Advanced Test Equipment Rentals
www.atecorp.com 800-404-ATEC (2832)

Instruction Manual

Tektronix

P6209
4 GHz 5X Active Probe

071-0634-04

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.

www.tektronix.com

Copyright © Tektronix, Inc. All rights reserved.

Tektronix products are covered by U.S. and foreign patents, issued and pending. Information in this publication supercedes that in all previously published material. Specifications and price change privileges reserved.

Tektronix, Inc., P.O. Box 500, Beaverton, OR 97077

TEKTRONIX, TEK, TEKPROBE, and SureFoot are registered trademarks, and SureToe, FlexLead, and KlipChip are trademarks of Tektronix, Inc.

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.

THIS WARRANTY IS GIVEN BY TEKTRONIX WITH RESPECT TO THIS PRODUCT IN LIEU OF ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED. TEKTRONIX AND ITS VENDORS DISCLAIM ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. TEKTRONIX' RESPONSIBILITY TO REPAIR OR REPLACE DEFECTIVE PRODUCTS IS THE SOLE AND EXCLUSIVE REMEDY PROVIDED TO THE CUSTOMER FOR BREACH OF THIS WARRANTY. TEKTRONIX AND ITS VENDORS WILL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IRRESPECTIVE OF WHETHER TEKTRONIX OR THE VENDOR HAS ADVANCE NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.

Table of Contents

General Safety Summary v
Service Safety Summary vii
Contacting Tektronix viii

Product Description

Options 1
Features and Standard Accessories 2
Optional Accessories 7

Configuration

Probe Offset 9

Functional Check

Operating Basics

Handling the Probe 13
Maximum Nondestructive Input Voltage 13
Input Linear Dynamic Range 13
Ground Lead Length 14

Helpful Hints

Low-inductance Grounding 17
SureFoot Grounding 18
Probe Tip Test Points 19

Specifications

Theory of Operation

Probe Head and Cable Assembly 30
Compensation Box 30
Offset Amplifier 30
Probe Identification EEPROM 30
TEKPROBE SMA Interface 31
VCC, +7 V Regulator 31

Performance Verification

Equipment Required 33
Equipment Setup 34
Output Zero 35
DC Attenuation Accuracy 36
Rise Time 38

Adjustments

Removing the Compensation Box Bottom Cover 43
Adjustment Locations 44
Offset Zero 44
Offset Scale 46

Maintenance

Inspection and Cleaning 49
Replacement Parts 49
Preparation for Shipment 49

Troubleshooting

Replaceable Parts

Parts Ordering Information 55
Using the Replaceable Parts List 56

List of Figures

Figure 1: Dynamic and offset limitations 10
Figure 2: Probe functional check connections 11
Figure 3: Ground lead equivalent circuit 14
Figure 4: Low-inductance grounding 17
Figure 5: Using a SureFoot adapter for grounding 18
Figure 6: Using a probe tip as a test point 19
Figure 7: Typical input impedance and phase versus frequency 24
Figure 8: Typical bandwidth 24
Figure 9: Dimensions of probe head and compensation box . . 26
Figure 10: P6209 simplified schematic diagram 29
Figure 11: TEKPROBE SMA Interface pin assignments 31
Figure 12: P6209 output zero setup 35
Figure 13: P6209 DC attenuation accuracy setup 37
Figure 14: Test system rise time setup 38
Figure 15: Test system and probe rise time setup 39
Figure 16: Removing the compensation box bottom cover . . . 43
Figure 17: P6209 adjustment and measurement locations 44
Figure 18: P6209 offset zero setup 45
Figure 19: P6209 offset range setup 47
Figure 20: Compensation box test point locations 52
Figure 21: TEKPROBE SMA Interface pin assignments 52
Figure 22: P6209 replaceable parts 57
Figure 23: P6209 standard accessories 58
Figure 24: P6209 optional accessories 60

General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. To avoid potential hazards, use this product only as specified.

Only qualified personnel should perform service procedures.

To Avoid Fire or Personal Injury

Connect and Disconnect Properly. Connect the probe outputs to the measurement instrument before connecting the probe to the circuit under test. Disconnect the probe input and the probe ground from the circuit under test before disconnecting the probe from the measurement instrument.

Observe All Terminal Ratings. To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

Connect the ground lead of the probe to earth ground only.

Do Not Operate Without Covers. Do not operate this product with covers or panels removed.

Do Not Operate With Suspected Failures. If you suspect there is damage to this product, have it inspected by qualified service personnel.

Do Not Operate in Wet/Damp Conditions.

Do Not Operate in an Explosive Atmosphere.

Keep Product Surfaces Clean and Dry.

Safety Terms and Symbols

Terms in This Manual. These terms may appear in this manual:

WARNING. *Warning statements identify conditions or practices that could result in injury or loss of life.*

CAUTION. *Caution statements identify conditions or practices that could result in damage to this product or other property.*

Terms on the Product. These terms may appear on the product:

DANGER indicates an injury hazard immediately accessible as you read the marking.

WARNING indicates an injury hazard not immediately accessible as you read the marking.

CAUTION indicates a hazard to property including the product.

Symbols on the Product. These symbols may appear on the product:

CAUTION
Refer to Manual

Service Safety Summary

Only qualified personnel should perform service procedures. Read this *Service Safety Summary* and the *General Safety Summary* before performing any service procedures.

Do Not Service Alone. Do not perform internal service or adjustments of this product unless another person capable of rendering first aid and resuscitation is present.

Contacting Tektronix

Phone	1-800-833-9200*
Address	Tektronix, Inc. Department or name (if known) 14200 SW Karl Braun Drive P.O. Box 500 Beaverton, OR 97077 USA
Web site	www.tektronix.com
Sales support	1-800-833-9200, select option 1*
Service support	1-800-833-9200, select option 2*
Technical support	Email: techsupport@tektronix.com 1-800-833-9200, select option 3* 6:00 a.m. – 5:00 p.m. Pacific time

*** This phone number is toll free in North America. After office hours, please leave a voice mail message.**
Outside North America, contact a Tektronix sales office or distributor; see the Tektronix web site for a list of offices.

Product Description

The Tektronix P6209 is a 4 GHz (probe only), 5X active FET probe with 1 pF input capacitance. The probe is designed primarily for use with sampling oscilloscopes, such as the CSA/TDS8000. The P6209 has a low input capacitance and high input resistance, which minimize circuit loading over a wide bandwidth range.

The small profile and low-mass head of the P6209 make manual probing of crowded circuits fast and easy. The accessory tips and adapters enable the P6209 to be used on a wide variety of circuit architectures.

The P6209 is powered through a TEKPROBE SMA interface between the probe compensation box and the oscilloscope.

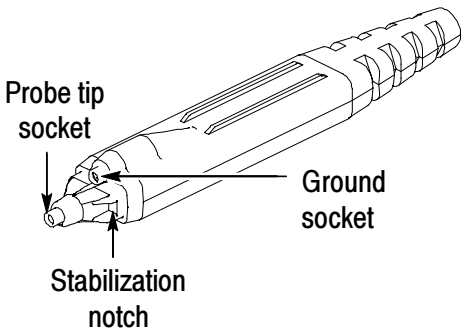
Options

The following options are available when ordering the P6209 probe:

- Option D1 – Calibration Data
- Option C3 – 3 years Calibration Service
- Option D3 – 3 years Calibration Data
- Option R3 – 3 years Extended Warranty

Features and Standard Accessories

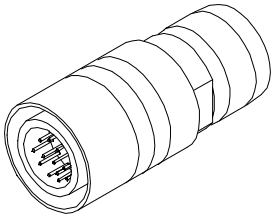
The P6209 probe is provided with several features and accessories designed to make probing and measurement a simpler task. Please familiarize yourself with these items and their uses. For part number information and quantities of standard and optional accessories, refer to *Replaceable Parts* on page 55.



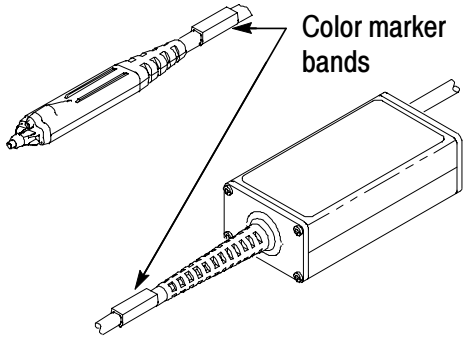
Probe head assembly. The probe head is designed for ease of use and high performance. Its small size makes it easy to handle in tight areas.

The probe tip socket is sized to easily press onto 0.025 inch pins for direct access. The ground socket provides a short ground path for high fidelity ground connections.

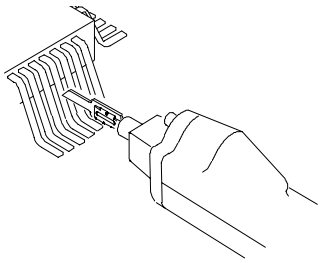
The stabilization notch permits you to use adjacent pins to reduce stresses on the probe and pins.



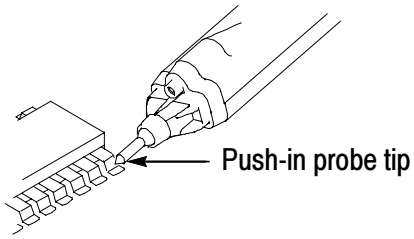
TEKPROBE SMA interface. The TEKPROBE SMA interface provides a communication path between the probe and the oscilloscope. Contact pins provide power, offset, and probe characteristic data transfer. See page 31 for more information.



Color marker bands. Attach matching pairs of the color marker bands onto the cable at the head and compensation box of each probe. The marker bands enable quick verification of which probe is connected to which instrument channel.

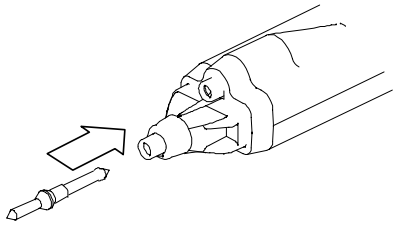


SureToe probe tip. The SureToe tip is a pointed probe tip useful for probing in dense circuitry. Attach the SureToe adapters the same way as the push-in probe tips. *Do not force the tip*. Also, be careful not to injure yourself with the sharp probe tip. They can be used with any of the socketed accessory leads.

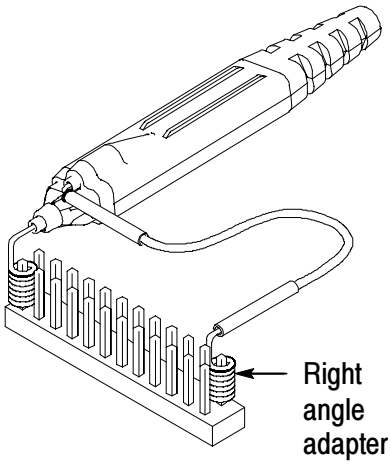


Push-in probe tip. Use the push-in probe tip for general purpose probing by hand. The tip may also be used as a temporary test point. See page 19 for more information.

The push-in probe tip may also be used with the other socketed leads and adapters.



Installing the push-in probe tip. Attach the push-in probe tip by seating the tip into the probe tip socket and pushing the tip in until it is seated. Either end of the tip may be used.
Do not force the tip. Also, be careful not to injure yourself with the sharp probe-tip. To remove the tip, *gently* grab the tip with small pliers and pull the tip out.

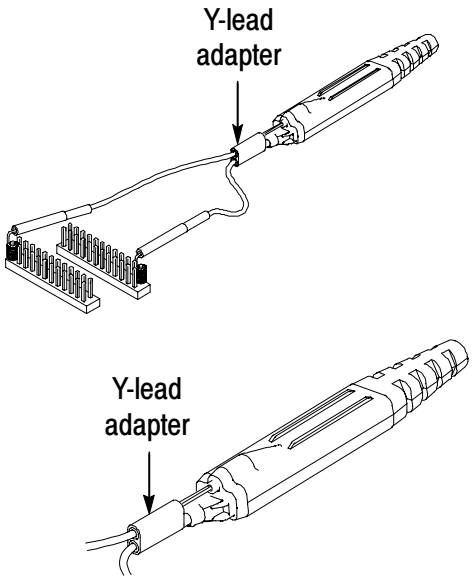


Right-angle adapter. Use the right-angle adapter for low-profile probing of 0.025 inch square pins.

The right-angle adapter allows the probe to lie flat against a circuit board. This enables probing in vertical circuits, such as computer or communications backplanes, or in tight areas, such as between circuit cards.

The right-angle adapter can be used directly with the probe head or attached to the Y-lead adapter or ground leads.

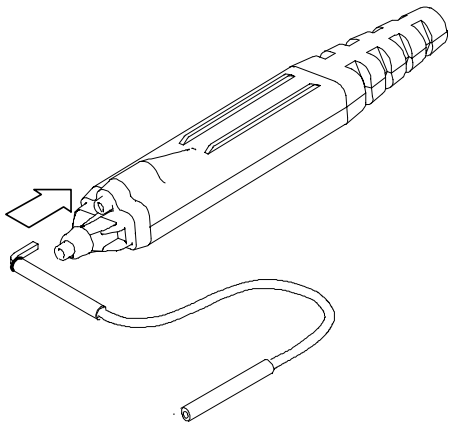
The right-angle adapter is attached the same way as the push-in probe tip and can be easily removed by hand.



Y-lead adapter. Use the Y-lead adapter to extend the physical reach of the probe and ground when necessary. The Y-lead adapter accepts any of the probe tips or adapters and can be pushed directly onto 0.025 inch pins.

When selecting the grounding connection, maintain as short a ground path as possible. Refer to page 14 for more information.

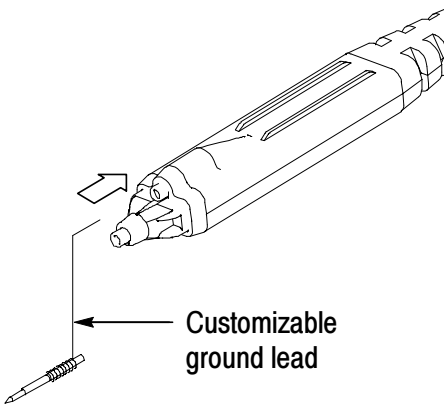
To attach the Y-lead adapter, gently press the lead pins into the probe head tip and ground receptacles. Using the black lead for ground is recommended.



Three-inch ground lead. Use the three-inch ground lead for general probing. The socketed end of the lead may be connected to any of the probe tips and adapters or fitted onto 0.025 inch pins.

To attach the ground lead, press and rotate the lead pin connector into the ground socket on the probe head. The lead may be removed by simply pulling the pin out by hand.

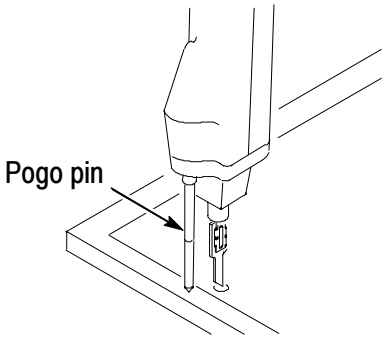
When selecting the grounding connection, maintain as short a ground path as possible. Refer to page 14 for more information.



Customizable ground lead. This ground lead wire can be bent or cut shorter.

NOTE: To ease insertion into the ground socket of the probe, cut the tip of this ground lead wire at a 30 to 60 degree angle.

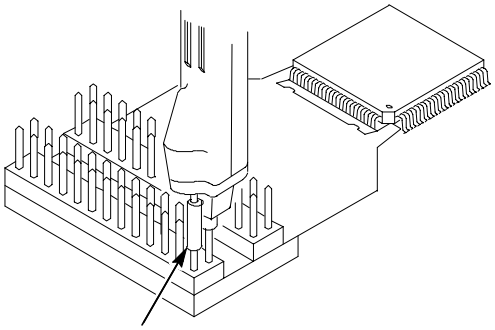
To maintain signal fidelity while probing, use as short a ground path as possible. Refer to page 14 for more grounding information.



Low-inductance ground pogo pin. Use the low-inductance ground pogo pin to substantially reduce ground lead inductance. Because the pogo pin simply touches the ground reference, you can easily move the probe to different points on the circuit under test.

To attach, press the pogo pin into the probe head ground socket.

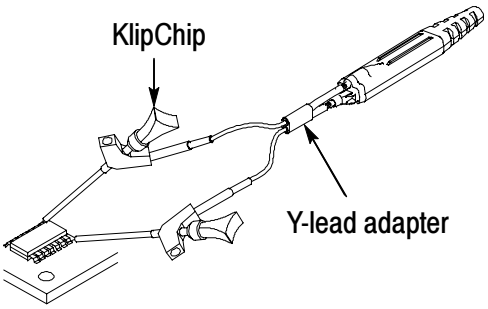
When selecting the grounding connection, maintain as short a ground path as possible. Refer to page 14 for more information.



Signal-ground adapter. The signal-ground adapter is ideal for use with signal/ground pairs on 0.100 inch header pins.

Attach the signal-ground adapter by gently pressing it into the ground socket on the probe head.

Be sure to use the stabilization notch whenever possible to avoid slipping and damaging the probe or circuitry under test.

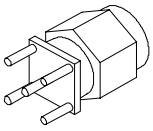


SMT KlipChip. Use the SMT KlipChip test clips to access fragile, dense circuitry.

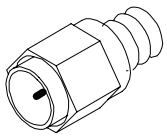
KlipChip test clips can be connected to the Y-lead or three-inch ground leads. Simply press the lead socket into the KlipChip handle.

The KlipChip body freely turns, allowing better probe orientation. To reduce stress and provide a lower profile on components being tested, the flexible sleeve of the KlipChip bends up to a 35 degree angle.

When selecting the grounding connection, maintain as short a ground path as possible. Refer to page 14 for more information.



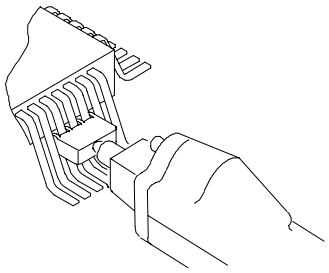
SMA adapter jack. Use the SMA adapter jack with the SMT KlipChips to gain access to calibration signals from SMA connectors on the oscilloscope front panel.



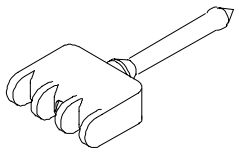
Male SMA termination. Protect the probe input circuitry by connecting the termination to the probe input connector when the probe is not in use.

Optional Accessories

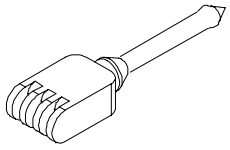
The following accessories are available for the probe. See the *Replaceable Parts List* on page 55 for ordering information.



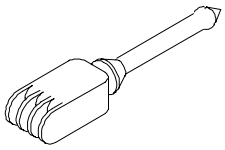
SureFoot probe tips. The SureFoot tip is an integral probe tip and miniature guide that enables fault-free probing of fine-pitch SMD packages. Attach SureFoot adapters the same way as the push-in probe tips. They can be used with any of the socketed accessory leads.



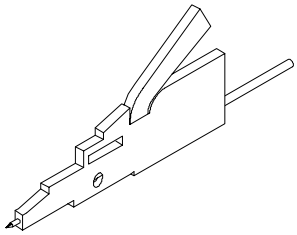
The orange, 0.050 inch SureFoot tip is compatible with 50 mil JEDEC packages such as SOIC, PLCC, and CLCC.



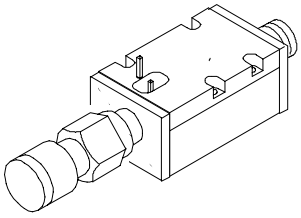
The blue, 0.025 inch SureFoot tip is compatible with 0.65 mm JEDEC and EIAJ packages.



The red, 0.5 mm SureFoot tip is compatible with EIAJ packages.



SMK4 Micro KlipChip adapters. Use the Micro KlipChip adapters to probe the leads on integrated circuits that are surface-mounted.



SMA-to-probe tip adapter. Use the adapter to connect the probe to SMA cables. The adapter includes a 50-ohm SMA termination.

Configuration

The P6209 provides the oscilloscope with the probe model number, serial number, and attenuation factor. When connected to the oscilloscope, the display readouts are corrected for the probe attenuation factor.

The probe offset control is controlled by the oscilloscope.

CAUTION. *To prevent damage to your probe, do not apply a voltage outside the Maximum Input Voltage rating. See* Specifications *on page* 21.

To prevent electrostatic damage to the instrument and sampling modules, follow the precautions described in the manuals accompanying your instrument.

Always use a wrist strap (provided with your probe) when handling the probe and sampling modules, and when making signal connections.

Probe Offset

The purpose of the offset capability is to permit the input signal to be positioned in the center of the dynamic range of the probe amplifier, to obtain the best transient response. Using the offset to cancel DC signal components enables optimal probe performance. See Figure 1 on page 10 for more information.

NOTE*. If the offset is not correctly positioned, clipping or distortion of the displayed signal may occur. See your oscilloscope manual for specific instructions on its operation and offset control.*

To set the probe offset, follow these steps:

1. Set the oscilloscope vertical scale to the least sensitive V/div setting (**500 mV/div** on the CSA/TDS8000).
2. Attach the probe to the circuit.
3. Adjust the probe offset to bring the trace onto the oscilloscope screen.
4. Change the volts/division setting to the desired range, adjusting the offset to keep the trace on screen.

NOTE. *The* P6209 *has a ±5.0 V offset range. The linear operating range is ±2.00 V. See Figure 1. Also, see page 13 for more information.*

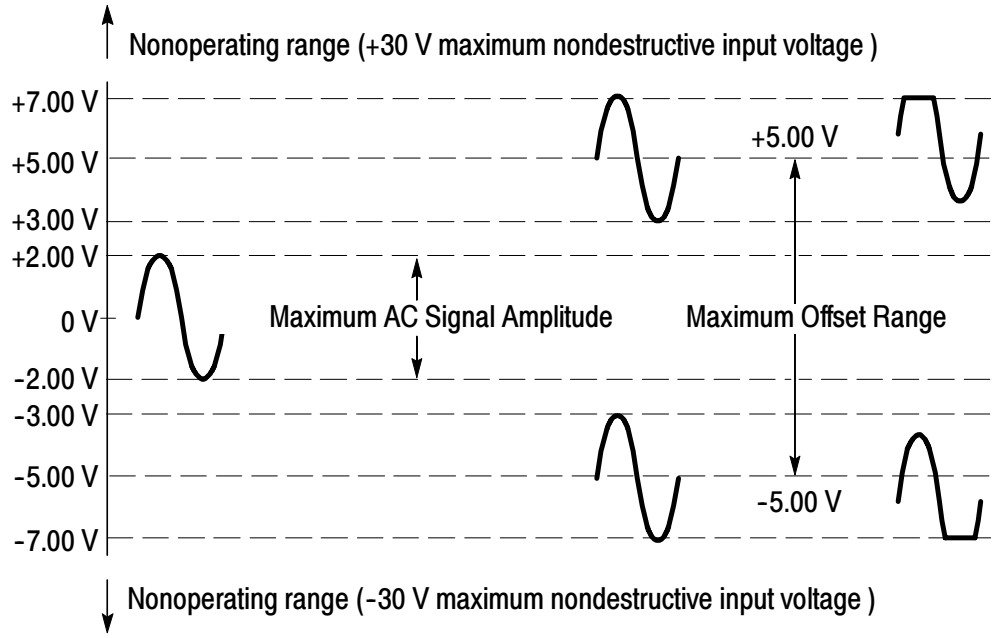


Figure 1: Dynamic and offset limitations

Functional Check

After installing the probe on the CSA/TDS8000 oscilloscope, a functional check may be performed using the INTERNAL CLOCK OUTPUT connection on the front panel of the oscilloscope. See Figure 2.

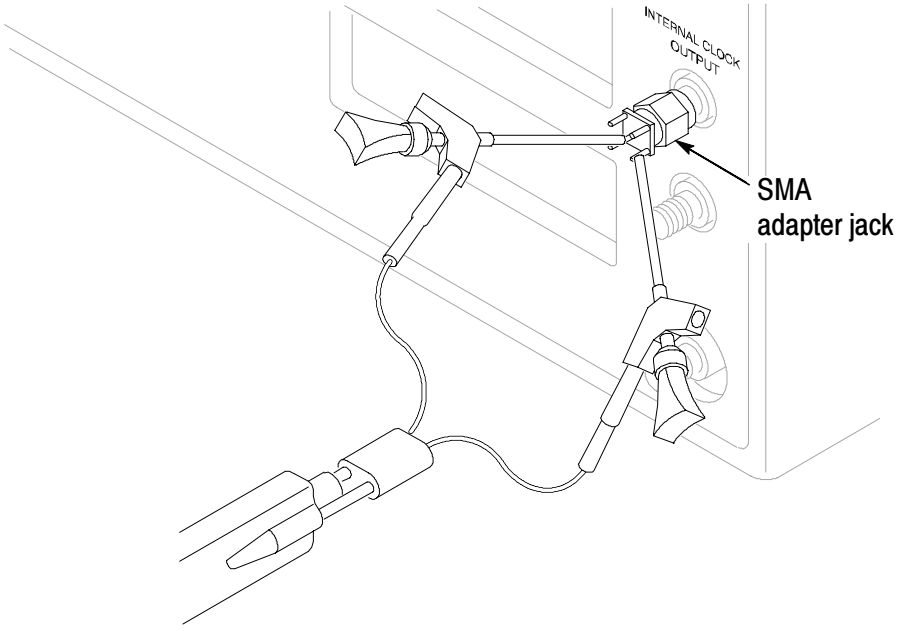


Figure 2: Probe functional check connections

1. Set the oscilloscope to display the probe channel.
2. Using the Y-lead connector, SMT KlipChips and the SMA adapter jack accessories, connect the probe to the INTERNAL CLOCK OUTPUT connection on the oscilloscope, as shown in Figure 2.
3. In the setup menu, set the trigger source to **internal clock** and the frequency to **200 kHz**.

4. Set the offset to **1V**, the vertical scale to **500 mV/div**, and the horizontal scale to **2 µs/div**.
5. The observed waveform should be a 200 kHz square wave with an amplitude of approximately 2 V (the clock output is unterminated), and have an offset of approximately 1 V.

If the probe does not pass this functional check, go to *Troubleshooting* on page 51.

Operating Basics

Please follow these operating guidelines to get optimum performance from your P6209 probe.

Handling the Probe

Exercise care when using and storing the P6209 probe. The probe and cable are susceptible to damage caused by careless use. Always handle the probe using the compensation box and probe head, avoiding undue physical strain to the probe cable, such as kinking, excessive bending, or pulling. Visible dents in the cable will increase signal aberrations. Do not drop the probe or subject it to physical shock. Damage to the probe may result.

CAUTION. *To prevent damage to your probe, do not apply a voltage outside the Maximum Nondestructive Input Voltage for the probe.*

Always use a wrist strap (provided with your probe) when handling the probe and sampling modules, and when making signal connections.

Maximum Nondestructive Input Voltage

Applying voltages above the P6209 design limits may damage the probe tip amplifier. Please refer to *Specifications* on page 21 for the maximum operating voltage and frequency derating information.

Input Linear Dynamic Range

The probe head amplifier used by the P6209 has a limited linear operating range. To keep the input linearity error less than 0.1%, you must limit the apparent signal input voltage to ±1.75 V.

Use the DC offset adjustment to maintain the probe within its dynamic range. The nominal offset adjustment range of the P6209 is ±5.0 VDC. For example: to offset a +2 VDC level in a circuit, set the offset to +2 V.

***NOTE**. The probe can tolerate input voltages of ±30 V (≤5 minutes) without damage; however, the linearity error specification does not apply to input voltages outside the linear dynamic range of the probe. See Figure 1 on page 10.*

Ground Lead Length

When you are probing a circuit, you should always use as short a ground lead as possible between the probe head and circuit ground.

The series inductance added by the probe tip and ground lead can result in a resonant circuit; this circuit may cause parasitic ringing within the bandwidth of your oscilloscope. 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 3.

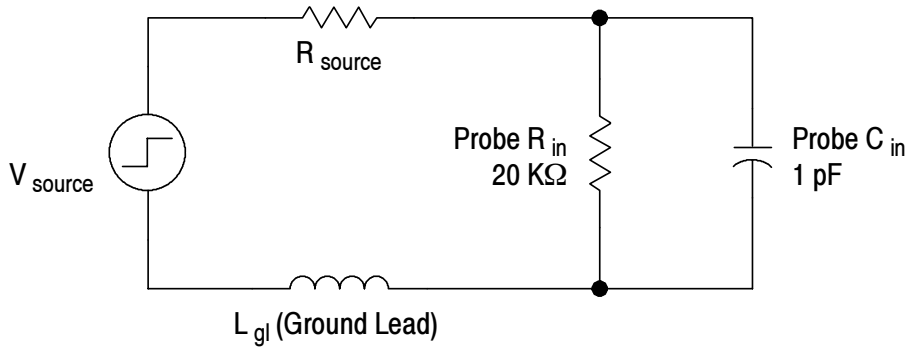


Figure 3: Ground lead equivalent circuit

Ringing and rise time degradation can be masked if the frequency content of the signal degradation is beyond the bandwidth of the oscilloscope.

You can determine if ground lead effects may be a problem in your application if you know the self-inductance (L) and capacitance (C) of your probe and ground lead. Calculate the approximate resonant frequency (f_0) at which this parasitic circuit will resonate with the following formula:

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

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 of your measurements.

The low-inductance ground contacts described in *Accessories* can help you reduce the effects of ground lead inductance on your measurements.

Helpful Hints

Follow these helpful hints to make probing easier and noise free.

Low-inductance Grounding

Placing a ground plane on top of a package being probed can minimize ground lead length and inductance. See Figure 4.

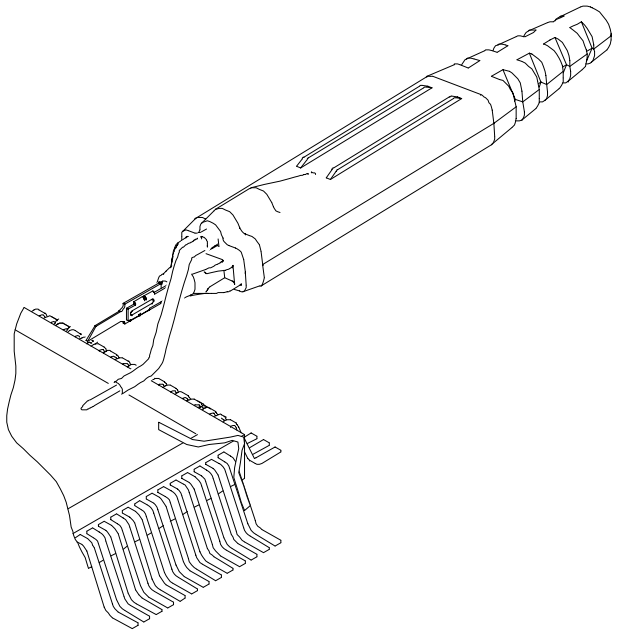


Figure 4: Low-inductance grounding

Attach a small piece of copper clad on top of the package and connect it to the package ground connection. Use the low-inductance ground lead provided with the P6209 to keep the ground lead length as short as possible.

This method is very useful when making many measurements on the same package. Using a ground plane on the package makes probing the package easier and avoids adding unnecessary ground lead length and distortion.

SureFoot Grounding

If you cannot use the recommended low-inductance grounding method, you may ground the probe to the package under test using a SureFoot adapter. Refer to Figure 5.

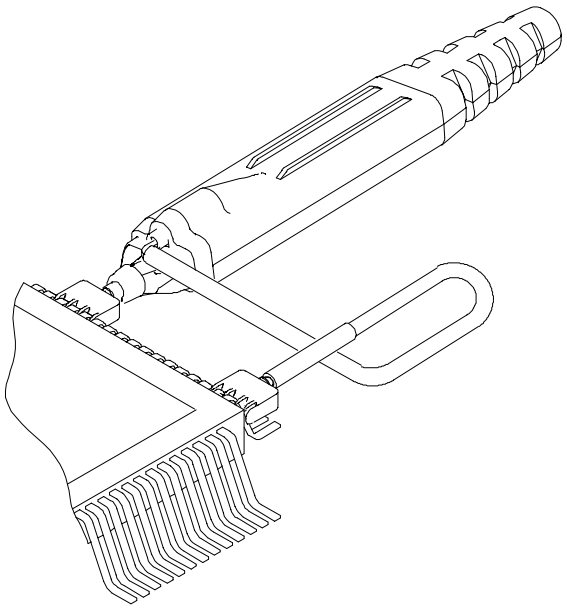


Figure 5: Using a SureFoot adapter for grounding

Use a SureFoot adapter at the end of a short ground lead to connect directly to the package ground. This method is preferred over using an adjacent circuit ground because it is the shortest ground path possible.

Probe Tip Test Points

You can solder the push-in probe tip or a 0.025 square pin to a circuit to be used as a temporary test point. See Figure 6.

Solder the tip onto a lead or pin with a low-power soldering iron. Press the probe head onto the tip to make a measurement, and then pull the probe head off when you are done.

The probe tip may be removed and reused by desoldering it from the circuit and soldering it into another circuit in the future.

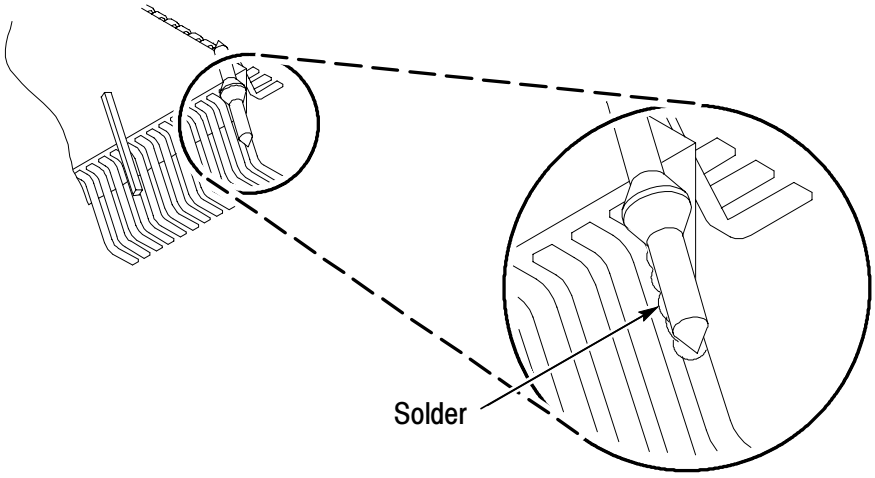


Figure 6: Using a probe tip as a test point

***NOTE**. Do not use pieces of solid-core copper wire as test points. If the wire breaks off in the probe tip socket, it may be impossible to remove the wire, and it will prevent insertion of other accessory tips.*

Specifications

These specifications apply to a P6209 probe when used with a CSA/TDS8000 oscilloscope, and other oscilloscopes with a TEKPROBE SMA interface.

The probe and oscilloscope must first be allowed to warm up for 20 minutes before measurements are taken.

CAUTION. *Do not apply voltages beyond the nondestructive input voltage range to the probe. Damage to the probe or circuit under test may result.*

Table 1: Warranted electrical specifications

DC Gain Accuracy (probe only)	0.2 ±2% (excludes offset error)
Rise Time (small signal, probe only)	≤120 ps (≤ 250 mV, 20-30° C)
Output Zero	±7.5 mV or less at output of probe (does not include oscilloscope offset control voltage error) (20-30° C) ±37.5 mV or less displayed on screen with TEKPROBE SMA interface (does not include oscilloscope offset control voltage error) (20-30° C)
Delay Time	5.95 ns ±0.2 ns (includes SMA output cable)
System Noise	300 μV rms or less at output of probe with probe tip grounded

Table 2: Typical electrical characteristics

Bandwidth, (probe only)	4 GHz (See Figure 8)
Linear Input Dynamic Range	-2.00 V to +2.00 V. (Equivalent to -0.40 V to +0.40 V at the output of the probe.)
Linearity Maximum deviation from linear regression expressed as a percentage of the specified full-scale dynamic range	± 0.1% over a dynamic range of -1.75 V to +1.75 V (±3.5 mV) ± 1.0% over a dynamic range of -2.00 V to +2.00 V (±40 mV)
Nondestructive Input Voltage Range	-30 V to +30 V (DC + peak AC) (5 minutes maximum continuous exposure)
Input Resistance	20 kΩ at DC. (See Figure 7)
Input Capacitance	0.85 pF @100 MHz
Offset Range	-5.0 V to +5.0 V
DC Offset Drift	150 μV/°C or less at output of probe 0.75 mV/°C or less displayed on screen with TEKPROBE SMA interface
DC Offset Scale Accuracy (gain of offset signal path)	± 2.0% (of 5X actual probe gain)
DC Voltage Measurement Accuracy (referred to input)	± [2% of input + (2% of offset) + 37.5* mV + (3.5 mV or 40 mV†)]

*** Worst case value.**

† Worst case values - see linearity specification.

Calculating DC Voltage Measurement Accuracy:

DC Voltage Measurement Accuracy (referred to input)

= ±[2% of input + (2% of offset) + 37.5 mV + 3.5 mV]

where:

gain error = ±2% of input voltage (relative to offset voltage)

offset gain error = ±2% of effective offset at probe tip

output zero = ±37.5 mV effective at probe tip (worst case, but does not include any oscilloscope offset control voltage error)

linearity error[1] = ±0.1% of ±1.75 V (3.5 V full scale)=±3.5 mV

High Error Example. To determine the maximum specified DC error when measuring a PECL logic high of approximately 4.1 V with probe offset set to 3.7 V:

±(2% of input voltage = 8 mV, +

2% of offset voltage = 74 mV, +

output zero = 37.5 mV (worst case value), +

linearity error = 3.5 mV)

= ±123 mV

Low Error Example. To determine the maximum specified DC error when measuring a LVDS low of approximately 1.0 V without any probe offset (0 V):

±(2% of input voltage = 20 mV, +

2% of offset voltage = 0 mV, +

output zero = 5 mV (effective offset at probe tip due to typical offset value of 1 mV at probe output), +

linearity error = 3.5 mV)

= ±28.5 mV

1 The linearity specification is rated with a segmented range (see page 22). The linearity error is higher at the extreme ends of the dynamic range.

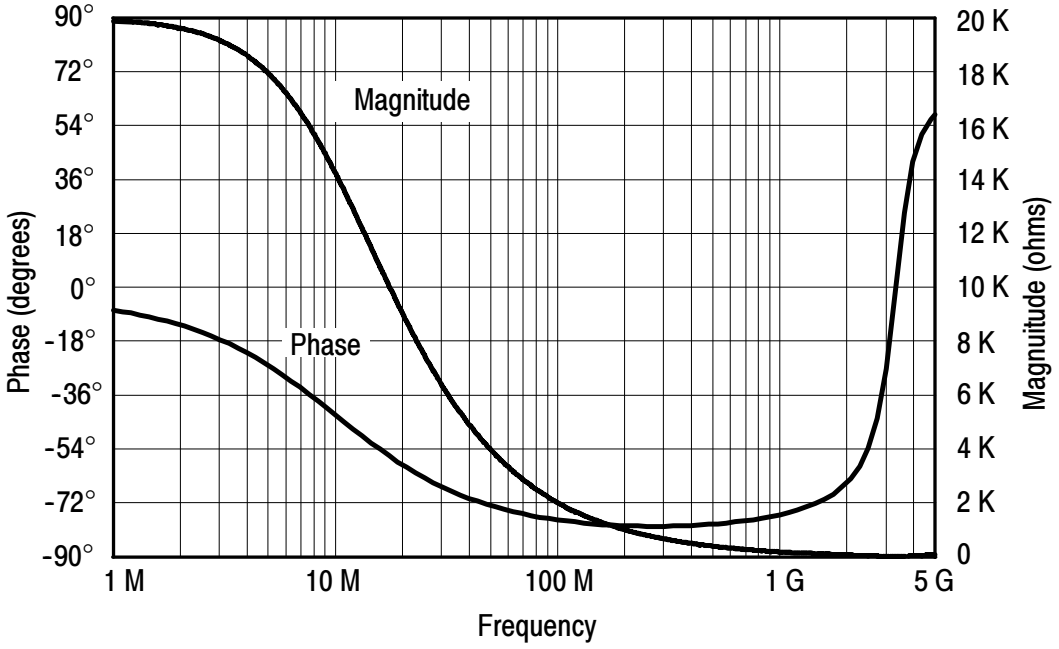


Figure 7: Typical input impedance and phase versus frequency

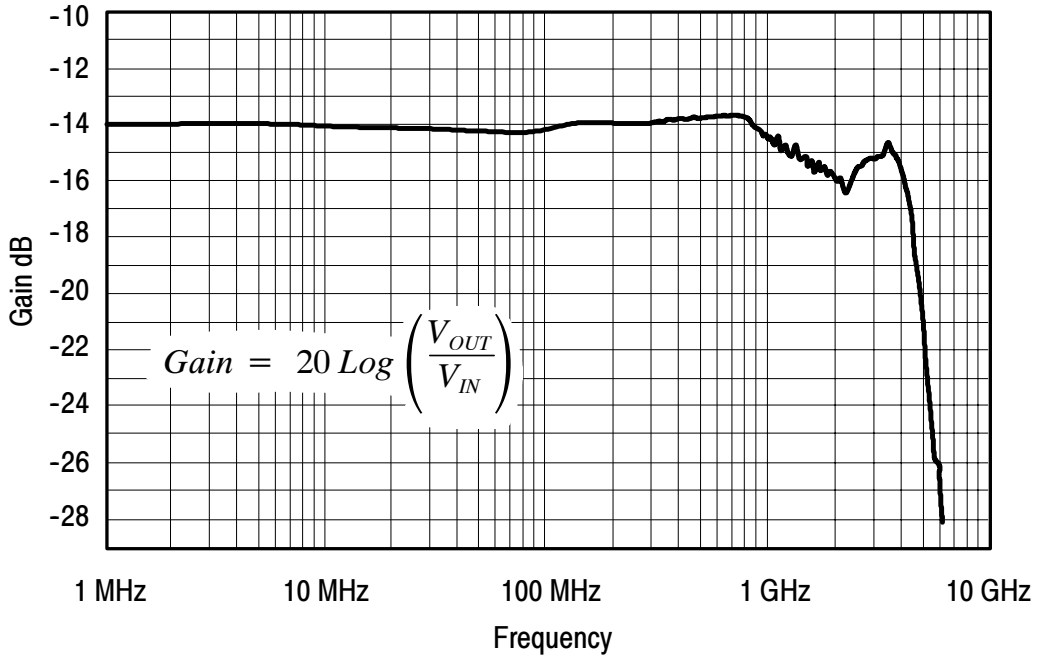


Figure 8: Typical bandwidth

Table 3: Environmental characteristics

Operating Temperature	0° C to +40° C The environmental exposure procedure used as stated in Tektronix Design Standard 062-2847-00 for Class 5 equipment.
Nonoperating Temperature	–40° C to +71° C The environmental exposure procedure used as stated in Tektronix Design Standard 062-2847-00 for Class 5 equipment.
Humidity	80% RH at 40° C The environmental exposure procedure used as stated in Tektronix Design Standard, 062-2847-00 for Class 5 equipment.
Altitude	Operating: 15,000 ft. NonOperating: 50,000 ft.

Table 4: Physical Characteristics

Net Shipping Weight	3.1 lb (1.4 kg)
Cable Length (probe tip to SMA)	(1.37 meters)

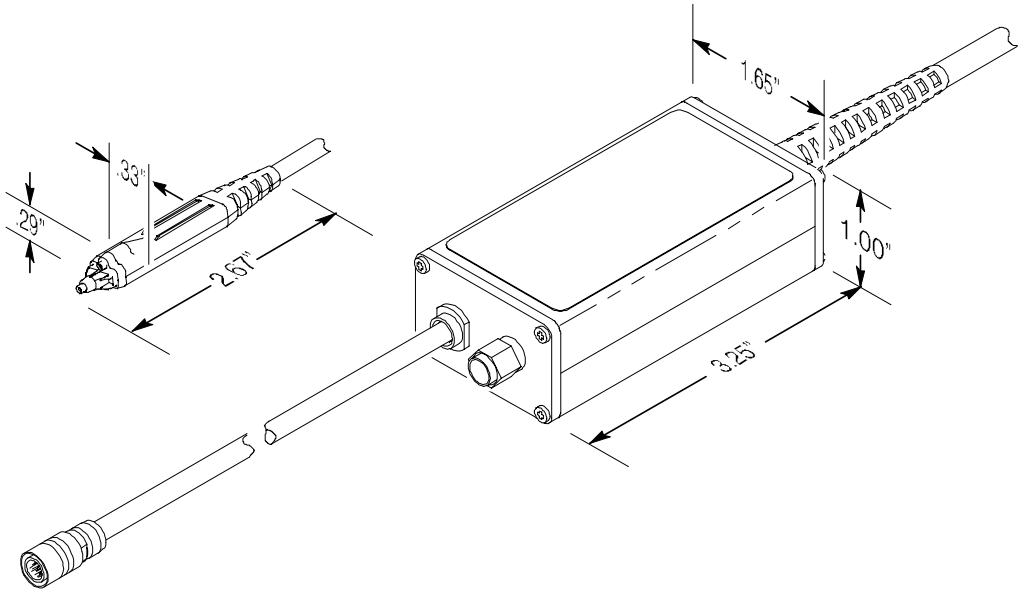


Figure 9: Dimensions of probe head and compensation box

WARNING

The following servicing instructions are for use only by qualified personnel. To avoid injury, do not perform any servicing other than that stated in the operating instructions unless you are qualified to do so. Refer to all safety summaries before performing any service.

Theory of Operation

There are no user replaceable parts within the probe or the compensation box; however, this theory of operation is provided to assist you in isolating failures to either the probe or the host oscilloscope. Refer to Figure 10 for the simplified schematic.

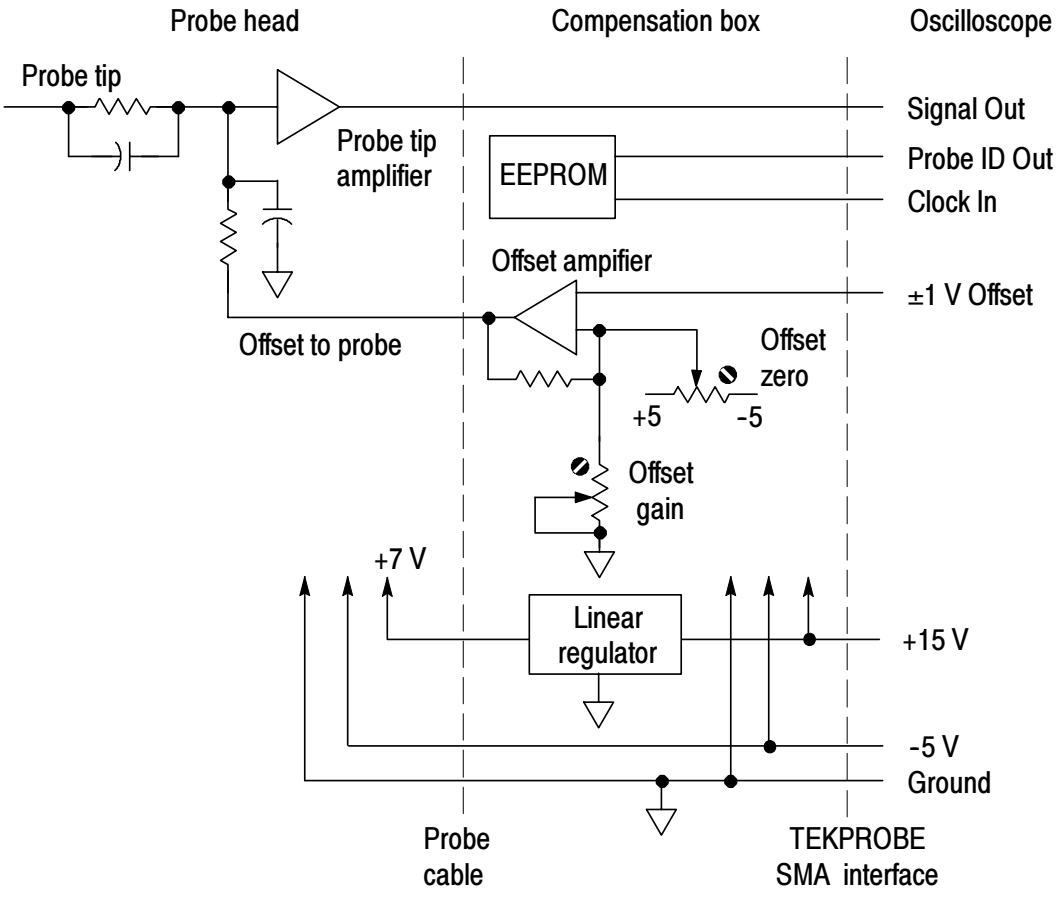


Figure 10: P6209 simplified schematic diagram

Probe Head and Cable Assembly

The probe head assembly contains an active amplifier circuit that buffers and amplifies the input signal. The amplifier receives power and an offset level from the compensation box assembly via the cable assembly.

All signal amplification and buffering is performed in the probe head assembly. No further amplification takes place in the compensation box.

Compensation Box

The compensation box contains the following circuits:

- Offset amplifier
- Probe identification EEPROM
- TEKPROBE SMA interface
- V_{CC}, +7 V linear regulator

Offset Amplifier

The offset amplifier is used to offset the input signal DC component so that it stays at the optimal point of the probe linear dynamic range. For more information on the linear dynamic range characteristic, refer to *Input Linear Dynamic Range* on page 13.

The offset amplifier receives offset information as a ±1 VDC voltage from the oscilloscope. The amplfier then amplifies it to match the probe characteristics and applies it to the probe head circuit.

The offset amplifier has two adjustments: offset zero and offset scale. These adjustments rarely need attention; however, detailed adjustment instructions are in the *Adjustment* section on page 43.

Probe Identification EEPROM

The probe identification EEPROM is used to configure the oscilloscope to the probe. The EEPROM receives a clock input from

the oscilloscope, and information about the probe is passed to the oscilloscope.

TEKPROBE SMA Interface

The TEKPROBE SMA interface provides a communication path between the probe and the oscilloscope. Contact pins provide power, signal, offset, and data transfer for the probe identification EEPROM.

Figure 11 shows the probe interface pin functions. Refer to your oscilloscope service documentation for more detailed specifications.

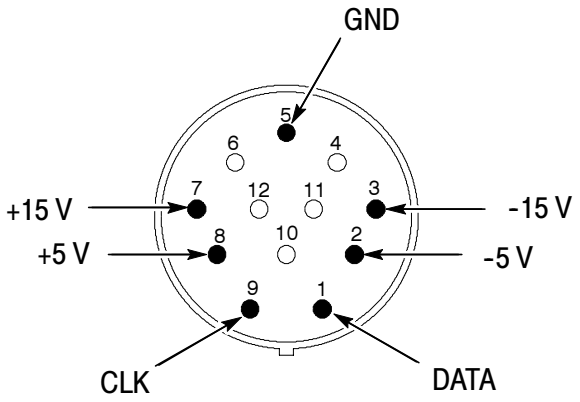


Figure 11: TEKPROBE SMA Interface pin assignments

V_{CC}, +7 V Regulator

The +15 V input is regulated to +7 V to supply the IC, V_{CC}.

Performance Verification

Use the following procedures to verify the warranted specifications of the P6209 probe. Before beginning these procedures, refer to page 41 and photocopy the test record and use it to record the performance test results. The recommended calibration interval is one year.

These procedures test the following specifications:

- Output offset voltage
- DC attenuation accuracy
- Rise time

Equipment Required

Refer to Table 5 for a list of the equipment required to verify the performance of your probe.

***NOTE**. These procedures use a CSA/TDS8000 as the host instrument. If you are using a TDS 820, the procedures will vary slightly.*

Table 5: Equipment required for performance verification and adjustment

Item description	Performance requirement	Recommended example
Oscilloscope	TEKPROBE SMA interface	Tektronix CSA/TDS8000 with a 80E00 Series Sampling Module, or TDS 820
Calibration Step Generator		067-1338-XX
DC Power Supply[1]	1 VDC at 1 mA	Tektronix PS280
DMM	0.5% accuracy at 2 VDC	Tektronix TX3

Table 5: Equipment required for performance verification and adjustment (Cont.)

Item description	Performance requirement	Recommended example
Feedthrough Termination	BNC, 50 Ω ±0.05 Ω	011-0129-00
Coaxial cables (2)	Male-to-Male SMA, 20 in	174-1427-00
Adapter	High Frequency Probe tip adapter w/50 Ω Termination	015-0678-00
Adapter	SMA Female-to-Female	015-1012-00
Adapter	SMA Female-to-BNC Male	015-0572-00
Adapter	SMA Male jack	131-7128-00
Adapter	BNC Female-to-Dual Banana	103-0090-00
Adapter	Y-lead adapter	196-3457-00
Adapters (2)	KlipChip adapter	206-0364-XX

[1] **Provides DC stimulus if using a TDS 820**

Equipment Setup

Use this procedure to set up the equipment to test the probe.

1. Connect the probe to the oscilloscope.
2. Connect a Y-lead adapter with KlipChip adapters attached to the probe.
3. Turn on the oscilloscope and enable the channel.
4. Allow 20 minutes for the equipment to warm up.

Output Zero

Use this procedure to verify the probe output zero.

1. Connect the test equipment as shown in Figure 12.
2. Ground the probe tip by connecting the two KlipChips together.

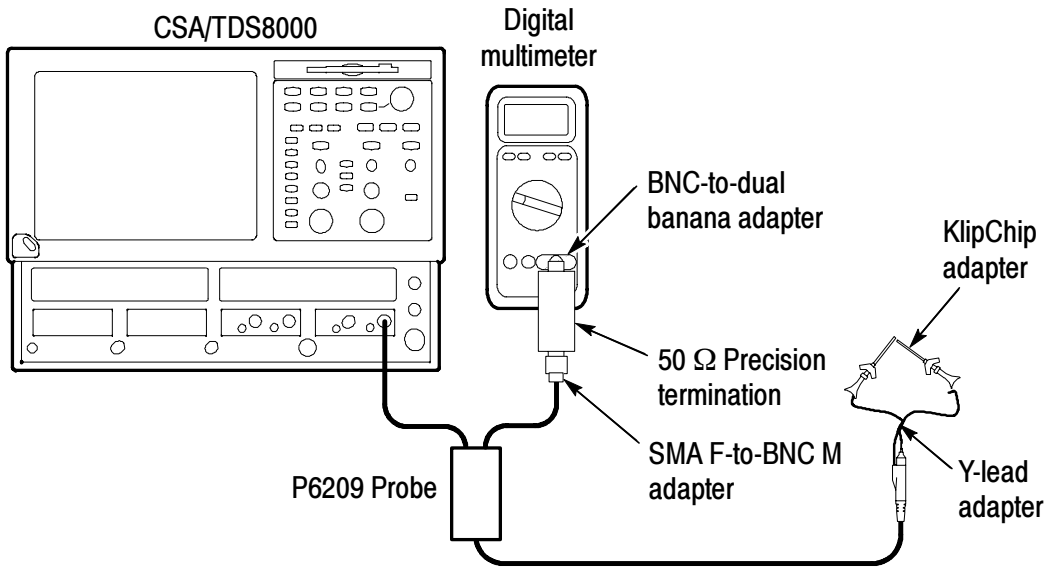


Figure 12: P6209 output zero setup

3. Set the oscilloscope trigger source to internal clock.
4. Set the oscilloscope channel vertical offset to 0.00 V.
5. Set the multimeter to read DC volts.
6. Record the multimeter reading on the test record.

The measured DC level should be 0.00 V ±10 mV for the CSA/TDS8000.

***NOTE**. The P6209 probe is guaranteed to have less than 7.5 mV offset. However, the CSA/TDS8000 and TDS 820 will have some residual voltage remaining when set to 0.00 V offset that will appear in this test as additional offset at the probe output.*

DC Attenuation Accuracy

Use this procedure to verify the probe DC attenuation accuracy.

1. Set the oscilloscope trigger to internal clock.
2. Set the oscilloscope channel vertical offset to 0.00 V.
3. Set the multimeter to read DC volts.
4. Connect the probe tip and ground to the DC calibrator output of the CSA/TDS8000, using the Y-lead adapter, KlipChips and SMA adapter jack.

   If the probe is being used with a TDS 820 oscilloscope, a separate DC power supply is needed to provide the stimulus. In this case, connect the probe to the power supply using the Y-lead adapter and KlipChips.

Record the results of steps 5 through 11 separately. Use the results to calculate the DC accuracy of the probe in step 12.

5. Set the DC calibration output of the CSA/TDS8000 (or external power supply if using a TDS 820), to +1.000 V. Use the multimeter to verify the DC voltage is as close to +1.000 V as possible. Record this measurement as Vmax.
6. Connect the multimeter as shown in Figure 13 on page 37.

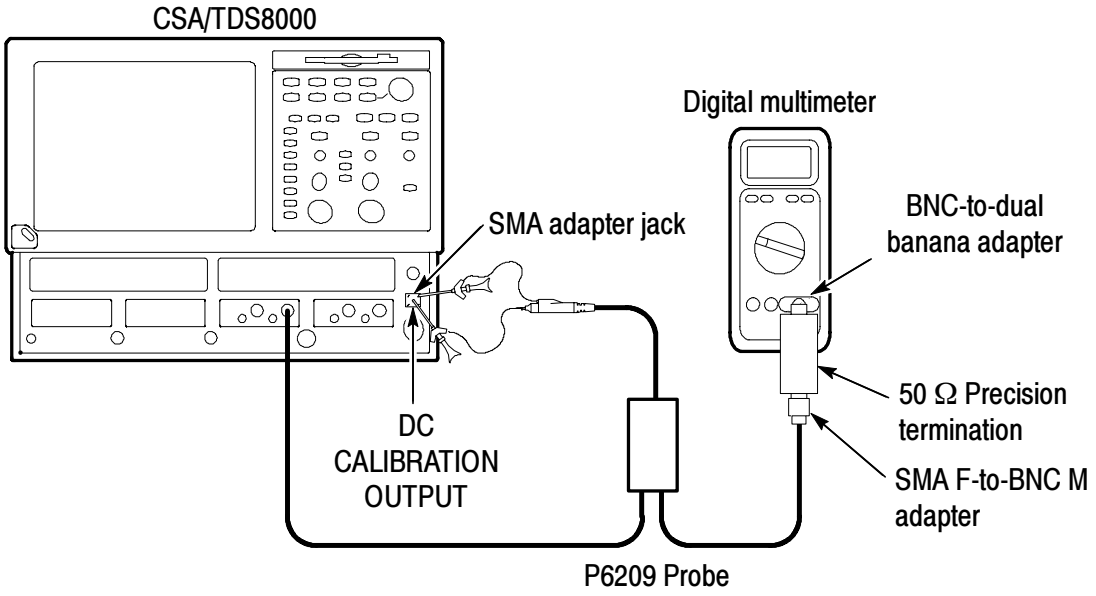


Figure 13: P6209 DC attenuation accuracy setup

7. Measure and record the multimeter reading as M1.
8. Disconnect the multimeter.
9. Set the DC calibration output of the CSA/TDS8000 (or external power supply if using a TDS 820), to -1.000 V. Use the multimeter to verify the DC voltage is as close to -1.000 V as possible. Record this measurement as Vmin.
10. Reconnect the multimeter as shown in Figure 13.
11. Measure and record the multimeter reading as M2.
12. Determine the percent error by using the formula below:

$$\%Error = \left[\frac{M1 - M2}{(Vmax - Vmin) \times .2} - 1 \right] \times 100\%$$

The calculated error should be ≤2%.

13. Record the results on the test record.

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.

1. Connect the test equipment as shown in Figure 14.
2. Set the oscilloscope to the following settings:
   - Trigger to internal clock
   - Vertical scale to 50 mV/div
   - Horizontal scale to 100 ps/div
   - Horizontal record length to 4000 points
   - Acquisition Mode to average at least 16 samples
3. Adjust the oscilloscope horizontal and vertical position controls to display a signal similar to that shown in Figure 14.

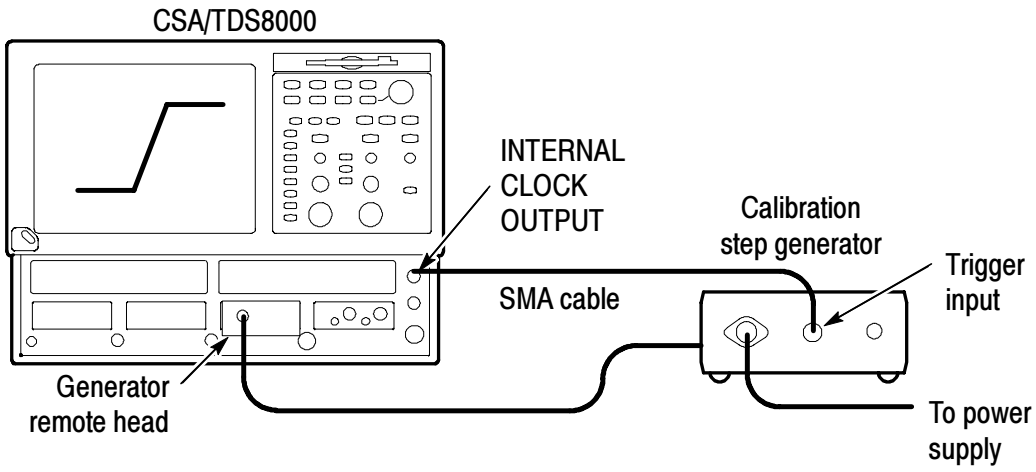


Figure 14: Test system rise time setup

4. Use the oscilloscope measurement capability to calculate and display rise time. Rise time is determined from the 10% and 90% amplitude points on the waveform. Record the rise time as t_s.

The system rise time (t_s) that you measured in step 4 represents the rise time of the test system without the probe.

The following steps instruct you to assemble the test system that includes the probe, as shown in Figure 15. The system and probe rise time (t_{s+p}) that you measure in step 8 is used to calculate the probe rise time (t_p) in step 9.

5. Connect the test equipment as shown in Figure 15.

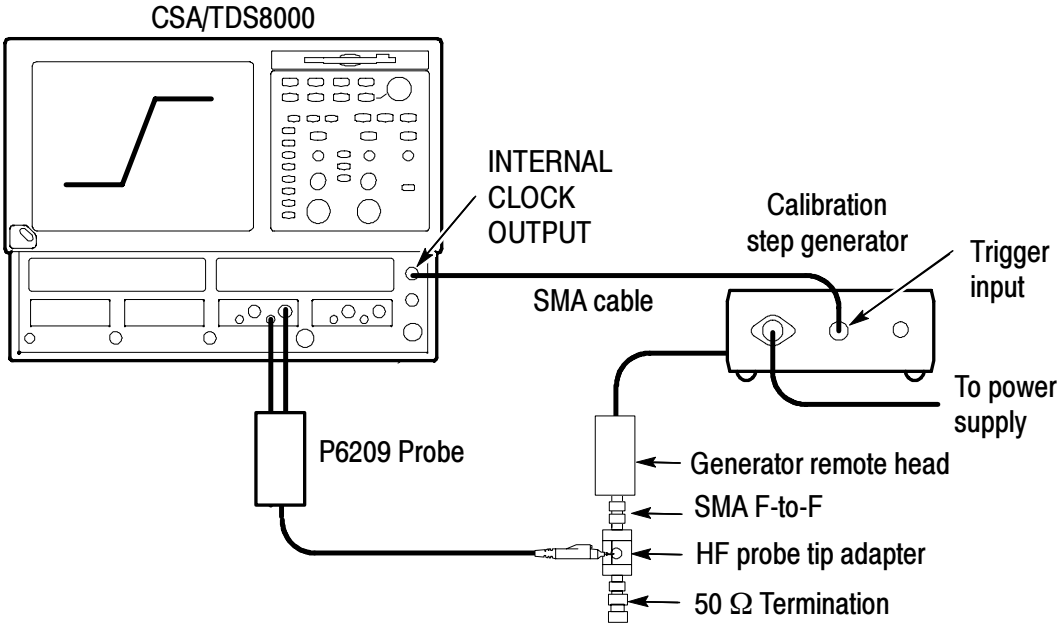


Figure 15: Test system and probe rise time setup

6. Set the vertical to 50 mV/div and horizontal to 500 ps/div.

7. Adjust the oscilloscope horizontal and vertical position controls to display a signal similar to that shown in Figure 15.

***NOTE**. Do not touch the probe tip adapter when making calibration measurements. Measurement accuracy is degraded when the probe tip adapter is handled.*

8. Use the oscilloscope measurement capability to calculate and 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}.

9. Calculate the probe only rise time using the following formula:

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

10. Check that the calculated rise time meets the probe specification. The rise time (t_p) must be $\leq$120 ps.

11. Record the results on the test record.

Test record

Probe Model: _____

Serial Number: _____

Certificate Number: _____

Temperature: _____

RH %: _____

Date of Calibration: _____

Technician: _____

Performance test	Minimum	Incoming	Outgoing	Maximum
Output zero voltage (at probe output) ± 10 mV (20° C to 30° C)[1]	- 10 mV	_____	_____	+ 10 mV
DC attenuation accuracy	- 2 %	_____	_____	+ 2 %
Rise time	N/A	_____	_____	≤120 ps

[1] **CSA/TDS8000 only**

Adjustments

The P6209 has two internal controls: offset zero and offset scale. These controls rarely need to be adjusted and only should be changed after a probe performance verification and functional check has been performed on the oscilloscope.

To make adjustments to the probe, the compensation box bottom cover must be removed and the equipment allowed to warm up for 20 minutes. Use the optional adjustment tool for making any adjustments. Refer to Table 5 on page 33 for a list of the equipment required to adjust your probe.

Removing the Compensation Box Bottom Cover

Follow these steps to gain access to the adjustment controls.

1. Using a Pozidrive screwdriver, remove the four screws that attach the bottom cover to the compensation box. Gently remove the cover. Refer to Figure 16.

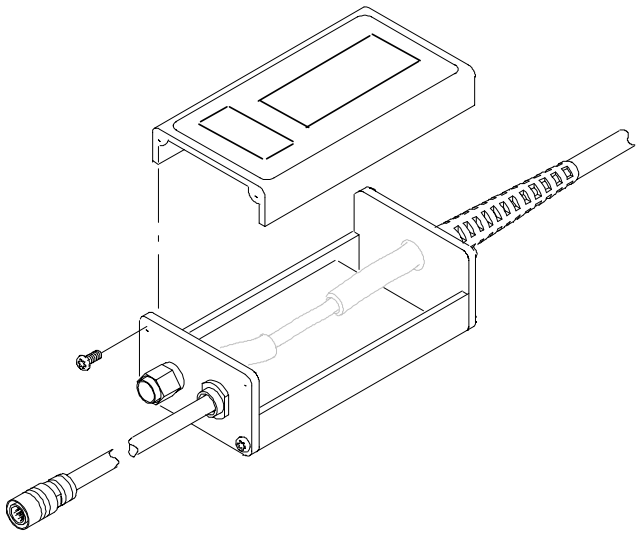


Figure 16: Removing the compensation box bottom cover

Adjustment Locations

Refer to Figure 17 for the location of the offset adjustments and measurement test points.

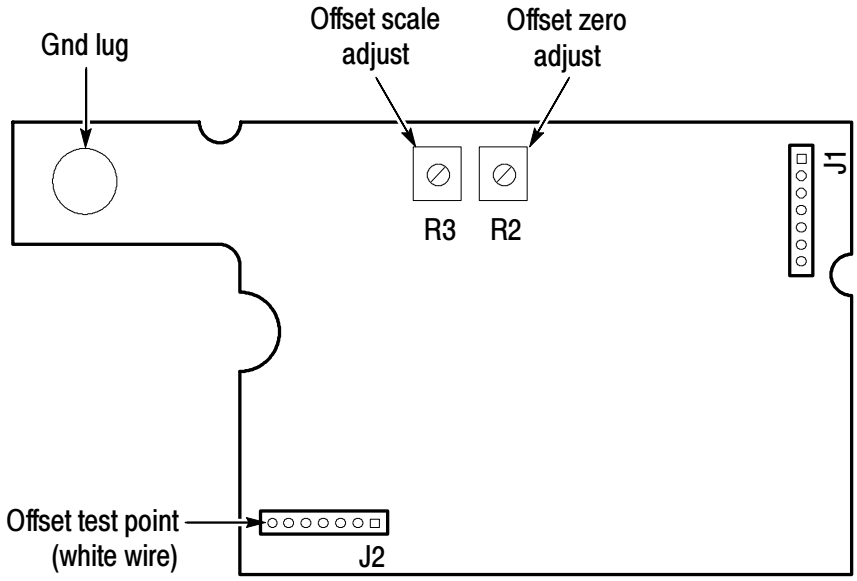


Figure 17: P6209 adjustment and measurement locations

Offset Zero

Use this procedure to adjust the probe offset zero.

1. Connect the probe power cable to the oscilloscope.
2. Ground the probe tip by connecting the two KlipChip leads together.
3. Set the oscilloscope trigger source to internal clock.
4. Set the channel vertical offset to 0.00 V.
5. Using the (-) lead of the DMM, probe the ground lug in the probe comp box. Refer to Figure 17 on page 44.

6. Using the (+) lead of the DMM, carefully probe pin 7 of J2 (white wire) in the probe compensation box. Refer to Figure 17 on page 44.

***NOTE**. The offset voltage measured on pin 7 will be of opposite polarity and approximately one fifth of the offset value displayed on the oscilloscope.*

---

7. Adjust the oscilloscope offset so that the voltage measures 0.000 V on the DMM. Set the offset as close to 0 V as possible.
8. Connect the equipment as shown in Figure 18.
9. Adjust **Offset Zero** (R2) in the probe compensation box for 0.00 V, ±1 mV on the DMM. Refer to Figure 17 on page 44 for the adjustment location.

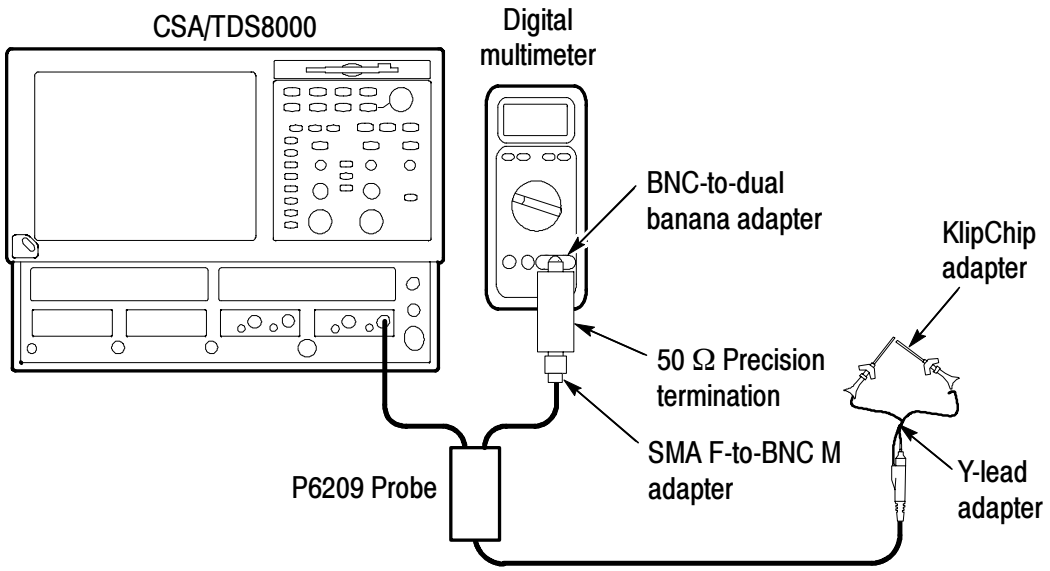


Figure 18: P6209 offset zero setup

Offset Scale

Use this procedure to adjust the offset scale of the probe. The offset zero of the probe should be checked before making any adjustment to the offset scale. Refer to Figure 17 on page 44 for the location of the test points and adjustments.

1. Connect the probe power cable to the oscilloscope.
2. Set the oscilloscope trigger source to internal clock.
3. Set the oscilloscope channel vertical offset to +2.5 V.
4. Ground the probe tip by connecting the two KlipChip leads together.
5. Using the (-) lead of the DMM, probe the ground lug in the probe compensation box.
6. Using the (+) lead of the DMM, carefully probe pin 7 of J2 (white wire) in the probe compensation box.

NOTE. *The offset voltage measured on pin 7 will be of opposite polarity and approximately one fifth of the offset value displayed on the oscilloscope.*

---

7. Adjust the oscilloscope offset so that pin 7 of J2 measures -0.50 V on the DMM.
8. Set the DC power supply to +2.5 V, as measured on the DMM.
9. Connect the equipment as shown in Figure 19. Take care not to disturb the offset level setting.
10. Adjust the **Offset Scale** (R3) in the probe compensation box so the output measures 0.000 V, ±1 mV on the DMM.

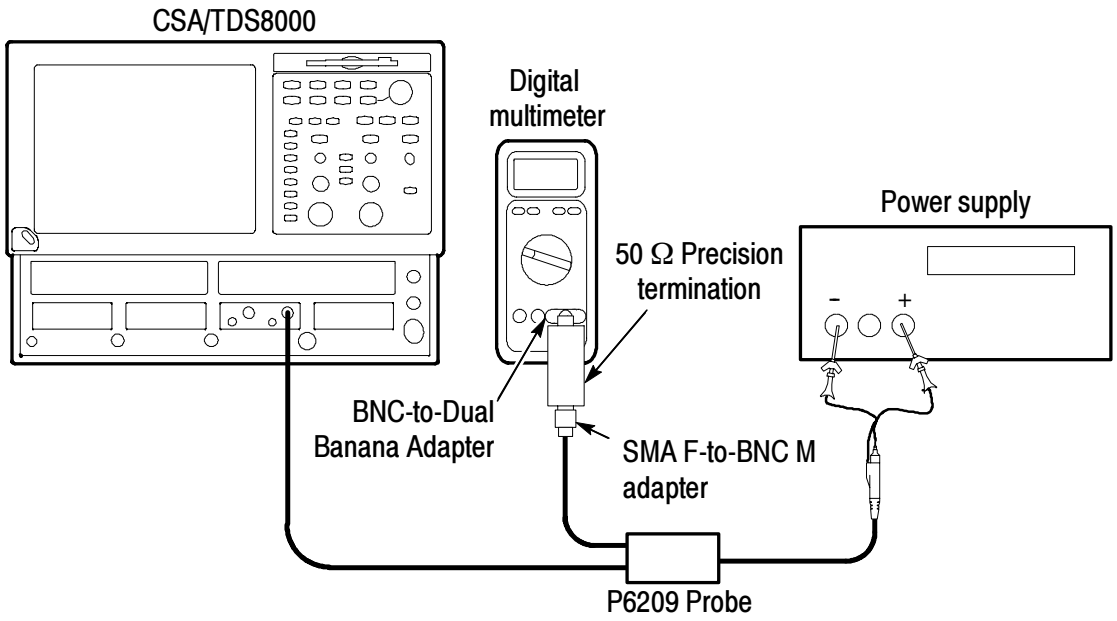


Figure 19: P6209 offset range setup

***NOTE**. After the offset adjustments have been made, use the* Performance Verification *procedures beginning on page 33 to verify your probe meets specifications.*

Maintenance

This section describes the maintenance procedures for the P6209.

Inspection and Cleaning

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

Do not immerse the probe or use abrasive cleaners.

Dirt may be removed with a soft cloth dampened with a mild detergent and water solution or isopropyl alcohol.

Replacement Parts

Refer to *Replaceable Parts* on page 55 for a list of customer replaceable parts. Due to the sophisticated design of the P6209 probe, there are no user replaceable parts within the probe.

Preparation for Shipment

If the original packaging is unfit for use or not available, use the following packaging guidelines:

1. Use a corrugated cardboard shipping carton having inside dimensions at least one inch greater than the probe dimensions. The box should have a carton test strength of at least 200 pounds.
2. Put the probe into a plastic bag or wrap to protect it from dampness.
3. Place the probe into the box and stabilize it with light packing material.
4. Seal the carton with shipping tape.

Troubleshooting

This troubleshooting documentation details isolation to either the probe or the oscilloscope.

To troubleshoot the P6209, the probe must be attached to an operating TEKPROBE SMA interface oscilloscope with the bottom cover of the compensation box removed. Refer to page 43 for instructions on opening the compensation box.

WARNING. *Operating voltages will be present. Observe caution when probing in the compensation box. Be careful not to touch or ground energized components.*

Work at a Level 1 ESD workstation when performing troubleshooting. The compensation box contains static sensitive devices.

Refer to Table 6 on page 53 for troubleshooting procedures and Figures 20 and 21 for troubleshooting test points.

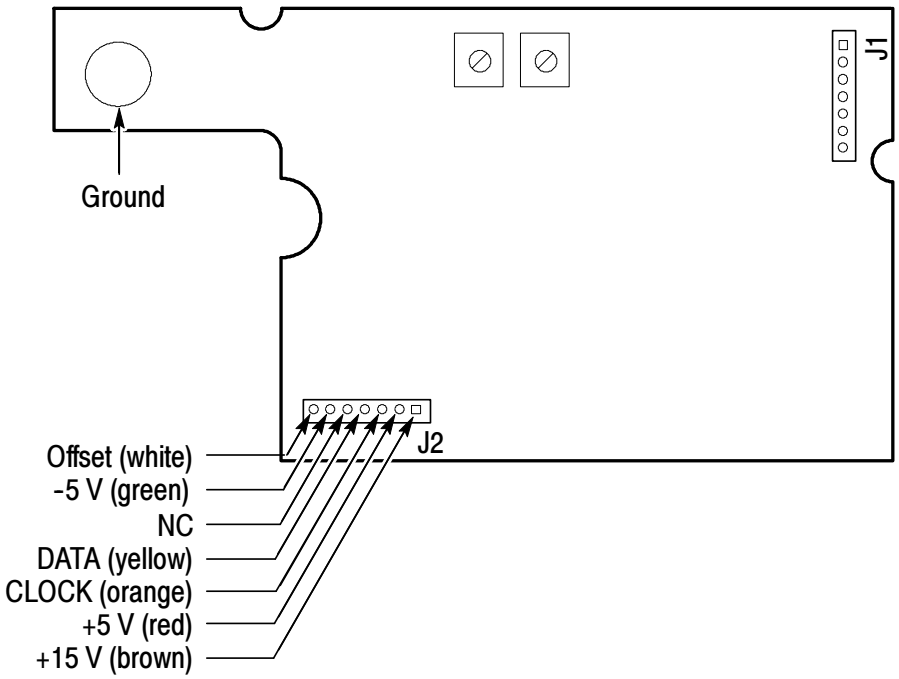


Figure 20: Compensation box test point locations

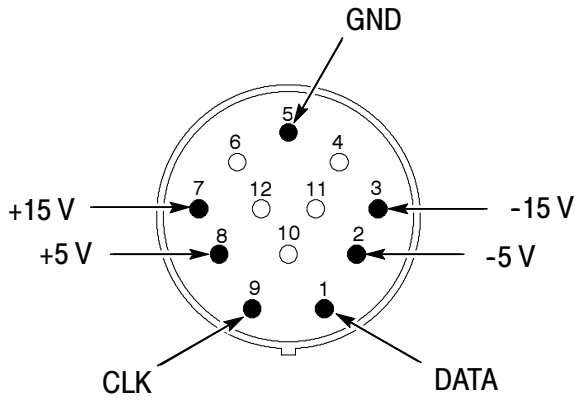


Figure 21: TEKPROBE SMA Interface pin assignments

Table 6: Troubleshooting guide

Symptom	Checks	Result	Action
No signal out	Check known signal	No signal.	Continue checks
	Go to *No Probe Power*	Probe power OK.	Replace probe.
Distorted or nonlinear signal	Is the signal within linear dynamic range? See page 13.	No	Set channel vertical offset to match signal characteristic.
No Offset Adjust (Signal present)	Go to *Probe Power* row	Probe power OK	Continue checks
	Check variation of offset input from host instrument. See Figure 20. Offset control voltage at pin 7 of J2 should vary between +1 V and -1 V.	Offset input OK	Replace probe.
No Probe Power	Check the power test points in the compensation box. See Figure 20.	Power OK	Continue checks.
		Power bad	Check for continuity between the TEKPROBE SMA connector pins and the test points in the compensation box. See Figures 20 and 21 on page 52.
			Try an adjacent channel.
			Repair host instrument

Replaceable Parts

This section contains a list of replaceable parts for the P6209 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 instruments 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
- Instrument type or model number
- Instrument serial number
- Instrument 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.

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 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.

Indentation System

This parts list is indented to show the relationship between items. The following example is 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 at 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

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

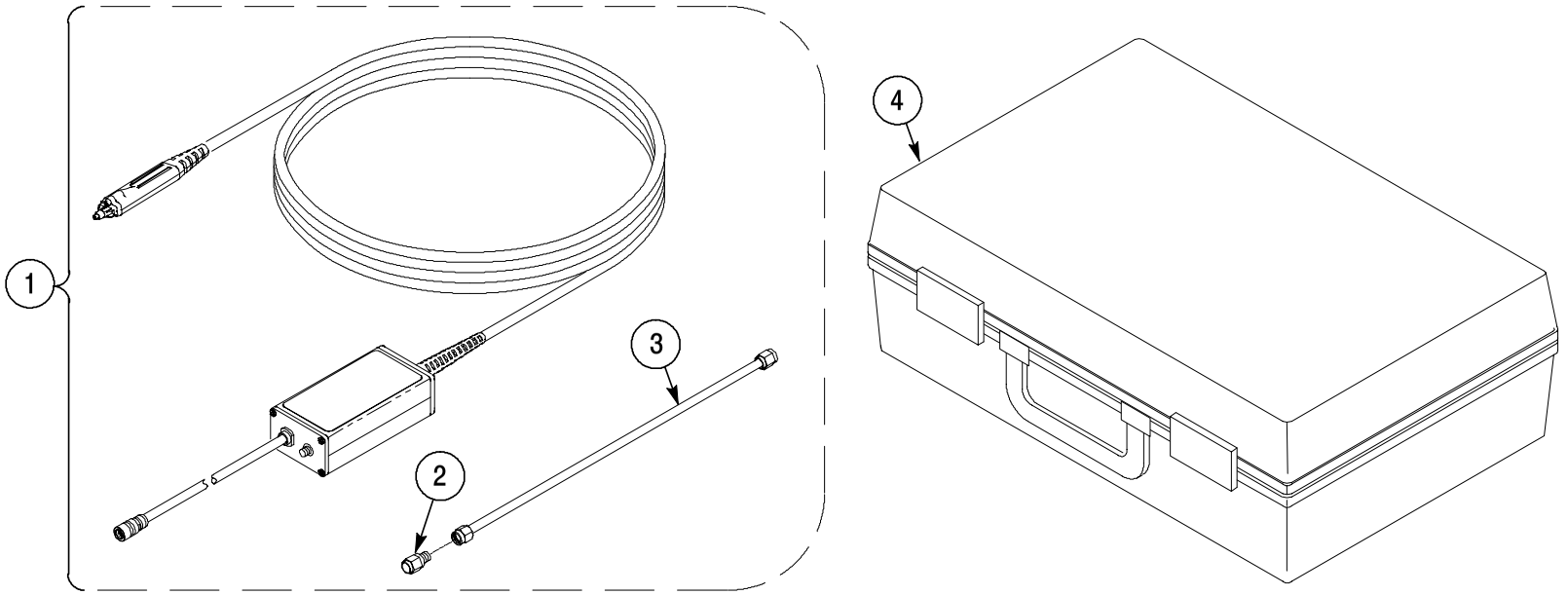


Figure 22: P6209 replaceable parts

Fig. & index no.	Tektronix part no.	Serial no. Effective	Dscont	Qty	12345 name & description	Mfr. code	Mfr. part no.
22-1	010-0638-00			1	PROBE ASSEMBLY:SERVICE REPLACEMENT, SERIALIZED	80009	010-0638-00
-2	015-1021-00			1	TERMN,COAXIAL:SHORT CIRCUIT,SMA,FEMALE	26805	2020-5353-00
-3	174-1120-00			1	CA ASSY,RF:COAXIAL,RFD,50 OHM,8.5 L,SMA,MALE	060D9	174-1120-00
-4	016-1879-01			1	CASE,STORAGE:PLASTIC,W/CND FOAM	TK6108	016-1879-01

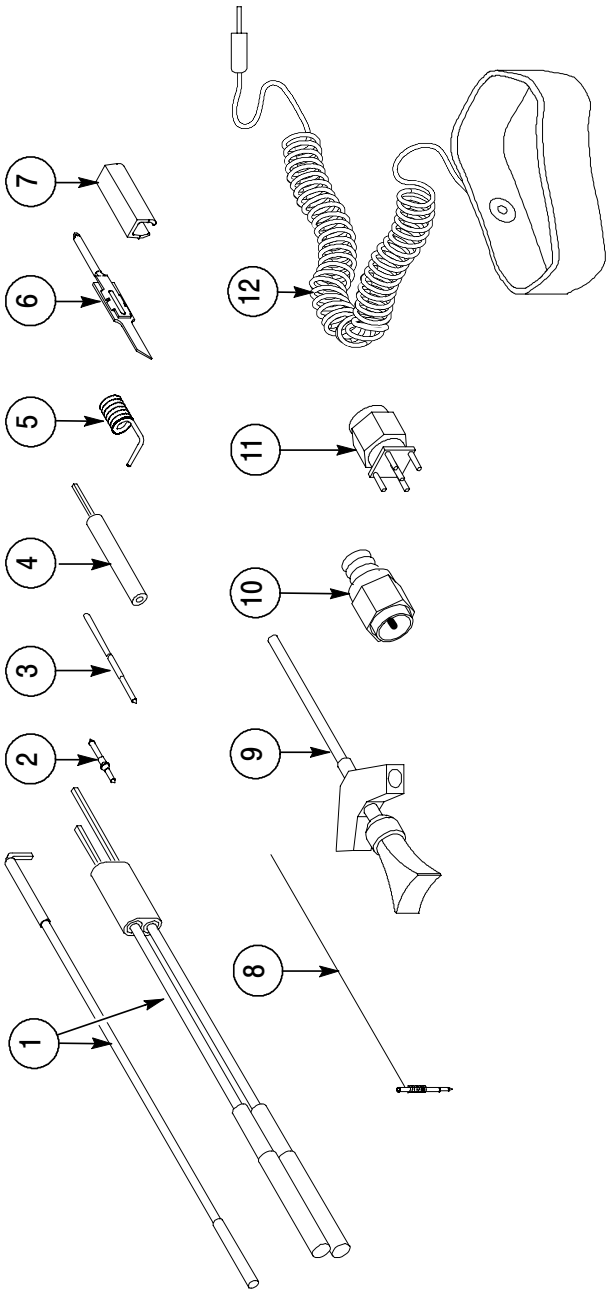


Figure 23: P6209 standard accessories

Fig. & index no.	Tektronix part no.	Serial no. Effective	Serial no. Dscont	Qty	12345 name & description	Mfr. code	Mfr. part no.
					STANDARD ACCESSORIES		
23-1	196-3456-00			1	LEAD SET:ACCESSORY KIT, INCL THREE 3.0 INCH GROUND LEAD, TWO DIFFERENTIAL LEAD	80009	196-3456-00
-2	131-5638-11			1	PROBE,TIP:PACKAGE OF 10	80009	131-5638-11
-3	016-1772-10			1	ACCESSORY KIT:POGO PIN,PKG OF 10	80009	016-1772-10
-4	016-1773-10			1	ACCESSORY KIT:GND PIN LENGTH ADAPTER,PKG OF 10	80009	016-1773-10
-5	016-1774-00			1	ACCESSORY KIT:ADAPTER SPRING,PKG OF 10	80009	016-1774-00
-6	----------			1	PROBE,TIP,SURETOE:PACKAGE OF 4 (REORDER ST501, PACKAGE OF 12)	80009	----------
-7	016-1315-00			1	MARKER KIT,ID:CABLE MARKER BAND,2 EA, VAR COLRS	80009	016-1315-00
-8	196-3482-XX			1	CUSTOMIZABLE GROUND LEAD, SET OF 5	80009	196-3482-XX
-9	206-0364-XX			2	TIP,PROBE:MICROCKT TEST,SMT KLIPCHIP	80009	206-0364-XX
-10	015-1020-00			1	TERMN,COAXIAL:SHORT CIRCUIT,SMA,MALE	0GZV8	64SMA-50-0-1
-11	131-7128-00			1	CONN,RF JACK:COAX,SMA,50 OHM,MALE,GOLD PL	74868	901-9895-RFX
-12	006-3415-04			1	STRAP,WRIST:3M TYPE 2214, ADJUSTABLE,6 FT COILED CORD	TK0623	RTI 8454001829
	071-0634-XX			1	MANUAL,TECH:INSTRUCTION,P6209	80009	071-0634-XX

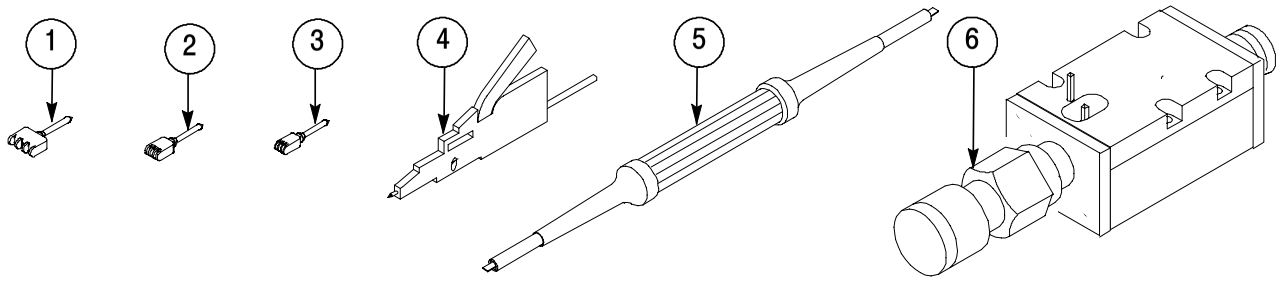


Figure 24: P6209 optional accessories

Fig. & index no.	Tektronix part no.	Serial no. Effective	Dscont	Qty	12345 name & description	Mfr. code	Mfr. part no.
					OPTIONAL ACCESSORIES		
24–1	SF503			1	ADPTR,SUREFOOT:0.5 MM EIAJ,PKG OF 12	80009	SF503
-2	SF502			1	ADPTR,SUREFOOT:25 MIL JEDEC,PKG OF 12	80009	SF502
-3	SF501			1	ADPTR,SUREFOOT:50 MIL JEDEC,PKG OF 12	80009	SF501
-4	SMK4			1	TIP,PROBE:MICROCKT TEST,PKG OF 4	80009	SMK4
-5	003-1433-02			1	TOOL:ADJUSTMENT TOOL,PLASTIC,BLACK	TK2565	003-1433-02
-6	015-0678-00			1	ADAPTER, PROBE:TIP,SMA 2 COMPACT SIZE,TERMINATED INTO 50 OHM TEST FIXTURE	80009	015-0678-00
	SMG50			1	MICROCKT TEST,SMT KLIPCHIP,PKG OF 20 (SEE 23-9)	80009	SMG50

CROSS INDEX - MFR. CODE NUMBER TO MANUFACTURER

Mfr. code	Manufacturer	Address	City, state, zip code
060D9	UNITREK CORPORATION	3000 COLUMBIA HOUSE BLVD, SUITE 120	VANCOUVER, WA 98661
0GZV8	HUBER & SUHNER INC	19 THOMPSON DRIVE	ESSEX JUNCTION, VT 05452-3408
26805	M/A COM OMNI SPECTRA INC	MICROWAVE CONNECTOR DIV 140 4TH AVE	WALTHAM, MA 02254
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON, OR 97077-0001
TK0623	GENERAL TOOL & SUPPLY CO	2705 NW NICOLAI ST	PORTLAND, OR 97210
TK2565	VISION PLASTICS INC	26000 SW PARKWAY CENTER DRIVE	WILSONVILLE, OR 97070
TK6108	KENT H LANDSBERG CO	27929 SW 95TH, SUITE 101	WILSONVILLE, OR 97070