

# Instruction Manual

**Tektronix**

**P6109B  
100 MHz 10X Passive Probe  
With Readout**

**070-7849-01**

**Warning**

The servicing instructions are for use by qualified personnel only. To avoid personal injury, do not perform any servicing unless you are qualified to do so. Refer to the Safety Summary prior to performing service.

**Please check for change information at the rear of this manual.**

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## WARRANTY

Tektronix warrants that this product will be free from defects in materials and workmanship for a period of one (1) year from the date of shipment. If any such product proves defective during this warranty period, Tektronix, at its option, either will repair the defective product without charge for parts and labor, or will provide a replacement in exchange for the defective product.

In order to obtain service under this warranty, Customer must notify Tektronix of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. Customer shall be responsible for packaging and shipping the defective product to the service center designated by Tektronix, with shipping charges prepaid. Tektronix shall pay for the return of the product to Customer if the shipment is to a location within the country in which the Tektronix service center is located. Customer shall be responsible for paying all shipping charges, duties, taxes, and any other charges for products returned to any other locations.

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inadequate maintenance and care. Tektronix shall not be obligated to furnish service under this warranty a) to repair damage resulting from attempts by personnel other than Tektronix representatives to install, repair or service the product; b) to repair damage resulting from improper use or connection to incompatible equipment; or c) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

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# P6109B

Thank you for choosing a Tektronix passive probe. This manual provides the information necessary to begin making measurements with your P6109B probe.

The P6109B is compatible with Tektronix 2200 series oscilloscopes. The probe can also be used with other general purpose oscilloscopes having a 1 M $\Omega$  input impedance and bandwidth up to 100 MHz.

The P6109B is compatible with Tektronix oscilloscopes that automatically detect the attenuation factor of the attached probe and adjust scale readout accordingly.

The P6109B has a cable length of 2 meters.

The P6109B is fully compatible with Tektronix accessories for miniature probes.

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## Safety

The P6109B probe is listed with Underwriters Laboratories Inc. and meets the requirements of UL 1244.

### **WARNING**

*To avoid explosion, do not operate this product in an explosive atmosphere unless it has been specifically certified for such operation.*

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## Installation

This section describes both attaching the probe to an oscilloscope and using the standard accessories with the probe.

### **Attaching the Probe to an Oscilloscope**

The probe uses a BNC connector to attach to an oscilloscope input connector. To ensure optimum performance from your probe and oscilloscope measurement system, verify that the probe and oscilloscope are appropriately matched. The oscilloscope input impedance should be 1 M $\Omega$ . The oscilloscope input capacitance must be between 15 and 35 pF.

Before using the probe, you should verify low-frequency compensation as described under "Operating Considerations" in this manual.

## Using the Standard Accessories

Your P6109B is shipped with the following accessories:

- **This instruction manual**—Read these instructions to familiarize yourself with the features, characteristics, and operation of the P6109B passive probe.

- **Marker rings**—Use the marker rings to help you keep track of individual probes and signal sources when you have a complicated test setup. Use the marker rings whenever you want to identify a particular probe for any reason. To make probe identification easy, clip matching colored rings onto the probe cable and tip as shown.

- **Ground lead**—Use the ground lead to establish a ground reference for your measurements.

To attach the ground lead to the probe, insert the spring clip into the receptacle as shown.

Use the alligator clip to attach the probe to a ground reference. Be careful not to bend or damage delicate leaded components with the alligator clip.

- **Retractable hook tip**—Use the retractable hook tip to make hands-free measurements. The hook tip attaches to components having leads, such as resistors, capacitors, and discrete semiconductors. You can also grip stripped wire, jumpers, busses, and test pins with the retractable hook. Be careful not to bend or damage delicate leaded components with the hook tip.

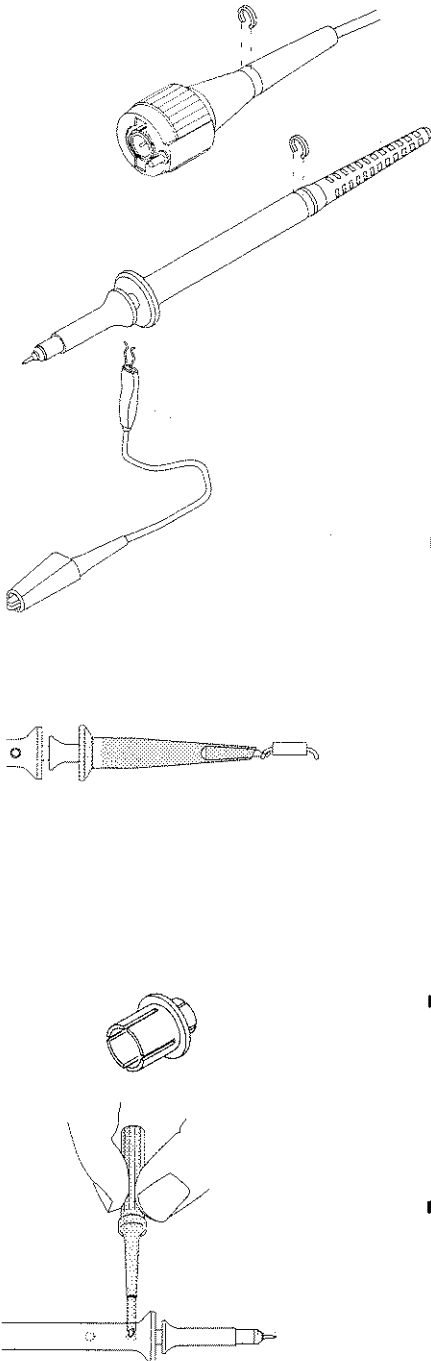
For maximum flexibility with the hook tip, use the optional 28-inch ground lead. For precise measurements at high frequency, however, long ground leads have too much inductance. For precise high-frequency measurements use the standard ground lead provided.

To remove the hook tip, simply pull it off the probe. Reinstall it by pushing it firmly onto the probe tip.

- **BNC-to-probe tip adapter**—Use the BNC-to-probe tip adapter to make a quick, easy, and stable probe connection to a BNC output connector.

To install the adapter, push the wide end firmly into a BNC connector. Then insert the probe tip firmly into the adapter. To remove the adapter, grasp it by the flange and withdraw it from the BNC connector.

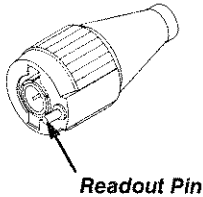
- **Adjustment tool**—Use the insulated adjustment tool to adjust the compensation trimmers in the probe.



## Operating Considerations

The information in this section will help you make the most effective use of your P6109B probe.

### Features and Controls

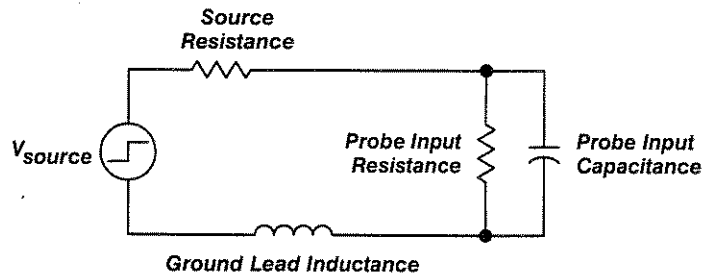


**Readout pin**—The BNC connector of the probe includes a spring-loaded pin that connects to a mating contact ring on certain oscilloscopes. These oscilloscopes recognize the attenuation factor of the probe and automatically correct the oscilloscope indication of scale factor. You can determine if your oscilloscope supports this feature by watching the oscilloscope vertical scale factor readout when attaching the probe. If the displayed scale changes by a factor of 10 — for instance, from 10 mV to 100 mV — your oscilloscope supports this feature.

### Ground Lead Inductance

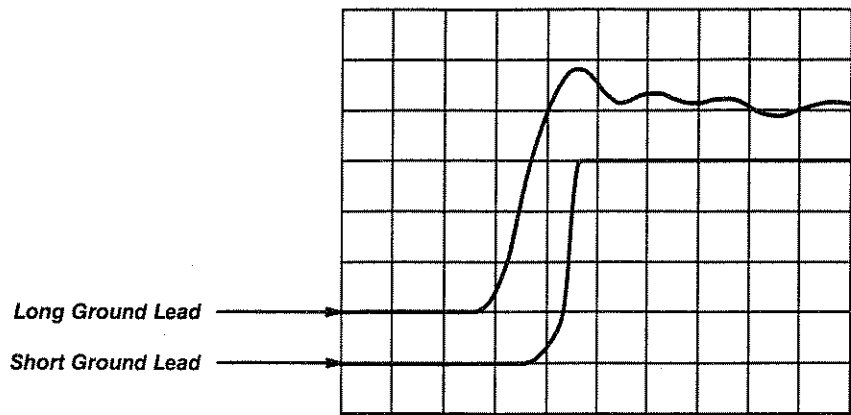
In order for an amplitude measurement to be meaningful, you must give the measurement some point of reference. The ground lead provides access to this ground reference.

When you touch your probe tip to a circuit element, you introduce additional resistance, capacitance, and inductance into the circuit (Figure 1).



**Figure 1: A Probe Adds Resistance, Capacitance, and Inductance**

A passive probe is capacitive for high-frequency signals. For most circuits, the high input resistance of a passive probe has a negligible effect on the signal. The series inductances represented by the probe tip and ground lead, however, can result in a parasitic resonant circuit that may “ring” within the bandwidth of the oscilloscope. If the ringing is at a frequency within the oscilloscope bandwidth, the ringing appears on the oscilloscope display as a distortion of the true waveform. Figure 2 shows the effect on the same signal through the same probe with different ground leads.



**Figure 2: Signal Distortion Introduced by Ground Lead Inductance**

Reducing ground lead inductance will raise the resonant frequency. Ideally, the inductance is low enough that the resulting resonant frequency is above the frequency at which you will take measurements. To maintain the best signal integrity, use the shortest possible ground lead and signal input path.

## Checks and Adjustments

The information in this section will help you make probe adjustments if they are ever required.

### Low-Frequency Probe Compensation

Passive probes require compensation to ensure maximum distortion-free output and to avoid high-frequency amplitude errors.

Because of variations in oscilloscope input characteristics, probe low-frequency (LF) compensation may need adjustment after moving the probe from one oscilloscope to another. Verify the compensation before making critical rise time or amplitude measurements.

If a 1-kHz calibrated square wave displayed at 1 ms/division shows significant differences between the leading and trailing edges (see figures at left), perform the following steps to optimize low-frequency compensation.



*Undercompensated*



*Overcompensated*



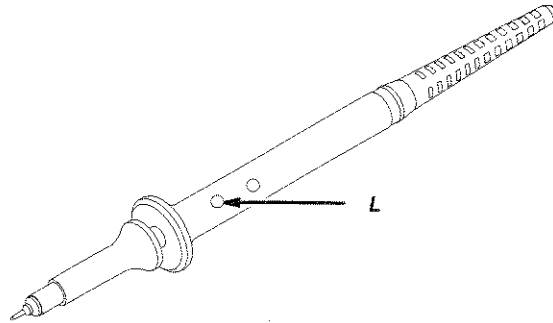
*Properly Compensated*

- Step 1:** Connect the probe tip to a calibration signal. Most oscilloscopes have a front panel test point for this purpose; if yours does not, use a signal generator that produces a well-formed square wave at approximately 1 kHz.
- Step 2:** Press **AUTOSET** (on many Tektronix oscilloscopes) or otherwise adjust the oscilloscope so that it displays a waveform similar to those shown in this section.

Optional: If your oscilloscope has a limited-bandwidth mode, enable it. Filtering out high-frequency noise will make the adjustment easier to perform.



- Step 3:** Trimmer **L** adjusts a long time constant component of the probe low-frequency response, beginning at the waveform front corner. Adjust trimmer **L** (refer to Figure 3) until you see a flat-top square wave on the display.



**Figure 3: Adjusting Low-Frequency Compensation**

### High-Frequency Probe Compensation

The probe high-frequency compensation should seldom require adjustment. Your probe requires high-frequency adjustment if any of the following are true:

- the probe has excessive high-frequency aberrations
- the probe does not perform at the rated bandwidth
- you have installed the probe on an oscilloscope having an input capacitance near the limits of the probe compensation range (see Table 1)

To perform the high-frequency compensation adjustment you will need a signal source that has all of the following characteristics:

- square-wave output at 100 kHz
- fast rise output with rise time less than 1 ns
- output terminated into 50  $\Omega$  load

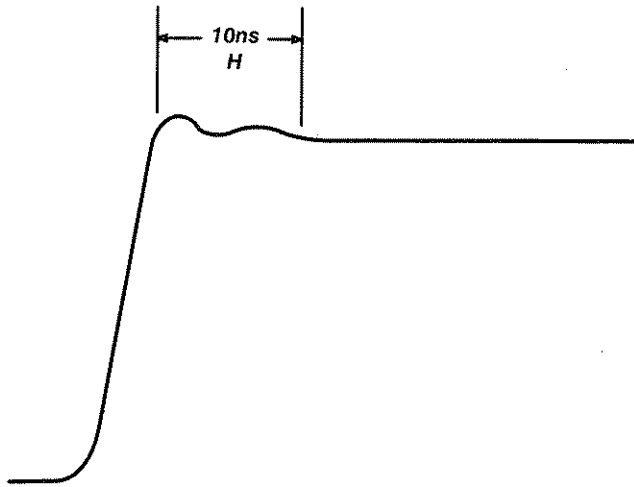
The Tektronix PG506A Calibration Generator meets these requirements.

#### **NOTE**

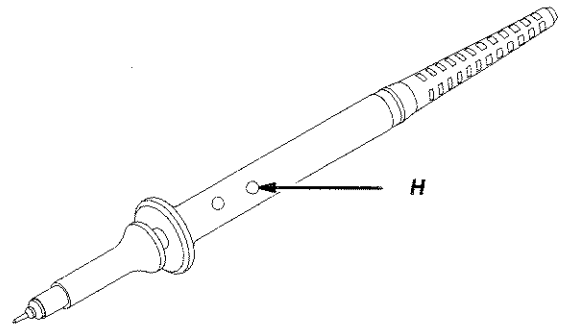
*We strongly recommend that you use the optional probe tip-to-BNC adapter (Tektronix part number 013-0084-01) to connect your probe to the signal source.*

- Step 1:** Connect the probe to the signal source and display a 100 kHz test signal on your oscilloscope. Adjust your oscilloscope to 5 ns/division. The display should be similar to that shown in Figure 4(a).

- **Step 2:** Trimmer **H** adjusts a short time constant component of the probe response, beginning at the waveform front corner. Refer to Figure 4(b). Adjust **H** to minimize probe aberrations while maintaining good rise time response.



(a) Area Of Waveform Affected By Trimmer



(b) Location of Trimmer

**Figure 4: Adjusting High-Frequency Compensation**

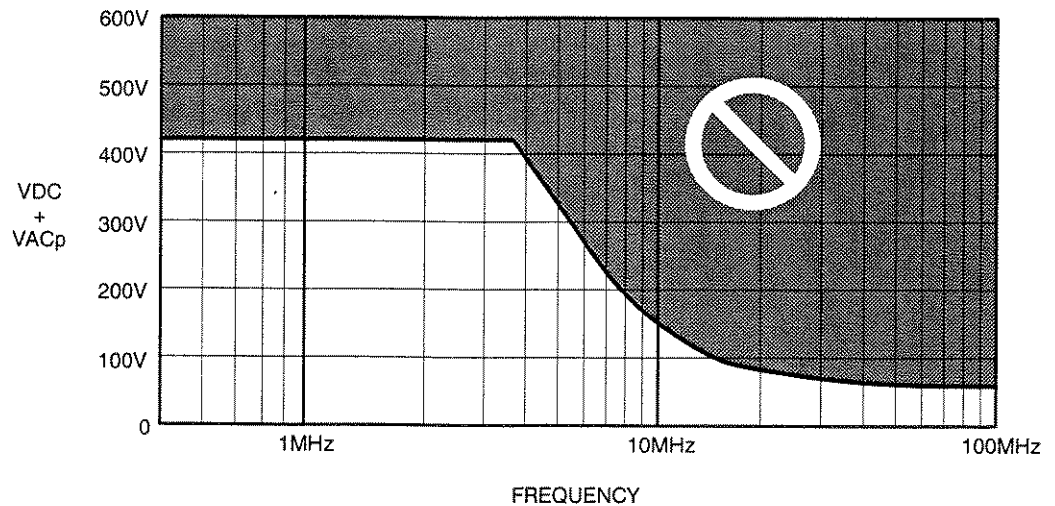
## Characteristics

These characteristics apply to a P6109B probe installed on a Tektronix 2252 oscilloscope. When used with another instrument, the oscilloscope must have an input impedance of 1 M $\Omega$  and a bandwidth not less than 100 MHz or more than 115 MHz.

The instrument must have a warm-up period of at least 20 minutes and be in an environment that does not exceed the limits described in Table 2.

**Table 1: Electrical Characteristics**

Characteristic	Standard
Attenuation (system)	10X $\pm$ 1.3% at DC
Input Resistance (system)	10 M $\Omega$ $\pm$ 1.3%
Input Capacitance	11.8 pF to 14.8 pF (13.3 pF nominal)
Compensation Range	15 pF to 35 pF
System Bandwidth ( $-3$ dB)	> 100 MHz
Maximum Nondestructive Input Voltage	420 V (DC+peak AC) (See Figure 5 for voltage derating curve)



**Figure 5: Derating Curve for Determining Maximum Input Voltage**

**Table 2: Physical and Environmental Characteristics**

<b>Characteristic</b>	<b>Standard</b>
Net Weight (including accessories)	< 320 g (0.7 lb)
Temperature Range <sup>(1)</sup>	
Operating	-15° C to +75° C (+5° F to +167° F)
Nonoperating	-62° C to +85° C (-80° F to +185° F)
Humidity <sup>(1)</sup>	95% to 97% Relative Humidity

<sup>(1)</sup> Tektronix Standard 062-2847-00, class 3. Refer to MIL-E-16400F, paragraph 4.5.9 through 4.5.9.5.1, class 4.

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## **Maintenance**

The information in this section will help you maintain your probe for a long service life.

### **Cleaning**

To prevent damage to probe materials, avoid using chemicals that contain benzine, benzene, toluene, xylene, acetone, or similar solvents.

Remove accumulated loose dust from the probe exterior using a soft cloth or small brush. Remaining dirt may be removed with a soft cloth dampened with a mild detergent and water solution, or isopropyl alcohol. Do not immerse the probe or use abrasive cleaners.

### **Replacing Probe Parts**

Other than accessories, only the probe tip is replaceable.

Replacement probe tips are available as optional accessories. Refer to the replaceable parts list at the end of this manual for more information.

To remove a tip assembly, firmly grasp the the pointed tip with pliers and withdraw the assembly from the barrel.

No tools are required to install a replacement tip. Insert a new probe tip into the probe barrel as far as possible using finger pressure. If necessary, seat the plastic portion of the tip against the probe barrel by pressing the tip gently but firmly against a hard surface, such as a wood block or table top.

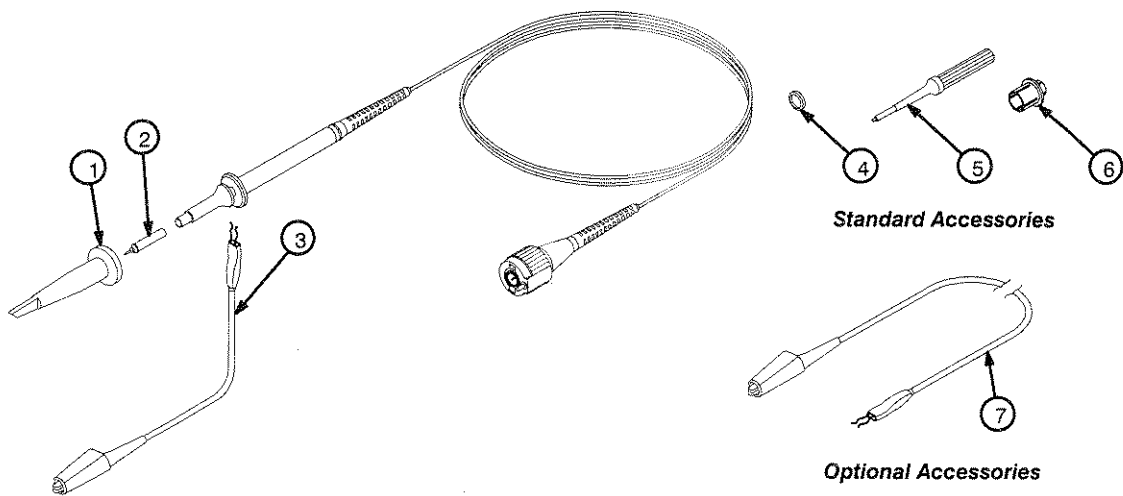


Figure 6: P6109B Replaceable Parts

Fig. & Index No.	Tektronix Part No.	Serial No. Effective Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
6-			1	PROBE,PASSIVE:P6109B,100MHZ,10X, W/READOUT		
-1	013-0107-07		1	TIP,PROBE:MINIATURE/COMPACT SIZE	80009	013010707
-2	-----		1	CONTACT,ELEC:PROBE TIP WITH INSULATOR ASSY (SEE OPTIONAL ACCESSORIES)		
-3	196-3120-00		1	LEAD,ELECTRICAL:23 AWG,6.0 L,GROUND	80009	196312000
<b>STANDARD ACCESSORIES</b>						
	020-2031-00	9240	1	ACCESSORY KIT:MINIATURE SIZE	80009	020203100
-4	-----		2	.BAND,MARKER:0.371 DIA,BLACK,PLASTIC		
	-----		2	.BAND,MARKER:0.371 DIA,ORANGE,PLASTIC		
	-----		2	.BAND,MARKER:0.371 DIA,RED,PLASTIC		
	-----		2	.BAND,MARKER:0.371 DIA,SILVER GRAY,PLASTIC (SEE OPTIONAL ACCESSORIES)		
-5	-----		1	.SCREWDRIVER:ADJUSTMENT TOOL,METAL TIP .PLASTIC,BLACK (SEE OPTIONAL ACCESSORIES)		
-6	-----	9240	1	.ADAPTER,CONN:BNC TO MINIATURE PROBE .TIP		
	-----		1	.2 TIP-INSULATOR ASSEMBLIES W/INFO CARD (SEE OPTIONAL ACCESSORIES)		
	070-7849-01		1	SHEET,TECHNICAL:INSTR,P6109B	80009	070784901
<b>OPTIONAL ACCESSORIES</b>						
-7	196-3120-20		1	LEAD,ELECTRICAL:PROBE GROUND,28.0 L	80009	196312020
	016-0633-00		1	MARKER SET,CA:2 EA VARIOUS COLORS	80009	016063300
	003-1433-01		1	SCREWDRIVER:ADJUSTMENT TOOL,PKG OF 5	80009	003143301
	131-4997-02		1	CONTACT,ELEC:30 PKGS OF 2 EA TIP-INSULATOR ASSEMBLIES W/INFO CARD	80009	131499702
80009	TEKTRONIX INC			14150 SW KARL BRAUN DR PO BOX 500		BEAVERTON OR 97077-0001

