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P6022

CURRENT PROBE AND TERMINATION

INSTRUCTION MANUAL

Tektronix, Inc.
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Product Group 60

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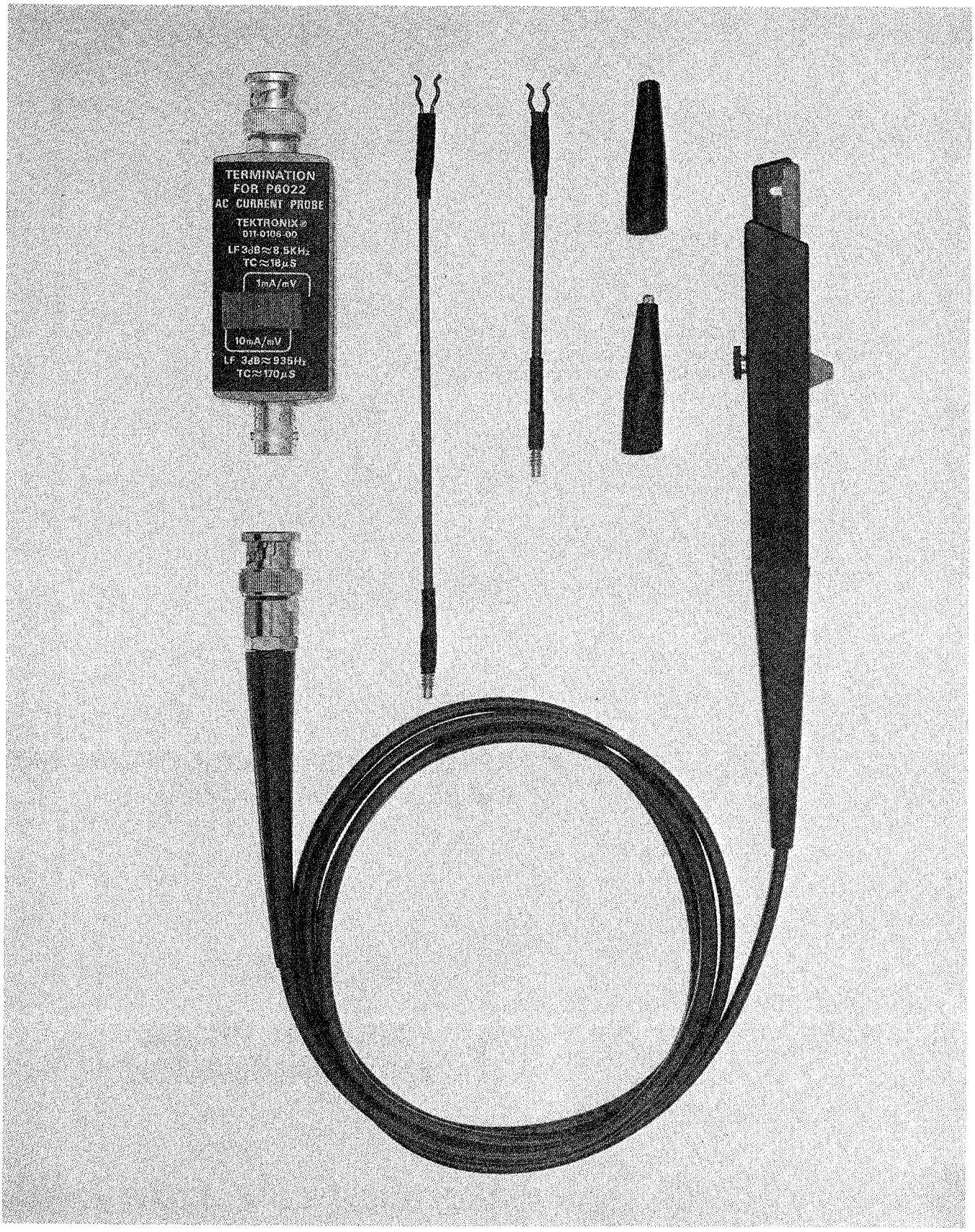


Fig. 1-1. P6022 Current Probe and Termination.

SECTION 1
SPECIFICATION

Introduction

The Tektronix P6022 5 foot and 9 foot Current Probes are designed to measure alternating current waveforms. These probes, used with current devices such as the Type 134 Current Probe Amplifier, 7A14 Current Probe Amplifier plug-in, or the P6022 Passive Termination permit a current waveform to be viewed and measured on the oscilloscope. This instruction manual deals primarily with the P6022 Current Probe as used with the Termination. For information concerning use with the current probe amplifiers, refer to the appropriate current probe amplifier instruction manual.

The specifications pertain to the P6022 Current Probe with Termination.

ELECTRICAL CHARACTERISTICS

Characteristic	Performance
Step Response	
Aberrations (Probe and Termination only)	
1 mA/mV	+3%, –3% or less, total of 4% or less peak to peak within 25 nanoseconds of step; +1%, –1% or less, total of 2% or less peak to peak thereafter.
10 mA/mV	+4%, –4% or less, total not to exceed 6% (5 foot probe) or 8% (9 foot probe) peak to peak within 25 nanoseconds of step; +1%, –1% or less, total not to exceed 2% peak to peak thereafter.
Risetime (Probe and Termination only)	
1 mA/mV	2.5 nanoseconds or less
10 mA/mV	2.2 nanoseconds or less
Risetime (with Type 454 test oscilloscope)	
1 mA/mV	3.5 nanoseconds or less

ELECTRICAL CHARACTERISTICS (cont)

Characteristic	Performance
10 mA/mV	2.9 nanoseconds or less
Tilt	
1 mA/mV	4% or less within one microsecond of step
10 mA/mV	4% or less within ten microseconds of step
Sensitivity	One milliampere or ten millamperes for each millivolt at oscilloscope input, selected by slide switch.
Accuracy	Within ±3%
Bandwidth (with Type 454 test oscilloscope)	
1 mA/mV	8.5 kilohertz or less to 100 megahertz or more
10 mA/mV	935 hertz or less to 120 megahertz or more
Maximum CW Current	6 amperes peak to peak sinewave between 10 kHz and 10 MHz at 1 mA/mV; between 3 kHz and 10 MHz at 10 mA/mV (see Fig. 1-2)
Maximum Pulse Current	100 amperes peak, not to exceed 9 ampere-microseconds or 2 amperes RMS. Ampere-second products in excess of 9 A-μs reduces probe output to zero due to core saturation.
Maximum Voltage	600 volts (DC + peak AC)
Maximum DC Saturation	200 milliamperes
Delay Time	≈9 nanoseconds (5 foot probe) or ≈15 nanoseconds (9 foot probe) with termination.
Insertion Impedance	0.03 Ω or less at 1 MHz, increasing to 0.2 Ω or less at 120 MHz.

ENVIRONMENTAL CHARACTERISTICS

Characteristic	Information
Temperature	
Storage	–40°C to +65°C
Operating	0°C to +50°C
Altitude	
Storage	To 50,000 feet
Operating	To 15,000 feet
Vibration	
Operating	15 minutes along each axis at 0.015". Vary the frequency from 10 to 50 to 10 c/s in 1-minute cycles. Three minutes at any resonant point or at 50 c/s.
Shock	
Nonoperating	30 g's, 1/2 sine, 11 microseconds duration, 2 shocks per axis. Total of 6 shocks.

PHYSICAL CHARACTERISTICS

Characteristic	Information
Dimensions	
Probe Body	≈0.6" H X 0.4" W X 6.0" L
Probe Cable	57.5" L (5 foot cable), or 105.5" L (9 foot cable)
Termination	≈0.9" H X 1.0" W X 3.5" L
Weight	
P6022 Probe and Cable	≈2.5 oz.
Termination	≈2.0 oz.
Finish	
Termination	Plated metal castings with gray plastic covers.

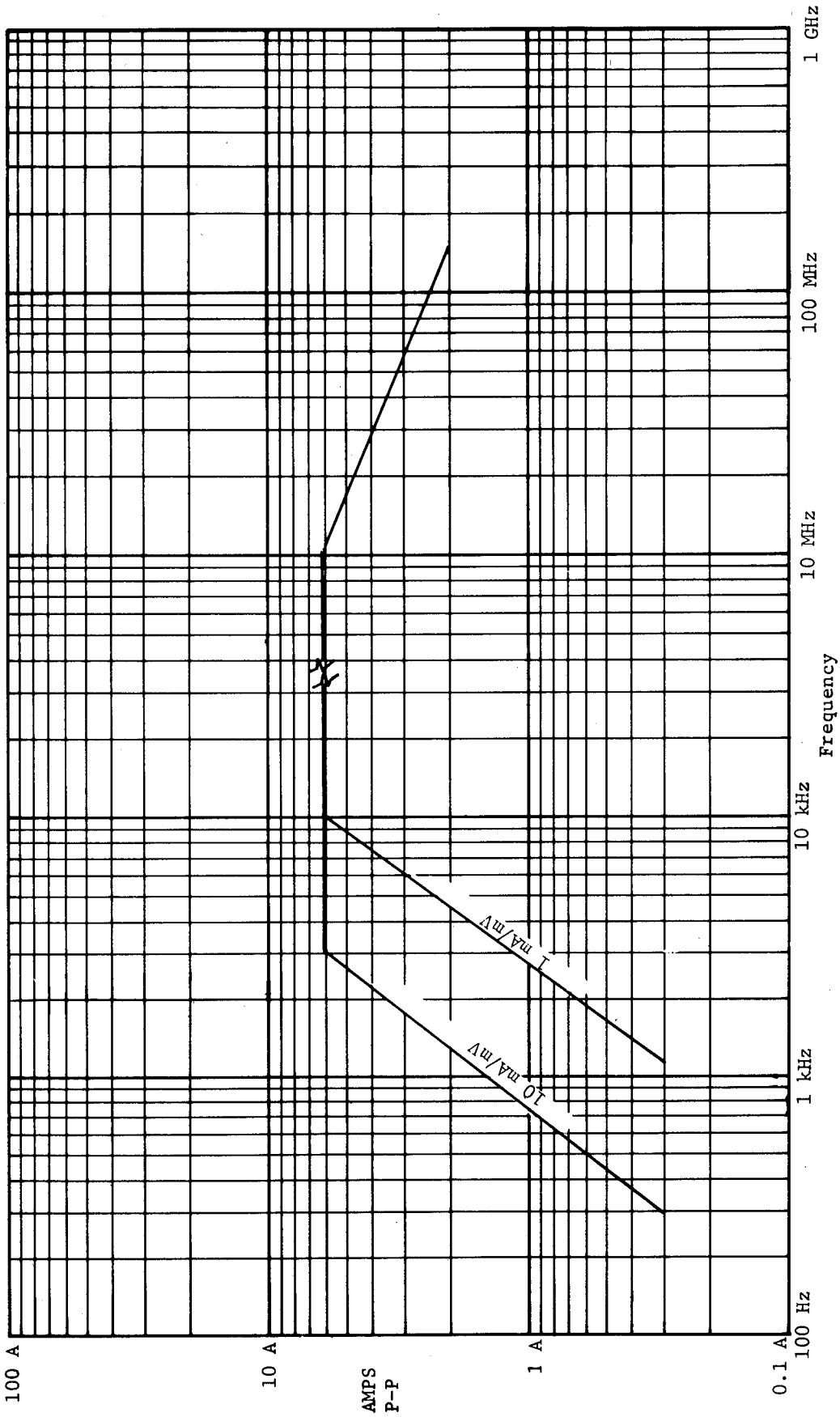


Fig. 1-2. P6022/Termination Input Current vs Frequency Derating

SECTION 2
OPERATING INSTRUCTIONS

General

The P6022 Current Probe, when used with a P6022 Termination and an oscilloscope, provides a means of measuring alternating current waveforms. To effectively use the P6022, the operation and capabilities of the probe should be known. This section gives first-time and general operating information and some basic applications for the probe.

Installation

When the P6022 Current Probe is used with the Termination, an oscilloscope having a vertical amplifier input impedance of one megohm is required. The probe and termination contain adjustments to optimize performance, matching the input characteristics of the vertical amplifier. To use the probe, first connect the P6022 Termination to the vertical input of the oscilloscope. Then connect the P6022 Current Probe to the termination (see Fig. 2-1).

Sensitivity Control

The P6022 Termination has a slide switch which changes the sensitivity of the probe and termination by a factor of ten. With the switch in the 1 mA/mV position, a current change of one milliampere in the conductor under test is seen as a change of one millivolt at the vertical input. In the 10 mA/mV position, a change of ten milliamperes produces one millivolt at the vertical input. The oscilloscope deflection factor may be set to any position, depending upon the amplitude of the signal. The overall deflection factor including the probe and termination may be found quickly by multiplying the slide switch position by the oscilloscope deflection factor. The following is an example:

Termination switch setting	10 mA/mV
Volts/div switch setting	20 mV/div

$$\frac{10\ \text{mA}}{\text{mV}} \times \frac{20\ \text{mV}}{\text{div}} = \frac{200\ \text{mA}}{\text{div}}$$

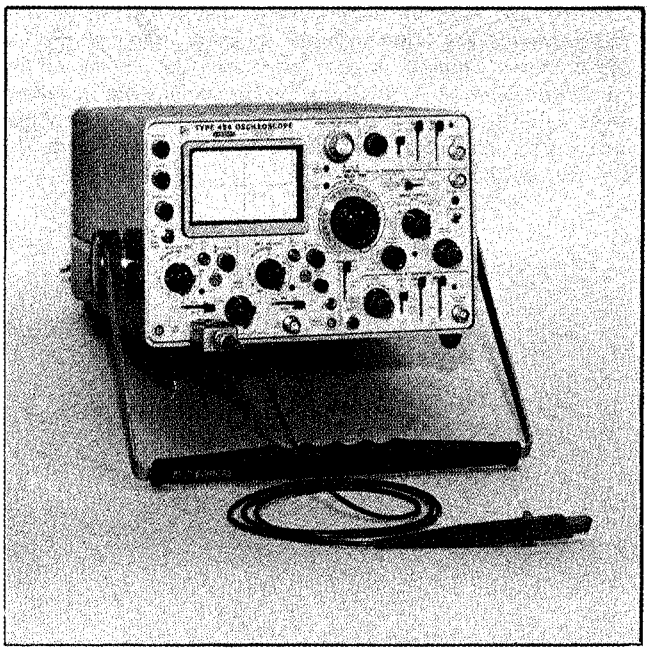


Fig. 2-1. The P6022 Current Probe and Termination connected to the oscilloscope.

Probe Slider

The thumb-controlled probe slider opens the transformer core located in the end of the probe and closes it around the conductor under test. The conductor under test becomes the primary of the transformer when the core is closed. When measurements are being made, the slider should always be pushed all the way forward, as this applies pressure to the movable portion of the transformer core, assuring complete contact to the stationary portion of the transformer core.

GENERAL OPERATING INFORMATION

Ground Clip Leads

Ground clip leads are furnished with the probe to ground the shield around the probe transformer at the probe end of the cable when desired. When observing high frequency waveforms, use the short ground clip lead to avoid ringing.

Direction of Current Flow

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

Loading Effect

To minimize loading effect of critical circuits, wherever possible clamp the probe at the low or ground end of a

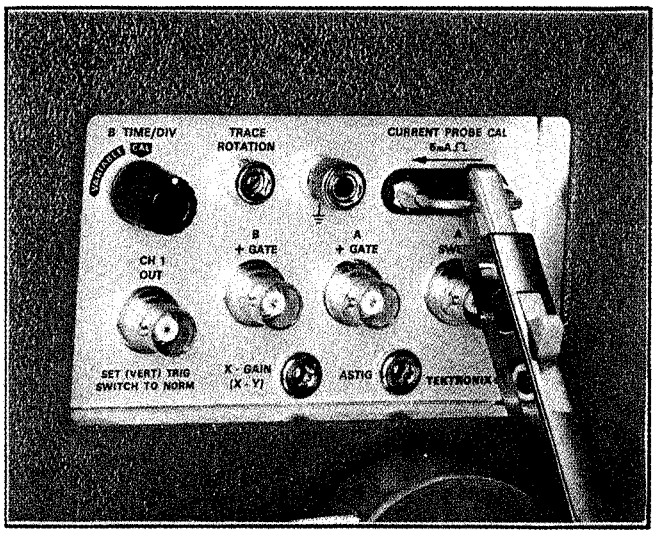


Fig. 2-2 Current flow in a conductor.

component lead. Also, less noise or spurious signal interference will be seen when the probe is connected near ground.

High Currents

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

Increasing the Sensitivity

The current sensitivity of the P6022 Current Probe and Termination can be increased by increasing the number of turns passing through the core of the probe. For example, if the conductor is looped through the probe two times, a two-turn primary winding is formed, increasing the secondary current by a factor of two. (The ratio of current in a transformer is inversely proportional to the turns ratio.) With the P6022 Termination switch set to 1 mA/mV and the oscilloscope vertical deflection factor set to 10 mV/div, the deflection factor would actually be reduced by a factor of two, to .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 number of primary turns. When observing high-frequency current waveforms or fast-rise pulses, the inductance added to the primary circuit by the additional turns may be significant.

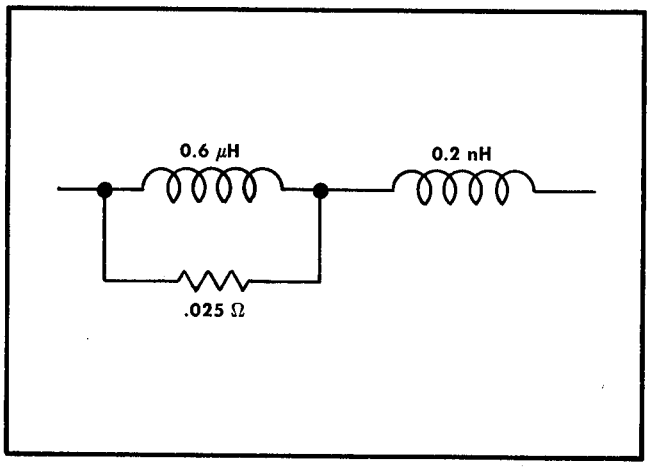


Fig. 2-3. Insertion Impedance of the P6022 Current Probe.

Insertion Impedance

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 a conductor. When observing fast-rise signals, this should be taken into consideration. Fig. 2-3 illustrates the approximate insertion impedance of the P6022 Current Probe.

Probe Shielding

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

If current measurements must be made in the presence of a strong external field, the external field interference may be minimized by the use of two current probes and a differential-input oscilloscope. Both current probes must be connected to the oscilloscope inputs in the same manner, using P6022 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 slider 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 and termination differences.

SECTION 3
CIRCUIT DESCRIPTION

Introduction

This section of the manual contains descriptions of the circuitry in the P6022 Current Probe and Termination. Complete circuit schematics are given in the Diagrams section. Refer to these diagrams throughout the following circuit description.

Current Probe

The P6022 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. The conductor under test forms a one-turn primary winding for the transformer; the windings around the stationary portion of the core form the secondary windings. Paralleled windings in the secondary assure a fast step 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.

As indicated on the probe body, the turns ratio of the P6022 Current Probe is 50:1. This refers to the number of windings in the secondary of the probe transformer. The two turns ratios manufactured by Tektronix, Inc. are 50:1 and 125:1. Due to the comparatively low inductance in the secondary of the 50:1 probe, this probe operates at a higher frequency range than the 125:1 probe.

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

Termination

The P6022 Termination consists of a 62.5-ohm impedance matching network to terminate the coaxial cable, and a voltage divider which is switched in by a slide switch, changing the sensitivity by a factor of ten. With the slide switch in the 1 mA/mV position, a ten milliampere current signal in the conductor under test induces a ten millivolt signal at the output of the termination when the termination is connected to a one-megohm input oscilloscope. In the 10 mA/mV position, the signal is attenuated to produce a one millivolt signal at the output.

SECTION 4
MAINTENANCE

Introduction

The information in this section will be helpful in removing and replacing parts in the P6022 Current Probe and Termination. When parts are replaced in either the probe or termination, it will be necessary to check the performance to determine if recalibration is needed. Refer to Section 5 of this manual for test equipment required to check the operation of the probe and termination.

Cleaning the Current Probe

The current probe should be taken apart and cleaned periodically, depending upon 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 light coating of 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. Dirty or worn mating surfaces between the transformer and the lid will degrade the low-frequency response. Clean these surfaces if necessary.

NOTE

Do not use any organic solvents to clean the probe.

Probe Disassembly

1. Hold the probe in a horizontal position with the slider up.

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

3. Carefully lift the upper half of the probe body slightly at the cable end and remove from the assembly.

4. Remove the small metal ball from the detent in the slider.

5. Remove the slider spring and spring holder from the slider.

6. Remove the slider and the top of the transformer. Note the position of the movable portion of the transformer in the slider.

7. If further disassembly is required, the connection between the circuit board and the ground strap connector must be unsoldered. After this is done, lift the transformer, circuit board, and cable out of the probe body as a unit. The P6022 Current Probe is shown disassembled in the Mechanical Parts List section of this manual.

8. Reassemble the probe, reversing the above procedure.

Repairing the Current Probe

To make repairs inside the probe body, take the probe apart as described previously. Observe positioning and length of soldered leads for re-assembly. To remove the current transformer, unsolder the leads from the circuit board. 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 shipped.

Repairing the Termination

Replacement of Connectors

1. Remove the plastic snap-on cover from the front of the termination. This can be done either with the fingers or by inserting a small screwdriver between the cover and the termination, near the part number, and turning slightly.

2. Using a heat sink, unsolder the lead(s) from the defective connector.

3. Unscrew the defective connnector and remove.

4. Replace the connector by reversing the above procedure. When replacing the front cover, align the switch with the slider in the front cover.

Removal of Circuit Board

1. Remove the plastic snap-on covers from the front and back of the termination.

2. Using a heat sink, unsolder the leads from the connectors.

3. Remove the two screws from the back of the circuit board.

4. Remove the circuit board from the termination.

CAUTION

If making repairs to the circuit board, do not apply excessive heat, as the bond between the circuit board and the conductive material may be damaged.

5. Replace the circuit board by reversing the above procedure. When replacing the front cover, align the switch with the slider in the front cover.

SECTION 5
PERFORMANCE CHECK/RECALIBRATION

Introduction

This section provides procedures to be used in checking performance or in calibrating the P6022 Current Probe and Termination. Limits and tolerances in this section are given as calibration guides and are not necessarily instrument specifications.

To ensure measurement assuracy, check the performance of the probe and termination whenever changing from one test oscilloscope to another, especially when changing input capacitance, and recalibrate if necessary. Check the calibration of the probe and termination every 1000 hours of operation, or every six months if used infrequently. Before calibration, thoroughly clean and inspect the probe as outlined in the Maintenance section. Dirty or worn mating surfaces between the transformer and the lid will degrade the low-frequency response. Clean these surfaces if necessary.

The features provided by this section are:

Index. The Short-Form Procedure lists the step numbers and titles of the complete Performance Check/Calibration Procedure.

Calibration Record. The Short-Form Procedure can be reproduced and used as a pemanent record of instrument calibration. Spaces are provided to record performance data for this instrument or to check off steps as they are completed.

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

Performance Check. The Calibration Procedure can be used as a performance checkout procedure by completing all portions except the ADJUST—part of a step. This checks the probe and termination to the original performance standards without removing the termination cover or making internal adjustments.

Complete Calibration. Completion of each step in the Calibration Procedure checks the probe and termination to the original performance standards and gives the procedure to set each adjustment to its optimum setting. Where possible, instrument performance is checked before an adjustment is made. For best overall instrument performance make each adjustment to the exact setting even if the CHECK—is with the allowable tolerance.

EQUIPMENT REQUIRED

General

The following items are required for calibration of the P6022 Current Probe and Termination. Specifications given are the minimum necessary for accurate calibration. All test equipment is assumed to be correctly calibrated and operating withinn the given specifications. If equipment is substituted, it must meet or exceed the specifications of the recommended equipment.

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

Test Equipment

1. Test oscilloscope. Bandwidth, DC to 150 megahertz; deflection factor, 5 mV/div to 20 mV/div. Tektronix Type 454 recommended.

2. Pulse generator. Risetime, 0.25 nanosecond, amplitude, 0 to 50 volts into 50 ohms. Tektronix Type 109 recommended.

3. Low-frequency constant amplitude signal generator. Frequency, 500 hertz to 50 kilohertz; output amplitude, variable from less than 3.5 volts to above 4 volts into 50 ohms; amplitude regulation accuracy, constant within 3% of reference at 50 kilohertz as output frequency changes. For example, General Radio 1310-A Oscillator.

4. Transmission line. Risetime, 0.1 nanosecond; delay, 60 nanoseconds. Tektronix Type 113 Delay Cable recommended.

Accessories

5. Cable (two). Impedance, 50 ohms; electrical length, 5 nanoseconds; connectors, GR. Tektronix Part No. 017-0502-00.

6. Attenuator (two). Impedance, 50 ohms; attenuation, 10×; connectors, GR. Tektronix Part No. 017-0078-00.

7. Attenuator. Impedance, 50 ohms; attenuation, 5×; connectors, GR. Tektronix Part No. 017-0079-00.

8. Termination. Impedance, 50 ohms; description, end-line; connector, GR. Tektronix Part No. 017-0081-00.

9. Termination. Impedance, 50 ohms; description, GR to BNC male. Tektronix Part No. 017-0083-00.

10. Adapter. Description, GR to BNC male. Tektronix Part No. 017-0064-00.

11. Adapter. Description, Dual banana plug to BNC female. Tektronix Part No. 103-0090-00.

12. Calibration Fixture. Description, 50 ohm terminating current loop; connector, GR. Tektronix Part No. 067-0559-00.

13. Viewing hood. Purpose, for viewing low-intensity displays on Type 454 test oscilloscope. Tektronix Part No. 016-0083-00.

14. Adjustment tool. Description, non-conducting screwdriver. Tektronix Part Nos. 003-0307-00 (handle), and 003-0334-00 (insert).

SHORT-FORM PROCEDURE

Type P6022 Probe and Termination, Date Code _____

Calibration date _____

Calibrated by _____

☐ 1. Check/Adjust Aberrations (C28, C29, R10)
REQUIREMENT: 1 mA/mV aberrations within +3%, −3%, total of 4%; 10 mA/mV aberrations within +4%, −4%, total not to exceed 6% (5 foot probe), or 8% (9 foot probe).
PERFORMANCE: Correct _____; incorrect (list exceptions) _____

☐ 2. Check Risetime
REQUIREMENT: 10 mA/mV risetime of ≤2.9 nanoseconds; 1 mA/mV risetime of ≤3.5 nanoseconds.
PERFORMANCE: Correct _____; incorrect (list exceptions) _____

☐ 3. Check Sensitivity
REQUIREMENT: 1 mA/mV sensitivity of 80 millivolts, ±3%, at test oscilloscope input with 4-volt pulse applied to Calibration Fixture; 10 mA/mV sensitivity of 80 millivolts, ±3%, at test oscilloscope input with 40-volt pulse applied to Calibration Fixture.
PERFORMANCE: Correct _____; incorrect (list exceptions) _____

☐ 4. Check Low Frequency Response
REQUIREMENT: 1 mA/mV low frequency response of ≤8.5 kilohertz; 10 mA/mV low frequency response of ≤935 hertz.
PERFORMANCE: Correct _____; incorrect (list exceptions) _____

PERFORMANCE CHECK/CALIBRATION PROCEDURE

General

The following procedure is arranged so that the P6022 Current Probe and Termination can be calibrated with the least interaction of adjustments and reconnection of equipment. The equipment required for the entire procedure is shown in Fig. 5-1. Following the picture is a complete list of control settings for the test equipment.

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

Preliminary Procedure for Complete Calibration

When performing calibration, remove the top cover only from the P6022 Termination. The snap-on cover may be removed either the fingers or by placing a small screwdriver between the cover and the termination, near the part number, and turning slightly. The bottom cover must remain in place whenever the termination is in use.

NOTES

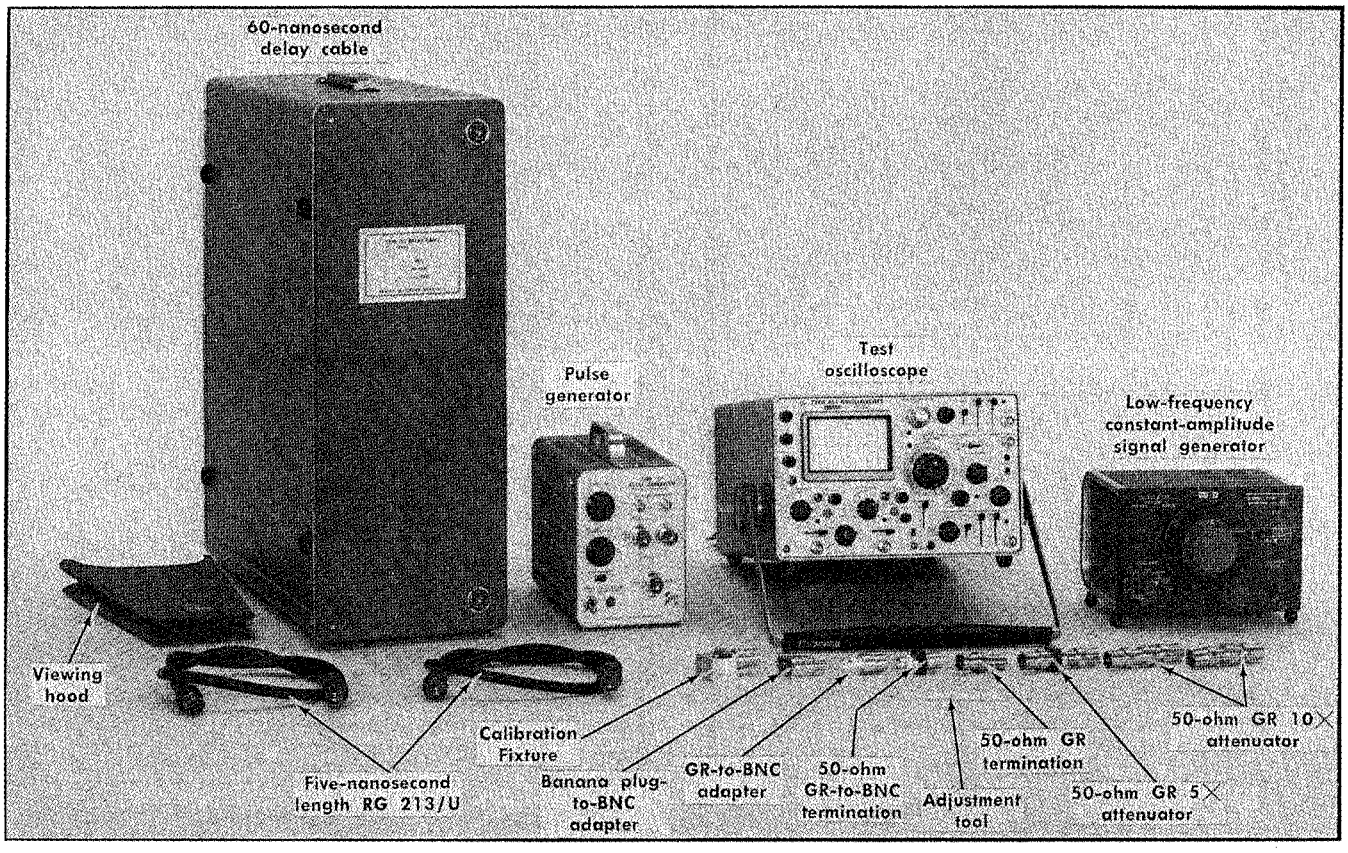


Fig. 5-1. Equipment required for calibration.

Control Settings

Test Oscilloscope

Intensity	Counterclockwise
Focus	Any position
Scale Illum	As desired
Bandwidth	Full
Ch 1 Volts/Div	20 mV
Variable Volts/Div	Cal
Mode	Ch 1
Trigger	Norm
Input Ch 1	DC
Time/Div	.05 μs
Horiz Display	A
Mag	Off
A Sweep Mode	Auto Trig
A Triggering	
Slope	+
Coupling	AC
Source	Int

Pulse Generator

Ampliude	5
Voltage Range	50
Pulse Polarity	+

1. Check/Adjust Aberrations

a. Connect a 50-ohm GR termination to one of the pulse generator charge line connectors.

b. Connect a five-nanosecond length of RG 213/U from the remaining charge line connector to one side of the 60-nanosecond delay cable.

c. Connect the Calibration Fixture to the pulse generator output connector.

d. Connect the P6022 Termination to the input of the test oscilloscope. Set the termination slide switch to the 1 mA/mV position.

e. Connect the P6022 Probe to the termination. Clamp the probe around the conductor in the Calibration Fixture and move the slider all the way forward.

f. Turn on the test equipment and adjust the triggering controls, Intensity, and pulse generator amplitude to obtain

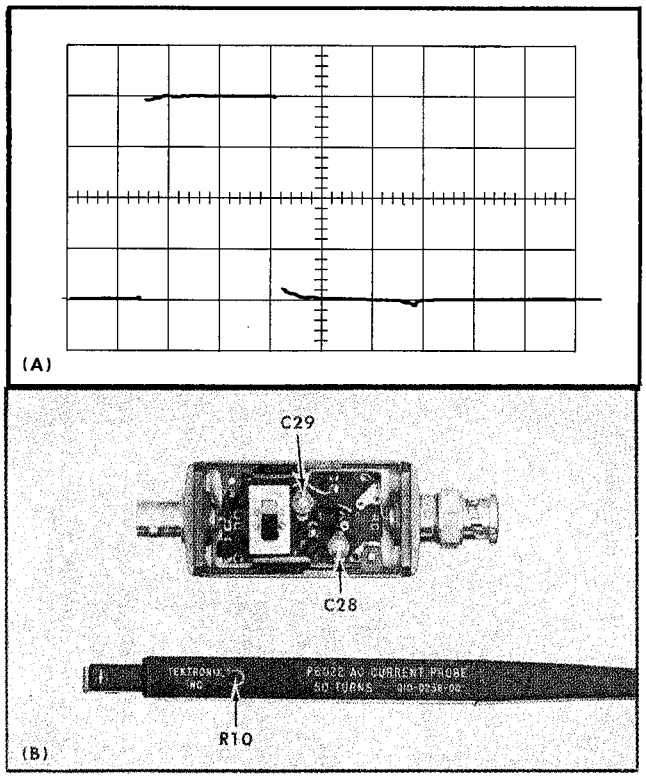


Fig. 5-2. P6022 aberrations, showing (A) four-division display of pulse generator output, and (B) location of three adjustments.

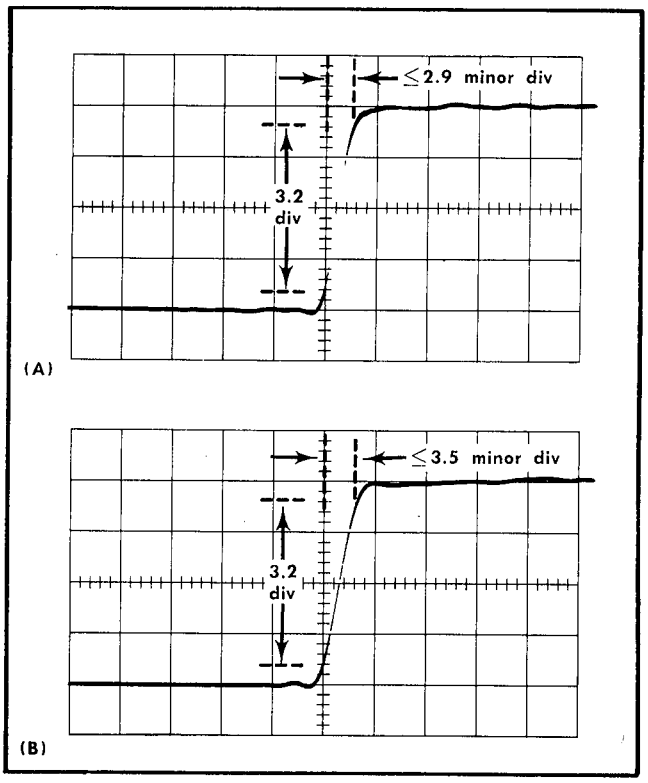


Fig. 5-3. Risetime check showing (A) 2.9 nanoseconds at 10 mA/mV, and (B) 3.5 nanoseconds at 1 mA/mV.

a four-division display. See Fig. 5-2A. (If necessary, use the viewing hood on the test oscilloscope.)

g. CHECK—First 25 nanoseconds of step for aberrations within +3%, −3%, total of 4% peak to peak; +1% −1%, total of 2% peak to peak thereafter (not including the effects of the test oscilloscope).

h. ADJUST—C28 and C29 (in the termination), then R10 (through the hole in the probe body), for aberrations within +3%, −3% total of 4% peak to peak during first 25 nanoseconds; +1%, −1%, total of 2% peak to peak thereafter (not including the effects of the test oscilloscope). See Fig. 5-2B for location of adjustments.

i. Set the termination slide switch to the 10 mA/mV position and increase the amplitude of the pulse generator output for four divisions of deflection.

j. CHECK—First 25 nanoseconds of step for aberrations within +4%, −4%, total of 6% (5 foot probe) or 8% (9 foot probe) peak to peak; +1%, −1%, total of 2% peak to peak thereafter (not including the effects of the test oscilloscope).

2. Check Risetime

a. Turn the test oscilloscope sweep magnifier to ×10 and position the leading edge of the display near the center of the CRT.

b. CHECK—CRT display for risetime of ≤2.9 nanoseconds (with Type 454 test oscilloscope operating within specification). See Fig. 5-3A.

c. Set the termination slide switch to the 1 mA/mV position, and adjust the amplitude of the pulse generator output for four divisions of deflection.

d. CHECK—CRT display for risetime of ≤3.5 nanoseconds (with Type 454 test oscilloscope operating within specification). See Fig. 5-3B.

3. Check Sensitivity

a. Remove the P6022 Probe, Termination, and Calibration Fixture from the test equipment.

b. Connect one 50-ohm GR 10× attenuator, one 50-ohm GR 5× attenuator, and a five-nanosecond length of RG 213/U cable to the output of the pulse generator.

c. Connect the other end of the cable through a 50-ohm GR to BNC termination to the input of the test oscilloscope.

d. Turn the sweep magnifier off and adjust the amplitude of the pulse generator output for four divisions of deflection. See Fig. 5-4A.

e. Remove the attenuators, cable, and termination and replace with the P6022 Probe, Termination, and Calibration Fixture.

f. CHECK—CRT display for four divisions of deflection, ±3% (not including GR attenuator error). See Fig. 5-4B.

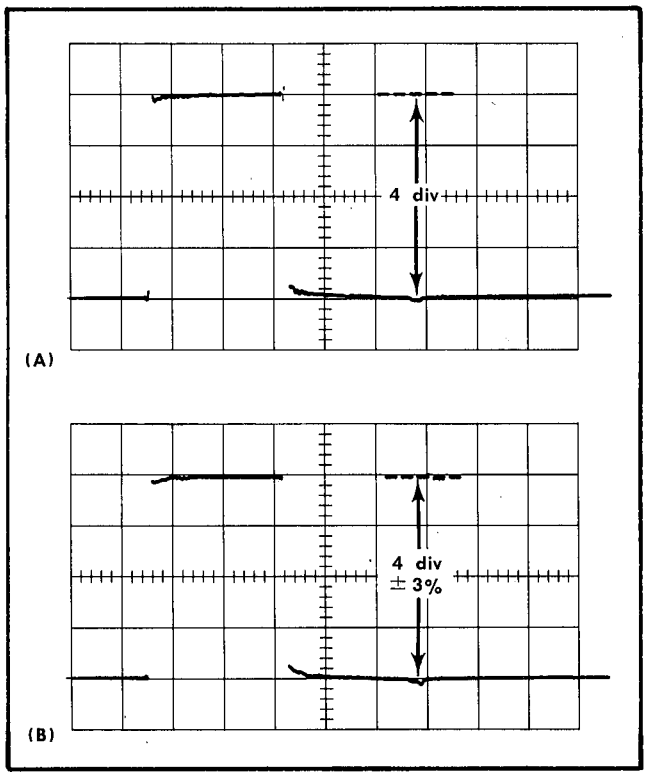


Fig. 5-4. Sensitivity check showing (A) four-division deflection from voltage source and (B) current probe and termination deflection of four divisions, ±3%.

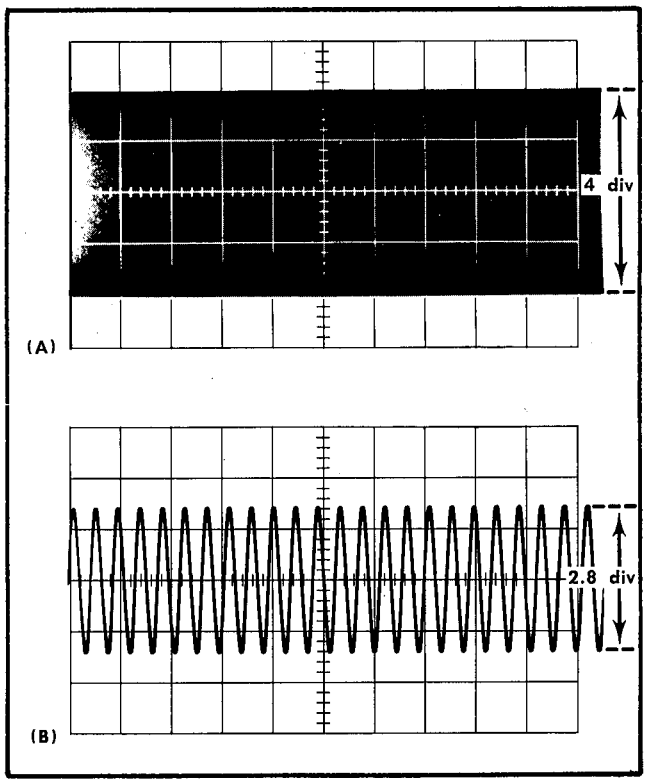


Fig. 5-5. Low-frequency response check, 1 mA/mV, showing (A) four-division, 50 kHz display, and (B) 2.8 division display.

g. Remove the P6022 Probe, Termination, and Calibration Fixture from the test oscilloscope.

h. Connect two 50-ohm GR 10× attenuators, one 50-ohm GR 5× attenuator, and a five-nanosecond length of RG 213/U cable to the output of the pulse generator.

i. Connect the other end of the cable through a 50-ohm GR to BNC termination to the input of the test oscilloscope.

j. Adjust the amplitude of the pulse generator output for four divisions of deflection. See Fig. 5-4A.

k. Remove the attenuators, cable, and termination and replace with the P6022 Probe, Termination, and Calibration Fixture. Set the termination slide switch to the 10 mA/mV position.

l. CHECK—CRT display for four divisions of deflection, ±3% (not including GR attenuator error). See Fig. 5-4B.

4. Check Low Frequency Response

a. Connect the banana plug to BNC adapter, the BNC to GR adapter, and the Calibration Fixture to the output of the low-frequency signal generator. Connect the P6022 Probe to the Calibration Fixture.

NOTES

b. Set the test oscilloscope Time/Div switch to .5 mS and the termination slide switch to the 1 mA/mV position.

c. Set the signal generator frequency to 50 kHz and adjust the output level for four divisions of vertical deflection. See Fig. 5-5A.

d. Lower the frequency of the signal generator until the amplitude of the display reduces to 2.8 divisions. See Fig. 5-5B.

e. CHECK—Signal generator frequency setting of $\leq$8.5 kHz.

f. Set the test oscilloscope Time/Div switch to 2 mS, Volts/Div to 5 mV, and the termination slide switch to the 10 mA/mV position.

g. Set the signal generator frequency to 50 kHz and adjust the output level for 1.4 divisions of vertical deflection. See Fig. 5-6A.

h. Lower the frequency of the signal generator until the amplitude of the display reduces to one division. See Fig. 5-6B.

i. CHECK—Signal generator frequency setting of $\leq$935 Hz.

j. Disconnect all test equipment and replace the termination cover.

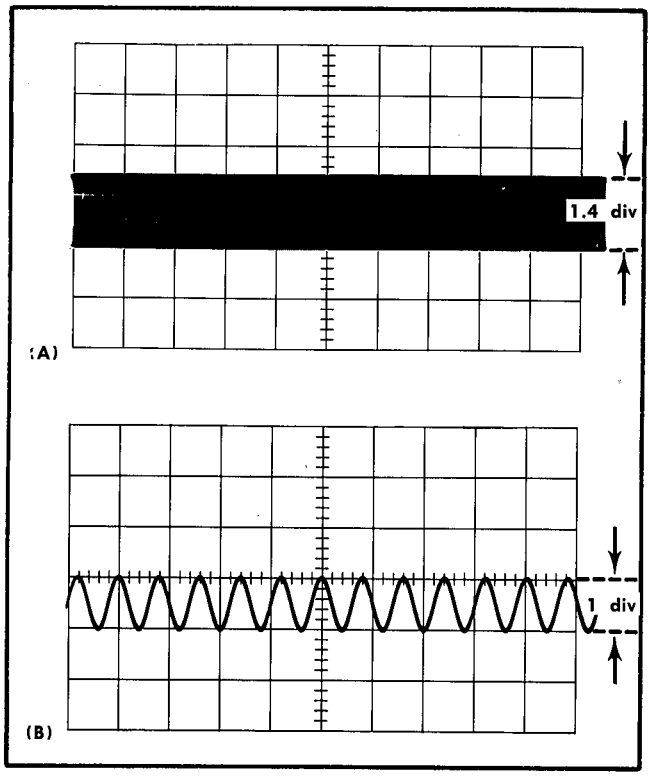
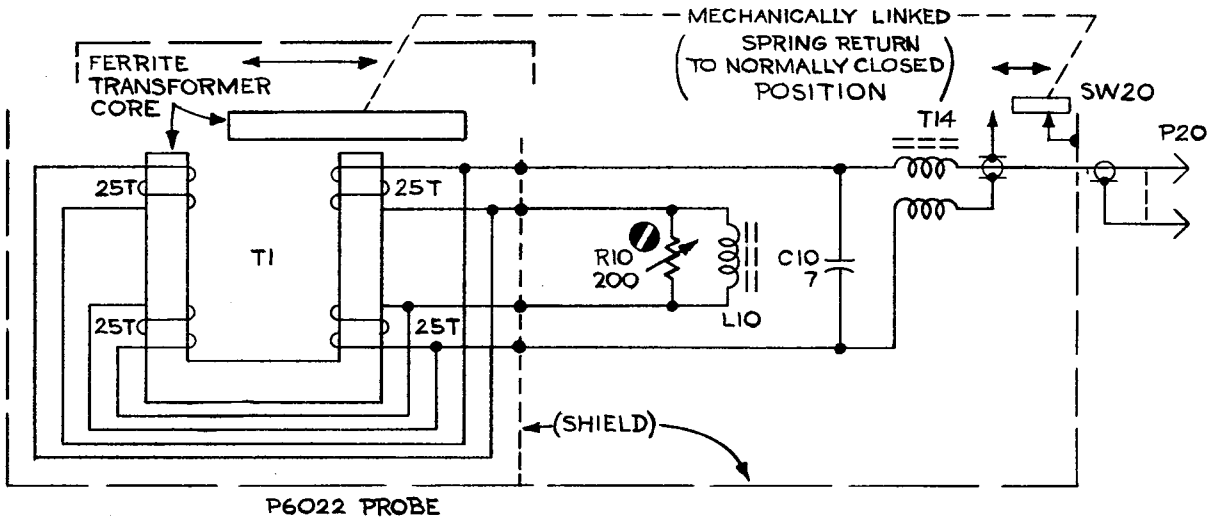
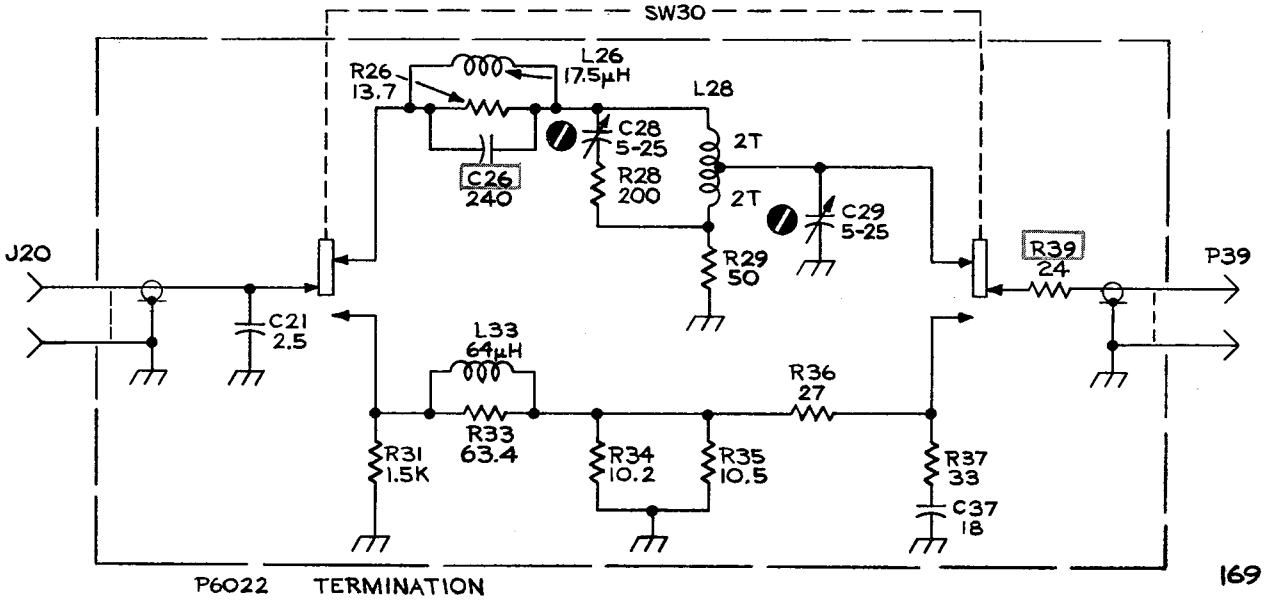


Fig. 5-6. Low-frequency response check, 10 mA/mV, showing (A) 1.4 division, 50 kHz display, and (B) one-division display.



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



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TYPE P6022 CURRENT PROBE & TERMINATION

REPLACEABLE ELECTRICAL PARTS

PARTS ORDERING INFORMATION

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

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

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

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

LIST OF ASSEMBLIES

A list of assemblies can be found at the beginning of the Electrical Parts List. The assemblies are listed in numerical order. When the complete component number of a part is known, this list will identify the assembly in which the part is located.

CROSS INDEX-MFR. CODE NUMBER TO MANUFACTURER

The Mfr. Code Number to Manufacturer index for the Electrical Parts List is located immediately after this page. The Cross Index provides codes, names and addresses of manufacturers of components listed in the Electrical Parts List.

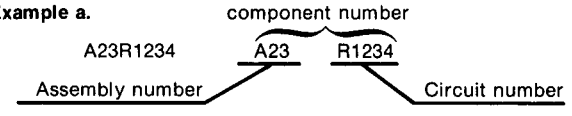
ABBREVIATIONS

Abbreviations conform to American National Standard Y1.1.

COMPONENT NUMBER (column one of the Electrical Parts List)

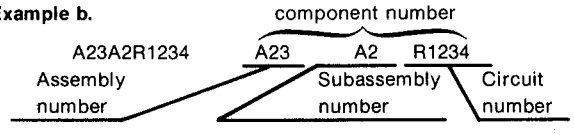
A numbering method has been used to identify assemblies, subassemblies and parts. Examples of this numbering method and typical expansions are illustrated by the following:

Example a.



Read: Resistor 1234 of Assembly 23

Example b.



Read: Resistor 1234 of Subassembly 2 of Assembly 23

Only the circuit number will appear on the diagrams and circuit board illustrations. Each diagram and circuit board illustration is clearly marked with the assembly number. Assembly numbers are also marked on the mechanical exploded views located in the Mechanical Parts List. The component number is obtained by adding the assembly number prefix to the circuit number.

The Electrical Parts List is divided and arranged by assemblies in numerical sequence (e.g., assembly A1 with its subassemblies and parts, precedes assembly A2 with its subassemblies and parts).

Chassis-mounted parts have no assembly number prefix and are located at the end of the Electrical Parts List.

TEKTRONIX PART NO. (column two of the Electrical Parts List)

Indicates part number to be used when ordering replacement part from Tektronix.

SERIAL/MODEL NO. (columns three and four of the Electrical Parts List)

Column three (3) indicates the serial number at which the part was first used. Column four (4) indicates the serial number at which the part was removed. No serial number entered indicates part is good for all serial numbers.

NAME & DESCRIPTION (column five of the Electrical Parts List)

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

MFR. CODE (column six of the Electrical Parts List)

Indicates the code number of the actual manufacturer of the part. (Code to name and address cross reference can be found immediately after this page.)

MFR. PART NUMBER (column seven of the Electrical Parts List)

Indicates actual manufacturers part number.

CROSS INDEX - MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
01121	ALLEN-BRADLEY CO	1201 S 2ND ST	MILWAUKEE WI 53204-2410
04222	AVX CERAMICS DIV OF AVX CORP	19TH AVE SOUTH P O BOX 867	MYRTLE BEACH SC 29577
19701	MEPCO/CENTRALAB A NORTH AMERICAN PHILIPS CO MINERAL WELLS AIRPORT	PO BOX 760	MINERAL WELLS TX 76067-0760
32997	BOURNS INC TRIMPOT DIV	1200 COLUMBIA AVE	RIVERSIDE CA 92507-2114
52763	STETCO INC	3344 SCHIERHORN	FRANKLIN PARK IL 60131
57668	ROHM CORP	8 WHATNEY PO BOX 19515	IRVINE CA 92713
59660	TUSONIX INC	7741 N BUSINESS PARK DR PO BOX 37144	TUCSON AZ 85740-7144
72982	ERIE SPECIALTY PRODUCTS INC	645 W 11TH ST	ERIE PA 16512
79727	C-W INDUSTRIES	130 JAMES WAY	SOUTHAMPTON PA 18966-3818
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97077-0001
91637	DALE ELECTRONICS INC	2064 12TH AVE PO BOX 609	COLUMBUS NE 68601-3632

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A1	----- -----			PROBE,CURRENT:P6022,W/ACCESSORIES		
A1A1	670-1112-00			CIRCUIT BD ASSY:PROBE	80009	670-1112-00
A1A1C10	283-0157-00			CAP,FXD,CER DI:7PF,5%,50V	04222	SR155A7R0DAA
A1A1L10	120-0285-00			XFMR,TOROID:	80009	120-0285-00
A1A1R10	311-0605-00			RES,VAR,NONWW:TRMR,200 OHM,0.5W	32997	3329H-G48-201
A1A1T1	120-0603-00			TRANSFORMER,CUR:	80009	120-0603-00
A1A1T14	120-0286-00			XFMR,TOROID:	80009	120-0286-00
A2	011-0106-00			TERMN,COAXIAL:	80009	011-0106-00
A2A1	670-1053-00		8917	CIRCUIT BD ASSY:TERMINATION	80009	670-1053-00
A2A1C21	283-0066-00			CAP,FXD,CER DI:2.5PF,+/-0.5PF,200V	72982	8101-047C0J259D
A2A1C26	283-0047-00		7926	CAP,FXD,CER DI:270PF,5%,500V	59660	0831604Z5F0271J
A2A1C26	281-0638-00	7927	8835	CAP,FXD,CER DI:240PF,5%,500V	52763	2RDPLZ007 240PM0
A2A1C26	281-0629-00	8836		CAP,FXD,CER DI:33PF,5%,600V	52763	2RDPLZ007 33P0JC
A2A1C28	281-0123-00			CAP,VAR,CER DI:5-25PF,100V	59660	518-000A5-25
A2A1C29	281-0123-00			CAP,VAR,CER DI:5-25PF,100V	59660	518-000A5-25
A2A1C37	283-0159-00		8835	CAP,FXD,CER DI:18PF,5%,50V	04222	SR155A180JAA
A2A1C37	283-0186-00	8836		CAP,FXD,CER DI:27PF,5%,50V	04222	SR155A 270JAA
A2A1L26	108-0409-01			COIL,RF:FIXED,17.5UH	80009	108-0409-01
A2A1L28	108-0523-00			XFMR,TOROID:FIXED,160NH	80009	108-0523-00
A2A1L33	108-0395-00			COIL,RF:FIXED,64UH	80009	108-0395-00
A2A1R26	321-0014-00			RES,FXD,FILM:13.7 OHM,1%,0.125W,TC=T0	57668	RB14FXE 13E7
A2A1R28	317-0201-00			RES,FXD,CMPSN:200 OHM,5%,0.125W	01121	BB2015
A2A1R29	321-0751-06			RES,FXD,FILM:50 OHM,0.25%,0.125W,TC=T9	91637	CMF55116C50R00C
A2A1R31	321-0210-00			RES,FXD,FILM:1.50K OHM,1%,0.125W,TC=T0	19701	5033ED1K50F
A2A1R33	321-0078-00			RES,FXD,FILM:63.4 OHM,1%,0.125W,TC=T0	91637	CMF55116G63R40F
A2A1R34	321-0002-00			RES,FXD,FILM:10.2 OHM,1%,0.125W,TC=T0	57668	RB14FXE 10E2
A2A1R35	321-0003-00			RES,FXD,FILM:10.5 OHM,1%,0.125W	57668	RB14FXE 10E5
A2A1R36	317-0270-00			RES,FXD,CMPSN:27 OHM,5%,0.125W	01121	BB2705
A2A1R37	317-0330-00		8835	RES,FXD,CMPSN:33 OHM,5%,0.125W	01121	BB3305
A2A1R37	317-0300-00	8836		RES,FXD,CMPSN:30 OHM,5%,0.125W	01121	BB3005
A2A1R39	317-0360-00		7926	RES,FXD,CMPSN:36 OHM,5%,0.125W	01121	BB3605
A2A1R39	317-0240-00	7927		RES,FXD,CMPSN:24 OHM,5%,0.125W	01121	BB2405
A2A1SW30	260-0723-00			SWITCH,SLIDE:DPDT,0.5A,125VAC	79727	GF126-0028

REPLACEABLE MECHANICAL PARTS

PARTS ORDERING INFORMATION

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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.

ITEM NAME

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

FIGURE AND INDEX NUMBERS

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

INDENTATION SYSTEM

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

1 2 3 4 5 *Name & Description*

Assembly and/or Component
Attaching parts for Assembly and/or Component
****END ATTACHING PARTS****
Detail Part of Assembly and/or Component
Attaching parts for Detail Part
****END ATTACHING PARTS****
Parts of Detail Part
Attaching parts for Parts of Detail Part
****END ATTACHING PARTS****

Attaching Parts always appear in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation.

Attaching parts must be purchased separately, unless otherwise specified.

ABBREVIATIONS

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

CROSS INDEX - MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
02660	AMPHENOL CORP COMMERCIAL AND INDUSTRIAL OPNS	4300 COMMERCE CT	LISLE IL 60532
12327	FREEWAY CORP	9301 ALLEN DR	CLEVELAND OH 44125-4632
24931	SPECIALTY CONNECTOR CO INC	2100 EARLYWOOD DR PO BOX 547	FRANKLIN IN 46131
34736	CONTINENTAL SWISS PRECISION PRODUCTS INC		SOUTH HACKENSACK NJ
78189	ILLINOIS TOOL WORKS INC SHAKEPROOF DIV	ST CHARLES ROAD	ELGIN IL 60120
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97077-0001
93907	TEXTRON INC CAMCAR DIV	600 18TH AVE	ROCKFORD IL 61108-5181

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
1-	----- -----			1	PROBE,CURRENT:P6022,W/TERMINATION		
-1	----- -----			1	.PROBE,CURRENT:P6022,W/ACCESSORIES		
-2	344-0046-00			2	..CLIP,ELECTRICAL:ALLIGATOR,1.56 L	80009	344-0046-00
-3	175-0263-01			1	..LEAD,ELECTRICAL:STRD,23 AWG,BLACK,3.0 L	80009	175-0263-01
-4	175-0124-01			1	..LEAD,ELECTRICAL:STRD,23 AWG,BLACK,5.0 L	80009	175-0124-01
-5	011-0106-00			1	..TERMN,COAXIAL:	80009	011-0106-00
					..(STANDARD AND OPTION 03 ONLY)		
					STANDARD ACCESSORIES		
	070-0948-00			1	MANUAL,TECH:INSTRUCTION P6022 CURRENT	80009	070-0948-00

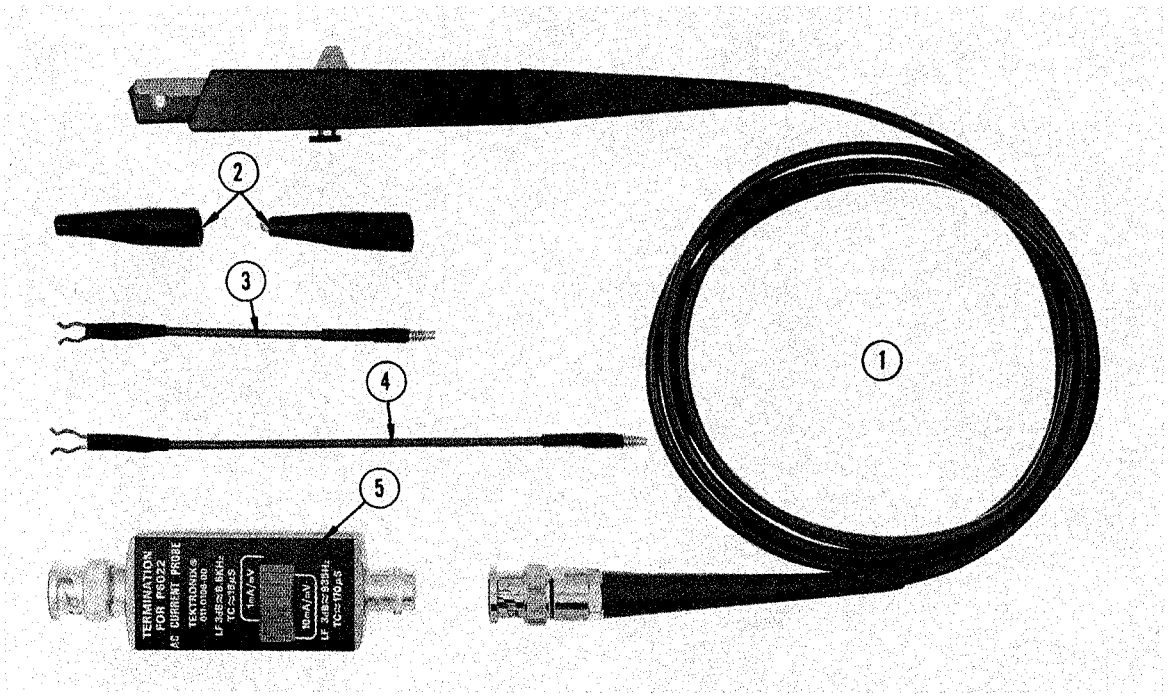
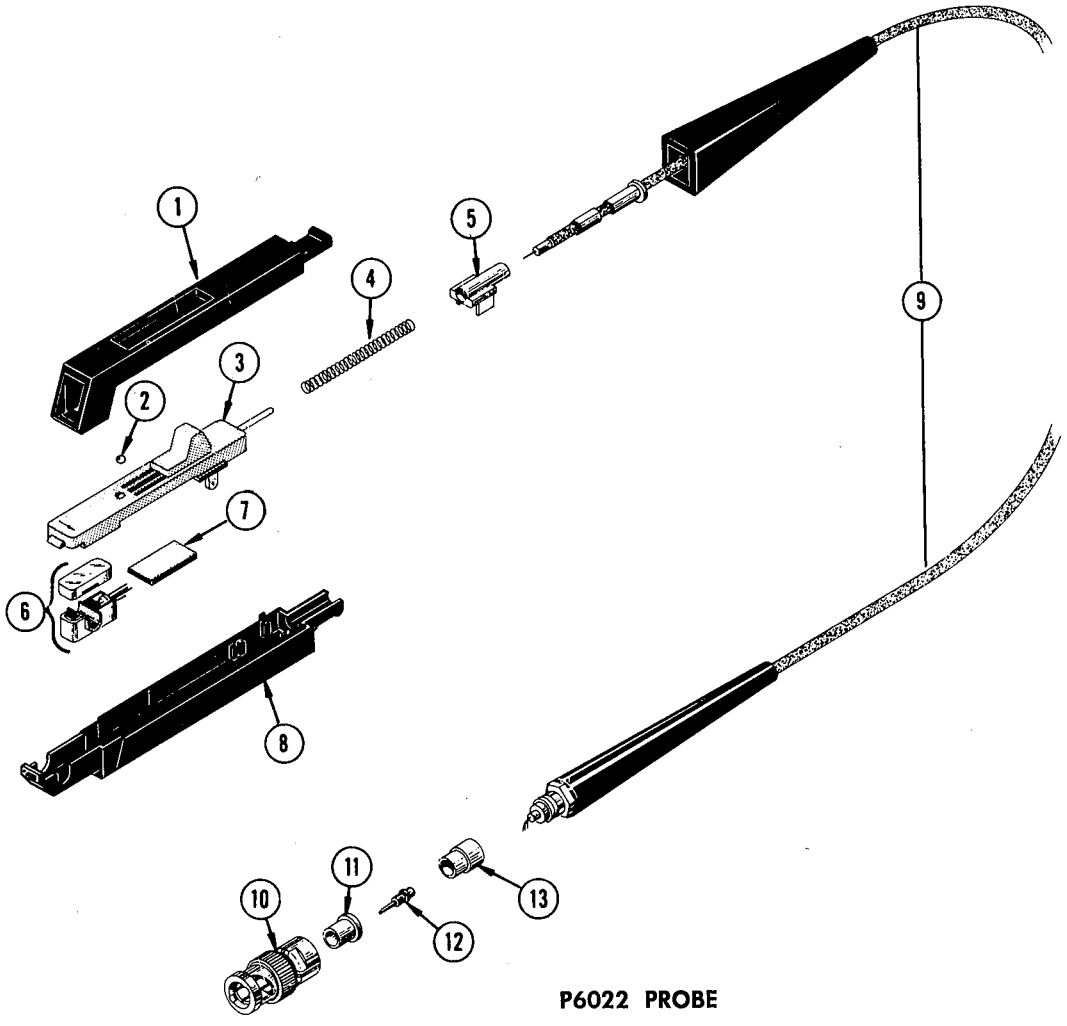
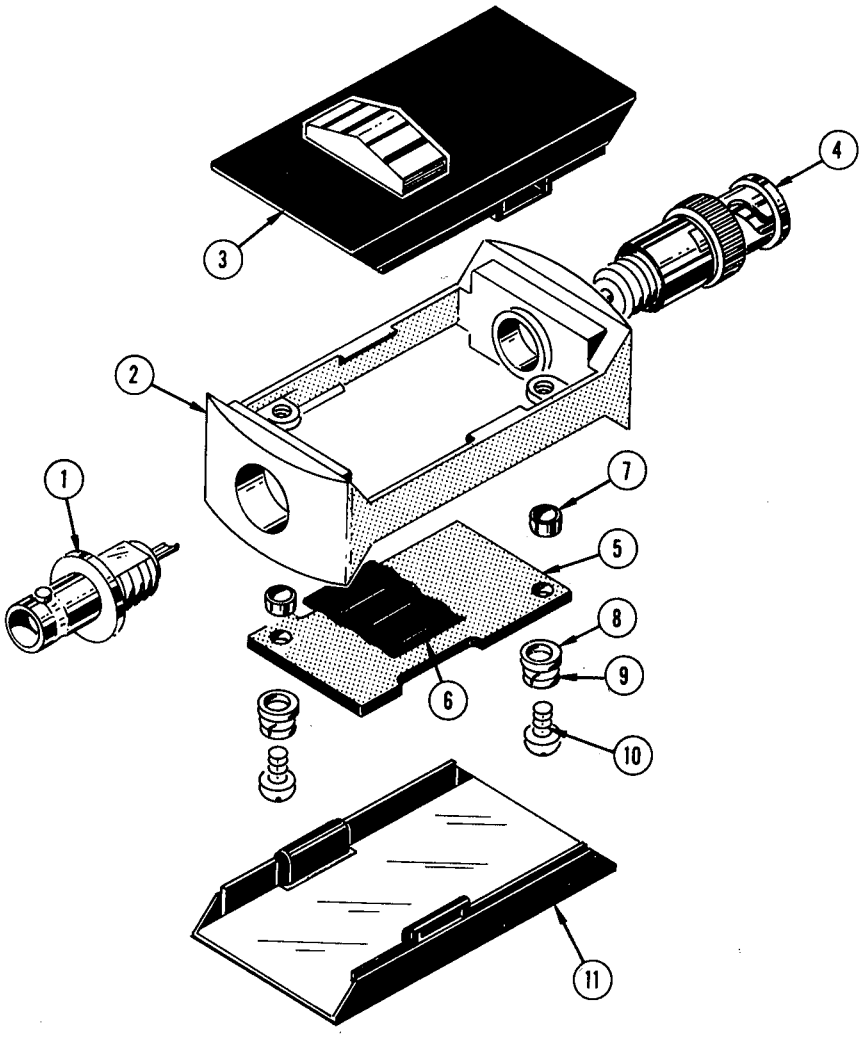


Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
2-	----- -----			1	PROBE,CURRENT:P6022,W/ACCESSORIES		
-1	204-0360-00			1	.BODY,PROBE:UPPER	80009	204-0360-00
-2	214-0581-00			1	.BALL,DETENT:0.062 DIA STEEL	80009	214-0581-00
-3	351-0174-00			1	.SLIDE,TEST PROD:ACETAL	80009	351-0174-00
-4	214-0735-00			1	.SPRING,HLCPS:0.12 OD X 1.5 L,OPEN ENDS,MUW	80009	214-0735-00
-5	214-1110-00			1	.RETAINER,SPRING:CURRENT PROBE	80009	214-1110-00
-6					.XFMR,CURRENT:UPPER,LOWER (SEE A1A1T1 REPL)		
-7					.CIRCUIT BD ASSY:PROBE (SEE A1A1 REPL)		
-8	204-0362-01		8634	1	.BODY ASSY,PROBE:LOWER	80009	204-0362-01
	204-0362-00	8635		1	.BODY ASSY,PROBE:LOWER	80009	204-0362-00
-9	175-1027-00			1	..CABLE ASSY,RF:62.5 OHM COAX,60.0 L ..(STANDARD AND OPTION 12 ONLY)	80009	175-1027-00
	175-1027-01			1	..CABLE ASSY,RF:62.5 OHM COAX,108.0 L ..(OPTION 03 AND OPTION 13 ONLY)	80009	175-1027-01
-10	134-0044-00			1	...SHELL,ELEC CONN:BNC	02660	31-202-1002
-11	358-0072-00			1	...INSULATOR,BSHG:0.192 ID X 0.192 OD X 0.323	80009	358-0072-00
-12	214-0109-01			1	...CONTACT,ELEC:CONN CTR CONT,BRS SIL PL	34736	ORDER BY DESCR
-13	361-0022-00			1	...INSULATOR,BSHG:0.29 ID X 0.29 OD X 0.353 L	80009	361-0022-00



P6022 PROBE

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
3-	011-0106-00			1	TERMN,COAXIAL:	80009	011-0106-00
-1	131-0106-02			1	.CONN,RCPT,ELEC:BNC,FEMALE	24931	28JR178-1
-2	426-0423-03			1	.FRAME,COAX TERM:	80009	426-0423-03
-3	200-0852-06			1	.COV,COAX TERMN:W/SHLD & KNOB	80009	200-0852-06
-4	131-0602-00			1	.CONN,RCPT,ELEC:BNC,MALE	80009	131-0602-00
-5	----- -----			1	.CKT BOARD ASSY:TERMINATION (SEE A2A1 REPL)		
-6	214-1108-00			1	..INSULATOR,PLATE:SLIDE SW,FISH PAPER	80009	214-1108-00
					.(ATTACHING PARTS FOR CKT BOARD ASSY)		
-7	361-0219-00			2	.SPACER,SLEEVE:0.06 L X 0.093 ID,BRS	80009	361-0219-00
-8	210-1008-00			2	.WASHER,FLAT:0.09 ID X 0.188 OD X 0.02,BRS	12327	ORDER BY DESCR
-9	210-0053-00			2	.WASHER,LOCK:#2 SPLIT,0.02 THK STL	78189	ORDER BY DESCR
-10	211-0001-00			2	.SCREW,MACHINE:2-56 X 0.25,PNH,STL	93907	ORDER BY DESCR
					.(END ATTACHING PARTS)		
-11	200-0851-03			1	.COV,COAX TERMN:	80009	200-0851-03



P6022 TERMINATION