INSTRUCTION MANUAL

Serial Number ______________

type P6016 current probe

type 131 current probe amplifier

passive termination

Tektronix, Inc.

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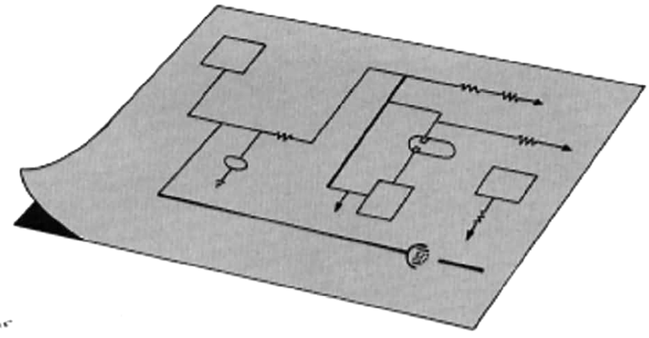


SECTION 1

CHARACTERISTICS

Introduction

The Type P6016 Current Probe is designed to extend the usefulness of Tektronix oscilloscopes. The probe, used with either a passive Termination or a Type 131 Current Probe Amplifier, permits a current waveform to be viewed and measured on the oscilloscope. No direct electrical connection to the circuit under test is required because the probe clamps around the current-carrying wire. Impedance change and loading of the circuit under test can be considered to be negligible.

Type P6016 Current Probe with Passive Termination

Sensitivity:

2 ma/mv or 10 ma/mv; accuracy within 3%.

(With Type L Plug-In Unit, maximum sensitivity is 10 ma/cm).

Risetime (with Type K or L Plug-In Unit in Type 540-Series Oscilloscope):

18 nanoseconds (approx. 20 mc at 3 db down).

Low-Frequency Response:

At 2 ma/mv—approx. 850 cps at 3 db down (5% tilt of 10-μsec square pulse).

At 10 ma/mv—approx. 230 cps at 3 db down (5% tilt of 35-μsec square pulse).

Maximum Current Rating:

15 amps, peak-to-peak.

Maximum Direct Current Saturation Threshold:

0.5 amp.

Maximum Breakdown Voltage:

600 volts with probe slide closed.

Insertion Impedance:

Refer to Table 1-1 where insertion impedance is listed as a function of time following the start of a fast-rise step current function. Also see Fig. 4-1 in the Circuit Description section.

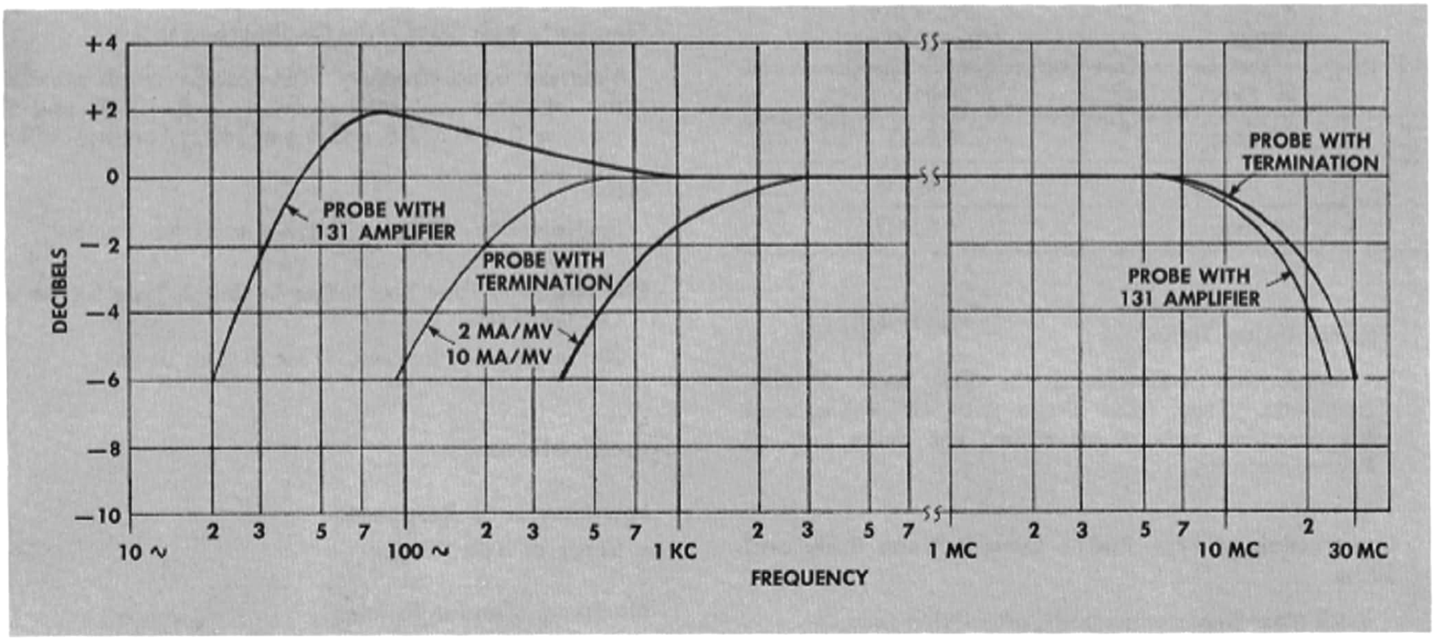


Fig. 1-1. Typical frequency response characteristics of the Type P6016 Current Probe with both the Type 131 Amplifier and the passive Termination, when used with a Type 545A Oscilloscope and a Type K Plug-In Unit. The low-frequency end of the "Probe With 131 Amplifier" curve will vary considerably with adjustment of the LOW FREQ. ADJ. control.

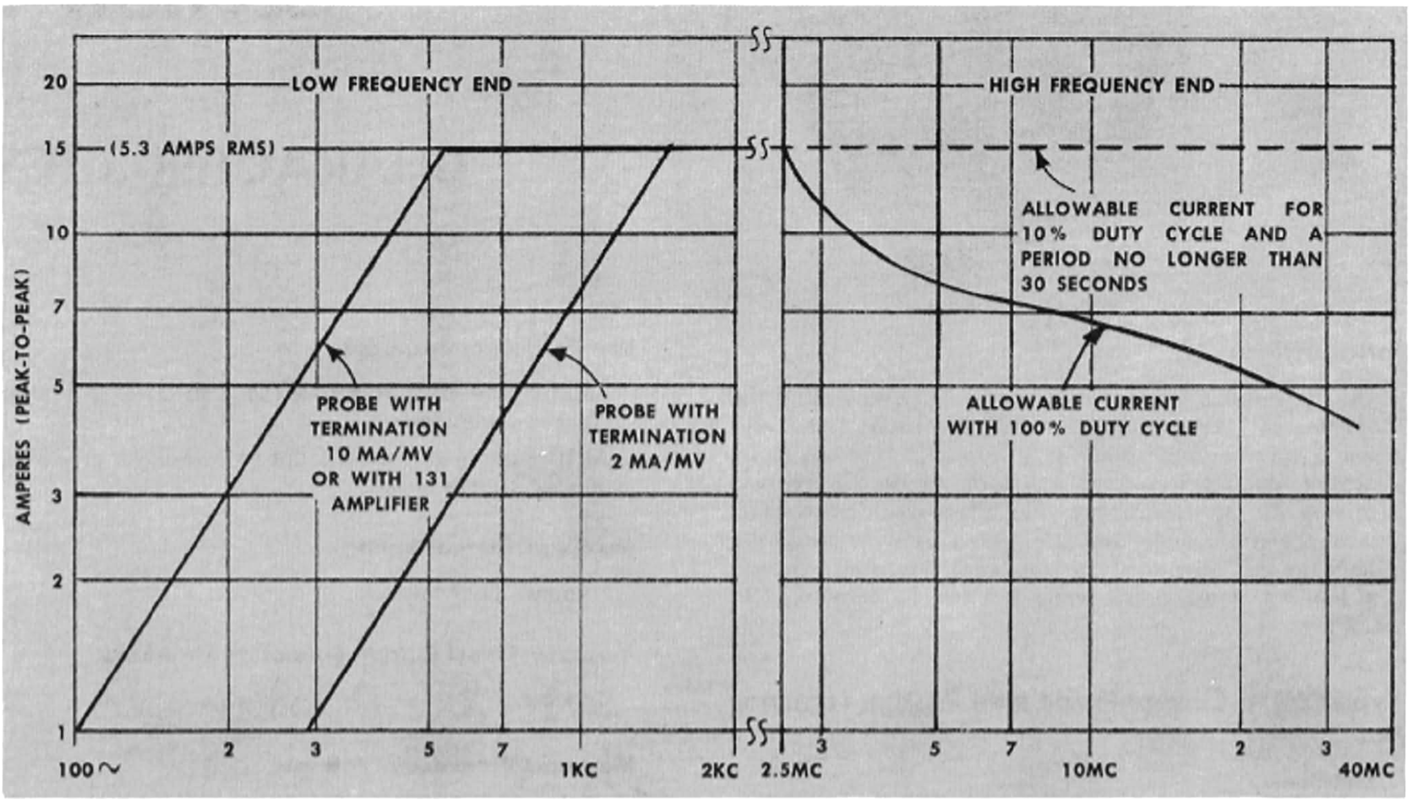


Fig. 1-2. Typical current versus frequency curve. At the low-frequency end detectable sine-wave distortion occurs as a result of core saturation. Although the probe distorts low-frequency current waveforms when the core starts to saturate, any high-frequency waveforms or short-duration microsecond pulses present at the same time are unaffected. At the high-frequency end, current rating may be exceeded under conditions indicated on the graph.

TABLE 1-1

TIME	INSERTION IMPEDANCE
50 nsec	0.06 Ω
100 nsec	0.04 Ω
1 μsec	0.015 Ω
10 μsec	0.006 Ω

Typical Delay Time:

12 nanoseconds measured at the 50% level of pulse amplitude. (Type P6000 Probe with 42" cable, used for observing voltage waveform, has delay time of 8 nanoseconds.)

Construction of Type P6016 Current Probe Body and Slide:

Black glass-filled styrene body, gray Delrin slide.

Construction of Passive Termination:

Zamac #5 die casting.

Type P6016 Current Probe with Type 131 Current Probe Amplifier

Sensitivity with 50 mv/div Oscilloscope Input:

1 ma/div basic sensitivity. Ten-position switch provides the following calibrated steps: 1, 2, 5, 10, 20 and 50 ma/div; 0.1, 0.2, 0.5 and 1 amp/div. Accuracy within 3%.

Noise:

Equivalent to 100-μamp, peak-to-peak input signal.

Risetime (with Type K or L Plug-In Unit in Type 540-Series Oscilloscope):

20 nanoseconds (approx. 17 mc at 3 db down).

Specifications

Low-Frequency Response:

50 cps at 3 db down.

Maximum Current Rating:

15 amps, peak-to-peak.

Maximum Direct Current Saturation Threshold:

0.5 amp.

Maximum Breakdown Voltage:

600 volts with probe slide closed.

Insertion Impedance:

Refer to Table 1-1. Also refer to Fig. 4-1 in the Circuit Description section.

Typical Delay Time:

32 nanoseconds measured at the 50% level of pulse amplitude. (Type P6000 Probe with 42" cable, used for observing voltage waveform, has delay time of 8 nanoseconds.)

Power Requirements: (Model 1, 2 and 3)

Line voltage and frequency—105 to 125 volts rms, or 210 to 250 volts rms using two 18 k, 1 watt, 10% resistors connected in series with line;* 50-60 cycles

Power—approx. 0.5 watt at 117 vac; approx. 1 watt at 234 vac.

*To obtain a ready-made 234 volt adapter, consult your local Tektronix Field Engineer or overseas Representative.

Power Requirements (Model 4-up)

Line voltage and frequency—105 to 125 volts rms, or 210 to 250 volts rms depending upon which transformer housing is used with the Type 131. The line frequency in either case must be 50-60 cycles.

AC Power—approx. 0.5 watt at 117 vac; approx. 1 watt at 234 vac. Battery voltage—the Type 131 requires a battery that will furnish 22½ volts at 10 ma of current.

Battery power—approx. 0.2 watt at 22½ volts.

Type 131 Mechanical Specifications: (Models 1, 2 and 3)

Construction—Aluminum-alloy cover and etched circuit board chassis. Extruded aluminum frame.

Finish—Photo-etched anodized cover.

Dimensions—3½" high, 1½" wide, 4½" deep (includes connectors).

Type 131 Mechanical Specifications: (Model 4-up)

Construction—Aluminum-alloy wrap-around cover and etched circuit board chassis.

Die cast end plates.

Finish—Blue Vinyl finished cover.

Dimensions—3$^{11}/_{16}$" high, 1$^{15}/_{16}$" wide, 4$^{13}/_{16}$" deep (includes connectors).

Weights:

Type P6016 Current Probe—4 oz.

Passive Termination—5 oz.

Type 131 Model 1, 2, 3 Current Probe and Amplifier—approx. 15 oz.

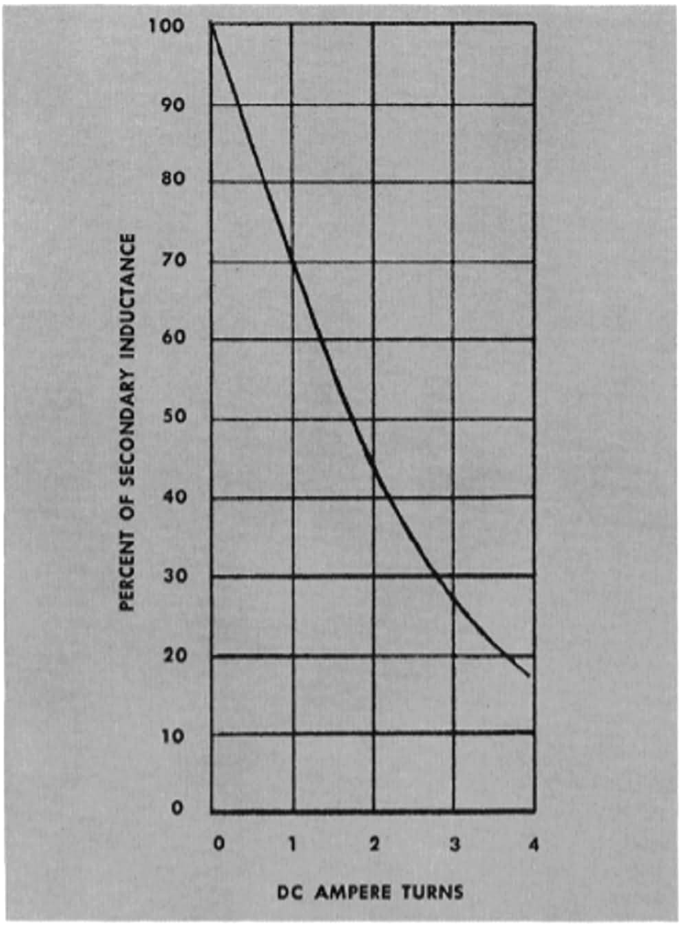


Fig. 1-3. Typical curve showing percent of secondary inductance versus primary dc-ampere turns. The curve shows that the secondary inductance of the current probe transfer decreases as the dc-ampere turns are increased, which impairs the low-frequency response. However, high-frequency response is not impaired.

Type 131 Model 4 Current Probe and Amplifier—approx. 16 oz.

AC Power Supplies add approximately 5 oz. to the total weight.

Accessories

1—Instruction manual

Ordering Information

The Type 131 and associated equipment is available in various combinations. See below for the proper stock number of the combination wanted.

P6016 Probe	010-037
Passive Termination	011-028
P6016 Probe and Passive Termination	011-044
Type 131 with 117 vac Transformer Housing	015-011
Type 131 with 234 vac Transformer Housing	015-024
P6016 Probe and Amplifier (Type 131)	015-030
Type 131 with Battery Adapter	015-026

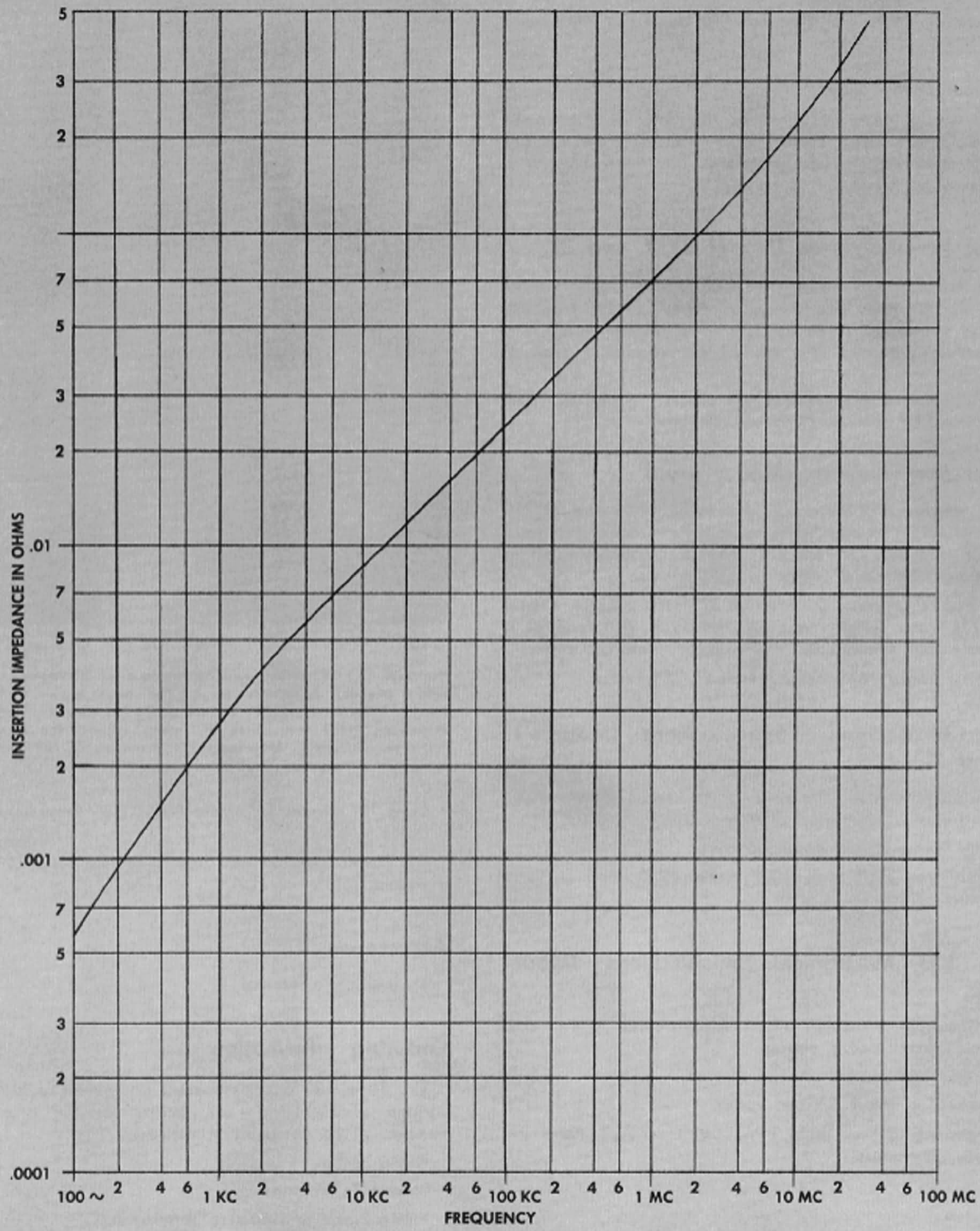
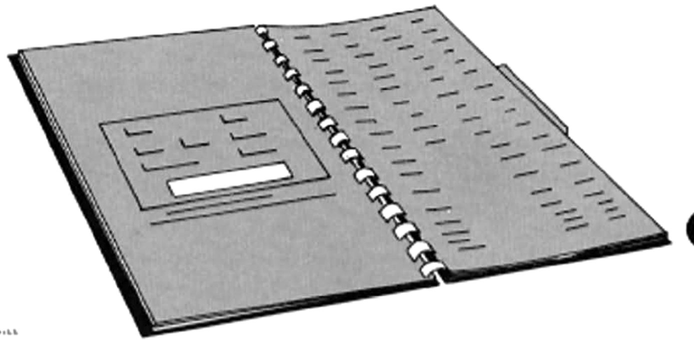


Fig. 1-4. Typical impedance inserted in a circuit by the Type P6016 Current Probe when properly terminated.



SECTION 2

OPERATING INSTRUCTIONS

Operation With Passive Termination

To use the Type P6016 Current Probe with a passive Termination unit and oscilloscope, connect the Termination between the probe cable and the input to the oscilloscope (see Fig. 2-1). Set the slide switch on the Termination to the desired sensitivity. Rotate the variable vertical sensitivity control on the oscilloscope to the detent position for calibrated sensitivity. Set the oscilloscope vertical sensitivity switch to suit the amplitude of the waveform to be observed and measured.

Clamp the current probe around the conductor under test. Make certain the thumb-controlled slide is moved fully forward. Set the remainder of the oscilloscope front-panel controls for a stable display. To measure the peak-to-peak current of the displayed waveform, the example to follow is given as a guide.

If the current probe sensitivity is set for 2 ma/mv and the oscilloscope is set for 50 mv/div (or 50 mv/cm) sensitivity, the overall sensitivity is:

$$2 \text{ ma/mv} \times 50 \text{ mv/div} = 100 \text{ ma/div.}$$

If the current waveform is 3 divisions (centimeters) peak-to-peak in amplitude, the current is:

$$3 \text{ div} \times 100 \text{ ma/div} = 300 \text{ ma, peak-to-peak.}$$

Frequency, phase, and time measurements of current waveforms are determined in the same manner as for voltage waveforms.

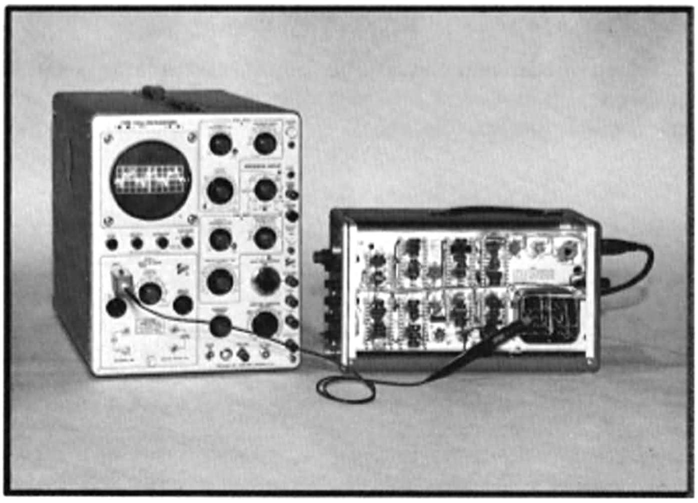


Fig. 2-1. The Type P6016 Current probe in operation when used with the Termination and an oscilloscope.

Direction of Current Flow

Direction of conventional current flow (plus to minus) in the conductor, as opposed to electron flow, is indicated by the arrows located on the top and bottom of the probe. Current flowing in the direction of the arrows produces an upward or positive deflection of the waveform on the crt.

Precautionary Notes

(a) Ground Clip Lead

A ground clip lead is furnished with the probe to ground the shielding at the probe end when desired. Normally, for most applications, the ground lead is unclipped from the probe and not used. Because of the three-wire power cord used on the Type 131 Amplifier, use of the ground clip lead may cause circulation of undesirable chassis currents.

(b) Clamping the Probe around a Bare Wire

Care must be used in clamping the probe around a bare wire lead when the device under test is operating. While the probe is being attached around the wire, the edges of the grounded, metallic shield in the stationary part of the probe, and the shield in the sliding portion, are exposed. Therefore, the probe must be attached without permitting the exposed edges of the shields to come into contact with the bare wire until the slide can be closed over the wire.

To prevent an accidental short circuit to ground through the shield, a piece of spaghetti insulation can be slit down one side and slipped over the bare wire. Then the probe can be safely clamped over the insulation. Or, if preferred, the device under test can be turned off before attaching the probe. Conductors up to 0.150 inch, or the size of a ½-watt composition resistor, can be accepted by the probe.

(c) Performance Limitations

When making current measurements and analyzing the waveform, take into consideration the combined bandwidth of the oscilloscope and the Type P6016 Current Probe (with either the Termination or Type 131). For optimum wideband performance with minimum distortion, the probe should be used with Type 540- and 550-Series Oscilloscopes with a Type K or Type L Plug-In Unit.

To preserve the low-frequency response of the probe, use care in clamping the probe around a conductor to prevent scratching the current transformer ferrite core.

(d) Minimizing 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.

(e) High Currents

When measuring high currents, do not leave the current probe clamped around the conductor while disconnecting the probe cable from either the Termination or the Type 131 Amplifier. With the probe cable unterminated under these conditions, a high voltage is developed in the secondary winding which may damage the probe current transformer.

In addition, if the probe is used with the Type 131 Amplifier and the probe cable is disconnected for some reason, unclamp the probe from the high-current carrying conductor before connecting the probe cable connector to the Type 131 Amplifier. This precautionary measure prevents high surge currents from damaging transistors in the amplifier.

Current Probe Amplifier Operation with a Type 131

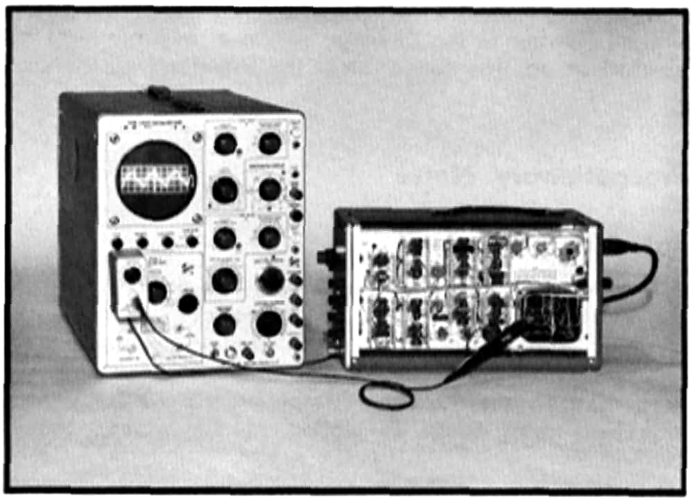


Fig. 2-2. The Type P6016 Current Probe and the Type 131 Current Probe Amplifier connected to the oscilloscope.

To use the P6016 Current Probe with the Type 131 Current Probe Amplifier, connect the Type 131 Amplifier between the probe cable and the input to the oscilloscope (see Fig. 2-2). Set the CURRENT/DIV. switch to the sensitivity you desire. Set the vertical sensitivity of the oscilloscope to 50 mv/div (or 50 mv/cm). Rotate the variable vertical sensitivity control to the detent position. Connect the Type 131 to the proper line voltage or battery.

Power is applied directly to the Type 131. Since power consumption is low and the unit has a long useful life, no power switch is provided.

NOTE

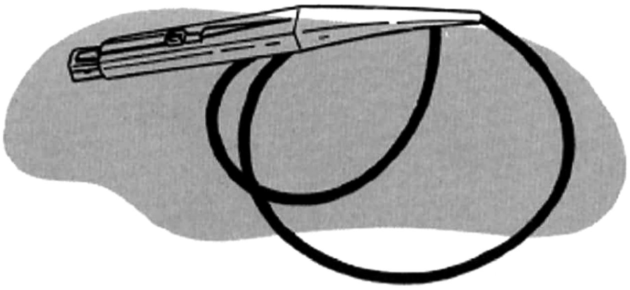
The probe shipped with the Type 131 is not necessarily the probe used in the factory calibration. Before using the Type 131 and probe, refer to the first four steps of the Calibration section. The first time the Type 131 is used on an oscilloscope, the Gain and Low-Frequency Compensation adjustments must be checked. Refer to steps 3 and 4 of the Calibration section for these adjustments.

When a current waveform is displayed on the oscilloscope, peak-to-peak measurements are made according to the following example.

If the CURRENT/DIV. switch is at the 5 mAMP. position and the peak-to-peak amplitude of the current waveform is 2.4 divisions (or centimeters), then the current is:

$$2.4 \text{ div} \times 5 \text{ mAMP./DIV.} = 12 \text{ ma.}$$

Other measurements of the current waveform such as frequency, phase, and time are determined in the same way as for voltage waveforms.



SECTION 3

APPLICATIONS

General

Information in this section of the manual has been selected to help you use the Type P6016 Current Probe. The probe, used in conjunction with the Termination or the Type 131 Current Probe Amplifier, 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 from the conductor, slide the core closed, and hold 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. The second probe must be used in conjunction with a similar Termination or Type 131 Amplifier as the one being used for the current measurement.

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 but do not clamp it around the conductor. By setting the oscilloscope controls for common-mode rejection, the undesirable current signal induced in the first probe can be minimized by the second. Complete cancellation of the undesirable signal may be difficult to obtain due to probe characteristics and time differences between the two probes and the Terminations or Amplifiers.

Tracing Magnetic Fields

The Type P6016 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 leaving the probe clamp open. 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 probe sensitivity is set for 1 ma/div for normal single-turn measurements, the sensitivity 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 current pulses, additional turns add inductance to the primary circuit.

Balancing Currents

The Type P6016 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 a Type P6016 Current Probe, a standard Attenuator Probe, and a dual-trace oscilloscope.

1. Connect the current probe through either the Termination or the Type 131 Amplifier 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 131 or the Termination switch, for suitable displays. Obtain the current and voltage readings from the respective displays on the crt.

Voltage Amplifier

A secondary application for the Type 131 is voltage amplification. Although not primarily intended for this purpose, the unit can be converted to operate as a miniature, low-level, wide-band, voltage preamplifier. Or, another unit can be purchased and converted specifically for this use to avoid changing one unit back and forth.

To make the conversion, a few simple changes need to be made at easily accessible locations within the unit. These changes, plus a choice of suggested conversion methods, are described here. Some typical performance figures are given first, since this information applies regardless of the method used. This and other information (except for noise level) was based on the unit operating with a Type 540- or a 550-Series Oscilloscope and a Type K or L Plug-In Unit.

Passband—Approx. 5 cps to 17 mc, within 3 db.

Risetime—Approx. 18 nanoseconds.

Max. DC Input Level—±1 volt at junction of input series resistor (R401) and input to attenuator switch (SW410, wafer 1R).

Max. Output Signal Amplitude—0.5 volt, peak-to-peak.

Max. Noise Level—100 μvolts, peak-to-peak, with input grounded.

To describe the main differences between methods (see Fig. 3-1), the first method uses a 10%-tolerance resistor in the input circuit because it is available locally. When this change is made, the input impedance is 50 ohms and voltage gain of the amplifier is 100. The second method uses closer tolerance input resistors to make the gain and attenuator tolerance of the unit more accurate. The third method changes the input impedance to 125 ohms and the gain to 50. The step-by-step method of conversion is as follows:

Method 1

1. Carefully unsolder and remove inductor L401. Care should be used because the inductor lead ends are wrapped around the leads of R401.

2. Solder a 220Ω, 10%, ½w resistor (with leads cut short) between the center conductor of the input connector and a convenient ground (chassis).

3. Disconnect resistor R482 (15k) where it connects to one terminal of control R481 (LOW FREQ. ADJ.) and solder a short-lead 470k, 10%, ½w resistor in series at this location.

Method 2

1. Carefully unsolder and remove inductor L401 and resistor R401 without separating the two parts. Solder a 52.5 Ω, 1% ½ w resistor in the place of the removed parts.

2. Add a short-lead 240Ω, 5%, ½w resistor between the input center connector and ground.

3. Same as step 3, Method 1.

Method 3

1. Carefully unsolder and remove inductor L401 and resistor R401 without separating the two parts. Solder a 115 Ω, 1%, ½w resistor in the place of the removed parts.

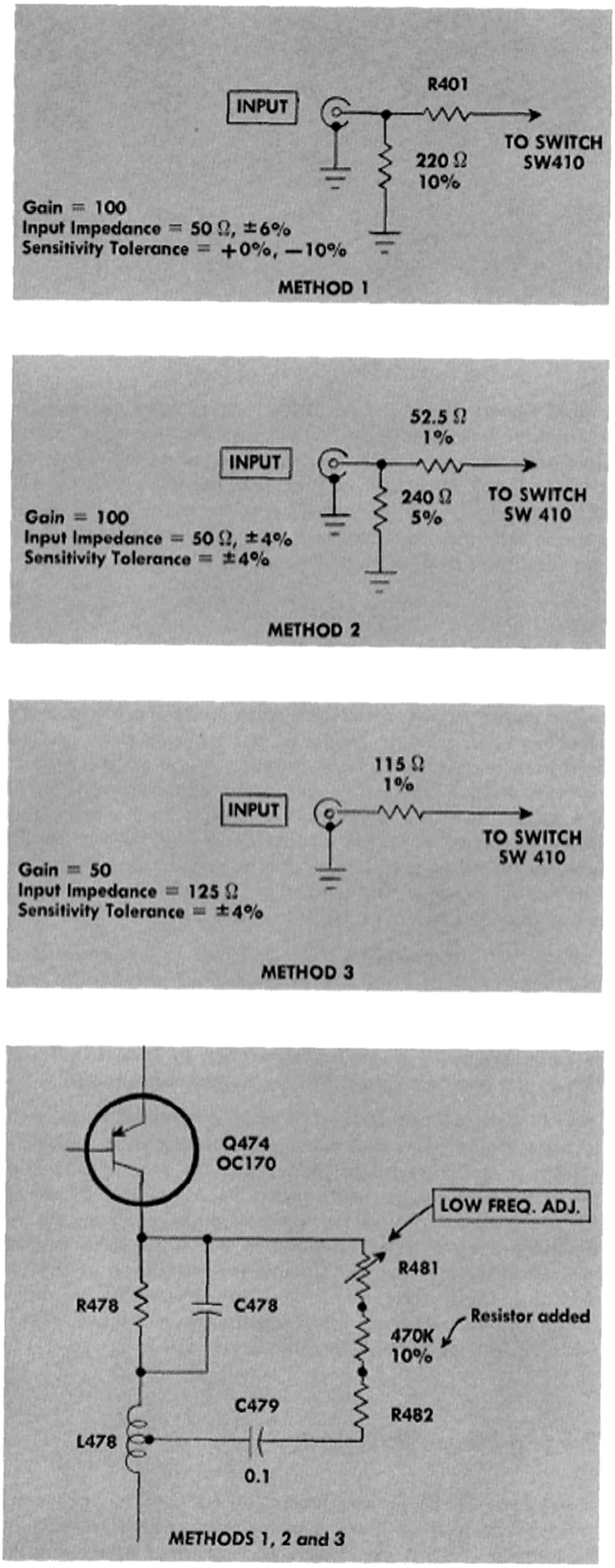
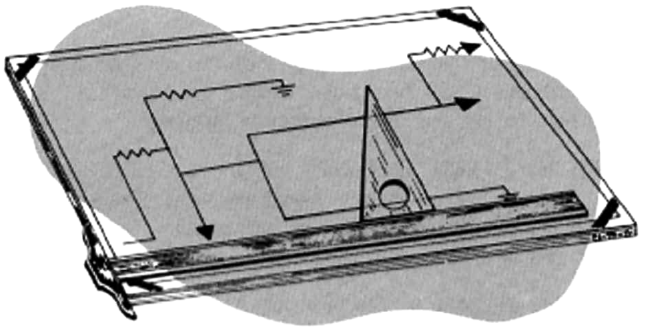


Fig. 3-1. Partial schematic diagrams of the Type 131 Amplifier showing changes to the circuitry using methods 1, 2 and 3.

2. Same as step 3, Method 1.

After completing the conversion, the high-frequency compensation should be readjusted for optimum operation if it is going to be used specifically for this purpose from now on. Refer to the Calibration procedure for information about the square-wave generator to use. The unit should then be labeled accordingly, so that it is not inadvertently used as a current amplifier with the current probe.



SECTION 4

CIRCUIT DESCRIPTION

Introduction

The circuits to be described in this section are divided into three parts: The Type P6016 Current Probe, the Termination, and the Type 131 Current Probe Amplifier. Schematic diagrams for these circuits are included in Section 7.

Type P6016 Current Probe

The Type P6016 Current Probe consists of a wide-range current transformer mounted in the nose of the case. The transformer contains a two-section, U-shape, 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 one end of the stationary core form the secondary winding.

Negligible loading of the circuit under test occurs when the probe is clamped around the conductor. Loading, which is the series impedance reflected into the primary circuit, is approximately equivalent to the circuit diagram shown in Fig. 4-1. The typical values given in the transformer shield section of the equivalent circuit apply the instant a step current waveform is present in the conductor.

The current waveform induced in the secondary winding of the current transformer is coupled through the 62.5-ohm probe cable to either the passive Termination or the Type 131 Amplifier.

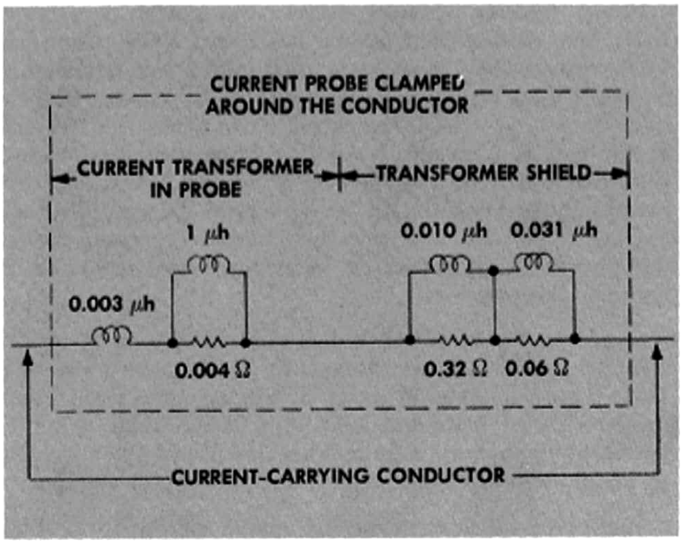


Fig. 4-1. Equivalent circuit of impedance reflected into a conductor when probe is attached.

Passive Termination

Two simplified passive Termination circuits are shown in Fig. 4-2. These schematics show the circuit configuration for both settings of the sensitivity switch. (For simplification, the circuits are shown are shown without the switch.)

At a sensitivity of 2 ma/mv, the signal from the probe is coupled virtually "straight through" to the input of the oscilloscope. When the sensitivity is 10 ma/mv, the signal is attenuated five times before being applied to the oscilloscope input.

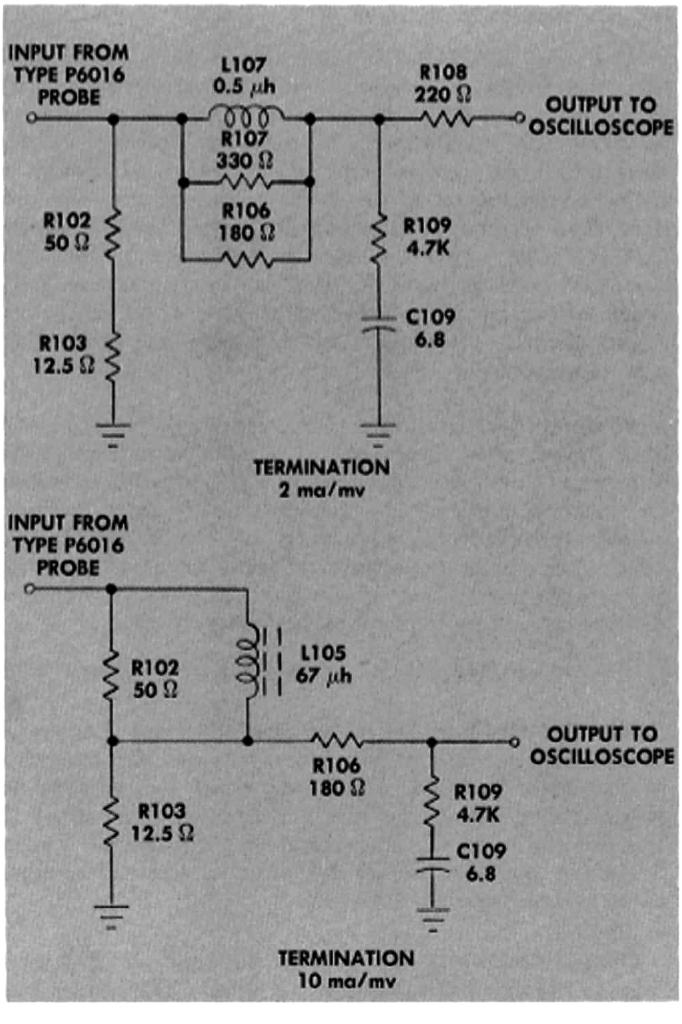


Fig. 4-2. Simplified circuits of the passive Termination unit when switch is omitted.

Resistors R102 and R103, at the INPUT connector, terminate the probe cable. Other components in the circuit provide the necessary compensation to optimize the transient response of the probe-termination combination.

Type 131 Current Probe Amplifier

The Type 131 Current Probe Amplifier consists of five circuits: the Attenuator, Input Amplifier, Second Amplifier, Output Amplifier, and Power Supply. These circuits are discussed separately in the following paragraphs.

Attenuator. When the Type P6016 Probe is connected to the Type 131 Amplifier, the current signal is coupled through a parallel LR network (L401-R401) to the CURRENT/DIV. switch (SW410). For higher frequencies, where it is important to terminate the probe cable, the impedance of the LR network is essentially the 56 ohms of resistance. This impedance, added to the 10-ohm input impedance of the amplifier, provides the proper cable termination for high-frequency signals.

For low-frequency signals, where the cable impedance is essentially zero, the impedance of the LR network is also essentially zero. This permits the probe to work into the 10-ohm input impedance of the amplifier, which extends the low-frequency response.

When the CURRENT/DIV. switch is in the 1 mAMP position, the signal is coupled, unattenuated, through C454 to the emitter of Q454. With the oscilloscope sensitivity set for 50 mv/div (calibrated), a conductor (probe primary) current of 1 ma, peak-to-peak, will produce one division of deflection on the crt. (1 ma in the probe primary will produce 8 μa in the probe secondary). For settings of the CURRENT/DIV. switch between 2 mAMP. and 1 AMP., precision attenuation networks are switched into the input circuit of the amplifier. These networks provide the correct current-dividing attenuation while maintaining a constant input impedance.

Input Amplifier. Transistor, Q454, connected in a common-base configuration, provides a low input impedance. R452, a screwdriver-adjust potentiometer (Z_{in}), provides a means for adjusting the emitter impedance to 10 ohms. In the 1 mAMP. (straight-through) position of the CURRENT/DIV. switch, the emitter impedance of Q454 becomes a portion of each attenuator. The resistance values are such, however, that the attenuator impedance is always 10 ohms.

The voltage gain of the Input Amplifier is about 50.

Second Amplifier. The signal from the Input Amplifier is coupled through half of L457, then through L456 and C457 to the base of Q464. Q464, connected in the common-emitter configuration, provides a voltage gain of about 10. The exact gain of this stage, and thus the overall gain of the entire amplifier, is set by R464, a screwdriver-adjust potentiometer labeled GAIN ADJ.

Output Amplifier. The signal at the collector of Q464 is coupled through C468 (Models 1, 2, 3) or C470 (Model 4-up) to the base of Q474, the Output Amplifier. C475 and the HF COMP. adjustment R475, located in the emitter circuit of Q474, compensate the stage for high frequencies. L478 in the collector circuit provides additional high-frequency compensation. C468 has been added to Model 4 and up instruments to reduce high frequency ringing.

C478, R478, R481 and R482, in the collector circuit of Q474, form a low-frequency boost network. The amount of low-frequency compensation is adjustable by means of R481, a screwdriver adjustment labeled LOW FREQ. ADJ.

The voltage gain of the Output Amplifier is about 1.25. This provides an exact gain of 625 for the amplifier, when the GAIN ADJ., R464, is correctly set. Thus, 8 μa at the emitter of Q454 will produce 50 mv at the OUTPUT TO OSCILLOSCOPE connector.

Power Supply (Model 1, 2, 3). The power transformer T601, two diodes D601 and D602, and capacitor C601 are enclosed in a plastic case as an integral part of the power plug. This arrangement permits the ac field to be isolated from the amplifier and reduces the size of the amplifier chassis. The remainder of the power supply is located on the etched-circuit board in the amplifier.

Power to the amplifier is furnished from a nominal 117-volt ac power source through a step-down transformer T601. The secondary winding is center-tapped so that full-wave rectification is obtained by employing two diodes. About 14 volts rms is obtained from each half of the secondary winding. Approximately 22 volts dc is obtained at the output of the two diodes.

The unfiltered dc at the output of the rectifier is coupled through a two-conductor cable to the amplifier unit. Most of the 120 cycle ripple is filtered by capacitor C610. Any fast-time constant fluctuations, coming in from the power line source, are by-passed through capacitor C601 (located in the power plug case) and C611 (in the amplifier unit).

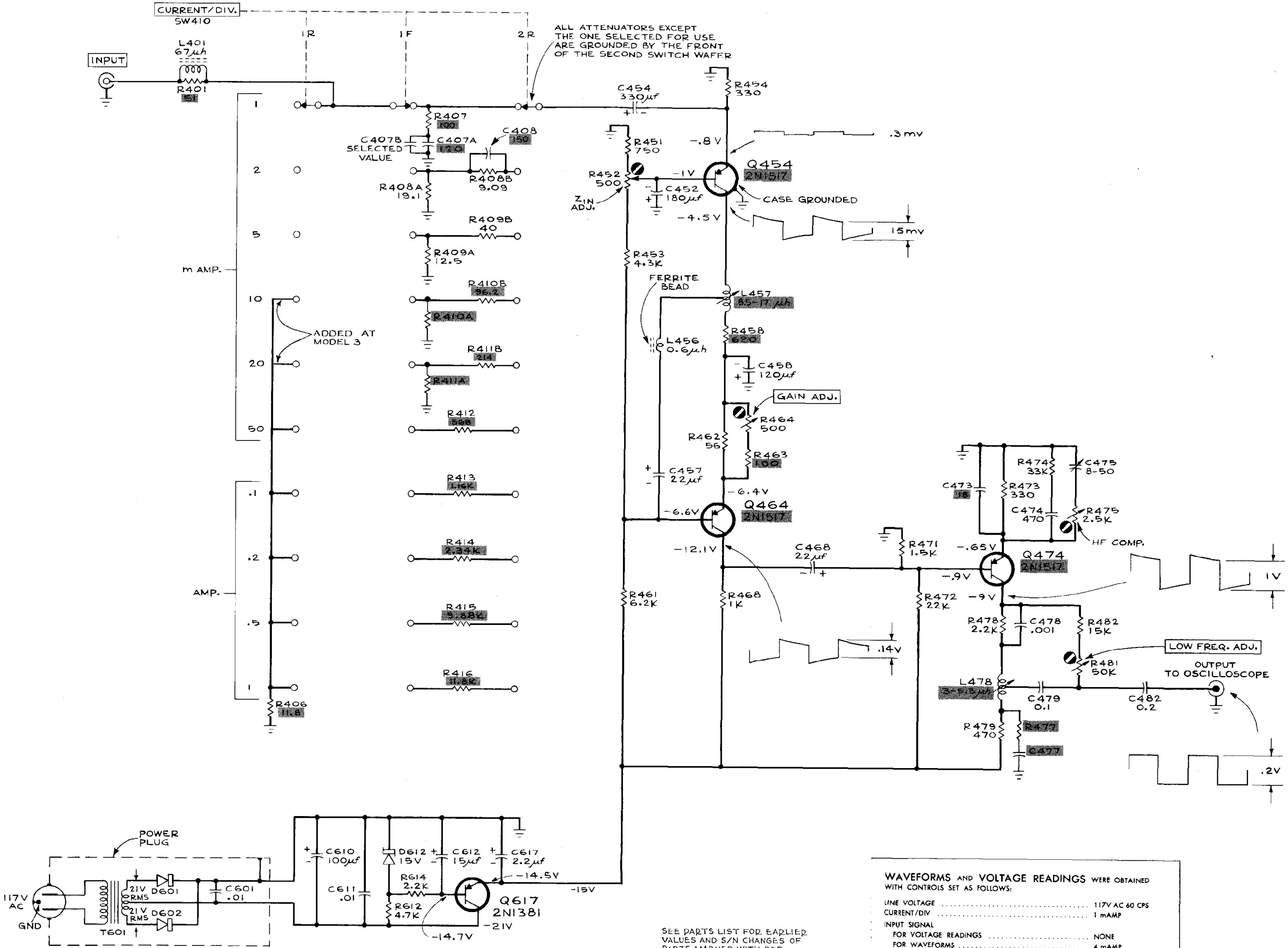
Zener diode D612 sets the dc level at the base of the series regulator, Q617. This stage maintains a steady dc supply voltage of approximately —15 volts. The collector to emitter impedance ratio of Q617 greatly decreases the ripple. Additional filtering by C612 and C617 reduces the ripple to less than 5 mv.

Power Supply (Model 4-up). The power transformer T601, four diodes D601, D602, D603 and D604, Capacitor C601, resistor R606 and Zener diode D606 are enclosed in a plastic case as an integral part of the power plug. In addition to the above mentioned components the 234 volt transformer housing also has two voltage dropping resistors R600 and R601. The arrangement of parts in a separate case permits the ac field to be isolated from the amplifier and reduces the size of the amplifier chassis. The remainder of the power supply circuit is located on the etched-circuit board in the amplifier.

Power to the amplifier is furnished from a nominal 117 volt ac power source through a step-down transformer T601. Approximately 21 volts is applied across the series combination of R606 and D606. The Zener diode will then establish the output voltage from the transformer housing at about —20 volts and partly filter the output voltage.

The partly filtered dc at the output of the transformer housing is coupled through a two-conductor cord to the amplifier unit. D611 in the amplifier unit will again filter the partly filtered 120 cycle ripple. Any fast-time constant fluctuations, coming in from the power line source, are by-passed through capacitor C601 (located in the power plug case) and C611 (in the amplifier unit).

Zener diode D612 sets the dc level at the base of the series regulator, Q617. This stage maintains a steady dc supply voltage of approximately —15 volts. The collector to emitter impedance ratio of Q617 greatly decreases the ripple. Additional filtering by C612 and C617 reduces the ripple to less than 5 mv.



SEE PARTS LIST FOR EARLIER VALUES AND S/N CHANGES OF PARTS MARKED WITH RED TINT BLOCKS

WAVEFORMS AND **VOLTAGE READINGS** WERE OBTAINED WITH CONTROLS SET AS FOLLOWS:

LINE VOLTAGE	117V AC 60 CPS
CURRENT/DIV	1 mAMP
INPUT SIGNAL	
FOR VOLTAGE READINGS	NONE
FOR WAVEFORMS	4 mAMP 1 KC SQUARE-WAVE

NOTE:

SET CALIBRATOR OF TEKTRONIX 530-540 SERIES OR EQUIVALENT OSCILLOSCOPE TO 100 VOLTS. CONNECT A 24.5 K RESISTOR FROM CAL. OUT CONNECTED TO GROUND. CLAMP CURRENT PROBE AROUND RESISTOR LEAD. CURRENT FLOW IS 4 mA.

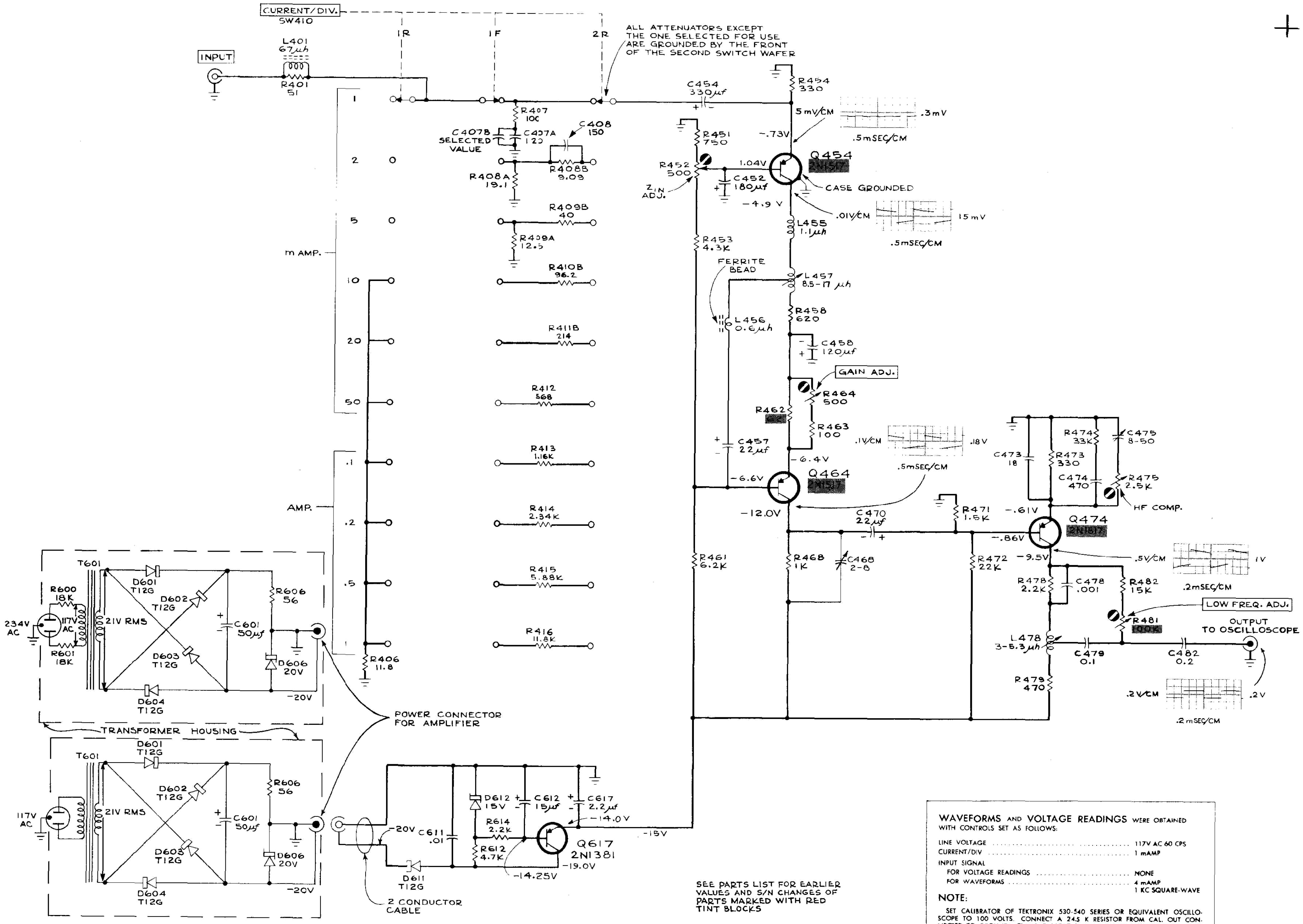
131 2631 CURRENT PROBE

TYPE 131

D2

CURRENT PROBE AMPLIFIER

MODELS 1, 2 & 3



SEE PARTS LIST FOR EARLIER VALUES AND S/N CHANGES OF PARTS MARKED WITH RED TINT BLOCKS

WAVEFORMS AND **VOLTAGE READINGS** WERE OBTAINED WITH CONTROLS SET AS FOLLOWS:

LINE VOLTAGE .... 117V AC 60 CPS
CURRENT/DIV .... 1 mAMP
INPUT SIGNAL
FOR VOLTAGE READINGS .... NONE
FOR WAVEFORMS .... 4 mAMP
1 KC SQUARE-WAVE

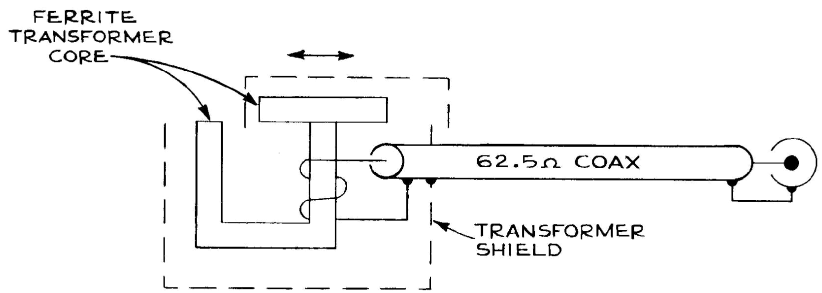
NOTE:

SET CALIBRATOR OF TEKTRONIX 530-540 SERIES OR EQUIVALENT OSCILLOSCOPE TO 100 VOLTS. CONNECT A 24.5 K RESISTOR FROM CAL. OUT CONNECTED TO GROUND. CLAMP CURRENT PROBE AROUND RESISTOR LEAD. CURRENT FLOW IS 4 mA.

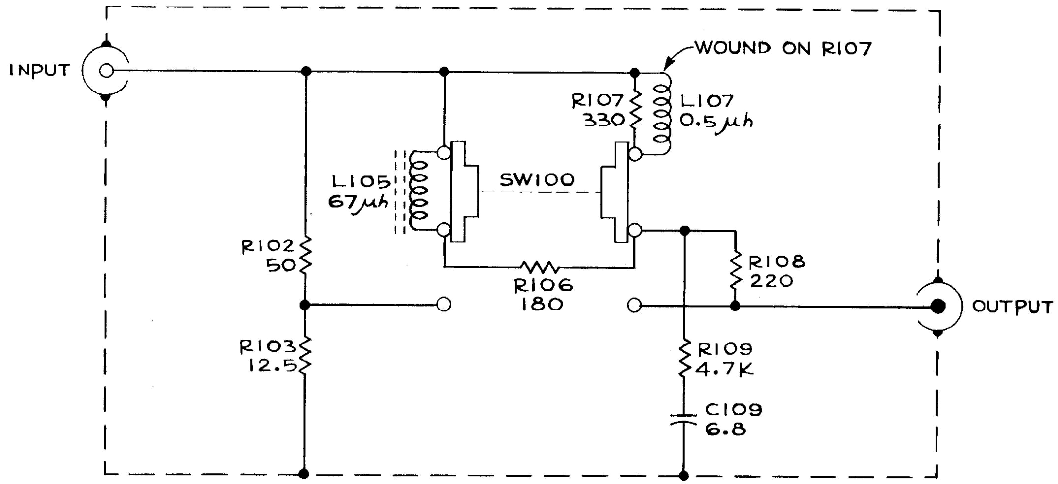
TYPE 131

F2

CURRENT PROBE AMPLIFIER
MODEL 4



CURRENT PROBE - P6016



PASSIVE TERMINATION

7-6-60
TR