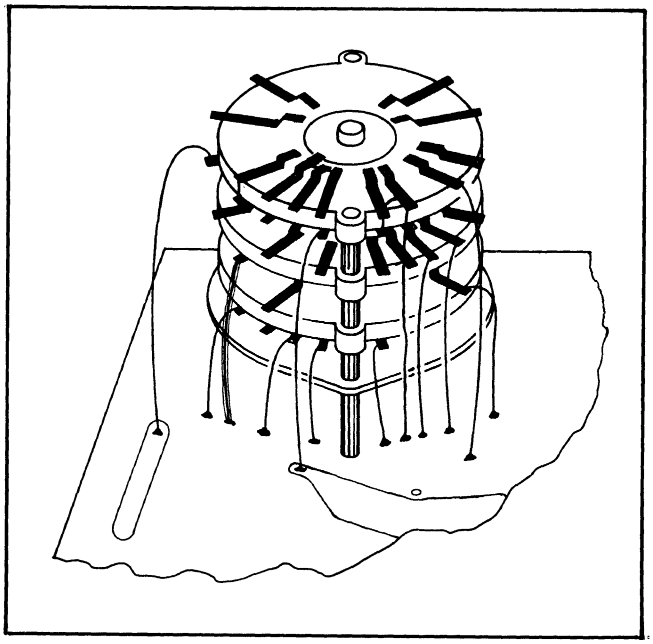


Fig. 4-5. Location of leads that must be removed to remove and replace the VERTICAL CURRENT/DIV switch.

Unsolder the leads and pull the switch away from the circuit board.

Replacement of the VERTICAL CURRENT/DIV Switch

Place the switch mounting screws into the circuit board mounting holes and place the lock washer and hex nut on the more accessible switch-assembly screw. Partially tighten the next nut.

Attach a piece of tape having adhesive on both sides, to a flat object (stick, screwdriver blade, etc.). Attach the nut to the tape and place the nut over the screw. With a screwdriver, turn the screw clockwise just far enough to start the nut on the screw. If the screw cannot be turned, loosen the nut on the opposite side of the board enough to allow the screw to turn.

Tighten the nut with a wrench while holding the screw-head.

Complete tightening both nuts, making sure that both nuts on the opposite side of the board are tight.

Resolder all leads into their respective switch terminals.

Removal of Indicator Lamps

Knob Sirt Lamps. Remove the right end from the 177 as shown in Fig. 4-3.

These lamp assemblies (gray plastic) snap into the plastic sleeve. To remove the lamp assembly, grasp the assembly with needle-nose pliers and pull the assembly away from the sleeve.

Unsolder the leads and remove the lamp assembly.

Red Dangerous Voltage Lamp. This lamp assembly is mounted in a rubber grommet and may be removed by pushing the assembly out through the front panel (push from the rear while pulling from the front).

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. Include 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.

CHECK AND ADJUSTMENT PROCEDURE

Introduction

This section of the manual contains separate check and adjustment procedures. The Check procedure is provided to check the instrument operation against the instrument specifications. The Adjustment procedure returns the circuitry to within the design capabilities.

Adjustment is generally required after a repair has been made, or after a long time interval in which normal aging of components may affect instrument accuracy.

For initial inspection, using the check procedure, leave the instrument side covers in place.

Services Available

Tektronix, Inc., provides complete instrument repair and calibration service at local field service centers and field offices. Contact your local Tektronix Field Office or representative for further information.

Test Equipment Required

The following test equipment, or equivalent, is required for calibration of the 177 Standard Test Fixture. All test equipment is assumed to be correctly calibrated and operating within the listed specifications.

1. Digital Voltmeter (4-1/2 digits) or a DC voltage bridge. Accuracy, 0.01%; voltage range, ±5 volts; input impedance, 500 MΩ. See footnote 1, Table 5-1.

2. Capacitor. Capacitance, 0.01 μF; working voltage, 1000; tolerance, ±20%.

3. Shunt resistors. Range 1 Ω to 10 MΩ. See the table. These resistors are available from Tektronix, Inc., as a kit (Tektronix Part Number 067-0691-00). Two 200 Ω, 1% resistors are included in this kit.

4. Extender Cable, (to permit making adjustment to the 177 without removing the 577 bottom panel) Tektronix Part Number 067-0721-00.

Resistance	Watts	Accuracy
1 Ω	10	1/4%
10 Ω	5	
100 Ω	1/2	
1 kΩ	1/4	
10 kΩ	1/4	
100 kΩ	1/8	
1 MΩ	1/8	
10 MΩ	1/8	

PERFORMANCE CHECK

Set the controls as follows:

577-D1 or D2

MAX PEAK VOLTS	6.5
SERIES RESISTORS	.12
COLLECTOR SUPPLY POLARITY	+DC
VARIABLE COLLECTOR %	0
HORIZ VOLTS/DIV	200 V, COLLECTOR
NUMBER OF STEPS	counterclockwise

All Dark Gray Buttons and Knobs in, except:

STEP FAMILY	SINGLE
X10 VERT MAG	out
Horizontal POSITION	Centered
Vertical POSITION	Centered

177

VERTICAL CURRENT/DIV	.2 A
Terminal Selector	EMITTER GROUNDED, BASE TERM, STEP GEN
LEFT-RIGHT	Off

1. Check Vertical Preamplifier Balance

a. Vertically and horizontally position the spot to graticule center.

b. Switch the VERTICAL CURRENT/DIV switch throughout its range.

c. CHECK—There should be not more than 0.5 major division of vertical movement while switching the VERTICAL CURRENT/DIV through its range. *(It may first be necessary to adjust R610 as in Step 1 of 177 adjustment procedure.)*

2. Check Vertical Preamplifier Common-Mode Rejection

a. Set the controls as follows:

VERTICAL CURRENT/DIV	10 nA
COLLECTOR SUPPLY POLARITY	AC
Vertical POSITION	centered
Horizontal POSITION	centered
LEFT-RIGHT	Off

b. Connect a patch cord between the 177 GROUND terminal (front panel) and TP630. To reach TP630, remove the plug in the bottom panel of the 177. TP630 is a 1/4-inch ring terminal at one end of C630. A hook tip, such as the E-Z HOOK TIP 1, provides a convenient means of connection to TP630.

c. Connect a patch cord between the 177 C and E terminals, right side.

d. Switch the LEFT-RIGHT switch to RIGHT.

e. Reset the VARIABLE COLLECTOR % to 100.

f. CHECK—Vertical deflection should be less than four major divisions.

g. Return the VARIABLE COLLECTOR % to 0. Switch the LEFT-RIGHT switch to Off.

h. Disconnect the ground lead from TP630. Leave the patch cord between C and E terminals.

WARNING

Replace the plug in the bottom panel of the 177 to avoid contact with potentially lethal voltage.

3. Check Vertical Current Per Division

a. Push X10 VERT MAG in. Reset the VERTICAL CURRENT/DIV to 2A, switch LEFT-RIGHT to RIGHT, turn VARIABLE COLLECTOR % to 100, and wait for the COLLECTOR SUPPLY CIRCUIT BREAKER to open.

b. Remove the C to E patch cord.

c. Reset the controls as follows:

STEP/OFFSET AMPL	.1V/Step
OFFSET MULT	0.000
STEP FAMILY SINGLE	press
OFFSET ZERO	out
OFFSET AID	in
VERTICAL CURRENT/DIV	2 nA
LEFT-RIGHT	Off

d. Connect the DVM between E and B on the right-side set of terminals. Connect a 10 MΩ, 1/4%, resistor (as shown in Table 5-1, second column) between the 177 B and C terminals, right side.

e. Switch the LEFT-RIGHT switch to RIGHT. Note the DVM reading.

f. Vertically position the spot to the eighth graticule line.

NOTE

The DISPLAY FILTER NORM button may have to be in the out position to reduce the display noise at high sensitivities.

g. With the OFFSET MULT, position the spot to the bottom graticule line.

h. CHECK—The difference in DVM reading, relative to the DVM reading is step e, should be within the limits shown in Table 5-1, columns 3 and 4.

i. Switch the VERTICAL CURRENT/DIV and STEP/OFFSET AMPL to the next settings in the table.

j. Press the OFFSET ZERO button in and note the DVM reading.

k. Position the spot to the eighth graticule line.

l. Release the OFFSET ZERO button. With the OFFSET MUTL, position the spot to the bottom graticule line.

m. CHECK—The difference in the DVM reading should be within the limits shown in Table 5-1.

n. Repeat the above procedure for each of the VERTICAL CURRENT/DIV steps, using the value of resistance specified in the table.

TABLE 5-1

VERTICAL CURRENT/ DIV	STEP/ OFFSET AMPL	Resistor (1/4%) C-B	Difference in DVM Reading B-E	Within ±3%, ±1 nA
2 nA	.1 V	10 MΩ	0.3200 V	0.0296 V
5 nA	.2 V		0.8000 V	0.0400 V
10 nA	.5 V		0.8800 V	0.0375 V
20 nA	1 V		1.760 V	0.0638 V
50 nA	2 V		4.400 V	0.1430 V

o. Switch the LEFT-RIGHT switch to Off.

p. Reconnect the DVM between B and C (or C SENSE).

q. Proceed as in steps 3 e through 3 h, using Table 5-2.

r. Switch the LEFT-RIGHT switch to Off.

s. Disconnect the DVM and resistor.

[1]If a DVM having an input impedance of 500 MΩ or less is used, use the formula:

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

where V_2 is the meter reading, V_1 is the reading in Table 5-2, R_m is the meter input impedance, and R_s is the current sensing resistor in the table. Do not use a DVM having an input impedance less than 100 MΩ.

[2]Magnification occurs only in the 577. These measurements check the .5A, 1A, and 2A ranges in the 177.

TABLE 5-2

VERTICAL CURRENT/ DIV	STEP/ OFFSET AMPL	Resistor (1/4%) C-B	Difference in DVM Reading C-B	Within ±3%, ±1 nA
.1 µA	.1 µA	1 MΩ[1]	0.800 V	0.024 V
.2 µA	.2 µA		1.600 V	0.048 V
.5 µA	.5 µA		4.000 V	0.120 V
1 µA	1 µA	100 kΩ[1]	0.800 V	0.024 V
2 µA	2 µA		1.600 V	0.048 V
5 µA	5 µA		4.000 V	0.120 V
10 µA	10 µA	10 kΩ	0.800 V	0.024 V
20 µA	20 µA		1.600 V	0.048 V
50 µA	50 µA		4.000 V	0.120 V
.1 mA	.1 mA	1 kΩ	0.800 V	0.024 V
.2 mA	.2 mA		1.600 V	0.048 V
.5 mA	.5 mA		4.000 V	0.120 V
1 mA	1 mA	100 Ω	0.800 V	0.024 V
2 mA	2 mA		1.600 V	0.048 V
5 mA	5 mA		4.000 V	0.120 V
10 mA	10 mA	10 Ω	0.800 V	0.024 V
20 mA	20 mA		1.600 V	0.048 V
50 mA	50 mA		4.000 V	0.120 V
.1 A	.1 A	1Ω[3]	0.800 V	0.024 V
.2 A	.2 A		1.600 V	0.048 V

Pull the X10 VERT MAG and proceed as in the previous steps.

				±4%
50 mA[2]	50 mA	10 Ω	4.000 V	0.160 V
.1 A	.1 A	1 Ω[3]	0.800 V	0.032 V
.2 A	.2 A	1 Ω[3]	1.600 V	0.064 V

t. Push to reset the COLLECTOR SUPPLY CIRCUIT BREAKER.

u. If DISPLAY FILTER was used, push NORM button in.

4. Check Kelvin Sensing

a. Set the controls as follows:

MAX PEAK VOLTS	25
SERIES RESISTORS	1.9
X10 HORIZ MAG	pull
HORIZ VOLTS/DIV	5 mV, COLLECTOR
Vertical POSITION	centered
X10 VERT MAG	in
VERTICAL CURRENT/DIV	1 A
LEFT-RIGHT	Off

[3]Measure near the body of low value resistors to reduce the effects of lead and contact resistance.

b. Place an 013-0111-00 Diode Adapter in the 177 terminals, right side. Place a short, clean, piece of 14 gauge solid copper wire (preferrably tinned) in the adapter.

c. Switch the LEFT-RIGHT switch to RIGHT.

d. Increase the VARIABLE COLLECTOR % control to display eight divisions of vertical deflection.

e. Horizontally position the bottom of the trace to graticule center line.

f. CHECK—The top of the display should be displaced horizontally, in either direction, not more than 15 mV (three major divisions) from the graticule center line. See Fig. 5-1 for an example of a typical display.

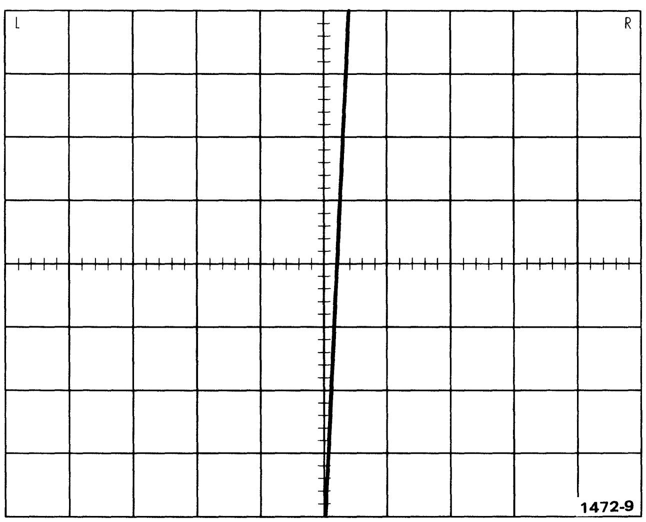


Fig. 5-1. Typical display for Kelvin sensing check.

g. If the above requirement is not met, the cause may be damaged Kelvin sensing resistors. See Maintenance section NOTE under Visual Inspection heading and Fig. 4-1.

5. Check Error Due to CMRR and Gain Misadjustment

a. Set the controls as follows:

VARIABLE COLLECTOR %	0
MAX PEAK VOLTS	6.5
SERIES RESISTORS	120
Horizontal POSITION	centered
VERTICAL CURRENT/DIV	.5 mA

b. Increase VARIABLE COLLECTOR % to produce an eight-division vertical display.

c. Horizontally position the bottom of the trace to graticule center.

d. CHECK—The top of the display should be displaced from graticule center not more than ±7 mV (1.4 divisions). If this requirement cannot be met, the cause could be incorrect adjustment of Vertical GAIN and CMRR controls.

ADJUSTMENT PROCEDURE

Initial Control Settings

MAX PEAK VOLTS	6.5
SERIES RESISTORS	.12
VARIABLE COLLECTOR %	0
HORIZ VOLTS/DIV	200 V, COLLECTOR
Horizontal POSITION	centered
X10 HORIZ MAG	in
Vertical POSITION	centered
X10 VERT MAG	in
VERTICAL CURRENT/DIV	.1 A
LEFT-RIGHT	Off

1. ADJUST Vertical Preamplifier Balance

a. Place the curve tracer on its right side.

b. ADJUST—R610, Atten Bal, for no vertical spot movement while switching the VERTICAL CURRENT/DIV from .1 A/DIV through 50 nA/DIV (adjust R610 through the access hole in the bottom cover, shown in Fig. 5-2).

2. Adjust Vertical Preamplifier Gain

a. Reset the controls as follows:

MAX PEAK VOLTS	400
SERIES RESISTORS	8 M
COLLECTOR SUPPLY POLARITY	+
STEP/OFFSET AMPL	.05 VOLTS/Steps
STEP FAMILY SINGLE	press
STEP/OFFSET POLARITY NORM	in
OFFSET ZERO	out
OFFSET AID	in
VERTICAL CURRENT/DIV	50 nA
LEFT-RIGHT	Off

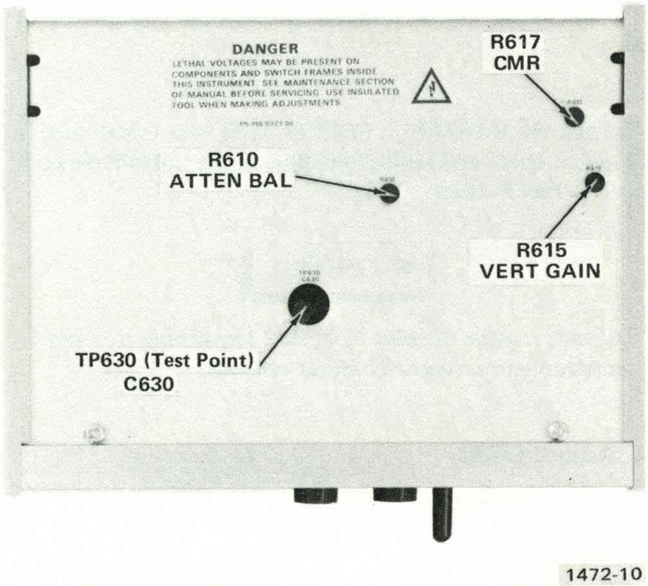


Fig. 5-2. Location of controls, 177 bottom panel.

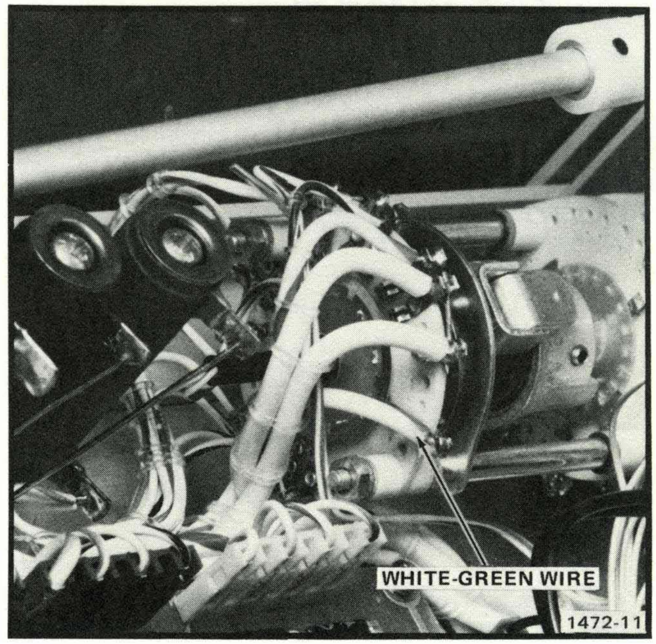


Fig. 5-3. Location of white-green wire on MAX PEAK VOLTS switch.

WARNING

Lethal voltages may be present on the MAX PEAK VOLTS switch and Collector Sweep circuit board in the 577 any time the VARIABLE COLLECTOR % control is not at 0. Lethal voltages may be present in the 177 only when the MAX PEAK VOLTS switch is in the 100 V, 400 V, or 1600 V positions, with the Interlock Defeat button pressed in.

b. Connect the GROUND terminal on the 177 front panel to the white-green wire on the rear wafer on the MAX PEAK VOLTS switch (See Fig. 5-3). Connect the DVM between the B terminal and the white-green wire on the MAX PEAK VOLTS switch.

c. Patch the B terminal to the C terminal, right side. Set the LEFT-RIGHT switch to RIGHT.

d. Set the OFFSET MULT to produce a DVM reading of +0.400 volt, ±0.4 mV.

e. Move the DVM lead from B terminal to terminal 4 of connector P129 (see Fig. 5-4) on the Collector Supply board (measure the voltage between the white-green wire on the MAX PEAK VOLTS switch and P129-4).

f. ADJUST—R615, Vert gain, through the bottom cover, for a DVM reading of 4.000 volts, ±20 mV.

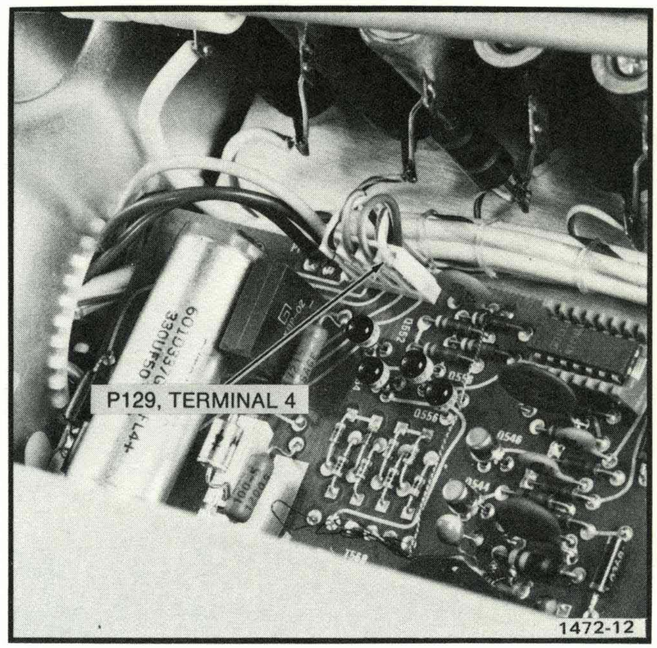


Fig. 5-4. Location of P129, Terminal 4.

g. Remove the DVM and the patch cord from GROUND to the white-green wire.

h. Remove the patch cord from C to B.

3. Adjust Common-Mode Rejection

a. Set the controls as follows:

MAX PEAK VOLTS	6.5
SERIES RESISTORS	.12
VARIABLE COL-LECTOR %	100
COLLECTOR SUPPLY POLARITY	AC
X10 VERT MAG	pulled
VERTICAL CUR-RENT/DIV	10 nA
LEFT-RIGHT	Off

b. Place a patch cord from the front-panel GROUND to C terminal, right side.

c. Connect a cord from front-panel GROUND to TP630. To reach TP630, remove the plug in the bottom cover of the 177. TP630 is a 1/4-inch ring terminal at one end of C630. A hook tip, such as the E-Z HOOK TIP 1, provides a convenient means of connection to TP630.

d. Switch LEFT-RIGHT to RIGHT.

e. ADJUST—R617, CMR, through the 177 bottom panel for minimum vertical deflection.

f. INTERACTION—If R617 is adjusted, repeat steps 1 and 2.

g. Set the VARIABLE COLLECTOR % to 0 and remove the patch cords and replace the plug in the bottom panel of the 177 Test Fixture.

WARNING

Always replace the plug in TP630 access hole to avoid contact with potentially lethal voltages.

4. Adjust C630

a. Set the controls as follows:

X10 HORIZ MAG	pull
HORIZ VOLTS/DIV	5 mV, COLLECTOR
VERTICAL CUR-RENT/DIV	2 nA
LEFT-RIGHT	Off

b. ADJUST—C630 for no trace tilt with the loop closed (keep the loop closed with the LOOPING COMPENSATION control while adjusting C630). Be sure that the TRACE ROTATION control is set properly. If in doubt, switch the VERTICAL CURRENT/DIV to 2 A and determine whether the trace is parallel to the horizontal graticule lines.

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
ASSY	ASSEMBLY
CAP	CAPACITOR
CER	CERAMIC
CKT	CIRCUIT
COMP	COMPOSITION
CONN	CONNECTOR
ELCTLT	ELECTROLYTIC
ELEC	ELECTRICAL
INCAND	INCANDESCENT
LED	LIGHT EMITTING DIODE
NONWIR	NON WIREWOUND
PLSTC	PLASTIC
QTZ	QUARTZ
RECP	RECEPTACLE
RES	RESISTOR
RF	RADIO FREQUENCY
SEL	SELECTED
SEMICOND	SEMICONDUCTOR
SENS	SENSITIVE
VAR	VARIABLE
WW	WIREWOUND
XFMR	TRANSFORMER
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
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P O BOX 5012, 13500 N CENTRAL EXPRESSWAY	DALLAS, TX 75222
03508	GENERAL ELECTRIC COMPANY, SEMI-CONDUCTOR PRODUCTS DEPARTMENT	ELECTRONICS PARK	SYRACUSE, NY 13201
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD,PO BOX 20923	PHOENIX, AZ 85036
08806	GENERAL ELECTRIC CO., MINIATURE LAMP PRODUCTS DEPARTMENT	NELA PARK	CLEVELAND, OH 44112
24546	CORNING GLASS WORKS, ELECTRONIC COMPONENTS DIVISION	550 HIGH STREET	BRADFORD, PA 16701
32997	BOURNS, INC., TRIMPOT PRODUCTS DIV.	1200 COLUMBIA AVE.	RIVERSIDE, CA 92507
52769	SPRAGUE GOODMAN ELEC., INC.	134 FULTON AVENUE	GARDEN CITY PARK, NY 11040
55292	LEDCO DIV., WILBRECHT ELECTRONICS, INC.	240 EAST PLATO BLVD.	ST. PAUL, MN 55107
56289	SPRAGUE ELECTRIC CO.	87 MARSHALL ST.	NORTH ADAMS, MA 01247
71313	CARDWELL CONDENSER CORP.	80 E. MONTAUK HIGHWAY	LINDENHURST, NY 11757
71450	CTS CORP.	905 N. WEST BLVD	ELKHART, IN 46514
72136	ELECTRO MOTIVE CORPORATION, SUB OF INTERNATIONAL ELECTRONICS CORPORATION	LAUTER AVE, P O BOX 7600	FLORENCE, SC 29501
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
76854	OAK INDUSTRIES, INC., SWITCH DIV.	S. MAIN ST.	CRYSTAL LAKE, IL 60014
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
81073	GRAYHILL, INC.	561 HILLGROVE AVE., PO BOX 373	LA GRANGE, IL 60525
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NE 68601

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1	670-2504-00	B010100	B030599	CKT BOARD ASSY:PREAMPLIFIER	80009	670-2504-00
A1	670-2504-01	B030600		CKT BOARD ASSY:PREAMPLIFIER	80009	670-2504-01
A2	670-2505-00			CKT BOARD ASSY:INTERFACE	80009	670-2505-00
C600	283-0128-00			CAP.,FXD,CER DI:100PF,5%,500V	72982	871-536T2H101J
C601	290-0525-00			CAP.,FXD,ELCTLT:4.7UF,20%,50V	56289	196D475X0050KA1
C602	290-0525-00			CAP.,FXD,ELCTLT:4.7UF,20%,50V	56289	196D475X0050KA1
C629	283-0087-00			CAP.,FXD,CER DI:300PF,10%,1000V	56289	403637
C630	281-0162-00	B010100	B054649	CAP.,VAR,MICA D:8-60PF,500V	72136	T50417-9
C630	281-0118-00	B054650		CAP.,VAR,MICA D:8-90PF,175V	52769	GSM231
C632	281-0197-01			CAP.,VAR,AIR DI:7.9-41PF,10%,1800V	71313	148-0081-011
CR601	152-0324-01			SEMICOND DEVICE:SILICON,50V,50PA AT 2OV,GE	03508	DE103
CR602	152-0324-01			SEMICOND DEVICE:SILICON,50V,50PA AT 2OV,GE	03508	DE103
CR611	152-0324-01			SEMICOND DEVICE:SILICON,50V,50PA AT 2OV,GE	03508	DE103
CR614	152-0324-01			SEMICOND DEVICE:SILICON,50V,50PA AT 2OV,GE	03508	DE103
CR651	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR652	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
DS650	150-0133-00			LAMP,CARTRIDGE:14V,80MA,RED DOME LENS	55292	70106-02
DS651	150-0048-00	B010100	B039999	LAMP,INCAND:5V,60MA	08806	683
DS652	150-0048-00			LAMP,INCAND:5V,60MA	08806	683
Q604A,B	151-1049-00			TRANSISTOR:SILICON,JFE,N -CHANNEL,DUAL	80009	151-1049-00
Q626	151-0190-01			TRANSISTOR:SILICON,NPN	80009	151-0190-01
Q628	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
R601	303-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,1W	01121	GB2225
R602	304-0391-00			RES.,FXD,CMPSN:390 OHM,10%,1W	01121	GB3911
R604	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R606	321-0306-00			RES.,FXD,FILM:15K OHM,1%,0.125W	91637	MFF1816G15001F
R610	311-1120-00			RES.,VAR,NONWIR:100 OHM,30%,0.25W	71450	201-YA5531
R611	321-0306-00			RES.,FXD,FILM:15K OHM,1%,0.125W	91637	MFF1816G15001F
R612	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	91637	MFF1816G10002F
R613	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	91637	MFF1816G10002F
R614	321-0481-00			RES.,FXD,FILM:1M OHM,1%,0.125W	24546	NA4D1004F
R615	311-1302-00			RES.,VAR,NONWIR:100K OHM,30%,0.25W	71450	201-YA5549
R616	321-0481-00			RES.,FXD,FILM:1M OHM,1%,0.125W	24546	NA4D1004F
R617	311-1302-00	B010100	B030599	RES.,VAR,NONWIR:100K OHM,30%,0.25W	71450	201-YA5549
R617	311-1235-00	B030600		RES.,VAR,NONWIR:100K OHM,20%,0.50W	32997	3386F-T04-104
R618	321-0637-00			RES.,FXD,FILM:9.9K OHM,0.5%,0.125W	24546	NC55C9901D
R619	321-0197-02			RES.,FXD,FILM:1.1K OHM,0.5%,0.125W	91637	MFF1816D11000D
R621	321-0222-07			RES.,FXD,FILM:2K OHM,0.1%,0.125W	91637	MFF1816C20000B
R622	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R623	315-0153-00	B030600		RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R624	315-0361-00	B030600		RES.,FXD,CMPSN:360 OHM,5%,0.25W	01121	CB3615
R625	315-0361-00	B030600		RES.,FXD,CMPSN:360 OHM,5%,0.25W	01121	CB3615
R626	315-0153-00	B030600		RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R627	321-0289-01			RES.,FXD,FILM:10K OHM,0.5%,0.125W	91637	MFF1816G10001D
R628	321-0289-01			RES.,FXD,FILM:10K OHM,0.5%,0.125W	91637	MFF1816G10001D
R629	321-0929-07			RES.,FXD,FILM:2.5K OHM,0.10%,0.125W	91637	MFF1816C25000B
R630	307-0358-00			RES.,FXD,FILM:10 OHM,0.1W	80009	307-0358-00
R631	308-0696-00			RES.,FXD,WW:90 OHM,0.5%,3W	91637	RS2B-B90R00D
R632	323-0729-01			RES.,FXD,FILM:900 OHM,0.5%,0.50W	75042	CECT0-9000D

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R633	323-0730-01			RES.,FXD,FILM:9K OHM,0.5%,0.50W	75042	CECT0-9001D
R634	323-0798-01			RES.,FXD,FILM:90K OHM,0.5%,0.50W	91637	MFF1226G90001D
R635	323-0611-01			RES.,FXD,FILM:900K OHM,0.5%,0.50W	91637	MFF1226G90002D
R636	323-0799-01			RES.,FXD,FILM:9M OHM,0.5%,0.50W	91637	HFF129G90003D
R640	301-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.50W	01121	EB3325
R641	301-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.50W	01121	EB2205
R643	301-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.50W	01121	EB2205
R645	301-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.50W	01121	EB2205
R646	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R647	301-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.50W	01121	EB2205
R648	301-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.50W	01121	EB2205
R649	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R650	311-1368-00			RES.,VAR,NONWIR:5K OHM,20%,1W	01121	73A1G040L502M
R651	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R651	----- -----			(USED IN S/N'S B010102, B010103, B010104,		
R651	----- -----			B010107, B010109, B010110, B010111, B010112		
R651	----- -----			B010116, B010117, B010119, B010120, B010121		
R651	----- -----			B010126, B010127 AND B010128 ONLY)		
R651	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R659	301-0226-00			RES.,FXD,CMPSN:22M OHM,5%,0.50W	01121	EB2265
R660	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	91637	MFF1816G100R0F
R661	323-0729-01			RES.,FXD,FILM:900 OHM,0.5%,0.50W	75042	CECT0-9000D
R662	323-0730-01			RES.,FXD,FILM:9K OHM,0.5%,0.50W	75042	CECT0-9001D
R663	323-0798-01			RES.,FXD,FILM:90K OHM,0.5%,0.50W	91637	MFF1226G90001D
R664	323-0611-01			RES.,FXD,FILM:900K OHM,0.5%,0.50W	91637	MFF1226G90002D
R665	323-0799-01			RES.,FXD,FILM:9M OHM,0.5%,0.50W	91637	HFF129G90003D
S626	----- -----			(SEE MECHANICAL PARTS LIST FOR REPLACEMENT		
S626	----- -----			ASSEMBLY, FIGURE 1-47 THROUGH 1-52.)		
S628	260-0247-00			SWITCH,PUSH:SPST,1A,115VAC	81073	30YY1009
S630	260-1459-00			SWITCH,ROTARY:VERTICAL SENSITIVITY	76854	5-33152-826
S640	260-1458-00			SWITCH,ROTARY:UNCTION SELECTOR	76854	5-28495-211
S650	260-1491-00			SWITCH,LEVER:4PDT,CENTER OFF	80009	260-1491-00
U616	156-0200-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	04713	MC1456P1
U624	156-0200-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	04713	MC1456P1

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols and Reference Designators

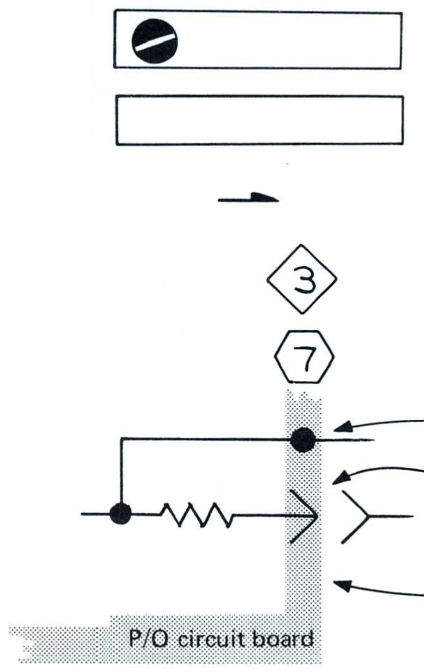
Electrical components shown on the diagrams are in the following units unless noted otherwise:

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

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

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

The following special symbols are used on the diagrams:



External Screwdriver adjustment.

External control or connector.

Clockwise control rotation in direction of arrow.

Refer to diagram number indicated in diamond.

Refer to waveform number indicated in hexagon.

Connection soldered to circuit board.

Connection made to circuit board with interconnecting pin.

Blue tint encloses components located on circuit board.

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

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

VOLTAGE AND WAVEFORM TEST CONDITIONS

577-177-D1 or D2

Voltages and waveforms (shown in blue) in the diagrams are not absolute and may vary from instrument to instrument because of differing component tolerances or internal calibration.

Typical DC voltage measurements were obtained using the following settings:

577-D1 or D2

VARIABLE COLLECTOR %	0
COLLECTOR SUPPLY POLARITY	AC
SERIES RESISTORS	.12
MAX PEAK VOLTS	6.5
STEP/OFF AMPL	1 VOLT
HORIZ VOLTS/DIV	100 V, COLLECTOR

All Dark Gray Buttons and Knobs in except:

STEP FAMILY	SINGLE
All Light Gray Buttons	out
INTENSITY	midrange
FOCUS	clockwise
BRIGHTNESS	clockwise
STORE button	out

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Terminal Selector	EMITTER GROUNDED, BASE TERM, STEP GEN
VERTICAL CURRENT/DIV	2 A

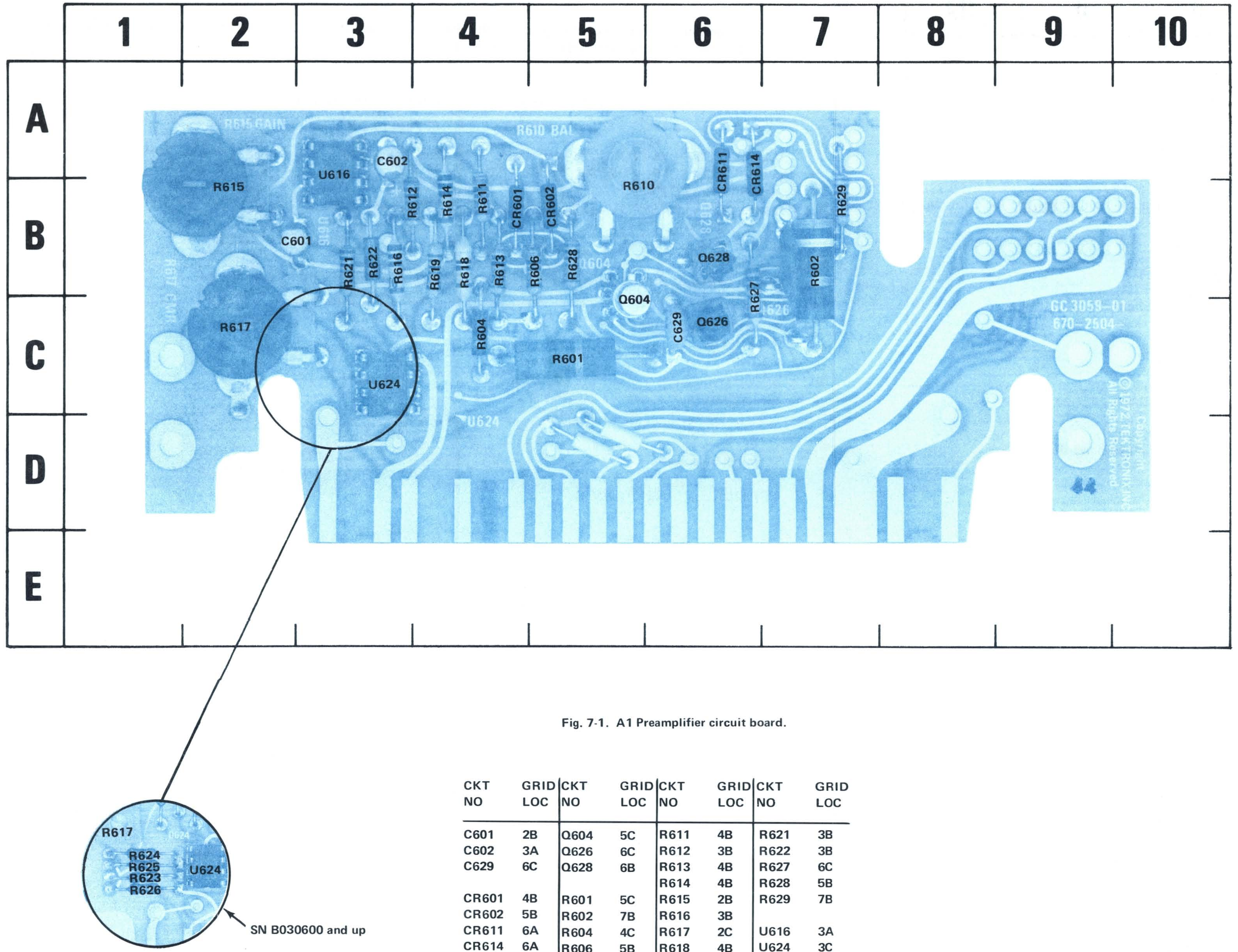


Fig. 7-1. A1 Preamplifier circuit board.

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C601	2B	Q604	5C	R611	4B	R621	3B
C602	3A	Q626	6C	R612	3B	R622	3B
C629	6C	Q628	6B	R613	4B	R627	6C
				R614	4B	R628	5B
CR601	4B	R601	5C	R615	2B	R629	7B
CR602	5B	R602	7B	R616	3B		
CR611	6A	R604	4C	R617	2C	U616	3A
CR614	6A	R606	5B	R618	4B	U624	3C
		R610	5B	R619	4B		

MORE

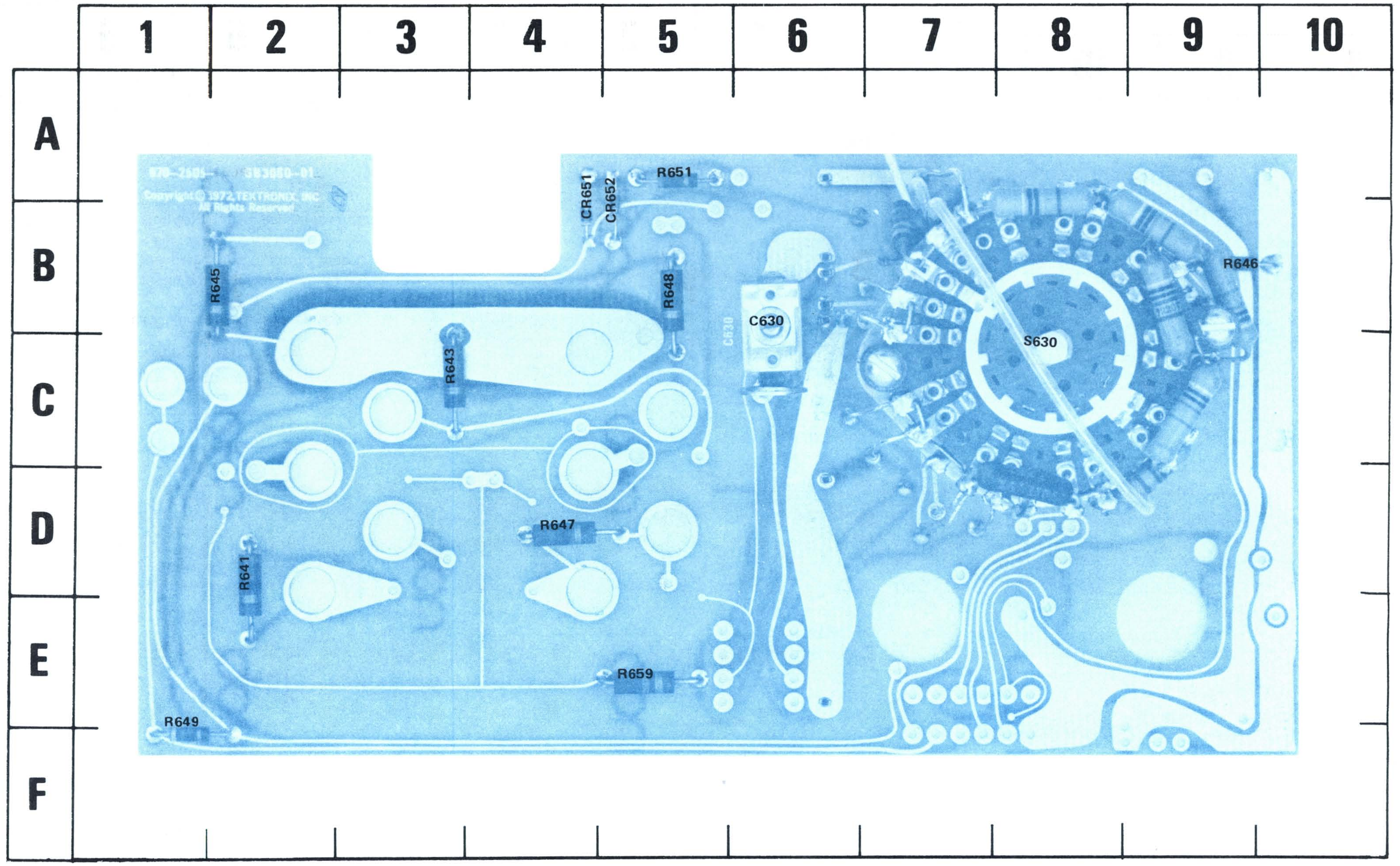


Fig. 7-2. A2 Interface circuit board.

CKT NO	GRID LOC	CKT NO	GRID LOC
C630	6B	R646	9B
		R647	4D
CR651	4B	R648	5B
CR652	5B	R649	1E
		R651	5A
R641	2D	R659	5E
R643	3C		
R645	2B	S630	8C

NOTE

LEAD CONFIGURATIONS AND CASE STYLES ARE TYPICAL, BUT MAY VARY DUE TO VENDOR CHANGES OR INSTRUMENT MODIFICATIONS.

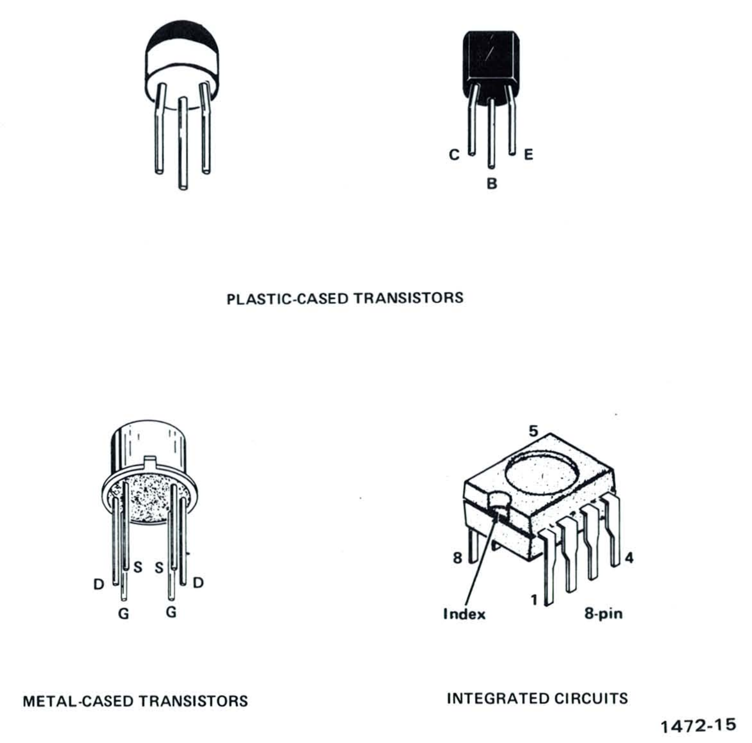
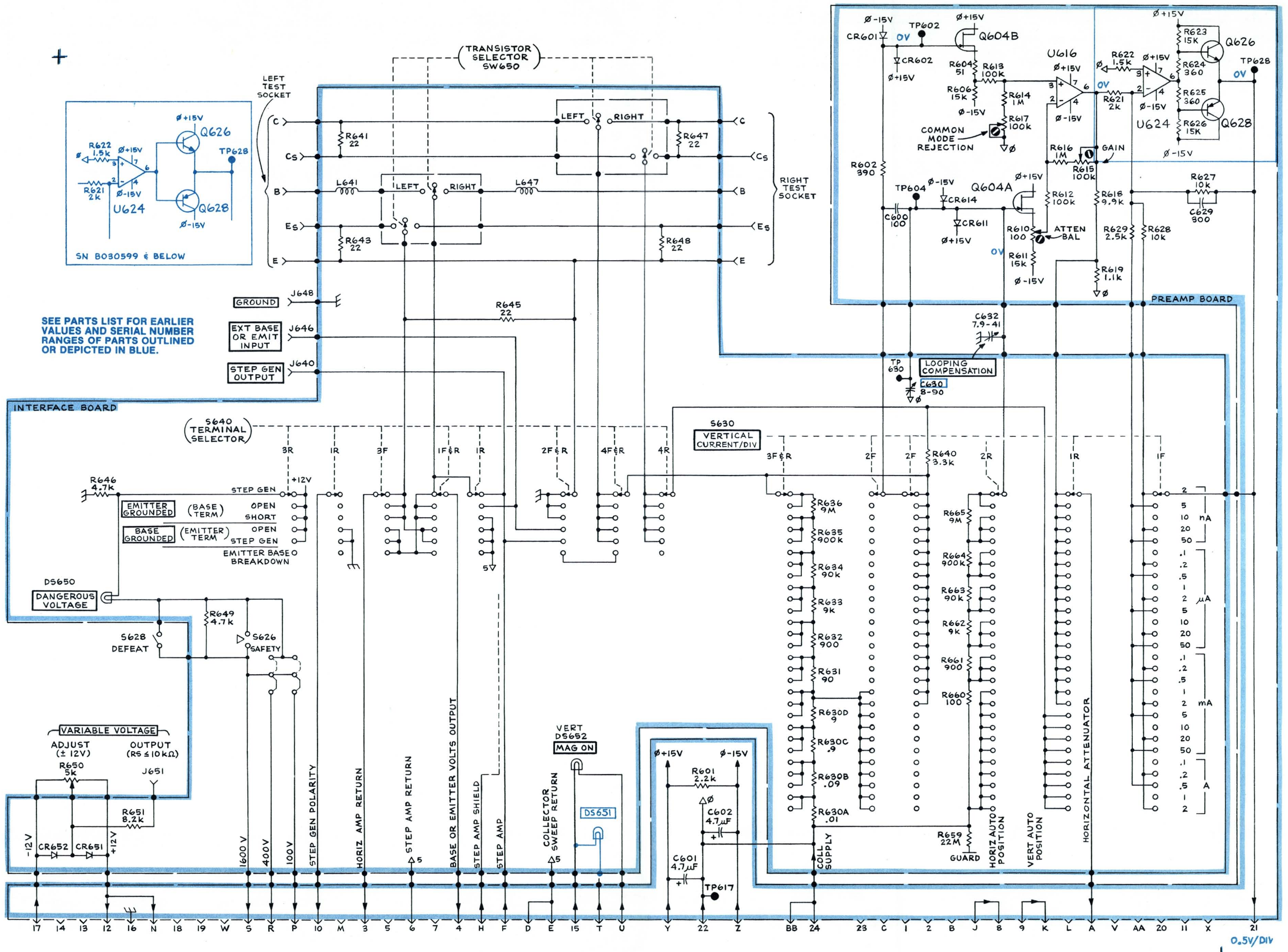


Fig. 7-3. Semiconductor lead configuration for 177 circuit boards.



1472-16
REV JUN 1983

177 STANDARD TEST FIXTURE

REPLACEABLE MECHANICAL PARTS

PARTS ORDERING INFORMATION

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

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

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

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

SPECIAL NOTES AND SYMBOLS

X000 Part first added at this serial number

00X Part removed after this serial number

FIGURE AND INDEX NUMBERS

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

INDENTATION SYSTEM

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

1 2 3 4 5 Name & Description

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

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

Attaching parts must be purchased separately, unless otherwise specified.

ITEM NAME

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

ABBREVIATIONS

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

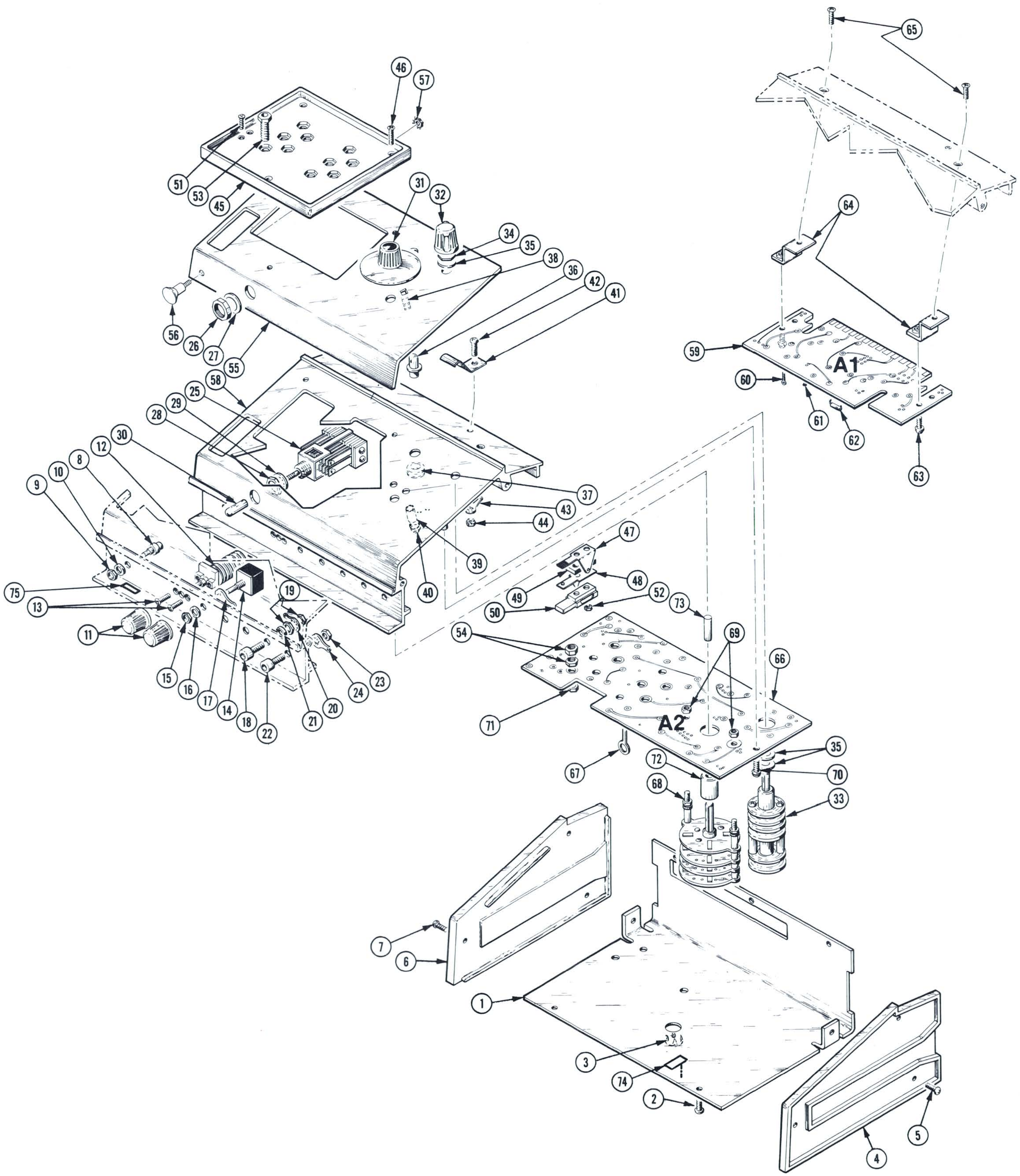
CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
000CY	NORTHWEST FASTENER SALES, INC.	7923 SW CIRRUS DRIVE	BEAVERTON, OR 97005
12327	FREEWAY CORPORATION	9301 ALLEN DRIVE	CLEVELAND, OH 44125
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
57668	R-OHM CORP.	16931 MILLIKEN AVE.	IRVINE, CA 92713
70485	ATLANTIC INDIA RUBBER WORKS, INC.	571 W. POLK ST.	CHICAGO, IL 60607
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
74970	JOHNSON, E. F., CO.	299 10TH AVE. S. W.	WASECA, MN 56093
78189	ILLINOIS TOOL WORKS, INC.		
	SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
78471	TILLEY MFG. CO.	900 INDUSTRIAL RD.	SAN CARLOS, CA 94070
79807	WROUGHT WASHER MFG. CO.	2100 S. O BAY ST.	MILWAUKEE, WI 53207
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
86928	SEASTROM MFG. COMPANY, INC.	701 SONORA AVENUE	GLENDALE, CA 91201

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-1	390-0323-00			1	COVER,TEST FXTR:BOTTOM	80009	390-0323-00
					**************(ATTACHING PARTS)***********		
-2	211-0503-00			5	SCREW,MACHINE:6-32 X 0.188 INCH,PNH STL	83385	OBD
					************(END ATTACHING PARTS)*********		
-3	134-0067-00			1	BUTTON,PLUG:GRAY PLASTIC	80009	134-0067-00
-4	390-0082-00			1	CAB.SIDE,PLUG-I:RIGHT,PLASTIC	80009	390-0082-00
					**************(ATTACHING PARTS)***********		
-5	213-0146-00			3	SCR,TPG,THD FOR:6-20 X 0.313 INCH,PNH STL	83385	OBD
					************(END ATTACHING PARTS)*********		
-6	390-0083-00			1	CAB.SIDE,PLUG-I:LEFT,PLASTIC	80009	390-0083-00
					**************(ATTACHING PARTS)***********		
-7	213-0146-00			3	SCR,TPG,THD FOR:6-20 X 0.313 INCH,PNH STL	83385	OBD
					************(END ATTACHING PARTS)*********		
-8	----- -----			1	SWITCH,PUSH:(SEE S628 REPL)		
					**************(ATTACHING PARTS)***********		
-9	210-0583-00			1	NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-10	210-0940-00			1	WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
					************(END ATTACHING PARTS)*********		
-11	366-0497-00			2	KNOB:GY,0.127 ID X 0.706 OD	80009	366-0497-00
	213-0153-00			1	.SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-12	----- -----			1	CAP.,VAR,AIR DI:(SEE C632 REPL)		
					**************(ATTACHING PARTS)***********		
-13	211-0038-00	B010100	B010315	2	SCREW,MACHINE:4-40 X 0.312,FLH,100 DEG	83385	OBD
	210-0580-00	B010316		1	NUT,PLAIN,HEX.:0.312-32 X 0.474 INCH,BRS	73743	OBD
	210-1025-00	B010316		1	WASHER,FLAT:0.312 ID X 0.469 OD,BRS	12327	OBD
					************(END ATTACHING PARTS)*********		
-14	----- -----			1	RES.,VAR,NONWIR:(SEE R650 REPL)		
					**************(ATTACHING PARTS)***********		
-15	210-0583-00			1	NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-16	210-0940-00			1	WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
-17	210-0223-00			1	TERMINAL,LUG:0.25 INCH DIA,SE	86928	A313-136
					************(END ATTACHING PARTS)*********		
	361-0234-00			1	RESTRAINT,SHAFT:	80009	361-0234-00
-18	136-0140-00			3	JACK,TIP:BANANA STYLE,CHARCOAL GRAY	80009	136-0140-00
					**************(ATTACHING PARTS)***********		
-19	210-0465-00			2	NUT,PLAIN,HEX.:0.25-32 X 0.375 INCH BRS	73743	3095-402
-20	210-0223-00			1	TERMINAL,LUG:0.25 INCH DIA,SE	86928	A313-136
-21	210-0895-00			1	WSHR,SHOULDERED:0.375 OD X 0.105 INCH THK	80009	210-0895-00
					************(END ATTACHING PARTS)*********		
-22	136-0140-00			1	JACK,TIP:BANANA STYLE,CHARCOAL GRAY	80009	136-0140-00
					**************(ATTACHING PARTS)***********		
-23	210-0465-00			1	NUT,PLAIN,HEX.:0.25-32 X 0.375 INCH BRS	73743	3095-402
-24	210-0223-00			1	TERMINAL,LUG:0.25 INCH DIA,SE	86928	A313-136
					************(END ATTACHING PARTS)*********		
-25	----- -----			1	SWITCH,LEVER:TRANSISTOR SELECTOR(SEE S650		
					**************(ATTACHING PARTS)***********		
-26	210-0473-00			1	NUT,PLAIN,DODEC:0.469-32 X 0.638 INCH,BRS	80009	210-0473-00
-27	210-0902-00			1	WASHER,FLAT:0.470 ID X 0.656 INCH OD,ST	12327	OBD
-28	210-0414-00			1	NUT,PLAIN,HEX.:0.468-32 X 0.562 INCH,BRS	73743	3167-402
-29	210-0021-00			1	WASHER,LOCK:INTL,0.476 ID X 0.60"OD ST	78189	1222-01-00-0541C
					************(END ATTACHING PARTS)*********		
-30	366-1126-00			1	KNOB:LEVER,GRAY PLASTIC	80009	366-1126-00
-31	366-1433-00	B010100	B039999	1	KNOB:W/SKIRT	80009	366-1433-00
	366-1433-01	B040000	B042444	1	KNOB:W/SKIRT	80009	366-1433-01
	366-1433-02	B042445		1	KNOB:GRAY,0.252 ID,0.7 OD,0.52 H	80009	366-1433-02
	213-0153-00			2	.SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-32	366-1028-00			1	KNOB:GRAY	80009	366-1028-00
	213-0153-00			2	.SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-33	----- -----			1	SWITCH,ROTARY:TERMINAL SELECTOR(SEE S640 R		
					**************(ATTACHING PARTS)***********		
-34	210-0590-00			1	NUT,PLAIN,HEX.:0.375 X 0.438 INCH,STL	73743	2X28269-402
-35	210-0978-00			3	WASHER,FLAT:0.375 ID X 0.50 INCH OD,STL	78471	OBD
					************(END ATTACHING PARTS)*********		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-36	----- -----			1	LAMP,INCAND:(SEE DS652 REPL)		
-37	348-0004-00			1	GROMMET,RUBBER:0.281 ID X 0.563 INCH OD	70485	763
-38	378-0635-00	B010100	B039999	2	LENS,LIGHT:WHITE	80009	378-0635-00
	378-0635-00	B040000		1	LENS,LIGHT:WHITE	80009	378-0635-00
-39	352-0157-01	B010100	B039999	2	LAMPHOLDER:BLACK PLASTIC	80009	352-0157-01
	352-0157-01	B040000		1	LAMPHOLDER:BLACK PLASTIC	80009	352-0157-01
-40	200-0935-00	B010100	B039999	2	BASE,LAMPHOLDER:0.29 OD X 0.19 CASE	80009	200-0935-00
	200-0935-00	B040000		1	BASE,LAMPHOLDER:0.29 OD X 0.19 CASE	80009	200-0935-00
-41	214-0276-02			1	CONTACT,ELEC:GROUNDING SPRING	80009	214-0276-02
					*************(ATTACHING PARTS)***********		
-42	211-0097-00			1	SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
-43	210-0201-00			1	TERMINAL,LUG:0.12 ID,LOCKING,BRZ TIN PL	86928	OBD
-44	210-0586-00			1	NUT,PL,ASSEM WA:4-40 X 0.25,STL	83385	OBD
					************(END ATTACHING PARTS)*********		
-45	386-1544-00			1	PL,MTG,TEST ADA:10 HOLE	80009	386-1544-00
					*************(ATTACHING PARTS)***********		
-46	211-0025-00			5	SCREW,MACHINE:4-40 X 0.375 100 DEG,FLH ST	83385	OBD
					************(END ATTACHING PARTS)*********		
-47	131-0749-00			1	CONTACT,ELEC:UPPER	80009	131-0749-00
-48	131-0748-00			1	CONTACT,ELEC:LOWER	80009	131-0748-00
-49	361-0259-00			1	INSULATOR,PLATE:0.320 X 0.60 INCH	80009	361-0259-00
-50	337-1152-00			1	SHIELD,ELEC:PUSH SWITCH	80009	337-1152-00
					*************(ATTACHING PARTS)***********		
-51	211-0112-00			2	SCREW,MACHINE:2-56 X 0.375,FLH,100 DEG	83385	OBD
-52	210-0405-00			2	NUT,PLAIN,HEX.:2-56 X 0.188 INCH,BRS	73743	12157-50
					************(END ATTACHING PARTS)*********		
-53	131-0031-00			10	JACK,TIP:0.635 INCH LONG W/LUG	74970	108-0740-023
					*************(ATTACHING PARTS)***********		
-54	210-0455-00			20	NUT,PLAIN,HEX.:0.25-28 X 0.375 INCH,BRASS	73743	3089-402
					************(END ATTACHING PARTS)*********		
-55	333-1658-00	B010100	B039999	1	PANEL,FRONT:	80009	333-1658-00
	333-1658-01	B040000	B042444	1	PANEL,FRONT:	80009	333-1658-01
	333-1658-02	B042445	B049999	1	PANEL,FRONT:	80009	333-1658-02
	333-1658-03	B050000		1	PANEL,FRONT:	80009	333-1658-03
-56	367-0213-00	B050000		2	HANDLE,PULL:CKT CARD	80009	367-0213-00
					*************(ATTACHING PARTS)***********		
-57	210-0586-00	B050000		2	NUT,PL,ASSEM WA:4-40 X 0.25,STL	83385	OBD
					************(END ATTACHING PARTS)*********		
-58	386-2406-00	B010100	B039999	1	SUBPANEL,FRONT:	80009	386-2406-00
	386-2406-01	B040000	B042444	1	SUBPANEL,FRONT:	80009	386-2406-01
	386-2406-02	B042445	B049999	1	SUBPANEL,FRONT:	80009	386-2406-02
	386-2406-03	B050000		1	SUBPANEL,FRONT:	80009	386-2406-03
-59	----- -----			1	CKT BOARD ASSY:PREAMPLIFIER(SEE A1 REPL)		
-60	214-0579-00			4	.TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-61	136-0252-07			28	.SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
-62	131-0566-00			2	.BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0
					*********(ATTACHING PARTS FOR CKT BD)		
-63	211-0116-00			4	SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
					************(END ATTACHING PARTS)*********		
-64	407-1122-00			2	BRACKET,ANGLE:CKT BOARD,ALUMINUM	80009	407-1122-00
					*************(ATTACHING PARTS)***********		
-65	211-0101-00			2	SCREW,MACHINE:4-40 X 0.25,100 DEG,FLH STL	83385	OBD
					************(END ATTACHING PARTS)*********		
-66	----- -----			1	CKT BOARD ASSY:INTERFACE(SEE A2 REPL)		
	136-0252-07			7	.SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
-67	210-0217-00			1	.TERMINAL,LUG:0.328 ID X 0.438 INCH OD,BR	80009	210-0217-00
-68	----- -----			1	.SWITCH,ROTARY:VERT SENS(SEE S630 REPL)		
					. ************(ATTACHING PARTS)***********		
-69	210-0449-00			2	.NUT,PLAIN,HEX.:5-40 X 0.250 INCH,BRS	73743	3030-402
					************(END ATTACHING PARTS)*********		
					*********(ATTACHING PARTS FOR CKT BD)		
-70	211-0116-00			1	SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
-71	210-0583-00			10	NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
					************(END ATTACHING PARTS)*********		
-72	384-1305-00			1	EXTENSION SHAFT:0.494 X 1.2" LONG,W/SHLDR	80009	384-1305-00
-73	361-0234-00			1	RESTRAINT,SHAFT:	80009	361-0234-00
-74	348-0070-01	B031150		1	PAD,CUSHIONING:0.69 INCH,RUBBER	80009	348-0070-01
-75	334-2088-00			1	LABEL,INFORMATI:DANGER	80009	334-2088-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
	198-2888-00			1	WIRE KIT,ELEC:ON(NOT SHOWN)	80009	198-2888-00



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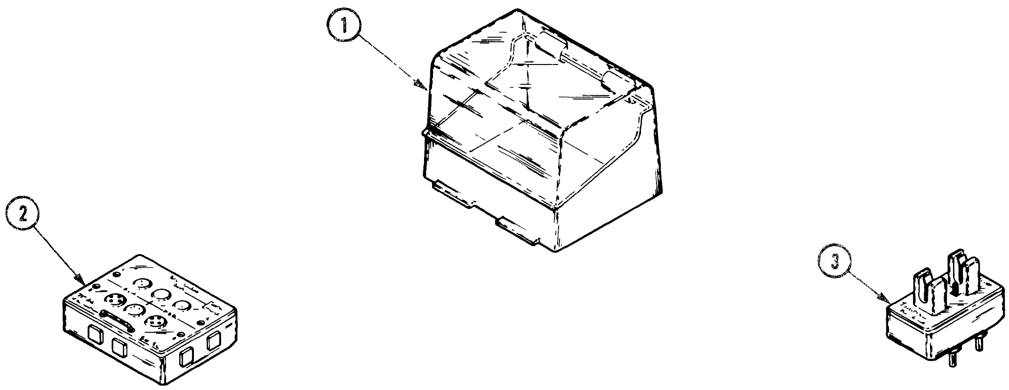

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-1	337-1194-00			1	SHIELD,ELEC:TRANSISTOR	80009	337-1194-00
-2	013-0098-02			1	ADAPTER,TEST:TRANSISTOR	80009	013-0098-02
-3	013-0111-00			1	ADAPTER,TEST:DIODE	80009	013-0111-00
	070-1472-00			1	MANUAL:INSTRUCTION	80009	070-1472-00

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.

MANUAL CHANGE INFORMATION

Tektronix®
COMMITTED TO EXCELLENCE

Date: 7-27-83 Change Reference: C2/0783

Product: 177 Standard Test Fixture Manual Part No.: 070-1472-00

DESCRIPTION PG 48

CHANGE TO:

(Page 5-6, Step 3g)

g. Set the VARIABLE COLLECTOR % to 0 and remove the patch cords.

(Page 5-6 Step 4, Adjust C630)

a. Set the controls as follows:

VARIABLE COLL %	100
HORIZONTAL VOLTS/DIV	2 V COLLECTOR
VERTICAL CURRENT/DIV	2 nA
LEFT-RIGHT	OFF

b. ADJUST-C630 for minimum trace tilt with the loop closed. (Keep the loop closed with the LOOPING COMPENSATION control while adjusting C630.) Be sure that the TRACE ROTATION control is set properly. If in doubt, switch the VERTICAL CURRENT/DIV to 2 A and determine whether the trace is parallel to the horizontal graticule lines. Replace the plug in the bottom panel of the 177 test fixture.

WARNING

Always replace the plug in TP630 access hole to avoid contact with potentially lethal voltages.