TEKTRONIX®

TYPE 134

CURRENT PROBE AMPLIFIER

015-0057-02

INSTRUCTION MANUAL

BEFORE READING

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

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TEKTRONIX®

TYPE 134

CURRENT PROBE AMPLIFIER

015-0057-02

INSTRUCTION MANUAL

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

Serial Number ______________

070-0990-01

369

WARRANTY

All TEKTRONIX instruments are warranted against defective materials and workmanship for one year. Any questions with respect to the warranty should be taken up with your TEKTRONIX Field Engineer or representative.

All requests for repairs and replacement parts should be directed to the TEKTRONIX Field Office or representative in your area. This will assure you the fastest possible service. Please include the instrument Type Number or Part Number and Serial Number with all requests for parts or service.

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TABLE OF CONTENTS

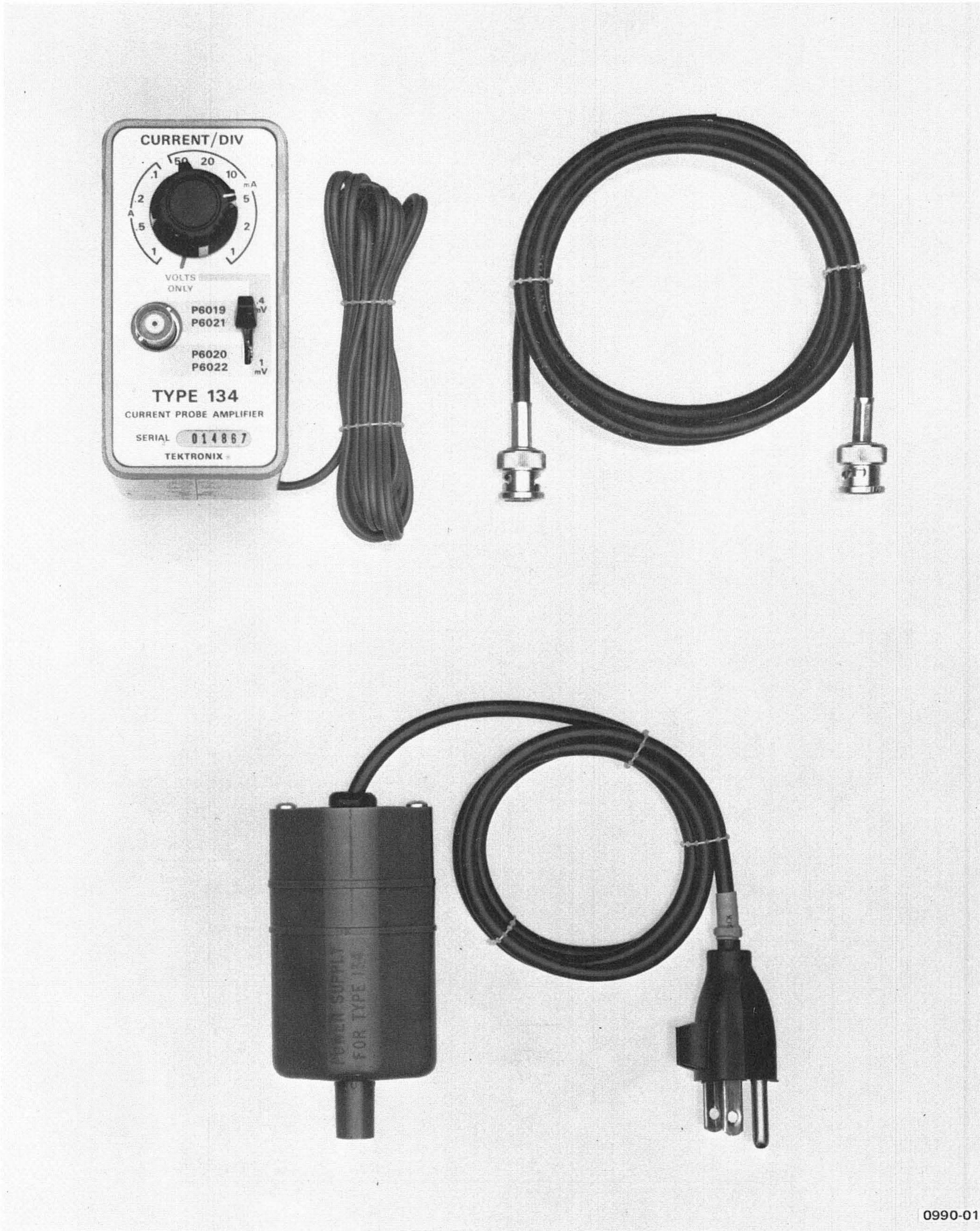


Fig. 1-1. Type 134 Current Probe Amplifier and accessories.

SPECIFICATION

Introduction

The Type 134 Current Probe Amplifier is intended primarily for use with Tektronix P6021 or P6022 Current Probes. When used with an oscilloscope, the amplifier and current probe form a complete alternating-current measuring system, with peak-to-peak currents read directly in milliamperes or amperes per division of vertical deflection. The Type 134 may also be used as a 50-ohm input voltage amplifier (without a current probe), with a gain of either 50 or 125, set by a front-panel switch.

The included separate power supply is available for use with either 115 volts or 230 volts nominal line voltage (must be specified at time of ordering).

Unless otherwise stated, the specifications listed below pertain only to the Type 134 Current Probe Amplifier and indicated current probe, and do not include the effects or limitations of the test oscilloscope. Bandwidths and risetimes with several different test oscilloscope bandwidths are given as examples of performance to be expected.

The performance requirements listed here apply over an ambient temperature range of 0° C to +50° C. The rated accuracies are valid when the instrument is calibrated at +20° C to +30° C, with warm-up time of ten minutes. A twenty minute warm-up is required for rated accuracies at 0° C ambient temperature.

ELECTRICAL CHARACTERISTICS

CURRENT MODE

Characteristics	Type 134 With P6021 Probe			Type 134 With P6022 Probe			
Deflection Factor (with 50 mV/div oscilloscope setting)	10 current amplifier steps from 1 mA/div to 1 A/div, 1-2-5 sequence.						
Accuracy	±3%						
	Test Oscilloscope Bandwidth						
	≥50 MHz	≥75 MHz	≥100 MHz	≥50 MHz	≥75 MHz	≥100 MHz	≥150 MHz
System Bandwidth (−3 dB)	≥30 MHz	≥35 MHz	≥36 MHz	≥40 MHz	≥50 MHz	≥54 MHz	≥59 MHz
Risetime (10%-90%)	≤11.6 ns	≤10.0 ns	≤9.6 ns	≤8.8 ns	≤7.0 ns	≤6.4 ns	≤5.9 ns
Low-Frequency Response (−3 dB)	≤12 Hz (see Figs. 1-2 and 1-3). ≤100 Hz (see Fig. 1-5).						

ELECTRICAL CHARACTERISTICS (cont)

CURRENT MODE (cont)

Characteristic	Type 134 With P6021 Probe	Type 134 With P6022 Probe
Aberrations (does not include aberrations due to test oscilloscope)	⩽ +5%, −5% (total of 5% p-p) from 1 mA/div to 20 mA/div; ⩽ +6%, −6% (total of 6% p-p) from 50 mA/div to 1 A/div, within 50 ns of step; ⩽ +1%, −1% (total of 2% p-p) thereafter.	Same as 134/P6021, except: ⩽ +2%, −2% (total of 2% p-p) after first 50 ns following a step.
Tilt (does not include effects of test oscilloscope)	⩽3% during first 400 μs following a step.	⩽3% during first 80 μs following a step.
Noise	⩽150 μA referred to input.	
Maximum Current	15 amperes p-p continuous wave (see Fig. 1-4).	6 amperes p-p continuous wave (see Fig. 1-5).
Maximum Voltage	600 V	

VOLTAGE MODE

Characteristics	Selector Set To P6019/P6021	Selector Set To P6020/P6022
Deflection Factor (50 mV/div oscill-oscope setting)	0.4 mV/div (gain of 125).	1 mV/div (gain of 50).
Accuracy	±3%	
Input Impedance	Approximately 50 ohms	
System Bandwidth (−3 dB)	⩾36 MHz (with 100 MHz test oscilloscope).	⩾59 MHz (with 150 MHz test oscilloscope).
Risetime (10%-90%)	⩽9.6 ns (with 100 MHz test oscilloscope).	⩽5.9 ns (with 150 MHz test oscilloscope).
Low-Frequency Response (−3 dB)	⩽10 Hz	⩽8 Hz
Aberrations (does not include aberrations due to test oscilloscope)	⩽ +5%, −5% (total of 5% p-p) within 50 ns of step; ⩽ +1%, −1% (total of 2% p-p) thereafter.	Same as P6019/P6021, except: ⩽ +2%, −2% (total of 2% p-p) after the first 50 ns following a step.
Tilt (does not include effects of test oscilloscope)	⩽3% during first 500 μs following a step.	⩽3% during first 600 μs following a step.

ELECTRICAL CHARACTERISTICS (cont)

POWER SUPPLY

Characteristics	115 Volt Power Supply	230 Volt Power Supply
Line Voltage Range	103.5 to 126.5 V ac	207 to 253 V ac
Line Frequency Range	50 to 400 Hz	
Output Voltage	+13.25 to +15.25 V dc	
Regulation (over line voltage range)	≤0.5 volt change	
Ripple	≤2 mV	

PHYSICAL CHARACTERISTICS

Construction: Aluminum-alloy wrap-around cover and circuit board chassis. Die-cast end plates.

Connectors: Front-panel input connector is BNC type; rear-panel output connector is locking-type BNC.

Finish: Anodized front panel with blue vinyl wrap-around cover.

Dimensions: Height—3-5/8" (9.2 cm); Width—1-7/8" (4.75 cm); Depth—6-1/8" (15.6 cm) (include connectors and controls).

STANDARD ACCESSORIES

Qty.	Tektronix Part No.	Description
1	014-0029-00	Hanger Assembly
1	012-0104-00	Cable Assembly
1	070-0990-01	Manual, Instruction

OPTIONAL ACCESSORIES

Tektronix Part No.	Description
103-0015-00	BNC/UHF Adapter—For use with oscilloscopes having UHF input connector.
016-0087-01	Carrying Case—For Type 134 and P6021 or P6022.
013-0050-00	Battery Adapter—To connect battery to power cord. (Use a 16 to 33 volt, 70 mA battery such as a Mercury E302580 or equivalent).
012-0259-00	Accessory Current-Loop Adapter for 7704A, 7603, 7613, 7623A, 7633, and 7313 Oscilloscopes.
012-0341-00	Accessory Current-Loop Adapter for 485, R7844, and R7903 Oscilloscopes.

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.

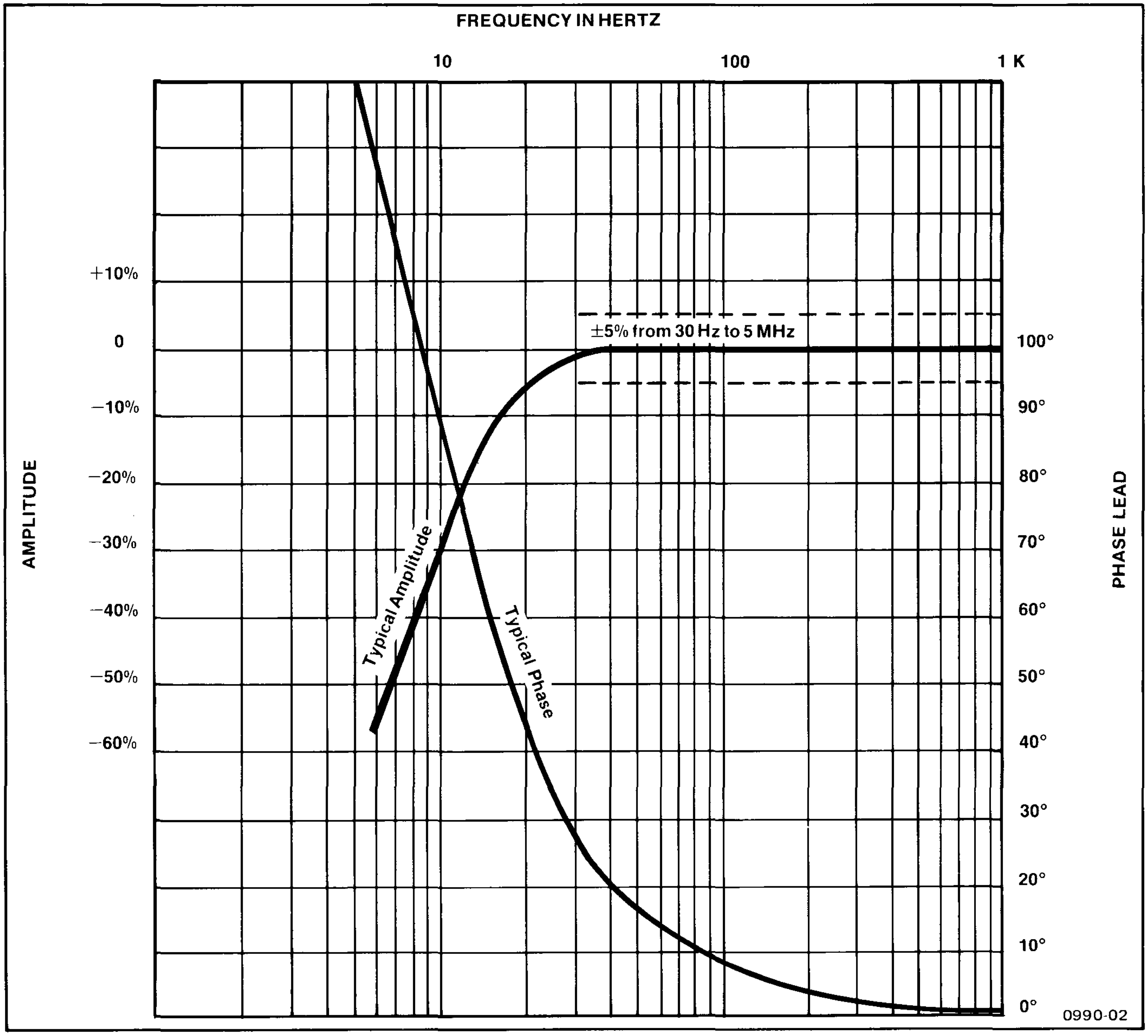


Fig. 1-2. Type 134 and P6021 amplitude and phase vs frequency.

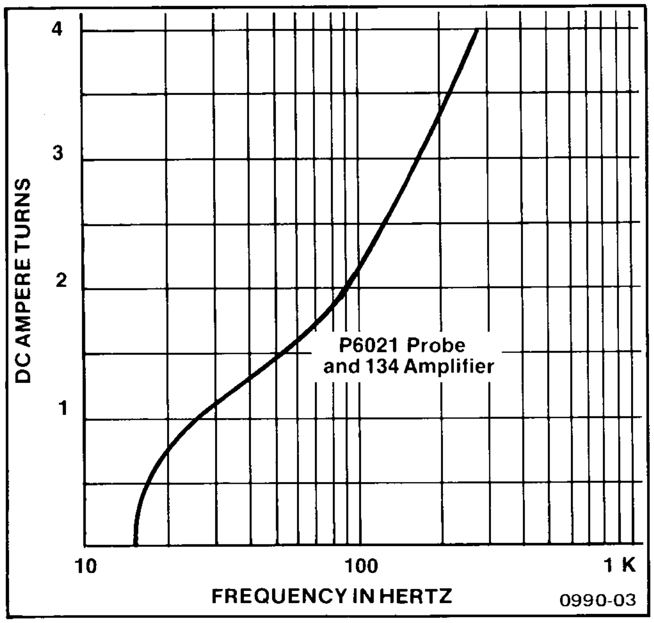


Fig. 1-3. Type 134 and P6021 low-frequency 3 dB point vs dc ampere turns.

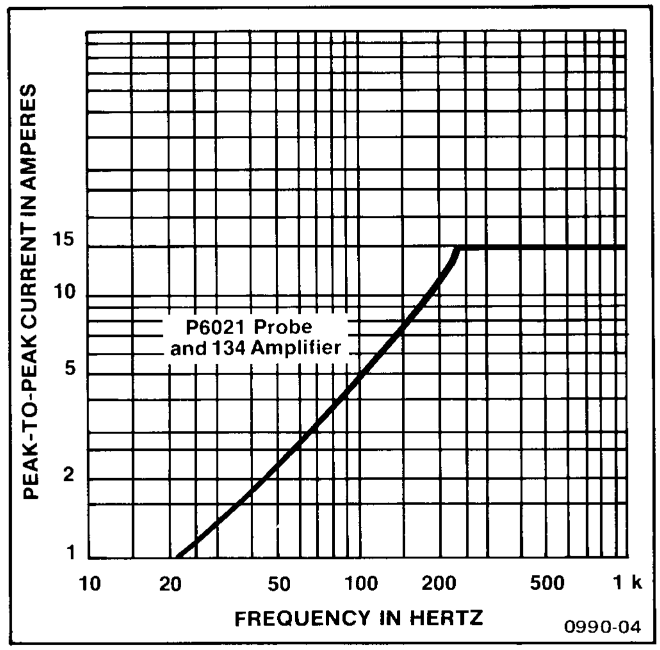


Fig. 1-4. Type 134 and P6021 low-frequency response vs peak-to-peak current. At the low-frequency end detectable sine-wave distortion occurs as a result of core saturation. Although the probe distorts low-frequency current waveforms when the core starts to saturate, any high-frequency waveforms or short-duration microsecond pulses present at the same time are unaffected. At the high-frequency end, current rating may be exceeded under conditions indicated on the graph.

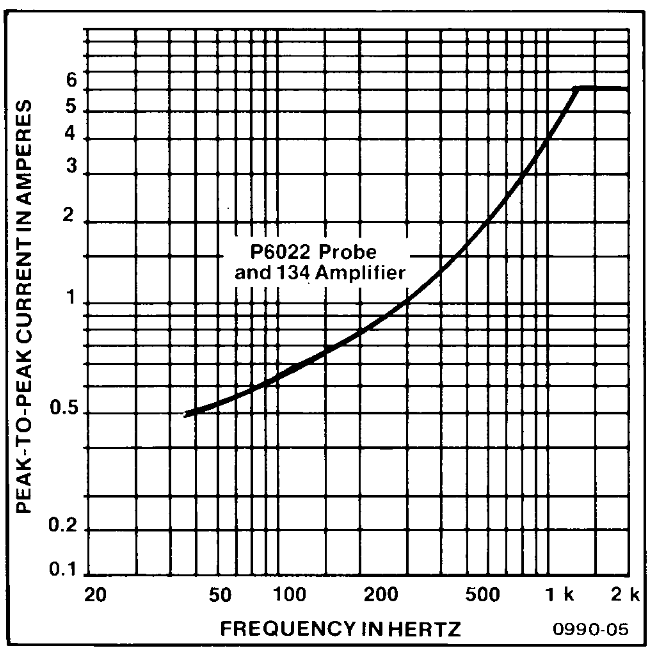


Fig. 1-5. Type 134 and P6022 low-frequency response vs peak-to-peak current. At the low-frequency end dectable sine-wave distortion occurs as a result of core saturation. Although the probe distorts low-frequency current waveforms when the core starts to saturate, any high-frequency or short-duration microsecond pulses present at the same time are unaffected. At the high-frequency end, current rating may be exceeded under conditions indicated on the graph.

OPERATING INSTRUCTIONS

General

The Type 134 Current Probe Amplifier operates with a Tektronix current probe and an oscilloscope to form a complete alternating current measuring system. To effectively use the Type 134, the operation and capabilities of the instrument should be known. This section describes the operation of the front-panel controls and connectors, gives first-time operating information, and lists some basic applications of the instrument.

Installation

The Type 134 is designed to connect to the vertical input of Tektronix oscilloscopes, either directly or through the 18-inch BNC female-to-male cable. When connecting directly, loosen the locking BNC output connector, plug into the vertical input connector, and tighten down until the Type 134 is rigidly supported. The Type 134 may also be fastened to the side of the instrument, using the hanger assembly supplied in the accessory kit. (Refer to Section 4 for hanger installation instructions.) In this case, connect the output of the Type 134 to the female end of the 18-inch cable and connect the male end of the cable to the vertical input connector.

Connect the appropriate (115-volt or 230-volt) power unit to the power source. Connect the power cord from the Type 134 to the power unit.

CONTROLS AND CONNECTORS

The controls required for the operation of the Type 134 are located on the front panel and right side of the unit. To make full use of this instrument, the operator should be familiar with the function and use of each of these controls. A brief description of the function or operation of each control follows:

CURRENT/DIV Selects the vertical deflection factor from 1 mA/DIV to 1 A/DIV in 10 steps, 1-2-5 sequence. The CURRENT/DIV control setting can be read directly only when the oscilloscope vertical deflection factor is set to 50 mV/div and the variable is in the calibrated position.

If an oscilloscope deflection factor other than 50 mV/div is used, the overall deflection factor must be calculated. The following is an example:

Oscilloscope deflection factor—5 mV/div
Type 134 CURRENT/DIV setting—1 mA/div

$$\frac{5}{50} \text{ X } 1 \text{ mA/div} = 100\ \mu\text{A/div}$$

At the greater sensitivity obtained in this example, of course, noise in the display may somewhat limit measurement usefulness.

The VOLTS ONLY position of the CURRENT/DIV switch changes the current probe amplifier to a voltage amplifier with 50-ohms input impedance.

Probe Selector Level switch provides the appropriate gain and peaking to correspond with the current probe being used. The low-frequency probes require more gain than do the high-frequency probes, due to the difference in turns ratios. The probes also require different peaking circuits in the amplifier. When the CURRENT/DIV switch is set to VOLTS ONLY, the voltage gain of the amplifier is 125 with the selector set to P6019/P6021, resulting in a deflection factor of 0.4 mV/div (oscilloscope set to 50 mV/div). The gain in the P6020/P6022 position is 50, and the deflection factor is 1 mV/div.

Input Connector BNC type connector. Input for current probes when operating in current mode; 50-ohm signal input when operating in voltage mode.

LF COMP Adjusted for optimum response when probe is first connected, or when changing from one probe to another.

GAIN P6020/P6022—Adjusts gain of amplifier when the front-panel selector switch is set to P6020/P6022.

P6019/P6021—Adjusts gain of amplifier when the front-panel selector switch is set to P6019/P6021.

FIRST-TIME OPERATION

General

The following steps demonstrate the basic operation of controls and connectors of the Type 134. It is recommended that this procedure be followed completely for familiarization with the instrument.

Current Measurement

1. Connect the Type 134 Amplifier to the vertical input of an oscilloscope. DC-couple the oscilloscope input and set the deflection factor to 50 mV/div, calibrated.

2. Plug the Type 134 power unit into the power source. Connect the power cord from the instrument to the power unit.

3. Connect a current probe to the input connector. Set the front-panel selector switch to correspond with the probe being used.

4. Slide the thumb-controlled portion of the probe back (open) and place the probe slot around the oscilloscope calibrator current loop (or appropriate accessory current-loop adapter; see Optional Accessories, Section 1). Push the slider forward into the locked position. The slider must be fully forward and locked, or low-frequency performance will be degraded.

5. Set the CURRENT/DIV control and the oscilloscope time-base controls to display the calibrator square wave.

6. Adjust LF COMP for a flat top on the displayed square wave.

NOTE

When connecting the current probe to the Type 134 for the first time, or when changing from one probe to another, the LF COMP must be adjusted.

7. Check the vertical deflection of the displayed square wave. There are two gain adjustments on the side of the Type 134 which correspond with the two positions of the front-panel selector switch. If gain adjustment is necessary, adjust the appropriate control.

Voltage Measurement

1. Connect the Type 134 Amplifier to the vertical input of an oscilloscope. Set the oscilloscope input to 50 mV/div, DC-coupled.

2. Plug the Type 134 power unit into the power source. Connect the power cord from the instrument to the power unit.

3. Set the CURRENT/DIV switch to VOLTS ONLY. In this position, the Type 134 becomes a voltage amplifier with an input impedance of 50 ohms.

4. Connect the signal source to the input connector. (Attenuator probes designed for use with 50-ohm systems, such as the P6056 10X Probe or the P6057 100X Probe, or unity gain FET probes, such as the P6045 or P6201, may be used as input couplers to the amplifier.)

NOTE

The Type 134 Current Probe Amplifier must be driven by a source having a DC return. Otherwise, the two capacitors in the input stage, C110 and C112, will be charged to the level of the signal and no signal will be passed (depending upon the duty cycle of the input signal).

5. With the front-panel selector switch in the P6019/P6021 position, the deflection factor is 0.4 mV/div (gain = 125). The deflection factor in the P6020/P6022 position is 1 mV/div (gain = 50). Set the selector switch to the desired position.

If an oscilloscope deflection factor other than 50 mV/div is used, the overall deflection factor must be calculated. The following is an example:

Attenuation ratio of the probe—10X
Gain of the Type 134 (P6020/P6022 position)—50
Oscilloscope deflection factor—0.1 V/div

$$\frac{10}{50} \times \frac{0.1\ \text{V}}{\text{div}} = 20\ \text{mV/div}$$

6. Connect the voltage probe to the calibrator output. Set the oscilloscope controls to display the calibrator square wave.

7. Adjust LF COMP for a flat top on the displayed square wave.

8. Check the vertical deflection of the displayed square wave. There are two gain adjustments on the side of the Type 134 which correspond with the two positions of the front-panel selector switch. If gain adjustment is necessary, adjust the appropriate control.

GENERAL OPERATING INFORMATION

Current Probe Selection

The current probes recommended for use with the Type 134 are Tektronix Types P6019, P6020, P6021, and P6022. Generally, the P6019 or P6021 should be used when measuring current waveforms in the low-to medium-frequency range, while the P6020 or P6022 should be used for medium- or high-frequency measurements. The current probes require different gain and peaking to provide an accurate representation of the current signal. These circuit changes are made by the front-panel selector switch.

Ground Clip Leads

Ground clip leads are furnished with the probe to ground the shield around the probe transformer at the probe end of the cable when desired. Normally the ground lead is not used in the 1, 2, 5, and 10 mA positions of the CURRENT/DIV switch, due to undersirable chassis currents which may appear in the more sensitive positions. When observing high-frequency waveforms, use the short ground clip lead to avoid ringing.

Direction of Current Flow

Direction of conventional current flow, as opposed to electron flow, is plus to minus. Conventional current flowing in the direction of the arrow on the probe produces a positive deflection of the waveform on the CRT (see Fig. 2-1).

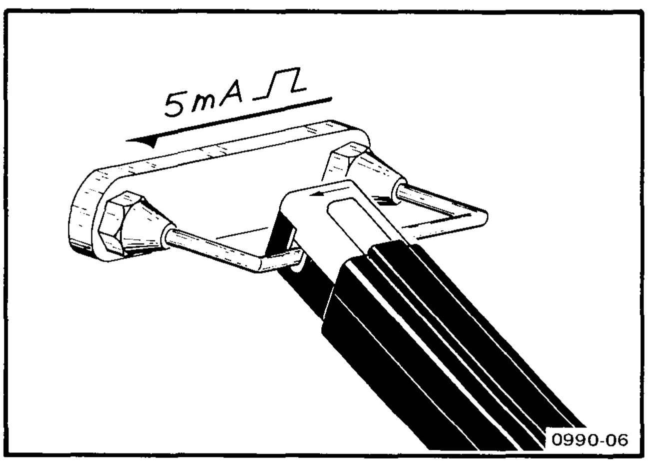


Fig. 2-1. Current flow in a conductor.

Loading Effect

To minimize loading effect of critical circuits, whenever possible clamp the probe at the low or ground end of a component lead. Also, less noise or spurious signal interference will be seen when the probe is connected near ground.

High Currents

When measuring high currents, do not leave the current probe clamped around the conductor while disconnecting the probe cable from the amplifier. With the probe cable unterminated under this condition, a high voltage is developed in the secondary winding which may damage the current probe transformer.

BASIC APPLICATIONS

Increasing the Sensitivity

The current sensitivity of the Type 134 and current probe can be increased by increasing the number of turns passing through the core of the probe. For example, if the conductor is looped through the probe two times, a two-turn primary winding is formed, increasing the secondary current by a factor of two. (The ratio of current in a transformer is inversely proportional to the turns ratio.) With the Type 134 CURRENT/DIV switch set to 1 mA, the deflection factor is actually reduced by a factor of two to 0.5 mA/division.

Remember, however, that the impedance reflected into the primary (circuit being measured) from the secondary (probe winding) varies as the square of the primary turns. When observing high-frequency current waveforms or fast-rise pulses, the inductance added to the primary circuit by the additional turns may be significant.

Probe Shielding

The current probe is shielded to minimize the effect of external magnetic fields. However, strong fields may interfere with a current signal being measured. If you suspect that an external field is interfering with your measurement, remove the probe from the conductor and place it in the vicinity of the original measurement. If you obtain appreciable deflection, attempt to measure the conductor current at another point away from the magnetic field source.

If current measurements must be made in the presence of a strong external field, the external field interference may be minimized by the use of two current probes and a differential-input oscilloscope. Both current probes must be the same type, and both must be connected to the oscilloscope inputs in the same manner, through two Type 134 Amplifiers.

With both probes connected to a differential-input oscilloscope, clamp one probe around the conductor in which the current is to be measured, and place the other probe near the first, with the slider closed. By setting the oscilloscope controls for common-mode rejection, the undersirable current signal induced in one probe can be minimized by the induced current in a second probe. Adjust the positions of the probes for best results. Complete cancellation of the undesirable signal may be difficult to obtain due to probe characteristics and time differences between the two probes and amplifiers.

Tracing Magnetic Fields

The Type 134 and current probe can be used to trace magnetic fields, such as those produced by chassis currents, to their source. This is most easily accomplished by holding the probe slider open, and scanning about the chassis. The increased sensitivity of the unshielded transformer permits the maximum field current to be induced in the probe.

Balancing Currents

The Type 134 and current probe can be used to balance currents in a push-pull circuit. This can be accomplished by clamping the probe around both cathode or emitter leads in the push-pull stage. Algebraic addition of the two currents can then be displayed on the oscilloscope. Adjustments can be made in the device under test until the two currents produce a null display.

Simultaneous Current and Voltage Measurements

Simultaneous current and voltage measurements can be obtained using the Type 134, a current probe, a voltage probe, and a dual-trace oscilloscope.

1. Connect the Type 134 Current Probe amplifier to one of the vertical input connectors on the oscilloscope. DC-couple the oscilloscope input and set the deflection factor to 50 mV/div, calibrated. Connect a current probe to the Type 134.

2. Connect the voltage probe to the other vertical input connector.

3. Connect the current probe around the conductor at the point where the signal is to be measured. (Use a ground lead if necessary.)

4. Connect the voltage probe tip to the point where the signal is to be measured. (Use a ground lead if necessary.)

5. Set the CURRENT/DIV switch and the oscilloscope controls for suitable displays. Obtain the current and voltage readings from the respective displays on the CRT.

CIRCUIT DESCRIPTION

Introduction

This section of the manual contains a description of the circuitry used in the Type 134. The description begins with a discussion of the amplifier, both as a current probe amplifier and as a voltage amplifier. The operation of the power supply is then described. Complete diagrams are given in the Diagrams section. Refer to these diagrams throughout the following circuit description for electrical values and relationship.

Type 134 Current Probe Amplifier

Current Positions of CURRENT/DIV Switch

The first stage of the amplifier (see AMPLIFIER circuit diagram), formed by Q114 and Q124, is a feedback amplifier, with the parallel combination of C118 and R118 providing the negative feedback loop. The value of C118 determines the frequency and amplitude of the negative feedback, thus providing high frequency compensation. The input impedance of Q114 is approximately two ohms. The input stage is AC-coupled by C110 and C112.

The input signal from the current probe (see ATTENUATORS circuit diagram) is terminated by R60, L60 and the two ohms input impedance of Q114 in the 1 mA through 20 mA positions of the CURRENT/DIV switch. C51-C52-R51, C53-R53, and C55-R55 are input impedance compensation networks. In the 50 mA through 1 AMP positions, the input signal is terminated by L62-R62, and the two ohms input impedance of Q114.

To achieve the desired 1-2-5 deflection factor sequence in the ten current positions of the CURRENT/DIV switch, four gain-setting networks are switched into the emitter of Q134, and the input signal is attenuated in the 20 mA through 1 AMP positions. In the 1 mA position, the ÷ 1 network, R91-C92-R92-C98-C99-R138, is switched into the emitter of Q134. In the 2 mA position, the ÷ 2 network, R94-C95-R95-C98-C99-R138, is switched in. In the 5 mA position, the ÷ 5 network, C98-C99-R99-R138, is switched in. In the 10 mA position, the ÷ 10 emitter resistor, R138 is switched in. In the 20 mA through .5 AMP positions, the ÷ 5 network is switched in and the input signal is attenuated through R70-R71-LR71, C69-R69-C73-R73, C75-R75, R77 and R79 in the CURRENT/DIV switch. In the 1 AMP position, the ÷ 10 resistor is switched in, and the input signal is attenuated through R81.

The gain of Q124 is set by the ratio of the collector circuit to emitter resistors R120-R121. Resistor R121 is bypassed by C121 to provide a high frequency boost. Emitter peaking circuits to correspond with the requirements of the current probe being used are selected by the Probe Selector switch, SW130. With SW130 in the P6019/P6021 position, C131 and R131 are connected from the emitter of Q124 to ground. In the P6020/P6022 position, R131-C132-R132 are switched in. Separate gain adjustments in the collector of Q124 are also provided by SW130. The wiper of R125 or R128, depending upon the position of SW130, is AC-grounded through C125. This AC-grounding provides gain adjustments without affecting the DC level of Q124. The parallel combination of LR126 prevents high frequency ringing of the circuit.

The signal at the collector of Q124 is AC-coupled through C130 to the base of Q133. Resistor R130 is a parasitic suppressor. Resistors R133-R134 set the bias for Q133. This emitter follower circuit isolates the collector load of Q124 from Q134 so that switching Q134 emitter resistor networks (see previous description) does not affect the gain of Q124. Resistors R137 and R140 are parasitic suppressors which prevent Q134 from oscillating. The parallel combination of LR136 provides high frequency peaking for Q134.

The signal at the collector of Q134 is AC-coupled through C140 to the output stage. Peaking circuit C139-R139 is connected from the base of Q143 to ground only in the P6020/P6022 position of SW130. Transistor Q143 isolates the base of Q154 from the collector of Q134. Peaking circuit C156-R156-R157-C158 is connected between ground and the emitter of Q154 only in the P6019/P6021 position of SW130. Variable capacitor C158 is adjusted to shape the front corner response when using the low frequency probe. Emitter peaking is provided by C160-R160-C161. Variable capacitor C160 is adjusted to shape the high frequency response with either current probe. Resistor R159 is the emitter load for Q154. The connections between pins D and G of the circuit board assembly and the Probe Selector switch are made with two twisted pairs of wires to reduce the inductance. The ground for this switch must be made at pin G, near the ground end of R159, to avoid ground currents.

A low-pass filter, in the negative feedback loop of the Q143-Q154 operational amplifier, is formed by C146-R146-R147. This stabilizes the DC operating point of Q154 as the emitter impedance changes with the switching of SW130. A low-frequency boost network is formed by C151-R151-R153-R154-C163. At high frequencies, the reactance of C163 is low; therefore, the output signal is developed across R150. At low frequencies, the reactances of C151 and C163 rise, and the signal is then developed across R150 and R151, resulting in a low frequency boost.

The low frequency signal is compensated by R154. Toroid T164 is switched out of the circuit in the current positions of the CURRENT/DIV switch. The output signal is AC-coupled through C165.

VOLTS ONLY Position of the CURRENT/DIV Switch

In the VOLTS ONLY position of the CURRENT/DIV switch, R67, LR83, and the input impedance of Q114 form a 50-ohm termination for the input signal. High frequency compensation is provided by C68-R68 to maintain the 50 ohms impedance at high frequencies. Since the input of the amplifier is AC-coupled, the driving source must have a DC return. If not, C110 and C112 charge and no signal is passed (depending upon the duty cycle of the input signal).

The emitter peaking for Q124, required for the current probes, is removed in the VOLTS ONLY position. The gain of the amplifier is set by the collector circuit of Q124 as previously described. The ÷ 1 network, R91-C92-R92-C98-C99-R138, is switched into the emitter of Q134 in the VOLTS ONLY position. Capacitor C163, the low frequency boost capacitor in the output stage, is bypassed in the VOLTS ONLY position. Toroid T164 isolates the capacitance of the CURRENT/DIV switch from the output of the amplifier.

Type 134 Power Supply

The power plug portion of the power supply consists of a transformer with a diode bridge in the secondary, which supplies unfiltered DC to the amplifier circuit board where it is filtered and regulated. The primary of the transformer is wound for 115 volts in both the 115-volt and the 230-volt power units. The 230-volt power unit has a resistor in each side of the line (R101 and R102) between the AC power cord and the primary of the transformer to reduce the line voltage to 115 volts. The frequency range of the power supply is 50 to 400 hertz.

The filter circuit, located in the amplifier portion of the power supply, is formed by C105-C106-C107-R105-R106. A 15-volt zener diode, D107, supplies a fixed voltage to the base of Q107, the power transistor. This produces a +14-volt supply at the emitter of Q107. Capacitor C107 eliminates any zener noise from D107.

To avoid shock hazard should the transformer windings short, the ground side of the secondary is held near ground by D105 and D106. (No other ground exists when the power cord is disconnected from the oscilloscope.) Neither diode will conduct unless a potential difference of more than 0.5 volt is present, therefore avoiding a ground loop. Should the transformer windings short, the primary fuse F101 will open before D105 or D106 are damaged. However, F101 will not open if the two sides of the diode bridge (power unit output) are shorted together.

MAINTENANCE

Introduction

This section of the manual contains maintenance information for use in preventive maintenance, corrective maintenance and troubleshooting of the Type 134 Current Probe Amplifier and Power Supply.

PREVENTIVE MAINTENANCE

General

Preventive maintenance consists of cleaning, visual inspection, lubrication, etc. Preventive maintenance performed on a regular basis may prevent instrument breakdown and will improve the reliability of this instrument. The severity of the environment to which the Type 134 is subjected determines the frequency of maintenance. A convenient time to perform preventive maintenance is preceding recalibration of the instrument.

Remove the Type 134 Cover

1. Unscrew the plastic portion of the locking BNC connector (output to the oscilloscope), and remove.

2. Remove the two screws on either side of the connector.

3. Remove the rear panel and wrap-around cover.

Cleaning

The Type 134 should be cleaned as often as operating conditions require. Accumulation of dirt in the instrument can cause overheating and component breakdown. Dirt on components act as an insulating blanket and prevent efficient heat dissipation. It also provides an electrical conduction path.

Exterior. Loose dirt accumulated on the outside of the Type 134 can be removed with a soft cloth or small paint brush. The paint brush is particularly useful for dislodging dirt on and around the front-panel controls. Dirt which remains can be removed with a soft cloth dampened in a mild detergent and water solution. Abrasive cleaners should not be used.

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

Lubrication

The reliability of potentiometers, switches and other moving parts can be maintained if they are kept properly lubricated. Do not over lubricate. A lubrication kit containing the necessary lubricants and instructions is available from Tektronix, Inc. Order Tektronix Part No. 003-0342-01.

Visual Inspection

The Type 134 should be inspected occasionally for such defects as broken connections, broken or damaged circuit boards, improperly seated transistors, and heat-damaged parts.

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

Transistor Checks

Periodic checks of the transistors in the Type 134 are not recommended. The best check of transistor performance is its actual operation in the instrument. More details on checking transistor operation is given under Troubleshooting.

Recalibration

To ensure accurate measurements, check the calibration of this instrument after each 1000 hours of operation or every six months if used infrequently. In addition, replacement of components may necessitate recalibration of the affected circuits. Complete calibration instructions are given in Section 5.

The Performance Check/Calibration Procedure can also be helpful in localizing certain troubles in the instrument. In some cases, minor troubles may be revealed and/or corrected by calibration.

TROUBLESHOOTING

Introduction

The following information is provided to facilitate troubleshooting of the Type 134. Information contained in other sections of this manual should be used along with the following information to aid in locating the defective component. An understanding of the circuit operation is very helpful in locating troubles. See the Circuit Description section for complete information.

Troubleshooting Aids

Diagrams. Circuit diagrams are given on foldout pages in Section 8. The component number and electrical value of each component in this instrument are shown on the diagrams. Important voltages are also shown on the diagrams.

Wiring Color-Code. All insulated wire and cable used in the Type 134 is color-coded to facilitate circuit tracing. Signal carrying leads are identified with one or two stripes.

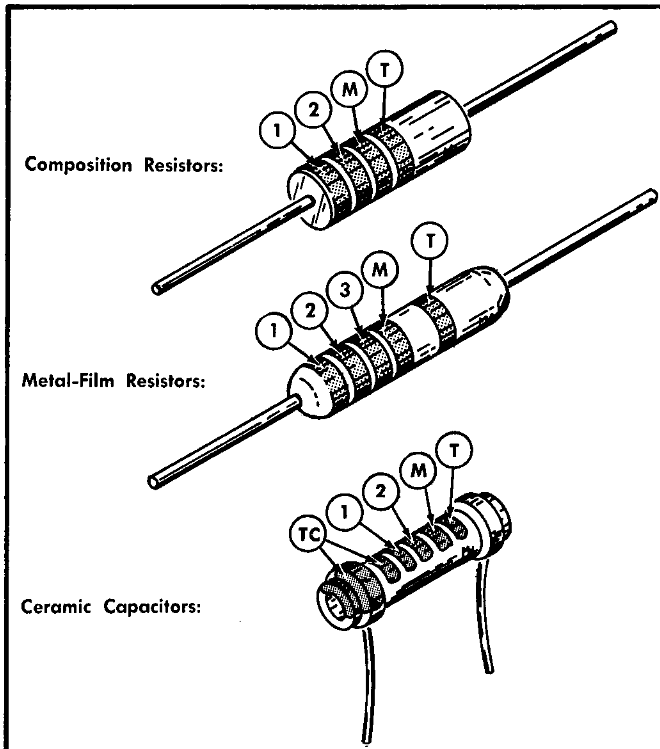
Resistor Color-Code. In addition to the brown composition resistors, some metal-film resistors are used in the Type 134. The resistance values of composition resistors and metal-film resistors are color-coded on the components (some metal film resistors may have the value printed on the body) with EIA color-code. The color-code is read starting with the stripe nearest the end of the resistor. Composition resistors have four stripes which consist of two significant figures, a multiplier and a tolerance value (see Fig. 4-1). Metal-film resistors have five stripes consisting of three significant figures, a multiplier and a tolerance value.

Capacitor Marking. The capacitance values of common disc capacitors and small electrolytics are marked in microfarads on the side of the component body. The white ceramic capacitors used in the Type 134 are color-coded in picofarads using a modified EIA code (see Fig. 4-1).

Diode Color-Code. The cathode end of each glass-enclosed diode is indicated by a stripe, a series of stripes or a dot. For most silicon or germanium diodes with a series of stripes, the color-code also indicates the type of diode or identifies the Tektronix Part Number using the resistor color-code system (e.g., a diode color-coded blue or pink-brown-gray-green indicates Tektronix Part Number 152-0185-00). The cathode and anode end of metal-encased diodes can be identified by the diode symbol marked on the body.

Troubleshooting Equipment

The following equipment is useful for troubleshooting the Type 134.



(1) (2) and (3) —1st, 2nd and 3rd significant figures;
(M) —multiplier; (T) —tolerance;
(TC) —temperature coefficient.

Resistor and Capacitor Color Code

Color	Significant Figures	Multiplier Resistors	Multiplier Capacitors	Tolerance Resistors	Tolerance Capacitors
Silver	---	10^{-2}	---	±10%	---
Gold	---	10^{-1}	---	±5%	---
Black	0	1	1	---	±20% or 2 pF*
Brown	1	10	10	±1%	±1% or 0.1 pF*
Red	2	10^2	10^2	±2%	±2%
Orange	3	10^3	10^3	±3%	±3%
Yellow	4	10^4	10^4	±4%	+100% −0%
Green	5	10^5	10^5	±0.5%	±5% or 0.5 pF*
Blue	6	10^6	10^6	---	---
Violet	7	---	---	---	---
Gray	8	---	10^{-2}	---	+80% −20% or 0.25 pF*
White	9	---	10^{-1}	---	±10% or 1 pF*
(none)	---	---	---	±20%	±10% or 1 pF*

***For capacitance of 10 pF or less.**

NOTE: (T) and/or (TC) color code for capacitors depends upon manufacturer and capacitor type. May not be present in some cases.

Fig. 4-1. Color-code for resistors and ceramic capacitors.

1. Transistor Tester

Description: Tektronix Type 576 Transistor-Curve Tracer or equivalent.

Purpose: To test the semiconductors used in this instrument.

2. Volt-ohmmeter

Description: 20,000 ohms/volt. 0-500 volts DC. Accurate within 3%. Test probes must be insulated.

Purpose: To measure voltages and resistances

Troubleshooting Techniques

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

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

2. Check Associated Equipment. Before proceeding with troubleshooting of the Type 134, check that the equipment used with this instrument is operating correctly. Check that the signal is properly connected and that the probe is not defective The oscilloscope can be checked for proper operation by substituting another which is known to be operating properly.

3. Check Instrument Calibration. Check the calibration of this instrument or the affected circuit if the trouble exists in one circuit. The apparent trouble may only be a result of misadjustment or may be corrected by calibration. Complete calibration instructions are given in Section 5.

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

5. Isolate Trouble to a Circuit. To isolate a trouble to a circuit, note the trouble symptom. The symptom often indicates the circuit in which the trouble is located.

6. Check Voltages. Often the defective component can be located by checking for the correct voltage in the circuit. Typical voltages are given on the diagrams.

NOTE

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

7. Check Individual Components. The following procedures describe methods of checking individual components in the Type 134. Components which are soldered in place are best checked by disconnecting one end. This isolates the measurement from the effects of surrounding circuitry.

A. TRANSISTORS. The best check of transistor operation is actual performance under operating conditions. If a transistor is suspected of being defective, it can best be checked by substituting a new component or one which has been checked previously. However, be sure that circuit conditions are not such that a replacement transistor might also be damaged. If substitute transistors are not available, use a dynamic tester (such as Tektronix Type 576) to check the transistor.

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

CAUTION

Do not use an ohmmeter scale that has a high internal current. High currents may damage the diode.

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

D. INDUCTORS. Check for open inductors by checking continuity with an ohmmeter. Shorted or partially shorted inductors can usually be found by checking the waveform response when high-frequency signals are passed through the circuit. Partial shorting often reduces high-frequency response (roll-off).

E. CAPACITORS. A leaky or shorted capacitor can best be detected by checking the resistance with an ohmmeter on the highest scale. Do not exceed the voltage rating of the capacitor. The resistance reading should be high after initial charge of the capacitor. An open capacitor can best be detected with a capacitance meter or by checking whether the capacitor passes AC signals.

8. Repair and Readjust the Circuit. If any defective parts are located, follow the replacement procedures given in this section. Be sure to check the performance of any circuit that has been repaired or that has had any electrical components replaced.

CORRECTIVE MAINTENANCE

General

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

Obtaining Replacement Parts

Standard Parts. All electrical and mechanical part replacements for the Type 134 can be obtained through your local Tektronix Field Office or representative. However, many of the standard electronic components can be obtained locally in less time than is required to order them from Tektronix, Inc. Before purchasing or ordering replacement parts, check the parts list for value, tolerance, rating and description.

NOTE

When selecting replacement parts, it is important to remember that the physical size and shape of a component may affect the performance in the instrument, particularly at high frequencies. All replacement parts should be direct replacements unless it is known that a different component will not adversely affect instrument performance.

Special Parts. In addition to the standard electronic components, some special parts are used in the Type 134. These parts are manufactured or selected by Tektronix, Inc. to meet specific performance requirements, or are manufactured for Tektronix, Inc. in accordance with our specifications. These special parts are indicated in the parts list by an asterisk preceding the part number. Most of the mechanical parts used in this instrument have been manufactured by Tektronix, Inc. Order all special parts directly from your local Tektronix Field Office or representative.

Ordering Parts. When ordering replacement parts from Tektronix,Inc., include the following information:

1. Instrument Type.

2. Instrument Serial Number.

3. A description of the part (if electrical, include circuit number).

4. Tektronix Part Number.

Soldering Techniques.

WARNING

Disconnect the instrument from the power source before soldering.

Circuit Board. The components mounted on the circuit board in the amplifier can be replaced using normal circuit board soldering techniques. Keep the following points in mind when soldering on the circuit boards:

1. Use a pencil-type soldering iron with a power rating from 15 to 50 watts.

2. Apply heat from the soldering iron quickly to the junction between the component and the circuit board.

3. Heat-shunt the lead of the component by means of a pair of long-nosed pliers.

4. Avoid excessive heating of the junction with the circuit board, as this could separate the circuit board wiring from the laminate.

5. Use electronic grade 60-40 tin-lead solder.

6. Clip off any excess lead length extending beyond the circuit board and clean off any residual flux with a flux-removing solvent. Be careful that the solvent does not remove any printing from the circuit board.

CAUTION

If possible, avoid soldering in the area of R64, a 2.1 Ω disc resistor. This resistor is extremely heat-sensitive, and if overheated will greatly affect the attenuation ratios in the 50 mA through 1 AMP position of the CURRENT/DIV switch.

Metal Terminals. When soldering metal terminals (e.g., switch terminals, potentiometers, etc), use 60-40 tin-lead solder and a 15 to 50 watt soldering iron. Observe the following precautions when soldering metal terminals:

1. Apply only enough heat to make the solder flow freely.

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

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

4. Clean the flux from the solder joint with a flux removing solvent.

Transistor Replacement

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

Replacement transistors should be of the original type or a direct replacement. Remount the transistors in the same manner as the original. Fig. 4-2 shows the lead configurations of the transistors used in this instrument. This view is as seen from the bottom of the transistor. When replacing transistors, check the manufacturer's basing diagram for correct basing.

Repairing the Type 134 Amplifier

The exploded-view drawings, Figs. 1, 2, and 3 (located at the rear of this manual on foldout pages) are helpful in the removal or disassembly of individual components or sub-assemblies.

Removing the Front Panel and Subpanel

1. Remove the CURRENT/DIV switch knob, using a 1/16 inch hexagonal wrench.

2. Remove the probe selector switch knob.

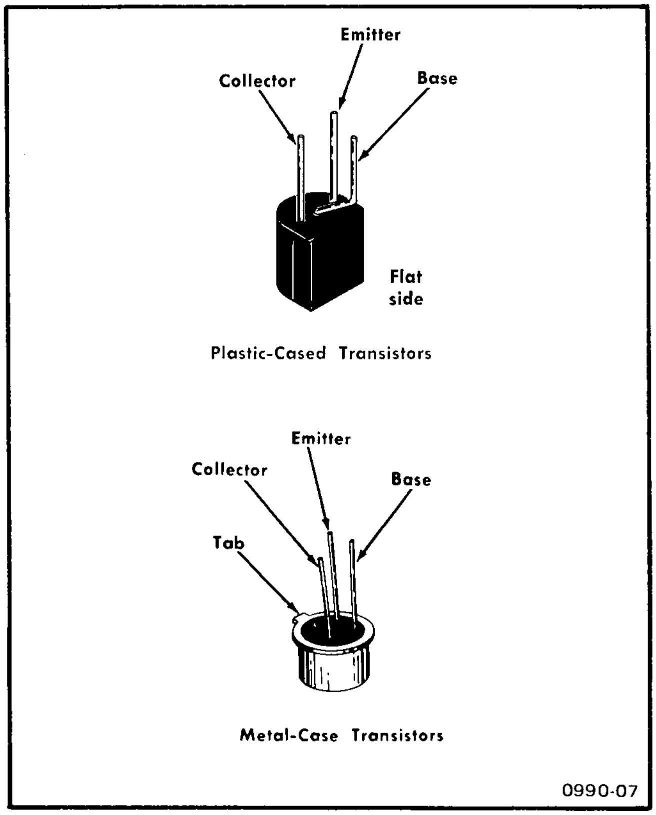


Fig. 4-2. Electrode configuration for transistors in Type 134.

3. Remove the 7/16-inch hexagonal nut from the CURRENT/DIV switch and remove the front panel.

4. Remove the six screws holding the subpanel to the chassis, selector switch, and input connector, and remove the subpanel.

Removing the Probe Selector Switch

1. Disconnect the three solderless connectors from pins 0, Q, and R of the circuit board.

2. Unsolder the leads from pins D and G of the circuit board.

3. Unsolder C125 (150 µF capacitor) between the switch and the circuit board.

4. Unsolder the connections to the feed-through tie points in the shield, and remove the switch.

Removing the CURRENT/DIV Switch

1. Disconnect the seven solderless connectors from pins A, B, C, E, I, N, and P of the circuit board.

2. Unsolder the strap from the CURRENT/DIV switch to the two 180 µF capacitors, C110, C112 on the circuit board.

3. Remove the screw from the center of the shield.

4. Turn the amplifier over and unsolder the ground straps between the switch and the circuit board.

5. Remove the switch, input connector, and shield intact.

6. Unsolder the connections to the shield, and to the feed-through tie points in the shield.

7. Unsolder the selector switch portion of the shield from the CURRENT/DIV switch.

8. Unsolder the input BNC connector.

Removing the Circuit Board Assembly

1. After the switches have been removed, remove the five remaining solderless connectors from pins F, H, K, L and M of the circuit board.

2. Unsolder the ground side of the power cord from the circuit board.

3. Remove the two screws from the corners of the circuit board, and remove the circuit board from the chassis.

Repairing the Power Unit

Removing the Cover

Remove the cover by removing the two screws on either side of the AC power cord.

Replacement of the Diodes

Use a heat sink when removing and replacing the diodes. Also, when replacing the diodes, observe the polarity.

CAUTION

Use care and minimum heat when soldering on the power transformer terminals. Overheating can cause the fine wire used in the transformer windings to break loose from the terminals.

Replacement of the Amplifier Power Connector

1. Using a heat sink, unsolder the connections to the diode bridge.

2. Remove the connector from the power unit chassis.

3. Replace the connector and resolder the diode connections.

Replacement of the AC Power Cord

1. Unsolder the connections at the power unit end of the power cord.

2. Remove the power cord from the cover plate.

3. Insert the new power cord into the cover plate.

4. Resolder the power cord connections.

Power Cord Conductor Identification

Conductor	Color	Alternate Color
Ungrounded (Line)	Brown	Black
Grounded (Neutral)	Blue	White
Grounding (Earthing)	Green-Yellow	Green-Yellow

Replacement of the Power Transformer

1. Remove the amplifier power connector and the AC power cord as previously described.

2. Unsolder the two diodes between the transformer and the power unit chassis.

3. Remove the transformer from the chassis.

4. Remove the diode bridge from the secondary and the remaining components from the primary.

5. Replace the transformer by reversing the above procedure.

Installing the Type 134 Hanger

Supplied with the Type 134 is a hanger that may be used to mount the amplifier on the side of the oscilloscope, rather than connecting directly to the vertical input.

1. Using the screws supplied with the hanger, fasten the large portion of the hanger to the right side of the Type 134 (see Fig. 4-3).

2. Position the Type 134 on the left side of the oscilloscope and mark the location of the hanger. The Type 134 should be mounted so that the front panel controls extend beyond the front of the oscilloscope for ease of operation.

3. Drill two 1/8-inch holes in line vertically and separated 1/2 inch.

4. Fasten the small portion of the hanger to the oscilloscope cabinet.

5. Replace the Type 134 in position and connect the amplifier output to the input of the oscilloscope, using the 18-inch BNC male to female cable.

Recalibration After Repair

After any electrical component has been replaced, the performance of that particular circuit should be checked, as well as the performance of other closely related circuits. The Performance Check procedure in Section 5 provides a quick and convenient means of checking instrument operation.

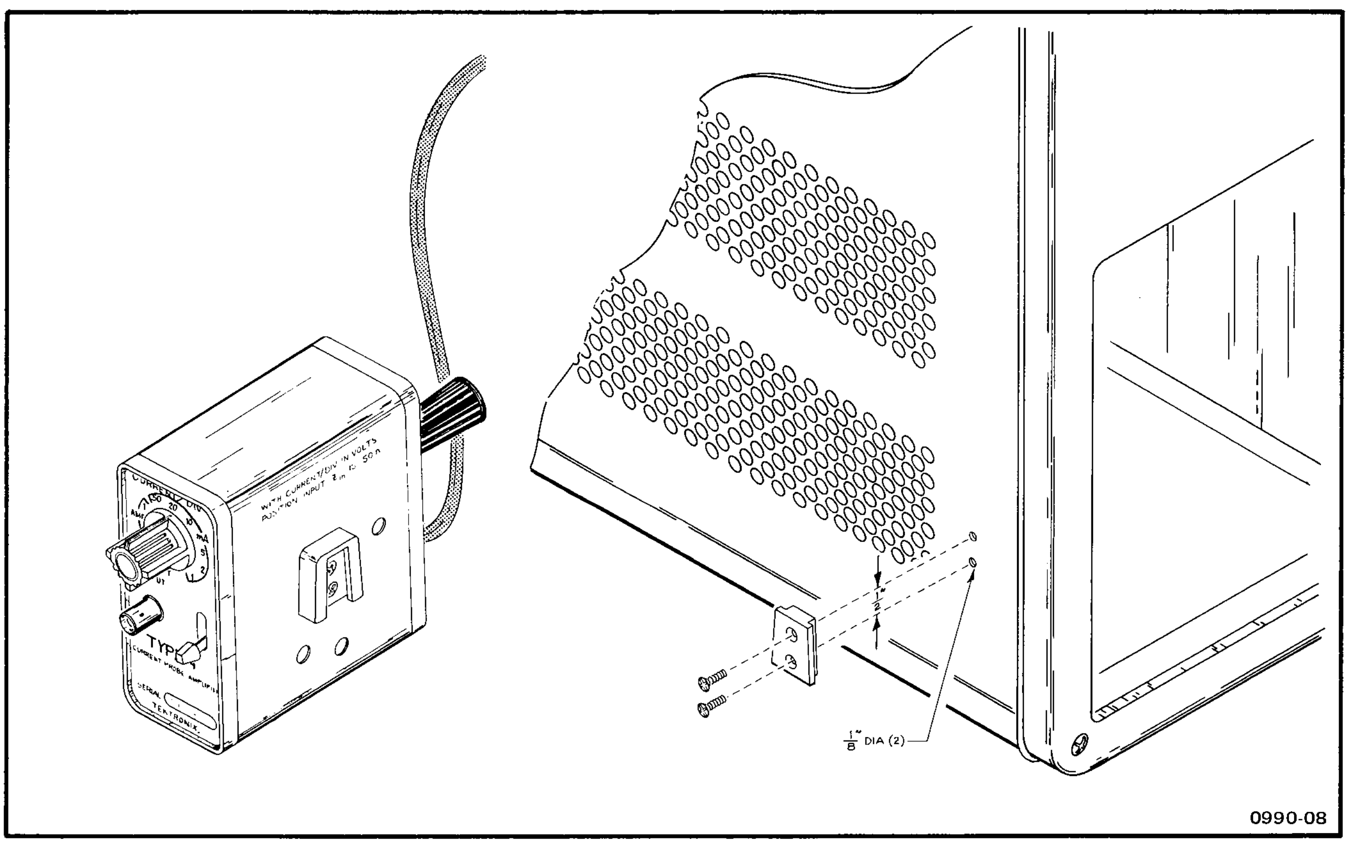


Fig. 4-3. Hanger installation.

PERFORMANCE CHECK/CALIBRATION

Introduction

This section provides procedures to be used in checking the performance or in calibrating the Type 134. Limits, tolerances, and waveforms in this section are given as calibration guides and are not necessarily instrument specifications.

To ensure measurement accuracy, check the calibration of the Type 134 every 1000 hours of operation, or every six months if used infrequently. Before calibration, thoroughly clean and inspect the instrument as outlined in the Maintenance section.

Completion of each step in the Calibration Procedure checks this instrument to the original performance standards and gives the procedure to set each adjustment to its optimum setting. Where possible, instrument performance is checked before an adjustment is made. For best overall instrument performance make each adjustment to the exact setting even if the CHECK is within the allowable tolerance. (See Fig. 5-1 for location of adjustments.)

Short-Form Procedure

The Short-Form Procedure lists the step numbers and titles of the complete Performance Check/Calibration Procedure and gives the page on which each step begins. Therefore, the Short-Form Procedure can be used as an index to the steps in the complete procedure.

The Short-Form Procedure also lists the adjustments necessary for each step and the applicable tolerance for correct calibration. The experienced calibrator who is familiar with the calibration of this instrument can use this procedure to facilitate checking or calibrating this instrument.

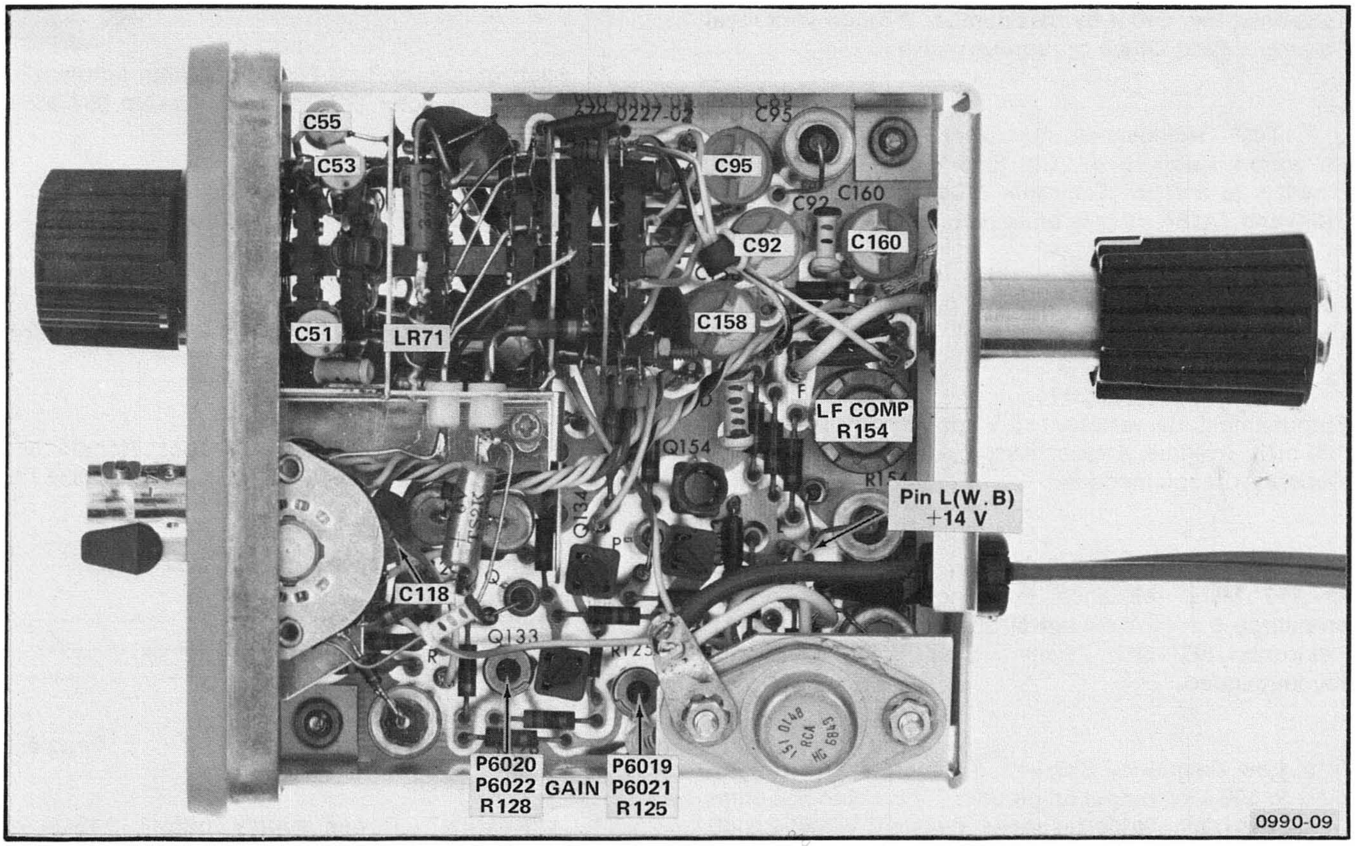


Fig. 5-1. Location of adjustments in Type 134.

The Short-Form procedure can be reproduced and used as a permanent record of instrument calibration.

Performance Check

The Calibration Procedure can be used as a performance checkout procedure by completing all portions except the ADJUST— part of a step (in Step 3, LF COMP, the adjustment must be performed.) This checks the Type 134 to the original performance without removing the instrument cover.

EQUIPMENT REQUIRED

General

The following items are required for complete calibration of the Type 134. Specifications given are the minimum necessary for accurate calibration. All test equipment is assumed to be correctly calibrated and operating within the given specifications. If equipment is substituted, it must equal or exceed the specifications of the recommended equipment.

For the quickest and most accurate calibration, special Tektronix calibration fixtures are used where necessary. These special calibration fixtures are available from Tektronix, Inc. Order by part number through your local Tektronix Field Office or representative.

1. Test Oscilloscope. Bandwidth, DC to 150 MHz; deflection factor, 5 mV/Div to 5 V/Div; sweep range, 5 ns/Div to 5 s/Div. Tektronix 7704A Oscilloscope with 7B50 and 7A16A plug-in units recommended.

2. 1X Passive Probe. Tektronix P6011.

3. Pulse Generator. Frequency, 10 Hz to 250 MHz; output amplitude, variable to 5 V into 50 ohms (variable to 100 mA); risetime, 1 ns or less. Tektronix PG 502 Pulse Generator recommended.

4. Leveled Sine-Wave Generator. Frequency, 250 kHz to 250 MHz; reference frequency, 50 kHz; output amplitude, 5 mV to 5.5 V into 50 ohms (variable to 110 mA). Tektronix SG 503 Leveled Sine Wave Generator recommended.

5. Low Frequency Sine-Wave Generator. Frequency, 5 Hz to 500 kHz; output amplitude, 7 V p-p into 600 ohms ($\approx$ 10 mA); amplitude response, constant within 0.3 dB over entire range. Tektronix SG 502 Oscillator recommended.

6. DC Voltmeter. Input R, 10 MΩ; range, 10 volts to 20 volts; accuracy, 0.1%. Tektronix DM 502 Digital Multimeter recommended.

7. Power Module for items 3, 4, 5, and 6. Tektronix TM 504.

8. Variable Autotransformer. Output range, variable from 103.5 Vac to 126.5 Vac (207 Vac to 253 Vac). For example, General Radio W10MT3W Metered Variac Autotransformer.

9. Current Probes. Tektronix P6021 (P6019) or P6022 (P6020) Current Probes.

10. Cable (2). Impedance, 50 ohms; type, RG58/U; length, 42 inches; connectors, BNC. Tektronix Part No. 012-0057-01.

11. Feedthrough Termination. Impedance, 50 ohms; connectors, BNC. Tektronix Part No. 011-0049-01.

12. Attenuators (2). Attenuation, 10X; impedance, 50 ohms; connectors, BNC. Tektronix Part No. 011-0059-02.

13. High-frequency Test Fixture. 50-ohm terminating current loop; connector, GR. Tektronix Part No. 067-0559-00.

14. Adapter. GR to BNC male. Tektronix Part No. 017-0064-00.

15. Resistor. 50 ohm (49.9 ohm ±1%; 1/2 W. Tektronix Part No. 323-0068-00).

16. Non-conducting Adjustment Tool. Handle and insert. Tektronix Part No. 003-0307-00 and 003-0334-00.

SHORT-FORM PROCEDURE

Type 134, Serial No. ______________________

Calibration date ______________________

Calibrated by ______________________

Power Supply Checks

Page 5-4

1. Check Regulation

REQUIREMENT: Power supply output +13.25 to +15.25 VDC at pin L as line voltage is varied between 103.5 and 126.5 VAC (207 and 253 VAC).

2. Check Ripple — Page 5-4

REQUIREMENT: Power supply ripple of less than 2 mV.

Current Mode

3. Adjust LF COMP — Page 5-5

REQUIREMENT: LF COMP must adjust for a straight but tilted top on the displayed square wave.

4. Check Tilt — Page 5-5

Type 134 and P6021 Probe

REQUIREMENT: Less than 3% deviation from horizontal during first 400 μs of displayed square wave.

Type 134 and P6022 Probe

REQUIREMENT: Less than 3% deviation from horizontal during first 80 μs of displayed square wave.

5. Check/Adjust GAIN — Page 5-6

Type 134 and P6021 Probe (R125)

REQUIREMENT: Correct deflection, ±3%.

Type 134 and P6022 Probe (R128)

REQUIREMENT: Correct deflection, ±3%.

6. Check/Adjust High-Frequency Compensation — Page 5-6

(C118, C160, C95, C92, C51, C53, C55, & C158)

REQUIREMENT: Aberrations less than 5% (not including effects of test oscilloscope.

7. Check Frequency Response — Page 5-7

Type 134 and P6021 Probe

REQUIREMENT: High-Frequency Response, within 3 dB at more than 36 MHz (with 100 MHz oscilloscope). Low-Frequency Response, within 3 dB at less than 12 Hz.

Type 134 and P6022

REQUIREMENT: High-Frequency Response, within 3 dB at more than 59 mHz (with 150 MHz oscilloscope). Low-Frequency Response, within 3 dB at less than 100 Hz.

8. Check High-Frequency Characteristics — Page 5-8

Type 134 and P6021 Probe Risetime

REQUIREMENT: Less than 9.6 ns (with 100 MHz oscilloscope).

Type 134 and P6022 Probe Risetime

REQUIREMENT: Less than 5.9 ns (with 150 MHz oscilloscope).

9. Check Low-Frequency Characteristics — Page 5-9

Type 134 and P6021 Probe

REQUIREMENT: Within 3 dB at less than 12 Hz: time constant, 13.2 ms.

Type 134 and P6022 Probe

REQUIREMENT: Within 3 dB at less than 100 Hz: time constant, 1.59 ms.

10. Check Noise — Page 5-10

Type 134 and P6021 or P6022 Probe

REQUIREMENT: Less than 100 μA referred to the probe input (measured tangentially).

Voltage Mode

11. Check Deflection Factor — Page 5-10

REQUIREMENT: Correct deflection, ±3%.

12. Check Frequency Response — Page 5-12

Selector switch set to P6019/P6021 position.

REQUIREMENT: Within 3 dB at more than 36 MHz (with 150 MHz oscilloscope).

Selector switch set to P6020/P6022 position.

REQUIREMENT: Within 3 dB at more than 59 MHz (with 150 MHz oscilloscope).

13. Check High-Frequency Characteristics — Page 5-12

Selector switch set to P6019/P6021 position.

REQUIREMENT: Risetime of less than 9.6 ns (with 100 MHz oscilloscope).

Selector switch set to P6020/P6022 position.

REQUIREMENT: Risetime of less than 5.9 ns (with 150 MHz oscilloscope).

14. Check Low-Frequency Characteristics — Page 5-13

Selector switch set to P6019/P6021 position.

REQUIREMENT: Within 3 dB at less than 10 Hz.

Selector switch set to P6020/P6022 position.

REQUIREMENT: Within 3 dB at less than 8 Hz.

PERFORMANCE CHECK/CALIBRATION PROCEDURE

General

The following procedure is arranged so that the Type 134 can be calibrated with the least interaction of adjustments and reconnection of equipment. The Current Mode portion of the procedure may be completed with either a P6021 Probe (or P6019) or a P6022 Probe (or P6020). The performance of the Type 134 as a voltage amplifier (Voltage Mode) is checked after the internal adjustments are made.

Each step continues from the equipment setup and control settings used in the preceding step, unless otherwise noted. External controls or adjustments of the Type 134 referred to in this procedure are capitalized (e.g., CURRENT/DIV). Internal adjustments referred to are initial capitalized only.

All waveforms shown in this procedure were taken with a Tektronix Oscilloscope Camera System. The following procedure uses the equipment listed under Equipment Required. If the equipment is substituted, control settings or equipment setup may need to be altered to meet the requirements of the equipment used. Detailed operating instructions for the test equipment are not given in this procedure. If in doubt as to the correct operation of any of the test equipment, refer to the instruction manual for that unit.

NOTE

This instrument should be calibrated at an ambient temperature of +25° C, ±5° C. The performance of this instrument can be checked at any temperature within the 0° C to +40° C range.

Preliminary Procedure for Performance Check Only

a. Connect all test equipment, including the Type 134 Power Supply, to the line voltage source.

b. Turn on all test equipment and allow twenty minutes warmup time. Set the test oscilloscope to a low intensity level.

c. Connect the power cable from the Type 134 to the Power Supply.

d. Proceed to Step 3, omitting Steps 1 and 2.

Preliminary Procedure for Complete Calibration

a. Remove the cover from the Type 134 as described in Section 4, Maintenance.

b. Set the variable line voltage source to 115 volts AC (230 volts AC).

c. Connect the Type 134 Power Supply to the variable line voltage source, and the power cable from the Type 134 to the Power Supply.

d. Connect all test equipment to a suitable line voltage source.

e. Turn on all test equipment and allow twenty minutes warmup time.

POWER SUPPLY CHECKS

1. Check Regulation

a. Set the DC Voltmeter controls to accommodate +15 volts DC.

b. Connect the DC Voltmeter between ground and the emitter of Q107. This point connects to the circuit board at pin L (see Fig. 5-1), near the power input line.

c. CHECK—The +14 V supply should be between +13.25 VDC and +15.25 VDC.

d. Vary the line voltage between 103.5 and 126.5 VAC (207 and 253 VAC).

e. CHECK—The +14 V supply should remain between +13.25 VDC and +15.25 VDC.

f. Return the variable line voltage source to 115 VAC (230 VAC).

2. Check Power Supply Ripple

a. Connect the 1X probe from the test oscilloscope vertical input to pin L. Use a ground lead on the probe.

b. Set the Volts/Div control to 5 mV/Div; input coupling AC.

c. CHECK—Power supply ripple is less than 2 mV p-p. Remove the probe and disconnect it from the test oscilloscope.

CURRENT MODE

NOTE

The Adjustment Procedure must be performed with the type of probe to be used because the LF COMP and high-frequency adjustments differ for each type of probe.

3. Adjust LF Comp

a. Connect the Type 134 to the vertical input of the test oscilloscope.

b. Set the test oscilloscope input to DC, the Volts/Div to 50 mV, and the sweep rate to 5 ms/Div (for the P6021) or 0.5 ms/Div (for the P6022).

c. Connect the 067-0559-00 High-Frequency Test Fixture to the pulse generator Output connector.

d. Connect the appropriate probe from the Type 134 to the Test Fixture. Be sure that the probe slider is fully closed.

e. Set the Type 134 CURRENT/DIV switch to 10 mA, and the probe selector switch to the appropriate position.

f. Obtain a triggered display of five to ten cycles of the signal by setting the pulse generator Period switch to 1 ms (P6021) or 0.1 ms (P6022), setting the pulse duration to square wave, and adjusting the Var control.

g. Adjust the output (Volts) control for a six-division display.

h. ADJUST—LF COMP (R154) for a straight slope on the square wave top. (See Fig. 5-1.) Fig. 5-2 illustrates correct and incorrect adjustments of LF Comp.

4. Check Tilt

a. With connections the same as for Step 3, set the test oscilloscope input to GND and the sweep rate to 5 ms/Div (for the P6021), or 0.5 ms/Div (for the P6022). Obtain a free-running trace. Position the trace on the center horizontal graticule line. Adjust the test oscilloscope Trace Rotation control until the trace is parallel with the center horizontal graticule line.

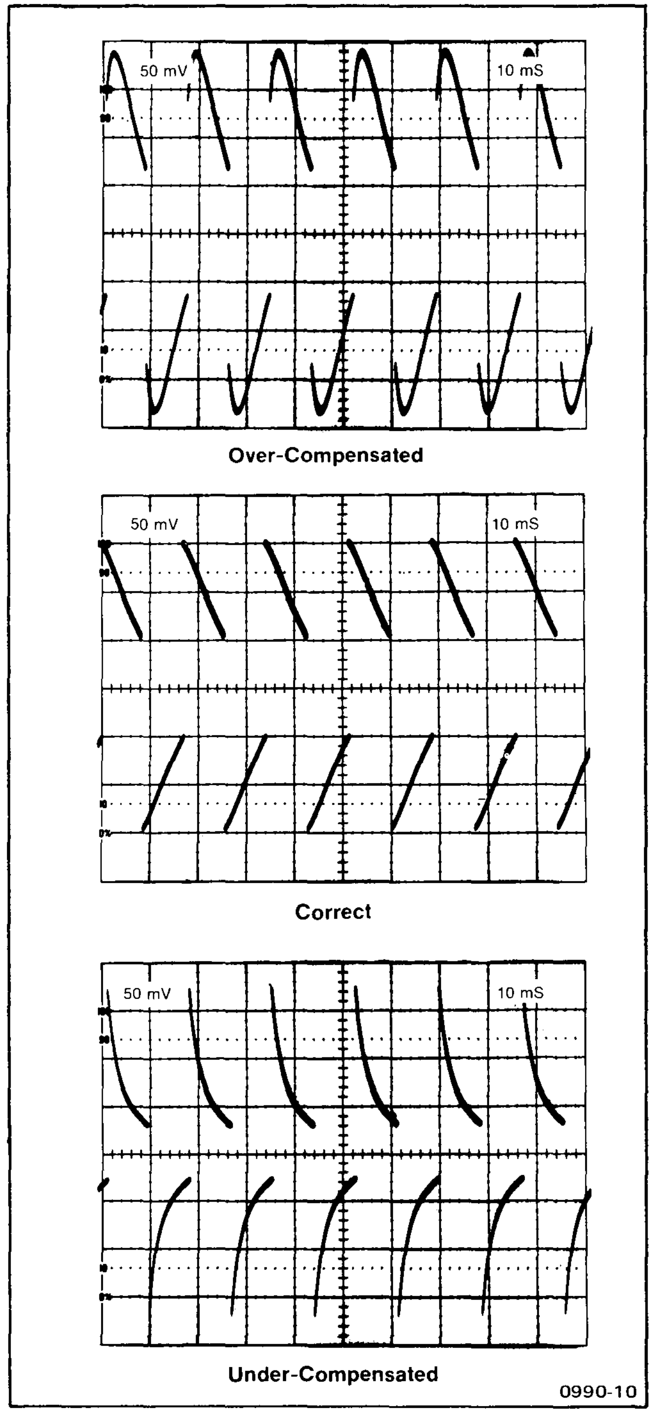


Fig. 5-2. Adjustment of LF COMP.

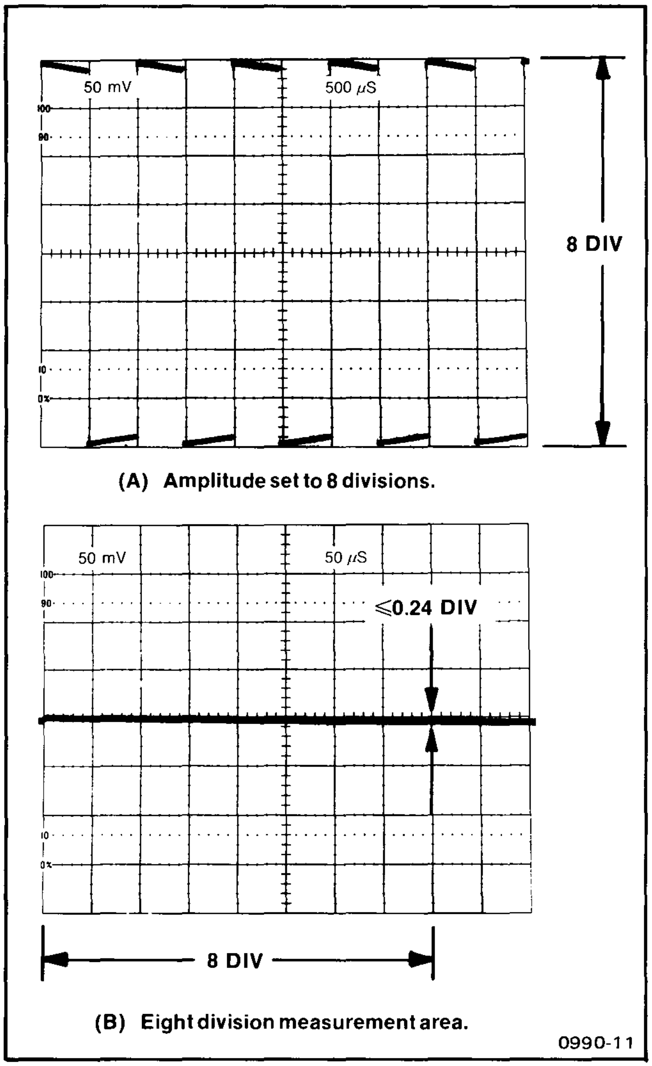


Fig. 5-3. Tilt measurement.

b. Set the test oscilloscope input to DC, the Volts/Div switch to 50 mV, the Type 134 to 5 mA/Div, and the pulse generator Period controls to display five cycles. Adjust the OUTPUT (VOLTS) for eight divisions of deflection, see Fig. 5-3A.

c. Change the sweep rate to 50 ms/Div for the P6021 or 10 ms/Div for the P6022. Vertically position the signal top on the center horizontal graticule line.

d. CHECK—For CRT trace deviation of less than 0.24 division during the first eight divisions of the displayed square wave. (See Fig. 5-3B.)

5. Check/Adjust Gain

a. Connect the 50-ohm resistor between the 0.4 V Calibrator output and GND on the test oscilloscope. With a 50-ohm load, the Calibrator on this range becomes 0.2 V, or 4 mA p-p.

b. Connect the appropriate probe to one lead of the 50-ohm resistor.

c. Set the Type 134 CURRENT/DIV to 1 mA, the test oscilloscope sweep rate to 500 µs/Div, and the Volts/Div to 50 mV.

d. CHECK—For CRT display of four divisions of deflection, ±3%, not including calibrator error.

e. ADJUST—P6019/P6021 Gain (R125), or P6020/P6022 Gain (R128), for four divisions of deflection. (See Fig. 5-1.) Remove the 50-ohm resistor.

6. Check/Adjust High-Frequency Compensation

a. Connect the High-Frequency Test Fixture to the pulse generator Output connector, using the GR to BNC male adapter (017-0064-00).

b. Connect the probe from the Type 134 to the test fixture.

c. Connect the +Trig Out from the pulse generator to the Ext Trig In connector on the test oscilloscope, using the 50-ohm cable and in-line termination.

d. Set the test oscilloscope sweep rate to .05 µs/Div and the trigger source to external.

e. Set the CURRENT/DIV to 5 mA, and the test oscilloscope Volts/Div to 50 mV.

f. Set the pulse generator Pulse Duration control to SQ Wave and the Period control to 1 µs. Adjust the Output (Volts) controls for six divisions of deflection, then obtain a stable display of the waveform leading edge.

g. CHECK—Front-corner square-wave aberrations of less than 5%, excluding the effects of the test oscilloscope. Fig. 5-4 illustrates typical response when high-frequency compensation is properly adjusted (5% x 6 Div = .3 Div). Excessive aberrations caused by the generator can be reduced by pulling the Back Termination switch on the pulse generator.

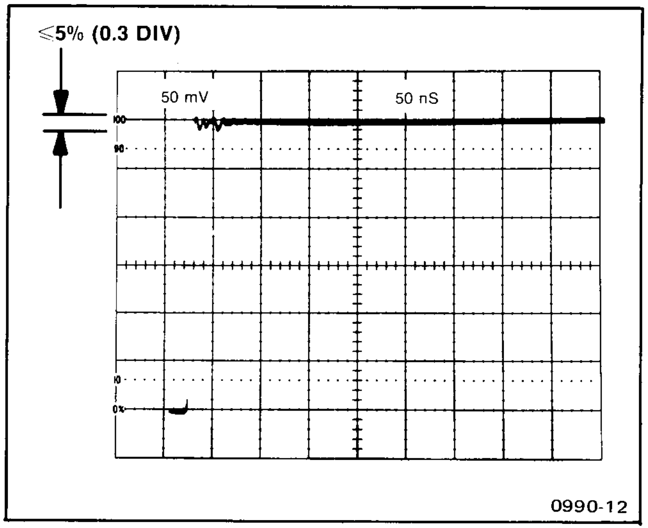


Fig. 5-4. Pulse response with high frequency compensation properly adjusted.

h. ADJUST—C118 and C160, see Fig. 5-1, (also C158 with P6021) for best front corner on the displayed square wave.

i. Set the CURRENT/DIV switch to 50 mA and reset the pulse generator Output (Volts) for six divisions of deflection. (Change the test oscilloscope Volts/Div to obtain adequate deflection). If the front corner has excessive fast overshoot, readjust C118 and C160 for the best compromise when switching between the 5 mA and 50 mA positions.

j. Set the CURRENT/DIV switch to 2 mA, the Volts/Div to 50 mV, and adjust the pulse generator Output (Volts) for six divisions of deflection.

k. CHECK—Front-corner square-wave aberrations of less than 5%, excluding the effects of the test oscilloscope.

l. ADJUST—C95 (see Fig. 5-1) for best front corner on the displayed square wave.

m. Set the CURRENT/DIV switch to 1 mA and reset the pulse generator Output (Volts) for six divisions of deflection.

n. CHECK—Front-corner square-wave aberrations of less than 5%, not including the effects of the test oscilloscope.

o. ADJUST—C92 and C51 (see Fig. 5-1) for best front corner on the displayed square wave.

p. Set the CURRENT/DIV switch to 5 mA and reset the pulse generator Output (Volts) for six divisions of deflection.

q. CHECK—Front-corner square-wave aberrations of less than 5%, not including the effects of the test oscilloscope.

r. ADJUST—C53 (see Fig. 5-1) for minimum aberrations.

s. Set the CURRENT/DIV switch to 20 mA, change the test oscilloscope Volts/Div to 20 mV, and adjust the pulse generator Output (Volts) for six divisions of deflection.

t. CHECK—Front-corner square-wave aberrations of less than 5%, not including the effects of the test oscilloscope.

u. ADJUST—C55 (see Fig. 5-1) for minimum aberrations.

NOTE

When checking the 20 mA setting, LR71 may need positioning for best response.

v. Recheck the 1 mA through 1 A positions of the CURRENT/DIV switch for shape of the waveform. From 20 mA/Div to 1 A/Div, the test oscilloscope Volts/Div control will have to be advanced to provide adequate deflection. At settings of .2 A, .5 A, and 1 A, six divisions of deflection will not be attainable.

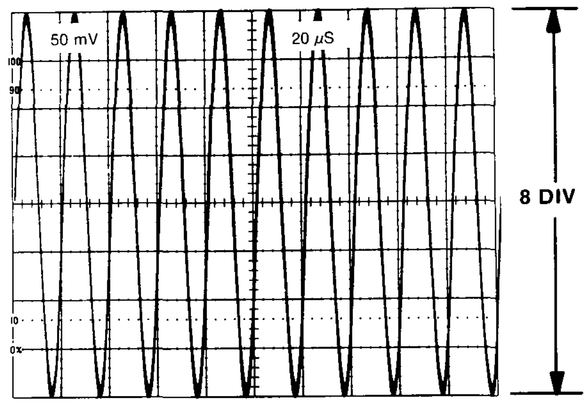
NOTE

Two separate procedures are used to check response of the amplifier/probe system, for both P6021 and P6022 probes. Step 7 checks frequency response of the system to sine waves. Steps 8 and 9 check the response characteristics of the system to pulses.

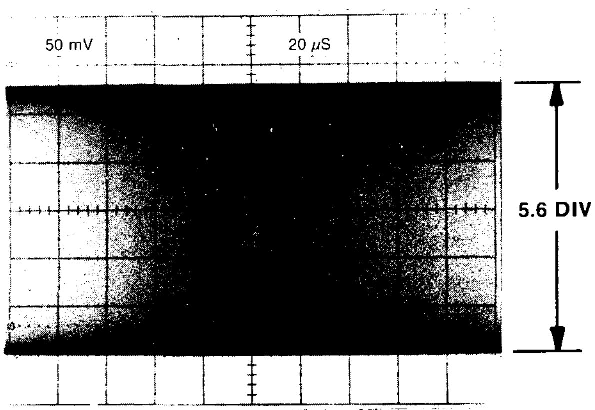
7. Check Frequency Response

a. Connect the 067-0559-00 High-Frequency Test Fixture to the output of the constant-amplitude sine-wave generator.

b. Connect the probe from the Type 134 to the test fixture.



(A) Setting 50 kHz reference amplitude.



(B) Checking upper −3 dB frequency.

0990-13

Fig. 5-5. High-frequency response check, showing 8-division reference and 5.6-division −3 dB frequency.

c. Set the CURRENT/DIV switch to 5 mA and the test oscilloscope sweep rate to 20 μs/Div.

d. Set the constant-amplitude signal frequency to 50 kHz and adjust the output amplitude for eight divisions of deflection. (See Fig. 5-5A.)

e. Increase the frequency of the signal generator until the display reduces in amplitude to 5.6 divisions. (See Fig. 5-5B.)

f. CHECK—Signal generator output frequency should be more than 36 MHz for a P6021 (using a test oscilloscope having a bandwidth of at least 100 MHz). Signal generator output frequency should be at least 59 MHz for a P6022 (using a test oscilloscope having a bandwidth of at least 150 MHz).

g. Remove the probe and test fixture from the signal generator output.

h. Connect the test fixture to the sine-wave output of the oscillator.

i. Connect the probe from the Type 134 to the test fixture.

j. Set the frequency of the oscillator to 20 kHz, the test oscilloscope Volts/Div switch to 20 mV, and adjust the output amplitude for eight divisions of deflection (similar to Fig. 5-5A).

k. Reduce the frequency of the oscillator until the display reduces in amplitude to 5.6 divisions. (Display should be similar to Fig. 5-5B.)

l. CHECK—Oscillator output frequency should be less than 12 Hz (P6021) or 100 Hz (P6022).

m. Remove the probe and test fixture from the oscillator.

8. Check High-Frequency Characteristics

NOTE

This step measures risetime of a fast-rise pulse, giving a direct indication of the high-frequency characteristics. Risetime can be converted to frequency by the formula:

$$F = \frac{.35}{T_r}$$

where f is in hertz, and T_r is in seconds.

a. Connect the 067-0559-00 High-Frequency Test Fixture to the output of the pulse generator.

b. Connect the probe from the Type 134 to the test fixture.

c. Set the CURRENT/DIV switch to 5 mA, the test oscilloscope sweep rate to .05 μs/Div, and the Volts/Div to 50 mV.

d. Connect the +Trig Out from the pulse generator to the Ext Trig In connector on the test oscilloscope, using the 50-ohm cable and in-line termination. Set the test oscilloscope trigger source to external.

e. Set the pulse generator Pulse Duration control to SQ Wave and the Period control to 1 μs. Set the Output (Volts) for six divisions of deflection, and set the test oscilloscope triggering controls for a stable display (see Fig. 5-4).

f. Center the display vertically and change the sweep rate to 5 ns/Div. (Use the X10 magnifier.) Center the leading edge of the signal, using the Horizontal Position control.

g. CHECK—For the P6021, risetime of less than 9.6 ns (using an oscilloscope bandwidth of at least 100 MHz); for the P6022, risetime of less than 5.9 ns (using an oscilloscope bandwidth of at least 150 MHz). Risetime is measured from 10% (0.6 Div) above the pulse baseline to 90% (5.4 Div) above the pulse baseline. A risetime graticule is recommended for this measurement. (See Fig. 5-6.)

h. Remove the probe, test fixture, and 50-ohm cable from the pulse generator.

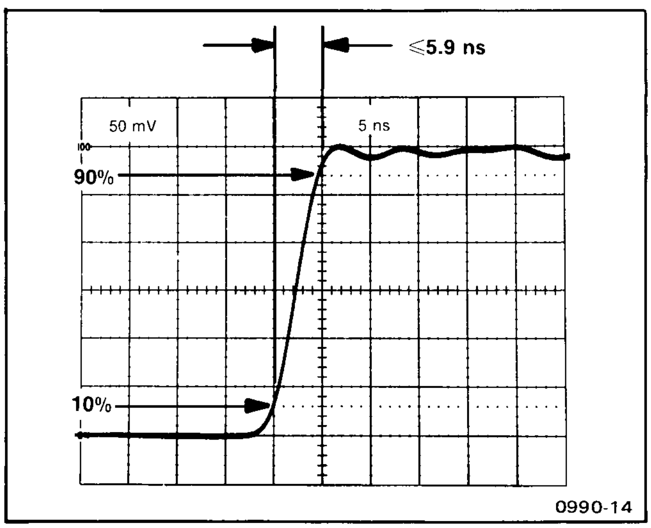


Fig. 5-6. Risetime measurement, showing response of Type 134/P6022.

9. Check Low-Frequency Characteristics

NOTE

This step measures the time-constant decay of a long-duration pulse, giving a direct indication of the low-frequency characteristics. The time constant can be converted to the lower frequency response by the formula:

$$f = \frac{.159}{TC}$$

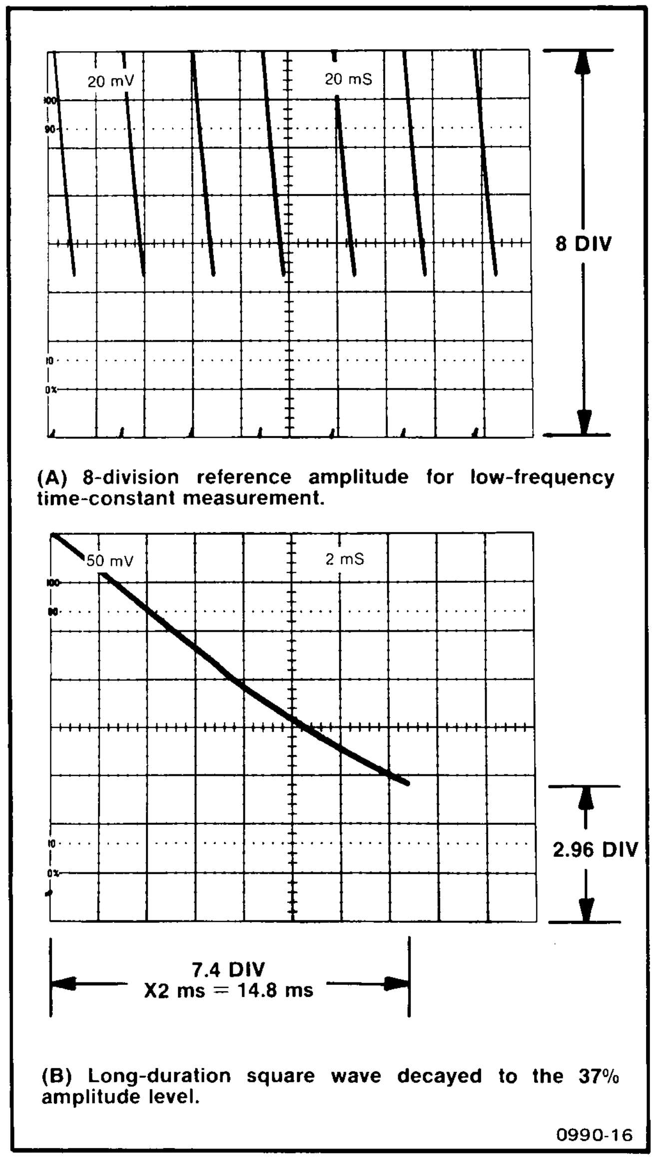
where f is in hertz, and TC is the time in seconds for the pulse to decay to 37% amplitude.

a. Connect the 067-0559-00 High-Frequency Test Fixture to the output of the pulse generator.

b. Connect the probe from the Type 134 to the test fixture.

c. Set the CURRENT/DIV switch to 5 mA, the test oscilloscope sweep rate to 20 ms/Div, the deflection factor to 50 mV, and the vertical input coupling switch to DC.

d. Set the pulse generator Pulse Duration control to SQ Wave and set the period controls to obtain 7 or 8 cycles across the screen. Adjust the Output (Volts) controls for eight divisions of deflection from leading edge of positive half cycle to trailing edge of negative half cycle. The display should be similar to Fig. 5-7A.



(A) 8-division reference amplitude for low-frequency time-constant measurement.

(B) Long-duration square wave decayed to the 37% amplitude level.

Fig. 5-7. Measurement of the low-frequency time-constant of Type 134/P6021.

e. Change the sweep rate to 2 ms/Div (P6021) or 1 ms/Div (P6022).

f. Carefully position the display so that the start of the positive half cycle is in the upper left corner of the graticule.

g. Vary the pulse generator Period Variable control (while maintaining the display start position in the upper left corner of the graticule) until the end of the positive half cycle occurs just below three divisions up from the bottom graticule line (37% X 8 Div = 2.96 Div).

h. CHECK—Display amplitude, from leading edge to trailing edge of positive excursion of square wave, should decay to 37% amplitude level as follows: using a P6021, the time constant must be more than 13.2 ms to be equivalent to a low-frequency 3 dB point of less than 12 Hz; using a P6022, the time constant must be more than 1.59 ms to be equivalent to a low-frequency 3 dB point of less than 100 Hz. To find equivalent frequency, apply the formula:

$$f = \frac{.159}{TC}$$

For example, Fig. 5-7B shows a time constant of 14.8 ms. Applying the formula:

$$f = \frac{.159}{.0148} = 10.74 \text{ Hz.}$$

i. Remove the probe and test fixture from the pulse generator output.

10. Check Noise

NOTE

In this procedure, noise is measured tangentially. A square-wave signal is applied to the system with the test oscilloscope and Type 134 set at highest sensitivity. System noise then rides on the postive and negative portions of the square wave. The time base is set to free-run, so that the display appears as two parallel bands of noise across the CRT. Amplitude of the square wave determines separation of the traces. The amplitude is adjusted until the two traces appear to be contiguous (just merged at their adjacent edges). Measurement of the applied square-wave amplitude then determines a noise value that correlates closely with the value interpreted by the eye from the cathode-ray tube display.

a. Connect the two 011-0059-02 10X attenuators in series with the output of the pulse generator. Connect the 067-0559-00 High-Frequency Test Fixture to the output of the attenuators.

b. Connect the probe from the Type 134 to the test fixture.

c. Set the CURRENT/DIV switch to 1 mA and the test oscilloscope deflection factor to 5 mV/Div. Set the sweep rate to 50 μs/Div.

d. Set the pulse generator Pulse Duration control to SQ Wave and the Period control to 1 ms.

e. Set the test oscilloscope triggering controls for a free-running display (two separated traces). Set the pulse generator Output (Volts) controls to obtain approximately one division of separation between the positive and negative portions (the upper and lower traces). See Fig. 5-8A.

f. Adjust the pulse generator Output (Volts) controls until the inner (adjacent) portions of the two traces just merge (the point at which the dark band between the traces just disappears). Fig. 5-8B illustrates the display when the amplitude is properly set for this measurement.

g. Remove the two 10X attenuators from the pulse generator output and re-attach the test fixture to the output.

h. Set the CURRENT/DIV switch to 2 mA and the test oscilloscope deflection factor to 50 mV/Div.

i. CHECK—Displayed amplitude of less than 7.5 divisions. This amplitude indicates 15 mA, but since 100X attenuation was removed, the reading must be divided by 100, equaling 150 μA. (See Fig. 5-8C.)

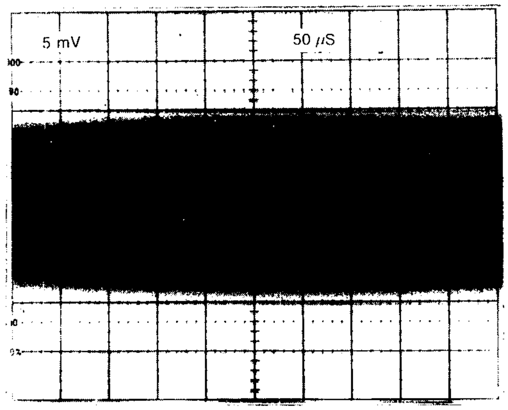
j. Remove the probe and test fixture from the pulse generator.

VOLTAGE MODE

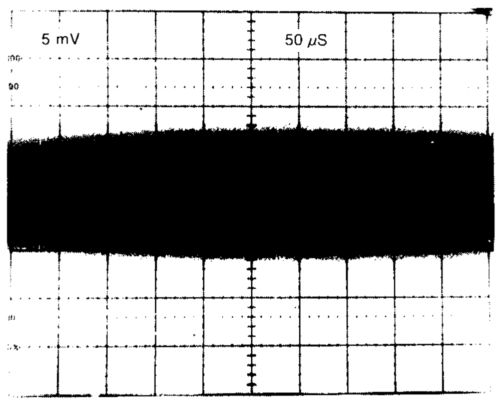
11. Check Deflection Factor

NOTE

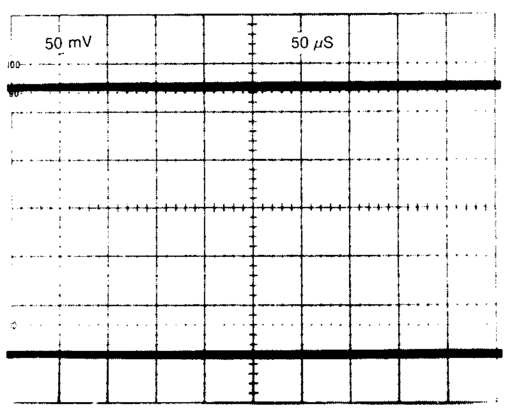
The adjustments for gain (or deflection factor) were made in Step 5, using current probes. The adjustments permit correction from probe to probe for small differences in the probe transformer turns ratios, as well as amplification differences in the amplifier transistors. If the Type 134 is to be used extensively in the VOLTS ONLY mode, gain may be set in this mode. For the .4 mV (P6019/P6021)



(A) Initial display, with excessive amplitude.



(B) Amplitude properly set.



(C) Amplitude measurement. This example shows 5.5 div X 2 mA = 11 mA. Divided by 100 = 100 μA.

0990-15

Fig. 5-8. Tangential noise measurement.

position of the probe selector switch, set R125; for 1 mV (P6020/P6022), set R128. When returning to current mode measurements using current probes, be sure to adjust the gain if necessary.

a. Disconnect the Type 134 from the test oscilloscope. Check the deflection accuracy of the test oscilloscope at 50 mV/Div and adjust as necessary. Set the sweep rate at 0.5 ms/Div.

b. Using the 50-ohm in-line termination and BNC cable, connect the oscillator sine-wave output to the vertical input of the test oscilloscope.

c. Set the oscillator output frequency to 5 kHz.

d. Adjust the oscillator variable attenuator to obtain four divisions of deflection on the CRT. The step attenuators should be disengaged to obtain sufficient amplitude.

e. Remove the termination from between the BNC cable and the oscilloscope. Connect the Type 134 to the vertical input. Set the CURRENT/DIV switch to VOLTS ONLY and set the probe selector switch to P6019/P6021 (.4 mV).

f. Select 40 dB attenuation on the oscillator. Connect the sine-wave output of the oscillator to the input of the Type 134, using the BNC cable.

g. CHECK—CRT deflection of five divisions, ±3% (±.15 Div). Gain set by R125 in Step 5.

h. Set the probe selector switch to P6020/P6022 (1 mV).

i. Set the test oscilloscope Volts/Div to 20 mV/Div.

. CHECK—For CRT deflection of five divisions, ±3% (±.15 Div). Gain set by R128 in Step 5.

NOTE

If unable to obtain an oscillator with step attenuators, use two 50-ohm, BNC, 10X attenuators to effect the 40 dB attenuation (011-0059-02).

Step 11 can also be performed by use of a square-wave generator in lieu of the oscillator, using the two 10X attenuators for 40 dB attenuation.

NOTE

Two separate procedures are used to check response of the amplifier in the Voltage mode. Step 11 checks frequency response of the amplifier to *sine waves. Steps 12 and 13 check the frequency response characteristics of the system to pulses, each using a different method for measurement.*

12. Check Frequency Response

a. Set the probe selector switch to P6019/P6021 (.4 mV).

b. Set the test oscilloscope deflection factor to 50 mV/Div and the sweep rate to 20 μs/Div.

c. Connect the output of the constant-amplitude sine-wave generator, through 10X attenuator, to the Type 134 input.

d. Set the constant-amplitude sine-wave generator to 50 kHz and adjust the output amplitude for eight divisions of deflection.

e. Increase the frequency of the sine-wave generator until the display reduces in amplitude to 5.6 divisions.

f. CHECK—Sine-wave generator output frequency is at least 36 MHz. Test oscilloscope bandwidth must be at least 150 MHz.

g. Set the probe selector switch to P6020/P6022 (1 mV).

h. Set the constant-amplitude sine-wave generator to 50 kHz and adjust the output amplitude for eight divisions of deflection.

i. Increase the frequency of the sine-wave generator until the display reduces in amplitude to 5.6 divisions.

j. CHECK—Sine-wave generator output frequency is at least 59 MHz.

k. Disconnect the sine-wave generator and the 10X attenuator from the Type 134 input.

l. Connect the sine-wave output of the oscillator to the Type 134 input.

m. Set the sweep rate to 2 ms, the generator frequency to 5 kHz, and adjust the attenuation for a 8-division display.

n. Decrease generator frequency until 5.6 divisions are displayed.

o. CHECK—Low-frequency sine-wave output frequency is less than 8 Hz.

p. Change probe selector switch to P6019/P6021 (.4 mV).

q. Repeat parts m and n of this step.

r. CHECK—Low-frequency sine-wave frequency is less than 10 Hz.

s. Disconnect the Type 134 from the oscillator.

13. Check High-Frequency Characteristics

NOTE

This step measures risetime of a fast-rise pulse, giving a direct indication of the high-frequency characteristics. (Risetime can be converted to equivalent frequency by the formula:

$$F = \frac{.35}{T_r}$$

where F is in hertz, and T_r is in seconds.

a. Connect two 10X attenuators in series to the output of the pulse generator. Connect the output of the attenuators to the input of the Type 134, using a 50-ohm cable.

b. Set the pulse generator Pulse Duration control to SQ Wave and the Period control to 1 μs. Connect the +Trig Out from the pulse generator to the Ext Trig In connector on the test oscilloscope.

c. Set the Type 134 probe selector switch to P6019/P6021 (.4 mV).

d. Set the test oscilloscope trigger source to external and the sweep rate to .05 μs.

e. Set the test oscilloscope triggering controls for a stable display of the leading edge of the signal, then adjust the pulse generator Output (Volts) controls for six divisions of deflection.

f. Center the display vertically and change the sweep rate to 5 ns/Div (use the X10 magnifier).

g. CHECK—Risetime of less than 9.6 ns (using an oscilloscope bandwidth of at least 100 MHz), between the points 0.6 division up from the bottom of the display and 0.6 division down from the top of the display (10% and 90% levels). Refer to Section 1 for other examples of equipment.

h. Set the probe selector switch to P6020/P6022 (1 mV).

i. Set the pulse generator Output (Volts) controls for six divisions of deflection.

j. CHECK—Risetime of less than 5.9 ns (using an oscilloscope bandwidth of at least 150 MHz).

k. Disconnect all signal cables.

14. Check Low-Frequency Characteristics

NOTE

This step measures the time constant decay of a long duration pulse, giving a direct indication of the low-frequency characteristics. The time constant can be converted to the lower frequency response by the formula:

$$f = \frac{.159}{TC}$$

where f is in hertz and TC = time constant (time in seconds for pulse to decay to 37% amplitude).

a. Connect two 10X attenuators in series to the output of the pulse generator. Connect the output of the attenuators to the input of the Type 134, using a 50-ohm cable. Also connect the pulse generator trigger output to the external trigger input.

b. Set the probe selector switch to P6019/P6021 (.4 mV) and the test oscilloscope sweep rate to 20 ms/Div, triggered normal and external.

c. Set the pulse generator Pulse Duration control to SQ Wave and adjust the Period controls to obtain 7 or 8 cycles across the screen. Set the Output (Volts) controls for eight divisions of deflection (from leading edge of the positive half cycle to trailing edge of the negative half cycle). The display should be similar to Fig. 5-7A.

d. Set the test oscilloscope sweep rate to 5 ms/Div.

e. Carefully position the display so that the start of the positive half cycle is in the exact upper left corner of the graticule.

f. Adjust the pulse generator Period Variable control (while maintaining the display start position in the upper left corner of the graticule) until the end of the positive half cycle occurs just below 3 divisions up from the bottom graticule line (37% X 8 divisions = 2.96 divisions).

g. CHECK—Display amplitude, from leading edge to trailing edge of positive excursion of square wave, should decay to 37% amplitude as follows: for an equivalent low-frequency 3 dB point of less than 10 Hz, the time constant must be at least 15.9 ms. To convert to equivalent frequency, apply the formula:

$$f = \frac{.159}{TC}$$

h. Set the probe selector switch to P6020/P6022 (1 mV) and the test oscilloscope sweep rate to 20 ms/Div.

i. Set the pulse generator Pulse Duration control to SQ Wave and set the Period controls to obtain 7 or 8 cycles across the screen. Set the Output (Volts) controls for eight divisions of deflection.

j. Set the test oscilloscope sweep rate to 5 ms/Div.

k. Repeat parts e through g, except as follows: in part g, for equivalent low-frequency 3 dB point of less than 8 Hz, the time constant must be at least 19.9 ms.

l. Disconnect all test equipment. This completes the Performance Check or Calibration procedure.

REPLACEABLE ELECTRICAL PARTS

PARTS ORDERING INFORMATION

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

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

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

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

SPECIAL NOTES AND SYMBOLS

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

ITEM NAME

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

ABBREVIATIONS

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

CROSS INDEX MFR. CODE NUMBER TO MANUFACTURER

MFR.CODE	MANUFACTURER	ADDRESS	CITY,STATE,ZIP
01121	ALLEN-BRADLEY CO.	1201 2ND ST. SOUTH	MILWAUKEE, WI 53204
02735	RCA CORP., SOLID STATE DIVISION	ROUTE 202	SOMERVILLE, NY 08876
03888	KDI PYROFILM CORP.	60 S. JEFFERSON RD.	WHIPPANY, NJ 07981
04222	AVX CERAMIC CORP.	P.O. BOX 867	MURTLE BEACH, SC 29577
05397	UNION CARBIDE CORP., MATERIALS SYSTEMS DIVISION	11901 MADISON AVE.	CLEVELAND, OH 44101
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS ST.	MOUNTAIN VIEW, CA 94042
12954	DICKSON ELECTRONICS CORP.	8700 E. THOMAS RD.	SCOTTSDALE, AZ 85252
56289	SPRAGUE ELECTRIC CO.		NORTH ADAMS, MA 01247
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
75915	LITTELFUSE, INC.	800 E. NORTHWEST HWY	DES PLAINES, IL 60016
78488	STACKPOLE CARBON CO.		ST. MARYS, PA 15857
80009	TEKTRONIX, INC.	P. O. BOX 500	BEAVERTON, OR 97077
80740	BECKMAN INSTRUMENTS, INC.	2500 HARBOR BLVD.	FULLERTON, CA 92634
81483	INTERNATIONAL RECTIFIER CORP.	9220 SUNSET BLVD.	LOS ANGELES, CA 90069
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NB 68601
95712	BENDIX CORP., THE ELECTRICAL COMPONENTS DIV., MICROWAVE DEVICES PLANT	HURRICANE ROAD	FRANKLIN, IN 46131

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1	670-0227-00	100	1849	CKT BOARD ASSY:AMPLIFIER	80009	670-0227-00
A1	670-0227-01	1850	6539	CKT BOARD ASSY:AMPLIFIER	80009	670-0227-01
A1	670-0227-02	6540		CKT BOARD ASSY:AMPLIFIER	80009	670-0227-02
C51	281-0579-00	100	4589	CAP.,FXD,CER DI:21PF,5%,500V	72982	301-050C0G0210J
C51	281-0123-00	4590		CAP.,VAR,CER DI:5-25PF,100V	72982	518-000A5-25
C52	281-0657-00	X4590		CAP.,FXD,CER DI:13PF,2%,500V	72982	374-005C0G0130G
C53	281-0564-00	100	6539	CAP.,FXD,CER DI:24PF,5%,500V	72982	301-000C0G0240J
C53	281-0123-00	6540		CAP.,VAR,CER DI:5-25PF,100V	72982	518-000A5-25
C55	281-0616-00	100	4589	CAP.,FXD,CER DI:6.8PF,+/-0.5PF,200V	72982	374-001C0H0689D
C55	281-0123-00	4590		CAP.,VAR,CER DI:5-25PF,100V	72982	518-000A5-25
C57	281-0612-00	100	6539X	CAP.,FXD,CER DI:5.6PF,+/-0.5PF,500V	72982	374-001C0H0569D
C57	281-0122-00	X8640		CAP.,VAR,CER DI:2.5-9PF,100V	72982	518-000A2.5-9
C66	281-0603-00	100	6539X	CAP.,FXD,CER DI:39PF,5%,500V	72982	308-000C0G0390J
C68	283-0054-00			CAP.,FXD,CER DI:150PF,5%,200V	72982	855-535U2J151J
C69	281-0516-00	X6540	8639X	CAP.,FXD,CER DI:39PF,+/-3.9PF,500V	72982	301-000U2J0390K
C73	281-0651-00	100	6539	CAP.,FXD,CER DI:47PF,5%,200V	72982	374-001T2H0470J
C73	283-0060-00	6540	8639	CAP.,FXD,CER DI:100PF,5%,200V	72982	855-535U2J101J
C73	281-0549-00	8640		CAP.,FXD,CER DI:68PF,10%,500V	72982	301-000U2J0680K
C75	281-0617-00			CAP.,FXD,CER DI:15PF,10%,200V	72982	374-001C0G0150K
C92	281-0092-00			CAP.,VAR,CER DI:9-35PF	72982	538-011 D9-35
C95	281-0091-00			CAP.,VAR,CER DI:2-8PF	72982	538-011 A2-8
C98	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8141N038651105Z
C99	290-0298-00	100	3649	CAP.,FXD,ELCTLT:1000UF,20%,6V	05397	T140D108M006AS
C99	290-0326-00	3650		CAP.,FXD,ELCTLT:820UF,10%,6V	56289	109D827X9006F2
C105	290-0273-00			CAP.,FXD,ELCTLT:68UF,10%,60V	56289	109D686X9060T2
C106	290-0296-00			CAP.,FXD,ELCTLT:100UF,20%,20V	56289	150D107X0020S2
C107	290-0296-00			CAP.,FXD,ELCTLT:100UF,20%,20V	56289	150D107X0020S2
C108	290-0267-00	100	9749	CAP.,FXD,ELCTLT:1UF,20%,35V	56289	162D105X0035CD2
C108	283-0177-00	9750		CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039651105Z
C110	290-0139-00			CAP.,FXD,ELCTLT:180UF,20%,6V	12954	D180C6M1
C112	290-0139-00			CAP.,FXD,ELCTLT:180UF,20%,6V	12954	D180C6M1
C114	290-0167-00			CAP.,FXD,ELCTLT:10UF,20%,15V	56289	150D106X0015B2
C118	281-0092-00			CAP.,VAR,CER DI:9-35PF	72982	538-011 D9-35
C121	290-0138-00			CAP.,FXD,ELCTLT:330UF,20%,6V	05397	T110D337M006AS
C125	290-0248-01			CAP.,FXD,ELCTLT:150UF,20%,15V	56289	150D157X0015S2
C130	290-0297-00			CAP.,FXD,ELCTLT:39UF,10%,10V	56289	150D396X9010B2
C131	281-0616-00			CAP.,FXD,CER DI:6.8PF,+/-0.5PF,200V	72982	374-001C0H0689D
C132	290-0114-00	X1850		CAP.,FXD,ELCTLT:47UF,20%,6V	56289	150D476X0006B2
C139	281-0589-00	100	1849	CAP.,FXD,CER DI:170PF,5%,500V	72982	301000Z5D171J
C139	281-0546-00	1850	6539	CAP.,FXD,CER DI:330PF,10%,500V	04222	7001-1380
C139	281-0524-00	6540		CAP.,FXD,CER DI:150PF,+/-30PF,500V	04222	7001-1381
C140	290-0134-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	150D226X0015B2
C141	281-0523-00	X6540		CAP.,FXD,CER DI:100PF,+/-20PF,500V	72982	301-000U2M0101M
C146	290-0246-00			CAP.,FXD,ELCTLT:3.3UF,10%,15V	56289	162D335X9015CD2
C151	281-0589-00			CAP.,FXD,CER DI:170PF,5%,500V	72982	301000Z5D171J
C156	281-0528-00	100	6539	CAP.,FXD,CER DI:82PF,+/-8.2PF,500V	72982	301-000U2M0820K
C156	283-0095-00	6540		CAP.,FXD,CER DI:56PF,10%,200V	72982	855-535A560K
C158	281-0093-00	100	3239	CAP.,VAR,CER DI:5.5-18PF	72982	538-011A5.5-18
C158	281-0092-00	3240		CAP.,VAR,CER DI:9-35PF	72982	538-011 D9-35
C160	281-0092-00			CAP.,VAR,CER DI:9-35PF	72982	538-011 D9-35
C161	283-0094-00	100	904	CAP.,FXD,CER DI:27PF,10%,200V	72982	835-515A270K
C161	281-0605-00	905		CAP.,FXD,CER DI:200PF,10%,500V	04222	7001-1375
C163	283-0026-00			CAP.,FXD,CER DI:0.2UF,+80-20%,25V	56289	274C3

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C165	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8141N038E105Z
D101[1]	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	80009	152-0107-00
D102[1]	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	80009	152-0107-00
D103[1]	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	80009	152-0107-00
D104[1]	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	80009	152-0107-00
D105[1]	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	80009	152-0107-00
D106[1]	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	80009	152-0107-00
D107[1]	152-0243-00			SEMICOND DEVICE:ZENER,0.4W,15V,5%	81483	1N965B
F101	159-0056-00			FUSE,CARTRIDGE:0.1A,125V,FAST-BLOW	75915	279-100
J51	131-0278-00			CONN,RCPT,ELEC:BNC	95712	30234-1
J169	131-0319-00			CONNECTOR,RCPT,:MALE,BNC	80009	131-0319-00
L60	108-0395-00			COIL,RF:64UH	80009	108-0395-00
L62	108-0395-00			COIL,RF:64UH	80009	108-0395-00
L79	276-0543-00			SHIELDING BEAD,:	80009	276-0543-00
L81	276-0543-00			SHIELDING BEAD,:	80009	276-0543-00
LR57	108-0330-00	100	6539X	COIL,RF:0.4UH	80009	108-0330-00
LR71	108-0399-00			COIL,RF:30NH	80009	108-0399-00
LR83	108-0398-00	100	7529	COIL,RF:0.4UH	80009	108-0398-00
LR83	108-0593-00	7530		COIL,RF:0.4UH	80009	108-0593-00
LR126	108-0423-00	X905	6539	COIL,RF:0.17UH	80009	108-0423-00
LR126	108-0582-00	6540		COIL,RF:0.19UH	80009	108-0582-00
LR136	108-0268-01	100	6539	COIL,RF:0.1UH	80009	108-0268-01
LR136	108-0575-00	6540		COIL,RF:0.6UH	80009	108-0575-00
Q107	151-0148-00			TRANSISTOR:SILICON,NPN	02735	39539
Q114	151-0192-00	100	3699	TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q114	151-0195-00	3700	15754	TRANSISTOR:SILICON,NPN	80009	151-0195-00
Q114	151-0195-01	15755		TRANSISTOR:SILICON,NPN,MOTOROLA ONLY	80009	151-0195-01
Q124	151-0192-00	100	3699	TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q124	151-0195-00	3700	15754	TRANSISTOR:SILICON,NPN	80009	151-0195-00
Q124	151-0195-01	15755		TRANSISTOR:SILICON,NPN,MOTOROLA ONLY	80009	151-0195-01
Q133	151-0198-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	80009	151-0198-00
Q134	151-0198-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	80009	151-0198-00
Q143	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q154	151-0109-01			TRANSISTOR:SILICON,NPN,30V	07263	S5835
R51	317-0680-00	100	4589	RES.,FXD,CMPSN:68 OHM,5%,0.125W	01121	BB6805
R51	317-0750-00	4590		RES.,FXD,CMPSN:75 OHM,5%,0.125W	01121	BB7505
R53	317-0910-00			RES.,FXD,CMPSN:91 OHM,5%,0.125W	01121	BB9105
R55	317-0111-00	100	4589	RES.,FXD,CMPSN:110 OHM,5%,0.125W	01121	BB1115
R55	317-0820-00	4590		RES.,FXD,CMPSN:82 OHM,5%,0.125W	01121	BB8205
R60	321-0079-00			RES.,FXD,FILM:64.9 OHM,1%,0.125W	91637	MFF1816G64R90F
R62	321-0079-00			RES.,FXD,FILM:64.9 OHM,1%,0.125W	91637	MFF1816G64R90F
R64	307-0097-00			RES.,FXD,FILM:2.1 OHM,1%,1W	03888	76D343-2R100
R66	317-0620-00	100	6539X	RES.,FXD,CMPSN:62 OHM,5%,0.125W	01121	BB6205
R67	321-0066-01			RES.,FXD,FILM:47.5 OHM,0.5%,0.125W	91637	MFF1816G47R50D
R68	317-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.125W	01121	BB1515
R69	315-0100-00	X6540	8639X	RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R70	325-0013-00			RES.,FXD,FILM:6 OHM,1%,0.50W	91637	A20-G6R000F
R71	325-0012-00			RES.,FXD,FILM:2.67 OHM,1%,0.5W	91637	A20-G2R670F
R73	321-0023-01			RES.,FXD,FILM:16.9 OHM,0.5%,0.125W	91637	MFF1816G16R90D
R75	321-1056-01			RES.,FXD,FILM:37.9 OHM,0.5%,0.125W	91637	MFF1816G37R90D
R77	321-1087-01			RES.,FXD,FILM:79.6 OHM,0.5%,0.125W	91637	MFF1816G79R60D
R79	321-0127-01			RES.,FXD,FILM:205 OHM,0.5%,0.125W	91637	MFF1816G205R0D

[1]These are common to both Standard and Option 4 Power Supplies.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R81	321-0127-01			RES.,FXD,FILM:205 OHM,0.5%,0.125W	91637	MFF1816G205R0D
R91	321-0078-01			RES.,FXD,FILM:63.4 OHM,0.5%,0.125W	91637	MFF1816G63R40D
R92	315-0510-00	100	6539	RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R92	315-0430-00	6540		RES.,FXD,CMPSN:43 OHM,5%,0.25W	01121	CB4305
R94	321-0114-01			RES.,FXD,FILM:150 OHM,0.5%,0.125W	91637	MFF1816G150R0D
R95	315-0910-00	100	6539	RES.,FXD,CMPSN:91 OHM,5%,0.25W	01121	CB9105
R95	315-0161-00	6540		RES.,FXD,CMPSN:160 OHM,5%,0.25W	01121	CB1615
R99	321-0173-01			RES.,FXD,FILM:619 OHM,0.5%,0.125W	91637	MFF1816G19R0D
R101[1]	308-0291-00			RES.,FXD,WW:2K OHM,5%,3W	91637	RS2B-B2000J
R102[1]	308-0230-00			RES.,FXD,WW:2.7K OHM,5%,3W	91637	RS2B-B27000J
R105	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R106	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R111	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
R114	321-0207-00			RES.,FXD,FILM:1.4K OHM,1%,0.125W	91637	MFF1816G14000F
R115	321-0173-01			RES.,FXD,FILM:619 OHM,0.5%,0.125W	91637	MFF1816G619R0D
R118	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R119	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	91637	MFF1816G200R0F
R120	315-0560-00			RES.,FXD,CMPSN:56 OHM,5%,0.25W	01121	CB5605
R121	315-0181-00			RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
R124	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R125	311-0622-00			RES.,VAR,NONWIR:100 OHM,10%,0.50W	32997	3326H-G48-101
R127	315-0101-00	100	14412X	RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R128	311-0622-00			RES.,VAR,NONWIR:100 OHM,10%,0.50W	32997	3326H-G48-101
R129	315-0201-00			RES.,FXD,CMPSN:200 OHM,(NOM VALUE),SELECTED	01121	CB2015
R130	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R131	315-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
R132	315-0511-00	100	1849	RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R132	315-0471-00	1850		RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R133	315-0113-00			RES.,FXD,CMPSN:11K OHM,5%,0.25W	01121	CB1135
R134	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R135	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R136	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R137	317-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.125W	01121	BB1015
R138	321-0174-01			RES.,FXD,FILM:634 OHM,0.5%,0.125W	91637	MFF1816G634R0D
R139	315-0752-00	100	1849	RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R139	315-0432-00	1850	6539	RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
R139	315-0912-00	6540		RES.,FXD,CMPSN:9.1K OHM,5%,0.25W	01121	CB9125
R140	315-0560-00			RES.,FXD,CMPSN:56 OHM,5%,0.25W	01121	CB5605
R141	315-0133-00	X6540		RES.,FXD,CMPSN:13K OHM,5%,0.25W	01121	CB1335
R142	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R144	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R146	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R147	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R150	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R151	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R153	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R154	311-0624-00			RES.,VAR,NONWIR:200K OHM,0.25W	01121	FR204T
R156	317-0151-00	100	3239	RES.,FXD,CMPSN:150 OHM,5%,0.125W	01121	BB1515
R156	317-0101-00	3240	6539	RES.,FXD,CMPSN:100 OHM,5%,0.125W	01121	BB1015
R156	317-0511-00	6540		RES.,FXD,CMPSN:510 OHM,5%,0.125W	01121	BB5115
R157	315-0430-00			RES.,FXD,CMPSN:43 OHM,5%,0.25W	01121	CB4305
R159	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105

[1]These parts are only in Option 4 (230V) Power Supply.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R160	317-0430-00			RES.,FXD,CMPSN:43 OHM,5%,0.125W	01121	BB4305
SW10	262-0765-00	100	4589	SWITCH ASSY,ROT:WIRED,ATTENUATOR	80009	262-0765-00
SW10	262-0765-01	4590	6539	SWITCH ASSY,ROT:WIRED,ATTENUATOR	80009	262-0765-01
SW10	262-0765-02	6540	8639	SWITCH ASSY,ROT:WIRED,ATTENUATOR	80009	262-0765-02
SW10	262-0765-03	8640		SWITCH ASSY,ROT:WIRED,ATTENUATOR	80009	262-0765-03
SW10	260-0761-00			SWITCH ASSY,ROT:ATTENUATOR,UNWIRED	80009	260-0761-00
SW130	260-0762-00			SWITCH,LEVER:1 SECT,2 POSN,30 DEG	80009	260-0762-00
T101[1]	120-0436-00			XFMR,PWR,STPDN:	80009	120-0436-00
T164	276-0557-00			CORE,FERRITE:0.23 ID X 0.12 ID X 0.125	78488	57-0131

[1]This part is common to both Standard and Option 4 Power Supply.

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).

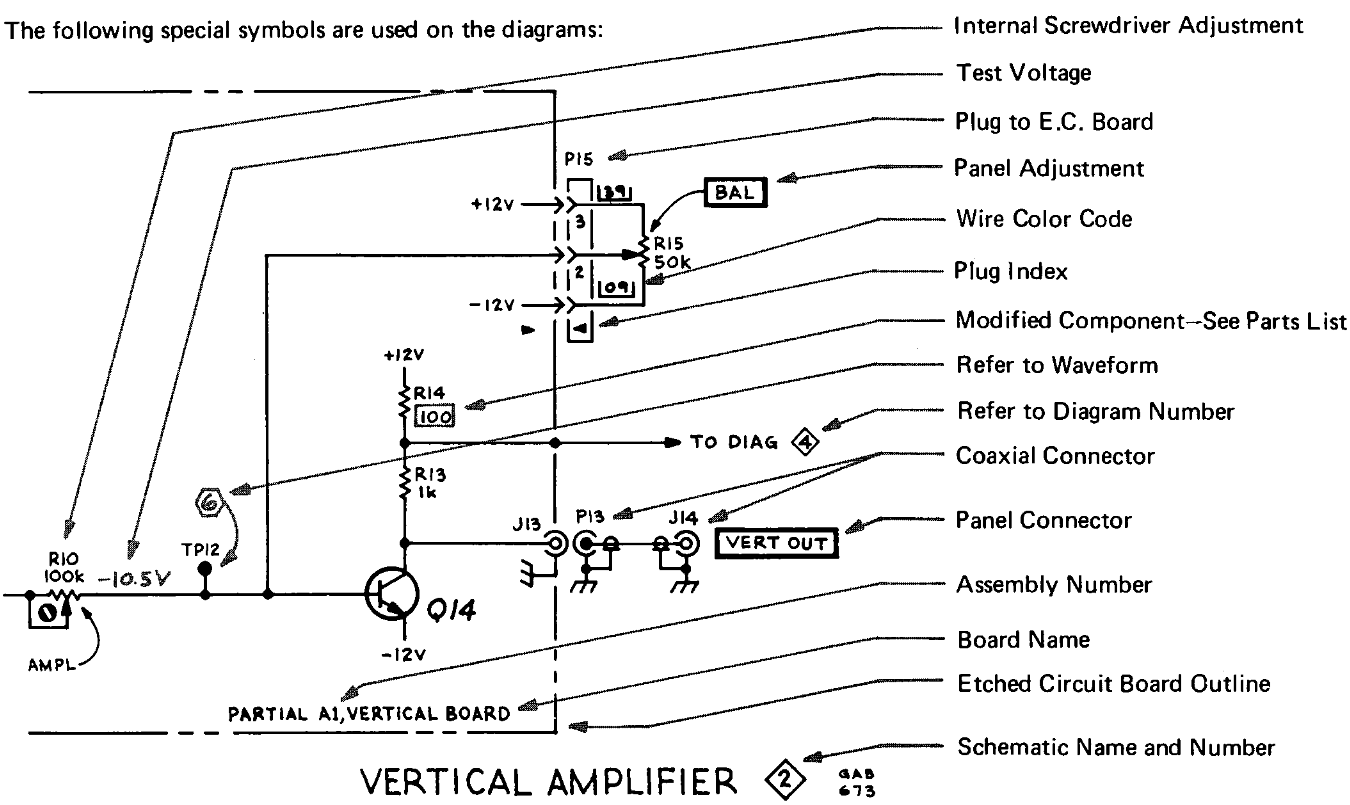
Symbols used on the diagrams are based on ANSI Standard Y32.2-1970.

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 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
CB	Circuit breaker
CR	Diode, signal or rectifier
DL	Delay line
DS	Indicating device (lamp)
E	Spark Gap
F	Fuse
FL	Filter
H	Heat dissipating device (heat sink, heat radiator, etc.)
HR	Heater
HY	Hybrid circuit
J	Connector, stationary portion
K	Relay
L	Inductor, fixed or variable
LR	Inductor/resistor combination
M	Meter
P	Connector, movable portion
Q	Transistor or silicon-controlled rectifier
R	Resistor, fixed or variable
RT	Thermistor
S	Switch
T	Transformer
TC	Thermocouple
TP	Test point
U	Assembly, inseparable or non-repairable (integrated circuit, etc.)
V	Electron tube
VR	Voltage regulator (zener diode, etc.)
Y	Crystal
Z	Phase shifter

The following special symbols are used on the diagrams:



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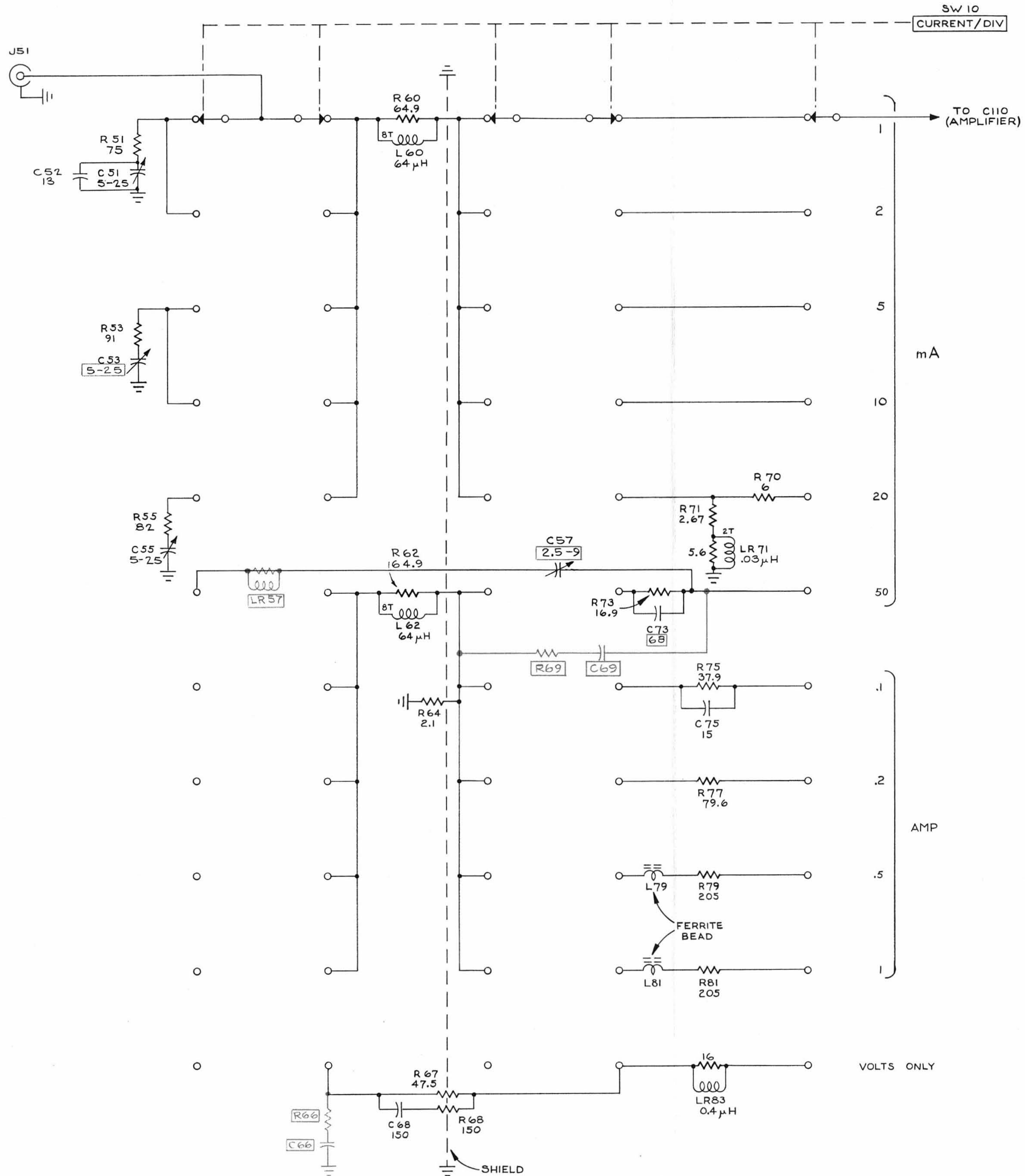
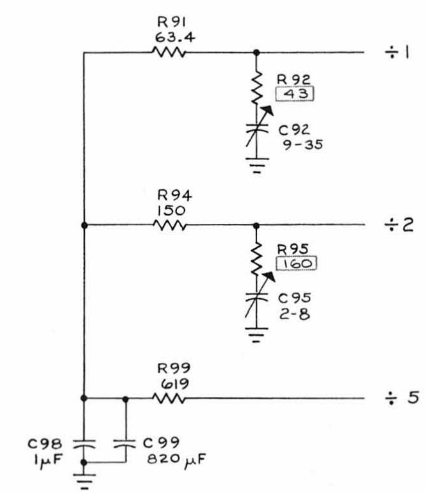




NOTES

1. ALL SWITCH POSITIONS ARE GROUNDED EXCEPT THE ONE BEING USED.

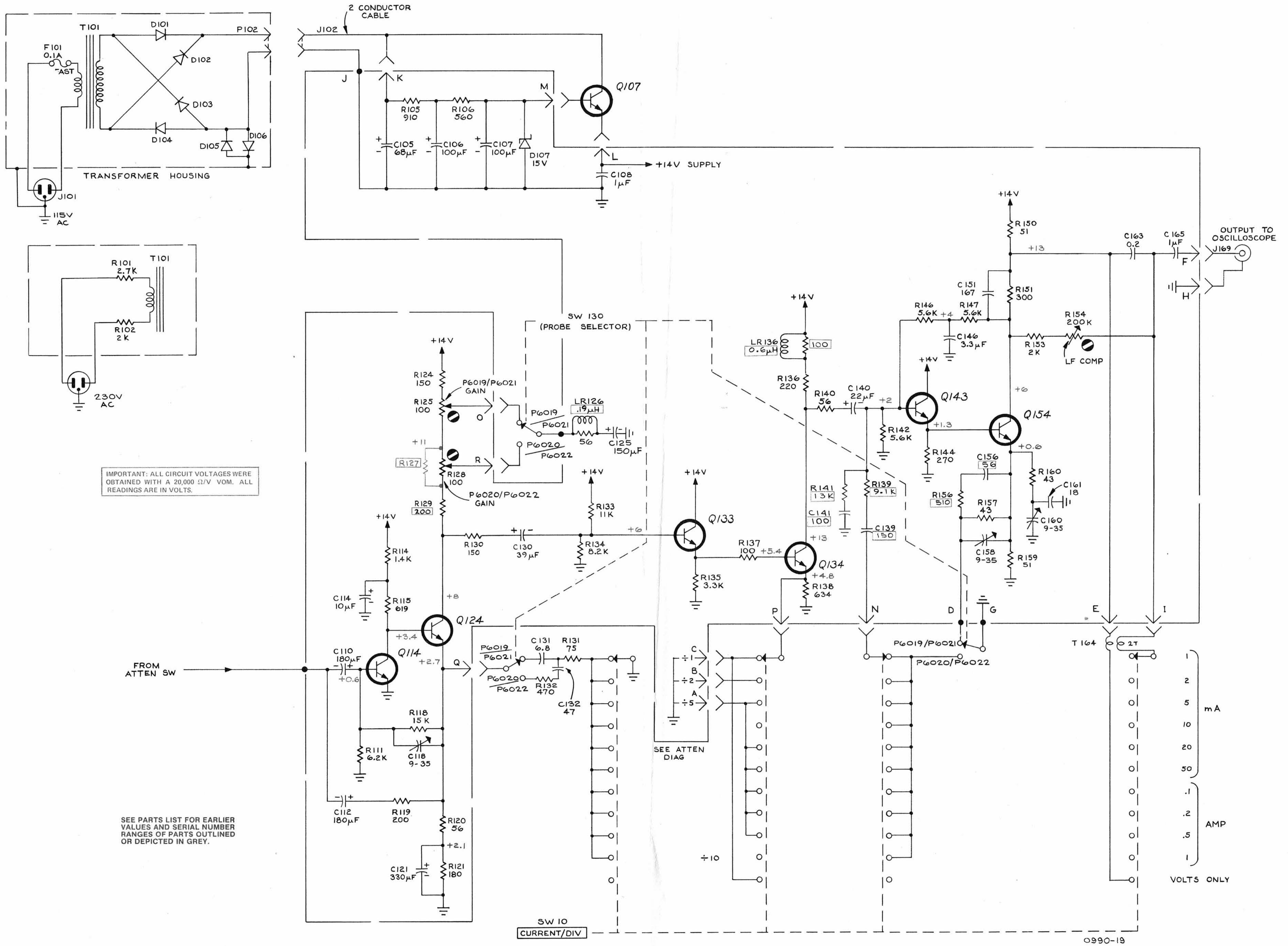
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.

0890-18

C670

Scan by Zenith

AMPLIFIER



TYPE 134

REV D, OCT 1975

CURRENT PROBE AMPLIFIER

1169

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

CROSS INDEX MFR. CODE NUMBER TO MANUFACTURER

MFR.CODE	MANUFACTURER	ADDRESS	CITY,STATE,ZIP
02735	RCA CORP., SOLID STATE DIVISION	ROUTE 202	SOMERVILLE, NY 08876
24655	GENERAL RADIO	300 BAKER AVE.	CONCORD, MA 01742
28520	HEYMAN MFG. CO.	147 N. MICHIGAN AVE.	KENILWORTH, NJ 07033
70903	BELDEN CORP.	415 S. KILPATRICK	CHICAGO, IL 60644
71785	TRW ELECTRONIC COMPONENTS, CINCH CONNECTOR OPERATIONS	1501 MORSE AVE.	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
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
80009	TEKTRONIX, INC.	P. O. BOX 500	BEAVERTON, OR 97077
83330	SMITH, HERMAN H., INC.	812 SNEDIKER AVE.	BROOKLYN, NY 11207
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
88245	LITTON SYSTEMS, INC., USECO DIV.	13536 SATICOY ST.	VAN NUYS, CA 91409
89663	REESE, J. RAMSEY, INC.	71 MURRAY ST.	NEW YORK, NY 10007
95712	BENDIX CORP., THE ELECTRICAL COMPONENTS DIV., MICROWAVE DEVICES PLANT	HURRICANE ROAD	FRANKLIN, IN 46131
98278	MALCO A MICRODOT CO., INC., CONNECTOR AND CABLE DIVISION	220 PASADENA AVE.	SOUTH PASADENA, CA 91030
98291	SEALECTRO CORP.	225 HOYT	MAMARONECK, NY 10544
98978	INTERNATIONAL ELECTRONIC RESEARCH CORP.	135 W. MAGNOLIA AVE.	BURBANK, CA 91502

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-	015-0057-02[1]			1	AMPL,CUR PROBE:W/POWER SUPPLY,115V	80009	015-0057-02
	015-0057-03[2]			1	AMPL,CUR PROBE:W/POWER SUPPLY,230V	80009	015-0057-03
	----- -----			-	. EACH AMPL ASSY INCLUDES:		
	015-0057-00[3]	100	6539	1	. AMPLIFIER,CUR:134	80009	015-0057-00
	015-0057-01[3]	6540		1	. AMPLIFIER,CUR:134	80009	015-0057-01
-1	200-0327-01			1	. . COVER,BOX,REAR:	80009	200-0327-01
					(ATTACHING PARTS)		
-2	211-0071-00			2	. . SCREW,MACHINE:4-40 X 0.375 1NCH,PHS STL	83385	OBD
					- - - * - - -		
-3	380-0095-00	100	6539	1	. . HSG,ELEK EQPT:WRAPAROUND	80009	380-0095-00
	380-0095-01	6540		1	. . HSG,ELEK EQPT:WRAPAROUND	80009	380-0095-01
-4	366-0215-01			1	. . KNOB:LEVER SWITCH	80009	366-0215-01
-5	366-0322-01			1	. . KNOB:GRAY	80009	366-0322-01
	213-0004-00			1	. . . SETSCREW:6-32 X 0.188 INCH,HEX.SOC STL	74445	OBD
-6	333-0931-01	100	6539	1	. . PANEL,FRONT:MARKED 134	80009	333-0931-01
	333-0931-02	6540		1	. . PANEL,FRONT:MARKED 134	80009	333-0931-02
					(ATTACHING PARTS)		
-7	210-0590-00			1	. . NUT,PLAIN,HEX.:0.375 X 0.438 INCH,STL	73743	2X28269-402
-8	210-0840-00			1	. . WASHER,FLAT:0.39 ID X 0.562 INCH OD,STL	89663	644R
					- - - * - - -		
-9	131-0278-00			1	. . CONN,RCPT,ELEC:BNC,(J51)	95712	30234-1
					(ATTACHING PARTS)		
-10	211-0038-00	100	239	2	. . SCREW,MACHINE:4-40 X 0.312"100 DEG,FLH STL	83385	OBD
	211-0099-00	240	5169	2	. . SCR,MACHINE:4-40 X 0.312" 100 DEG,SLOT,STL	83385	OBD
	211-0038-00	5170		2	. . SCREW,MACHINE:4-40 X 0.312"100 DEG,FLH STL	83385	OBD
-11	210-0586-00			2	. . NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
					- - - * - - -		
-12	----- -----			1	. . SWITCH,LEVER:PROBE SELECTOR(SEE SW 130 EPL)		
					(ATTACHING PARTS)		
-13	211-0101-00			2	. . SCREW,MACHINE:4-40 X 0.25" 100 DEG,FLH STL	83385	OBD
-14	210-0406-00			2	. . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-15	210-0004-00			2	. . WASHER,LOCK:INTL,0.12 ID X 0.26"OD,STL	78189	1204-00-00-0541C
					- - - * - - -		
-16	131-0158-00			2	. . TERMINAL,FEEDTH:INSULATED,0.566 INCH LONG	98291	FTSM19L1
-17	337-0820-00			1	. . SHIELD,ELEC:LEVER SWITCH	80009	337-0820-00
					(ATTACHING PARTS)		
-18	213-0055-00			1	. . SCR,TPG,THD FOR:2-32 X 0.188 INCH,PNH STL	83385	OBD
					- - - * - - -		
-19	----- -----			1	. . SWITCH ASSY,ROT:WIRED,ATTEN(SEE SW10 EPL)		
	260-0761-00			1	. . . SWITCH,ROTARY:UNWIRED,ATTENUATOR	80009	260-0761-00
-20	124-0126-00	100	3649	1	. . TERM,STRIP,GND:0.125 X 1.0" LONG,BRZ	80009	124-0126-00
	124-0124-00	3650		1	. . TERM,STRIP,GND:0.125 X 1.5" LONG,BRZ	80009	124-0124-00
-21	200-0327-02			1	. . COVER,BOX,FRONT:	80009	200-0327-02
					(ATTACHING PARTS)		
-22	211-0101-00			2	. . SCREW,MACHINE:4-40 X 0.25" 100 DEG,FLH STL	83385	OBD
					- - - * - - -		
-23	----- -----			1	. . CKT BOARD ASSY:AMPLIFIER(SEE A1 EPL)		
					(ATTACHING PARTS)		
-24	211-0116-00			2	. . SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
					- - - * - - -		
	----- -----			-	. . . CKT BOARD ASSY INCLUDES:		
-25	131-0344-00			2	. . . TERMINAL,STUD:BIFURCATED	88245	421837-9
-26	136-0220-00			6	. . . SOCKET,PLUG-IN:3 PIN,SQUARE	71785	133-23-11-034
	132-0119-00			4	. . . INSULATOR,WSHR:	24655	0874-7590
-27	214-0506-00	100	1849	15	. . . CONTACT,ELEC:0.045 SQ X 0.375 INCH L	80009	214-0506-00
	131-0633-00	1850		15	. . . CONTACT,ELEC:0.385 INCH LONG	80009	131-0633-00
-28	214-0693-00			1	. . . HEAT SINK, ELEC:0.25 ID X 0.75 INCH LONG	98978	TXD017-075
-29	337-0828-00			1	. . . SHIELD,RTRY SW:INPUT	80009	337-0828-00
-30	----- -----			1	. . TRANSISTOR:(SEE Q107 EPL)		
					(ATTACHING PARTS)		
-31	211-0012-00	100	7100	2	. . SCREW,MACHINE:4-40 X 0.375 INCH,PNH STL	83385	OBD
	211-0038-00	7101		2	. . SCREW,MACHINE:4-40 X 0.312"100 DEG,FLH STL	83385	OBD
-32	210-0054-00	100	7100	2	. . WASHER,LOCK:SPLIT,0.118 ID X 0.212"OD STL	83385	OBD

[1] Standard 134, W/115 Volt Power Supply.
[2] Option 4 134 W/230 Volt Power Supply.
[3] 134 W/O Power Supply.

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-33	210-0994-00	100	7100	2	. . WASHER,FLAT:0.125 ID X 0.25" OD,STL	83385	OBD
-34	210-0849-00	100	7100	2	. . WSHR,SHOULDERED:0.11 ID X 0.188"OD,FIBER	83330	2151
	358-0288-00	7101		2	. . BUSHING,INSUL:0.115 ID X 0.28" OD,PLSTC	80009	358-0288-00
-35	210-0004-00	100	7100X	1	. . WASHER,LOCK:INTL,0.12 ID X 0.26"OD,STL	78189	1204-00-00-0541C
-36	210-0201-00	100	7100	1	. . TERMINAL,LUG:SE #4	78189	2104-04-00-2520N
	210-0202-00	7101		1	. . TERMINAL,LUG:SE #6	78189	2104-06-00-2520N
-37	210-0406-00	100	7100X	2	. . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
					- - - * - - -		
-38	386-0143-00			1	. . INSULATOR,PLATE:0.002 INCH MICA,FOR TO-2	02735	DF31A
-39	175-0680-00			1	. . LEAD,ELECTRICAL:NO. 22 AWG WIRE,2.0" LONG	80009	175-0680-00
-40	131-0371-00			1	. . . CONTACT,ELEC:FOR NO.26 AWG WIRE	98278	12093-8
-41	131-0319-00			1	. . CONNECTOR,RCPT,:MALE,BNC,(J169)	80009	131-0319-00
					(ATTACHING PARTS)		
-42	210-0270-00			1	. . TERMINAL,LUG:0.456" ID,SE	80009	210-0270-00
					- - - * - - -		
-43	161-0020-00			1	. . CABLE ASSY,PWR:W/COAX CONN 1 END	70903	KG9858
					(ATTACHING PARTS)		
-44	358-0091-00			1	. . BSHG,STRAIN RLF:HEYCO	28520	SR2MI
					- - - * - - -		
-45	407-0227-00	100	7100	1	. . BRKT,FRAME:	80009	407-0227-00
	407-0227-03	7101		1	. . BRKT,FRAME:	80009	407-0227-03
-46	131-0371-00			14	. . CONTACT,ELEC:FOR NO.26 AWG WIRE	98278	12093-8
-47	015-0058-00[1]	100	6911	1	. POWER SUPPLY:PROBE AMPLIFIER,115V	80009	015-0058-00
	015-0058-01[1]	6912		1	. POWER SUPPLY:PROBE AMPLIFIER,115V	80009	015-0058-01
-48	015-0059-00[2]	100	6911	1	. POWER SUPPLY:PROBE AMPLIFIER,230V	80009	015-0059-00
	015-0059-01[2]	6912		1	. POWER SUPPLY:PROBE AMPLIFIER,230V	80009	015-0059-01

ACCESSORIES

	070-0990-01			1	MANUAL,TECH:INSTRUCTION	80009	070-0990-01
	012-0104-00			1	CABLE ASSY,RF:50 OHM COAX,W/M,F BNC,18" LONG	80009	012-0104-00
	014-0029-00			1	ACCESSORY,PKG:HANGER ASSY W/HARDWARE	80009	014-0029-00

[1]Standard 134 Power Supply.
[2]Option 4 134 Power Supply.

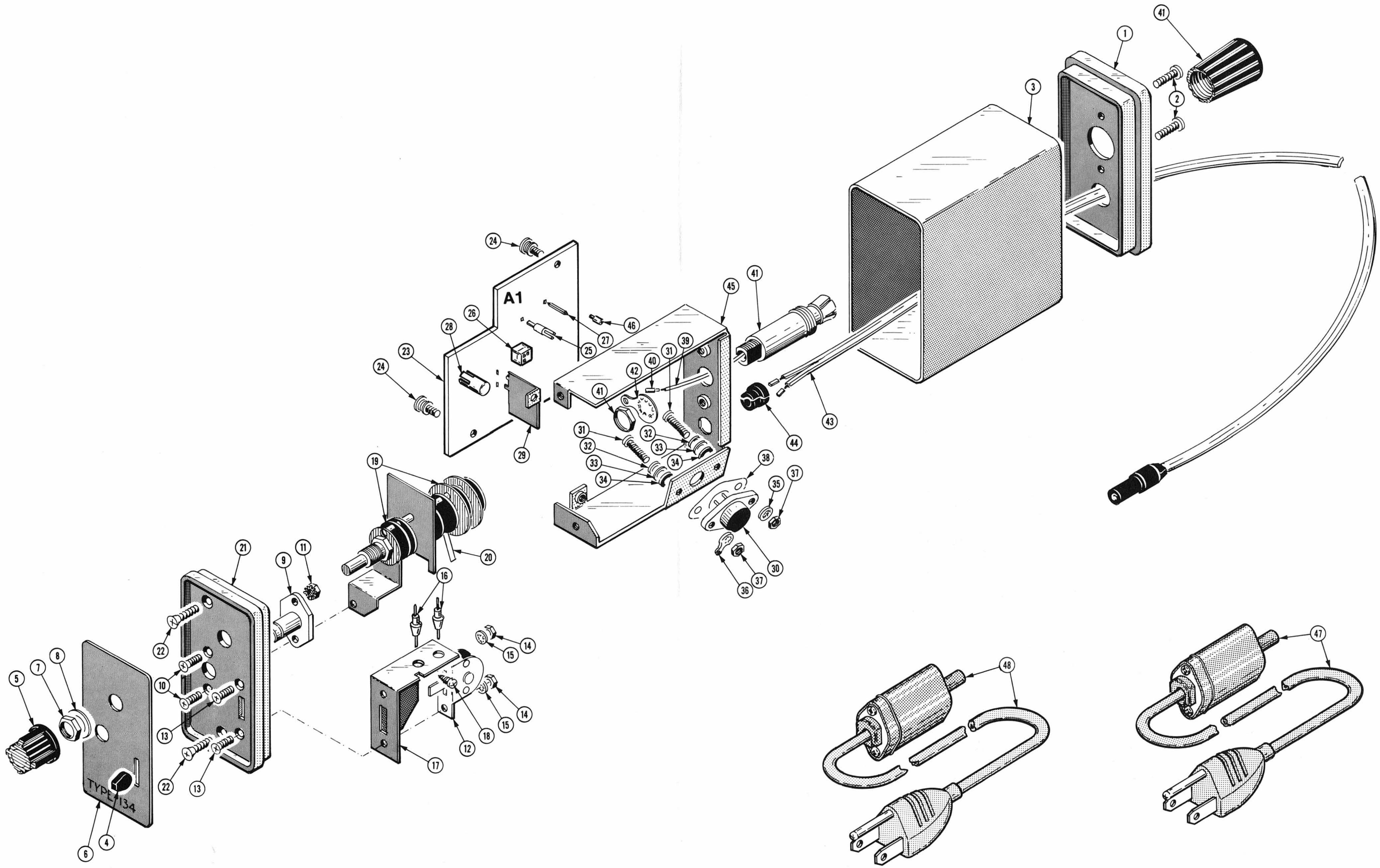


FIG. 1 EXPLODED VIEW

FIG. 2

115-Volt Power Supply (015-0058-01)

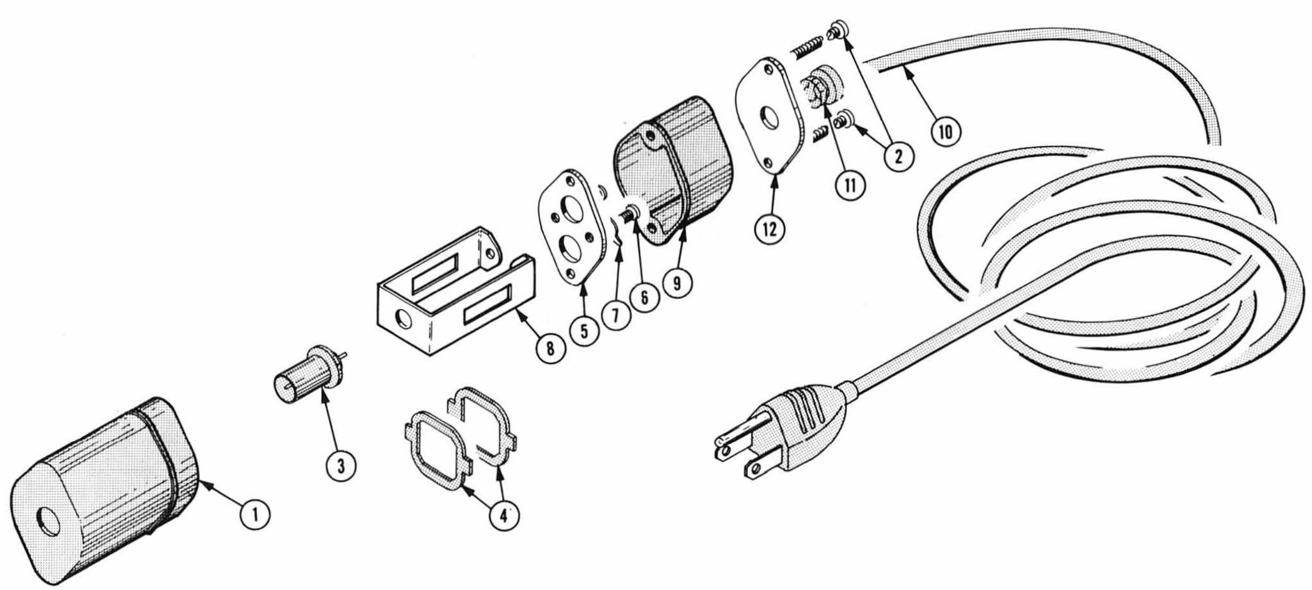


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-	015-0058-01[1]			1	POWER SUPPLY:PROBE AMPLIFIER,115V	80009	015-0058-01
-1	200-0246-03			1	. COVER,PWR SPLY:	80009	200-0246-03
					(ATTACHING PARTS)		
-2	213-0206-00			2	. SCR,TPG,THD FOR:6-32 X 1.25 INCH,PNH STL	80009	213-0206-00
					- - - * - - -		
-3	131-0190-01			1	. CONN,RCPT,ELEC:PIN TYPE	80009	131-0190-01
-4	214-0696-00			2	. RETAINER,XFMR:1.19 INCH DIA,PLASTIC	80009	214-0696-00
-5	387-0265-00			1	. PLATE,CONN RTNG:1.288 X 1.814", AL	80009	387-0265-00
					(ATTACHING PARTS)		
-6	211-0007-00			2	. SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
-7	210-0261-00			1	. TERMINAL,LUG:0.270 INCH DIA,SE	80009	210-0261-00
					- - - * - - -		
-8	407-0226-00			1	. BRACKET,XFMR:PWR SUPPLY,STL	80009	407-0226-00
-9	200-0957-00			1	. COVER,PWR SPLY:REAR	80009	200-0957-00
-10	161-0071-03			1	. CABLE ASSY,PWR:3 FEET LONG	80009	161-0071-03
					(ATTACHING PARTS)		
-11	358-0091-00			1	. BSHG,STRAIN RLF:HEYCO	28520	SR2MI
					- - - * - - -		
	----- -----			-	. . POWER CORD INCLUDES:		
	334-1205-00			1	. . SLEEVE,MKR,CA:1.5 INCHES LONG	80009	334-1205-00
-12	386-1541-00			1	. PANEL,REAR:	80009	386-1541-00

[1]Standard Power Supply.

FIG. 3

230-Volt Power Supply (015-0059-01)

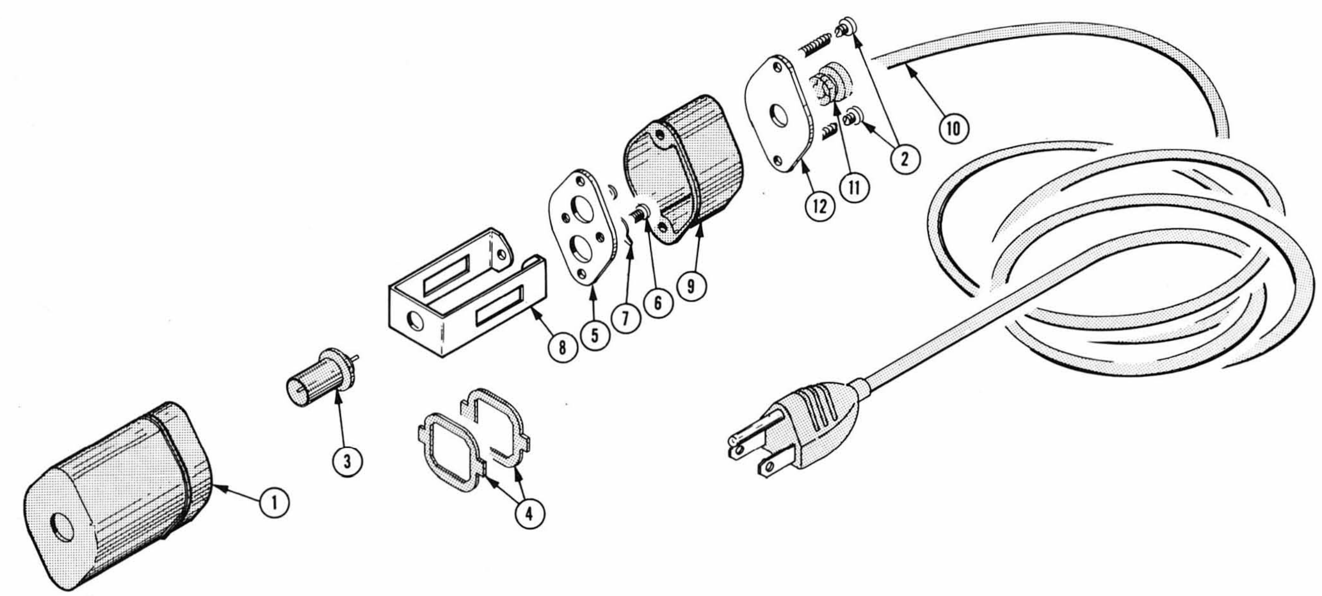


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
3-	015-0059-01[1]			1	POWER,SUPPLY:PROBE AMPLIFIER,230V	80009	015-0059-01
-1	200-0246-04			1	. COVER,PWR SPLY:	80009	200-0246-04
					(ATTACHING PARTS)		
-2	213-0206-00			2	. SCR,TPG,THD FOR:6-32 X 1.25 INCH,PNH STL	80009	213-0206-00
					- - - * - - -		
-3	131-0190-01			1	. CONN,RCPT,ELEC:PIN TYPE	80009	131-0190-01
-4	214-0696-00			2	. RETAINER,XFMR:1.19 INCH DIA,PLASTIC	80009	214-0696-00
-5	387-0265-00			1	. PLATE,CONN RTNG:1.288 X 1.814 INCH,AL	80009	387-0265-00
					(ATTACHING PARTS)		
-6	211-0007-00			2	. SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
-7	210-0261-00			1	. TERMINAL,LUG:0.270 INCH DIA,SE	80009	210-0261-00
					- - - * - - -		
-8	407-0226-00			1	. BRACKET,XFMR:PWR SUPPLY,STL	80009	407-0226-00
-9	200-0957-00			1	. COVER,POWER SPLY:REAR	80009	200-0957-00
-10	161-0071-03			1	. CABLE ASSY,PWR:3 FEET LONG	80009	161-0071-03
					(ATTACHING PARTS)		
-11	358-0091-00			1	. BSHG,STRAIN RLF:HEYCO	28520	SR2MI
					- - - * - - -		
	----- -----			-	. . POWER CORD INCLUDES:		
	334-1205-00			1	. . SLEEVE,MKR,CA:1.5 INCHES LONG	80009	334-1205-00
-12	386-1541-00			1	. PANEL,REAR:	80009	386-154-00

[1]Option 4 Power Supply.

MANUAL CHANGE INFORMATION

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

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

A single change may affect several sections. Since the change information sheets are carried in the manual until all changes are permanently entered, some duplication may occur. If no such change pages appear following this page, your manual is correct as printed.

SERVICE NOTE

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

CALIBRATION TEST EQUIPMENT REPLACEMENT

Calibration Test Equipment Chart

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

Comparison of Main Characteristics

DM 501 replaces 7D13		
PG 501 replaces 107	PG 501 - Risetime less than 3.5 ns into 50 Ω.	107 - Risetime less than 3.0 ns into 50 Ω.
108	PG 501 - 5 V output pulse; 3.5 ns Risetime.	108 - 10 V output pulse; 1 ns Risetime.
111	PG 501 - Risetime less than 3.5 ns; 8 ns Pretrigger pulse delay.	111 - Risetime 0.5 ns; 30 to 250 ns Pretrigger Pulse delay.
114	PG 501 - ±5 V output.	114 - ±10 V output. Short proof output.
115	PG 501 - Does not have Paired, Burst, Gated, or Delayed pulse mode; ±5 V dc Offset. Has ±5 V output.	115 - Paired, Burst, Gated, and Delayed pulse mode; ±10 V output. Short-proof output.
PG 502 replaces 107		
108	PG 502 - 5 V output	108 - 10 V output.
111	PG 502 - Risetime less than 1 ns; 10 ns Pretrigger pulse delay.	111 - Risetime 0.5 ns; 30 to 250 ns Pretrigger pulse delay.
114	PG 502 - ±5 V output	114 - ±10 V output. Short proof output.
115	PG 502 - Does not have Paired, Burst, Gated, Delayed & Undelayed pulse mode; Has ±5 V output.	115 - Paired, Burst, Gated, Delayed & Undelayed pulse mode; ±10 V output. Short-proof output.
2101	PG 502 - Does not have Paired or Delayed pulse. Has ±5 V output.	2101 - Paired and Delayed pulse; 10 V output.
PG 506 replaces 106	PG 506 - Positive-going trigger output signal at least 1 V; High Amplitude output, 60 V.	106 - Positive and Negative-going trigger output signal, 50 ns and 1 V; High Amplitude output, 100 V.
067-0502-01	PG 506 - Does not have chopped feature.	0502-01 - Comparator output can be alternately chopped to a reference voltage.
SG 503 replaces 190, 190A, 190B	SG 503 - Amplitude range 5 mV to 5.5 V p-p.	190B - Amplitude range 40 mV to 10 V p-p.
191	SG 503 - Frequency range 250 kHz to 250 MHz.	191 - Frequency range 350 kHz to 100 MHz.
067-0532-01	SG 503 - Frequency range 250 kHz to 250 MHz.	0532-01 - Frequency range 65 MHz to 500 MHz.
TG 501 replaces 180, 180A	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	180A - Marker outputs, 5 sec to 1 μs. Sinewave available at 20, 10, and 2 ns. Trigger pulses 1, 10, 100 Hz; 1, 10, and 100 kHz. Multiple time-marks can be generated simultaneously.
181	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns.	181 - Marker outputs, 1, 10, 100, 1000, and 10,000 μs, plus 10 ns sinewave.
184	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	184 - Marker outputs, 5 sec to 2 ns. Sinewave available at 50, 20, 10, 5, and 2 ns. Separate trigger pulses of 1 and .1 sec; 10, 1, and .1 ms; 10 and 1 μs. Marker amplifier provides positive or negative time marks of 25 V min. Marker intervals of 1 and .1 sec; 10, 1, and .1 ms; 10 and 1 μs.
2901	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	2901 - Marker outputs, 5 sec to 0.1 μs. Sinewave available to 50, 10, and 5 ns. Separate trigger pulses, from 5 sec to 0.1 μs. Multiple time-marks can be generated simultaneously.

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