

# Service Manual



## **P7225** **2.5 GHz Active Probe** **071-1186-00**

### **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](http://www.tektronix.com)**



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# Table of Contents

<b>General Safety Summary</b> .....	<b>iii</b>
<b>Service Safety Summary</b> .....	<b>v</b>
<b>Preface</b> .....	<b>vii</b>
Manual Structure .....	vii
Related Documentation .....	vii
Contacting Tektronix .....	viii
<b>Description</b> .....	<b>1</b>
Performance Verification .....	1
Replaceable Parts .....	1
Equipment Required .....	2
Special Adapters Required .....	2
<b>Performance Verification</b> .....	<b>7</b>
Equipment Setup .....	7
Output Zero .....	8
DC Gain Accuracy .....	9
Rise Time .....	10

## List of Figures

<b>Figure 1: TekConnect-to-SMA adapter</b> .....	<b>3</b>
<b>Figure 2: Probe tip adapter</b> .....	<b>3</b>
<b>Figure 3: TekConnect Interface Calibration Adapter</b> .....	<b>4</b>
<b>Figure 4: Setup for output zero</b> .....	<b>8</b>
<b>Figure 5: Setup for DC gain accuracy</b> .....	<b>9</b>
<b>Figure 6: Test system rise time setup</b> .....	<b>11</b>
<b>Figure 7: Test system and probe rise time setup</b> .....	<b>13</b>

## List of Tables

<b>Table 1: Equipment required for performance verification</b> .....	<b>2</b>
<b>Table 2: TekConnect interface calibration adapter features</b> .....	<b>5</b>
<b>Table 3: Test record</b> .....	<b>15</b>

# 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.*

While using this product, you may need to access other parts of the system. Read the *General Safety Summary* in other system manuals for warnings and cautions related to operating the system.

## **To Avoid Fire or Personal Injury**

**Connect and Disconnect Properly.** Do not connect or disconnect probes or test leads while they are connected to a voltage source.

**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.

Do not apply a potential to any terminal, including the common terminal, that exceeds the maximum rating of that terminal.

**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.**

**Symbols and Terms**

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



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

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

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**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.** The following symbols may appear on the product:



# 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.

**Disconnect Power.** To avoid electric shock, switch off the instrument power, then disconnect the power cord from the mains power.

**Use Care When Servicing With Power On.** Dangerous voltages or currents may exist in this product. Disconnect power, remove battery (if applicable), and disconnect test leads before removing protective panels, soldering, or replacing components.



# Preface

This is the service manual for the P7225 2.5 GHz Active Probe. Read this preface to learn how this manual is structured and where you can find other information related to servicing this product.

## Manual Structure

This manual contains two sections - *Description* and *Performance Verification*, and is intended to be used by qualified service personnel. Replaceable parts are limited to accessories and adapters, and are described in the user manual that is shipped with the probe.

Be sure to read the introductions to all procedures. These introductions provide important information needed to service the probe correctly, safely, and efficiently.

## Related Documentation

The probe is shipped with the following manual:

- *P7225 2.5 GHz Active Probe User Manual*. Tektronix part number 071-1187-XX.

## Contacting Tektronix

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

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\* **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.**

# Description

This document describes the *Performance Verification* for the P7225 2.5 GHz Probe.

## Performance Verification

Use the performance verification procedures to verify the warranted specifications of the P7225 probe. The recommended interval for verifying the warranted specifications is one year. No software is required to complete a performance verification of the probe.

The performance verification procedures check the following specifications:

- Output zero
- DC gain accuracy
- Rise time

## Replaceable Parts

There are no user-replaceable parts inside the probe. If the probe fails the performance verification procedure, contact your Tektronix service center.

## Equipment Required

Refer to Table 1 for the equipment required to perform the service procedures.

**Table 1: Equipment required for performance verification procedures**

Item description	Performance requirement	Recommended example
Sampling Oscilloscope	$\geq 12.5$ GHz bandwidth	Tektronix TDS8000
Sampling head, with extension cable	$\geq 12.5$ GHz bandwidth	Tektronix 80E0X with 012-1568-00 cable
Oscilloscope	TekConnect Interface	Tektronix TDS7254
TekConnect calibration adapter	TekConnect Interface	067-0422-00
Calibration Step Generator	250 mV step, $\leq 30$ ps rise time	067-1338-0X
Adapter	TekConnect-to-SMA	TCA-SMA
Adapter	Probe tip with $50 \Omega$ termination	015-0678-00
DC Power Supply	1 VDC at 1 mA	Tektronix PS280
DMM (2) with leads	0.05% accuracy, 0.1 mV resolution	Fluke 87 or equivalent
Feedthrough Termination	$50 \Omega \pm 0.05 \Omega$	011-0129-00
BNC-to-BNC coaxial cable (2)	$50 \Omega$ coaxial cable	012-0057-01
Coaxial cable	Male-to-Male SMA	012-0649-00
Lead (2)	Banana-to-Banana connector, Red	012-0031-00
Lead (2)	Banana-to-Banana connector, Black	012-0039-00
Adapter	SMA Male-to-Male connector	015-1011-00
Adapter	SMA Female-to-Female connector	015-1012-00
Adapter	SMA Male-to-BNC Female connector	015-0554-00
Adapter	BNC Female-to-Dual Banana connector	103-0090-00
Adapter	Y-lead adapter	Part of 196-3456-00
Adapters (2)	KlipChip adapter	206-0364-00
SMA torque wrench	5/16-in, 7 in-lb.	
SMA adapter wrench	7/32-in	

## Special Adapters Required

Some of the adapters listed in Table 1 are custom-made and available only from Tektronix. The adapters are described on the following pages.

**TekConnect-to-SMA Adapter**

The TekConnect-to-SMA Adapter, Tektronix part number TCA-SMA, allows signals from an SMA cable or probe to be connected to a TekConnect input. See Figure 1. Connect and disconnect the adapter the same way as you do the P7225 Probe.



**Figure 1: TekConnect-to-SMA adapter**

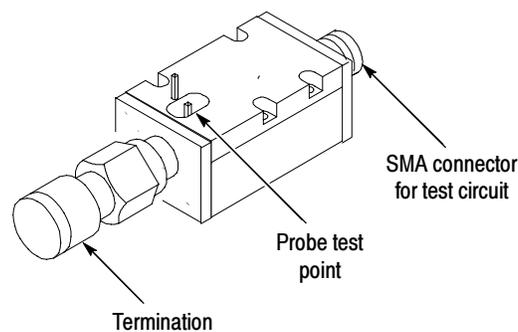
**Probe Tip Adapter**

The probe tip adapter, Tektronix part number 015-0678-00, provides a low-noise method for connecting the P7225 to signals present on SMA cables. The adapter has a test point for the probe and two SMA connectors. A 50  $\Omega$  termination is included with the adapter, and is connected to the SMA connector nearest the probe test point to minimize reflections. Connect the cable from the test circuit to the other SMA connector. See Figure 2.

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**NOTE.** When taking measurements, do not touch the probe tip adapter. Measurement accuracy is degraded when the probe tip adapter is handled.

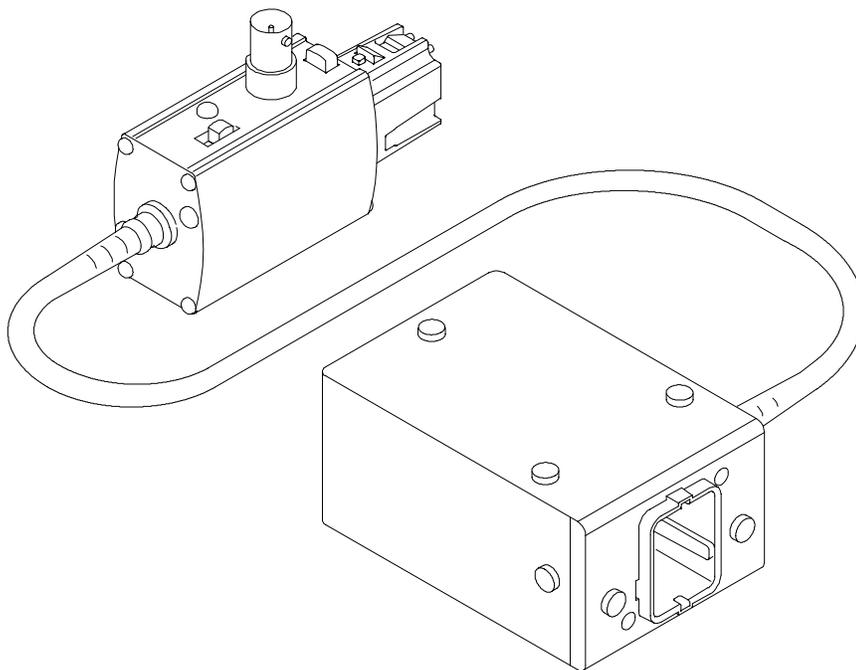
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**Figure 2: Probe tip adapter**

**TekConnect Interface Calibration Adapter**

The TekConnect Interface Calibration Adapter, Tektronix part number 067-0422-00, connects to the host instrument and the probe under test, and provides connectors for probe signal and offset voltage measurements. See Figure 3.

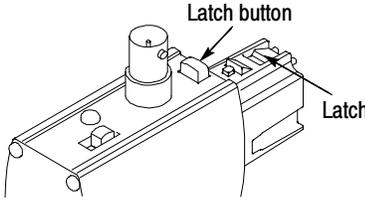
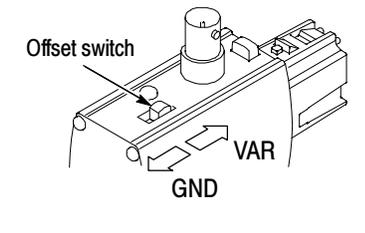
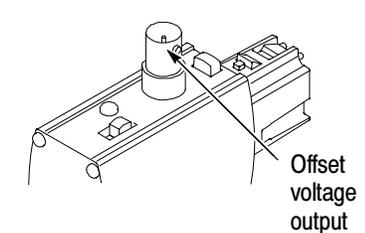
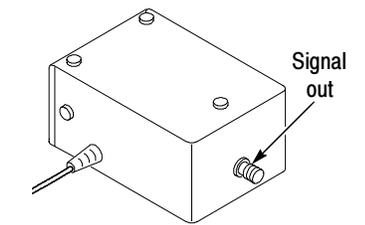


**Figure 3: TekConnect Interface Calibration Adapter**

When the adapter is connected to the host instrument, the adapter is identified as a valid calibration device. However, additional power supplies necessary to power the probe are not enabled until a TekConnect probe is connected to the adapter and identified by the host instrument. When a probe is detected through the adapter, the Volts/div readout on the host instrument displays ##.

Refer to Table 2 on page 5 for features of the calibration adapter.

**Table 2: TekConnect interface calibration adapter features**

Feature	Description
 <p>The diagram shows a top-down view of the adapter. A cylindrical component is labeled 'Latch button' and a rectangular component is labeled 'Latch'.</p>	<p><b>Latch button.</b> The spring-loaded latch mechanically connects the adapter to the host instrument. To release the adapter, grasp the adapter housing, depress the latch button, and pull the adapter straight out of the host instrument.</p>
 <p>The diagram shows a top-down view of the adapter. A switch is labeled 'Offset switch'. Two positions are indicated with arrows: 'VAR' and 'GND'.</p>	<p><b>Offset output select switch.</b> The offset output switch allows you to select between ground and the offset voltage level from the host instrument. Leave the switch in the ground position for the performance verification procedures.</p>
 <p>The diagram shows a top-down view of the adapter. A BNC connector is labeled 'Offset voltage output'.</p>	<p><b>Offset voltage.</b> The offset voltage of the probe is accessed through the BNC connector. Measure the offset voltage using a DVM, BNC coaxial cable, and BNC-to-dual-banana jack.</p>
 <p>The diagram shows a side view of the adapter. An SMA connector is labeled 'Signal out'.</p>	<p><b>Signal out.</b> The SMA connector on the rear of the box allows for direct monitoring of the probe signal.</p>

Description

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# Performance Verification

Before you begin the performance verification procedures, perform a probe verification routine on your host instrument with the probe you are verifying. The probe verification routine verifies that the probe and the host instrument are working within nominal limits. The host instrument measures the gain and offset of the probe and uses these values for optimal system performance. Refer to the online help of your host instrument for more information on how to perform a probe verification routine.

Use the following procedures to verify the warranted specifications of the P7225 probe listed in the test record on page 15. Before beginning these procedures, photocopy the test record and use it to record the performance test results. The recommended interval for verifying the warranted specifications is one year. These procedures test the following specifications:

- Output zero
- DC gain accuracy
- Rise time

## Equipment Setup

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

1. Connect the probe calibration adapter to the host instrument.
2. Connect the probe to the probe calibration adapter.
3. Turn on the host instrument, and select the channel that the probe calibration adapter is connected to.
4. Verify that the Volts/div readout on the host instrument channel displays ## (the host instrument recognizes the probe through the adapter).
5. Set the multimeter to read DC volts.
6. Allow 30 minutes for the equipment to warm up.

## Output Zero

Use this procedure to verify the probe output zero.

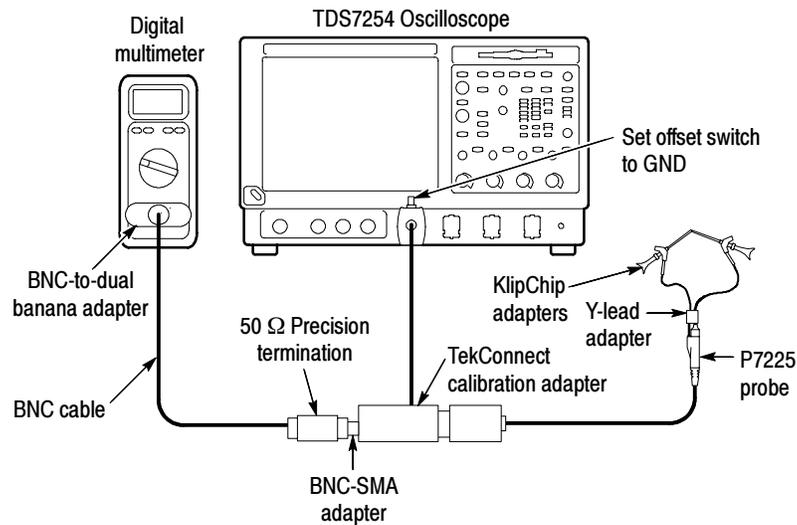
1. Connect the test equipment as shown in Figure 4.
2. Set the offset switch on the calibration adapter to **GND**.

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**NOTE.** Leave the offset switch in the ground position for all of the performance verification checks.

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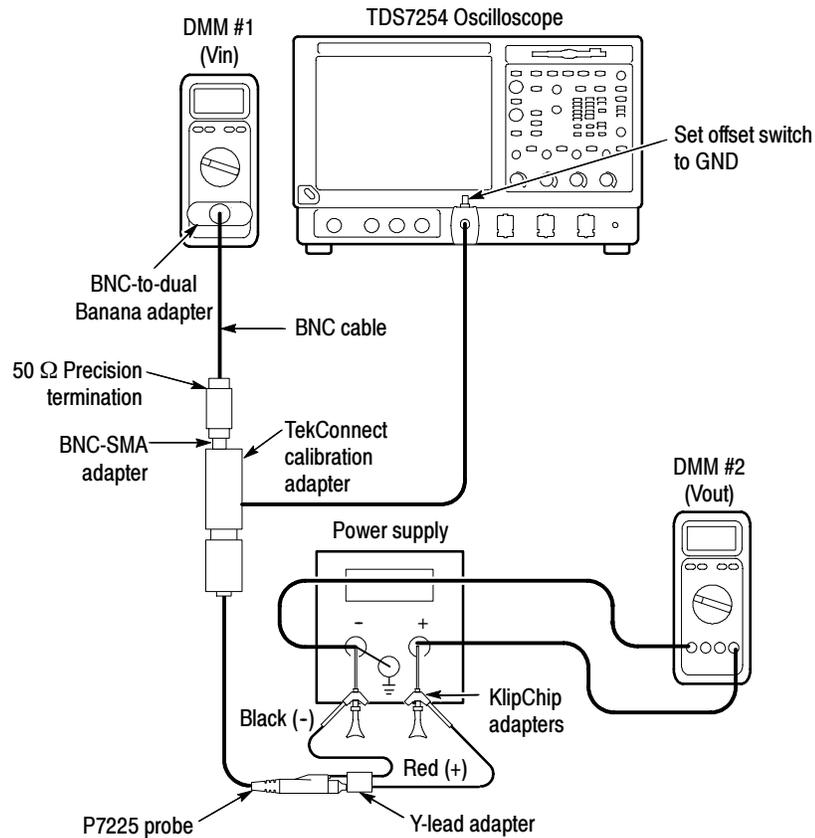
3. Ground the probe tip by connecting the probe tip to the probe ground socket. (Connecting two KlipChip adapters together is recommended.)
4. Observe the multimeter display.
5. Record the results in the test record on page 15 and compare the results against the Output Zero Voltage specification on page 15.



**Figure 4: Setup for output zero**

## DC Gain Accuracy

1. Disconnect the probe tip ground (KlipChip adapters), and connect the equipment as shown in Figure 5.



**Figure 5: Setup for DC gain accuracy**

2. Record the results of steps 3 through 6 separately. Use the results to calculate the DC attenuation accuracy of the probe in step 7 on page 10.
3. Set the power supply to +1.000 V. Use Digital Multimeter (DMM) #2 to verify that the DC voltage is as close to +1.000 V as possible. Record this measurement as  $V_{max}$ .
4. Measure and record the reading of DMM #1 as  $M1$ .
5. Set the power supply to -1.000 V. Use DMM #2 to verify that the DC voltage is as close to -1.000 V as possible. Record this measurement as  $V_{min}$ .
6. Measure and record the reading of DMM #1 as  $M2$ .

7. Determine the percent error by using the formula below:

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

Example:

$$\begin{aligned} \%Error &= \left[ \frac{0.1014 - (-0.1010)}{[1.007 - (-0.998)] \times .1} \right] - 1 \times 100\% \\ &= \frac{0.2024}{0.2005} - 1 \times 100\% \\ &= 1.0097 - 1 \times 100\% \\ &= +0.95\% \end{aligned}$$

8. Record the results in the test record on page 15 and compare the results against the DC attenuation accuracy (% error) specification on page 15.

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**NOTE.** An unacceptable error value may result if a precision 50 Ω terminator is not used for the recommended termination.

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## Rise Time

This procedure verifies that the probe meets rise time specifications.

The probe rise time is calculated using rise times measured from the test system separately, and the test system including the probe.

1. Connect the test equipment as shown in Figure 6 on page 11.

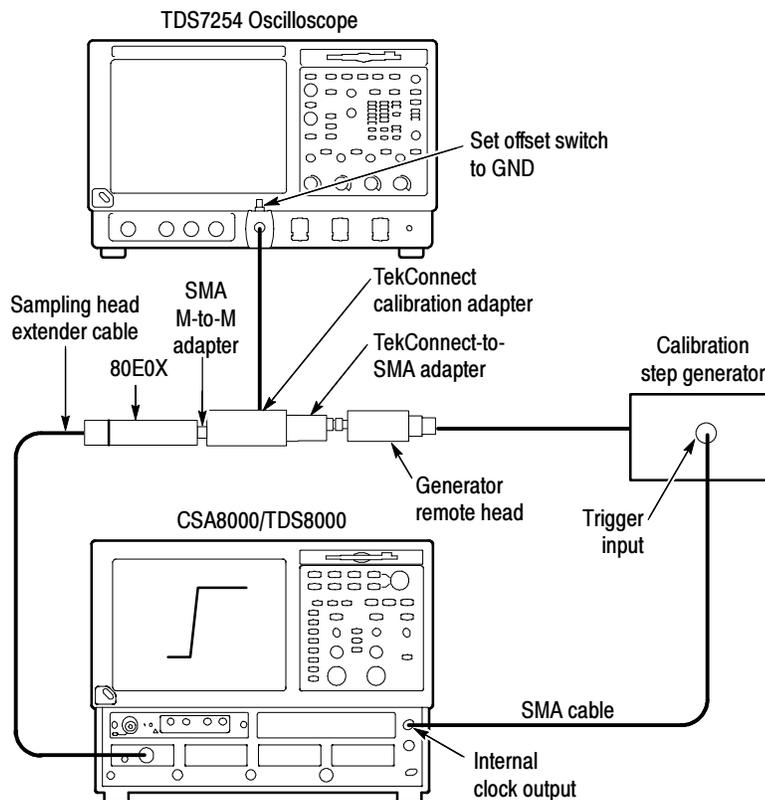



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**CAUTION.** To prevent damage, use care when working with SMA connectors: support equipment to avoid mechanical strain on the connectors, and when tightening connections, use a torque wrench to 7.5 in-lbs.

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**NOTE.** The TDS7254 powers the TekConnect Calibration adapter and the P7225. Any instrument adjustments in this procedure are made on the CSA8000/TDS8000.



**Figure 6: Test system rise time setup**

2. Set the measurement instrument trigger to internal clock.
3. Select the channel that you have connected to on the 80E0X sampling head, and then set the measurement instrument vertical scale to 50 mV/div.

**NOTE.** The output of the step generator rises from a  $-250$  mV level to ground.

4. Adjust the measurement instrument horizontal and vertical position controls to display a signal similar to that shown in Figure 6.
5. Set the measurement instrument horizontal scale to 50 ps/div and center the waveform.

6. Use the measurement capability of the measurement instrument to display rise time. Increase the stability of the pulse edge measurement by using averaging, if available. 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 6 represents the rise time of the test system without the probe.

After you assemble the test setup that includes the probe, as shown in Figure 7, measure the system and probe rise time ( $t_{s+p}$ ) in step 13. This is used to calculate the probe rise time ( $t_p$ ) in step 14.

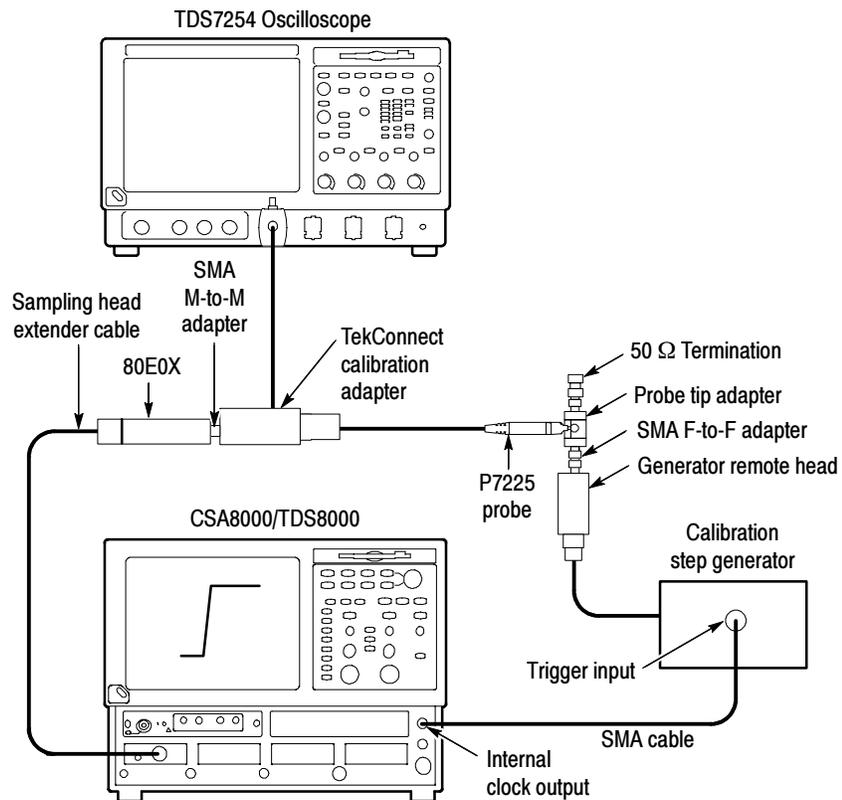
7. Set the step generator control switch to standby.
8. Remove the TekConnect-SMA adapter from the test setup.
9. Connect the test equipment as shown in Figure 7 on page 13.



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**CAUTION.** To prevent damaging the SMA connectors, use a 7/32-inch wrench when connecting and disconnecting the female-to-female SMA adapter.

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**Figure 7: Test system and probe rise time setup**

10. Set the step generator control switch to on.
11. On the measurement instrument, expand the horizontal scale to locate the step edge. Set the vertical scale to 5 mV/div, and adjust horizontal range to 100 ps/div while maintaining the edge view. For a more stable measurement display, turn on averaging.
12. Adjust the measurement instrument horizontal and vertical position controls to display a signal similar to that shown in Figure 7.

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

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13. Use the measurement capability of the measurement instrument to display rise time. Rise time is determined from the 10% and 90% amplitude points on the waveform. Record the rise time as  $t_{s+p}$ .

- 14.** Calculate the probe-only rise time using the following formula:

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

Example:

$$\begin{aligned} t_p &= \sqrt{135^2 - 35^2} \\ &= \sqrt{(18225 - 1225)} \\ &= \sqrt{17000} \\ &= 130.4 \end{aligned}$$

- 15.** Record the results in the test record on page 15 and compare the results against the rise time ( $t_p$ ) specification on page 15.

**Table 3: 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)	- 10 mV	_____	_____	+ 10 mV
DC attenuation accuracy (% error)	N/A	_____	_____	≤2 %
Rise time ( $t_p$ )	N/A	_____	_____	≤140 ps

