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Instruction Manual

Tektronix

P6217

FET Probe

070-8553-02

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 all safety summaries prior to performing service.

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Contents

Welcome

This manual describes the Tektronix P6217 FET Probe and provides operating, maintenance, and accessory information.

Operator Safety Summary

Please exercise care when operating this or any equipment. In addition to applying common sense, please keep the following in mind as you use your P6217 FET Probe.

Do Not Operate In Explosive Atmospheres

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

Safety Terms

The following terms and symbols appear in this manual:



To prevent damage to your probe or other property, carefully read the caution statement.

WARNING

To prevent injury, carefully read and follow the instructions given in a warning statement.



To prevent damage caused by electrostatic discharge, wear a properly grounded wrist strap and observe static control precautions.

Service Safety Summary

The probe should be serviced only by qualified service personnel.

To prevent personal injury, disconnect the probe from any signal or power source before servicing.

Do not service electrical equipment unless another person capable of rendering first aid and resuscitation is present.

Electrostatic Discharge



To prevent damage to the instrument and probe, follow the precautions described in this manual and the manuals accompanying your oscilloscope.

Circuitry in the probe is susceptible to damage from electrostatic discharge (ESD) and from overdrive signals and excessive DC voltages. Be sure to operate the probe only in a static-controlled environment. Be sure to discharge to ground any electrostatic charge that may be present on cables or circuit board runs before connecting the probe.

Wear a wrist grounding strap whenever you handle the probe, and in particular when handling either the probe tip or the output connector.

Install the ESD protective tip cover whenever the probe is not in use.

Whenever you handle static-sensitive devices, follow these general precautions:

- Minimize handling of components. Handle components only at a static-free workstation.
- Place component assemblies on a metal or other conductive surface. Do not slide the assembly across any surface.
- Wear a wrist strap when handling component assemblies to discharge static voltage from your body.
- Avoid materials that are capable of generating a static charge.

Manual Organization

This manual is divided into two sections, user information and service information.

Section 1: User Information

General Information describes the P6217 FET Probe. Read *General Information* for an overview of probe features and accessories.

Operating Information gives you the information you need to make effective use of your P6217 FET Probe. Read *Operating Information* to understand important operating concepts and the performance limitations of your probe. This section also explains how to use the standard accessories that are shipped with your probe.

Performance Verification provides procedures that you can follow to verify the performance of your probe.

Section 2: Service Information

Service should be performed only by qualified service personnel.

Theory of Operation provides information and diagrams to help you understand how the probe works.

Maintenance describes preventive maintenance and troubleshooting, and gives you the information you need to replace probe modules or return the probe for repair or replacement. *Maintenance* also lists the replaceable parts of your probe as well as the available optional accessories.

If your probe fails or does not perform as specified, and you cannot resolve the problem using the information in *Maintenance*, please contact your Tektronix Service Center.

Appendix

Appendix A lists selected electrical, environmental, and physical specifications of the P6217 FET Probe.

Index

Use the index to locate specific information quickly.

Conventions

This manual uses the following conventions when referring to Tektronix products:

- P6217 refers to the P6217 FET Probe
- Calibration generator refers to any of the Tektronix 067-1338-0X Calibration Step Generators.
- Sampling head refers to any of the following Tektronix sampling heads: SD-22, SD-24, SD-26.

The following convention applies to procedures:

- Literal equipment connectors or controls are indicated by bold face type as shown in the following example:

*Connect the cable to the oscilloscope output labelled **CALIBRATOR**.*

This convention does not apply to descriptive names of features and controls:

Your oscilloscope may not have a calibrator output.

Contacting Tektronix

There are a number of ways that you can obtain product support, service support, or other information.

Product Support

For application-oriented questions about a Tektronix measurement product, call toll free in North America:
1-800-TEK-WIDE (1-800-835-9433 ext. 2400)
6:00 a.m. – 5:00 p.m. Pacific time

Or contact us by e-mail:
tm_app_supp@tek.com

For product support outside of North America, contact your local Tektronix distributor or sales office.

Service Support

Contact your local Tektronix distributor or sales office. Or visit our web site for a listing of worldwide service locations.

<http://www.tek.com>

For other information

In North America:
1-800-TEK-WIDE (1-800-835-9433)
An operator will direct your call.

To write us

Tektronix, Inc.
P.O. Box 1000
Wilsonville, OR 97070-1000

User Information

General Information

General Information describes the P6217 FET Probe and lists standard probe accessories.

Product Description

The Tektronix P6217 FET Probe is an active high-impedance 10X-attenuating probe that is compatible with Tektronix 11000 Series digitizing oscilloscopes.

With the P6217 you can make high-frequency measurements with less capacitive loading than a passive resistive-divider probe. The P6217 uses FETs to establish the high input impedance at high frequencies that is characteristic of active probes.

The P6217 has a typical bandwidth of 4 GHz and an input impedance of 100 k Ω in parallel with 400 fF (femtofarad). The P6217 output must terminate into 50 Ω .

The P6217 features the TEKPROBE Level 2 interface.

When used with a compatible oscilloscope, the host instrument provides power for the probe. The oscilloscope can also control the probe offset voltage through the interface.

The probe provides the oscilloscope with the probe model number, serial number, and attenuation factor. Oscilloscope display readouts are corrected for the probe attenuation factor and the oscilloscope input is automatically set to 50 Ω (if possible).

Check your oscilloscope manual to determine if your oscilloscope fully supports the TEKPROBE interface.

Standard Accessories

The P6217 FET Probe is shipped with the following standard accessories:

- instruction manual
- ground contact springs (assorted)
- ESD protective tip cover
- edge-tab ground sockets (5)
- SureFoot probe tip adapters (2 each 0.50 mm/20 mil (red), 0.65 mm/25 mil (blue), and 50 mil (orange))
- four-post ground sockets (8)
- marker rings (4 colors, 2 each)
- wrist strap

Operating Information in this section describes how to attach and use the standard accessories.

Part numbers for the standard and optional accessories are listed under *Replaceable Parts* in Section 2.

Operating Information

Operating Information discusses several important topics that will help you make the most effective use of your P6217 FET Probe. Using the standard accessories is also described.

NOTE

Save the probe shipping and packaging materials for reuse should shipping the probe become necessary.

Probe Handling

Despite its small size and simple appearance, the P6217 is a high-performance measurement instrument; it contains a number of complex components that could be damaged by rough handling. To maintain the accuracy and reliability of your probe, always handle it carefully.

For cleaning instructions, refer to *Maintenance* in Section 2.

WARNING

To reduce risk of electric shock and ESD damage, keep your fingers behind the finger guard on the probe body

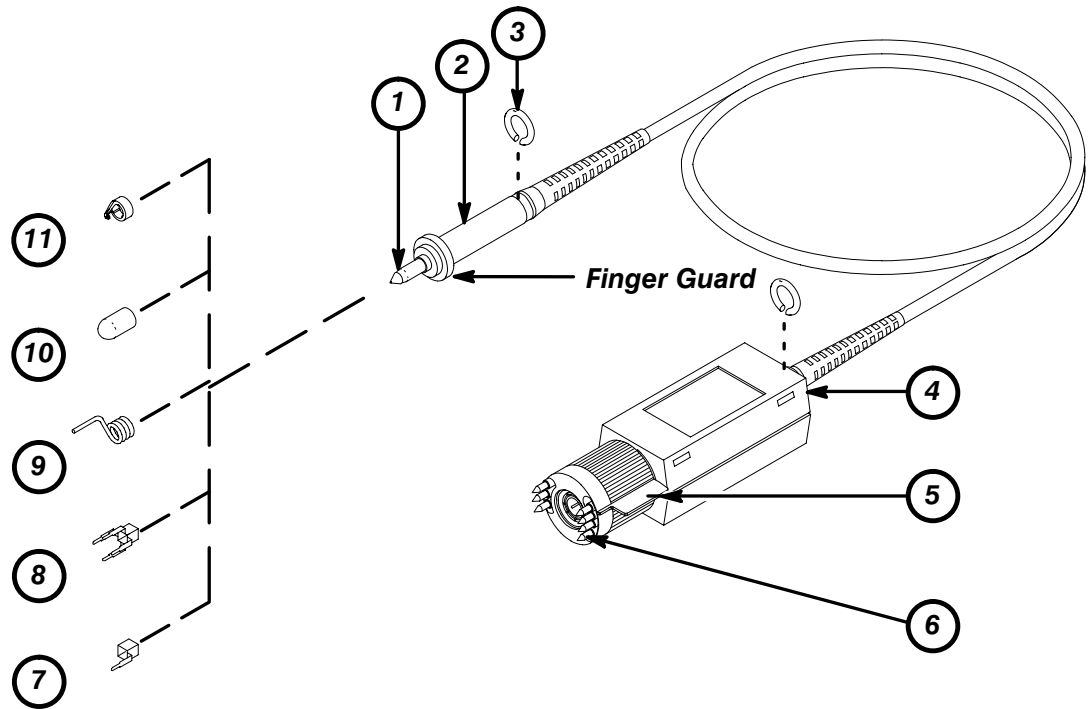


The P6217 FET Probe contains static-sensitive devices. To prevent damage to the probe caused by electrostatic discharge, wear a properly grounded wrist strap when handling the probe. Refer to Electrostatic Discharge following the safety information at the front of this manual.

Probe Parts

Figure 1-1 identifies the primary parts of the P6217 FET Probe and shows how the standard accessories are used or attached. Detailed information about using the standard accessories is provided later in this section.

The main components of the probe are the probe head and cable, ground connection, the compensation box, and the TEKPROBE connector.



- | | |
|------------------------|-----------------------------|
| ① Ground Connection | ⑥ TEKPROBE Contact Pins |
| ② Probe Head and Cable | ⑦ Edge-Tab Ground Socket |
| ③ Marker Band | ⑧ Four-Post Ground Socket |
| ④ Compensation Box | ⑨ Low Inductance Ground Tip |
| ⑤ BNC Locking Ring | ⑩ ESD Protective Cover |
| | ⑪ SureFoot Adapter |

Note: Wrist strap accessory is not shown.

Figure 1-1: The P6217 FET Probe and Standard Accessories

Ground Connection

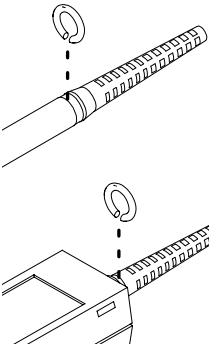
The ground connection makes it possible to reference the signal at the probe tip to ground. The effects of ground lead (or ground connection) inductance are discussed later in this section.

Operating Information

The metal barrel of the probe head allows several alternative ground connections. Read “Standard Accessories” in this section for more information about making ground connections.

Probe Head and Cable

The probe tip makes the physical connection to your test point. The probe head contains a hybrid circuit described in greater detail in *Theory of Operation* in Section 2. The cable gives you the flexibility to make measurements in a variety of applications.



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.

Compensation Box

The compensation box contains additional circuitry, including elements of the TEKPROBE interface. There are no internal adjustments for you to make.



To prevent damage from static discharge, wear a properly grounded wrist strap when handling the probe.

BNC Locking Ring

The BNC locking ring houses the TEKPROBE interface contact pins and provides a positive attachment to the host instrument.

To install the probe, open the locking ring by rotating it counterclockwise; push the assembly firmly onto the oscilloscope (or power supply) BNC input connector and rotate the ring clockwise one-quarter turn to secure it to the input connector.

To remove the probe, reverse the installation procedure.

Wrist Strap

Wear the wrist strap, properly connected to ground, to prevent electrostatic discharge damage to static-sensitive devices, including the probe. Refer to *Electrostatic Discharge* in the front of this manual for more information about static control practices.

The TEKPROBE Interface

The TEKPROBE interface provides a communication path between the probe and the host instrument. Contact pins provide connections for power, signal, offset, and data transfer.

The interface allows the oscilloscope to configure for the correct attenuation factor, input impedance and DC offset. The instrument can also access the probe serial number.

Your oscilloscope may not implement all features of the TEKPROBE interface. Check your oscilloscope manual for details.

Operating Information

The P6217 is an active probe and requires external power to operate. If your oscilloscope does not have the TEKPROBE interface, we recommend that you use the Tektronix 1103 TEKPROBE Power Supply.

You can use an oscilloscope having a conventional BNC input by first connecting the probe to the 1103 input; then connect the 1103 output to your oscilloscope input.

The 1103 can power two P6217 probes. If you use an 1103, keep the cable connecting the 1103 output to the oscilloscope input as short as possible to maintain the best possible high-frequency response of the system. You must also remember to use a 50 Ω oscilloscope input.

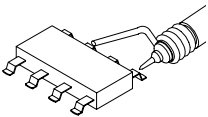
Using an 1103 probe power supply will not add TEKPROBE functionality to an oscilloscope that does not already have it.

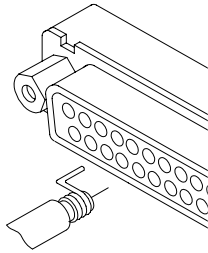
Standard Accessories

The standard accessories provided with your probe will help you make effective use of the P6217 FET Probe. Use the descriptions below to determine which accessories are appropriate for your application. For a list of optional accessories, study the replaceable parts list found under *Maintenance* in Section 2.

Low-Inductance Contact (Spring Tip)

Use the low-inductance spring-tip assembly to reduce ground lead inductance. The performance of a probe fitted with the low-inductance ground contact approaches that of no-lead probe fixtures and adapters.





With the spring-tip assembly installed, measurements up to the system bandwidth of your probe and oscilloscope can be made with negligible signal degradation caused by ground lead inductance effects. Refer to “Ground Lead Inductance” later in this section.

The low-inductance spring-tip is ideal for repetitive production use. Because the spring tip is slightly flexible, you can use it on a variety of components, including edge connectors, IC packages, multi-pin connectors and receptacles, and adjacent runs on circuit boards or other devices.

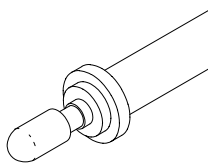
Because the spring-tip simply contacts the ground reference (instead of clipping onto it) you can move the probe around your device under test with ease. Use care to avoid accidentally shorting component leads to ground with the spring-tip contact.

To install the low-inductance spring-tip contact, push it onto the metal barrel of the probe tip while taking care not to pierce yourself with the sharp probe tip.

NOTE

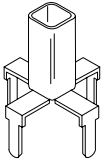
The spring contact installs more easily if you rotate the spring counterclockwise (loosening the spring tension slightly) as you push it onto the probe barrel.

ESD Protective Tip



Use the ESD (electrostatic discharge) protective tip cover to reduce the chance of static discharge damage to your probe. Place the protective cover over the probe tip whenever you are not using the probe to make measurements.

Four-Post Ground Sockets



Use the four-post ground sockets to design-in minimum inductance test points on your next circuit board. With this type of socket installed, the practical frequency limit of your measurements is determined by system performance specifications instead of ground lead inductance effects.

These adapters are available in large quantities. For maximum performance and ease of testing, we strongly recommend that you incorporate four-post sockets into your next design.

Install the sockets as shown in Figure 1-2.

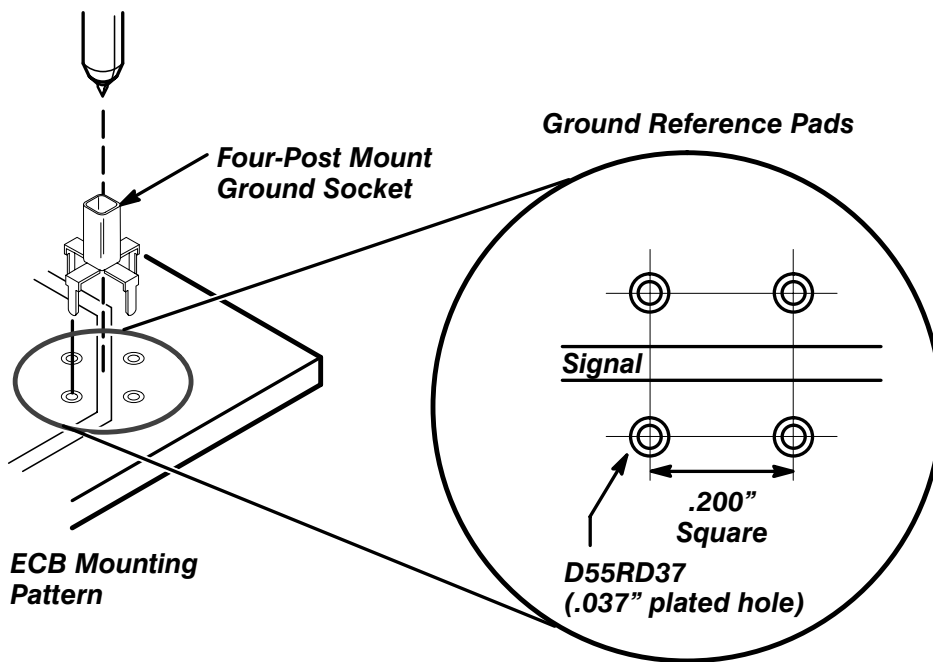
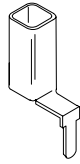


Figure 1-2: Installing Four-Post Ground Sockets

To use your probe with these adapters, insert the probe tip firmly into the adapter until the probe tip contacts the signal test point.

Edge-Tab Ground Sockets



Edge-tab ground sockets can also be used to provide minimum inductance test points, with the same benefits as the four-post ground sockets.

While the four-post sockets are more rigidly mounted, the edge-tab socket is easily mounted in a variety of configurations. An example of edge-tab ground socket mounting is shown in Figure 1-3.

These adapters are also available in large quantities.

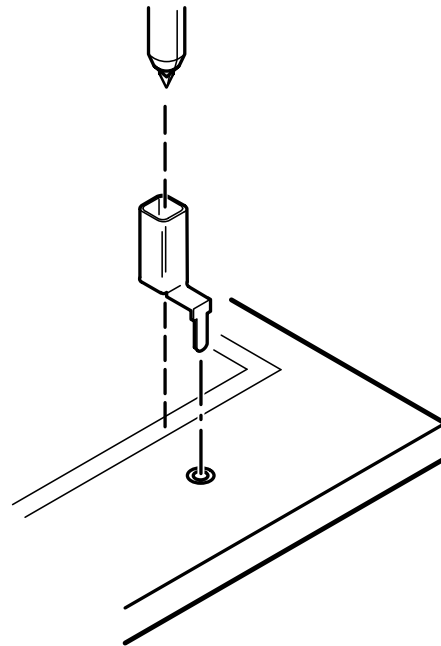


Figure 1-3: Installing Edge-Tab Ground Sockets

SureFoot Adapters



The SureFoot adapters allow probing of fine-pitch devices without shorting adjacent leads. To accomplish this, each adapter has a small tab that fits between the tightly spaced leads to prevent the probe tip from slipping. (see Figure 1-4).

Operating Information

There are adapters for three pitch sizes 0.50 mm/20 mil (red), 0.65 mm/25 mil (blue), and 50 mil (orange).

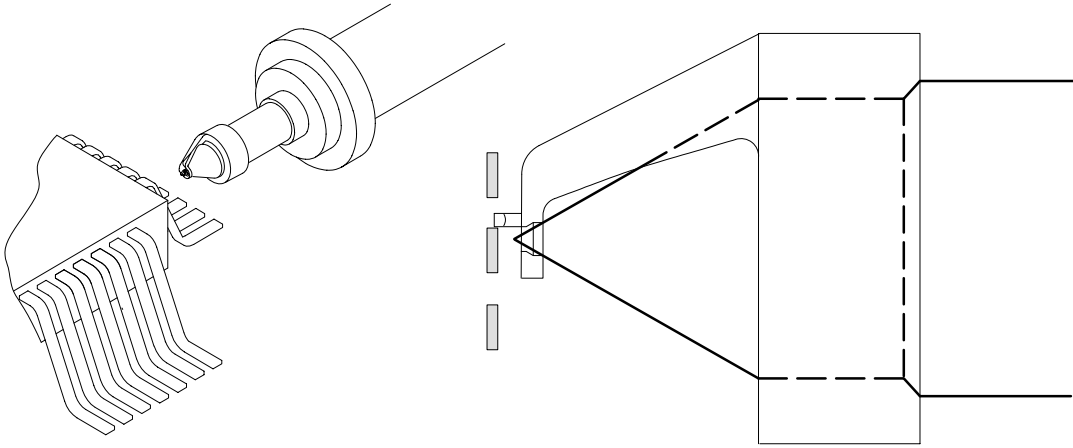


Figure 1-4: Using the SureFoot Adapter

Ground Lead Inductance

When you touch your probe tip to a circuit element, you are introducing a new resistance, capacitance, and inductance into the circuit. Refer to Figure 1-5.

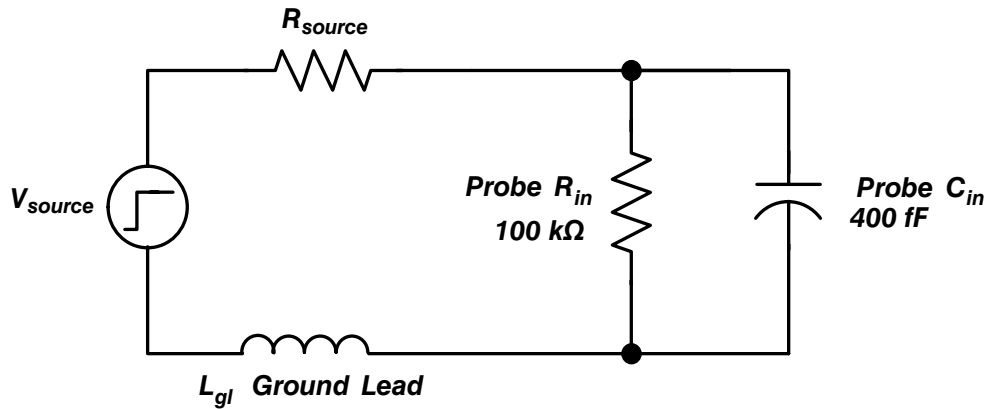


Figure 1-5: Ground Lead Equivalent Circuit

For most circuits, the high input resistance of the probe has a negligible effect. 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 your oscilloscope.

Note that the ringing and rise time degradation could be masked if the frequency content of the signal degradation is beyond the bandwidth of the oscilloscope. You can determine if ground lead effects are likely to be a problem in your application.

If you know the self-inductance (L) and capacitance (C) of your probe and ground lead, you can calculate the approximate resonant frequency (f_0) at which this parasitic circuit will resonate:

$$f_0 = \frac{1}{2\pi\sqrt{LC}}$$

The preceding equation shows that reducing the ground lead inductance will raise the resonant frequency. If your measurements are affected by ringing, your goal is to lower the inductance of your ground path until the resulting resonant frequency is well above the frequency at which you want to take measurements.

The low-inductance ground contacts (spring tip, four-post, and edge-tab) described in “Standard Accessories” can help you reduce the effects of ground lead inductance on your measurements.

Input Linear Dynamic Range

The internal amplifier used by the P6217 FET Probe to drive a 50- Ω load has a limited range. To keep the input linearity error less than 3% you must limit the signal input voltage to ± 4 V (including any DC offset).

NOTE

If you are using your probe with a TEKPROBE-compatible oscilloscope, use the DC offset adjustment to maintain the probe within its dynamic range. The nominal offset adjustment of the P6217 FET Probe is ± 5 VDC.

Note that the probe can tolerate input voltages of ± 40 V without damage; however, the linearity error specification does not apply to input voltages exceeding ± 4 V (including any DC offset).

Performance Verification

Performance Verification provides procedures that you can use to verify the performance of your P6217 FET Probe. The following performance characteristics are verified:

- system attenuation
- system rise time
- probe output offset zero and gain

Performance requirements that are not verified are characteristics that are either extremely stable and unlikely to change, or impractical to verify.

Please verify probe performance by using the procedures provided in the order presented. Each procedure assumes that the previous procedure has been completed.

When to Verify Performance

You may use the performance verification procedures as an acceptance test for the probe. You should verify the performance of the probe after replacing any probe components or attempting any repair. With daily use, you should verify the performance of your probe at least once a year.

If your probe fails any of the performance checks, refer to *Troubleshooting* in Section 2 and take the recommended action.

Limits and Tolerances

The limits and tolerances given in this procedure apply to the probe under test only. Errors arising from test equipment are not included unless specifically noted.

Test Equipment Required

The items listed in Table 1-1 are necessary to complete the performance verification procedures. Any specified test equipment specifications are minimum requirements that must be met to ensure that verification results are valid. Substituted equipment must meet the minimum performance specifications.

Stabilization

Before beginning the verification procedures, be certain to allow sufficient time for the test equipment to stabilize. A warm-up period of 20 minutes is usually sufficient.

Equipment Operation

If you are unsure of how to use the specified test equipment, refer to the user's manual for the instrument. If you have substituted test equipment for the instruments or equipment recommended, the steps of the procedure may have to be modified to reflect your setup. Refer to the appropriate instrument or equipment manual for detailed operating information.

Table 1-1: Required Test Equipment

Item Description	Performance Requirement	Recommended Example
oscilloscope	Bandwidth: DC to 20 GHz Input: 50 Ω input	11801A or CSA 803 with SD-22, SD-24, or SD-26 sampling head
probe power supply	TEKPROBE interface connector	1103 Tekprobe Power Supply
calibration step generator		Tektronix part number 067-1338-0X
probe tip adapter	4 mm probe tip-to-SMA (“T” or pickoff type)	Tektronix part number 013-0271-00
adapter	SMA female-female	Tektronix part number 015-1012-00
adapters (2)	SMA female-to- BNC male	Tektronix part number 015-0572-00
50 Ω termination	SMA male	Tektronix part number 015-1022-00
general purpose coaxial cable	male-male SMA length: 20 in.	Tektronix part number 174-1427-00
coaxial precision delay cable	male-male SMA delay: 2 ns.	Tektronix part number 015-0560-00

Equipment Connections



To prevent electrostatic discharge damage to the oscilloscope input, wear a properly grounded wrist strap whenever you make an oscilloscope input connection.

Calibrate the Test System

Before beginning the performance verification procedures, connect the calibration step generator (refer to Figure 1-6 as necessary) and calibrate the sampling head channel that will be used to perform the procedures:

- Step 1:** Connect the power supply provided with the calibration step generator to an appropriate power source.
- Step 2:** Connect the power supply cable to the calibration step generator.
- Step 3:** Using the general purpose male-male SMA cable, connect the calibration step generator **TRIGGER INPUT** to the oscilloscope **INTERNAL CLOCK OUTPUT**.
- Step 4:** Select Initialize from the Utility main menu to initialize the oscilloscope.
- Step 5:** From the Enhanced Accuracy main menu, select Calibrate All.

In the Selected Channel window, choose the appropriate sampling head input channel.

- **Step 6:** From the Calibrate menu, choose Measure Reference Channel and follow the on-screen instructions.

NOTE

Use the precision coaxial cable and 50 Ω termination as required by the on-screen calibration procedure.

- **Step 7:** Select Calibrate Channel from the Calibrate menu and follow the on-screen instructions.

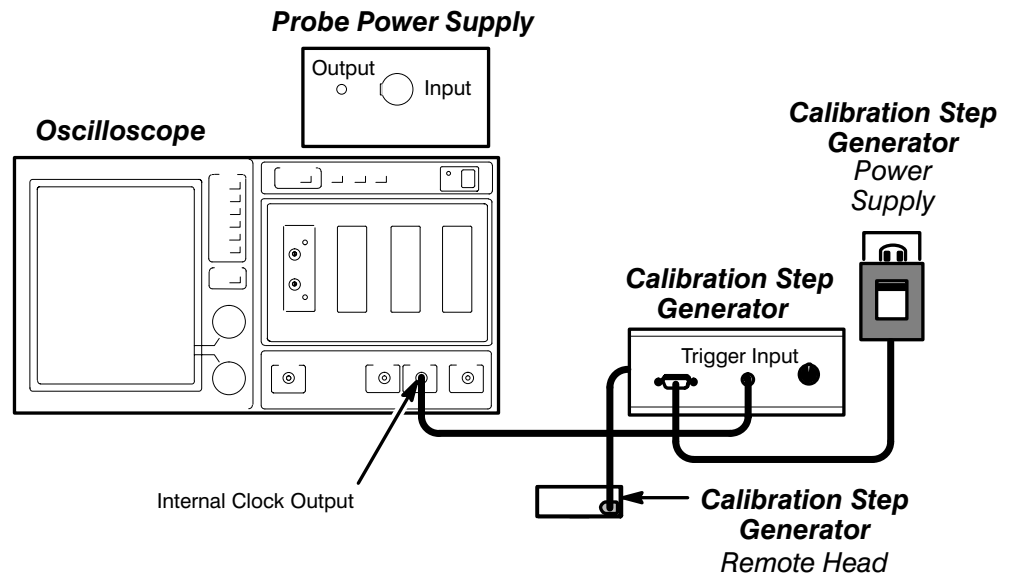


Figure 1-6: Calibration Step Generator Setup

Attenuation

This procedure verifies that the probe attenuation factor meets specification. With this procedure you compare a reference signal provided by the oscilloscope to the same signal attenuated by the probe.

- Step 1:** Install one SMA-BNC adapter on to the channel 1 output of the 1103 power supply and install another SMA-BNC adapter on the channel 1 input of the 1103 power supply.
- Step 2:** Use the male-male SMA precision flexible delay cable to connect the channel 1 output of the 1103 power supply to a sampling head input channel.
- Step 3:** Connect the calibration step generator remote head to the channel 1 input of the 1103 power supply. Refer to Figure 1-7.

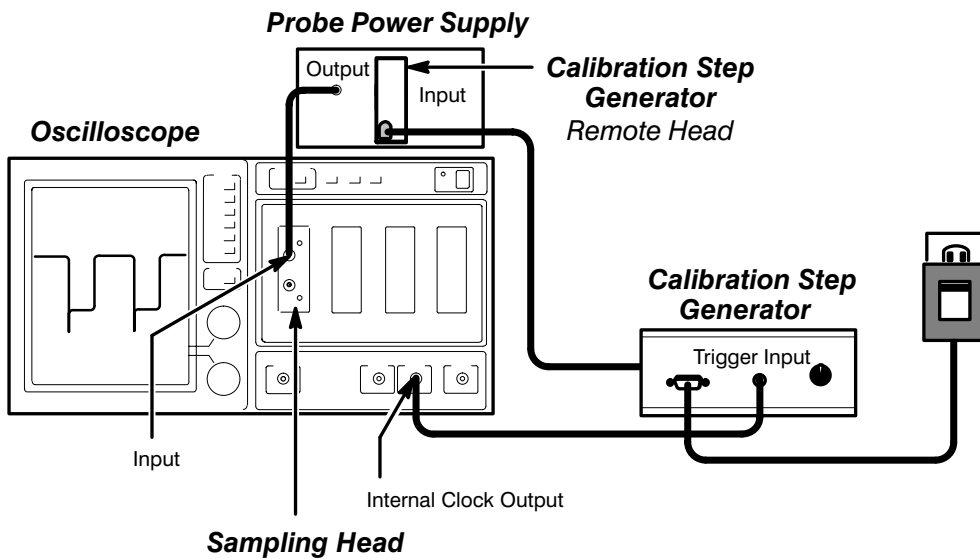


Figure 1-7: Attenuation Test Initial Setup

- Step 4:** Press the sampling head button labelled **SELECT CHANNEL** to enable the corresponding sampling head input. Make or verify the following oscilloscope settings.

trigger source internal clock
 waveform averaging on
 number of waveforms
 to average 16
 cursor type horizontal bars
 cursor knob
 resolution fine

- Step 5:** Press the oscilloscope **AUTOSET** button. Set the vertical and horizontal controls as follows:

volts/division 50 mV
 time/division 2 μ s

- Step 6:** Adjust the oscilloscope controls as necessary to obtain a display similar to that shown previously in Figure 1-7.



Use the cursor measurement capability of the oscilloscope to display the Δ voltage of the waveform. Measure the low frequency portion of the waveform near the back corner (see figure at left). Record the Δ voltage as V_1 .

- Step 7:** Disconnect the calibration generator remote head from the 1103 power supply input. Remove the SMA-BNC adapter from the 1103 power supply input.
- Step 8:** Use the BNC locking ring to connect the P6217 probe to the 1103 power supply channel 1 input. If the 1103 power supply offset feature is enabled, disable the offset control on channel 1 of the 1103 power supply by pressing the lighted button.

Performance Verification

- **Step 9:** Attach the SMA 50 Ω termination to the probe tip adapter. Connect the probe tip adapter to the calibration step generator remote head using the SMA female-female adapter. Insert the probe tip into the probe tip adapter and secure the probe tip by tightening the thumb screw on the probe tip adapter. Refer to Figure 1-8.

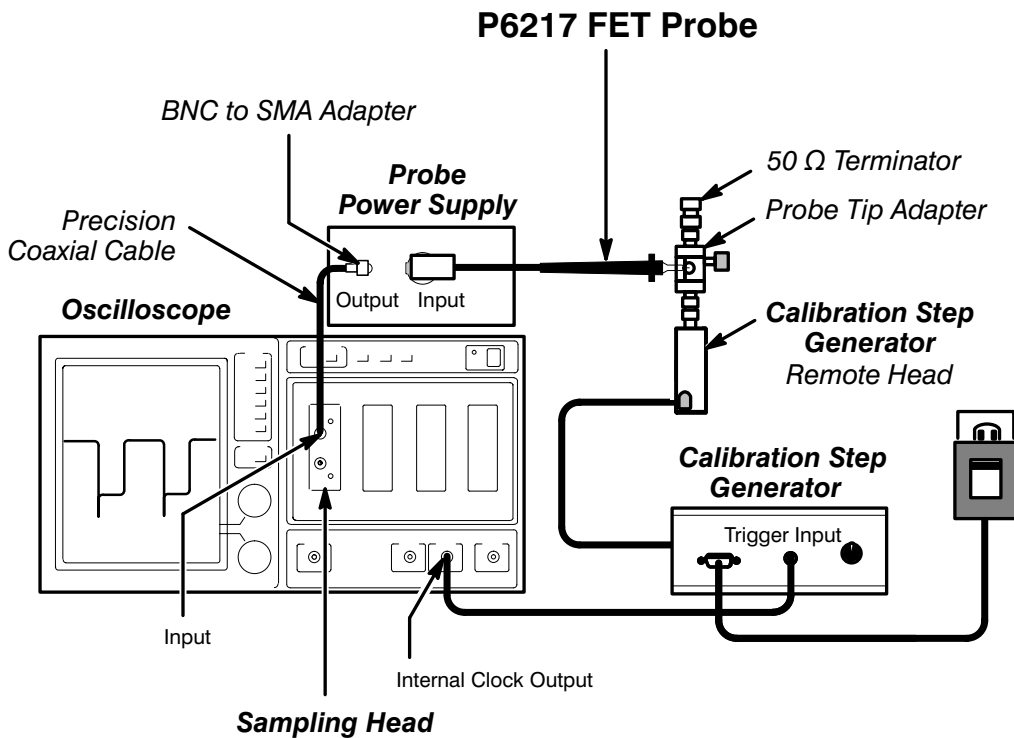


Figure 1-8: Attenuation Test Final Setup

- **Step 10:** Press the oscilloscope **AUTOSET** button. Set the vertical and horizontal controls as follows:
volts/division 5 mV
time/division 2 μ s

Use the cursor measurement capability of the oscilloscope to display the Δ voltage of the waveform. Measure the low frequency portion of the waveform near the back corner. Record the Δ voltage as V_2 .

- Step 11:** Calculate the attenuation error using the following formula:

$$\% \text{ error} = \frac{V_2(10) - V_1}{V_1} \times 100$$

- Step 12:** Check probe attenuation. The attenuation error must be $\leq 2.0\%$.

Rise Time

This procedure verifies that the probe meets rise time specifications.

The probe rise time is calculated from rise times obtained by measuring the test system without the probe attached, and the test system plus the probe.

Step 1: After completing the previous procedure (attenuation), disconnect the calibration step generator remote head from the probe tip adapter. Disconnect the probe from the 1103 power supply input.

Step 2: Connect the calibration step generator remote head to the channel 1 input of the 1103 power supply using the SMA-BNC adapter.

Step 3: Set the oscilloscope volts/division to 50 mV.

volts/division 50 mV
time/division 100 ps

Step 4: Adjust the oscilloscope horizontal and vertical position controls to display a signal similar to that shown in Figure 1-9.

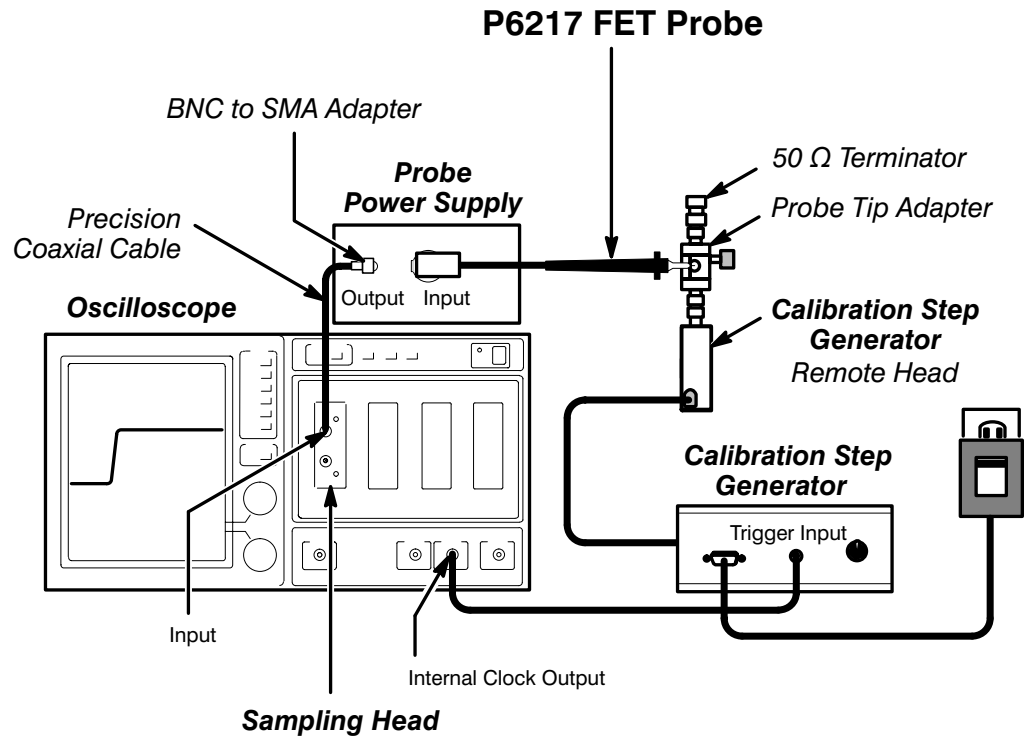


Figure 1-9: Rise Time Test Setup

- Step 5:** Use the oscilloscope measurement capability to display rise time. Rise time is determined from the 10% and 90% amplitude points on the waveform. Record the rise time as t_s .
- Step 6:** Disconnect the calibration generator remote head from the 1103 power supply input. Remove the SMA-BNC adapter from the 1103 power supply input.
- Step 7:** Use the BNC locking ring to connect the P6217 probe to the 1103 power supply channel 1 input. Disable the offset control on channel 1 of the 1103 power supply.

Performance Verification

- Step 8:** Connect the probe tip adapter to the calibration step generator remote head using the SMA female-female adapter. Insert the probe tip into the probe tip adapter and secure the probe tip by tightening the thumb screw on the probe tip adapter. Refer to Figure 1-9.
- Step 9:** Press the **AUTOSET** button. Set the vertical and horizontal controls as follows:
volts/division 5 mV
time/division 100 ps
- Step 10:** Adjust the oscilloscope horizontal and vertical position controls to display a signal similar to that shown in Figure 1-9.
- Step 11:** Use the oscilloscope measurement capability to display rise time. Rise time is determined from the 10% and 90% amplitude points on the waveform. Record the rise time as t_{s+p} .
- Step 12:** Calculate the probe only rise time using the following formula:

$$t_p = \sqrt{t_{(s+p)}^2 - t_s^2}$$

- Step 13:** Check that the calculated rise time meets the probe specification. The rise time (t_p) must be ≤ 100 ps.

Probe Output Offset Zero

This procedure verifies that the probe output offset and offset gain meets specification. With this procedure, you measure the offset voltage that results from attaching the probe to an oscilloscope input. You will also verify the operation of the probe offset function.

- Step 1:** After completing the previous procedure, disconnect the probe tip adapter from the calibration step generator remote head.
- Step 2:** Verify that the P6217 probe tip is inserted into the probe tip adapter assembly. (One end of the probe tip adapter is not used.) Verify that the 50 Ω termination is installed. Refer to Figure 1-10.
- Step 3:** Make or verify the following oscilloscope settings:
 - volts/division 2 mV
 - trigger coupling DC
 - time/division 1 μ s
 - trigger source internal
- Step 4:** Adjust the oscilloscope offset control to 0.0 volts.
- Step 5:** Temporarily disconnect the coaxial cable from the sampling head input. Measure and record the inherent sampling head offset as V_s .

Reconnect the coaxial cable to the sampling head.

Performance Verification

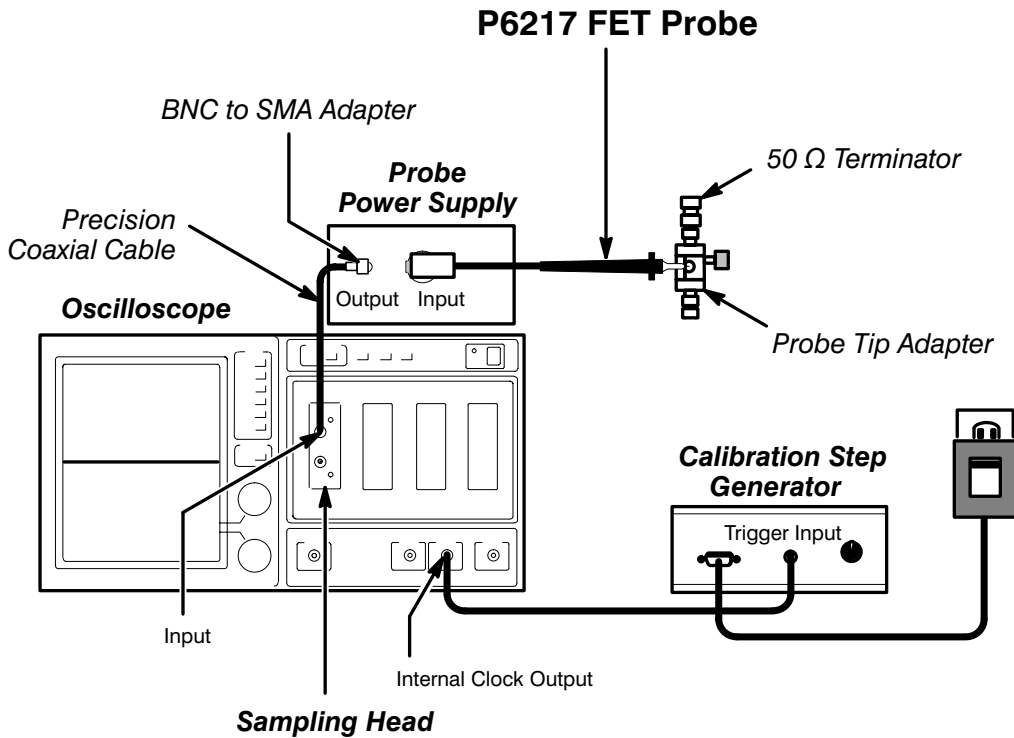


Figure 1-10: Probe Offset Setup

- Step 6:** Measure and record the offset of the probe-plus-sampling head as V_{p+s} .
- Step 7:** Use the following equation to verify that the probe output offset zero meets the probe

$$\text{Offset} = V_{p+s} - V_s$$

The probe output offset zero voltage must be less than ± 10 mV.

Offset Function

This procedure is functional check to verify that the probe offset responds to input from the oscilloscope. The offset range is nominally ± 5 V (note that the oscilloscope scale factor readout reflects the 10X attenuation of the probe).

- Step 1:** Set the oscilloscope volts/division to 200 mV.
- Step 2:** Enable the 1103 Power Supply offset control and turn the offset adjust knob fully clockwise.
- Step 3:** Check that the free running trace has moved up 2.5 divisions from the center graticule.
- Step 4:** Turn the 1103 Power Supply offset adjust knob fully counterclockwise.
- Step 5:** Check that the free running trace has moved down 2.5 divisions from the center graticule.

Performance Verification

Service Information

Theory of Operation

Theory of Operation gives a general idea of how the P6217 FET Probe operates. Because the critical assembly tolerances and modular construction of the P6217 do not support service to the component level, this information is provided for orientation purposes only.

The P6217 FET Probe can be divided into two functional blocks: the probe head and the compensation box.

Figure 2-1 shows a block diagram of the probe divided into the two functional areas.

Theory of Operation

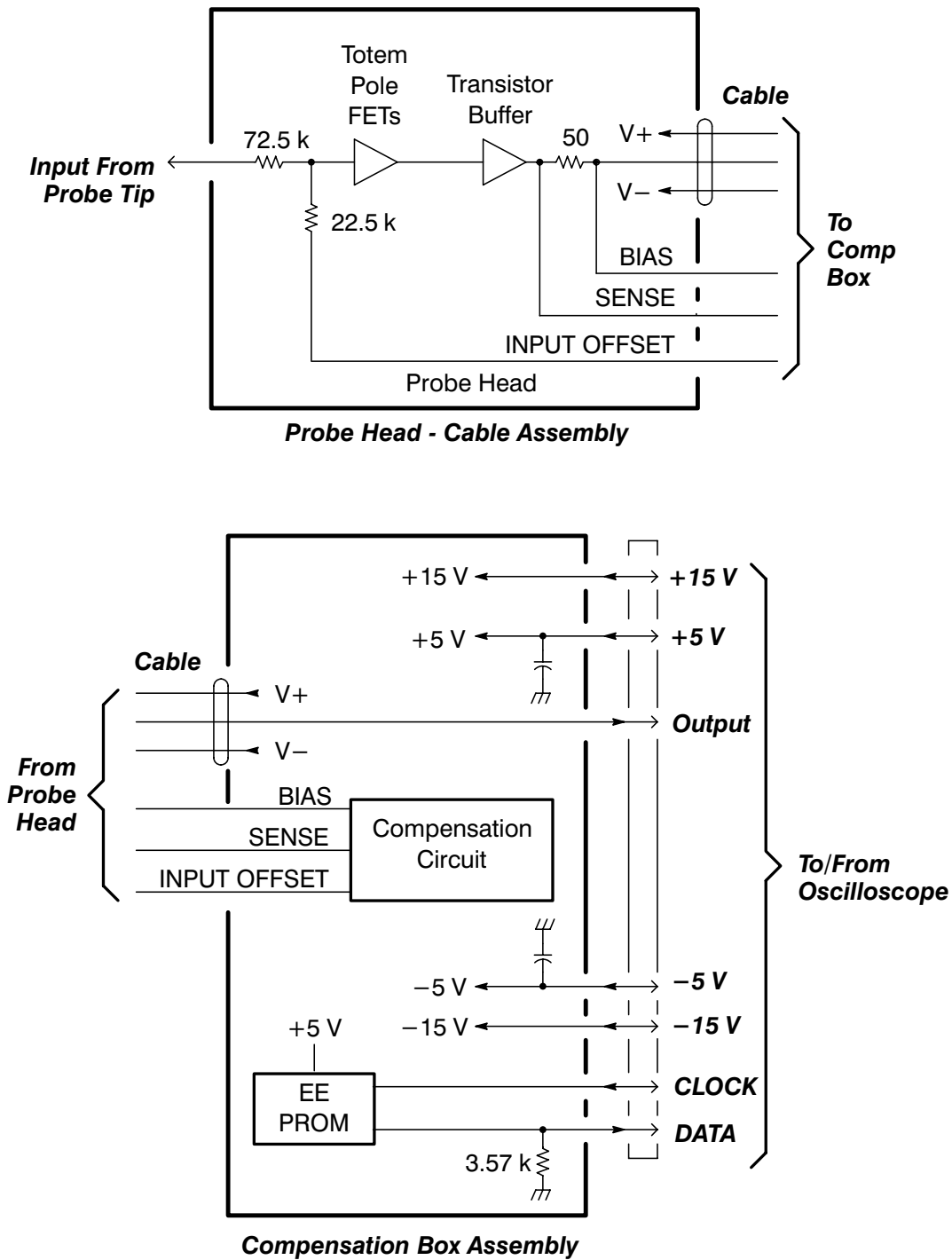


Figure 2-1: Functional Block Diagram of the Probe

Probe Head

The probe head houses a hybrid assembly. The hybrid assembly contains a high-impedance attenuator and a high-frequency unity-gain FET buffer.

The active buffer circuit has a totem-pole FET input stage and a transistor buffer output stage.

Compensation Box

The compensation box on a P6217 probe houses the TEKPROBE interface board and the probe compensation circuit board.

TEKPROBE Interface

The P6217 features the TEKPROBE Level 2 interface. When used with a compatible oscilloscope the probe is powered by the host instrument and provides the oscilloscope with the probe model number, serial number, and attenuation factor. The oscilloscope input channel is automatically set to 50 Ω (if applicable) and the display readout is automatically corrected for the probe attenuation factor.

Figure 2-2 shows the pin assignments for the P6217 FET Probe data and power connector.

Theory of Operation

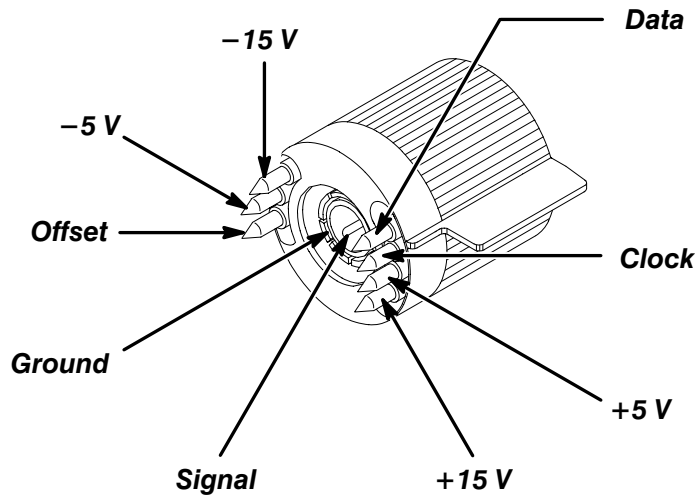


Figure 2-2: Probe Interface Pin Assignments

Compensation Circuits

Probe compensation is accomplished in three functional areas: voltage regulation, feedforward correction, and DC offset drive.

Voltage Regulation — Voltage regulators control the precision low voltage supplies required by the probe head hybrid circuit.

Feedforward Correction — Feedforward correction ensures the low-frequency accuracy of the probe and sets the input offset voltage for the probe head hybrid circuit.

Offset Drive — The offset drive circuit controls the offset voltage seen by the feedforward correction circuit, translating the oscilloscope offset voltage into a voltage appropriate for the probe head hybrid circuit.

Maintenance

Maintenance provides information about the following maintenance topics:

- preventive maintenance
- troubleshooting
- corrective maintenance

Preventive Maintenance

WARNING

To prevent electric shock, disconnect the probe from both signal source and oscilloscope or power supply before performing preventive maintenance.

Preventive maintenance consists of cleaning and visual inspection. Performed on a regular basis, preventive maintenance will improve reliability and can prevent probe failure.

The severity of the environment in which you use your probe should determine the frequency of maintenance. A convenient time to perform preventive maintenance is just before performing a performance verification procedure.

Static Sensitive Devices



The P6217 FET Probe contains devices that are susceptible to damage from static discharge.

To prevent damage to static-sensitive devices, observe the following precautions whenever the covers are off the compensation box or you handle component assemblies:

- Minimize handling of components. Handle components only at a static-free workstation.
- Place component assemblies on a metal or other conductive surface. Do not slide the assembly across any surface.
- Wear a wrist strap when handling component assemblies to discharge static voltage from your body.
- Avoid materials that are capable of generating a static charge.

Cleaning



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

Exterior

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. Do not immerse the probe or use abrasive cleaners.

Interior

With normal use, the interior of the probe compensation box will not require cleaning.

Visual Inspection

The best indicator of probe condition is the performance of the probe. In addition to performing the performance verification procedures, occasionally inspect the probe tip, body, cable, compensation box, and connectors for bent, broken or damaged parts.

To ensure optimum performance of your probe, replace any damaged assembly as soon as practical.

Troubleshooting

If your probe fails to operate or meet a performance requirement, use the following information to determine the appropriate corrective action.

Table 2-1 lists a number of possible probe problems, their probable cause, and recommended actions.

Procedures for replacing failed or defective parts are provided after Table 2-1.

Troubleshooting Techniques

To simplify troubleshooting, follow the steps listed below. The steps help you eliminate some other trouble areas before identifying the probe as defective.

- Step 1:** Check probe operation. Review the operating information contained in Section 1 of this manual, including specifications and performance limitations. Be certain that you are using the probe appropriately.
- Step 2:** Check associated equipment. Associated equipment at either the input or output end of the probe may be defective. Verify the expected signal using an alternative method. Verify that the vertical amplifier section of your oscilloscope is operating and correctly adjusted.
- Step 3:** Check calibration. Measurement errors will result if either the oscilloscope or probe are out of calibration.
- Step 4:** Make visual checks. Many problems can be located visually. Check all equipment for broken wires, damaged connectors, or damaged circuit boards and components. When heat-damaged components are discovered, be certain to isolate and repair the cause of the overheating to prevent recurrence of the problem.
- Step 5:** Refer to the troubleshooting guide, Table 2-1.
- Step 6:** Contact your local Tektronix field office or representative.

Table 2-1: Troubleshooting Guide

Fault Indication	Probable Cause	Corrective Action
Wrong attenuation factor	1. Defective probe assembly	1. Replace probe
	2. Input signal amplitude exceeds probe dynamic range	2. Reduce signal amplitude to within specification limits
	3. Oscilloscope input impedance incorrect	3. Set oscilloscope input impedance to 50 Ω
Rise time or aberrations exceed specification	1. Defective probe head assembly	1. Replace probe
	2. Excessive ground lead inductance	2. Reduce ground lead inductance (refer to “Ground Lead Inductance” in <i>Operating information</i>)
Probe output exceeds offset specification	1. Defective power supply	1. Check oscilloscope vertical amplifier fuses
	2. Broken or unsoldered wire or component in compensation box	2. Replace probe
	3. Hybrid assembly damaged by static discharge	3. Replace probe

Table 2-1: Troubleshooting Guide (Cont.)

Fault Indication	Probable Cause	Corrective Action
Signal intermittent or absent	1. Broken or unsoldered wire or component in compensation box	1. Replace probe
	2. Defective probe head assembly	2. Replace probe
	3. Signal path shorted to ground	3. Replace probe
Oscilloscope does not respond to installed probe	1. EEPROM damaged	1. Replace probe
	2. Oscilloscope does not support TEKPROBE interface	2. Check oscilloscope manual to determine which features are supported
	3. Defective TEKPROBE interface pin(s)	3. Replace pin(s)

Corrective Maintenance

Corrective maintenance consists of replacing defective parts or assemblies. To ensure satisfactory operation and performance of your P6217 probe, no internal parts or assemblies are field replaceable, except for the TEKPROBE interface contact pins. For information about replaceable accessories, refer to *Replaceable Parts*.

Precautions

WARNING

To prevent electric shock, disconnect the probe from both signal source and oscilloscope or power supply before performing corrective maintenance.

To maintain probe performance, do not attempt to replace the individual components contained on or in the replaceable assemblies.

Obtaining Replacement Parts

The components and assemblies used in your P6217 probe are manufactured, selected, or specified by Tektronix to meet specific performance requirements. Order all replacement parts from your local Tektronix field office or representative.

Ordering Parts

When ordering replacement parts for your probe be certain to specify all of the following information:

- probe type, including option or modification number
- probe serial number
- description of the part (and circuit number if known)
- Tektronix part number

Replacing TEKPROBE Interface Contact Pins

To replace a TEKPROBE interface contact pin, use a pair of needle-nosed pliers to pull the pin straight out of the BNC assembly. Refer to Figure 2-3.

To install a new pin, hold the pin carefully with the needle-nosed pliers while pushing the pin into the BNC assembly.

Use care to avoid crushing or bending the hollow pin. Verify that the installed pin is seated to the same depth as the other pins.

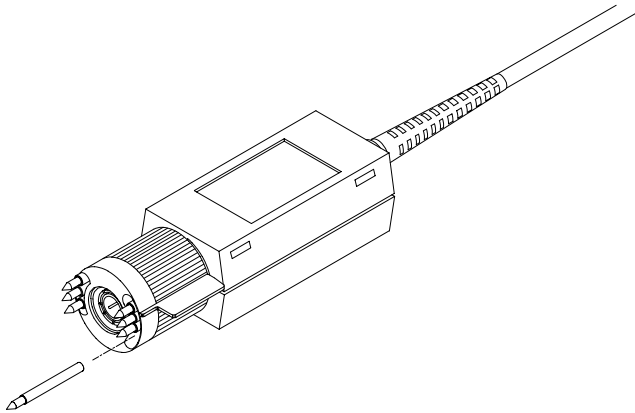


Figure 2-3: Replacing TEKPROBE Interface Contact Pins

Replaceable Parts List

This section contains a list of the parts that are replaceable for the P6217 FET Probe. Use this list to identify and order replacement parts.

Parts Ordering Information

Replacement parts are available from or through your local Tektronix, Inc. service center or representative.

Changes to Tektronix probes are sometimes made to accommodate improved components as they become available and to give you the benefit of the latest circuit improvements. Therefore, when ordering parts, it is important to include the following information in your order:

- Part number
- Probe type or model number
- Probe serial number
- Probe modification number, if applicable

If a part you order has been replaced with a different or improved part, your local Tektronix service center or representative will contact you concerning any change in the part number.

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

Using The Replaceable Parts List

The tabular information in the replaceable parts list is arranged for quick retrieval. Understanding the structure and features of the list will help you find the all the information you need for ordering replacement parts.

Item Names

In the replaceable 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, U.S. Federal Cataloging Handbook H6-1 can be used where possible.

Abbreviations

Abbreviations conform to American National Standards Institute (ANSI) standard Y1.1

CROSS INDEX – MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
TK1163	POLYCAST INC	9898 SW TIGARD ST	TIGARD OR 97223
TK1326	NORTHWEST FOURSLIDE INC	18224 SW 100TH CT	TUALATIN OR 97062
8X345	NORTHWEST SPRING & MFG CO	5858 WILLOW LANE	LAKE OSWEGO OR 97034–5343
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97077–0001

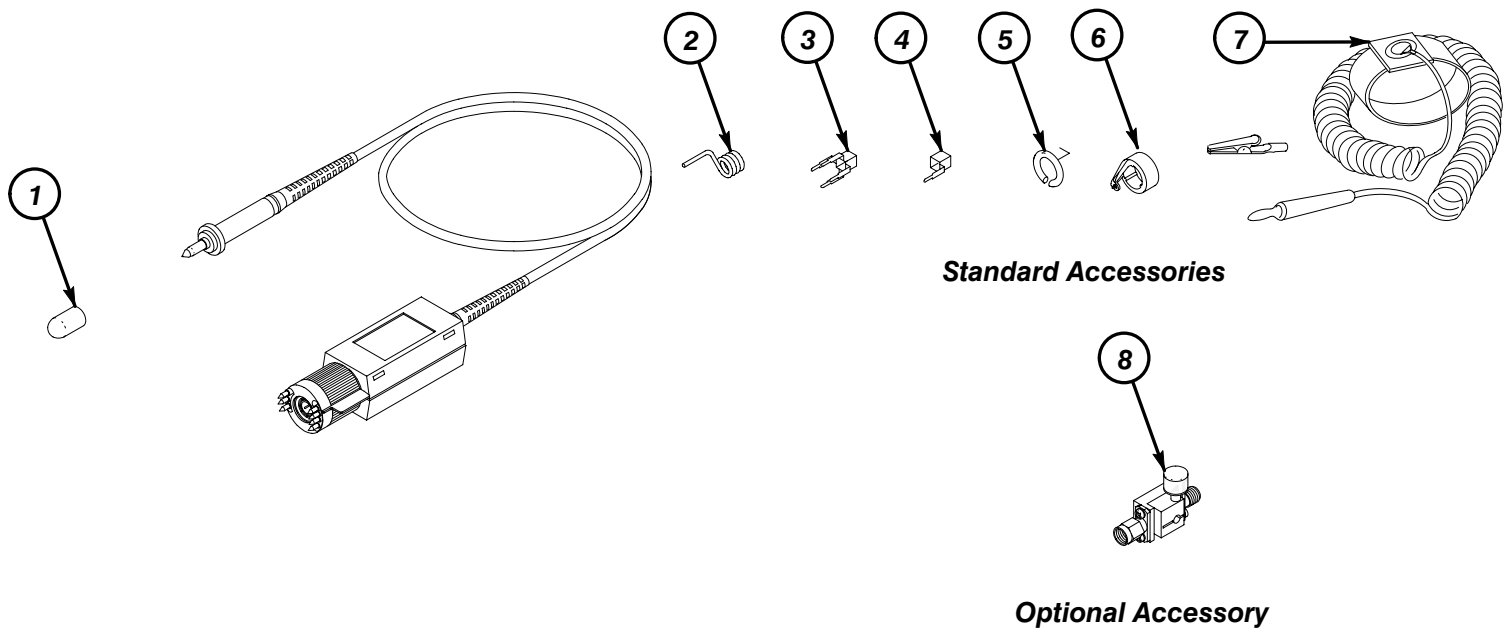


Figure 2-4: P6217 and Accessories

Fig. & Index No.	Tektronix Part No.	Serial No.		Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
		Effective	Dscont				
2-4-				1	P6217, PROBE, ACTIVE: 4 GHZ, 0.4PF, 10X, TEKPROBE		
-1	200-3961-00			1	COVER, PROBE TIP: ESD PROTECTIVE	TK1163	ORDER BY DESC
STANDARD ACCESSORIES							
-2	131-5482-00			1	CONTACT, ELEC: TIP GROUND, PKG OF 2 EA OF 5 LENGTHS	8X345	131-5482-00
-3	131-5308-00			8	CONTACT, ELEC: 4 LEGS	TK1326	ORDER BY DESC
-4	131-5309-00			5	CONTACT, ELEC: 1 LEG	TK1326	ORDER BY DESC
-5	-----			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)		
	070-8553-02			1	MANUAL, TECH: P6217	80009	070855302
-6	-----			2	ADAPTER, SMD, ORANGE, 50 MIL		
	-----			2	ADAPTER, SMD, BLUE, 0.65 mm/25 mil		
	-----			2	ADAPTER, SMD, RED, 0.50 mm/20 mil (SEE OPTIONAL ACCESSORIES)		
-7	006-3415-04			1	STRAP, WRIST: ADJUSTABLE, 5FT COILED CORD	80009	006341504

Fig. & Index No.	Tektronix Part No.	Serial No.		Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
		Effective	Dscont				
OPTIONAL ACCESSORIES							
-6	342-1039-10			12	ADAPTER, SMD, ORANGE, 50 MIL	80009	342103910
	342-1038-10			12	ADAPTER, SMD, BLUE, 0.65 mm/25 mil	80009	342103810
	342-1037-10			12	ADAPTER, SMD, RED, 0.50 mm/20 mil	80009	342103710
-8	013-0271-00			1	ADAPTER,T TIP:SMA TO SD14	80009	013027100
	016-0633-00			1	MARKER SET,CA:2 EA VARIOUS COLORS	80009	016063300

Appendix

Specifications

This section lists the electrical, environmental, and physical characteristics of the P6217 FET Probe. Following the specification tables are a series of graphs that characterize impedance by frequency, maximum input voltage by frequency, and typical bandwidth.

Performance Conditions

The electrical performance specifications listed in tables A-1 and A-2 apply to a calibrated probe used with a calibrated oscilloscope system, each operating within the environmental limitations listed in Table A-3.

Performance Verification

Specifications are separated into two categories, warranted specifications, and nominal or typical characteristics.

Warranted characteristics, Table A-1, are guaranteed performance specifications. This manual provides performance verification procedures for these specifications.

Nominal and typical characteristics, Table A-2, are not guaranteed and are provided to characterize the configuration, performance or operation of typical systems.

In any table, supplemental information consists of explanatory notes, setup descriptions, or performance characteristics for which no absolute limits are specified, or that are impractical to verify.

Specifications

Other specifications do not have verification procedures because the characteristics are stable and unlikely to change, or the equipment required to verify them is extremely expensive or not readily available.

Physical and environmental specifications are not verified in this manual.

Specifications are subject to change without notice.

Table A-1: Warranted P6217 FET Probe Characteristics

Characteristic	Specification	Supplemental Information
Attenuation	10X ± 2% at DC	2.0 VDC input 50 Ω ± 0.5% load.
Output Offset (output zero)	±10 mV	20 to 30° C
Rise Time (probe only)	≤ 100 ps	10% to 90% amplitude

Table A-2: Nominal and Typical Characteristics

Characteristic	Description	Supplemental Information
Aberrations		(typical)
first 300 ps	+15%, –10%	System (probe plus oscilloscope) aberrations using Tektronix 11801A Digitizing Oscilloscope
after 300 ps	±5%	
Bandwidth	> 4 GHz	(typical) Refer to Figure A-3 for typical frequency response
DC Thermal Drift	≤ 150 μV/° C	(typical) Probe output voltage
Delay Time	4.25 ns ± 200 ps	(typical) Probe tip to output connector 50% points of a 250 mV _{p-p} input signal
Dynamic Range	–4 V to +4 V	(typical)
Input Capacitance	< 400 fF	(typical) Refer to Figure A-1 for typical input impedance
Input Resistance (probe)	100 kΩ ± 5% at DC	(typical) Probe operating Refer to Figure A-1 for typical input impedance
Linearity	±3%	(typical) Within dynamic range

Specifications

Table A-2: Nominal and Typical Characteristics (cont.)

Characteristic	Description	Supplemental Information
Offset Range	± 5 V	(nominal) Not adjustable
Maximum Nondestructive Input Voltage	± 40 V	(typical) DC plus peak AC Refer to Figure A-2
Probe Coding		TEKPROBE Level 2

Table A-3: Environmental Characteristics

Characteristic	Description	Supplemental Information
Electrostatic Immunity		Tektronix does not warrant the P6217 FET Probe to meet the requirements listed in IEC 801-2
Humidity	10 to 30° C: $\leq 95\%$ R.H. 30 to 40° C: $\leq 75\%$ R.H. 40 to 50° C: $\leq 45\%$ R.H.	Meets the requirements of MIL-STD 28800 E Type III, Class 5
Temperature Range		Meets the requirements of MIL-STD 28800 E Type III, Class 5
Operating	0 to +50° C (+32 to +122° F)	
Nonoperating	-40 to +71° C (-40 to +160° F)	

Table A-4: Physical Characteristics

Characteristic	Performance Requirement	Supplemental Information
Shipping Weight (including accessories)	0.1 kg (0.22 lbs)	(nominal)
Probe Cable Length	1 m (3.3 ft)	(nominal)

Specifications

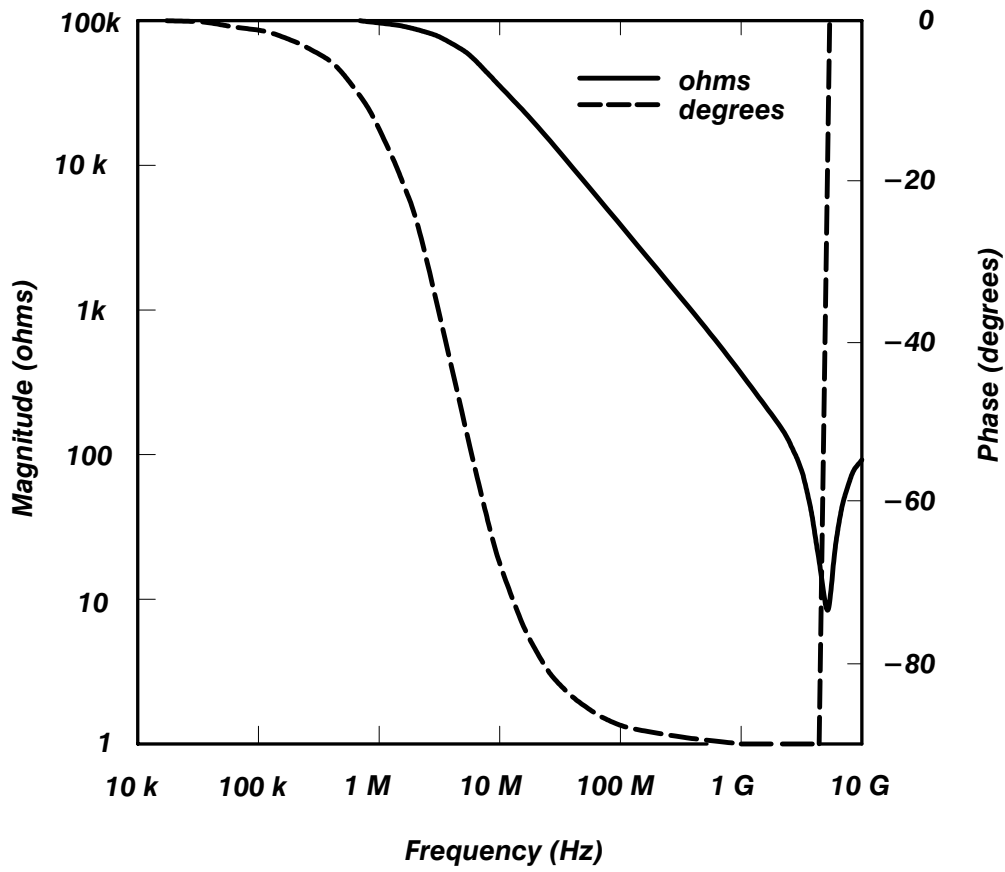


Figure A-1: Typical Input Impedance vs Frequency

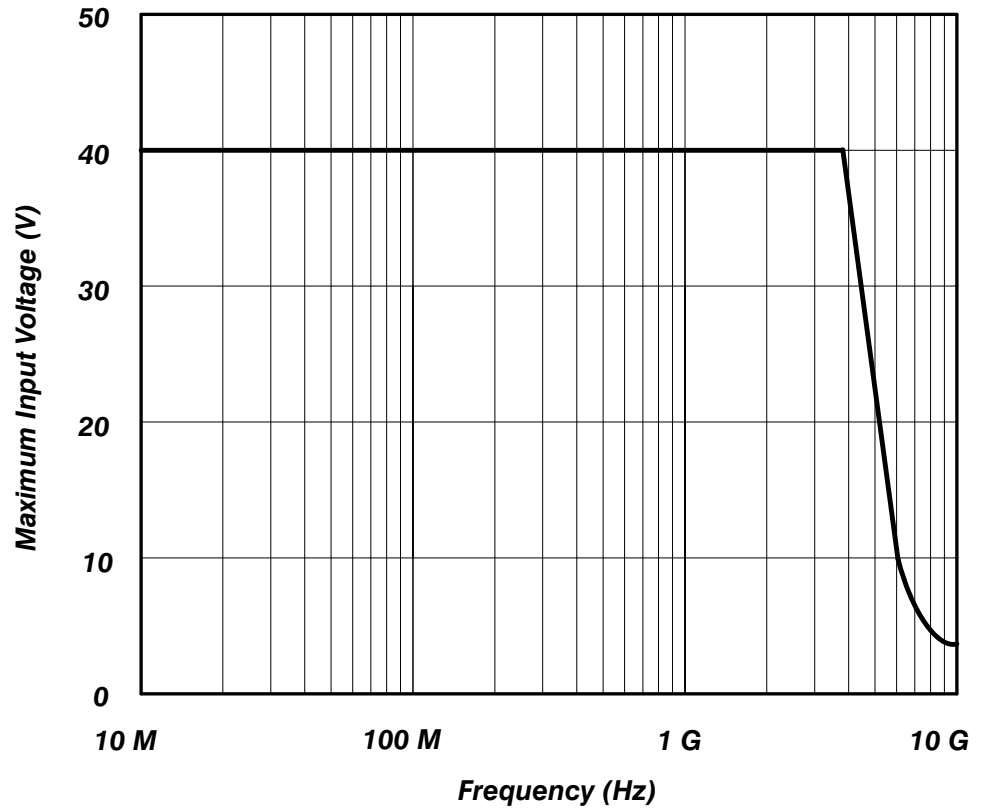


Figure A-2: Voltage Derating vs Frequency

Specifications

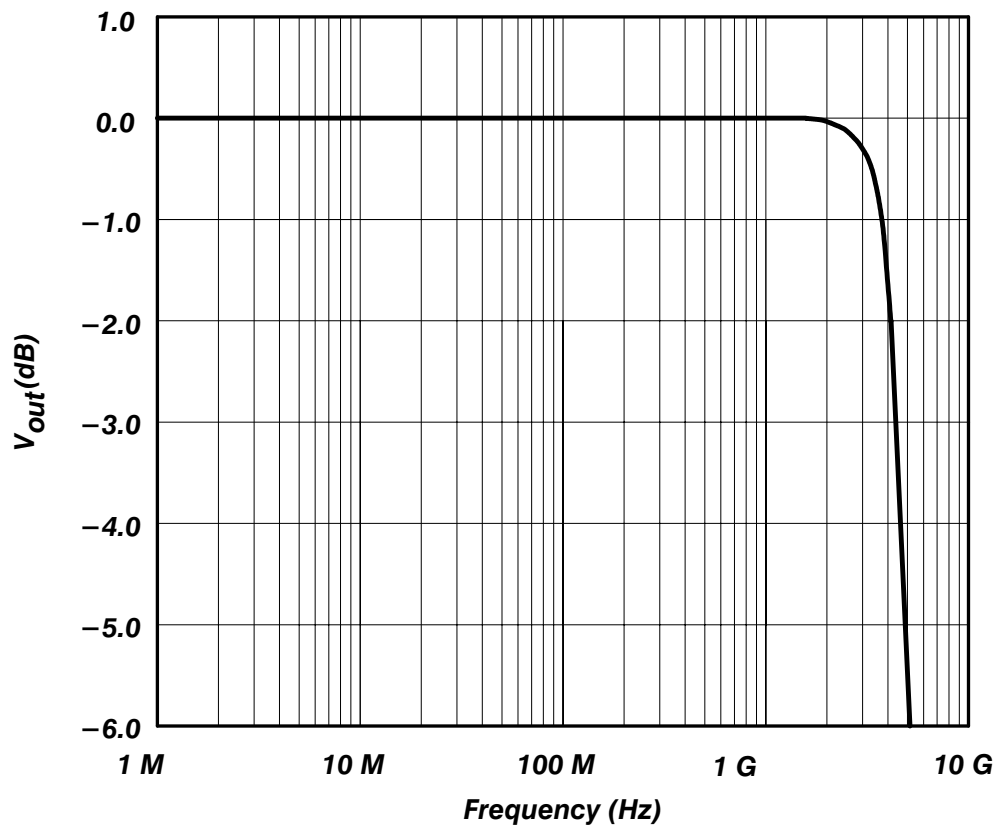


Figure A-3: Typical Frequency Response

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