INSTRUCTION MANUAL

Serial Number _____

134 CURRENT PROBE AMPLIFIER

P6019/P6020 PROBES

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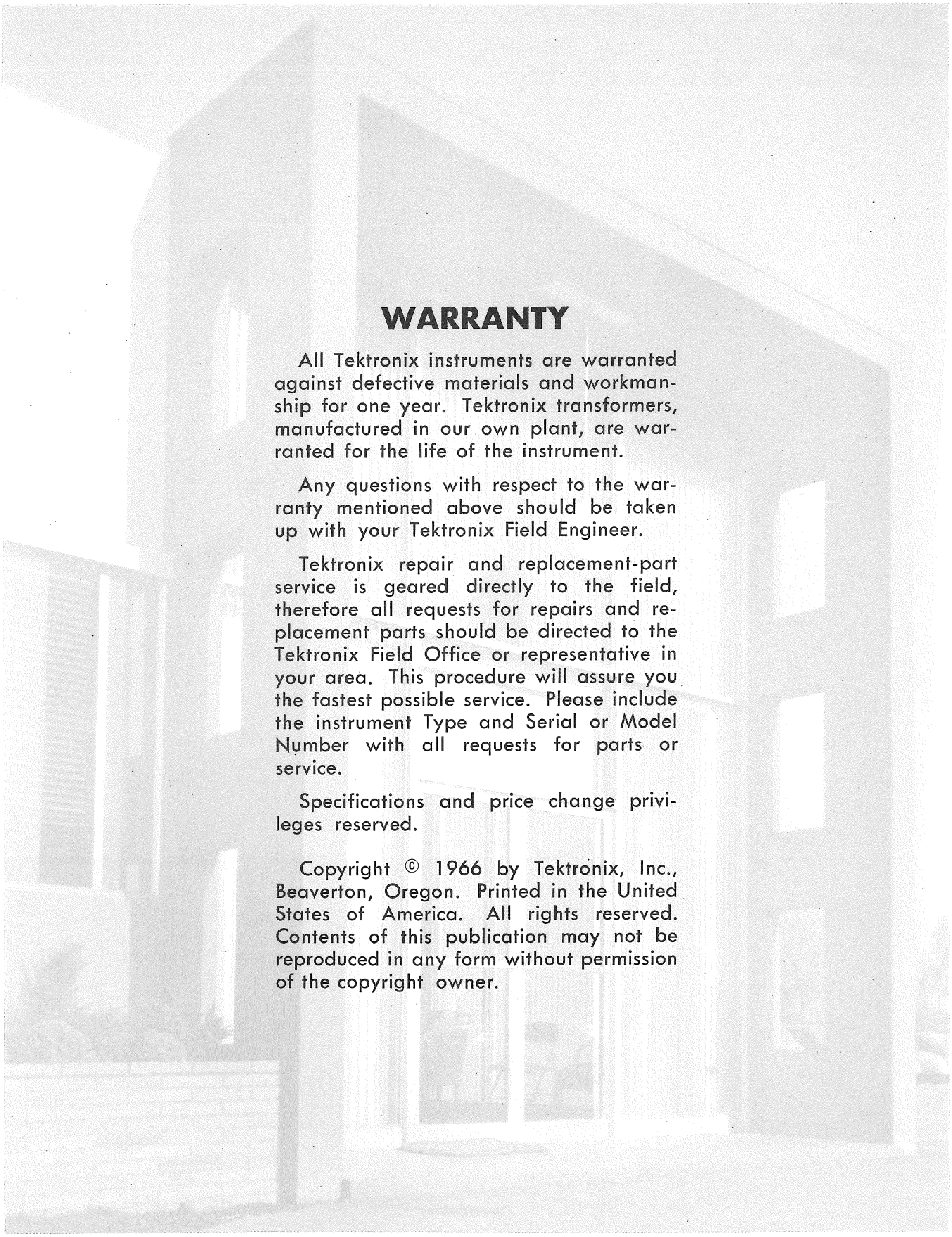


WARRANTY

All Tektronix instruments are warranted against defective materials and workmanship for one year. Tektronix transformers, manufactured in our own plant, are warranted for the life of the instrument.

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

Tektronix repair and replacement-part service is geared directly to the field, therefore all requests for repairs and replacement parts should be directed to the Tektronix Field Office or representative in your area. This procedure will assure you the fastest possible service. Please include the instrument Type and Serial or Model Number with all requests for parts or service.

Specifications and price change privileges reserved.

CONTENTS

Abbreviations and symbols used in this manual are based on, or taken directly from, IEEE Standard 260 "Standard Symbols for Units", MIL-STD-12B and other standards of the electronics industry. Change iformation, if any, is located at the rear of this manual.

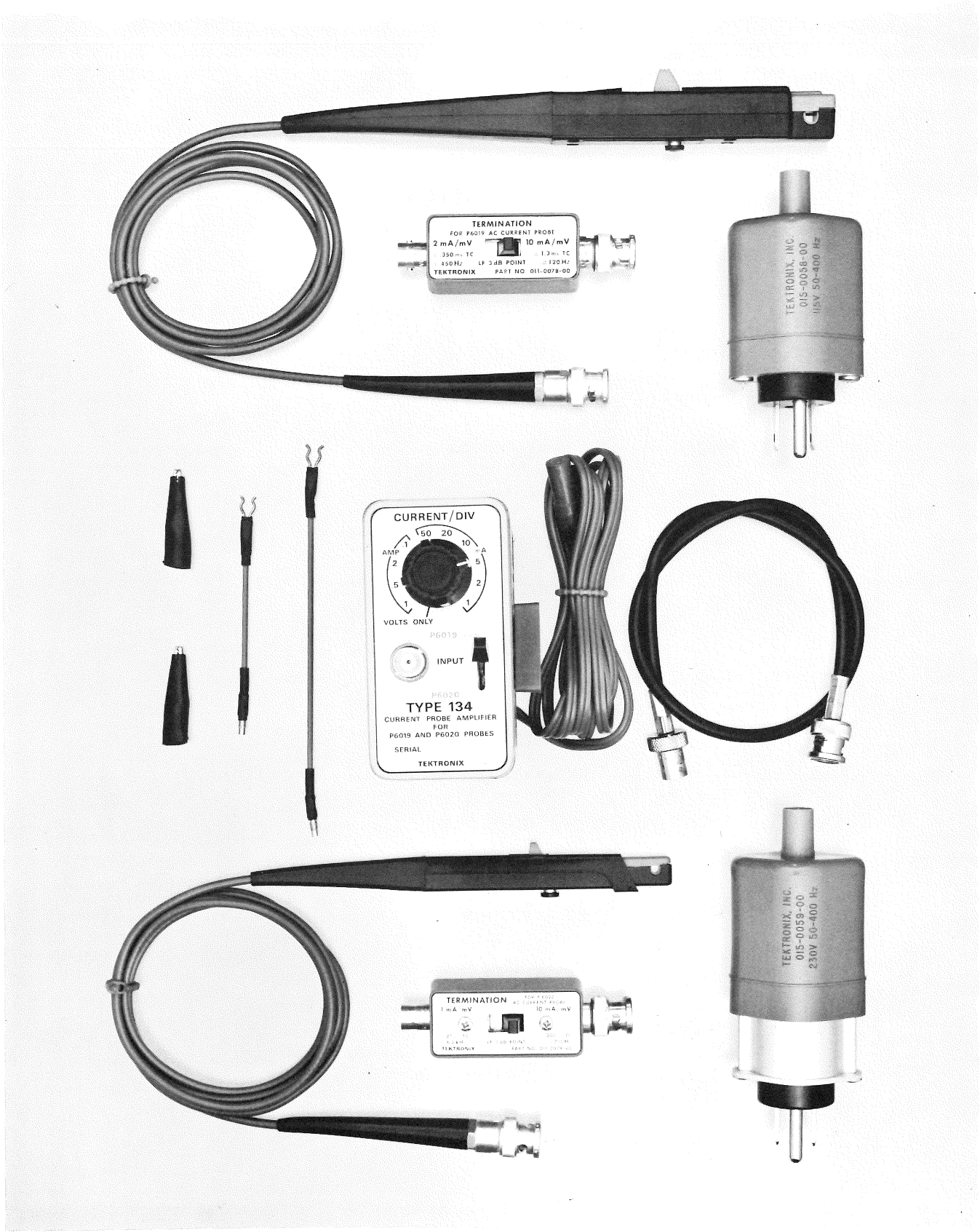


FIG. 1-1. Type 134 Current Probe Amplifier, P6019 and P6020 Current Probes, and accessories.

SECTION 1

CHARACTERISTICS

Introduction

The Type P6019 and P6020 Current Probes are designed to extend the usefulness of Tektronix oscilloscopes. The probe, used with either a Type 134 Current Probe Amplifier or a passive Termination, permits a current waveform to be viewed and measured on the oscilloscope. No direct electrical connection to the circuit under test is required, as the probe clamps around the current-carrying conductor.

The insertion impedance of the P6019 Current Probe is 2.8 μH paralleled by .004 Ω, in series with 1.7 nH (See Fig. 4-1). The insertion impedance of the P6020 Current Probe is 0.6 μH paralleled by .025 Ω, in series with 0.2 nH (See Fig. 4-2).

The characteristics listed below pertain only to the Type 134 and Probes, and do not include the oscilloscope.

ELECTRICAL CHARACTERISTICS

Characteristics	P6019 with 134	P6020 with 134	P6019 with Termination	P6020 with Termination	134 Volts Only P6019 Position	134 Volts Only P6020 Position
Deflection Factor with 50 mV/div oscilloscope	1 mA/div to 1 A/div ±3% in 1, 2, 5 sequence	1 mA/div to 1 A/div ±3% in 1, 2, 5 sequence	2 mA or 10 mA/div ±3%, selected by slide switch	1 mA or 10 mA/div ±3%, selected by slide switch	0.4 mV/div ±3% (gain of 134 is 125)	1 mV/div ±3% (gain of 134 is 50)
Low Frequency Response (3 dB down)	≤12 Hz (see Fig. 1-2)	≤100 Hz	≤450 Hz at 2 mA/mV, ≤120 Hz at 10 mA/mV	≤8.5 kHz at 1 mA/mV, ≤935 Hz at 10 mA/mV	≤10 Hz	≤8 Hz
High Frequency Response (3 dB down)	≥40 MHz	≥70 MHz	≥60 MHz	≥200 MHz	≥30 MHz	≥54 MHz
Maximum Current Rating	15 A, peak to peak (see Fig. 1-4)	6 A, peak to peak (see Fig. 1-5)	15 A, peak to peak (see Fig. 1-4)	6 A, peak to peak (see Fig. 1-5)		
Maximum DC Voltage	600 V, with slide closed (P6019 only)	600 V, with slide closed (P6020 only)	600 V	600 V	+ and — 1 V (134 only)	+ and — 1 V (134 only)
Risetime	≤8.75 ns	≤5 ns	≤5.8 ns	≤1.75 ns	≤11.5 ns	≤6.5 ns
Ringing, Rounding, or Overshoot	≤5% during first 50 ns of displayed waveform	≤5% during first 50 ns of displayed waveform	≤5% during first 50 ns of displayed waveform	≤4% during first 50 ns of displayed waveform	≤5% during first 50 ns of displayed waveform	≤5% during first 50 ns of displayed waveform
Tilt	≤3% during 400 μs of displayed waveform	≤3% during 80 μs of displayed waveform	≤4% during 10 μs of displayed waveform at 2 mA/mV; ≤4% during 100 μs of displayed waveform at 10 mA/mV	≤4% during 1 μs of displayed waveform at 1 mA/mV; ≤4% during 10 μs of displayed waveform at 10 mA/mV	≤3% during 500 μs of displayed waveform	≤3% during 600 μs of displayed waveform
Noise	≤150 μA referred to the input	≤150 μA referred to the input				

POWER SUPPLY

Characteristic	115 Volt Power Supply	230 Volt Power Supply
Line Voltage Range	103.5 to 126.5 Volts AC 50 to 400 Hz	207 to 253 Volts AC 50 to 400 Hz
Output Voltage	+13.25 to +15.25 Volts DC	+13.25 to +15.25 Volts DC
Regulation	≤0.5 Volts change	≤0.5 Volts change
Ripple	≤2 millivolts	≤2 millivolts

Mechanical Specifications

Type 134

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—3⅝ inches high, 1⅞ inches wide, 6 3/16 inches deep (includes connectors).

Terminations

Zamac No. 5 die casting.

Probes

Black plastic case, grey plastic slide.

Parts Ordering

The following parts may be ordered either individually, or by the package numbers shown in the chart below.

PACKAGE PART NUMBERS

Type and Individual Part Number	015-0065-00	015-0066-00	015-0067-00	015-0068-00	015-0069-00	015-0070-00	015-0071-00	015-0072-00
P6019 010-0196-00[1]	X		X	X			X	X
P6020 010-0197-00[1]		X			X	X	X	X
134 Amplifier 015-0057-00			X	X	X	X	X	X
115 V Power Supply 015-0058-00			X		X		X	
230 V Power Supply 015-0059-00				X		X		X
Accessory Hanger 014-0029-00			X	X	X	X	X	X
18 inch BNC Cable 012-0104-00			X	X	X	X	X	X
P6019 Termination 011-0078-00	X							
P6020 Termination 011-0079-00		X						
Carrying Case 016-0087-00			X	X	X	X	X	X
Instruction Manual 070-0524-00	X	X	X	X	X	X	X	X

[1]Includes one 3 inch Ground Lead (175-0263-00), one 5 inch Ground Lead (175-0124-00), and two Alligator Clips (344-0046-00).

Optional Accessories

Battery Adapter (013-0050-00)—To connect battery to power cord (Use a 16 to 33 Volt, 70 mA battery such as a Mercury E302580 or equivalent).

Calibrator Adapter (013-0092-00)—Connects to Calibrator, develops a current signal which can be displayed with the Current Probe.

BNC/UHF Adapter (103-0015-00)—For use with oscilloscope having UHF input connectors.

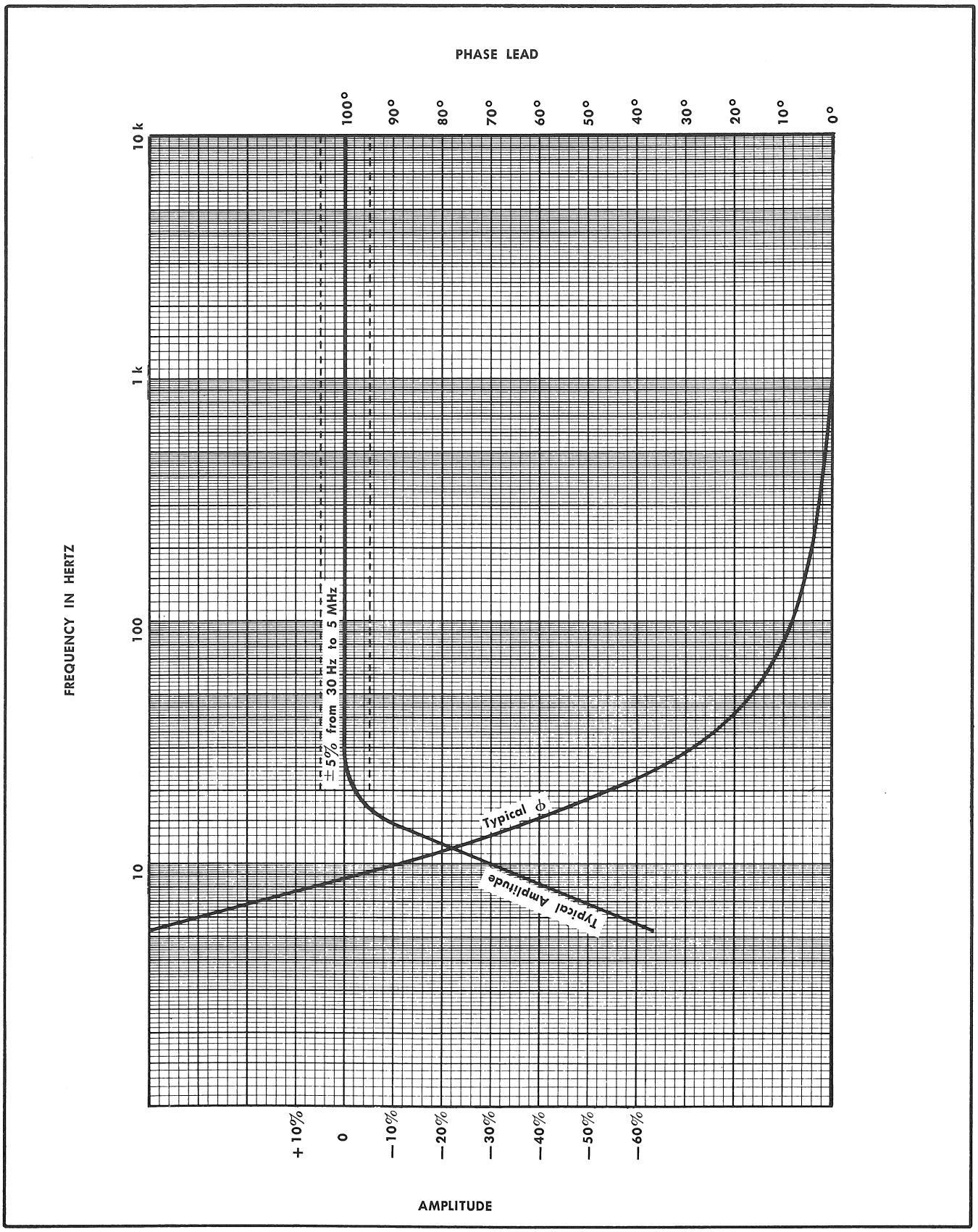


Fig. 1-2. Type 134 and P6019 amplitude and phase vs frequency.

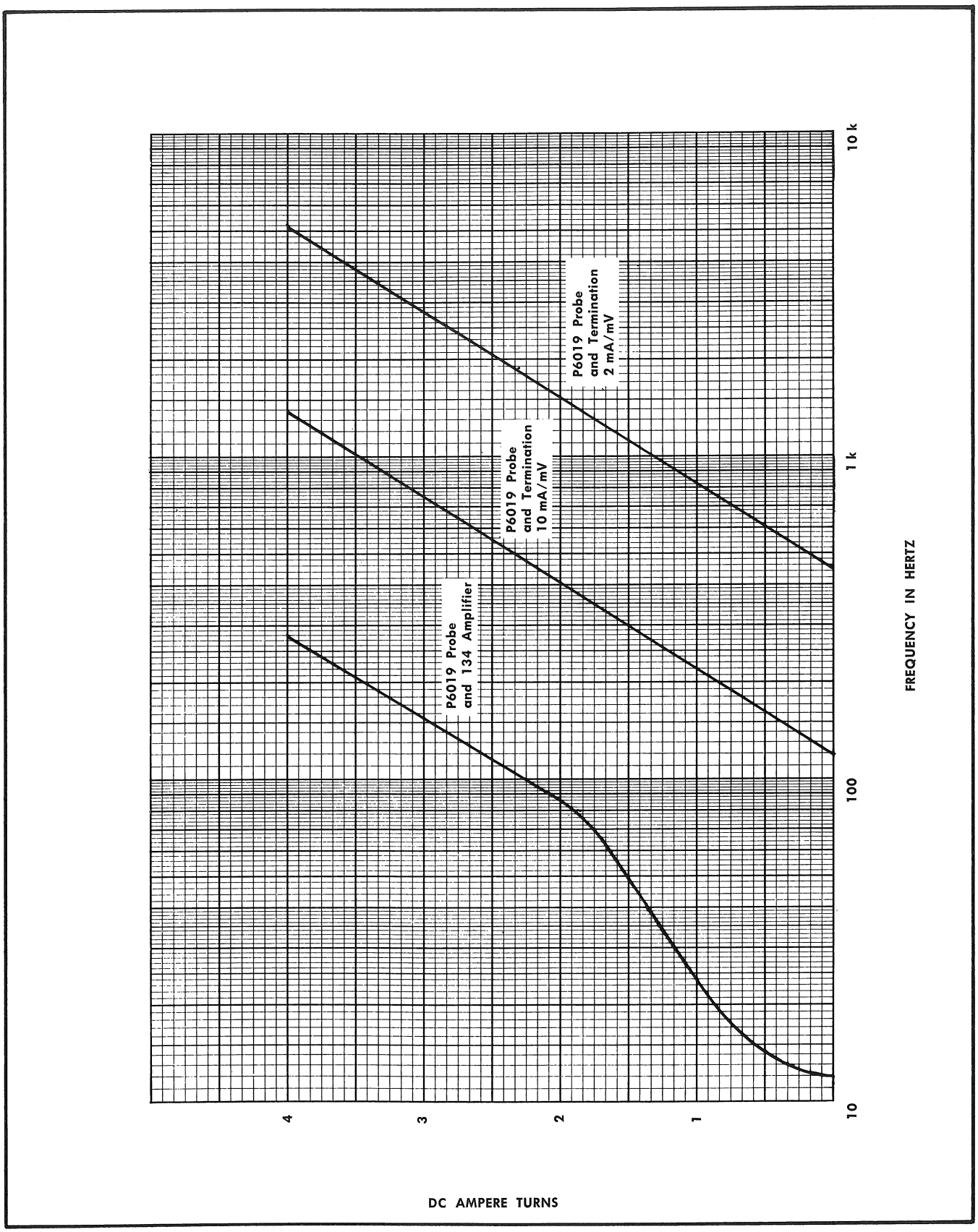


Fig. 1-3. Type P6019 low frequency 3 dB point vs DC-ampere turns.

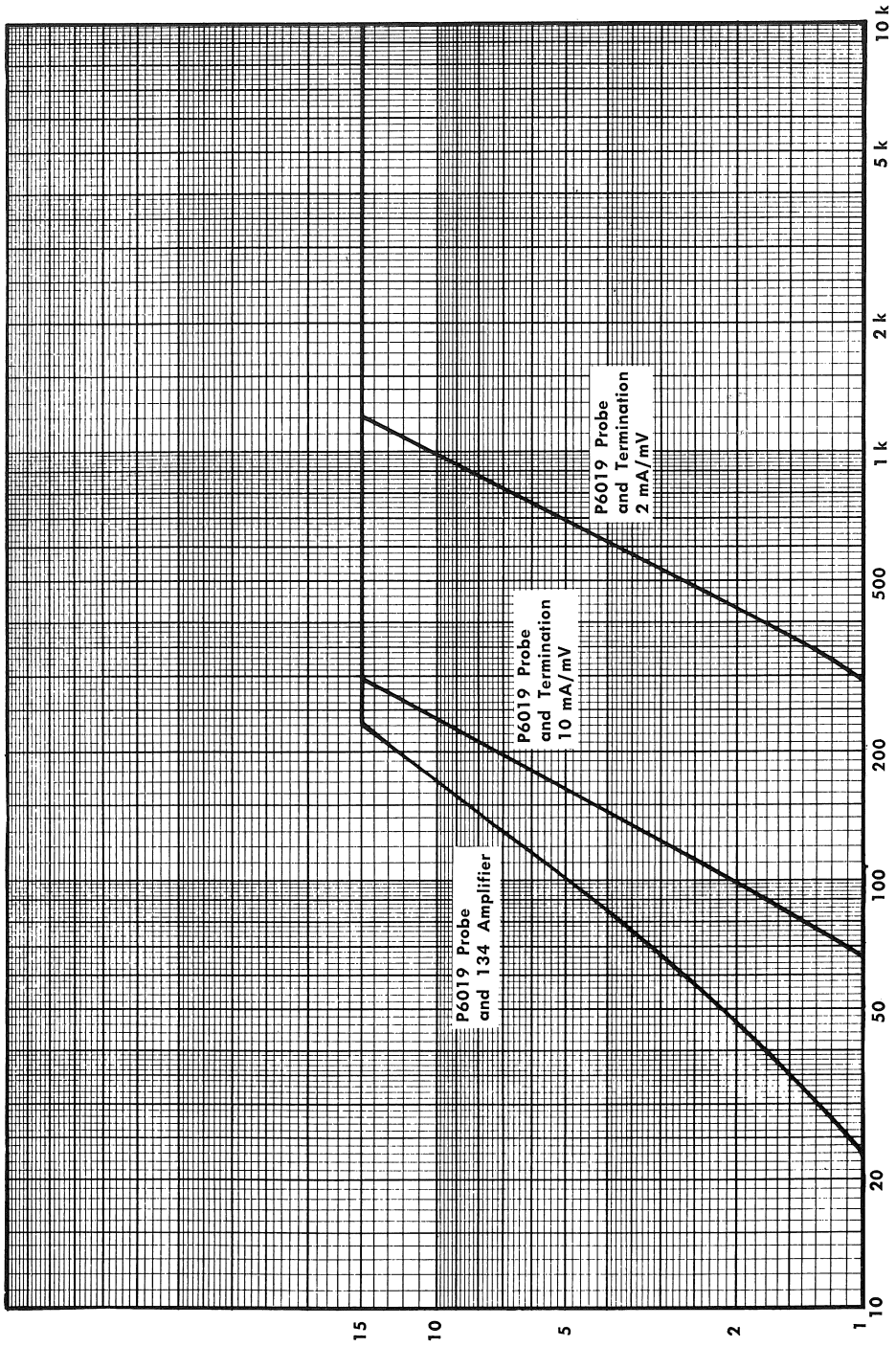


Fig. 1-4. Type P6019 low frequency response vs peak-to-peak current. At the low-frequency end detectable sine-wave distortion occurs as a result of core saturation. Although the probe distorts low-frequency current waveforms when the core starts to saturate, any high-frequency waveforms or short-duration 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.

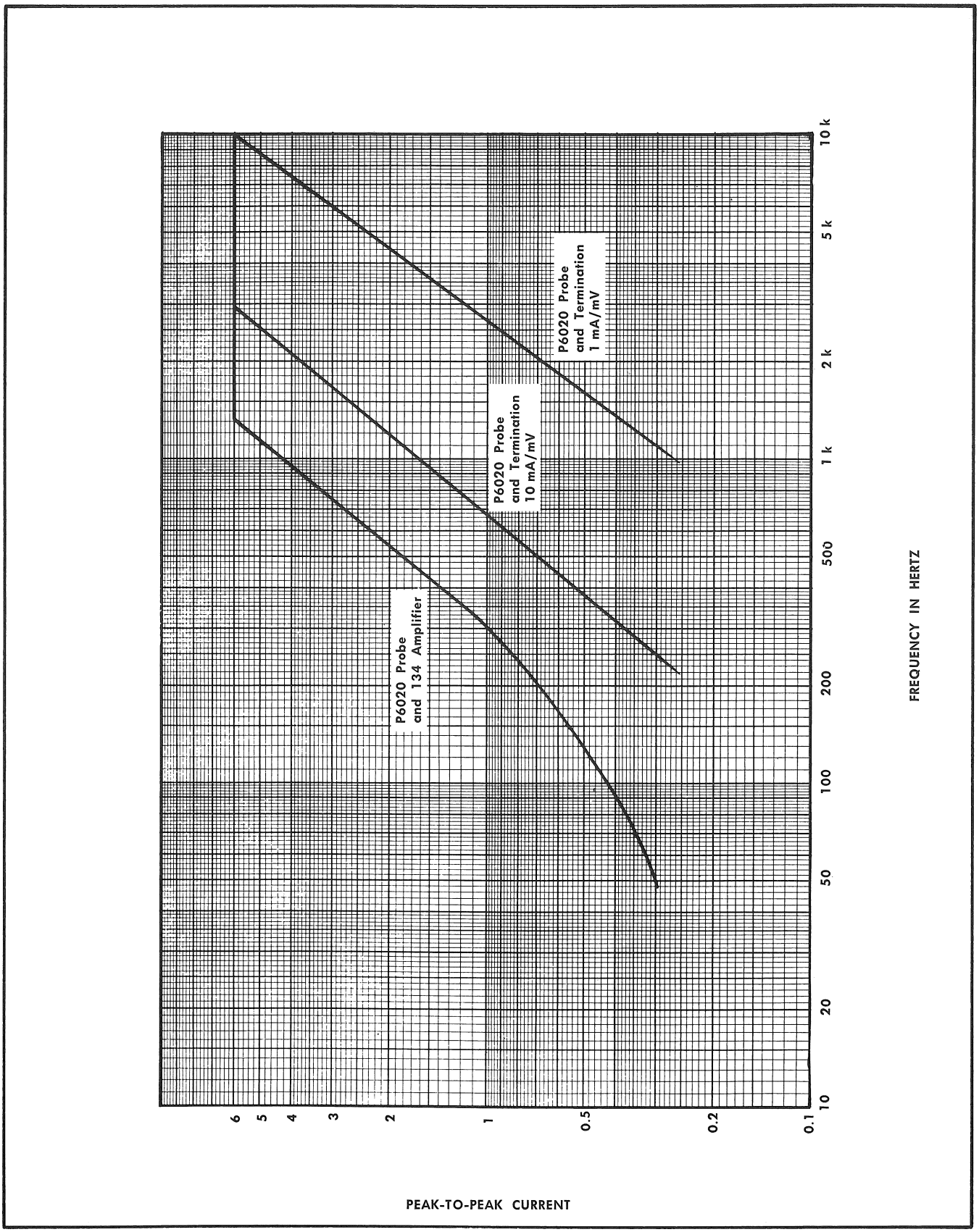


Fig. 1-5. Type P6020 low frequency response vs peak-to-peak current. At the low-frequency end detectable sine-wave distortion occurs as a result of core saturation. Although the probe distorts low-frequency current waveforms when the core starts to saturate, any high-frequency waveforms or short-duration microsecond pulses present at the same time are unaffected. At the high-frequency end, current ratings may be exceeded under conditions indicated on the graph.

SECTION 2
OPERATING INSTRUCTIONS

General

Current waveforms can best be observed using either the Type P6019 or P6020 Current Probe, with the Type 134 Current Probe Amplifier. The Type 134 is designed for use from 12 Hz to 40 MHz using the P6019 Probe, and from 100 Hz to 70 MHz using the P6020. Waveforms having adequate amplitude may be observed using the P6019 or P6020 Probe with the passive Termination.

Precautionary Notes

Ground Clip Leads

Ground clip leads are furnished with the probe to ground the shield at the probe end 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 undesirable chassis currents which may appear in the more sensitive positions. When observing high frequency waveforms, use the short ground clip lead to avoid ringing.

Performance Limitations

When making current measurements and analyzing the waveform, take into consideration the combined bandwidth of the oscilloscope, the Current Probe, and the Type 134 or Termination.

For most applications, effective system bandwidth may be calculated by

$$Tr = \left[(Tr_1)^2 + (Tr_2)^2 \ldots + (Tr_n)^2\right]^{\frac{1}{2}}$$

Where Tr_n = risetime of an individual increment of the system.

Minimize Loading Effect

To minimize any loading effect of critical circuits, wherever 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 either the Type 134 Amplifier or the Termination. With the probe cable unterminated under these conditions, a high voltage is developed in the secondary winding which may damage the probe current transformer.

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).

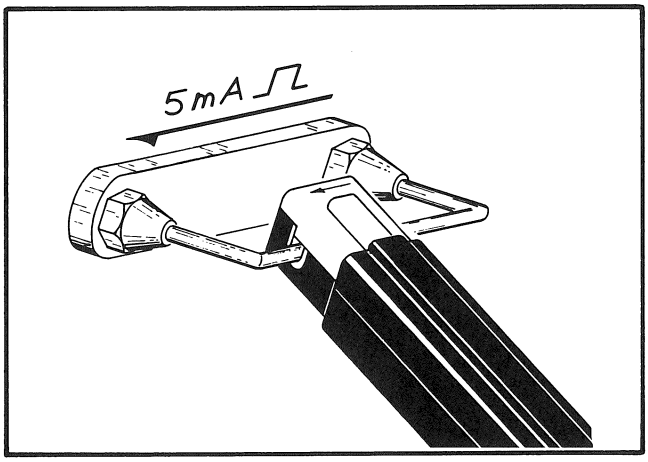


Fig. 2-1. Current flow in a conductor.

Operation with Type 134 Amplifier

To observe and measure current waveforms using either the P6019 or the P6020 Current Probe and the Type 134 Current Probe Amplifier, connect the Type 134 to the front panel input of the oscilloscope, and set the oscilloscope deflection factor to 50 mV/div. Rotate the variable Volts/division control to the calibrated position and DC couple the input. Plug the Amplifier power supply into the power source and connect the power cord from the Type 134 to the power supply. Connect the probe to the Type 134 INPUT (see Fig. 2-2). Set the Type 134 Probe Selector switch to the appropriate switch position, P6019 or P6020, for the probe being used. Set the CURRENT/DIV switch to suit the amplitude of the current waveform to be observed and measured.

NOTE

When connecting the P6019 or P6020 Probe to the Type 134 for the first time, or when changing from one probe to the other, the LOW FREQ compensation (R154) must be adjusted. Refer to the Calibration section of this manual.

Slide the thumb-controlled portion of the probe back, place the probe around the conductor under test, and allow the core to move forward. Set the oscilloscope front-panel controls for a stable display. With the oscilloscope set to 50 mV/div, the amplitude of the waveform may be read directly from the CURRENT/DIV switch.

If a different oscilloscope deflection factor is desired, the overall deflection factor must be calculated. The following is an example:

CURRENT/DIV switch setting—5 mA

Volts/div switch setting—10 mV/div

Peak to peak deflection of waveform—2 divisions

5 mA/50 mV × 10 mV/div × 2 div = 2 mA

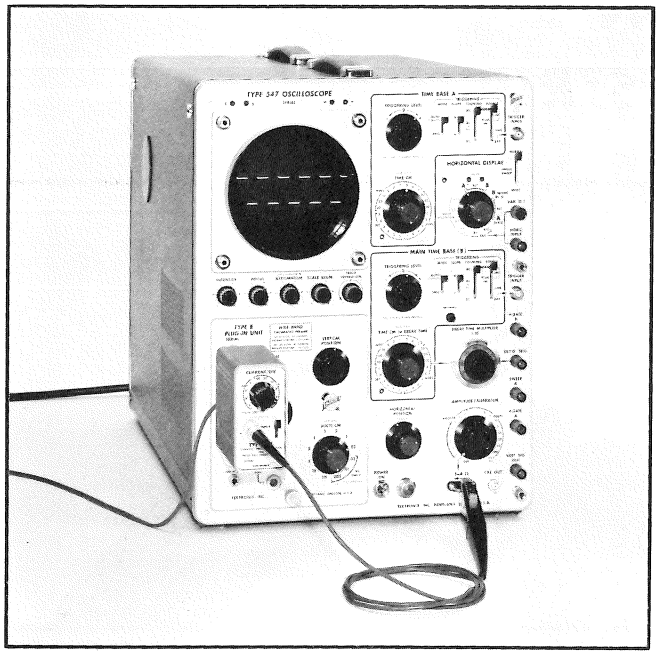


Fig. 2-2. The Current Probe and the Type 134 Current Probe Amplifier connected to the oscilloscope.

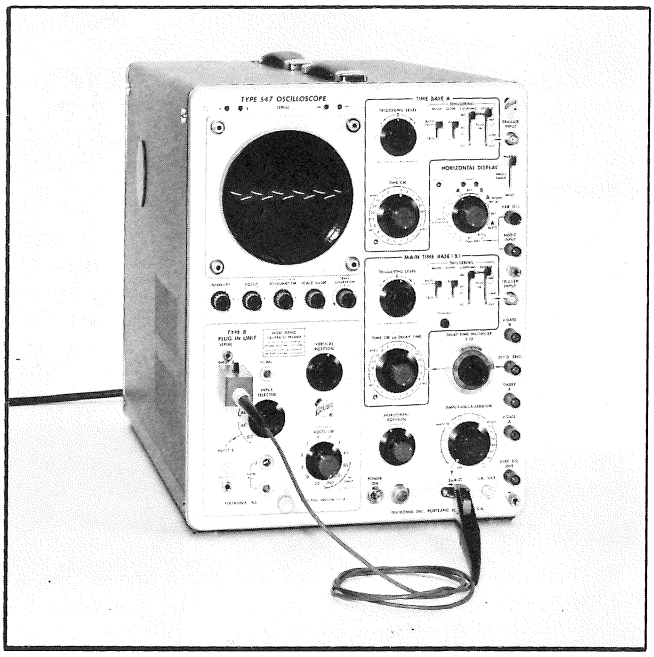


Fig. 2-3. The Current Probe and the Termination connected to the oscilloscope.

Operation with Passive Termination

To display current waveforms using either the P6019 or P6020 Current Probe and passive Termination, connect the appropriate termination between the probe connector and the input to the oscilloscope. (See Fig. 2-3.) Set the slide switch on the termination to the desired sensitivity. Rotate the variable Volts/division control on the oscilloscope to the calibrated position. Set the oscilloscope deflection factor to suit the amplitude of the current waveform to be observed and measured.

Place the probe around the conductor under test, and set the front panel controls for a stable display. To measure the peak to peak current of the displayed waveform, first multiply the setting of the slide switch on the termination by the vertical deflection factor, which gives the overall deflection factor. Then multiply the overall deflection factor by the deflection of the waveform. The following is an example:

Termination switch setting—2 mA/mV

Volts/Div switch setting—50 mV/div

Peak to peak deflection of waveform—3 divisions

2 mA/mV × 50 mV/div × 3 div = 300 mA

Using the Type 134 as a Voltage Amplifier

An additional application for the Type 134 is voltage amplification. When the CURRENT/DIV switch is set to the VOLTS ONLY position, the Type 134 becomes an AC-coupled voltage amplifier with a gain of 125 in the P6019 position, and 50 in the P6020 position. The input impedance of the amplifier is 50 Ω.

Attenuator probes designed for use with 50 Ω systems, such as the P6034 10× Probe or the P6035 100× Probe, can be used with the Type 134. To measure the amplitude of the display on the oscilloscope, divide the attenuation ratio of the probe by the gain of the Type 134 Amplifier and multiply the quotient by the oscilloscope deflection factor. This gives the overall deflection factor. Multiply the overall deflection factor by the deflection of the waveform. The following is an example:

Attenuation ratio of the probe—10×

Gain of the Type 134 Amplifier (P6020 position)—50

Volts/div switch setting—50 mV/div

Peak-to-peak deflection of waveform—4 div

10/50 × 50 mV/div × 4 div = 40 mV

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).

SECTION 3

APPLICATIONS

General

Information in this section of the manual has been selected to help you use the Current Probe. The probe, used in conjunction with the Type 134 Current Probe Amplifier or the Termination, will increase the usefulness of your oscilloscope. To lay the groundwork for many of the applications that may be encountered, some basic applications are illustrated and explained here.

Undesirable Magnetic Fields

The current probe is shielded to minimize the effect of external magnetic fields. However, strong fields may interfere with a current signal to be measured. If you suspect that an external field is interfering with your measurement, remove the probe near the conductor 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, either through Type 134 Amplifiers or through Terminations.

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 slide closed. By setting the oscilloscope controls for common-mode rejection, the undesirable 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 the Amplifiers or Terminations.

Tracing Magnetic Fields

The 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 clamp open, and scanning about the chassis. The increased sensitivity of the unshielded transformer permits the maximum field current to be induced in the probe.

Increasing the Sensitivity

The sensitivity of the 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 twice through the probe, a two-turn primary winding is formed and the sensitivity of the probe is doubled. (The sensitivity of the probe is directly proportional to the number of turns.) If, for example, the oscilloscope deflection factor is set for 1 mA/div, for normal single-turn measurements, the deflection factor using a two-turn loop would actually be 0.5 mA/div.

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, additional turns add inductance to the primary circuit.

Balancing Currents

The 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 Current Probe, a standard attenuator probe, and a dual-trace oscilloscope.

1. Connect the Current Probe through either the Type 134 Amplifier or the Termination to one of the vertical input connectors on the oscilloscope, and connect the attenuator probe to the other vertical input connector.

2. Connect the Current Probe around the conductor at the point where the current is to be measured.

3. Connect the attenuator probe tip and ground lead between the two points at which the voltage is to be measured (the conductor and the chassis, the two ends of a resistor, etc).

4. Adjust the oscilloscope controls, and the CURRENT/DIV switch on the Type 134, or the Termination switch, for suitable displays. Obtain the current and voltage readings from the respective displays on the CRT.

NOTES

SECTION 4

CIRCUIT DESCRIPTION

Introduction

The circuits to be described in this section are divided into four parts: the P6019 and P6020 Current Probes, the P6019 and P6020 Terminations, the Amplifier Power Supply, and the Type 134 Current Probe Amplifier.

P6019 and P6020 Current Probes

The Current Probe consists of a current transformer mounted in the nose of the case, an impedance matching network, and a switch to disconnect the transformer shield from ground.

The transformer contains a two-section U-shaped ferrite core. One section is stationary, the other is mechanically movable to permit closing the core around the conductor being measured for current. The conductor forms a one-turn primary winding for the transformer; the windings around the stationary portion of the core form the secondary windings. The paralleled windings assure a fast response. The circuitry between the transformer and the coaxial cable corrects any difference in level between the pulses induced in the paralleled windings of the secondary, and matches the balanced probe winding to the cable.

The insertion impedance of the Current Probe is the equivalent circuit which is placed in the circuit under test when the probe is clamped around the conductor. When observing fast-rise signals, this should be taken into consideration. Fig. 4-1 and Fig. 4-2 illustrate the approximate insertion impedance of the P6019 and P6020 Current Probes.

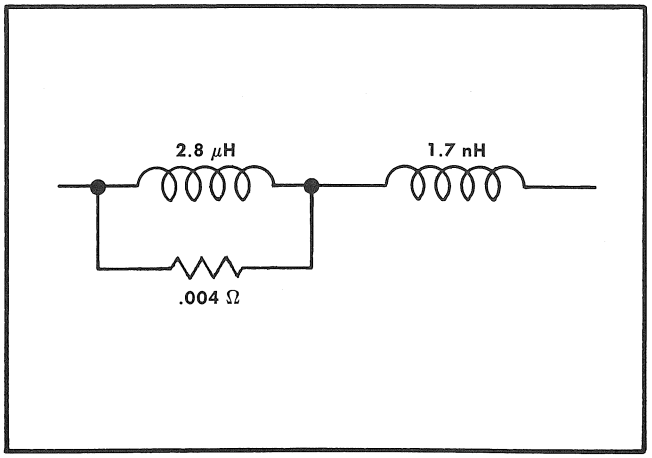


Fig. 4-1. Insertion impedance of the P6019 Current Probe.

The Type P6020 Current Probe is designed for use at a higher frequency range than the P6019. The inductance of the P6020, therefore, is lowered by placing fewer windings in the secondary. This results in the P6020 having a greater sensitivity than the P6019. Due to this difference in sensitivity, the gain of the Type 134 Current Probe Amplifier is set by the Probe Selector switch to correspond with the probe being used.

The transformer in the nose of the probe is shielded to eliminate interference from outside signals. To eliminate the possibility of shorting this shield to the conductor being measured when removing or replacing the probe, a slide switch, SW20, disconnects the ground from the shield when the slide portion of the probe is open.

P6019 and P6020 Passive Terminations

The Passive Termination consists of a 62-ohm impedance matching network to terminate the coaxial cable, and a voltage divider which is switched in by a slide switch, changing the sensitivity.

P6019 Termination

With the slide switch in the 2 mA/mV position, a 10 mA current signal in the conductor induces a 5 mV signal at the output of the termination. In the 10 mA/mV position, the 10 mA signal is attenuated to one-fifth and a 1 mV signal is seen at the output.

P6020 Termination

With the slide switch in the 1 mA/mV position, a 10 mA current signal in the conductor induces a 10 mV signal at the output of the termination. In the 10 mA/mV position, the signal is attenuated 10×, producing 1 mV at the output.

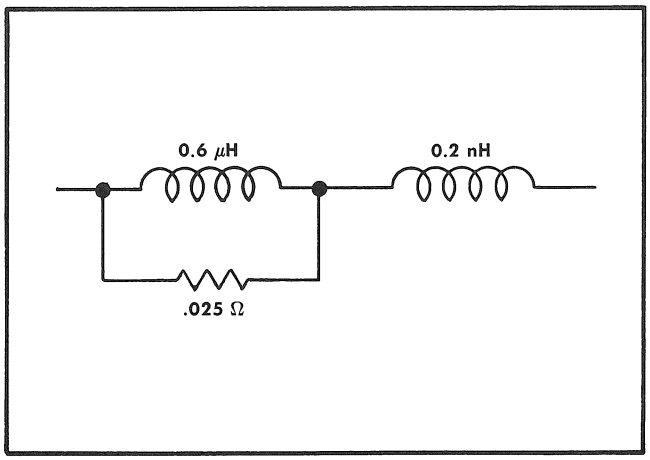


Fig. 4-2. Insertion impedance of the P6020 Current Probe.

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 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

supplies. The 230 volt supply has a resistor in each side of the line (R101 and R102) between the plug and the primary to reduce the line voltage to 115 volts. The frequency range of the power supply is 50 to 400 Hz.

The filter circuit, located in the Amplifier portion of the power supply, is formed by C105, C106, C107, R105, and R106. A 15 volt zener diode, D107, is used to supply a constant voltage to the base of Q107, the power transistor. This produces a +14 volt supply at the emitter of Q107. C107 eliminates any zener noise from D107, and lowers the base drive impedance at 120 Hz.

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 volts appears. A ground loop is therefore avoided. Should the transformer windings short, the primary fuse F101 would open before D105 and D106 were damaged. However, F101, will not open if the two sides of the diode bridge are shorted together.

Type 134 Current Probe Amplifier

Current Positions of CURRENT/DIV Switch

The input signal from the probe is terminated by R60, L60, and the 2 Ω input impedance of the amplifier in the 1 mA through 20 mA positions of the CURRENT/DIV switch, and by R62, L62, and the 2 Ω input impedance in the 50 mA through 1 AMP positions. C51-R51, C53-R53, and C55-R55 are input impedance compensation networks.

To achieve the desired deflection factor in the ten current positions of the CURRENT/DIV switch, the signal is attenuated in the 20 mA through 1 AMP positions, and the gain of Q134 is changed by switching the emitter to one of the four emitter resistor networks.

The input of the amplifier is AC-coupled by C110 and C112. C118 provides damping to prevent ringing. For gain considerations, the wiper of R125 or R128, depending upon the position of the Probe Selector switch, is at ground potential. Therefore, the gain of the stage can be adjusted for either probe without affecting the DC operating point of Q124, which is set by R120 through R129. High frequency peaking for the P6019 Probe is provided by C131 and R131.

The emitter follower circuit, with Q133, isolates the collector load of Q124 from Q134 so that when switching Q134 emitter resistors the loading does not reflect back and change the gain of Q124. R130 is a parasitic suppressor which keeps Q133 from oscillating. R137 and R140 are parasitic suppressors which keep Q134 from oscillating. LR136 provides high frequency peaking for Q134.

When the gain is switched in the emitter of Q154 by the Probe Selector switch, varying load impedances are seen at the base of Q154. Q143, therefore, isolates the collector of Q134 from Q154. Much of the peaking is done in this output stage. C158 shapes the front corner of the waveform in the P6019 position; C160 shapes the high frequency waveform observed with both the P6019 and P6020.

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.

R146, R157, and C146 form a low-pass filter which allows feedback for the low frequency operational amplifier Q143-Q154. This is to stabilize the DC operating point due to the lower impedance in the emitter of Q154 when the Probe Selector switch is in the P6019 position.

At high frequencies, the reactance of C163 is low; therefore, the output signal is developed across R150. At low frequencies, the reactance of C163 rises, and the signal is then developed across R150 and R151. This results in a low frequency boost. The low frequency signal is compensated by R154. T164 isolates the capacitance of the switch from the output.

VOLTS ONLY Position of the CURRENT/DIV Switch

In the VOLTS ONLY position of the CURRENT/DIV switch, R67, in addition to the input impedance of the amplifier, forms a 50-ohm termination for the input signal. R66 and C66 keep the impedance at 50 ohms 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 peaking required for the Current Probe is removed in the VOLTS ONLY position, and the gain of the Amplifier is set by the collector circuit of Q124 and the emitter circuit of Q154, depending upon the position of the Probe Selector switch. C163, the low frequency boost capacitor in the output stage is switched out in the VOLTS ONLY position.

SECTION 5

MAINTENANCE

General Information

The information in this section will assist you in removing and replacing parts in the Probe, Termination, Amplifier, and Power Supply. When parts are replaced in the Type 134 Current Probe Amplifier, it will be necessary to check the Amplifier gain and performance to determine if recalibration is needed. Refer to the Performance Check section of this manual for test equipment required to check the operation of the instrument.

Soldering Precautions

A 60-watt soldering iron should be used when servicing the circuit board assembly. Excessive heat will deteriorate the bond between the etched wiring and the base material.

To preserve the wide-band characteristics of the Type 134 Amplifier and the Termination, mount new replacement parts in the same physical location as the old parts. Use short leads, and solder each part carefully into place. Use care in handling component leads to keep them from being weakened or broken.

In general, the proper technique for soldering short-lead components requires the use of a hot (60-watt) soldering iron for a short time at the connection to be soldered. The tinned tip of the iron should come in contact with both the component lead and the etched surface for fast transfer of heat as the solder is being applied. Use long-nosed pliers to grip the lead near the component to provide a heat sink.

Installing the Type 134 Hanger

Supplied with the Type 134 is a hanger which 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. 5-1).

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 one-eighth inch holes in line vertically and separated one-half inch.

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

5. Place the Type 134 in position and connect the Amplifier output to the input of the oscilloscope, using the eighteen inch male-to-female cable.

Cleaning the Current Probe

The Current Probe should be taken apart and cleaned periodically, depending upon the local conditions.

Use a soft bristle brush to dislodge the dust and wipe clean with a soft cloth. If a persistent coating of dirt remains, it can be removed by washing the plastic portions of the probe in warm water with some liquid detergent added. Allow the parts to air dry thoroughly, or wipe dry with a lint-free cloth. Apply a coating of Lubriplate or some similar lubricant to the contact areas of the spring.

While cleaning the probe, make a visual check of the probe parts. Look for any excessive wear of the slide parts which may cause improper operation later on.

NOTE

Do not use any organic solvents to clean the probe.

Probe Disassembly

P6019 Probe

1. Remove the four screws which hold the probe halves together.

2. Separate the probe halves about one inch at the nose end of the probe.

3. Move the stain relief boot back over the cable.

4. Remove the half of the probe body containing the slide.

5. Remove the cable, switch, and transformer assembly from the other half of the probe body. The P6019 Probe is shown disassembled in Fig. 5-2.

6. When reassembling the probe, the curved portion of the retaining spring must be hooked into position in the slide. As the two halves are brought together, the slide switch contact must seat into position in the slide, and the square holes inside the boot must match up with the raised squares on the base of the probe halves. When tightening the front screws, hold the slide back slightly.

P6020 Probe

1. Hold the Probe in a horizontal position with the slide up.

2. Move the strain relief boot back over the cable.

3. Carefully lift the upper half of the probe body up slightly at the cable end and remove the slide spring and holder.

4. Leaving the slide in place, remove the upper half of the probe body.

5. Remove the slide and the top of the transformer.

6. Remove the cable, switch, and transformer assembly from the other half of the probe body. The P6020 Probe is shown disassembled in Fig. 5-3.

7. Reassemble the probe, reversing the above procedure.

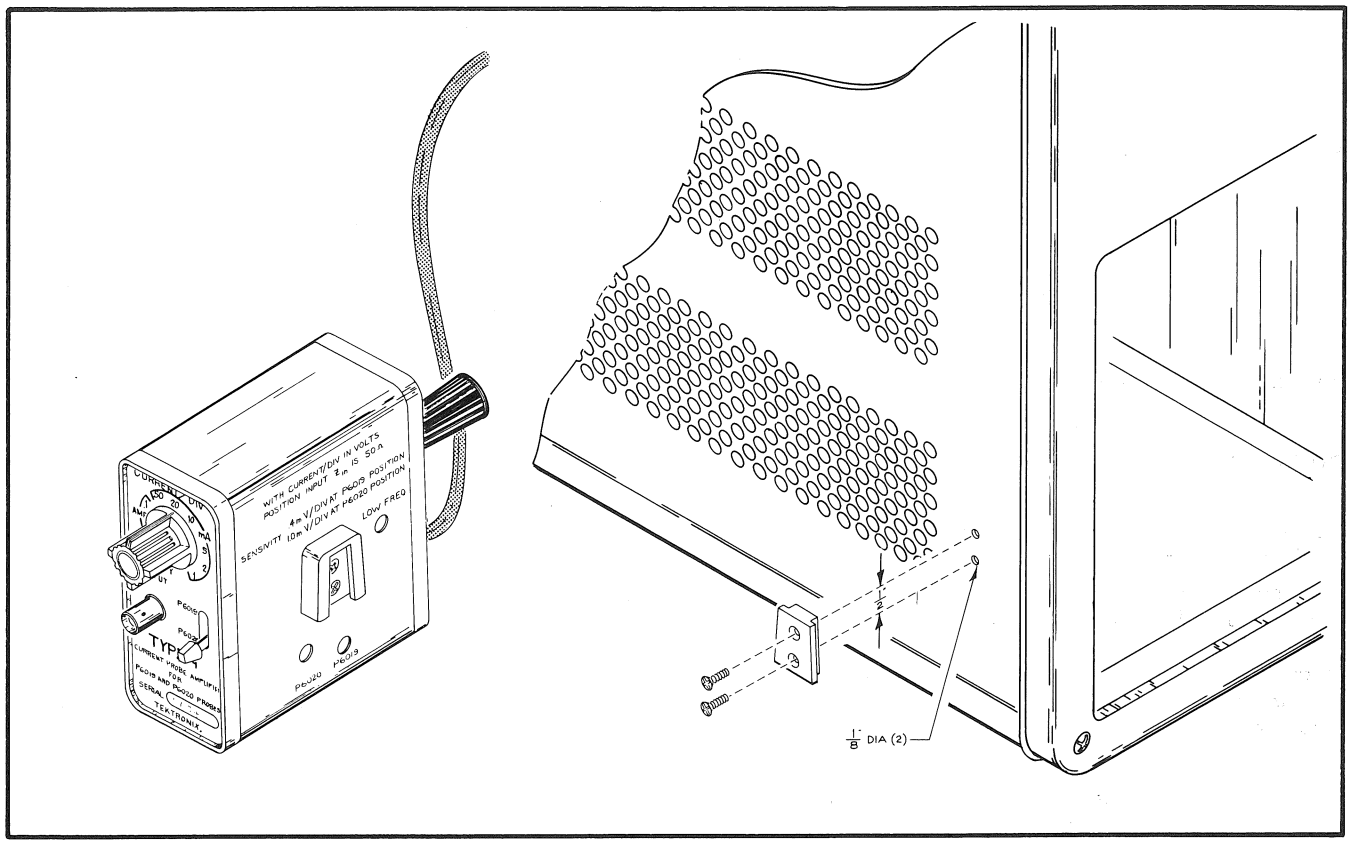


Fig. 5-1. Hanger installation.

Repairing the Current Probe

To replace the current transformer or to make other repairs inside the probe body, take the probe apart as described previously. To remove the current transformer, the cable must be unsoldered from the transformer. The transformer can then be removed. When replacing the current transformer, replace the entire assembly, including the core mounted in the slide. The complete transformer assembly is matched at the factory before it is released for shipment.

Repairing the Type 134 Current Amplifier

Removing 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.

Replacing Transistors

When any of the transistors in the amplifier stages are replaced, the amplifier will require calibration. Refer to the Calibration procedure for instruction.

For optimum performance, checked transistors may be ordered from Tektronix.

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.

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 O, Q, and R of the circuit board.

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

3. Unsolder C125, the 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 on the circuit board.

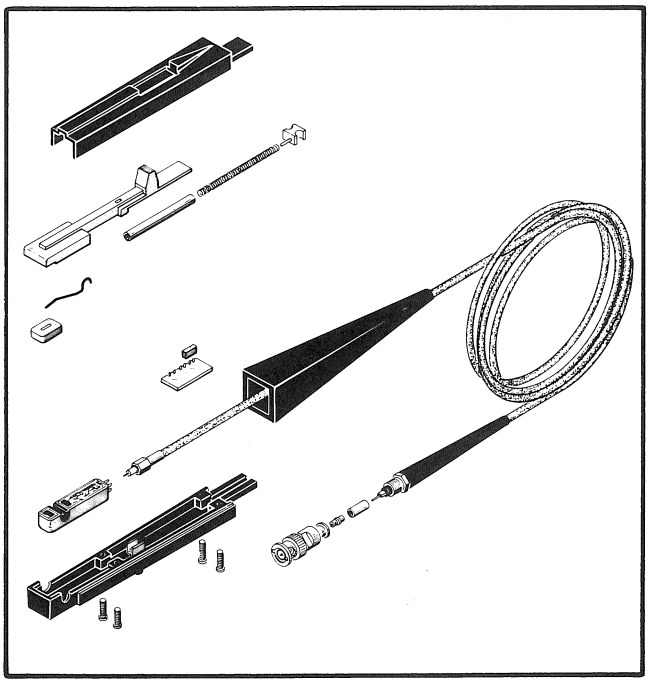


Fig. 5-2. Disassembled P6019 Probe.

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.

Replacing Components

When replacing components on the circuit board assembly, or on the switches, avoid using excessive heat. Provide a heat sink, using a pair of long-nose pliers.

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 positions of the CURRENT/DIV switch.

Repairing the Power Transformer Housing Components

Removing the Cover

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

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 to the power transformer terminals. Overheating can cause the fine wire used in the transformer winding to break loose from the terminals.

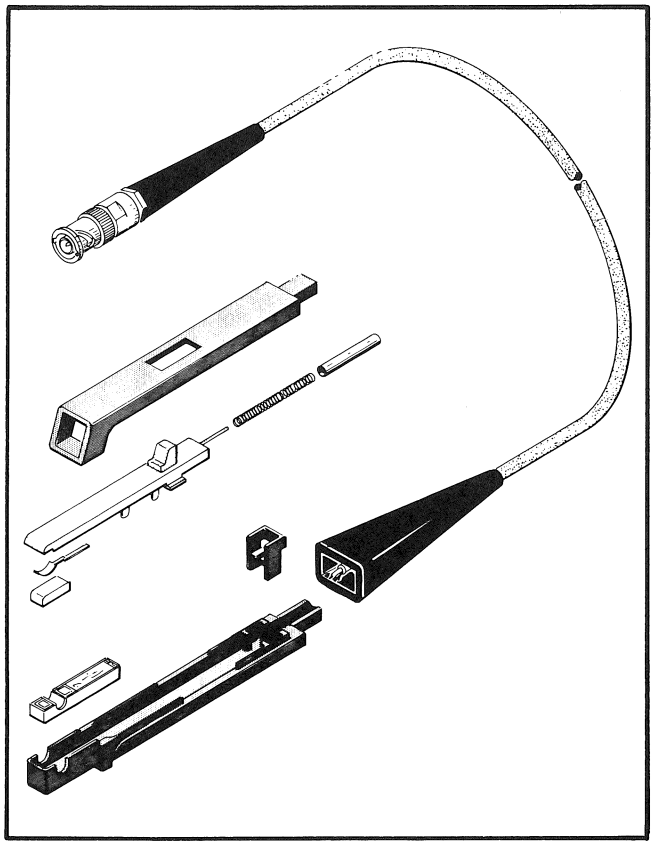


Fig. 5-3. Disassembled P6020 Probe.

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 plug chassis.

Replacement of the Power Plug

1. Unsolder the connections to the transformer primary.

2. Remove the ground pin and screw from the power plug.

3. 230 volt supply only—Unsolder the two resistors from the power plug.
115 volt supply only—Unsolder the fuse from the power plug.

Replacement of the Transformer

1. Remove the connectors as in steps C and D.

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

3. Remove the transformer from the chassis.

4. Remove the diode bridge from the secondary.

Repairing the Terminations

Replacement of Connectors

1. Remove the back cover plate from the Termination.

2. Using a heat sink, unsolder the lead from the connector inside the termination.

3. Loosen the 0.050 inch hexagonal head set screw holding the connector in place, and slide the connector out.

4. Replace the connector by reversing the above procedure.

Replacement of Components

P6019 Termination

1. Remove the back cover plate.

2. Using a heat sink, remove the component to be replaced.

3. Reassemble, reversing the above procedure.

P6020 Termination

1. Remove the back cover plate and front panel.

2. Unsolder the leads from the connectors and remove the female (input) connector.

3. Remove the two screws holding the switch and assembly in place.

4. Replace the component and reassemble, reversing the above procedure.

SECTION 6

PERFORMANCE CHECK

This section of the manual provides a means of checking the performance of the Type 134. It is intended to check the calibration of the instrument without the need for performing the complete Calibration Procedure.

Failure to meet the requirements given in this procedure indicates the need for internal checks or adjustments. The user should refer to the Calibration section of this manual.

Equipment Required

1. Test Oscilloscope—10 mV/div deflection factor, .05 μsec/div sweep rate with ×5 magnification and 4 ns risetime (Tektronix Type 581A Oscilloscope with Type 82 Plug-In recommended).

2. Constant Amplitude Signal Generator—50 kHz to 100 MHz sine wave at 1 V into 50 Ω (Tektronix Type 191 recommended).

3. Low-Frequency Sine Wave Oscillator—5 Hz to 20 kHz.

4. AC Current Source—Standard Amplitude Calibrator (067-0502-00), or 540-series Oscilloscope with 5 mA current loop, or Calibrator Adapter (013-0092-00).

5. Pulse Generator—0.25 ns risetime pulses from 0 to 50 V into 50 Ω (Tektronix Type 109 recommended).

6. Transmission Line—60 ns delay, 0.1 ns risetime (Tektronix Type 113 Delay Cable recommended).

7. Two Coaxial Cables—5 ns length. (017-0502-00).

8. GR High Frequency Current Test Fixture (50 Ω terminating current loop)—(067-0559-00).

9. GR 50 Ω through-type Termination—(017-0083-00).

10. GR to BNC adapter—(017-0064-00).

11. Square Wave Generator—60 Hz to 25 kHz square wave at 1 V into 50 Ω (Tektronix Type 105 recommended).

12. Two 10× Attenuators (with BNC connectors)—50 Ω (011-0059-00).

13. Load Resistor—1000 Ω, 1%, ¼ W (322-0193-00).

NOTE

The specifications listed throughout this manual include only the P6019 or P6020 Current Probes, and the Type 134 Current Probe Amplifier or passive Termination, and do not include the test oscilloscope.

1. Type 134—Voltage Mode

The following checks are to be made with the test oscilloscope deflection factor set to 50 mV/div, and the Type 134 CURRENT/DIV switch in the VOLTS ONLY position.

a. Deflection Factor

Connect the Type 134 to the Type 581A test oscilloscope input, and set the Probe Selector switch to P6019. Connect the calibrator output through the 1000 Ω load resistor to the Type 134 INPUT. Set the calibrator to the 20 mV position and check for 2 divisions of deflection, ±3%.

Change the Probe Selector switch to P6020 and switch the calibrator to the 50 mV position. Check for 2 divisions of deflection, ±3%.

b. High Frequency Response

Remove the Type 134 from the test oscilloscope input and connect the constant amplitude signal generator, using the 50 Ω termination and GR to BNC adapter. Set the signal generator to 350 kHz and adjust the amplitude for a 4-division display. Increase the frequency until the display amplitude reduces to 2.8 divisions. Note the frequency setting and calculate the risetime of the test oscilloscope by:

$$Tr_1 = \frac{.35}{BW}$$

Remove the signal generator from the test oscilloscope input and reconnect the Type 134. Connect the signal generator to the Type 134 INPUT, set the frequency to 350 kHz, and adjust the amplitude for a 4-division display. Increase the frequency until the display amplitude reduces to 2.8 divisions. Note the frequency setting and calculate the system risetime by:

$$Tr_2 = \frac{.35}{BW}$$

Calculate the risetime of the Type 134 for ≤11.7 ns by:

$$Tr = (Tr_2^2 - TR_1^2)^{1/2}$$

Calculate the bandwidth of the Type 134 for ≥30 MHz by:

$$BW = \frac{.35}{Tr}$$

Change the Probe Selector switch to P6020 and repeat the system bandwidth measurement. Calculate the Type 134 risetime for ≤6.5 ns and the bandwidth for ≥54 MHz.

c. Low Frequency Response

Set the Probe Selector switch to P6019 and connect the low-frequency oscillator, set for 20 kHz, to the INPUT. Adjust the oscillator for 4 divisions of deflection. To maintain constant amplitude, monitor the oscillator output with a DC-coupled test oscilloscope. Reduce the frequency until the amplitude of the display is 2.8 divisions. Check the frequency of the oscillator for less than 10 Hz.

Change the Probe Selector switch to P6020 and repeat the low frequency check for a frequency of less than 8 Hz.

d. Transient Response and Tilt

Set the Probe Selector switch to P6019. Connect one end of the transmission line to one of the charge line connectors on the pulse generator, using a 5 ns length of coaxial cable. Connect a 50 Ω termination to the other charge line connector. Connect a 5 ns length of coaxial cable between the pulse generator output and the Type 134 INPUT. Adjust the pulse generator amplitude for a 4 division display and check the first 50 ns of the display for less than 5% overshoot or ringing.

Change the Probe Selector switch to P6020 and repeat the transient response check.

Change the Probe Selector switch to P6019 and connect the square wave generator, set for 1 kHz, through two 10× attenuators to the Type 134 INPUT. Set the test oscilloscope sweep rate to display 500 μs of square wave input. Check deviation from horizontal for less than 3% after the first 50 ns.

Change the Probe Selector switch to P6020, and the square wave generator to 800 Hz. Set the sweep rate to display 600 μs of square wave input, and check tilt for less than 3% after the first 50 ns.

2. Type 134 and P6019 Probe

The following checks are to be made with the test oscilloscope deflection factor set to 50 mV/div unless otherwise noted, the Type 134 Probe Selector switch in the P6019 position, and using a P6019 Probe.

NOTE

Before checking the performance of the P6019 Probe and the Type 134 Amplifier, the LOW FREQ compensation (R154) must be adjusted. Refer to the Calibration section of this manual.

a. Deflection Factor

Using 5 mA Current Loop on Amplitude Calibrator

Connect the P6019 Probe to the 5 mA current loop and set the calibrator to the 5 mA square wave position. Set the Type 134 CURRENT/DIV switch to 5 mA and check for 1 division of deflection ±3%.

Using Calibrator Adapter (013-0092-00)

Connect the calibrator adapter to the calibrator output, and set the calibrator to the 100 V square wave position. At the 100 V position the calibrator adapter, which consists of a 24.5 kΩ resistor to ground, produces a 4 mA square wave. Set the CURRENT/DIV switch to 2 mA and check for 2 divisions of deflection ±3%.

b. High Frequency Response

Connect the high frequency current test fixture (067-0559-00) to the output of the constant amplitude signal generator. Connect the P6019 Probe from the test fixture to the INPUT of the Type 134. Set the CURRENT/DIV switch to 1 mA and adjust the signal generator frequency for 4 divisions of deflection at 350 kHz. Increase the frequency until the display amplitude reduces to 2.8 divisions. Note the frequency setting and calculate the system risetime by:

$$Tr_4 = \frac{.35}{BW}$$

Using the test oscilloscope risetime from step 1b (Tr_1), calculate the risetime of the Type 134 and P6019 for ≤8.8 ns by:

$$Tr = (Tr_4^2 - Tr_1^2)^{1/2}$$

Calculate the bandwidth of the Type 134 and P6019 for ≥40 MHz by:

$$BW = \frac{.35}{Tr}$$

Repeat the system bandwidth measurement in the 2 mA through .1 A positions of the CURRENT/DIV switch.

c. Low Frequency Response

Connect the test fixture to the output of the low-frequency oscillator. Connect the P6019 to the test fixture and set the CURENT/DIV switch to 5 mA. Set the oscillator to 20 kHz and adjust the amplitude for 4 divisions of deflection. Monitor the oscillator output with a DC-coupled oscilloscope to maintain a constant amplitude. Reduce the frequency to 30 Hz and check for less than 5% deviation in amplitude. Reduce the frequency until the display is 2.8 divisions and check for less than 12 Hz.

d. Transient Response and Tilt

Connect the transmission line to the charge line connectors on the pulse generator, using the two lengths of coaxial cable. Connect the test fixture to the pulse generator output. Set the CURRENT/DIV switch to 5 mA and connect the P6019 to the test fixture. With the test oscilloscope sweep rate set to .05 μs, ×5 magnification, adjust the pulse generator for a 4-division display. Check the first 50 ns of the display for less than 5% overshoot or ringing.

Connect the output of the square wave generator, set for 1 kHz, through two 10× attenuators to the test fixture. Set the CURRENT/DIV switch to 5 mA, and the test oscilloscope sweep rate to display 400 μs of square wave input. Check deviation from horizontal for less than 3% after the first 50 ns.

e. Noise

Set the test oscilloscope deflection factor to 10 mV/div, and the CURRENT/DIV switch to 1 mA. With the P6019 Probe connected to the INPUT of the Type 134, check for less than 0.75 division of deflection (150 μA referred to the input).

3. Type 134 and P6020 Probe

The following checks are to be made with the test oscilloscope deflection factor set to 50 mV/div unless otherwise noted, the Type 134 Probe Selector switch in the P6020 position, and using a P6020 Probe.

NOTE

Before checking the performance of the P6020 Probe and the Type 134 Amplifier, the LOW

FREQ compensation (R154) must be adjusted. Refer to the Calibration section of this manual.

a. Deflection Factor

Using 5 mA Current Loop on Amplitude Calibrator

Connect the P6020 Probe to the 5 mA current loop and set the calibrator to the 5 mA square wave position. Set the Type 134 CURRENT/DIV switch to 5 mA and check for 1 division of deflection ±3%.

Using Calibrator Adapter (013-0092-00)

Connect the calibrator adapter to the calibrator output, and set the calibrator to the 100 V square wave position. At the 100 V position the calibrator adapter, which consists of a 24.5 kΩ resistor to ground, produces a 4 mA square wave. See the CURRENT/DIV switch to 2 mA and check for 2 divisions of deflection ±3%.

b. High Frequency Response

Connect the high frequency current test fixture (067-0559-00) to the output of the constant amplitude signal generator. Connect the P6020 Probe from the test fixture to the INPUT of the Type 134. Set the CURRENT/DIV switch to 1 mA and adjust the signal generator frequency until the display amplitude reduces to 2.8 divisions. Note the frequency setting and calculate the system risetime by:

$$Tr_5 = \frac{.35}{BW}$$

Using the test oscilloscope risetime from step 1b (Tr_1), calculate the risetime of the Type 134 and P6020 for 5 ns by:

$$Tr = (Tr_5^2 - Tr_1^2)^{1/2}$$

Calculate the bandwidth of the Type 134 and P6020 for 70 MHz by:

$$BW = \frac{.35}{Tr}$$

Repeat the system bandwidth measurement in the 2 mA through .1 A positions of the CURRENT/DIV switch.

c. Low Frequency Response

Connect the test fixture to the output of the low-frequency oscillator. Connect the P6020 to the test fixture and set the CURRENT/DIV switch to 5 mA. Set the oscillator to 20 kHz and adjust the amplitude for 4 divisions of deflection. Monitor the oscillator output with a DC-coupled oscilloscope to maintain a constant amplitude. Reduce the frequency until the display is 2.8 divisions and check for less than 100 Hz.

d. Transient Response and Tilt

Connect the transmission line to the charge line connectors on the pulse generator, using the two lengths of coaxial cable. Connect the test fixture to the pulse generator output. Set the CURRENT/DIV switch to 5 mA and connect the P6020 to the test fixture. With the test oscilloscope sweep rate set to .05 μs, ×5 magnification, adjust the pulse generator for a 4-division display. Check the first 50 ns of the display for less than 5% overshoot or ringing.

Connect the output of the square wave generator, set for 1 kHz, through one 10× attenuator to the test fixture. Set the CURRENT/DIV switch to 5 mA, and the test oscilloscope sweep rate to display 80 μs of square wave input. Check deviation from horizontal for less than 3% after the first 50 ns.

e. Noise

Set the test oscilloscope deflection factor to 10 mV/div, and the CURRENT/DIV switch to 1 mA. With the P6020 Probe connected to the INPUT of the Type 134, check for less than 0.75 division of deflection (150 μA referred to the input).

NOTES

SECTION 7
CALIBRATION

This section of the manual contains information for calibrating and checking the operation of the Type 134 Current Probe Amplifier. In addition, this section may be used as an aid in isolating troubles occuring within the Amplifier unit. Abnormal indications occurring during the calibration checks will often aid in narrowing the trouble to a definite circuit or stage within the unit.

Equipment Required

1. Test Oscilloscope—10 mV/div deflection factor, .05 μs/div sweep rate with ×5 magnification and 4 ns risetime (Tektronix Type 581A Oscilloscope with Type 82 plug-in recommended).

2. Test Oscilloscope—5 mV/div deflection factor, for checking power supply ripple only (Tektronix Type 581A Oscilloscope, Type 81 Plug-In Adapter, and a 5 mV/div vertical plug-in unit such as a Type B, H, or L recommended).

3. Variable Line Voltage Source—103.5 to 126.5 VAC (Tektronix Type TU76 recommended).

4. AC Current Source—Standard Amplitude Calibrator (067-0502-00), or 540-series Oscilloscope with 5 mA current loop, or Calibrator Adapter (013-0092-00).

5. Pulse Generator—0.25 ns risetime pulses from 0 to 50 V into 50 Ω (Tektronix Type 109 recommended).

6. Transmission Line—60 ns delay, 0.1 ns risetime (Tektronix Type 113 Delay Cable recommended).

7. Coaxial Cable (2)—5 ns length (017-0502-00).

8. GR High Frequency Current Test Fixture (50 Ω terminating current loop)—(067-0559-00).

9. GR 50 Ω through-type Termination—(017-0083-00).

10. GR to BNC Adapter—(017-0064-00).

11. Square Wave Generator—60 Hz to 25 kHz square wave at 1 V into 50 Ω Tektronix Type 105 recommended).

12. 10X Attenuator (with BNC connectors)—50 Ω (011-0059-00).

13. DC Voltmeter—20,000 Ω/Volt.

14. Nylon Adjusting Tool—Handle (003-0307-00), Insert (003-0334-00).

15. Load Resistor—1000 Ω, 1%, ¼ W (322-0193-00).

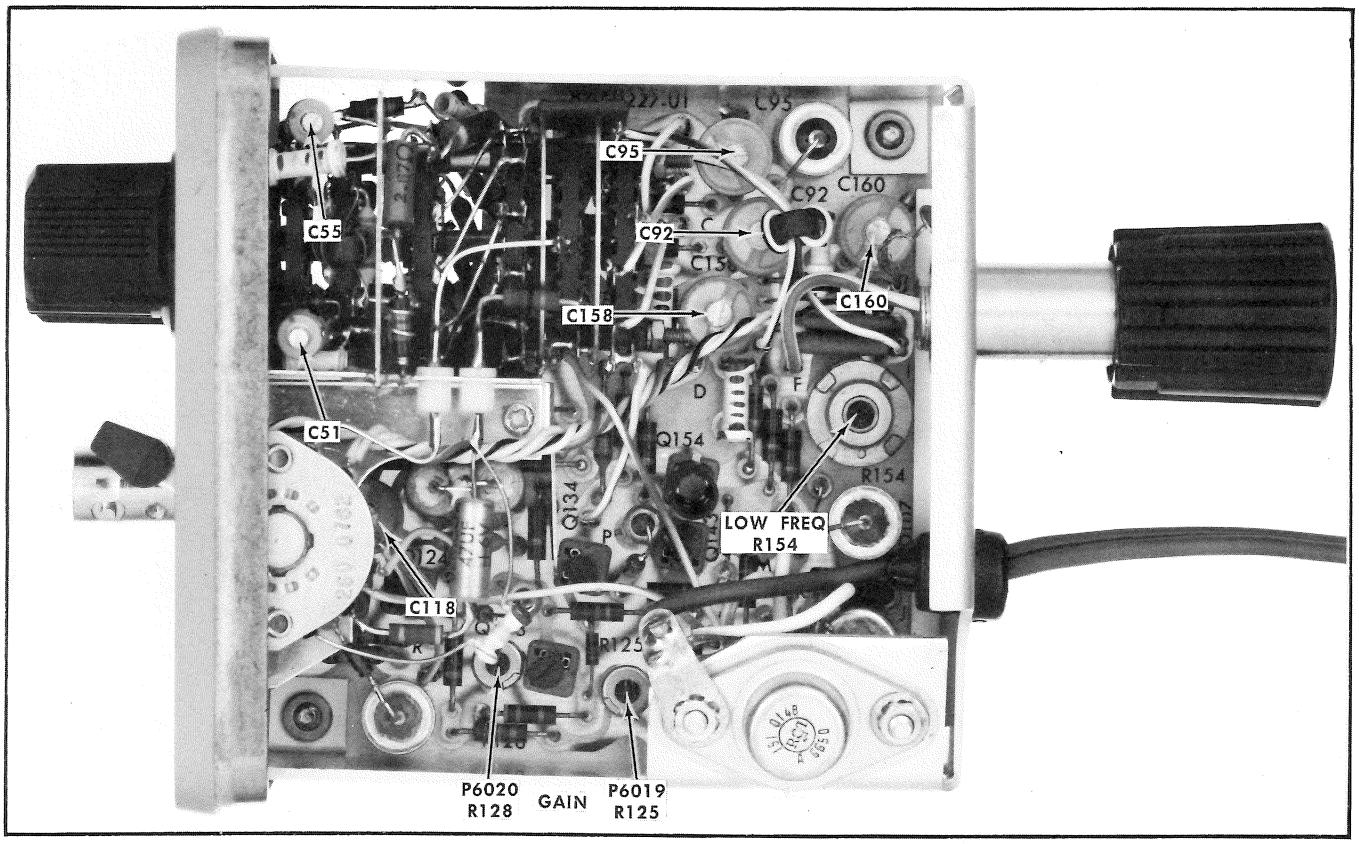


Fig. 7-1. Location of adjustments.

CALIBRATION PROCEDURE

Preliminary Information

Remove the cover from the Type 134 Current Probe amplifier. Connect the amplifier power cable to the Type 134 power supply. Plug the power supply into the variable line voltage source.

1. Check Regulator Circuit

Set the variable line voltage source to 115 volts. Connect the DC voltmeter between the emitter of Q107 (pin L of the circuit card assembly) and ground. The reading should be +13.25 to +15.25 volts. Vary the line voltage between the limits of 103.5 and 126.5 VAC. The emitter of Q107 should not vary more than 0.5 volts.

Using the 5 mV/div oscilloscope with a 1X probe, check the ripple at the same point. The ripple should not exceed 2 millivolts peak to peak. Disconnect the probe from the test point.

2. Low Frequency Adjustment and Flatness Check—Current Mode

Type 134 and P6019 Probe

Connect the Type 134 to the input of the 10 mV/div oscilloscope. Set the test oscilloscope deflection factor to 50 mV/div. Connect the output of the square wave generator, through the 10× attenuator and BNC to GR adapter to the test fixture. Connect the P6019 Probe from the test fixture to the Type 134 INPUT (see Fig. 7-2). Set the CURRENT/DIV switch to 5 mA and set the Probe Selector switch to P6019. Set the square wave generator to 60 Hz and adjust the amplitude for a 2-division display. Adjust LOW FREQ (R154) for a straight but tilted top on the displayed square wave (see Fig. 7-3).

Set the test oscilloscope sweep rate to display 400 μs of square wave input. Check the square wave top for less than 3% deviation from horizontal, excluding the first 50 ns.

Type 134 and P6020 Probe

Connect the Type 134 to the input of the 10 mV/div oscilloscope. Set the test oscilloscope deflection factor to 50

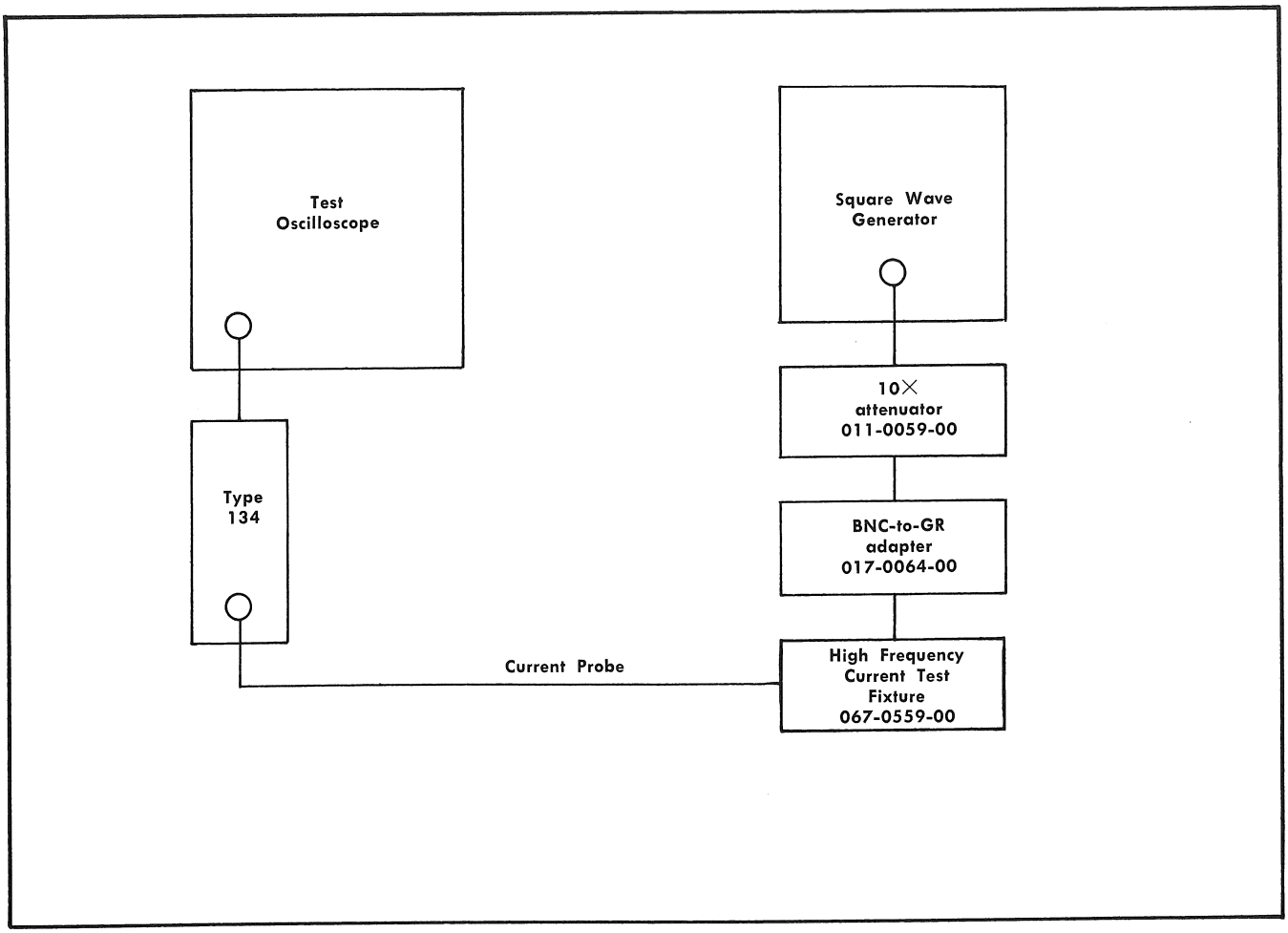


Fig. 7-2. Test setup for low frequency adjustment.

mV/div. Connect the output of the square wave generator, through the 10× attenuator and BNC to GR adapter to the test fixture. Connect the P6020 Probe from the test fixture to the Type 134 INPUT (see Fig. 7-2). Set the CURRENT/DIV switch to 5 mA and set the Probe Selector switch to P6020. Set the square wave generator to 1 kHz and adjust the amplitude for a 2-division display. Adjust LOW FREQ (R154) for a straight but tilted top on the displayed square wave (similar to Fig. 7-3).

Set the test oscilloscope sweep rate to display 80 μs of square wave input. Check the square wave top for less than 3% deviation from horizontal, excluding the first 50 ns.

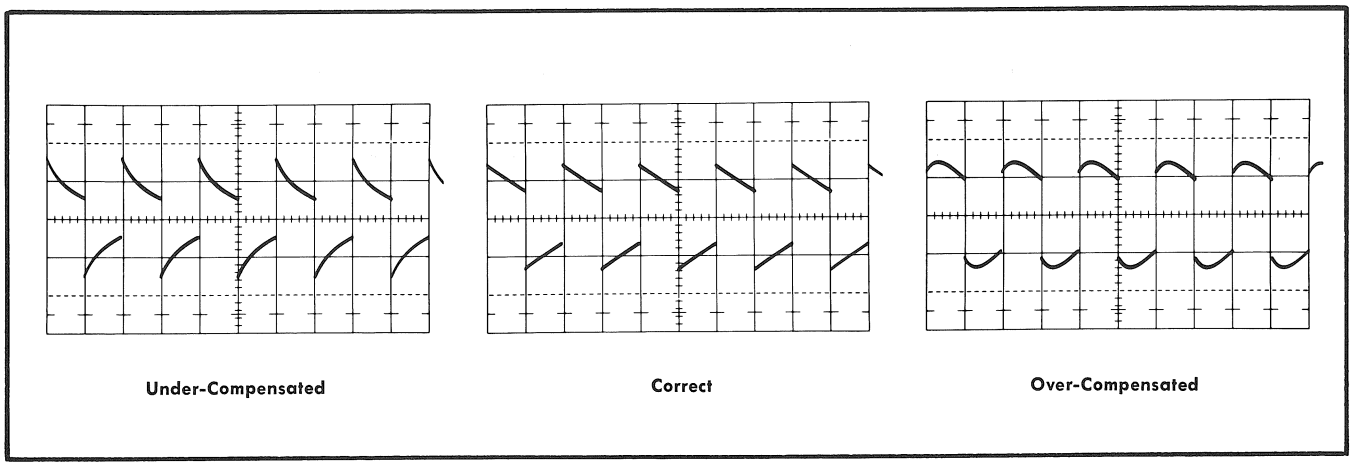


Fig. 7-3. Low frequency compensation (R154).

NOTE

When changing from one current probe to another, readjust the LOW FREQ compensation and set the Probe Selector switch to correspond with the type current probe being used.

3. P6019 Gain Adjustment

a. Current Mode

Connect the P6019 probe to the Type 134 INPUT and set the Probe Selector switch to P6019. Set the test oscilloscope to 50 mV/div.

Using 5 mA Current Loop on Amplitude Calibrator

Connect the P6019 probe to the 5 mA current loop and set the calibrator to the 5 mA square wave position. Set the Type 134 CURRENT/DIV switch to 5 mA and obtain a stable display. Adjust P6019 GAIN (R125) for 1 division of deflection.

Using Calibrator Adapter (013-0092-00)

Connect the calibrator adapter to the calibrator, set to the 100 V square wave position. In the 100 V position the calibrator adapter produces a 4 mA square wave. Set the CURRENT/DIV switch to 2 mA and obtain a stable display. Adjust P6019 GAIN (R125) for 2 divisions of deflection.

b. Voltage Mode

Connect the Type 134 to the Type 581A test oscilloscope, set to 50 mV/div, set the Probe Selector switch to P6019, and set the CURRENT/DIV switch to VOLTS ONLY. Connect the calibrator output through the 1000 Ω load resistor to the Type 134 INPUT. Set the calibrator to 20 mV and adjust P6019 GAIN (R125) for 2 divisions of deflection.

4. P6020 Gain Adjustment

a. Current Mode

Connect the P6020 probe to the Type 134 INPUT and set the Probe Selector switch to P6020. Set the test oscilloscope to 50 mV/div.

Using 5 mA Current Loop on Amplitude Calibrator

Connect the P6020 probe to the 5 mA current loop and set the calibrator to the 5 mA square wave position. Set the Type 134 CURRENT/DIV switch to 5 mA and obtain a stable display. Adjust P6020 GAIN (R128) for 1 division of deflection.

Using Calibrator Adapter (013-0092-00)

Connect the calibrator adapter to the calibrator, set to the 100 V square wave position. In the 100 V position the calibrator adapter produces a 4 mA square wave. Set the CURRENT/DIV switch to 2 mA and obtain a stable display. Adjust P6020 GAIN (R128) for 2 divisions of deflection.

b. Voltage Mode

Connect the Type 134 to the Type 581A test oscilloscope, set to 50 mV/div, set the Probe Selector switch to P6020, and set the CURRENT/DIV switch to VOLTS ONLY. Connect the calibrator output through the 1000 Ω load resistor to the Type 134 INPUT. Set the calibrator to 50 mV and adjust P6020 GAIN (R128) for 2 divisions of deflection.

5. P6020 High Frequency Compensation

Connect the transmission line to the pulse generator charge line connectors, using the two 5 ns coaxial cables. Connect the test fixture to the pulse generator output. Connect the P6020 Probe from the test fixture to the Type 134 INPUT (see Fig. 7-4). Set the test oscilloscope sweep rate

to .05 μs/div, and the deflection factor to 50 mV/div. Set the Type 134 CURRENT/DIV switch to 5 mA nd adjust the pulse generator amplitude for a 4-division display. Adjust C118 and C160 for a square corner on the displayed waveform. Recheck the waveform in the 50 mA position of the CURRENT/DIV switch. If the front corner of the waveform has fast overshoot, readjust C118 and C160 for the best compromise between the 5 mA and 50 mA positions. Change the CURRENT/DIV switch to 2 mA nd adjust the pulse generator for a 4-division display. Adjust C95 for a square corner on the waveform. Change the CURRENT/DIV switch to 1 mA and readjust the pulse generator for a 4-division display. Adjust C92 for a square corner on the waveform. Adjust C51 for minimum aberrations. Change the CURRENT/DIV switch to 20 mA and adjust the pulse generator for a 4-division display. Adjust C55 for minimum aberrations. Recheck the 1 mA through 1 A positions of the CURRENT/DIV switch for shape and risetime of the waveform.

NOTE

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

Use a short ground lead on the probe when checking the positions from 20 mA to 1 A.

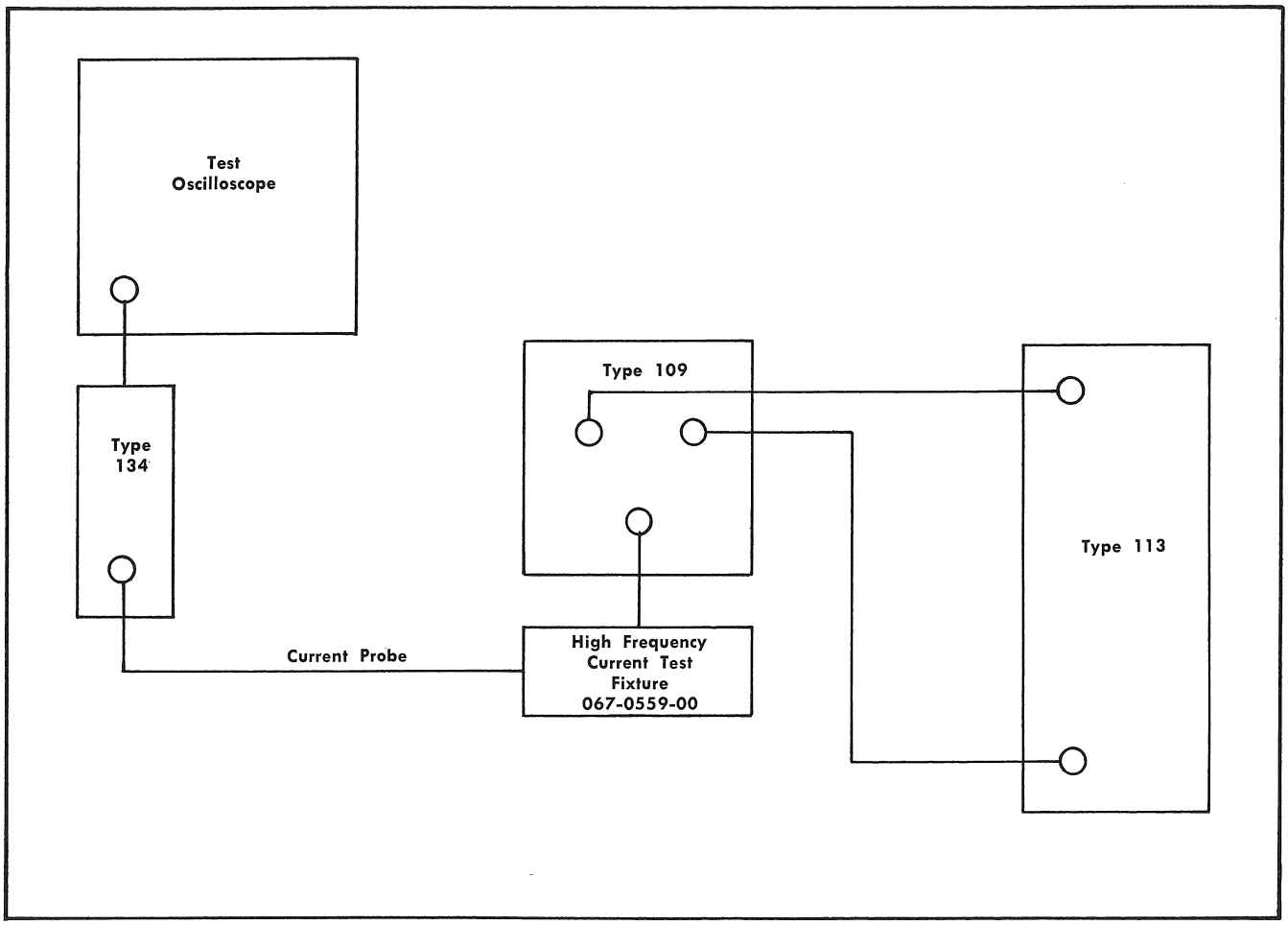


Fig. 7-4. Test setup for high frequency adjustments.

6. P6019 High Frequency Compensation ◐

Connect the test equipment as described in Step 5, using a P6019 in place of the P6020 Probe. Set the Probe Selector switch to P6019, and the CURRENT/DIV switch to 5 mA. Adjust the pulse generator for a 4-divisions display. Adjust C158 for a square corner on the displayed waveform. Check compensation in all positions from 1 mA to 1 A. If the 1 mA position has overshoot, adjust C92 and recheck with the P6020 as described in Step 5.

7. Check Noise

Set the test oscilloscope deflection factor to 10 mV/div, and the Type 134 CURRENT/DIV switch to 1 mA. Connect either the P6019 or the P6020 Probe to the Type 134 INPUT and set the Probe Selector switch to correspond with the probe being used. Check for less than 0.75 division of deflection (150 μA referred to the input of the Type 134, or 7.5 millivolts at the input of the test oscilloscope).

ABBREVIATIONS AND SYMBOLS

A or amp	amperes
AC or ac	alternating current
AF	audio frequency
α	alpha—common-base current amplification factor
AM	amplitude modulation
$\approx$	approximately equal to
β	beta—common-emitter current amplification factor
BHB	binding head brass
BHS	binding head steel
BNC	baby series "N" connector
$\times$	by or times
C	carbon
C	capacitance
cap.	capacitor
cer	ceramic
cm	centimeter
comp	composition
conn	connector
$\sim$	cycle
c/s or cps	cycles per second
CRT	cathode-ray tube
csk	countersunk
Δ	increment
dB	decibel
dBm	decibel referred to one milliwatt
DC or dc	direct current
DE	double end
°	degrees
°C	degrees Celsius (degrees centigrade)
°F	degrees Fahrenheit
°K	degrees Kelvin
dia	diameter
$\div$	divide by
div	division
EHF	extremely high frequency
elect.	electrolytic
EMC	electrolytic, metal cased
EMI	electromagnetic interference (see RFI)
EMT	electrolytic, metal tubular
ε	epsilon—2.71828 or % of error
$\geqslant$	equal to or greater than
$\leqslant$	equal to or less than
ext	external
F or f	farad
F & I	focus and intensity
FHB	flat head brass
FHS	flat head steel
Fil HB	fillister head brass
Fil HS	fillister head steel
FM	frequency modulation
ft	feet or foot
G	giga or 10^9
g	acceleration due to gravity
Ge	germanium
GHz	gigahertz
GMV	guaranteed minimum value
GR	General Radio
$>$	greater than
H or h	henry
h	height or high
hex.	hexagonal
HF	high frequency
HHB	hex head brass
HHS	hex head steel
HSB	hex socket brass
HSS	hex socket steel
HV	high voltage
Hz	hertz (cycles per second)
ID	inside diameter
IF	intermediate frequency
in.	inch or inches
incd	incandescent
∞	infinity
int	internal
$\int$	integral
k	kilohms or kilo (10^3)
k Ω	kilohm
kc	kilocycle
kHz	kilohertz
L	inductance
λ	lambda—wavelength
$\gg$	large compared with
$<$	less than
LF	low frequency
lg	length or long
LV	low voltage
M	mega or 10^6
m	milli or 10^{-3}
MΩ or meg	megohm
μ	micro or 10^{-6}
mc	megacycle
met.	metal
MHz	megahertz
mm	millimeter
ms	millisecond
—	minus
mtg hdw	mounting hardware
n	nano or 10^{-9}
no. or #	number
ns	nanosecond
OD	outside diameter
OHB	oval head brass
OHS	oval head steel
Ω	omega—ohms
ω	omega—angular frequency
p	pico or 10^{-12}
/	per
%	percent
PHB	pan head brass
ϕ	phi—phase angle
π	pi—3.1416
PHS	pan head steel
+	plus
$\pm$	plus or minus
PIV	peak inverse voltage
plstc	plastic
PMC	paper, metal cased
poly	polystyrene
prec	precision
PT	paper, tubular
PTM	paper or plastic, tubular, molded
pwr	power
Q	figure of merit
RC	resistance capacitance
RF	radio frequency
RFI	radio frequency interference (see EMI)
RHB	round head brass
ρ	rho—resistivity
RHS	round head steel
r/min or rpm	revolutions per minute
RMS	root mean square
s or sec.	second
SE	single end
Si	silicon
SN or S/N	serial number
$\ll$	small compared with
T	tera or 10^{12}
TC	temperature compensated
TD	tunnel diode
THB	truss head brass
Θ	theta—angular phase displacement
thk	thick
THS	truss head steel
tub.	tubular
UHF	ultra high frequency
V	volt
VAC	volts, alternating current
var	variable
VDC	volts, direct current
VHF	very high frequency
VSWR	voltage standing wave ratio
W	watt
w	wide or width
w/	with
w/o	without
WW	wire-wound
xmfr	transformer

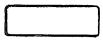
PARTS ORDERING INFORMATION

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 or model 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.

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number
*000-0000-00	Asterisk preceding Tektronix Part Number indicates manufactured by or for Tektronix, Inc., or reworked or checked components.
Use 000-0000-00	Part number indicated is direct replacement.
	Screwdriver adjustment.
	Control, adjustment or connector.

SECTION 8

ELECTRICAL PARTS LIST

Values are fixed unless marked Variable.

AMPLIFIER

Capacitors

Tolerance ±20% unless otherwise indicated.

Ckt. No.	Tektronix Part No.	Description				S/N Range
C51	281-0579-00	21 pF	Cer	500 V	5%	100-4589
C51	281-0123-00	5-25 pF	Cer Var	100 V		4590-up
C52	281-0657-00	13 pF	Cer	500 V	2%	X4590-up
C53	281-0564-00	24 pF	Cer	500 V	5%	
C55	281-0616-00	6.8 pF	Cer	200 V		100-4589
C55	281-0123-00	5-25 pF	Cer Var	100 V		4590-up
C57	281-0612-00	5.6 pF	Cer	200 V	±0.5 pF	
C66	281-0603-00	39 pF	Cer	500 V	5%	
C68	283-0054-00	150 pF	Cer	200 V	5%	
C73	281-0651-00	47 pF	Cer	200 V	5%	
C75	281-0617-00	15 pF	Cer	200 V		
C92	281-0092-00	9-35 pF	Cer Var			
C95	281-0091-00	2-8 pF	Cer Var			
C98	283-0059-00	1 μF	Cer	25 V	+80%—20%	
C99	290-0298-00	1000 μF	EMT	6 V		100-3649
C99	290-0326-00	820 μF	EMT	6 V	10%	3650-up
C105	290-0273-00	68 μF	EMT	60 V	10%	
C106	290-0296-00	100 μF	EMT	20 V		
C107	290-0296-00	100 μF	EMT	20 V		
C108	290-0267-00	1 μF	EMT	35 V		
C110	290-0139-00	180 μF	EMT	6 V		
C112	290-0139-00	180 μF	EMT	6 V		
C114	290-0167-00	10 μF	EMT	15 V		
C118	281-0092-00	9-35 pF	Cer Var			
C121	290-0138-00	330 μF	EMT	6 V		
C125	290-0248-01	150 μF	EMT	15 V		
C130	290-0297-00	39 μF	EMT	10 V	10%	
C131	281-0616-00	6.8 pF	Cer	200 V		
C132	290-0114-00	47 μF	EMC	6 V		X1850-up
C139	281-0589-00	167 pF	Cer	500 V	5%	100-1849
C139	281-0546-00	330 pF	Cer	500 V	10%	1850-up
C140	290-0134-00	22 μF	EMT	15 V		
C146	290-0246-00	3.3 μF	EMT	15 V	10%	
C151	281-0589-00	167 pF	Cer	500 V	5%	
C156	281-0528-00	82 pF	Cer	500 V	10%	
C158	281-0093-00	5.5-18 pF	Cer Var			100-3239
C158	281-0092-00	9-35 pF	Cer Var			3240-up
C160	281-0092-00	9-35 pF	Cer Var			
C161	283-0094-00	27 pF	Cer	200 V	10%	100-904
C161	281-0650-00	18 pF	Cer	200 V	10%	905-up
C163	283-0026-00	0.2 μF	Cer	25 V		
C165	283-0059-00	1 μF	Cer	25 V	+80%—20%	

Diodes

Ckt. No.	Tektronix Part No.	Description	S/N Range
D101	*152-0107-00	Silicon Replaceable by 1N647	
D102	*152-0107-00	Silicon Replaceable by 1N647	
D103	*152-0107-00	Silicon Replaceable by 1N647	
D104	*152-0107-00	Silicon Replaceable by 1N647	
D105	*152-0107-00	Silicon Replaceable by 1N647	
D106	*152-0107-00	Silicon Replaceable by 1N647	
D107	152-0243-00	Zener 1N965B, 0.4 W, 15 V, 5%	

Fuse

F101	159-0056-00	0.1 A	Fast-Blo	(115 V Power Supply Only)

Connectors

J51	131-0278-00	BNC, 2 hole mounted
J169	131-0319-00	BNC, locking male cable end

Inductors

L60	*108-0395-00	Toroid, 64 μH	
L62	*108-0395-00	Toroid, 64 μH	
L79	276-0543-00	Core, Ferrite	
L81	276-0543-00	Core, Ferrite	
LR57	*108-0330-00	0.4 μH (wound on 56 Ω, 1/4 W, 5% resistor)	
LR71	*108-0399-00	0.03 μH (wound on a 5.6 Ω, 1/4 W, 5% resistor)	
LR83	*108-0398-00	0.4 μH (wound on a 16 Ω, 1/4 W, 5% resistor)	
LR126	*108-0423-00	0.17 μH (wound on a 56 Ω, 1/8 W, 5% resistor)	X905-up
LR136	*108-0268-01	0.1 μH (wound on a 36 Ω, 1/8 W, 5% resistor)	

Transistors

Q107	*151-0148-00	Silicon Selected RCA 40250	
Q114	*151-0192-00	Silicon Replaceable by MPS-6521	100-3699
Q114	*151-0195-00	Silicon Replaceable by MPS-6515	3700-up
Q124	*151-0192-00	Silicon Replaceable by MPS-6521	100-3699
Q124	*151-0195-00	Silicon Replaceable by MPS-6515	3700-up
Q133	*151-0198-00	Silicon Replaceable by MPS-918	
Q134	*151-0198-00	Silicon Replaceable by MPS-918	
Q143	*151-0192-00	Silicon Replaceable by MPS-6521	
Q154	*151-0109-00	Silicon Selected from 2N918	

Resistors

Ckt. No.	Tektronix Part No.	Description				S/N Range
Resistors are fixed, composition, ±20% unless otherwise indicated.						
R51	317-0680-00	68 Ω	1/8 W		5%	100-4589
R51	317-0750-00	75 Ω	1/8 W		5%	4590-up
R53	317-0910-00	91 Ω	1/8 W		5%	
R55	317-0111-00	110 Ω	1/8 W		5%	100-4589
R55	317-0820-00	82 Ω	1/8 W		5%	4590-up
R60	321-0079-00	64.9 Ω	1/8 W	Prec	1%	
R62	321-0079-00	64.9 Ω	1/8 W	Prec	1%	
R64	307-0097-00	2.1 Ω	1 W		1%	
R66	317-0620-00	62 Ω	1/8 W		5%	
R67	321-0066-01	47.5 Ω	1/8 W	Prec	1/2%	
R68	317-0151-00	150 Ω	1/8 W		5%	
R70	325-0013-00	6 Ω	1/2 W	Prec	1%	
R71	325-0012-00	2.67 Ω	1/2 W	Prec	1%	
R73	321-0023-01	16.9 Ω	1/8 W	Prec	1/2%	
R75	321-1056-01	37.9 Ω	1/8 W	Prec	1/2%	
R77	321-1087-01	79.6 Ω	1/8 W	Prec	1/2%	
R79	321-0127-01	205 Ω	1/8 W	Prec	1/2%	
R81	321-0127-01	205 Ω	1/8 W	Prec	1/2%	
R91	321-0078-01	63.4 Ω	1/8 W	Prec	1/2%	
R92	315-0510-00	51 Ω	1/4 W		5%	
R94	321-0114-01	150 Ω	1/8 W	Prec	1/2%	
R95	315-0910-00	91 Ω	1/4 W		5%	
R99	321-0173-01	619 Ω	1/8 W	Prec	1/2%	
R101	308-0291-00	2 kΩ	3 W	WW	5%	(230 V Pwr. Supply only)
R102	308-0230-00	2.7 kΩ	3 W	WW	5%	(230 V Pwr. Supply only)
R105	315-0911-00	910 Ω	1/4 W		5%	
R106	315-0561-00	560 Ω	1/4 W		5%	
R111	315-0622-00	6.2 kΩ	1/4 W		5%	
R114	321-0207-00	1.4 kΩ	1/8 W	Prec	1%	
R115	321-0173-01	619 Ω	1/8 W	Prec	1/2%	
R118	315-0153-00	15 kΩ	1/4 W		5%	
R119	321-0126-00	200 Ω	1/8 W	Prec	1%	
R120	315-0560-00	56 Ω	1/4 W		5%	
R121	315-0181-00	180 Ω	1/4 W		5%	
R124	315-0151-00	150 Ω	1/4 W		5%	
R125	311-0622-00	100 Ω	Var			
R127	315-0101-00	100 Ω	1/4 W		5%	
R128	311-0622-00	100 Ω	Var			
R129	315-0201-00	200 Ω	1/4 W		5%	
R130	315-0151-00	150 Ω	1/4 W		5%	
R131	315-0750-00	75 Ω	1/4 W		5%	
R132	315-0511-00	510 Ω	1/4 W		5%	100-1849
R132	315-0471-00	470 Ω	1/4 W		5%	1850-up
R133	315-0113-00	11 kΩ	1/4 W		5%	

Resistors *(Cont)*

Ckt. No.	Tektronix Part No.		Description			S/N Range
R134	315-0822-00	8.2 kΩ	1/4 W		5%	
R135	315-0332-00	3.3 kΩ	1/4 W		5%	
R136	315-0221-00	220 Ω	1/4 W		5%	
R137	317-0101-00	100 Ω	1/8 W		5%	
R138	321-0174-01	634 Ω	1/8 W	Prec	1/2%	
R139	315-0752-00	7.5 kΩ	1/4 W		5%	100-1849
R139	315-0432-00	4.3 kΩ	1/4 W		5%	1850-up
R140	315-0560-00	56 Ω	1/4 W		5%	
R142	315-0562-00	5.6 kΩ	1/4 W		5%	
R144	315-0271-00	270 Ω	1/4 W		5%	
R146	315-0562-00	5.6 kΩ	1/4 W		5%	
R147	315-0562-00	5.6 kΩ	1/4 W		5%	
R150	315-0510-00	51 Ω	1/4 W		5%	
R151	315-0301-00	300 Ω	1/4 W		5%	
R153	315-0202-00	2 kΩ	1/4 W		5%	
R154	311-0624-00	200 kΩ		Var		
R156	317-0151-00	150 Ω	1/8 W		5%	100-3239
R156	317-0101-00	100 Ω	1/8 W		5%	3240-up
R157	315-0430-00	43 Ω	1/4 W		5%	
R159	315-0510-00	51 Ω	1/4 W		5%	
R160	317-0430-00	43 Ω	1/8 W		5%	

Switches

	Unwired	Wired			S/N Range
SW10	260-0761-00	*262-0765-00	Rotary	CURRENT/DIV	100-4589
SW10	260-0761-00	*262-0765-01	Rotary	CURRENT/DIV	4590-up
SW130	260-0762-00		Lever	PROBE SELECTOR	

Transformers

T101	*120-0436-00	Power
T164	276-0557-00	Core, Toroid

P6019 TERMINATION

Code Date

Capacitor

C31	281-0628-00	15 pF	Cer	600 V	5%

Connectors

J30	131-0106-00	Coaxial, 1 contact, BNC
J39	*131-0428-00	BNC, Assembly

Inductors

Ckt. No.	Tektronix Part No.	Description	Code Date
L30	*108-0306-00	0.09 μH	6617-6626
L30	*108-0307-00	0.06 μH	6627
L30	*108-0306-00	0.09 μH	6628-up
L34	*108-0395-00	Toroid, 64 μH	
LR33	*108-0223-00	0.06 μH (wound on a 27 Ω, 1/4 W, 10% resistor)	
LR38	*108-0331-00	0.75 μH (wound on a 120 Ω, 1/4 W, 5% resistor)	6616X
LR38	*108-0331-00	0.75 μH (wound on a 120 Ω, 1/4 W, 5% resistor)	X6627X
LC38	*108-0438-00	0.45 μH (wound on a 0.68 pF capacitor)	X6617-6626X X6628-up

Resistors

Resistors are fixed, composition, ±10% unless otherwise indicated.

R30	315-0200-00	20 Ω	1/4 W		5%	6617-6626
R30	315-0150-00	15 Ω	1/4 W		5%	6627
R30	315-0200-00	20 Ω	1/4 W		5%	6628-up
R31	315-0101-00	100 Ω	1/4 W		5%	
R34	322-0068-00	49.9 Ω	1/4 W	Prec	1%	
R35	321-0039-00	24.9 Ω	1/8 W	Prec	1%	
R36	321-0039-00	24.9 Ω	1/8 W	Prec	1%	
R39	321-0081-00	68.1 Ω	1/8 W	Prec	1%	6617-6626
R39	317-0270-00	27 Ω	1/8 W		5%	6627
R39	321-0081-00	68.1 Ω	1/8 W	Prec	1%	6628-up

Switch

	Unwired	Wired	
SW35	260-0447-00		Slide DPDT

P6020 TERMINATION

Capacitors

Tolerance ±20% unless otherwise indicated.

C32	283-0032-00	470 pF	Cer	500 V	5%	6617-6809
C32	283-0150-00	650 pF	Cer	200 V	5%	6810-up
C33	281-0650-00	18 pF	Cer	200 V	10%	
C34	281-0618-00	4.7 pF	Cer	200 V	±0.5 pF	X6810-up
C44	281-0670-00	1.8 pF	Cer	500 V	±0.1 pF	X6810-up
C45	281-0653-00	3.3 pF	Cer	200 V	±1 pF	

Connectors

J30	131-0342-00	Coaxial, 1 contact, BNC
J49	*131-0428-00	BNC, Assembly

Inductors

L33	*108-0215-00	1.1 μH	
L35	*108-0409-00	5 turns	
L45	*108-0395-00	Toroid, 64 μH	
LR36	*108-0408-00	7 turns (wound on a 51 Ω, 1/8 W, 5% resistor)	6617-6809
LR36	*108-0468-00	0.11 μH (wound on a 51 Ω, 1/8 W, 5% resistor)	6810-up
LR38	*108-0407-00	3 turns (wound on a 51 Ω, 1/8 W, 5% resistor)	

Resistors

Ckt. No.	Tektronix Part No.		Description			Code Date
Resistors are fixed, composition, ±10% unless otherwise indicated.						
R32	317-0150-00	15 Ω	1/8 W		5%	
R34	321-0162-00	475 Ω	1/8 W	Prec	1%	
R39	321-0073-00	56.2 Ω	1/8 W	Prec	1%	
R42	315-0182-00	1.8 kΩ	1/4 W		5%	
R44	321-0230-00	2.43 kΩ	1/8 W	Prec	1%	X6810-up
R45	321-0079-00	64.9 Ω	1/8 W	Prec	1%	
R47	321-0002-00	10.2 Ω	1/8 W	Prec	1%	
R48	321-0002-00	10.2 Ω	1/8 W	Prec	1%	
R49	315-0121-00	120 Ω	1/4 W		5%	6617-6809
R49	315-0620-00	62 Ω	1/4 W		5%	6810-up

Switch

	Unwired	Wired				
SW35	260-0783-00		Slide DPDT			

P6019 PROBE

Plug

P20[1]

Switch

SW20[1]

Transformer

T1	*120-0429-00	Assembly				

P6020 PROBE

Capacitor

C19	283-0140-00	4.7 pF	Cer	50 V	5%	

Plug

P20[1]

Switch

SW20[1]

Transformer

T1	*120-0441-00	Assembly				

[1]See Mechanical Parts List

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations which appear on the pullout pages immediately following the Diagrams section of this instruction manual.

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.

Assembly and/or Component
Detail Part of Assembly and/or Component
mounting hardware for Detail Part
Parts of Detail Part
mounting hardware for Parts of Detail Part
mounting hardware for Assembly and/or Component

Mounting hardware always appears 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.

Mounting hardware must be purchased separately, unless otherwise specified.

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 or model 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.

ABBREVIATIONS AND SYMBOLS

For an explanation of the abbreviations and symbols used in this section, please refer to the page immediately preceding the Electrical Parts List in this instruction manual.

INDEX OF MECHANICAL PARTS LIST ILLUSTRATIONS

(Located behind diagrams)

SECTION 9

MECHANICAL PARTS LIST

FIG. 1 TYPE 134 EXPLODED VIEW

Fig. & Index No.	Tektronix Part No.	Serial/Modal No. Eff	Serial/Modal No. Disc	Qty 1 2 3 4 5	Description
1-1	015-0057-00			1	TYPE 134 CURRENT PROBE AMPLIFIER
	- - - - - -			-	amplifier includes:
-1	333-0931-01			1	PANEL, front
-2	200-0327-02			1	COVER, box
-3	366-0322-01			1	KNOB, charcoal—CURRENT/DIV
	- - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
-4	262-0765-00	100	4589	1	SWITCH, wired—CURRENT/DIV
	262-0765-01	4590		1	SWITCH, wired—CURRENT/DIV
	- - - - - -			-	switch includes:
	260-0761-00			1	SWITCH, unwired—CURRENT/DIV
	- - - - - -			-	mounting hardware: (not included w/switch)
-5	210-0840-00			1	WASHER, flat, 0.390 ID x 9/16 inch OD
-6	210-0590-00			1	NUT, hex., 3/8-32 x 7/16 inch
-7	366-0215-01			1	KNOB, charcoal—PROBE SELECTOR
-8	260-0762-00			1	SWITCH, lever—PROBE SELECTOR
	- - - - - -			-	mounting hardware: (not included w/switch)
-9	211-0101-00			2	SCREW, 4-40 x 1/4 inch, 100° csk, FHS
-10	210-0004-00			2	LOCKWASHER, internal, #4
-11	210-0406-00			2	NUT, hex., 4-40 x 3/16 inch
-12	131-0158-00			2	CONNECTOR, feed thru
-13	337-0820-00			1	SHIELD, probe selector switch
	- - - - - -			-	mounting hardware: (not included w/shield)
	213-0055-00			1	SCREW, thread forming, 2-32 x 3/16 inch
-14	131-0278-00			1	CONNECTOR, coaxial, 1 contact, BNC
	- - - - - -			-	mounting hardware: (not included w/connector)
-15	211-0038-00	100	239	2	SCREW, 4-40 x 5/16 inch, 82° csk, FHS
	211-0099-00	240		2	SCREW, 4-40 x 5/16 inch, 100° csk, FHS
-16	210-0586-00			2	NUT, keps, 4-40 x 1/4 inch
-17	407-0227-00			1	BRACKET, frame
	- - - - - -			-	mounting hardware: (not included w/bracket)
-18	211-0101-00			2	SCREW, 4-40 x 1/4 inch, 100° csk, FHS
-19	- - - - - -			1	TRANSISTOR
	- - - - - -			-	mounting hardware: (not included w/transistor)
-20	386-0143-00			1	WASHER, mica
-21	211-0012-00			2	SCREW, 4-40 x 3/8 inch, PHB
	210-0054-00			2	LOCKWASHER, split #4
-22	210-0849-00			2	WASHER, fiber, shouldered, #4
	210-0994-00			2	WASHER, flat, 0.125 ID x 0.250 inch OD
-23	210-0004-00			1	LOCKWASHER, internal, #4
-24	210-0201-00			1	LUG, solder, SE #4
-25	210-0406-00			2	NUT, hex., 4-40 x 3/16 inch

FIG. 1 TYPE 134 EXPLODED VIEW *(Cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Modal No. Eff	Serial/Modal No. Disc	Qty	1 2 3 4 5	Description
1-26	131-0319-00			1		CONNECTOR, BNC, locking
	- - - - - -			-		connector includes:
	- - - - - -			1		NUT
-27	- - - - - -			1		COVER, BNC
-28	670-0227-00	100	1849	1		ASSEMBLY, circuit board
	670-0227-01	1850		1		ASSEMBLY, circuit board
	- - - - - -			-		assembly includes:
-29	131-0344-00			2		CONNECTOR, bifurcated feed thru
-30	136-0220-00			6		SOCKET, transistor, 3 pin
	132-0119-00			4		DISC, Plastic
-31	337-0828-00			1		SHIELD, input
	388-0697-00			1		BOARD, circuit
	- - - - - -			-		board includes:
	388-0697-01			1		BOARD, circuit
-32	214-0506-00			15		PIN, connector, straight
-33	214-0693-00			1		HEAT SINK, transistor
	- - - - - -			-		mouning hardware: (not included w/assembly)
-34	211-0116-00			2		SCREW, sems, 4-40 x 5/16 inch, PHB
-35	358-0091-00			1		BUSHING, strain relief
-36	161-0020-00			1		CORD, power, connector one end
-37	380-0095-00			1		HOUSING, amplifier, wrap around
-38	200-0327-01			1		COVER, box, aluminum cast
	- - - - - -			-		mounting hardware: (not included w/cover)
-39	211-0071-00			2		SCREW, 4-40 x 3/8 inch, PHS
-40	210-0270-00			1		LUG, terminal
-41	175-0680-00			1		LEAD, electrical
	- - - - - -			-		lead includes:
-42	131-0371-00			1		CONNECTOR, pin
-43	131-0371-00			14		CONNECTOR, pin
-44	124-0126-00	100	6713	1		STRIP, brass
	124-0124-00	6714		1		STRIP, brass
						STANDARD ACCESSORIES
	070-0524-00			2		MANUAL, instruction (not shown)

FIG. 2 P6019 PROBE

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	1 2 3 4 5	Description
2-	010-0196-00			1		PROBE PACKAGE, P6019
	- - - - - -			-		probe package includes:
-1	204-0264-00			1		BODY, probe, top half
-2	351-0099-00			1		SLIDE (SW20)
-3	214-0658-00			1		SPRING, helical, compression
-4	351-0098-00			1		GUIDE, return spring
-5	- - - - --			1		TRANSFORMER ASSEMBLY, upper and lower (T1)
-6	214-0657-00			1		SPRING, retaining, 0.035 inch diameter
-7	214-0676-00			1		RETAINER, return spring, 1.325 inches long
-8	214-0656-00			1		CONTACT, electrical sliding type, channel shaped (SW20)
-9	129-0084-00			1		BOARD, terminal
-10	175-0361-00			1		CABLE ASSEMBLY
-11	204-0263-00			1		BODY, probe, bottom half
-12	211-0034-00			4		SCREW, 2-56 x 1/2 inch, RHS
-13	134-0044-00			1		PLUG, probe, BNC
-14	358-0072-00			1		BUSHING, insulator, BNC
-15	214-0109-00			1		PIN, probe contact, male
-16	361-0022-00			1		SPACER, 23/64 inch long, w/center hole

STANDARD ACCESSORIES

	344-0046-00			2		CLIP, probe
	175-0263-00			1		CABLE, ground lead, 3 inch
	175-0124-00			1		CABLE, ground lead, 5 inch
	006-0351-00			1		BAG, plastic, 6 x 4 inch (not shown)
	070-0524-00			2		MANUAL, instruction

FIG. 3 P6020 PROBE

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	1 2 3 4 5	Description
-3	010-0197-00			1		PROBE PACKAGE, P6020
	- - - - - -			-		probe package includes:
-1	175-0385-00			1		CABLE ASSEMBLY
-2	204-0266-00			1		BODY, probe, top half
-3	351-0106-00			1		SLIDE (SW20)
-4	214-0722-00			1		STRIP, contact, RF grounding (SW20)
-5	- - - - - -			1		TRANSFORMER ASSEMBLY, upper & lower (T1)
-6	204-0274-00			1		BODY, probe, bottom half
-7	214-0735-00			1		SPRING, compression
-8	352-0098-00			1		HOLDER, spring retainer
-9	214-0726-00			1		RETAINER, return spring
-10	361-0022-00			1		SPACER, $^{23}/_{64}$ inch long, w/center hole
-11	214-0109-00			1		PIN, probe contact, male
-12	358-0072-00			1		BUSHING, insulator, BNC
-13	134-0044-00			1		PLUG, probe, BNC

STANDARD ACCESSORIES

344-0046-00		2	CLIP, probe
175-0263-00		1	CABLE, ground lead, 3 inch
175-0124-00		1	CABLE, ground lead, 5 inch
006-0351-00		1	BAG, plastic, 6 x 4 inch (not shown)
070-0524-00		2	MANUAL, instruction

FIG. 4 PASSIVE TERMINATION FOR P6019

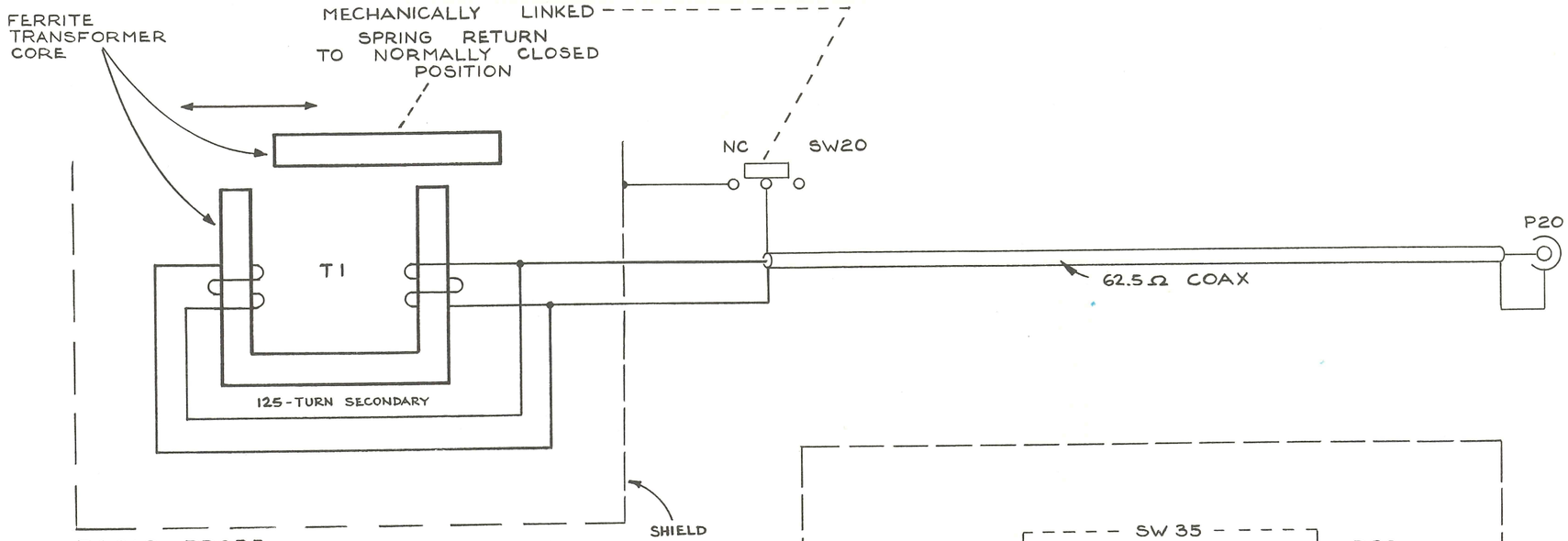
Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	1 2 3 4 5	Description
4-	011-0078-00			1		P6019 PASSIVE TERMINATION
	- - - - - -			-		termination includes:
-1	131-0428-00			1		ASSEMBLY, connector, BNC
	- - - - - -			-		assembly includes:
-2	134-0044-00			1		PLUG, probe, BNC
-3	358-0072-00			1		BUSHING, insulator, BNC
-4	214-0109-01			1		PIN, probe contact, male
-5	166-0217-00			1		TUBE, spacer, insulator, BNC
-6	132-0081-00			1		NUT, BNC
-7	334-1017-00			1		TAG, label
-8	211-0101-00			2		SCREW, 4-40 x 1/4 inch, 100° csk, FHS
-9	131-0106-00			1		CONNECTOR, coaxial, 1 contact, female
-10	202-0054-00			1		BOX, terminal
-11	213-0048-00			2		SCREW, set, 4-40 x 1/8 inch, HSS
-12	260-0447-00			1		SWITCH, slide
-13	210-0004-00			1		LOCKWASHER, internal, #4
-14	210-0406-00			2		NUT, hex., 4-40 x 3/16 inch
-15	200-0252-00			1		COVER, bottom
-16	213-0141-00			2		SCREW, thread forming, 4-40 x 1/4 inch, PHS
-17	210-0201-00			1		LUG, solder, SE #4

FIG. 5 PASSIVE TERMINATION FOR P6020

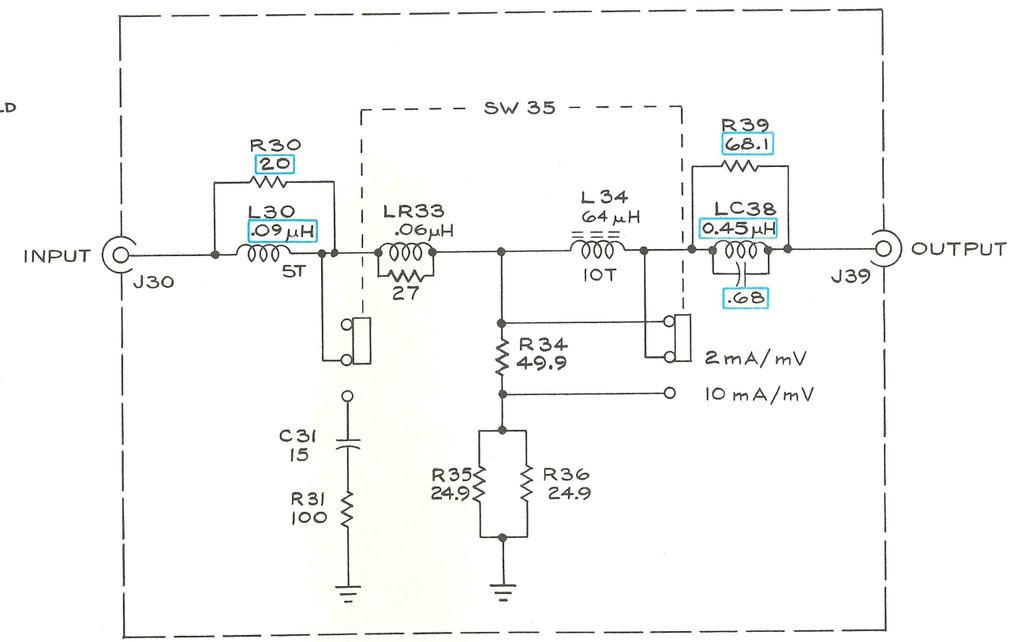
5-	011-0079-00			1		P6020 PASSIVE TERMINATION
	- - - - - -			-		termination includes:
-18	131-0428-00			1		ASSEMBLY, connector, BNC
	- - - - - -			-		assembly includes:
-19	134-0044-00			1		PLUG, probe, BNC
-20	358-0072-00			1		BUSHING, insulator, BNC
-21	214-0109-01			1		PIN, probe contact, male
-22	166-0217-00			1		TUBE, spacer, insulator, BNC
-23	132-0081-00			1		NUT, BNC
-24	334-1044-00			1		TAG, label
-25	211-0008-00			2		SCREW, 4-40 x 1/4 inch, PHS
-26	131-0342-00			1		CONNECTOR, coaxial, 1 contact, female
-27	202-0054-00			1		BOX, terminal
-28	213-0048-00			2		SCREW, set, 4-40 x 1/8 inch, HSS
-29	260-0783-00			1		SWITCH, slide
-30	200-0252-00			1		COVER, bottom
-31	211-0008-00			2		SCREW, 4-40 x 1/4 inch, PHS
-32	388-0749-00			1		BOARD, circuit
	214-0868-00			1		INSULATOR, slide switch, fish paper

FIG. 6 CURRENT PROBE AMPLIFIER POWER SUPPLIES

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	1 2 3 4 5	Description
6-1	015-0058-00			1		POWER SUPPLY, current probe amplifier (115 V)
	- - - - - -			-		power supply includes:
-2	211-0015-00			1		SCREW, 4-40 x 1/2 inch, RHS
-3	200-0185-00			1		COVER, motor base, 3 wire
-4	214-0078-00			2		PIN, connecting
-5	377-0041-00			1		INSERT, motor base
-6	387-0265-00			1		PLATE, cover transformer
-7	- - - - - -			1		TRANSFORMER
-8	214-0696-00			2		COLLAR, transformer
-9	200-0246-01			1		COVER, power supply (115 V)
-10	129-0060-00			1		POST, ground, slotted one end
-11	213-0041-00			2		SCREW, thread cutting, 6-32 x 3/8 inch, THS
-12	407-0226-00			1		BRACKET, 1 3/4 x 4 1/2 inches
-13	131-0190-00			1		CONNECTOR, molded pin assembly
-14	015-0059-00			1		POWER SUPPLY, current probe amplifier (230 V)
	- - - - - -			-		power supply includes:
-15	211-0027-00			1		SCREW, 4-40 x 1 1/2 inches, RHS
-16	200-0185-00			1		COVER, motor base, 3 wire
-17	211-0545-00			2		SCREW, 6-32 x 1 1/4 inches, THS
-18	377-0041-00			1		INSERT, motor base
-19	361-0012-00			1		SPACER, motor base
-20	- - - - - -			1		TRANSFORMER
-21	214-0696-00			2		COLLAR, transformer
-22	200-0246-02			1		COVER, power supply (230 V)
-23	129-0062-00			1		POST, ground, slotted one end
-24	214-0078-00			2		PIN, connecting
-25	387-0265-00			2		PLATE, cover, transformer
-26	407-0226-00			1		BRACKET, 1 3/4 x 4 1/2 inches
-27	131-0190-00			1		CONNECTOR, molded pin assembly



P6019 PROBE

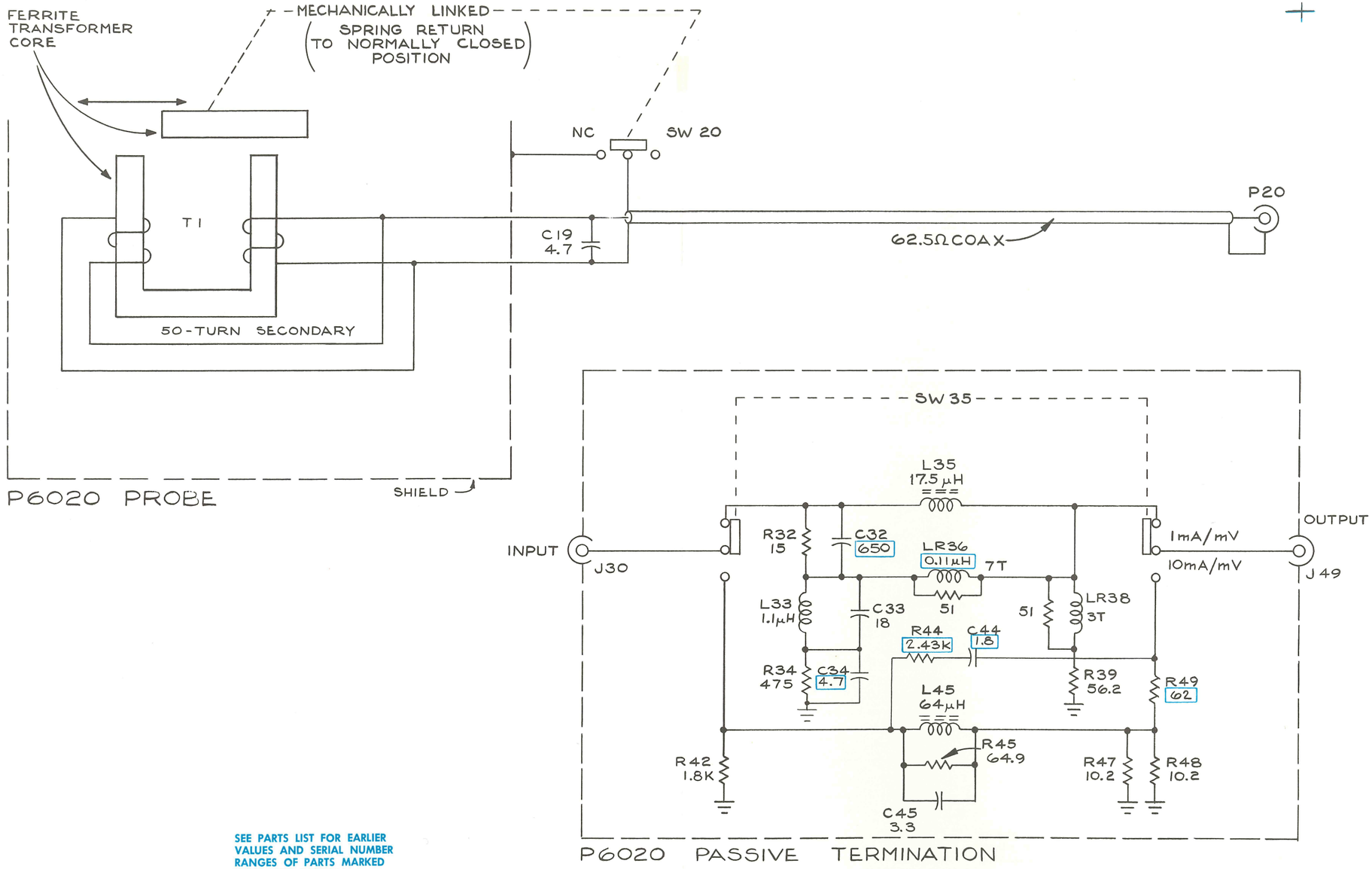


P6019 PASSIVE TERMINATION

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

P6019 CURRENT PROBE & TERMINATION

1266

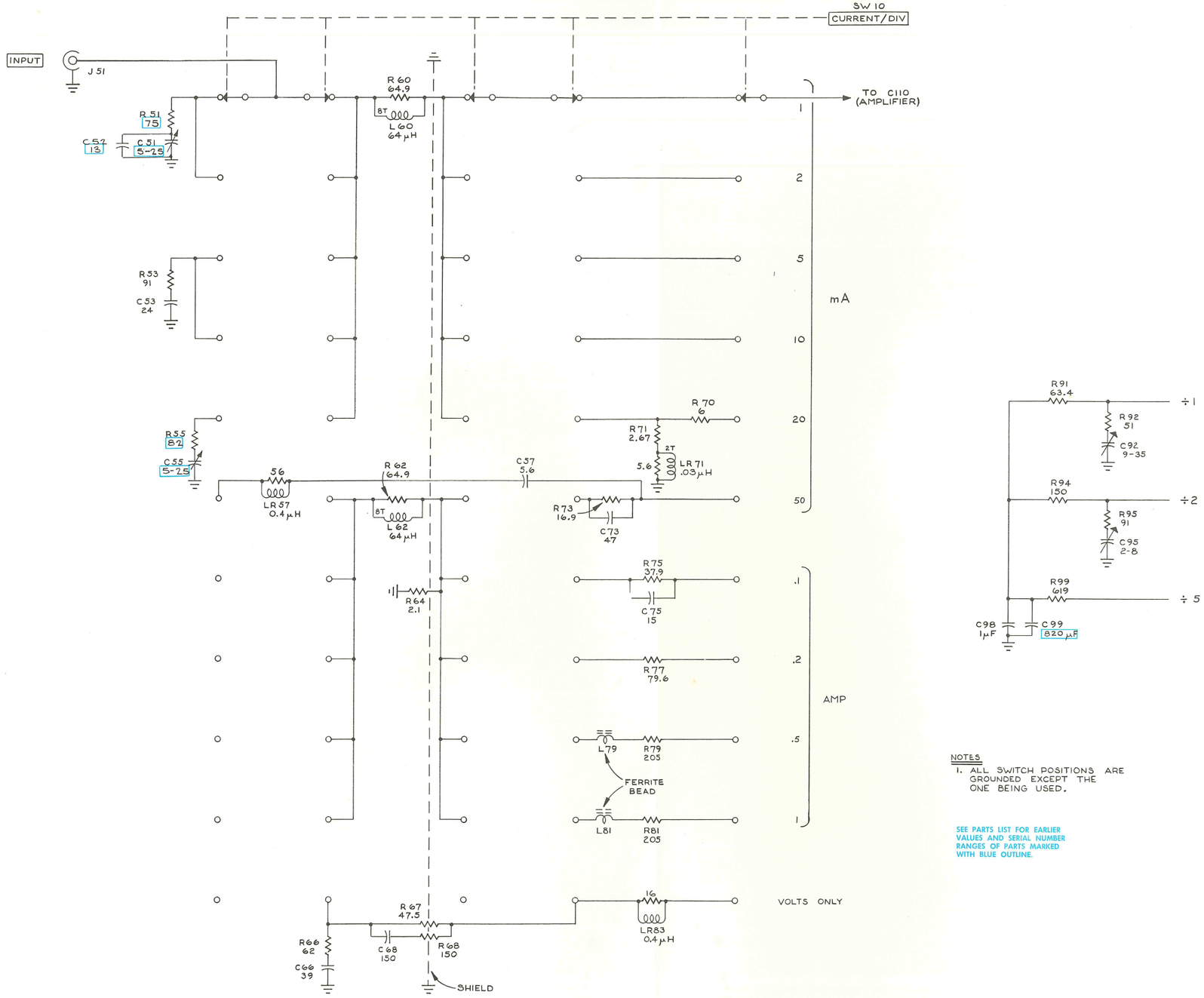


SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

B1

P6020 CURRENT PROBE & TERMINATION

268



NOTES

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

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

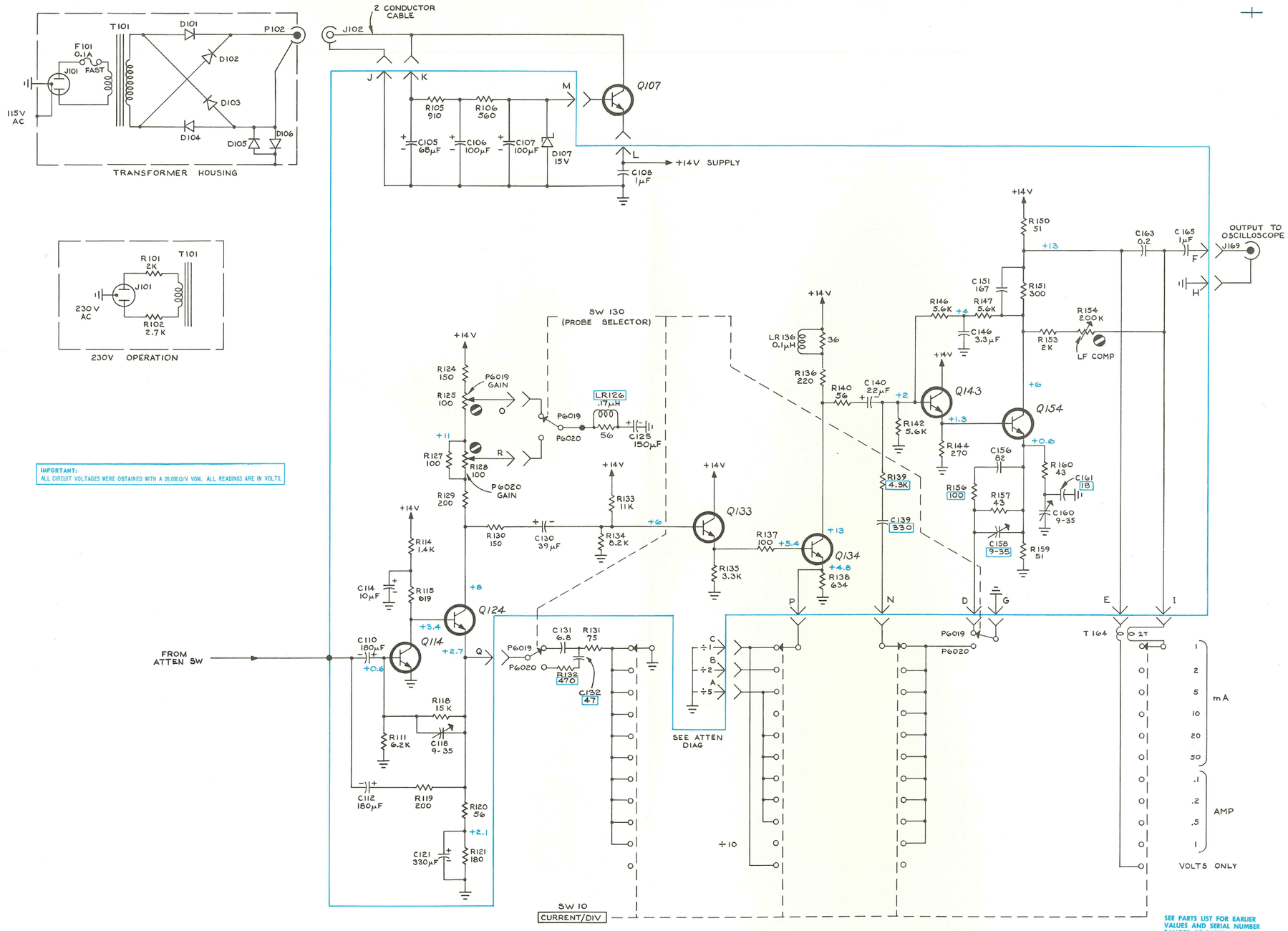

T101
D101
P102
F101
0.1A
FAST
J101
D102
D103
D104
D105
D106
115V AC
TRANSFORMER HOUSING
2 CONDUCTOR CABLE
J102
J
K
M
Q107
R105 910
R106 560
C105 68µF
C106 100µF
C107 100µF
D107 15V
L
+14V SUPPLY
C108 1µF
R101 2K
T101
J101
230V AC
R102 2.7K
230V OPERATION
IMPORTANT:
ALL CIRCUIT VOLTAGES WERE OBTAINED WITH A 20,000Ω/V VOM. ALL READINGS ARE IN VOLTS.
SW 130
(PROBE SELECTOR)
+14V
R124 150
P6019 GAIN
R125 100
LR126 .17µH
P6019
P6020
56
C125 150µF
+11
R127 100
R
R128 100
P6020 GAIN
R129 200
R130 150
C130 39µF
R133 11K
R134 8.2K
+6
Q133
R135 3.3K
R137 100
+5.4
+13
Q134
+4.8
R138 634
R114 1.4K
C114 10µF
R115 619
+8
Q124
+3.4
Q114
+2.7
Q
C110 180µF
+0.6
FROM ATTEN SW
C131 6.8
R131 75
P6019
P6020
R132 470
C132 47
SEE ATTEN DIAG
C
÷1
B
÷2
A
÷5
÷10
R118 15K
C118 9-35
R111 6.2K
C112 180µF
R119 200
R120 56
+2.1
C121 330µF
R121 180
SW 10
CURRENT/DIV
LR136 0.1µH
36
R136 220
R140 56
C140 22µF
+2
R142 5.6K
R139 4.3K
C139 330
R146 5.6K
R147 5.6K
+4
C146 3.3µF
C151 167
R150 51
+13
R151 300
R153 2K
R154 200K
LF COMP
+6
Q143
Q154
+1.3
+0.6
R144 270
C156 82
R156 100
R157 43
C158 9-35
R160 43
C161 18
C160 9-35
R159 51
P
N
D
G
E
I
C163 0.2
C165 1µF
F
H
OUTPUT TO OSCILLOSCOPE
J169
P6019
P6020
T 164
2T
1
2
5
10
20
50
mA
.1
.2
.5
1
AMP
VOLTS ONLY
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

FIG. 1 EXPLODED VIEW

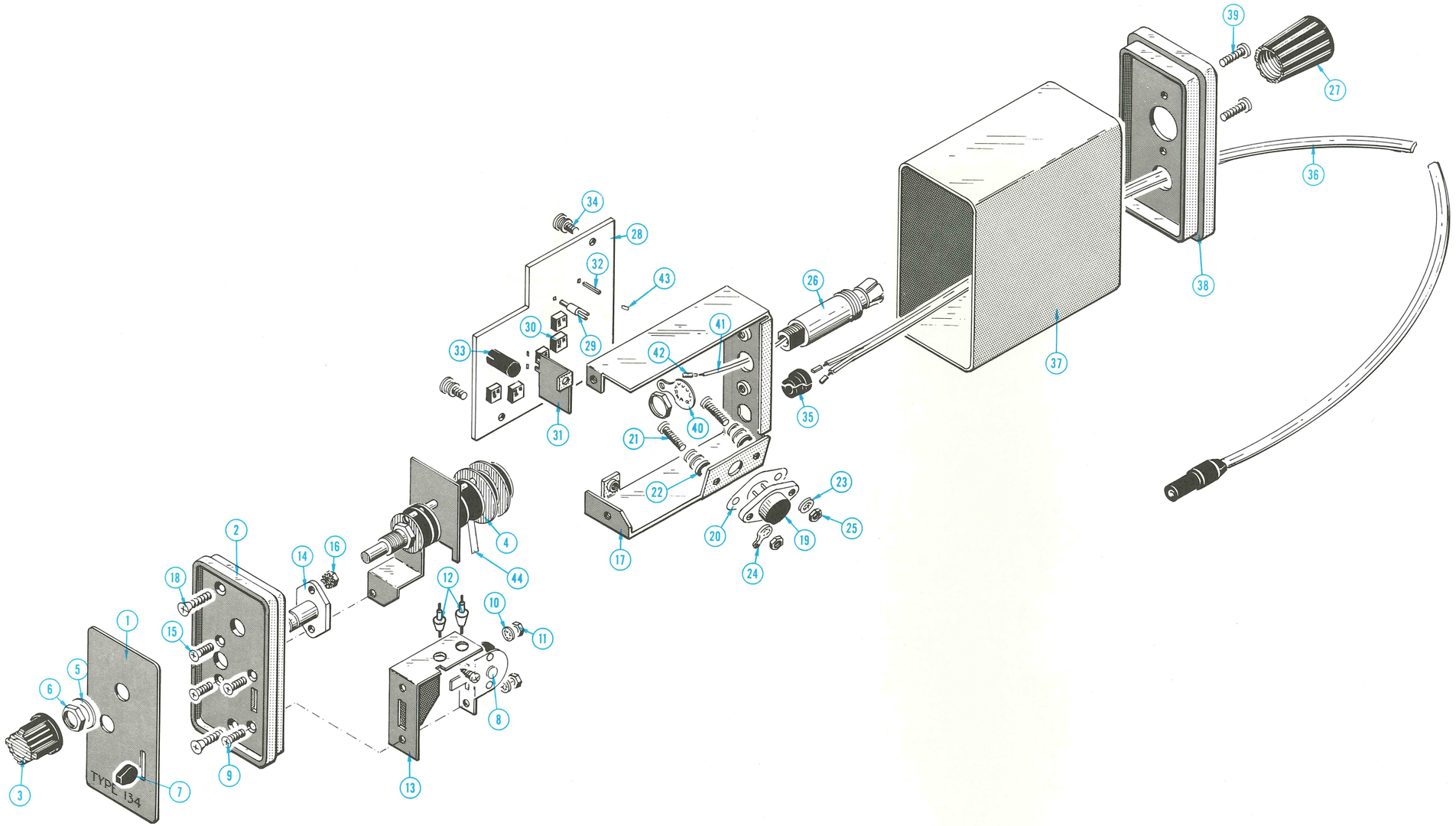
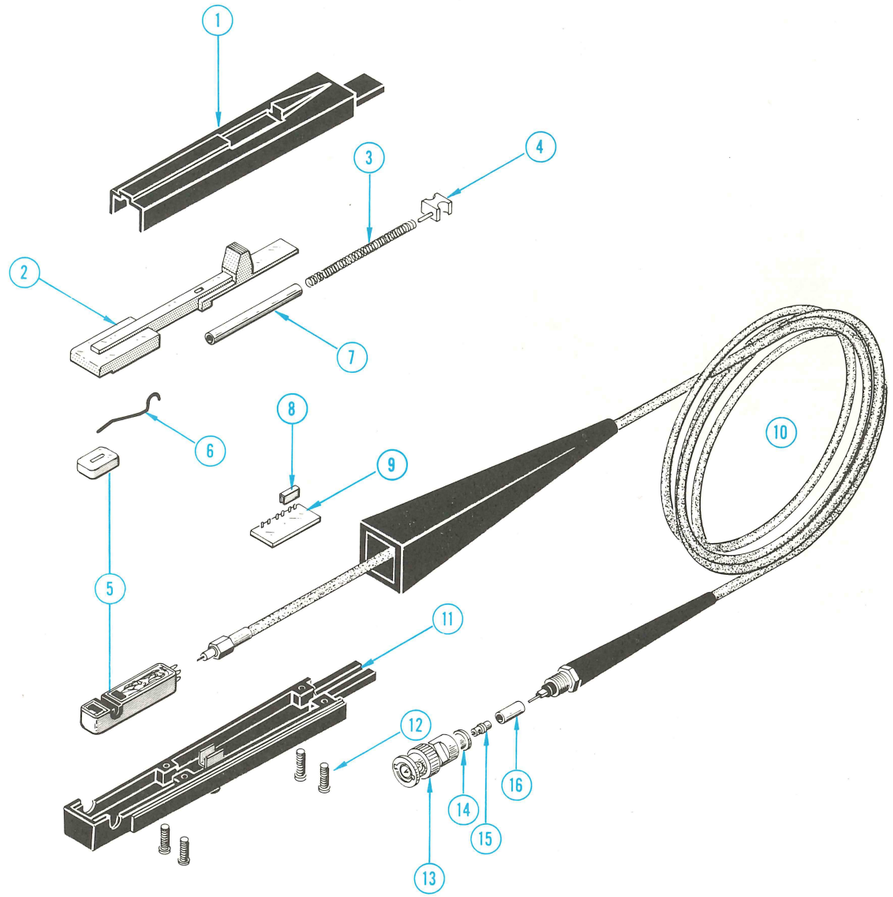
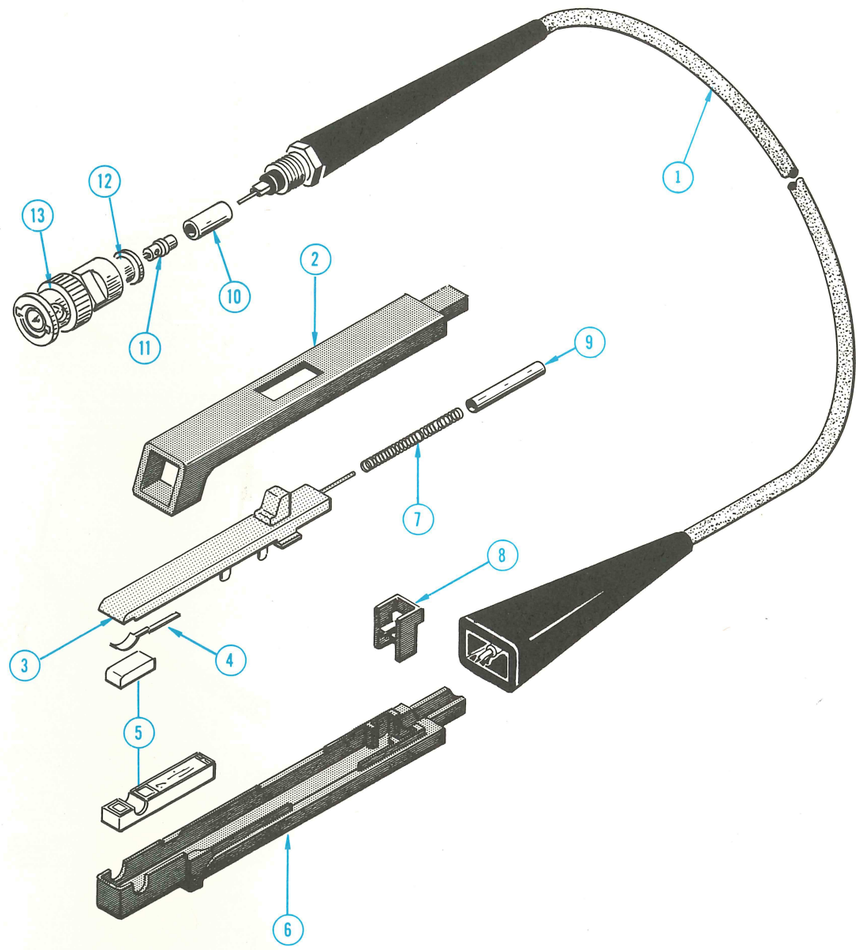


FIG. 2 P6019 PROBE



A

FIG. 3 P6020 PROBE



B

FIG. 2 & 3

FIG. 4 P6019 PASSIVE TERMINATION

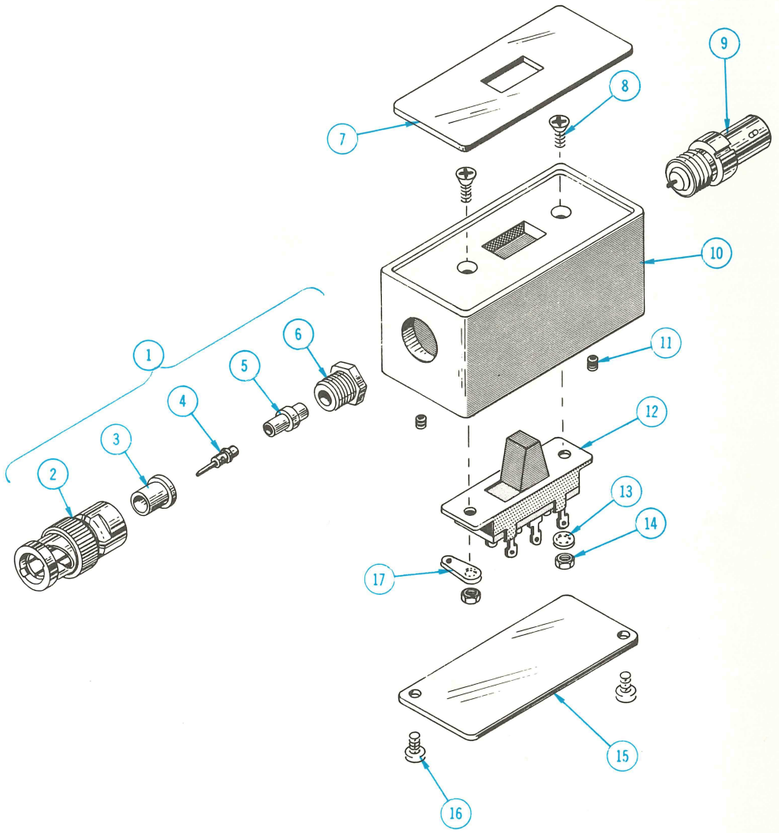


FIG. 5 P6020 PASSIVE TERMINATION

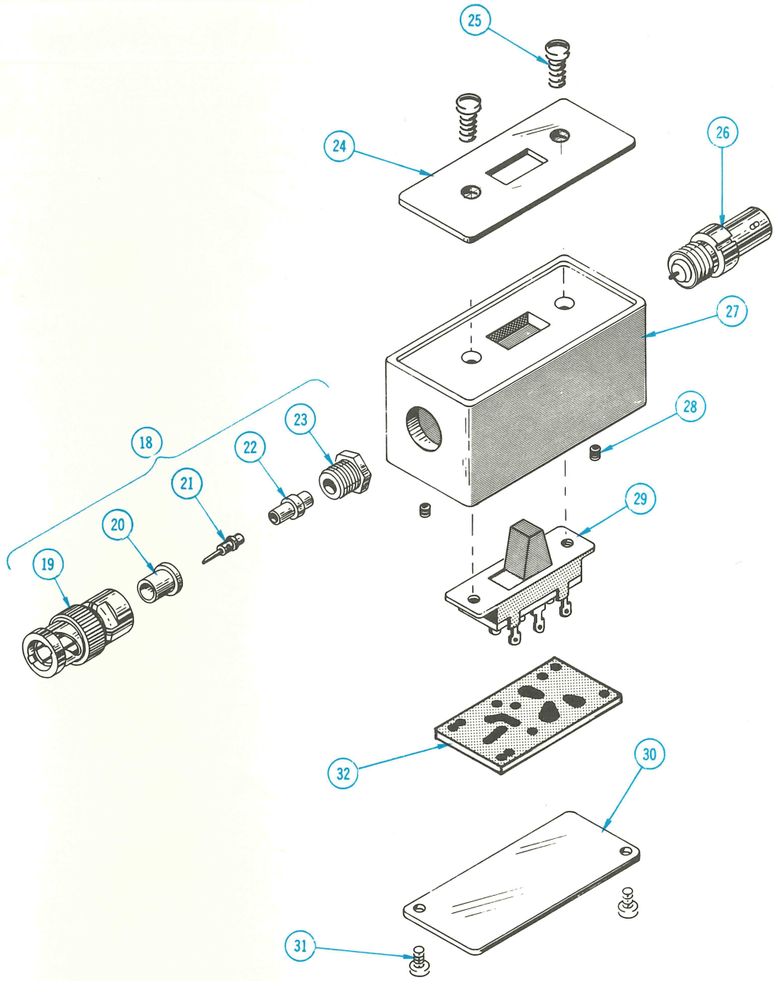
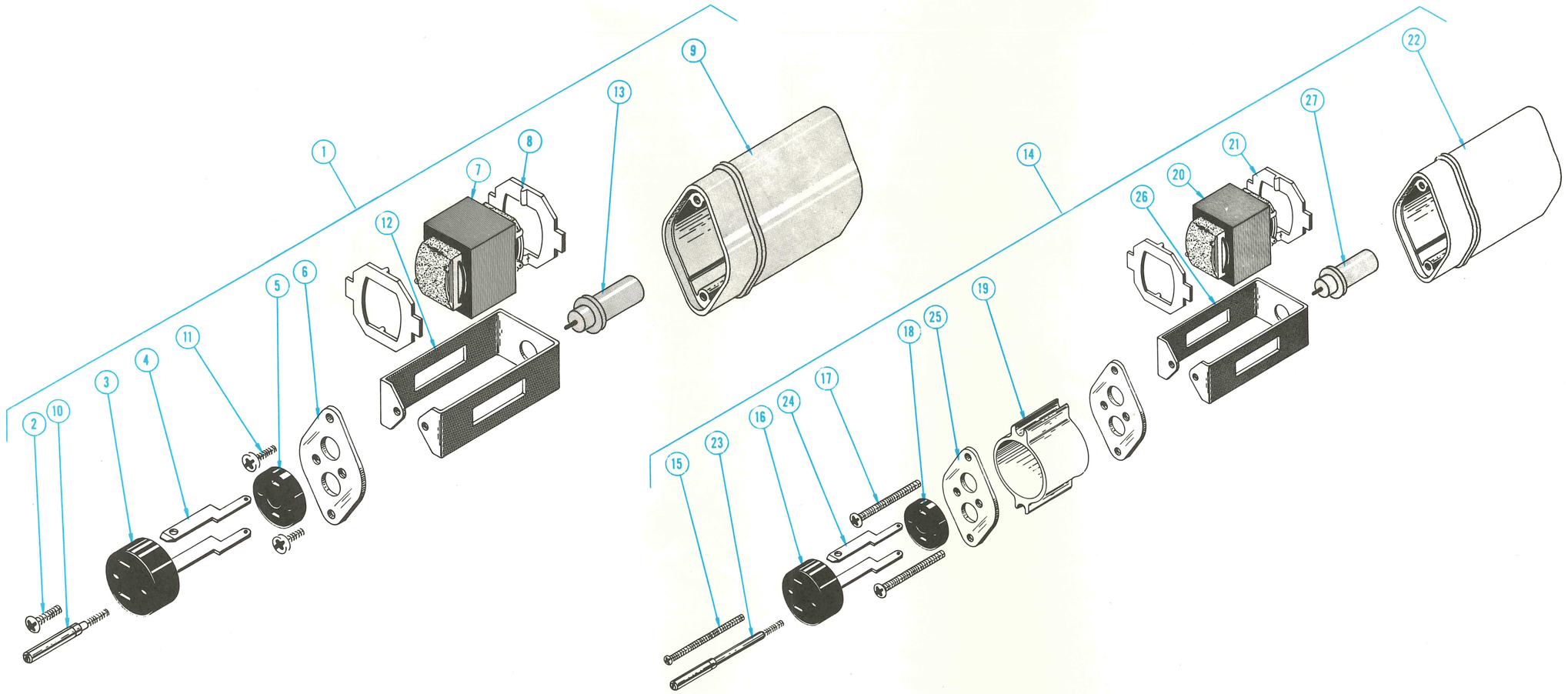


FIG. 6 CURRENT PROBE AMPLIFIER POWER SUPPLIES



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. If it does not, your manual is correct as printed.

ELECTRICAL CHARACTERISTICS

Characteristics	P6019 PROBE WITH PASSIVE TERMINATION			P6019 PROBE WITH TYPE 134 AMPLIFIER			P6020 PROBE WITH PASSIVE TERMINATION			P6020 PROBE WITH TYPE 134 AMPLIFIER		
Deflection Factor	2 mA/mV or 10 mA/mV; selected by termination switch. Accuracy ±3%			Switched current amplifier steps from 1 mA/div to 1 A/div (with 50 mV/div oscilloscope setting). Accuracy ±3%			1 mA/mV or 10 mA/mV; selected by termination switch. Accuracy ±3%			Switched current amplifier steps from 1 mA/div to 1 A/div (with 50 mV/div oscilloscope setting). Accuracy ±3%		
High-Frequency Response (-3 dB) (Risetime = $\frac{.35}{BW}$)	580-series set to 20 mV	Type 453 set to 20 mV	Type 547/1A1 set to 20 mV	580-series	Type 453	Type 547/1A1	Type 454 set to 20 mV	647-series set to 20 mV	580-series set to 20 mV	Type 454	647-series	580-series
	≥52 MHz at 2 mA, ≥54 MHz at 10 mA	≥38 MHz at 2 mA, ≥42 MHz at 10 mA	≥25 MHz at 2 mA, ≥26 MHz at 10 mA	≥35 MHz	≥28 MHz	≥28 MHz	≥100 MHz at 1 mA, ≥150 MHz at 10 mA	≥75 MHz at 1 mA, ≥100 MHz at 10 mA	≥60 MHz at 1 mA, ≥75 MHz at 10 mA	≥59 MHz	≥54 MHz	≥51 MHz
Low-Frequency Response (-3 dB)	≤ 450 Hz at 2 mA/mV, ≤ 120 Hz at 10 mA/mV			≤ 12 Hz (see Fig. 1-2)			≤ 8.5 kHz at 1 mA/mV, ≤ 935 Hz at 10 mA/mV			≤ 100 Hz		
Aberrations (does not include circuit effects of plug-in or oscilloscope)	≤ 4% during first 50 ns of displayed pulse			≤ 5% from 1 mA to 20 mA ≤ 6% from 50 mA to 1 A			≤ 4% total, except with Type 454; ≤ + or - 4%, total 8% (p-p) with Type 454. Measured during first 50 ns of displayed pulse			≤ 5% from 1 mA to 20 mA ≤ 6% from 50 mA to 1 A		
Tilt (does not include circuit effects of plug-in or oscilloscope)	≤ 4% during 10 µs of a displayed square wave at 2 mA/mV, and during 35 µs of a displayed square wave			≤ 3% during first 400 µs of displayed square wave			≤ 4% during 1 µs of a displayed square wave at 1 mA/mV, and during 10 µs of a displayed square wave			≤ 3% during first 80 µs of displayed square wave		
Noise				≤ 150 µA referred to input						≤ 150 µA referred to input		
Maximum Current	15 A peak to peak (see Fig. 1-4)			15 A peak to peak (see Fig. 1-4)			6 A peak to peak (see Fig. 1-5)			6 A peak to peak (see Fig. 1-5)		
Maximum Voltage	600 V			600 V			600 V			600 V		

Characteristics	TYPE 134 VOLTS ONLY P6019 POSITION	TYPE 134 VOLTS ONLY P6020 POSITION
Deflection Factor (with 50 mV/div oscilloscope)	0.4 mV/div (gain of 125). Accuracy ±3%	1 mV/div (gain of 50). Accuracy ±3%
Risetime	≤ 11.7 ns	≤ 6.5 ns
High-Frequency Response (-3 dB)	≥ 30 MHz	≥ 54 MHz
Low-Frequency Response (-3 dB)	≤ 10 Hz	≤ 8 Hz
Aberrations	≤ 5%	≤ 5%
Tilt	≤ 3% during 500 µs of displayed square wave	≤ 3% during 600 µs of displayed square wave

POWER SUPPLY		
Characteristics	115 Volt Supply	230 Volt Supply
Line Voltage Range	103.5 to 126.5 V AC	207 to 253 V AC
Line Frequency Range	50 to 400 Hz	50 to 400 Hz
Output Voltage	+13.25 to +15.25 V DC	+13.25 to +15.25 V DC
Regulation	≤ 0.5 V change	≤ 0.5 V change
Ripple	≤ 2 mV	≤ 2 mV

NOTE: In Section 6, performance should be checked to the above specifications. (When making bandwidth measurements, use one of the above specified instruments and check for the combined response of the system.)

TEXT CORRECTION

Section 1 Characteristics

Page 1-2 Package Part Numbers

CHANGE: the P6020 Termination part number to 011-0079-01.

PARTS LIST CORRECTIONS

Section 8 Electrical Parts List

Page 8-5

CHANGE TO:

C32	283-0150-00	650 pF	200V		5%
LR36	108-0468-00	0.11 µH			
R49	315-0620-00	62 Ω	1/4W		5%

ADD:

C34	281-0618-00	4.7 pF	200V		±0.5 pF
C44	281-0670-00	1.8 pF	500V		±0.1 pF
R44	321-0230-00	2.43 k	1/8W	Prec	1%

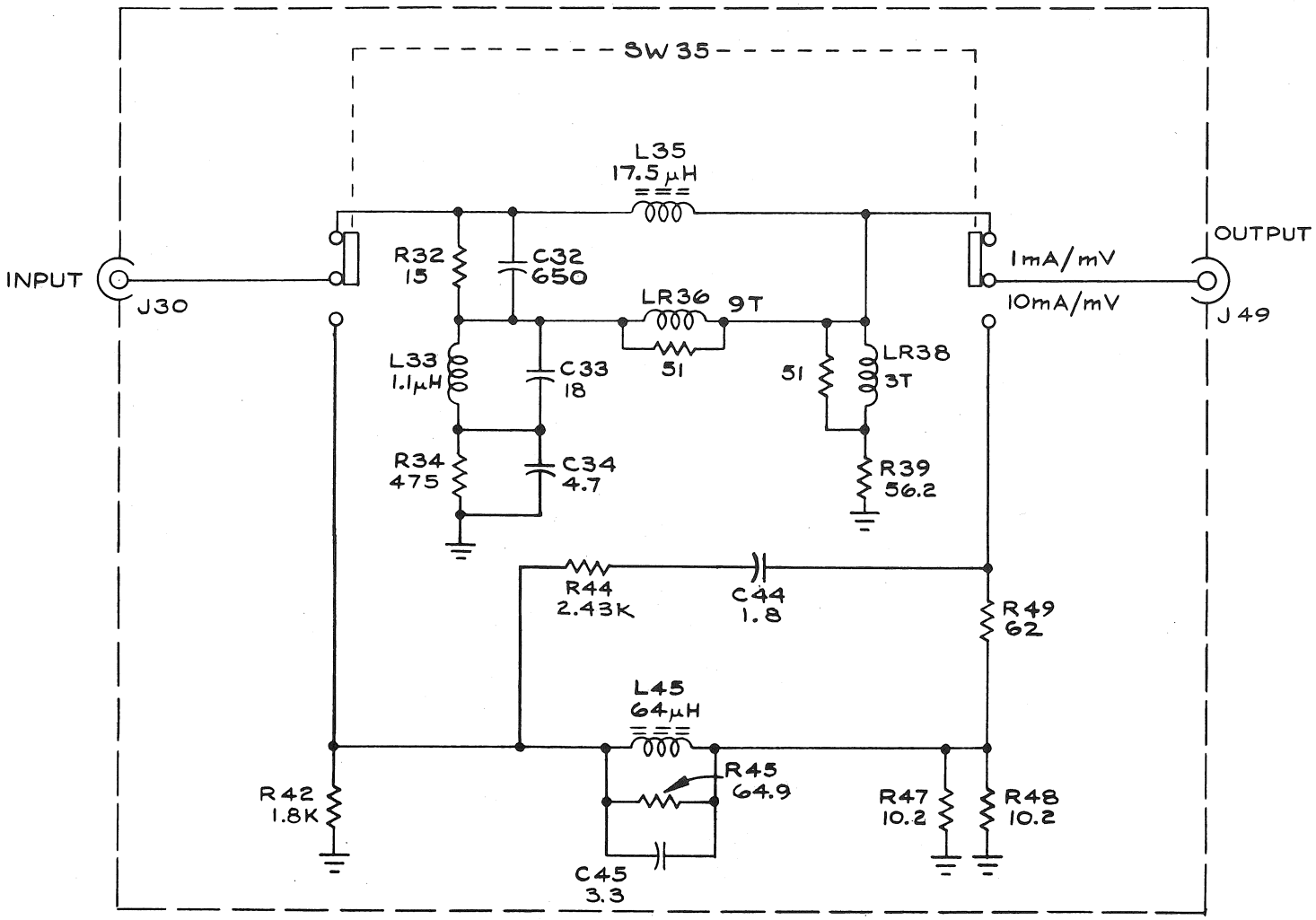
Section 9 Mechanical Parts List

Page 9-5

CHANGE TO:

Index No. 5-	011-0079-01	P6020 Passive Termination
Index No. 5-24	334-1135-00	TAG, label
Index No. 5-32	388-0749-01	BOARD, circuit

P6020 PASSIVE TERMINATION (after M12362)



P6020 PASSIVE TERMINATION