



**P7700 Series
TriMode™ Probes
User Manual**



071-3421-03





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TriMode™ Probes
User Manual**

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071-3421-03

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- Worldwide, visit www.tek.com to find contacts in your area.

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Important safety information

This manual contains information and warnings that must be followed by the user for safe operation and to keep the product in a safe condition.

General safety summary

Use the product only as specified. Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. Carefully read all instructions. Retain these instructions for future reference.

This product is not intended for detection of hazardous voltages.

To avoid fire or personal injury

Observe all terminal ratings. To avoid fire or shock hazard, observe all rating 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, or with the case open. Hazardous voltage exposure is possible.

Avoid exposed circuitry. Do not touch exposed connections and components when power is present.

Do not operate in wet/damp conditions. Be aware that condensation may occur if a unit is moved from a cold to a warm environment.

Do not operate in an explosive atmosphere.

Keep product surfaces clean and dry. Remove the input signals before you clean the product.

Probes and test leads

Remove all probes, test leads and accessories that are not in use.

Inspect the probe and accessories. Before each use, inspect probe and accessories for damage (cuts, tears, or defects in the probe body, accessories, or cable jacket). Do not use if damaged.

Use only specified replacement parts.

Risk assessment warnings and information

Terms in the 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



When this symbol is marked on the product, be sure to consult the manual to find out the nature of the potential hazards and any actions which have to be taken to avoid them. (This symbol may also be used to refer the user to ratings in the manual.)

The following symbols may appear on the product:



CAUTION
Refer to Manual

Compliance Information

This section lists the environmental standards with which the instrument complies.

Environmental compliance

This section provides information about the environmental impact of the product.

Product end-of-life handling

Observe the following guidelines when recycling an instrument or component:

Equipment recycling. Production of this equipment required the extraction and use of natural resources. The equipment may contain substances that could be harmful to the environment or human health if improperly handled at the product's end of life. To avoid release of such substances into the environment and to reduce the use of natural resources, we encourage you to recycle this product in an appropriate system that will ensure that most of the materials are reused or recycled appropriately.



This symbol indicates that this product complies with the applicable European Union requirements according to Directives 2012/19/EU and 2006/66/EC on waste electrical and electronic equipment (WEEE) and batteries. For information about recycling options, check the Tektronix Web site (www.tek.com/productrecycling).

Preface

This manual describes the installation and operation of the P7700 Series TriMode Probes. Basic probe operations and concepts are presented in this manual. All documents listed below are accessible from the Tektronix Web site (www.tek.com/manuals).

Probe models

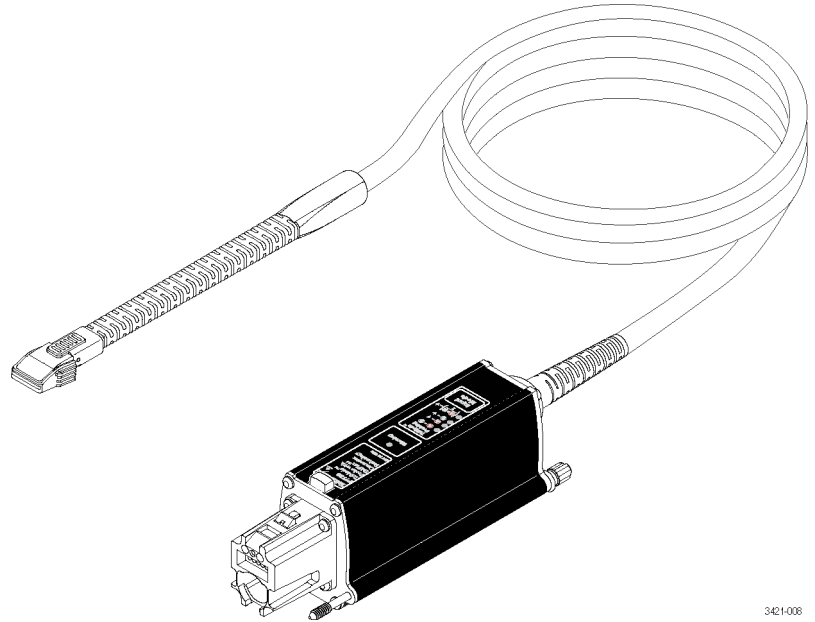
These P7700 Series TriMode Probe family includes these models:

- P7708 8 GHz
- P7713 13 GHz
- P7716 16 GHz
- P7720 20 GHz

Key features

The P7700 Series TriMode Probes allow you to take differential, single-ended, and common mode measurements with one probe connection. Key features include:

- Low loading for low power circuits
- Thin solder-in tips that can fit into tight spaces on a device under test
- Flexible solder-in tips and main probe cable
- Lightweight probe cable and head
- TekFlex™ connector technology that makes the probe easy to connect to accessories
- Optional 2.92 mm adapter for connecting to 50 Ω RF test points
- Browser accessory with adjustable tips and headlight
- Full AC calibration of the probe and accessory tips with unique S-parameters
- Solder-in tips operate at extended temperature range



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Documentation

To read about	Use these documents
Installation and Operation (overviews)	Read this manual for information about how to set up and use your probe.
In-Depth Operation	Use the technical reference manual and this manual.
Specifications	Use the technical reference manual.
Reordering accessories	Use the <i>Accessories and Options</i> section or refer to the insert in your accessory kit when reordering accessories.

Installation

Before you connect the probe to your instrument, read the following *Operating considerations* and *Overview* sections to understand the operating characteristics and sequence of events necessary to properly install the probe and adapters.



CAUTION. *To avoid ESD damage to the probe, always use an antistatic wrist strap (provided with your probe), and work at a static-approved workstation when you handle the probe.*

Operating considerations

Table 1: P7700 Series TriMode probes

Characteristic	Description	Specification		
		TekFlex solder-in tips	P77BRWSR	P77C292MM adapter
Input Voltage	Dynamic range	2.5 Vpp (single-ended) 5.0 Vpp (differential input)	6.0 Vpp (single-ended) 12.0 Vpp (differential input)	1.2 Vpp (single-ended) 2.0 Vpp (differential input)
	Operating voltage window	±5.25 V	±10.0 V	±4.0 V
	Offset voltage range	-4 V to +4 V	-10 V to +10 V	-4 V to +4 V
	Maximum non-destructive input voltage	-15 V to +15 V (tip attached or detached)		-5 V to +5 V

Characteristic	Description	Specification		
		TekFlex solder-in tips	P77BRWSR	P77C292MM adapter
Temperature	Operating	Probe compensation box: 0 °C to 45 °C (32 °F to 113 °F)		
		Probe cable, solder tips, and P77292MM adapter: -35 °C to 85 °C (-31 °F to 185 °F); Minimum Airflow required 46°C to 85°C (114.8 °F to 185 °F)		
	Non-operating	Probe compensation box: -20 °C to 60 °Cg (-4 °F to 140 °F)		
		Probe cable, solder tips, and P77292MM adapter: -35 °C to 85 °C (-31 °F to 185 °F)		
Humidity	Operating	Probe Compensation Box, Cable, Tips, and SMA adapter: 20% to 80% Relative Humidity (%RH) at up to 45°C non-condensing		
	Non-operating	Probe Compensation Box, Cable, Tips, and P77292MM adapter: 10% to 90% (Relative Humidity), non-condensing		
Altitude	Non-operating	Probe Compensation Box, Cable, Tips, and SMA adapter: 12,000 meters (39,370 feet)		
Pollution Degree		2, Indoor use only		

Installation overview



CAUTION. To avoid ESD damage to the probe, always use an antistatic wrist strap (provided with your probe), and work at a static-approved workstation when you handle the probe.

1. Connect the probe to the host instrument.

If it is the first time the probe has been connected to the oscilloscope, the oscilloscope will download the S-parameters stored in the probe. Once the oscilloscope has stored the S-parameters for the probe, it doesn't matter which channel the probe is plugged into. The stored S-parameters will be available for any channel the probe is moved to.

2. Connect the probe tip to the TekFlex connector on the probe.

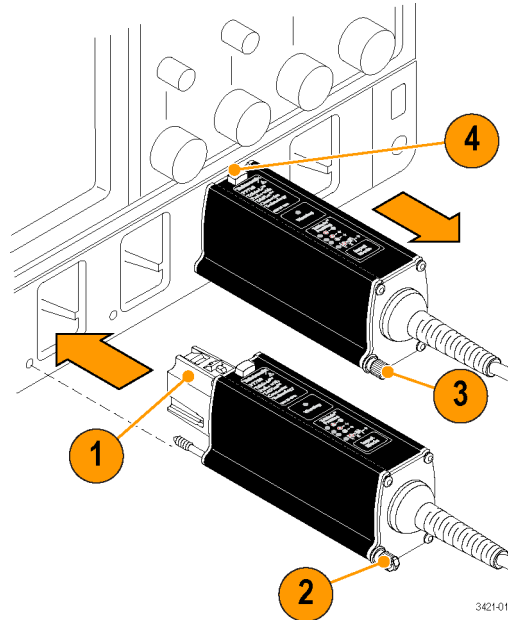
When a tip is inserted into the probe for the first time, the oscilloscope will download the S-parameter data stored in the tip.

3. The probe performs a self test, and then one Input Mode LED remains on.
4. Open the Calibration menu (found in the Vertical menu).
5. Perform the DC probe calibration procedure using the optional DC probe cal fixture. See [TriMode probe DC compensation](#) on page 27.
6. Use the Probe Setup screen to set the probe parameters as described in the *Basic operation* section.

Connect to the host instrument

NOTE. Your TekConnect instrument may require a firmware upgrade to support full functionality of the P7700 Series probes.

1. Before you connect the probe, check the version requirements. See [Host instrument firmware](#) on page 93.
2. Slide the probe into the TekConnect receptacle. The probe clicks into place when fully engaged.
3. Optional. Turn the thumbscrew clockwise (finger-tight only) to secure the probe to the instrument.



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Disconnect

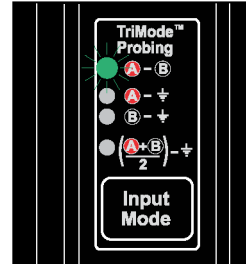
4. To disconnect, turn the thumbscrew counter-clockwise.
5. Press the latch release button and pull the probe away from the instrument.

Probe and probe tip power-on

After the connection to the oscilloscope is made:

1. The probe briefly turns on all LEDs during a self-test, and then the A – B Input Mode LED remains on. If a probe tip is attached, an LED on the tip also turns on when properly attached to the probe.
2. The probe transfers data from the probe and tip to the host instrument, and a message displays on the instrument as the transfer occurs.

1



2

Performing Long Operation

Please wait while the oscilloscope copies S-parameter files from the accessory. This operation will take a few minutes. Once the files are copied it will not be necessary to copy them again.

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The data transfer takes a few minutes, and is only done when the host instrument discovers a new probe or new probe tip. The data transfer only occurs on instruments that are fully compatible with the probe.

3. After the data transfer is done, the probe is ready for a functional check and compensation. See [Functional check](#) on page 19.

If the probe's warning light remains on, the power-on self-test likely failed. See [Error conditions](#) on page 95.

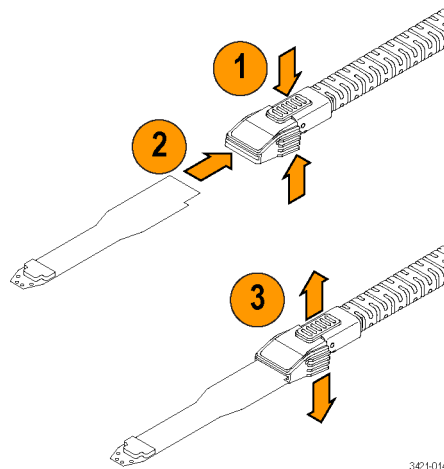
Connect accessories to the TekFlex connector

All of the P7700 accessories mate with the new TekFlex (zero insertion force) connector. This connector provides an easy connection with one handed operation for attaching to the P7700 series accessories. The following procedures show the steps for connecting probe tips to the TekFlex connector; the procedures for connecting to other accessories are similar.

Connect the tip to the probe TekFlex connector as follows:

1. Pinch the TekFlex connector to open the jaws.
2. Orient the tip with the probe head (notch to the left) and slide the tip connector into the TekFlex connector.

A green LED will light up when the tip is inserted. The LED is the first indication that the tip is powered and is inserted. You also need to confirm that the connector pins on the TekFlex connector fit through the alignment holes on the tip.



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3. Once the tip is fully inserted, release the pinch and the TekFlex connector closes. When closed and properly seated, the top of connector will be flush with the probe tip housing.

Probe comp box controls and indicators

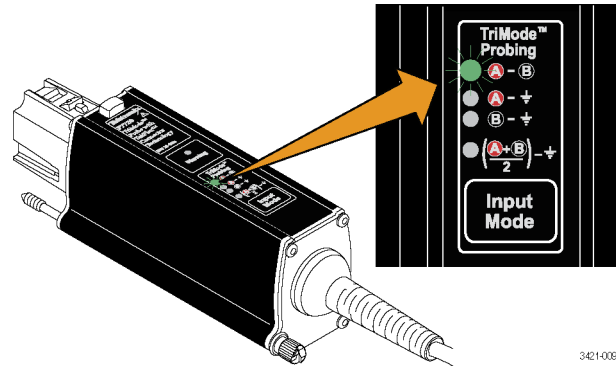
Input mode buttons and LEDs

The P7700 Series solder-in tips support TriMode operation. TriMode enables you to switch the probe between four different measurement types without changing the probe's connection:

NOTE. You can also change the Input Mode in the oscilloscope Probe Setup panel.

Press the Input Mode button to select one of the four TriMode measurements. The modes cycle in the following sequence:

- A – B (for differential signal measurement)
- A – GND (for A input single-ended measurement)
- B – GND (for B input single-ended measurement)
- $(A + B)/2$ – GND (for common mode measurement)

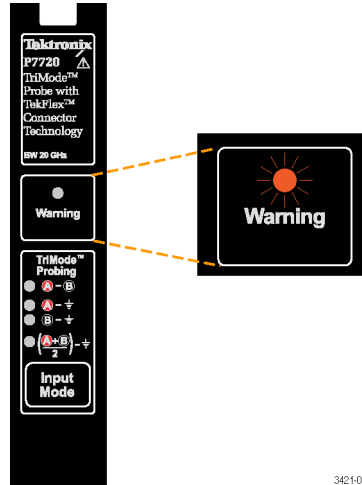


Warning LED

The Warning LED glows amber under the following conditions:

- Probe power-on self test failure
- Probe tip over-temperature detected
- The input voltage on either the A or B input exceeds the allowable limit

The Warning LED clears when the condition causing the warning is removed. A notifier message of a probe warning condition can also be seen on the oscilloscope.



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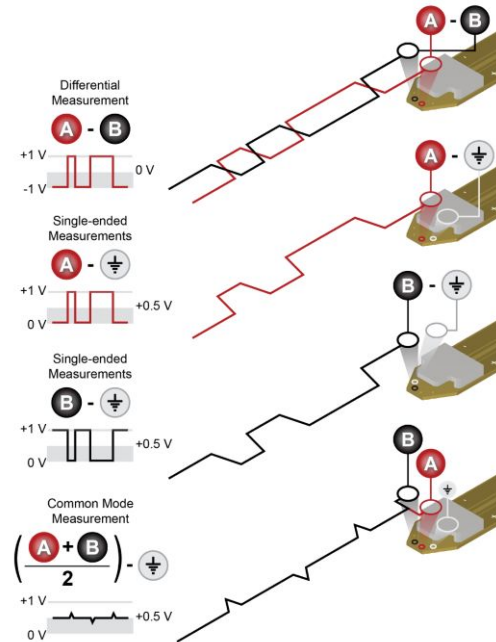


CAUTION. Do not exceed the input voltage limits of the probe and probe tips. The probe or oscilloscope circuits may be damaged if the limits are exceeded. Make sure that you understand and work within the limits of the probe and probe tips.

TriMode probing

The TriMode feature allows you to view two single-ended signals and the resultant differential waveform and common-mode voltage without moving the probe connection. Press the Input Mode button to cycle through the waveform views.

This example shows a typical signal on the A and B inputs. The resultant differential waveform and common-mode voltage are shown.



Functional check and calibration

After you connect the probe to the oscilloscope, you can perform a functional check using either the optional deskew fixture designed for the probe or the optional P77C292MM Adapter.



CAUTION. To avoid ESD damage to the probe, always use an antistatic wrist strap (provided with your probe), and work at a static-approved workstation when you handle the probe.

Functional check

This procedure checks the four TriMode settings on the probe, using the FAST EDGE signal from the front panel of the oscilloscope. It verifies the signal path of both the probe A and B input signals and their combination in the four TriMode settings. The P7700 Series Probe deskew fixture is used to connect the FAST EDGE signal to the probe tip input. See [Table 2: Required equipment, functional check with probe tip](#) on page 20. Alternately, the P7700 Series probe with the optional coaxial input adapter can connect directly to the FAST EDGE signal. See [Table 3: Required equipment, functional check with SMA adapter](#) on page 20.

Table 2: Required equipment, functional check with probe tip

Item description	Performance requirement	Recommended example ¹
Oscilloscope	TekConnect Interface	Tektronix MSO/DPO70000C/70000DX
Probe tip	Solder tip or Browser tip	P77STFLXA
Test board	Probe deskew fixture	P77DESKEW ²
USB cable assembly	USB 2.0, A male to Micro B male, 1 m	174-6919-xx (included with P77DESKEW)
Coaxial cable	SMA, 50Ω, male-to-male	174-1120-xx

Table 3: Required equipment, functional check with SMA adapter

Item description	Performance requirement	Recommended example
Oscilloscope	TekConnect Interface	Tektronix MSO/DPO70000C/70000DX
SMA adapter	Coaxial input SMA adapter	P77C292MM ³

¹ Nine-digit part numbers (xxx-xxxx-xx) are Tektronix part numbers

² Optional accessory

³ Optional accessory

4. Connect a P7700 Series probe tip to either the Port1 or Port2 on the P77DESKEW fixture. If a TekFlex solder-in tip is used to make this connection, its tip input should be inserted into the plastic clamp of the deskew fixture port. This is done by compressing the spring-loaded clamp, inserting the probe tip input into the clamp, and then releasing the clamp so that it locks the connection.

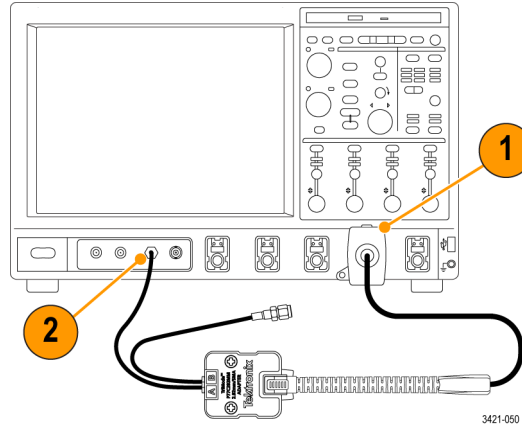
An additional set of green LEDs will light up under the probe tip clamp when the solder-down probe tip is properly inserted into the clamp.

Finally, connect the TekFlex connector at the end of the probe main cable to the probe tip inserted into the deskew fixture port. An LED on the probe tip will also light up when the tip is properly inserted into the TekFlex connector of the probe.

5. If a P77BRWSR tip is used instead of a solder-down tip to make connection to the Deskew Fixture, the TekFlex connector of the probe should first be connected to the P77BRWSR tip. The P77BRWSR tip inputs must then be pressed into place against the A and B signal traces on the P77DESKEW fixture board edge, located between the Port1 and Port2 clamps. Either of the two sets of A and B signal trace connection patterns located on the P77DESKEW fixture board edge may be used.

Test setup with the P77C292MM adapter

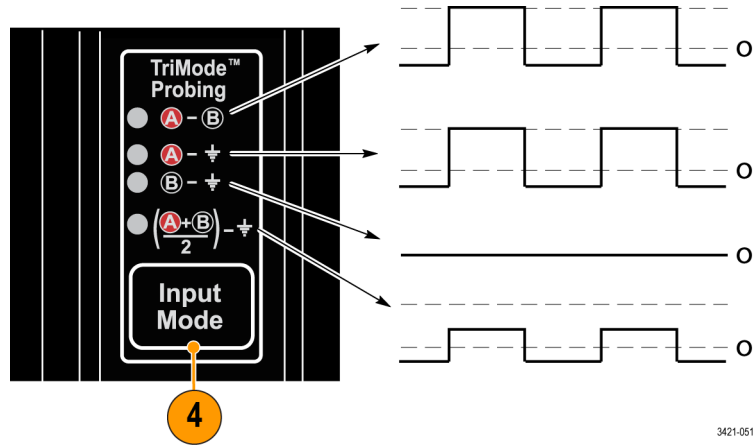
1. Connect the probe to any channel (1-4) of the oscilloscope (connection to CH4 is shown). Set the oscilloscope to display the connected channel. Connect the probe to the P77C292MM adapter.
2. Connect the A cable from the P77C292MM adapter to the FAST EDGE output connector on the oscilloscope. Leave the B cable disconnected for now.



Test procedure

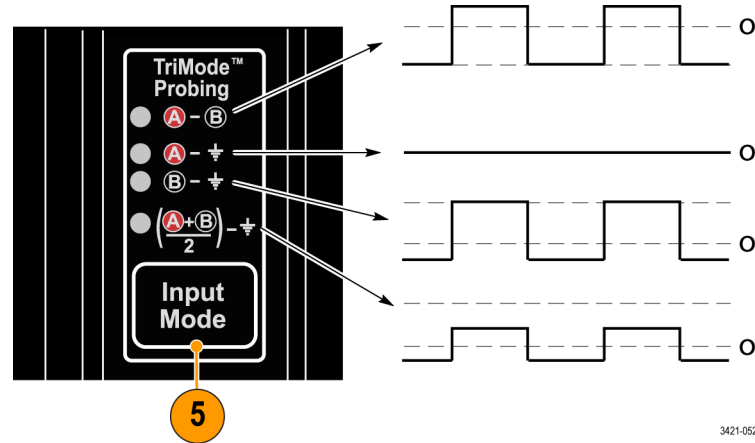
1. Set the probe Input Mode to A-B.
2. Adjust the oscilloscope to display a stable waveform (or press the Autoset button). The FAST EDGE signal is a 1 kHz square wave. The amplitude of the FAST EDGE signal is attenuated by 2X, compared to a single path termination, due to the power splitter built into the P77DESKEW fixture.

3. When you see a stable square waveform, check the amplitude (use the horizontal cursors). The attenuated amplitude displayed for a DPO70000 oscilloscope FAST EDGE signal routed through the Deskew Fixture should be about 100 mVpp.
4. Cycle the Input Mode button through the remaining selections and compare the displayed waveforms to the waveform measured in the setup steps.
 - A-B
 - A-GND (same amplitude and polarity as previously measured)
 - B-GND (the B input is grounded; no signal is measured)
 - $(A+B)/2$ -GND (half-amplitude, but the same polarity as previously measured)



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5. Change the FAST EDGE cable connection from the Deskew Fixture A input to the B input. If using the P77CSMAMM adapter, disconnect the A SMA cable from the FAST EDGE output and connect the SMA B cable. Repeat the displayed waveform checks. The measurements should be different as follows:



- A-B (the polarity of the signal will be inverted due to the B signal inversion, although the p-p amplitude should be the same)
- A-GND (the A input is grounded; no signal is measured)
- B-GND (same amplitude but non-inverted polarity compared to the A-B mode)
- $(A+B)/2$ - GND (half-amplitude, but the same polarity as measured in the B-GND mode)

TriMode probe DC compensation

To maximize the amplitude accuracy of measurements made with a P7700 series probe, you should run a probe compensation routine on each channel that you use. The probe compensation operation minimizes measurement errors by optimizing the DC gain and offset of the probe. Individual compensation constants are stored for all TriMode settings, on each probe, on each channel.



CAUTION. *To avoid ESD damage to the probe, always use an antistatic wrist strap (provided with your probe), and work at a static-approved workstation when you handle the probe.*

Table 4: Required equipment, DC compensation

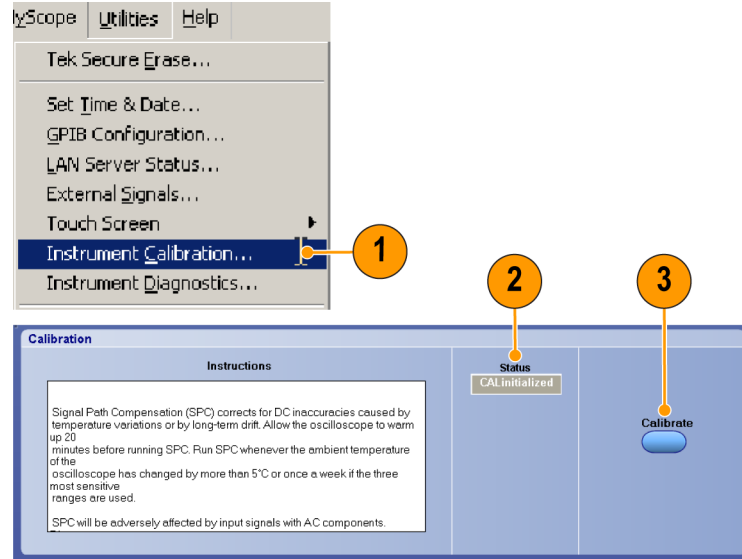
Item description	Performance requirement	Recommended example ¹
Oscilloscope	TekConnect Interface	Tektronix MSO/DPO70000C/70000DX
Probe tip or SMA adapter	Solder tip or Browser tip Coaxial input SMA adapter	P77STFLXA (standard accessory) P77STFLXB (optional accessory) P77C292MM (optional accessory)
Test fixture	Probe DC calibration fixture	067-4889-xx (optional accessory)
Coaxial cable	BNC, 50Ω, male-to-male	012-0208-xx (standard accessory)

¹ Nine-digit part numbers (xxx-xxxx-xx) are Tektronix part numbers

Check the instrument calibration status

The Calibration Status of the instrument Signal Path Compensation test must be **Pass** for the probe compensation routine to run.

1. From the Utilities menu, select Instrument Calibration.
2. In the Calibration box, check that the Status field is **Pass**.
3. If the status is not pass, disconnect all probes and signal sources from the oscilloscope, and run the Signal Path Compensation routine.



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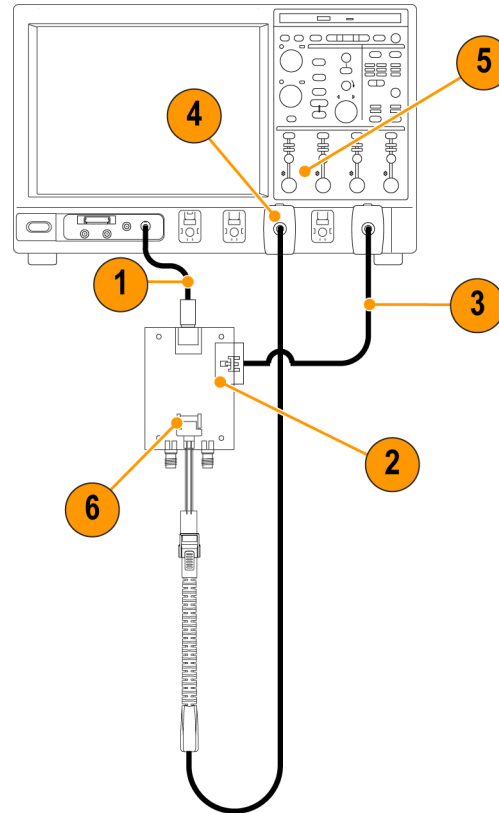
When the Signal Path compensation test status is **Pass**, continue calibrating the probe. See [Compensate the probe](#) on page 30.

Compensate the probe

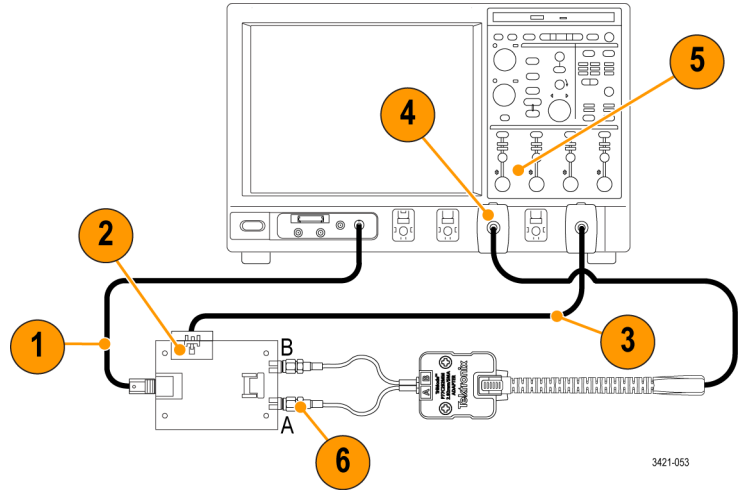
1. Connect a BNC cable from the DC Probe Cal output connector on the oscilloscope to the BNC connector on the TriMode DC Calibration board.
2. Connect the cable from the TekConnect adapter to the connector on the calibration board.
3. Connect the other end of the TekConnect adapter cable to the Aux In channel on the oscilloscope.
4. Connect the probe to any channel of the oscilloscope. Allow the probe to warm up for 20 minutes.
5. Set the oscilloscope to display the channel.
6. Depending on your setups, do one of the following:

- Attach a P7700 Series probe tip to the TekFlex connector of the probe. For a solder-in probe tip open the fixture's tip clamp, insert the input end of the tip, then release the clamp. For a P77BRWSR browser tip, the browser's pins should be pressed into the array of vias on the calibration fixture.

NOTE. A set of green LEDs will light up under the probe tip clamp when the solder-down probe tip is properly inserted into the clamp.



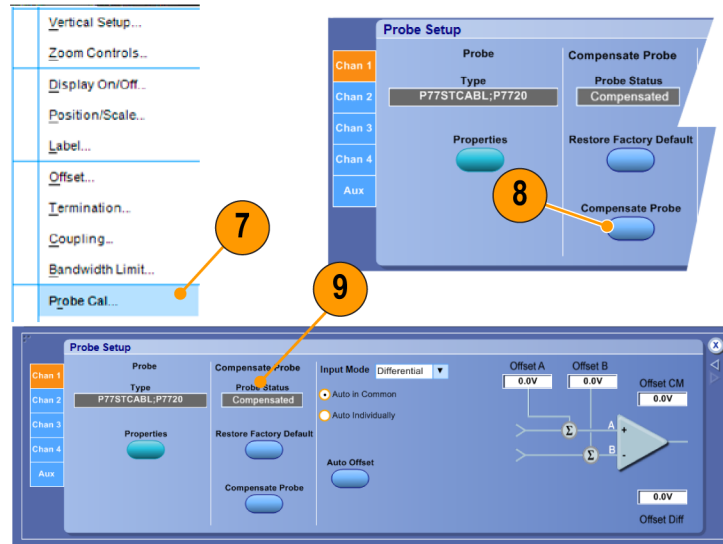
- Attach a P77C292MM Adapter to the TekFlex connector of the probe. Connect the A and B cables from the adapter to the A and B connectors on the calibration fixture.



7. In the oscilloscope menu bar, select Vertical and then select Probe Cal.
- The Probe Setup dialog box appears.
8. Select the Compensate Probe button.

The probe calibration routine runs, optimizing the probe to the oscilloscope for each input mode setting.

NOTE. A switching relay on the fixture emits a clicking sound when the calibration runs; this is normal.



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9. When the compensation routine completes, Compensated appears in the Probe Status box.

NOTE. *If the Probe Cal routine fails, check the connection of the tip to the probe body and the tip to the calibration board.*

Basic operation

This section includes information about the probe input limits, using the probe controls, and procedures for connecting the probe to your circuit.

Probe input model

A simplified input model of the probe is shown below to illustrate the probe offset voltage controls. The probe has two symmetrical signal inputs, the A input and the B input, which you can display independently or in combination by selecting the appropriate probe input mode. The probe also has independent offset voltage controls for the probe A and B input signals.

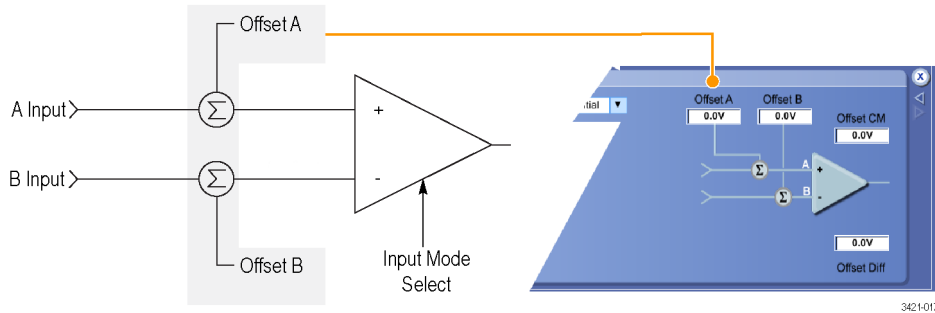
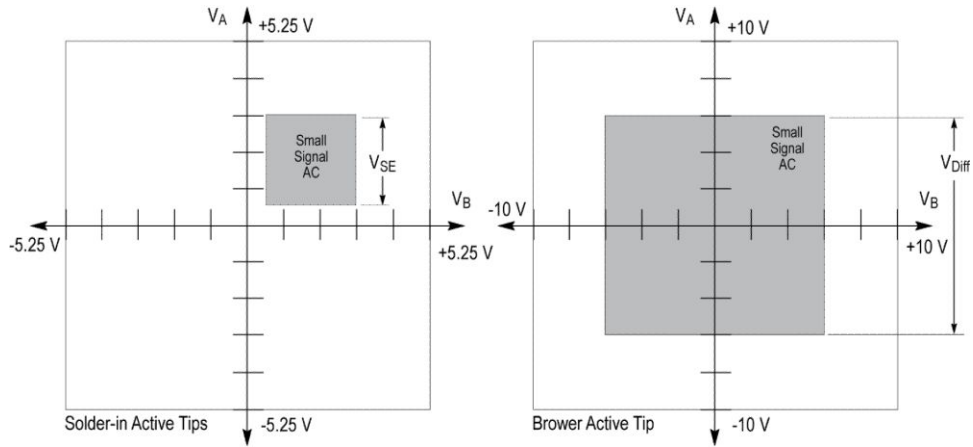


Figure 1: Simplified probe input model

Offset voltage

The offset voltage adjusts the probe input dynamic range within the larger probe input operating range, as shown in the following figure. The probe input dynamic range is the region where an input signal is within the linear operating region of the probe. The probe A and B offset voltages are set and stored as common settings for all four input modes.



V_A - Operating voltage on A input V_B - Operating voltage on B input V_{SE} - Single-ended dynamic range V_{Diff} - Differential dynamic range

3421-037

Figure 2: Input dynamic range for solder-in tips and browser

Using the offset voltages

The offset voltage nulls out the DC bias component of an input signal, allowing the (generally smaller) AC component of the signal to be displayed. The size of the probe input dynamic range depends on the probe tip that you are using, as shown in the diagrams, and can also depend on the input mode selected. The probe input dynamic range limits are shown on the oscilloscope display with a momentary annunciating, arrow-tipped line, when the vertical scale setting is large enough.

To set the offset voltages on the probe, you can use the controls in the Probe Setup screen. See [Probe setup screen](#) on page 39.

To display the Probe Setup screen, select Probe Cal from the oscilloscope Vertical menu. You can also use the offset knobs on the oscilloscope to set the offset voltage of the probe.

Probe setup screen

Use the Probe Setup screen to adjust the probe input settings for the measurement you are taking. To display the Probe Setup screen, select Probe Cal from the oscilloscope Vertical menu. The Probe Setup screen can be used to select the TriMode Input Mode setting and is also used to adjust the offset voltage controls for the probe tip A and B inputs.

The following pages describe the controls and status fields in the Probe Setup screen.

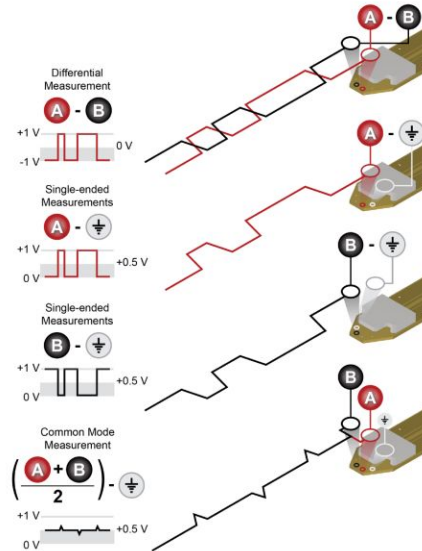


Figure 3: Probe setup screen

Selecting the TriMode input mode

The Input Mode button on the probe toggles the internal probe input selector switches among the four input mode selections. The mode can also be selected from the drop-down menu in the Probe Setup screen. This TriMode feature allows full characterization of a differential signal from a single connection.

A-B mode The A-B Mode is used for making differential signal measurements and represents the traditional differential probe functionality. Since the A-B Mode measures the difference between the A and B input signals, it eliminates any common mode voltage, such as a DC bias common to both inputs, within the CMRR performance capability of the probe.



A-GND mode The A-GND mode is used for making single-ended measurements with the probe A input. The probe ground input connects the probe tip and main cable shield. The A-GND Mode is designed for minimal coupling from any signal present on the B input within the A input isolation performance of the probe.

B-GND mode. The B-GND mode is used for making single-ended measurements with the probe B input. The probe ground input connects the probe tip and main cable shield. The B-GND Mode is designed for minimal coupling from any signal present on the A input within the B input isolation performance of the probe.

(A+B)/2 mode. The (A+B)/2 Mode is used for making common mode measurements on a differential signal and represents a capability that previously could only be made using oscilloscope math on multiple channels. For a differential signal, the common mode measurement indicates the DC bias level and also shows the degree of asymmetry between the A and B inputs. Since the (A+B)/2 Mode measures the average between the A and B input signals, it eliminates any complementary differential signal voltage, within the DMRR performance capability of the probe. This measurement also requires a ground connection to the probe.

Selecting the offset voltage

You can set both the A and B offset voltages to levels that are common for all input modes.

Offset voltages may be automatically generated by the probe and can be set automatically using the Auto Offset button and two mode selection buttons in the Offset section of the Probe Setup screen. You can also enter specific offset values directly in the Offset fields.

There are four manual offset voltage value entry fields which also display the current offset voltage settings. An offset voltage entry field is activated for adjustment by clicking in the setting window. A single click activates both the setting window and the general purpose knobs on the oscilloscope front panel. A second click in the setting window when activated also brings up a keypad entry window. Although all four offset voltage value entry fields are active, only two of the control pairs are independent. The manual controls interact with each other as follows:

Adjusting the A or B settings affects the Differential and Common settings

- Differential = $(A - B)$
- Common = $(A + B)/2$

Adjusting the Differential or Common settings affects the A and B settings

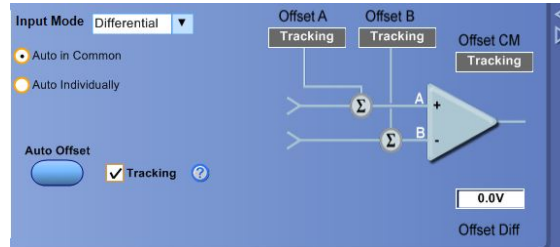
- $A = \text{Common} + (\text{Differential}/2)$
- $B = \text{Common} - (\text{Differential}/2)$

The oscilloscope vertical channel offset control also adjusts the selected Input mode offset voltage field.

Auto Offset voltage set buttons

The probe A and B signal inputs are sensed, monitored, and averaged by probe internal circuitry and the sensed values are used by the automatic offset voltage control buttons.

Auto in Common. This selection selects the common value Auto Offset mode. When this mode is selected and the Auto Offset button is pushed, the A and B offset fields are both set to the mean value between the A and B signal levels.



Auto Individually. Click this selection to select the individual value Auto Offset mode. When this mode is selected and the Auto Offset button is pushed, Offset A offset is set to the average value of the A signal and Offset B is set to the average value of the B signal.

Auto Offset. Push this button to initiate a momentary Auto Offset cycle. The Offset A and Offset B values are automatically set based on the selected Auto Offset mode and the A and B signal input voltages.

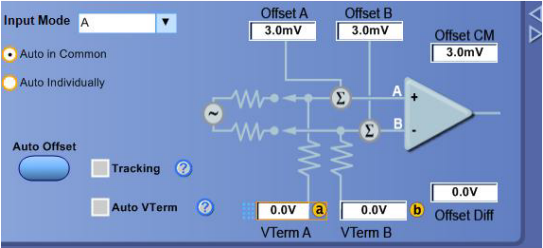
Tracking. When this box is selected, the probe continually measures the common mode voltage currently present on the inputs of the probe. Using the measured common mode values the A, B, and CM offsets will be set automatically. When Tracking is enabled, the A, B, and CM offsets cannot be changed manually.

The tracking function works best when measuring a differential signal. When making single-ended measurements in Differential Input mode with a browser tip, set the offset voltage control manually so that the tracking mode will be shut off. If single-ended measurements are made with tracking mode active, the Offset A voltage will likely not be optimum and will be affected by the duty cycle of the A input signal. The Offset A voltage should be set manually to the center of the A signal voltage swing.

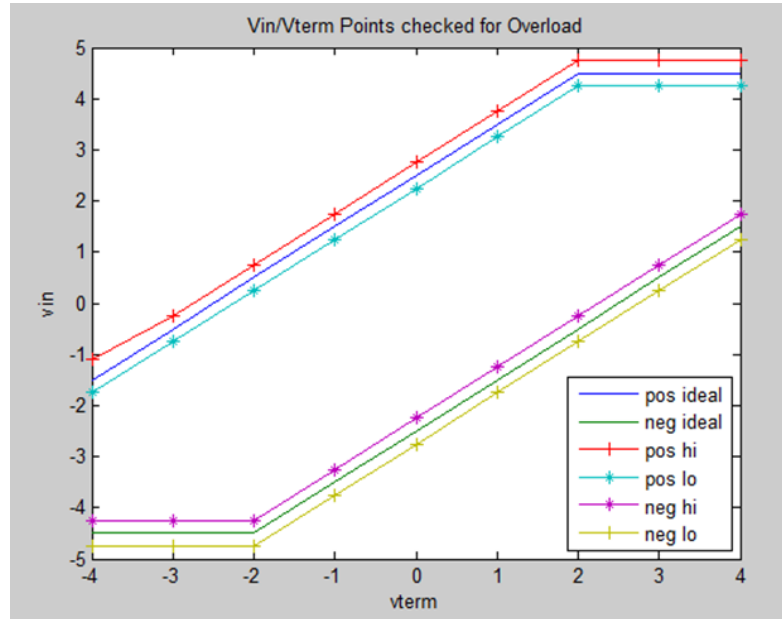
Termination voltage

For the P77C292MM adapter, the termination voltage adjusts the effective probe DC loading of the 50 Ω input termination. Use the voltage to minimize the DC loading of the probe input signals. By setting the voltage equal to the DC bias voltage of the input signal, the probe DC loading is nulled out, as if a DC block was inserted. However, unlike a DC block, the signal DC voltage is still present at the probe input and might require you to adjust the Offset voltage to move the signal into the probe input dynamic range. There are some signal measurement applications that benefit from the availability of an adjustable termination voltage and avoid the need for a pair of bias tees.

The probe A and B termination voltages are set and stored independently for each of the four input modes. When using the P77C292MM adapter, the voltage can be adjusted over a limited operating range before reaching an overload condition.



A graph of the operating limits of the termination voltage with respect to the input voltage is shown for the P77C292MM adapter. The hi and lo lines represent the hysteresis sections and the limits are the points where the Status light turns on.



Probe tip information

NOTE. *Probe tip ID is fully automatic. Manual selection is not required.*

When the probe is first connected to the oscilloscope channel, the oscilloscope queries the probe for status information, including the probe type, serial number, and the model number of the tip that is connected to the probe. The first time a probe or probe tip is connected to a host oscilloscope, the probe and probe tip serial numbers are logged and the stored S-parameters are downloaded. If the probe or probe tip are moved to another channel on the same oscilloscope, the logged information is automatically processed without repeating the download process.

The Probe Controls described below are accessed using the Probe Controls selection from the oscilloscope Vertical menu.

Controls

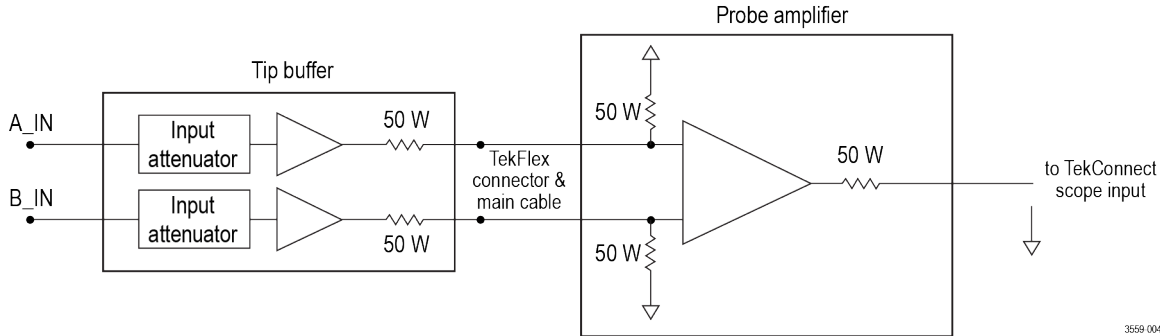
Click on the Control button to display the Probe Controls screen. This screen displays a subset of the selections that are available in the Probe Setup screen. The resulting shorter display height allows more room for the waveform display area.

Improving measurement accuracy

This section covers some of the features and characteristics of the probe that can affect the accuracy of your measurements, and some steps that you can take to improve the performance of the probe.

Probe architecture

The probe measurement setup, as shown in the simplified drawing below, requires a host TekConnect oscilloscope, a P7700 Series probe, and probe tips. An active probe tip includes a dual input buffer capable of driving the 50 ohm signal path of the probe TekFlex connector and probe main cable. The dual input buffer is designed for good matching of the A and B probe tip inputs to support differential measurements.



3559 004

Figure 4: Simplified probe architecture diagram

The probe tip dual input buffer also provides high DC resistance input attenuators, which are carefully designed to minimize high frequency loading on the input signals. The attenuation factor of the buffer input attenuators depends on the probe tip type. Using a different attenuation factor allows you to trade-off dynamic range for noise performance.

The probe comp box contains the main probe amplifier, as shown above. This main probe amplifier has a differential input termination network that receives the buffered A and B input signals from the active probe tip. The main probe amplifier has a TriMode input configuration for switching between differential, single-ended, and common-mode measurements. The probe main amplifier has a wide gain range with variable gain control for calibrated gain performance and to optimize noise performance. The probe main amplifier is also capable of driving the 50 ohm signal path of the probe TekConnect interface with the host oscilloscope.

Solder-in tip connection wire length

There are four via locations for soldering wire connections between the probe tip and the measurement DUT.

The via connections include the probe tip A and B inputs for a differential signal and two ground connections for best performance and flexibility in connecting to a close DUT ground. In general, the probe tip soldered wire connection length should be kept as short as possible. In addition, the probe tip A and B input wires should be matched in length for best Differential mode measurement performance.

The Differential input mode does not require a ground reference wire connection, since the differential measurement process provides its own virtual ground. The single-ended input modes, which include A-GND mode, B-GND mode, and Common mode, all require at least one ground wire connection. However, if there is room for another connection and a circuit ground near the probe tip, hooking up a ground connection is recommended. This might help avoid a situation where a large potential on the ground plane of the DUT causes the test signal to drift outside of the linear range of the input amplifier of the probe. Ideally, it is a good idea to hook up the differential inputs and the ground to avoid clipping of the signal in the probe amplifier.

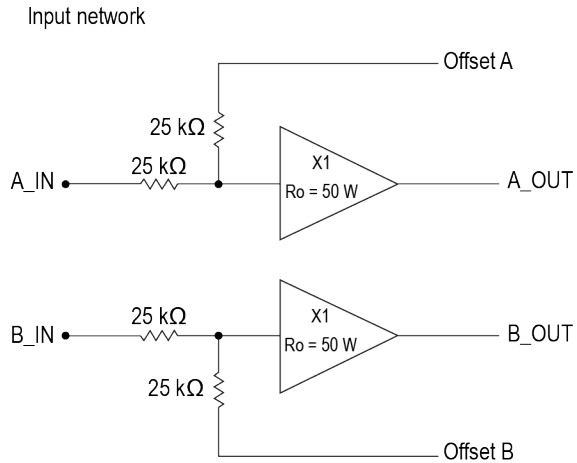
The measurement performance of the single-ended input modes is affected by the length of the ground wire connection, with high frequency performance degradation increasing with increased ground wire length. The solder-in probe tip performance is specified using a test fixture built with a probe tip having a signal wire length of 10 mils (.25 mm) and a ground wire length of 66 mils (1.7 mm).

Please see the *Specifications Technical Reference* manual available for download at the Tektronix website for more detailed specifications on wire length as it affects tip performance.

Using offset voltage to extend P7700 series solder-in tip input voltage range

The single-ended linear dynamic range of the TekFlex solder-in tip inputs is specified to be $2.5 V_{p-p}$, which is a range from $-1.25 V$ to $+1.25 V$ with zero volt offset. The dynamic range of P7700 Series buffers is limited by the input attenuation factor, which is 2X for the solder-in probe tips as shown in the simplified drawing. See [Figure 5: Simplified drawing of input attenuation factor of the tip buffers](#) on page 53. A 2X attenuation factor was selected for the probe tips as a compromise between dynamic range and noise, since a higher attenuation factor would have increased probe noise.

Although the dynamic range of the probe tip buffer cannot be extended, it is possible to extend the range over which the tip dynamic range window can be moved by adjusting the probe offset voltage. The offset voltage range of the TekFlex solder-in tips is $-4 V$ to $+4 V$, which is adjusted using the Probe Setup screen of the oscilloscope or the offset knobs on the oscilloscope front panel. Using the offset voltage controls, it is possible to make measurements within any $2.5 V_{p-p}$ window between $-5.25 V$ and $+5.25 V$. For example, by setting the offset voltage to $+3.0 V$, it is possible to measure an HDMI signal, which has a signal swing between about $+2.8 V$ and $+3.3 V$.



3559-005

Figure 5: Simplified drawing of input attenuation factor of the tip buffers

The offset voltage affects the probe tip buffer's measured signal through a resistive summer configuration that forms the buffer's input attenuator network. The high value resistors used in the buffer's input attenuator result in an interaction between the input signal and the offset voltage DC level.

Calibrated offset voltage performance requires that both the input signal and the offset voltage generator in the probe have a source resistance that is very small compared to the 25 k Ω attenuator resistors. The source resistance of the offset voltage generator in the probe is less than an ohm. Typically, when the probe and tip are connected to a DUT, the DUT signals have a source resistance, R_S , much less than 25 k Ω .

If a TekFlex solder-in tip is attached to a probe but not soldered to anything, the inputs will be open which effectively makes the source resistance look much larger than the 25 k Ω attenuator resistors. As a result, the offset voltage control is no longer calibrated and will have 2X their calibrated effect on the measured probe output. This effect can be helpful in troubleshooting connection issues with the tips. If a probe tip has been soldered to a DUT and adjusting the offset voltage causes the offset to move 2X the adjustment, it could indicate a broken solder joint that has left the probe tip input open.

Making single ended measurements using the P77BRWSR differential probe tip

Making single-ended measurements with a TriMode probe tip, such as a TekFlex solder-in tip, is quite straightforward, because a TriMode tip provides solder connections for a DUT ground reference for both the A and B probe inputs. Although the differential input mode of the probe is normally used to make a differential signal measurement, single-ended measurements can be made using Differential Input mode when the probe input connections and offset voltage controls are configured properly. This single-ended configuration process is particularly important to understand when using the tip, since this variable-spacing Browser tip operates only in Differential Input mode. Differential Input mode provides a measurement of the difference ($A - B$) between the A and B input signals. If the probe tip B input is connected to a DUT ground, the resulting Differential Input mode measurement ($A - 0$ V) results in a display of the single-ended A input signal response.

When making differential signal measurements, the P77BRWSR Offset Voltage control is normally set to the Common-mode (CM) Tracking mode. With CM tracking mode active, the A and B input signals are monitored and the Offset A and Offset B settings are both adjusted to match the DC common-mode voltage of the A and B input signals $[(A + B)/2]$. When making single-ended measurements in Differential Input mode with a browser tip, the offset voltage control should be set manually, so tracking mode should be shut off. The Offset A voltage should be set manually to the center of the A signal voltage swing. For a +5 V CMOS logic signal; for example, the Offset A voltage should be set to +2.5 V. The A signal input voltage should then range from +5 V to 0 V, which is within the $6 V_{p-p}$ dynamic range of the Browser tip as long as the offset voltage is set near the center of its expected voltage swing. The Offset B voltage should also be set manually to 0 V. This Offset B voltage setting is not only at the center of the dynamic range for a grounded B input signal, it also causes the differential offset voltage to equal the Offset A voltage. This is true because the differential offset voltage equals the difference between the Offset A voltage setting and the Offset B voltage setting. The differential offset voltage is used by the oscilloscope as the displayed offset voltage in Differential Input mode.

With the tip configured for a single-ended measurement in Differential Input mode, the displayed signal voltage should match the A input signal response and the displayed offset voltage should match the Offset A setting. Since the host oscilloscope uses both the displayed signal voltage and displayed offset voltage in calculating its set of available oscilloscope automated measurements, it is important that both the Differential Input mode signal voltage and offset voltage are configured properly as shown in the following figure. See [Figure 6: Proper configuration of the Differential Input mode signal and offset voltage](#) on page 56.

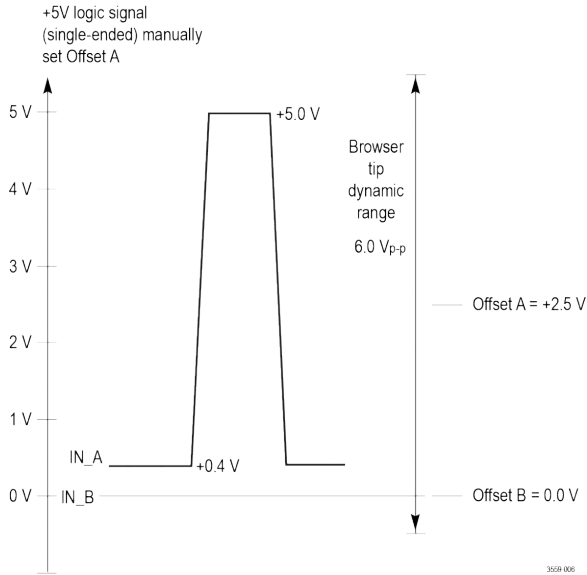


Figure 6: Proper configuration of the Differential Input mode signal and offset voltage

The configuration process described in this section will maximize the available dynamic range of the P77BRWSR tip when making single-ended measurements.

Temperature compensation

These probes employ temperature compensation to optimize measurement accuracy. Whenever a probe setting is changed, such as Input Mode, Offset Voltage, or vertical scale factor, a temperature compensation update occurs. Continuous temperature compensation is not done to avoid introducing noise into the probe amplifiers.

To maximize measurement accuracy when the probe is first powered on from a cold start condition, you must allow the probe and oscilloscope a 20 minute warm-up period. After the warm-up period, you should adjust or toggle a probe setting, such as the vertical scale factor, to trigger the temperature compensation update. Otherwise, a cold temperature compensation value may be used, which would result in a small gain error.

DSP correction

This series of probes contain S-parameter characterization data for the probe, which is downloaded to the attached oscilloscope when the probe is first connected. The probe tips also contain S-parameter characterization data for the tip, which is also downloaded to the attached oscilloscope when the probe tip is attached to the probe. This probe and tip characterization data is used to generate DSP correction filters that improves high frequency measurement accuracy.

Solder tip measurement configuration

In many of the high-frequency signaling standards that the P7700 Series probes are designed for, a 50 Ω termination at the transmitter is in parallel with another 50 Ω termination at the end of the transmission line path, effectively making a 25 Ω signal source impedance. In this application, the solder tip adapter measurement configuration is designed to pick off the transmitted signal at a location in the signal transmission path.

The input impedance for a solder tip, Z probe, varies with frequency. For a P77STxxxx tip the DC input resistance is about 50 k Ω and decreases with frequency above about 10 MHz to about 100 Ω above 10 GHz.

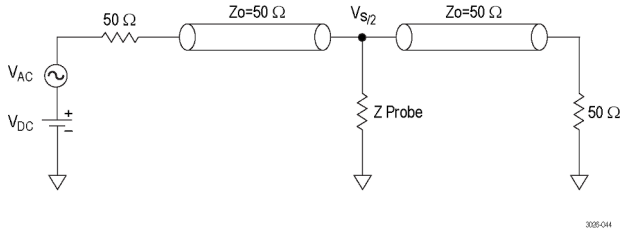


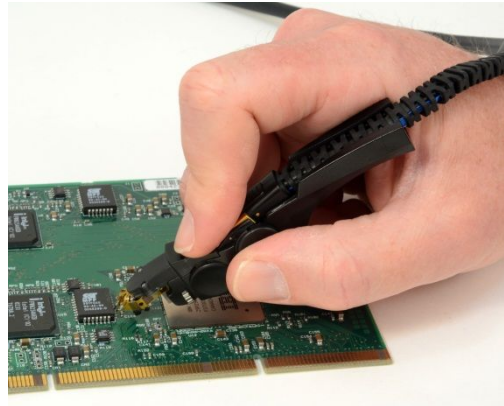
Figure 7: Solder tip measurement configuration

Connecting to a circuit board

TriMode tips are necessary to complete the connection between the P7700 Series probes and your circuit. The tips are available as both standard and optional accessories and provide several connection options.

P77BRWSR browser and accessories (Pen wand and hands free Tri-Pod)

The browser connects to the circuit using two tips with very fine point tips. These tips have built-in compliance (0.02", 0.5 mm) and adjustable spacing (.008-.210" (0.2-5.3 mm)). The browser can be held in place with a hand or can be used with the hands free Tri-Pod accessory or a probe positioner such as the Tektronix PPM203B. See [Making single ended measurements using the P77BRWSR differential probe tip](#) on page 54.



The browser is a differential only probe accessory, but can be used to measure ground referenced, single-ended circuits as well. When measuring a ground referenced signal, connect the A side (positive) input to the signal to be measured and the B side (negative) to the ground connection.



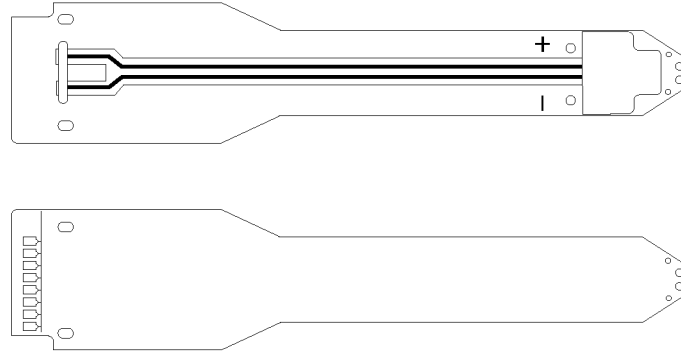
NOTE. *The pins on the browser are small and delicate, so use caution when pressing them to make a connection.*

If a probe tip breaks, it can be easily replaced. See [Browser tip replacement](#) on page 94.

Flex circuit based solder tips

The flex circuit based solder tips are connected to the circuit using thin (38 AWG) wire connected to the vias on the tip. The steps to follow when soldering the tip to the circuit are shown in the soldering procedure section below.

The flex circuit based solder tips support TriMode operation. To use TriMode, a minimum of three connections are needed, the A and B side inputs and one of the ground connections.

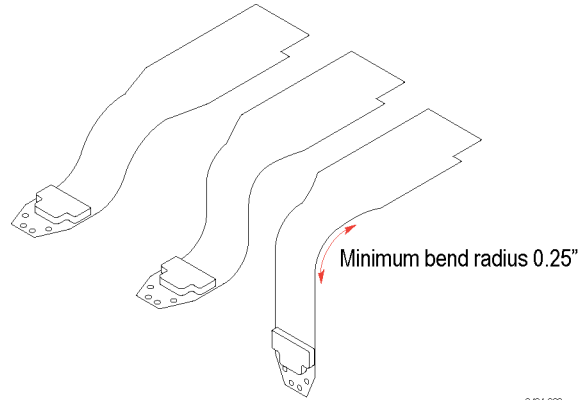


3421-042

The flex circuit based solder tips are made with flex circuit material and can be bent and shaped to fit around or into spaces where it is difficult to reach a test point.

The minimum bend radius for the flex tips is 1.0 in (25.4 mm). There is no impact on the performance of the tip when it is bent into a curved shape that conforms to bend radius limits.

Typical life for tips are 30 - 50 bending cycles before replacement is needed.



3421-033

P77STCABL Solder-in Tip

The P77STCABL solder-in tips have similar input via connections for thin (38 AWG) wire. The steps to follow when soldering this tip to the circuit are identical to the flex circuit based solder tips and are shown in the soldering procedure section below. These tips are longer than the flex circuit based solder tips and are more flexible.

These tips support TriMode operation. To use TriMode, a minimum of three connections are needed, the A and B side inputs and one of the ground connections.



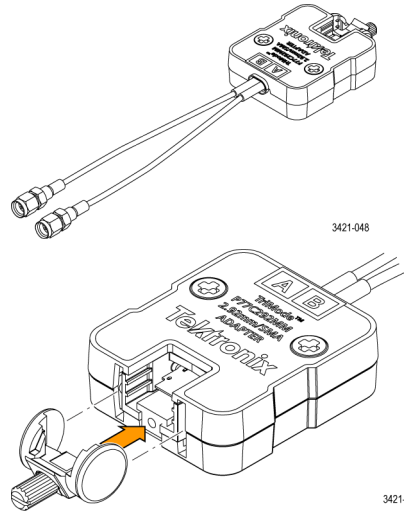
NOTE. There is no exposed metal surface on the P77STCABL tip except for the TriMode inputs and the TekFlex contacts.

P77C292MM, 2.92 mm Adapter

Use this adapter to connect a P7700 series probe to a DUT with 50 Ω test point connectors. Also use the adapter to connect to SMA connections.

After connecting the adapter to the flex cable, use the retainer to provide a secure connection to the flex cable to minimize movement or to attach the adapter to the hand's free tripod.

An accessory kit is available with linkage adapters for stacking the adapters.



Tip soldering



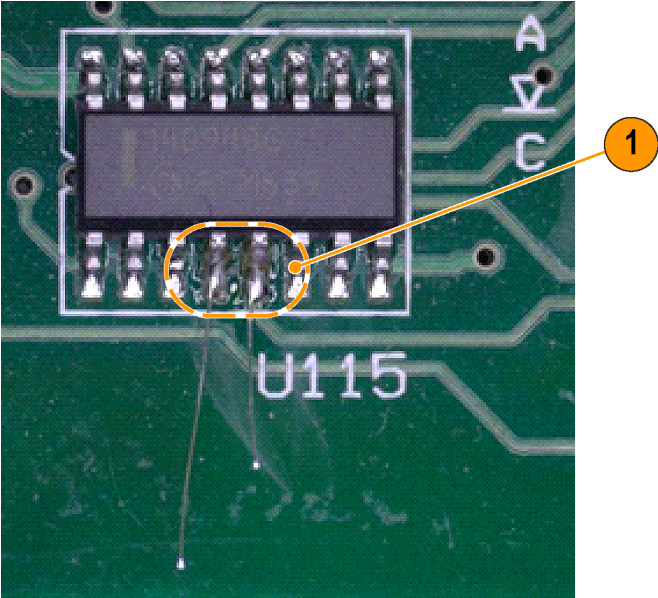
CAUTION. *This procedure uses equipment at high temperature. Avoid touching hot surfaces.*

Recommended equipment

- Lead-free solder
- 4 mil diameter (38 AWG) wire (a spool of 38 AWG wire is included as a standard accessory with each P7700 Series probe)
- MetCal Soldering Station + UFTC-7CN04 (Conical UltraFine Soldering Cartridge, max tip temp 775 °F (412 °C)) or equivalent
- Solder-Wick Rosin SD Size #1 (80-1-10) or equivalent
- Tweezers and sharp wire cutters

Tip soldering procedure. Keep the wires short as possible for best signal fidelity. Soldering wires first to the test points and then attaching the P7700 Solder tips is the best way to keep wire lengths short.

- 1. Solder wires to the test points. Cut wires with different lengths. This will make it easier to thread the wires onto the solder tips.

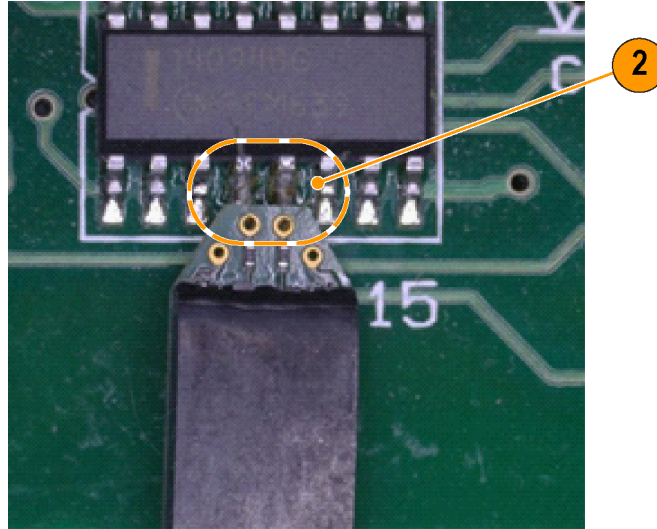


3421-001

2. Thread tip onto wires. The two middle vias are the A(+) and B(-) inputs of the tip.

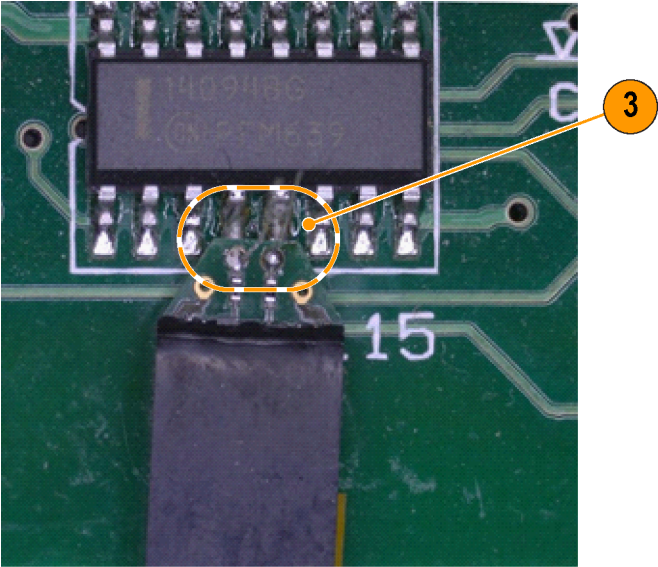
You may find it useful to use the double-sided foam tape that was shipped with your probe to hold the probe tip in place.

NOTE. *The double-sided foam tape is only good for one use. For maximum strain relief, always use a fresh piece of tape each time you attach a tip.*



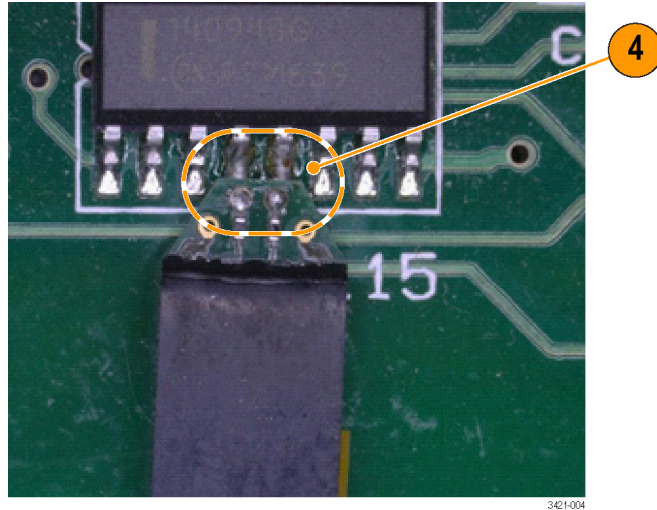
3421-002

- 3. With the tip in position, quickly solder the wires to the vias. If the soldering iron is left too long on the tip, it may cause the 0201 input resistors to reflow and move.

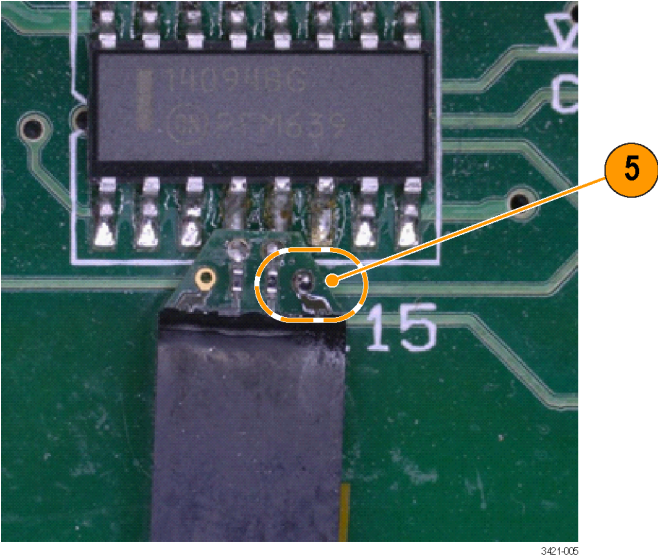


3421-003

4. Trim wires flush with the board on the probe tip.

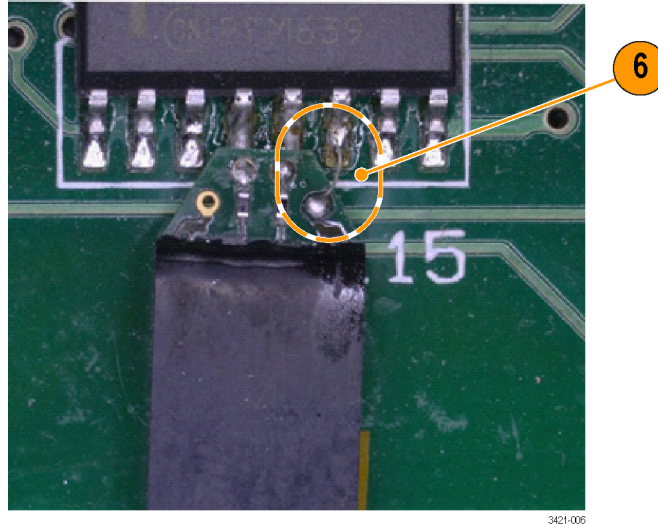


- 5. Attach the ground wire for TriMode input to the probe tip. First add solder to the test point and the nearest ground via on the solder tip.



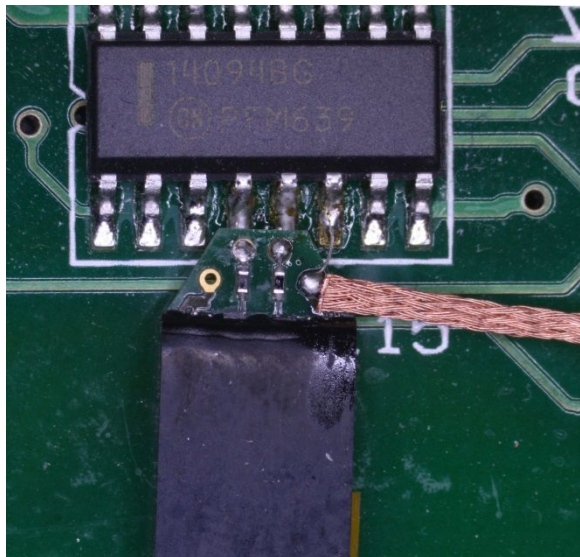
3421005

6. Second, solder a short piece of wire between the ground via on the tip and the ground test point. This configuration optimizes the performance of the probe for differential measurements. Longer wires on the ground path will have an impact on Single-Ended Mode and Common Mode performance. If there is a ground test point conveniently placed, it would be best to use the same solder technique shown on the A and B inputs of the tip to ensure the shortest ground path. Once the tip is fully soldered in place, it is recommended to firmly secure the tip to the board using additional foam tape or hot melt glue.

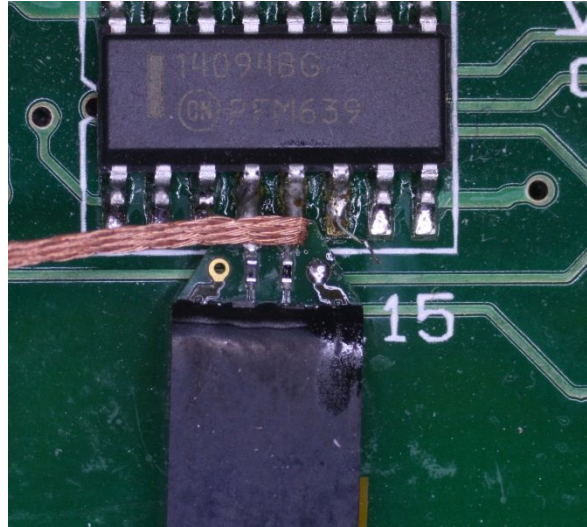


Tip unsoldering procedure.

1. Use small solder-wick to remove the solder and wire from the tip ground via. Size #1 Solder-Wick is recommended due to the small size of the tip and vias. Do not place the solder wick over the 0201 input resistors and these parts might accidentally be unsoldered from the board.

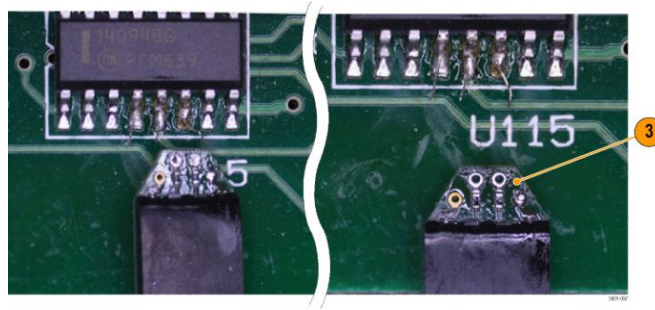


2. Use the solder-wick to remove excess solder from the input vias. Again, be careful not to place the solder-wick too close to the input resistors.



3. If the solder cannot be fully removed from the input via while attached to the test points, it is possible rock the tip side to side while reflowing the solder in the vias. Since the wires are cut flush to the board, the tip can be slowly removed from the vias using this method. Once the tip has been removed from the board, use the solderwick to clean out the vias so the tip can be reused.

If you used double-sided foam tape for strain relief rocking and moving the tip from side to side will loosen the tape's adhesion to the tip. Do not try to pull the tip directly off of the tape. Pulling the tip up without first breaking the tape's adhesion can damage the tip.



Precautions when connecting to the circuit. To achieve the best performance and service life of the probe and tips, observe the best practices below when you make connections:

- Wear the antistatic wrist strap that is supplied with the probe and work at an antistatic-approved workstation.
- The flex circuit based solder tips are built with flexible circuit board material and are susceptible to mechanical overstress and harsh handling particularly at the ends of the probe tip where the components are mounted. Always support the probe tips by taping or gluing them to your circuit or by providing a means to prevent strain on the tips and circuit connections.
- The flex circuit based solder tips contain active circuitry. The majority of the tips, including the cover on the buffer amplifier, are non-conductive surfaces. However, the back end of the tips includes some small surface mount devices and pads on the top that present a small risk of shorting with the DUT circuitry. This was necessary to minimize the size and weight of the probe tips. If you need to use the flex circuit based solder tips where their topside components might contact the DUT, take care to avoid shorting the exposed circuitry of the tips to the DUT circuitry. Covering these areas with non-conductive tape is one method to avoid shorting.
- The P77STCABL tip is designed to be more flexible than the flex circuit based solder tips; care should be taken to avoid bending the connecting cables at too sharp an angle, since overstress can cause damage or reduce signal performance.
- To preserve the cables and maintain the highest signal fidelity, never kink the wires or put undue stress on them. Support the probe head by taping it to your circuit or providing a means to prevent strain on the circuit connection.

Care of TekFlex solder-in tips.

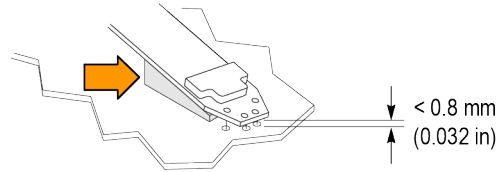
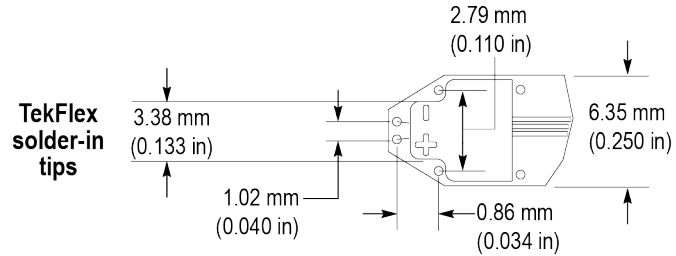


CAUTION. *The top of the tips contain active components and can cause shorting if the tips are mounted top-down and the discrete components on the back end of the tips come into contact with an active circuit. Ensure that metal components do not touch anything else.*

If the tips are mounted with the top up or if the TekFlex connector is attached, it is unlikely that the components on the board will contact the active circuit. The covers on the buffer amplifier of the tips are non-conductive. There are no conductive surfaces on the bottom of the tips except for the TriMode inputs and the TekFlex contacts.

Tip dimensions

The dimensions of the solder tip connections are provided here for reference. You can also design the tip footprint into your circuit board layout for easier test connections.

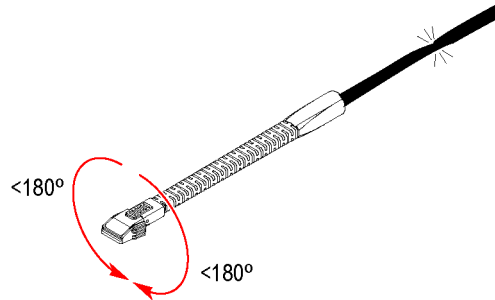
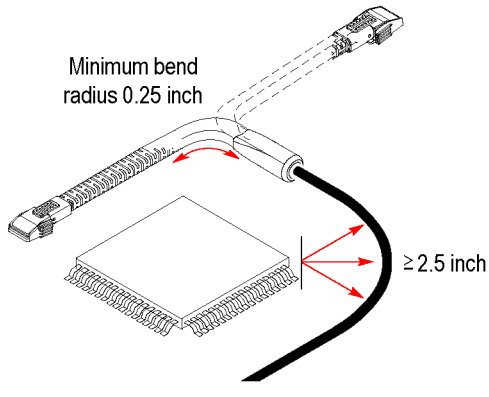


3421-057

Probe handling best practices

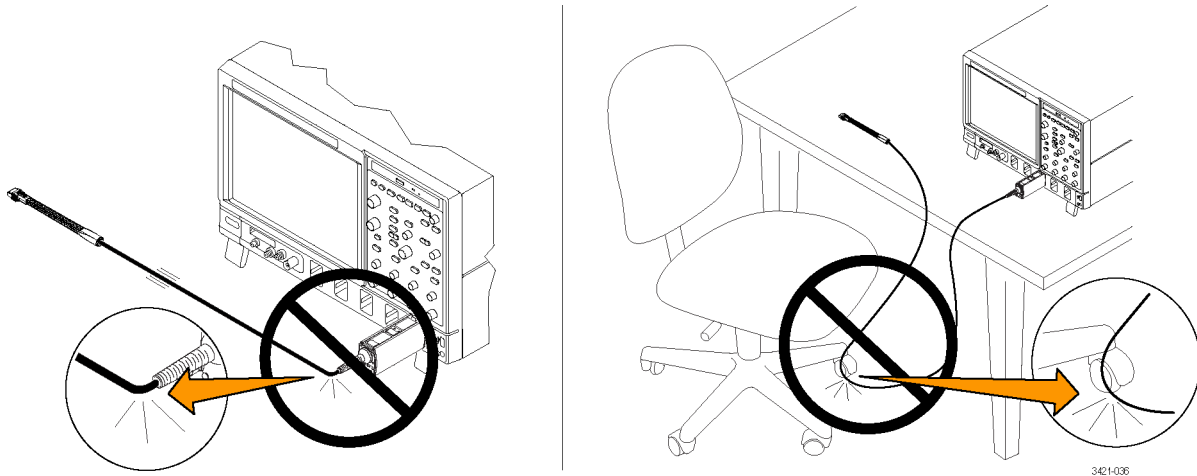
Tektronix TriMode probes are quality measurement tools and should be treated with care to avoid damage or performance degradation due to mishandling. Take the following precautions when handling the probe cables:

- Never over-bend the probe main or tip cables, which can put a permanent kink into the cable. When storing the probe do not coil it too tightly. It is best to use the protective foam carrying case which is designed to not exceed the minimum bend radius for the cable of 2.5 inches. The minimum bend radius for the flex cable is 0.25 inches (6.35 mm).
- To maximize probe life, limit the amount of cable twist relative to the probe comp box to ± 180 degrees. Always uncoil a probe cable gently before applying the twisting forces needed to orient the probe head for connection to the probe tip.



3421-005

- Do not excessively pull or twist the probe cables when positioning the probe for measurements.
- Never crush the cable, as will occur when you run over the probe with a chair wheel or drop something heavy on the cable.

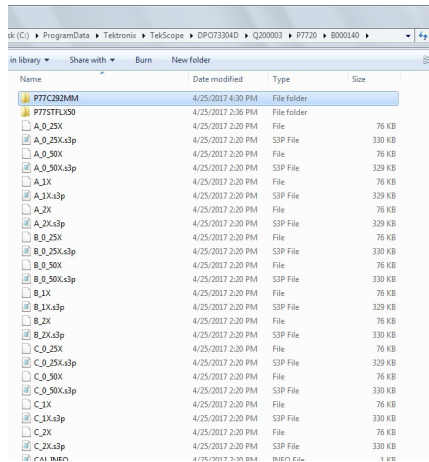


S-parameter information

The S-parameter files for the probe are unique to each serial numbered probe and accessory tip. The files are stored on the oscilloscope in a file structure that corresponds to the probe, tip, and serial numbers. The root path for the folders containing the S-parameter is `C:\ProgramData\Tektronix\TekScope\Instrument` (where Instrument is the instrument model, such as DPO73304). Starting in this folder, look through the folders for the probe, tip model numbers, and serial numbers. At the lowest level, there are `.s3p` files unique to the probe and tip.

The S-parameter file names correspond to the various settings of the TriMode feature and the gain setting of the probe. For example, if the file name is `x_1X_A_0_25X.3Sp`, the TriMode setting is: single-ended A mode, Gain setting = 0.25 (4x attenuation).

Choose a `.s3p` file that matches the TriMode setting that you are using, single-ended (A or B), differential (D), or common mode (C). Note that for browser tips, only D mode is supported.





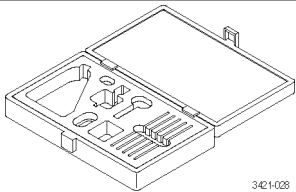
CAUTION. *Changing or deleting the S-parameter files can cause the probes to not operate properly. To avoid problems, do not change or delete the S-parameter files.*

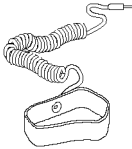

Accessories and options



You can reorder the following replacement parts and accessories. Note that in some cases, the reorder quantities may differ from those that ship with the probe.

Standard accessories




The following accessories are shipped with the P7700 Series probes. If no quantity is listed, only one of that item is shipped.

Standard accessory	Reorder part number and quantity	Description
	202-0545-xx	Wood box carrying case with inserts. This carrying case has several compartments to hold the probe and accessories.
	P77STFLXA	Active tips (3 solder tips)
	020-3167-xx	Adhesive tape
	016-2111-xx	Color bands
	017-0103-xx	Wire kit (38 AWG, 4 mil)
	071-7386-xx	Accessory re-order and info card

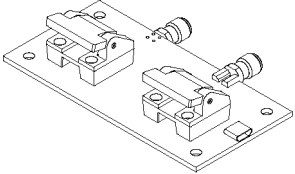
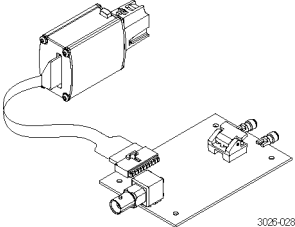
Standard accessory	Reorder part number and quantity	Description
	006-3415-xx	<p>Antistatic wrist strap. When you use the probe, always work at an antistatic work station and wear the antistatic wrist strap.</p>
	-	<p>Calibration certificate. A certificate of traceable calibration is provided with every probe.</p>

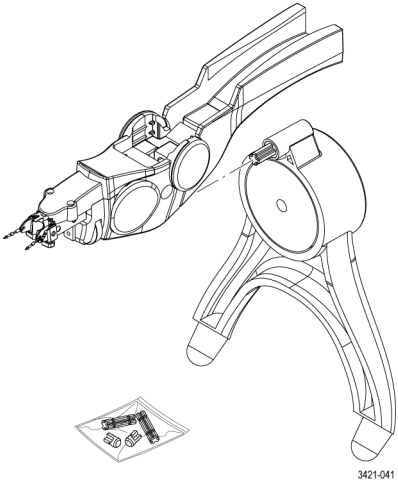
Standard accessory	Reorder part number and quantity	Description
 A white rectangular document with the text "Data Calibration Report" centered on it.	-	Data calibration report. The Data Calibration Report lists the manufacturing test results of your probe at the time of shipment and is included with every probe.
 A spiral-bound manual with a blue and white cover, showing a probe tip.	071-3421-xx	User manual. The manual provides instructions for using the P7700 Series TriMode Probes. Other documents, such as the technical reference and other probe literature are located on the Tektronix web site (www.tek.com/manuals).

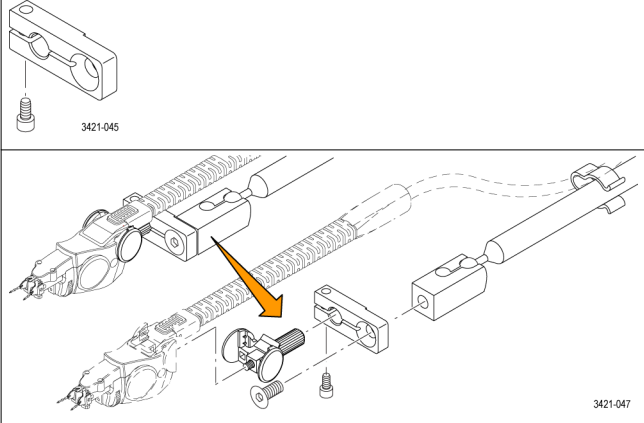
Optional accessories

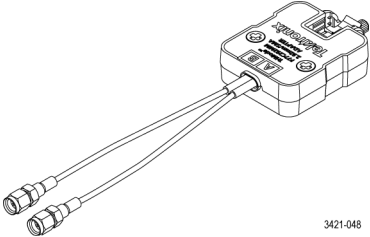
Optional accessory	Part and description
	<p>P77STCABL, Solder-in active tip This tip provides a soldered, multi-point connection that supports full TriMode measurement capabilities at full probe bandwidth.</p>
	<p>P77STFLXA Flex circuit based solder tips These tips use flex circuit material and provide soldered, multi-point connections. Designed for the lowest loading across the full bandwidth of the probe. ¹</p>
	<p>P77STFLXB Flex circuit based solder in tips for memory interposer probing. These tips use flex circuit material and provide soldered, multi-point connections. Designed to be used with Nexus Technology memory interposers.</p>


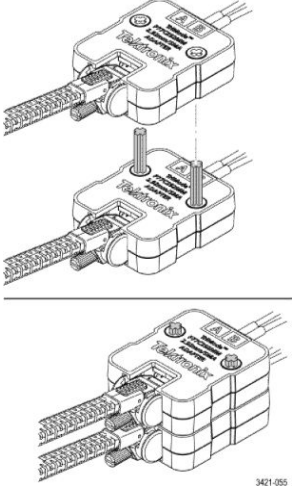
¹ 3 tips included with probe.

Optional accessory	Part and description
 <p>3421-029</p>	<p>P77DESKEW, Deskew fixture</p> <p>Use this fixture to compensate a probe, deskew up to 2 probes at once, or to perform a probe functional check.</p>
 <p>3026-028</p>	<p>DC probe calibration fixture</p> <p>Use this fixture (067-4889-xx) to perform a DC compensation with the host instrument.</p>

Optional accessory	Part and description
 <p>3421-041</p>	<p>P77BRWSR, Browser accessory includes these items:</p> <p>Browser wand. Extends the length of the browser for a more comfortable grip. (Part number 020-3160-xx.)</p> <p>Browser hands-free tripod. Holds the browser on a test point without the need to use your hands. (Part number 020-3161-xx.)</p> <p>Browser replacement tips. Use to repair any browser tips that are broken with use. (Part number 020-3162-xx.)</p> <p>Adapter attachment. Attaches the browser to the hands-free tripod or other holders.</p> <p>Ground lead. Attaches the browser to a circuit ground if necessary.</p> <p>The browser accessories can be stored in the TekFlex accessories box that comes standard with the probe.</p>

Optional accessory	Part and description
 <p>3421-045</p> <p>3421-047</p>	<p>407-6019-xx, Probe adapter Use this accessory to attach the browser to the PPM203B. probe arm/positioner</p>

Optional accessory	Part and description
 <p>3421-048</p>	<p>P77C292MM, 2.92 mm adapter Use this adapter to connect a P7700 series probe to a DUT with 50 Ω test point connectors.</p>

Optional accessory	Part and description
 <p>3421-056</p>	<p>020-3179-xx, Linkage adapter kit Use the adapters for stacking two or more P77C292MM 2.92 mm adapters.</p>
 <p>3421-055</p>	<p>Use two gray adapters to stack two P77C292MM adapters; use two black adapters to stack three or four P77C292MM adapters. Insert the linkage adapters into the P77C292MM adapters as shown (gray linkage adapters shown).</p>

Maintenance

This section contains maintenance and support information for your probe.

Host instrument firmware

Some oscilloscopes might require a firmware upgrade to support full functionality of the P7700 Series probes. Instruments with lower versions of firmware might not display all probe controls and indicators on screen, and in some cases require you to power-cycle the instrument to restore normal instrument operation.

The following table lists the required versions of instrument firmware for some of the oscilloscopes that currently support the P7700 Series probes.

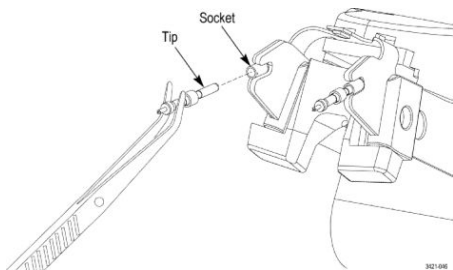
Instrument	Firmware version
MSO/DSA/DPO70000C Series oscilloscope	V 10.7.1 or higher
DSA/DPO70000D Series oscilloscope	V 10.7.1 or higher
MSO/DPO70000DX Series oscilloscope	V 10.7.1 or higher
DSO70000SX Series oscilloscopes	V 10.7.1 or higher

To check the firmware version on Windows-based instruments, from the menu bar, click Help/About TekScope. If you need to upgrade your instrument firmware, go to www.tek.com/downloads to download the latest firmware.

Browser tip replacement

NOTE. *Note: It may be helpful to have a magnifying device or glasses when performing this operation.*

The tips of the P77BRWSR can break during use. If one of the tips on your browser breaks, it is easy to replace the tip with a new one and be ready to make measurements again in a few seconds. To replace the tip, you will need a pair of tweezers. Using the tweezers, grip the shaft of the tip and pull downward to remove it. Dispose of the broken tip.



Once the old tip has been removed, retrieve a new, replacement tip from its storage vial in the accessory kit. Grip the replacement tip with the tweezers, gently push the tip into the socket on the browser's front end.

Error conditions

LED indicators

If one of the Input Mode LEDs does not remain on after you connect the probe, an internal probe diagnostic fault exists. Disconnect and reconnect the probe to restart the power-on diagnostic sequence. If the symptoms continue, connect the probe to another oscilloscope channel or oscilloscope. If the symptoms remain, return the probe to Tektronix for repair.

There is an amber-colored Status indicator LED located on the top plate of the probe comp box. This LED turns on when any of the following conditions exist and remains on until the problem condition is cleared:

- Probe power-on self-test failure (clear by disconnecting and reconnecting the probe)
- Probe tip over-temperature detected (may require forced air to be applied to cool the tip)
- Probe input over-voltage detected (reduce input over-voltage to clear)

Signal display

If the probe is connected to an active signal source and you do not see the signal displayed on the oscilloscope:

- Perform an Autoset operation on the host oscilloscope. This will automatically adjust the oscilloscope settings to try to display a useable waveform.
- Check the probe tip connection at the probe TekFlex connector. The LED on top of the accessory tip should be on if the tip is connected properly.
- Check that the input signal is within the allowable input voltage range. The Auto Offset control in the Probe Setup menu can be used to set the offset of the probe voltages to maximize the probe tip input dynamic range.
- Perform a functional check procedure. See [Functional check](#) on page 19. This procedure will check that the probe is operating properly.

Measurement errors

- If you suspect that your measurement may not be accurate, and you are using a solder in connection, check that the solder tip signal and ground connections are correct and intact.
- Checking the signal measurement in some of the other TriMode Input modes may provide some clue if there is a measurement problem. For example, operating the probe in DIFF mode does not require a ground connection. Switching the input mode between DIFF and SE might point out a grounding problem
- If the signal being measured is a differential signal, temporarily switch the TriMode input on the probe to A only and B only and verify that each component of the differential signal looks correct. Switch the probe's input to the common mode setting and see if there is a large and unexpected common mode signal present on the probe input.

- Remove the tip from the DUT and perform a DC Probe CAL operation on the probe. Passing this DC CAL check will verify that the probe DC performance is operating within allowable limits and will optimize the probe DC gain and offset. See [TriMode probe DC compensation](#) on page 27.
- Perform a Functional Check operation on the probe. This should verify that a fast rise time signal can be measured by the probe with a comparable probe tip attached. See [Functional check](#) on page 19.

Handling the probe

This probe is a precision high-frequency device; exercise care when you use and store the probe. The probe and cable are susceptible to damage caused by careless use. Always handle the probe at the comp box and probe body to avoid undue physical strain to the probe cable, such as kinking, excessive bending, or pulling. Visible dents in the cable will increase signal aberrations.



CAUTION. *To prevent damage to the probe, always use an antistatic wrist strap connected to a static-controlled workstation when you handle the probe. The probe input contains electronic components that can be damaged by contact with high voltages, including static discharge.*

Observe the following precautions when using the probe. Do not do any of the following:

- Drop the probe or subject it to physical shock
- Subject the probe to adverse weather conditions

- Kink or fold the probe main cable tighter than a 2.5 inch radius; minimum bend radius for the solder tips is 0.25 inch (6.35 mm)
- Solder the tips with excessive heat or duration
- Injure yourself with the sharp tips

See [Probe handling best practices](#) on page 78.

Cleaning the probe



CAUTION. *To prevent damage to the probe, do not expose it to sprays, liquids, or solvents. Avoid getting moisture inside the probe during exterior cleaning.*

Do not use chemical cleaning agents; they may damage the probe. Avoid using chemicals that contain benzene, benzene, toluene, xylene, acetone, or similar solvents.

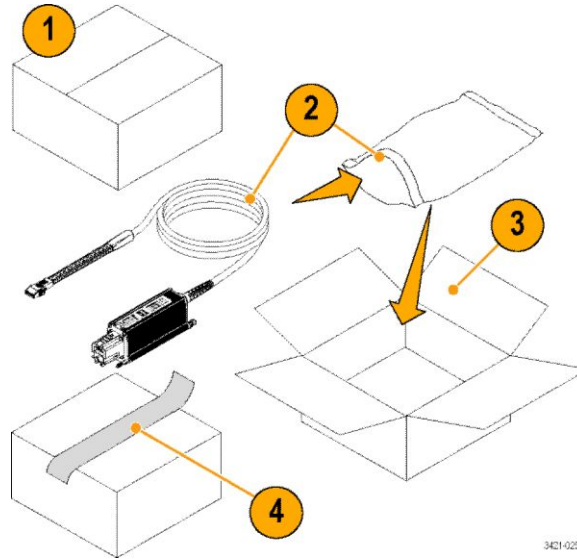
Clean the exterior surfaces of the probe with a dry, lint-free cloth or a soft-bristle brush. If dirt remains, use a soft cloth or swab dampened with a 75% isopropyl alcohol solution and rinse with deionized water. A swab is useful to clean narrow spaces on the probe; use only enough solution to dampen the swab or cloth. Do not use abrasive compounds on any part of the probe.

Returning the probe for servicing

If your probe requires servicing, you must return it to Tektronix. If the original packaging is unfit for use or not available, use the following packaging guidelines:

Preparation for Shipment

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 an antistatic bag or wrap it 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.
5. Refer to *Contacting Tektronix* at the beginning of this manual for the shipping address.



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