Tektronix®

P7700 Series
TriMode™ Probes

User Manual

071-3421-01

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www.tek.com

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Contacting Tektronix

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For product information, sales, service, and technical support:

- In North America, call 1-800-833-9200.
- Worldwide, visit www.tek.com to find contacts in your area.

Warranty

Tektronix warrants that this product will be free from defects in materials and workmanship for a period of one (1) year from the date of shipment. If any such product proves defective during this warranty period, Tektronix, at its option, either will repair the defective product without charge for parts and labor, or will provide a replacement in exchange for the defective product. Parts, modules and replacement products used by Tektronix for warranty work may be new or reconditioned to like new performance. All replaced parts, modules and products become the property of Tektronix.

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

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

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[W2 – 15AUG04]

Table of Contents

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.

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, 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 on specified replacement parts.

Terms in this manual

These terms may appear in this manual:

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

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

Symbols and 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.

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 symbol(s) may appear on the product:

Compliance information

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

Environmental considerations

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

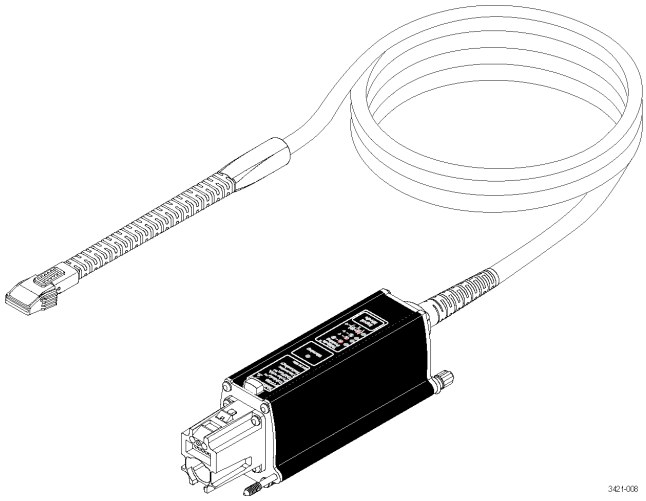
Documentation

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 *Accessories and Options* section or refer to the insert in your accessory kit when reordering accessories.

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
- 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



Operating considerations

Table 1: P7700 Series TriMode probes

Characteristic	Description	Specification	
		TekFlex solder-in tips	P77BRWSR
Input Voltage	Dynamic range	2.5 Vpp (single-ended) 5.0 Vpp (differential input)	6.0 Vpp (single-ended) 12.0 Vpp (differential input)
	Operating voltage window	±5.25 V	±10.0 V
	Offset voltage range	-4 V to +4 V	-10 V to +10 V
	Maximum non-destructive input voltage	-15 V to +15 V (tip attached or detached)	
Temperature	Operating	Probe compensation box: 0 °C to 45 °C (32 °F to 113 °F)	
		Probe cable: -40 °C to 85 °C (-40 °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: -40 °C to 85 °C (-40 °F to 185 °F)	
Humidity	Operating	Probe Compensation Box, Cable and Tips: 20% to 80% Relative Humidity (%RH) at up to 45°C non-condensing	
	Non-operating	Probe Compensation Box, Cable and Tips: 10% to 90% (Relative Humidity), non-condensing	
Altitude	Non-operating	Probe Compensation Box, Cable and Tips: 12,000 meters (39,370 feet)	
Pollution Degree		2, Indoor use only	

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.*

Installation

Before you connect the probe to your instrument, read the *Overview* below to understand the 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.*

Overview

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).

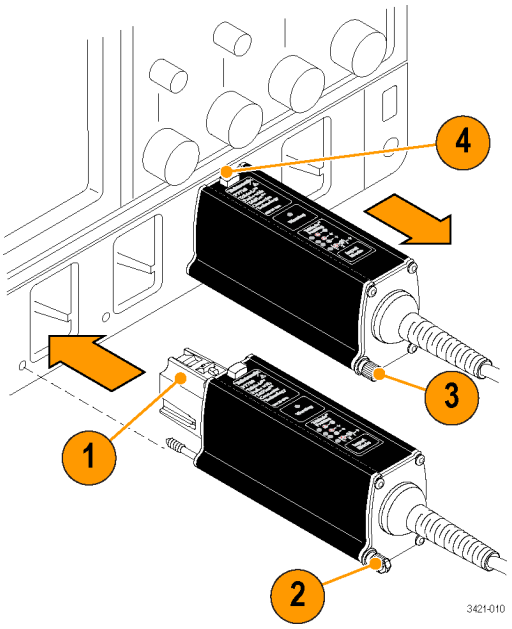
5. Perform the DC probe calibration procedure using the DC probe cal fixture that ships standard with each probe. (See page 12, *TriMode probe DC calibration*.)

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. Before you connect the probe, check the version requirements. (See page 42, Host instrument firmware.)*

1. Slide the probe into the TekConnect receptacle. The probe clicks into place when fully engaged.
2. Optional. Turn the thumbscrew clockwise (finger-tight only) to secure the probe to the instrument.



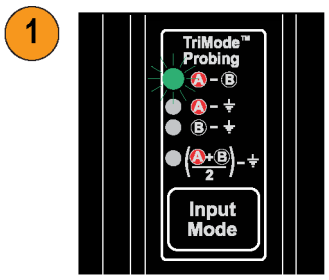
Disconnect

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

Probe and probe tip power-on

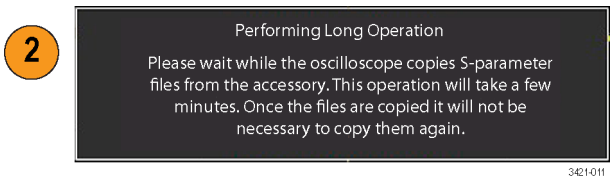
After the connection to the oscilloscope is made:

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.

   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 calibration. (See page 9, *Functional check*.)

NOTE. *If the probe's warning light remains on, the power-on self-test likely failed.*

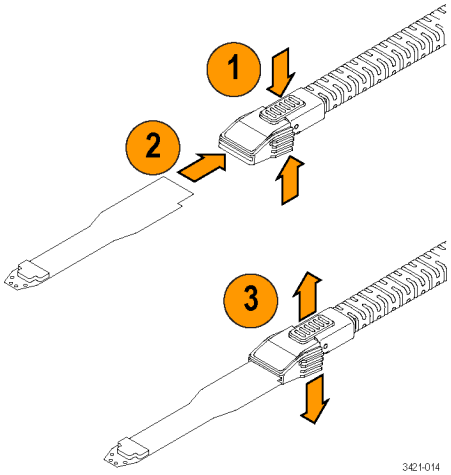
(See page 43, Error conditions.)

Connect TriMode tips using 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 P7700 series probe tips.

Connect the tips to the TekFlex connector

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.
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

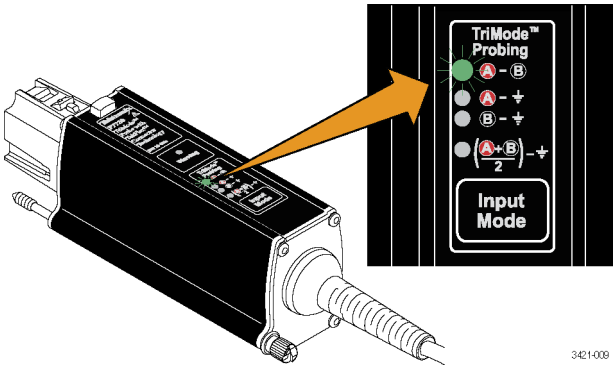
Input mode buttons and LEDs

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 screen.*

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)

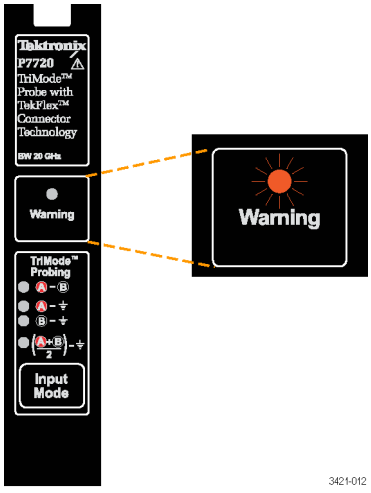


Warning LED

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.

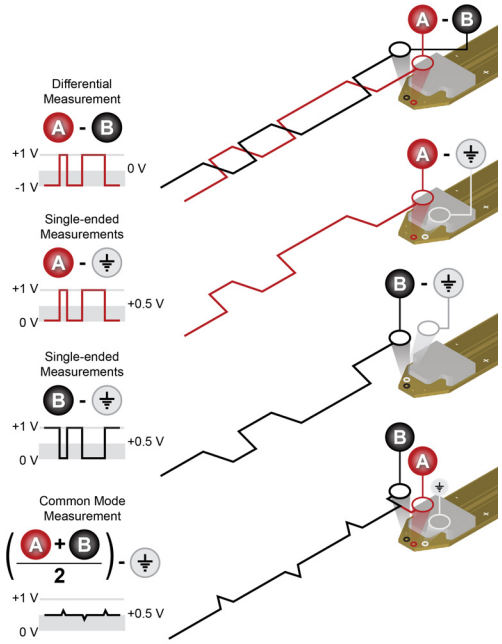


CAUTION. *Do not exceed the input voltage limits of the probe and probe tips. The probe or oscilloscope circuits may be damaged if the limits are exceeded. Make sure that you understand and work within the limits of the probe and probe tips.*

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 the optional deskew fixture designed for the probe.

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. A P7700 Series Probe deskew fixture is used to connect the FAST EDGE signal to the probe tip input. This procedure verifies the signal path of both the probe A and B input signals and their combination in the four TriMode settings.

Table 2: Required equipment, functional check

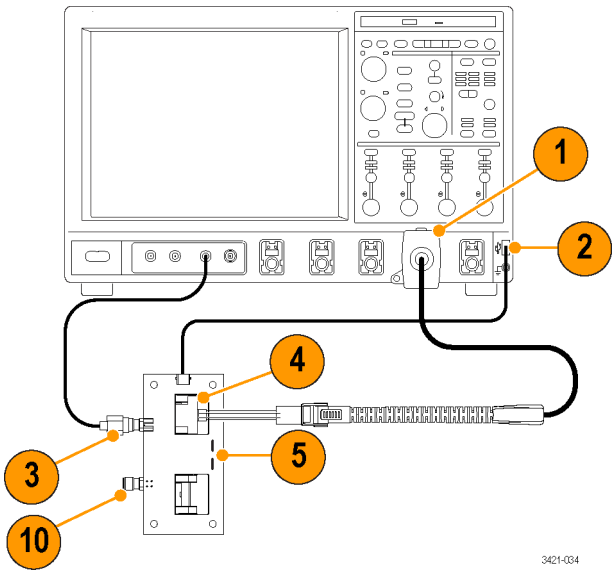
Item Description	Performance Requirement	Recommended Example [1]
Oscilloscope	TekConnect Interface	Tektronix MSO/DPO70000C/70000DX
Probe tip	Solder tip or Browser tip	P77STFLXA
Test board	Probe deskew fixture	P77DESKEW [2]
USB cable assembly	USB 2.0, A male to Micro B male, 1 m	174-6919-xx (included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

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

2 Optional accessory

Test setup

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.
2. Connect the USB cable assembly supplied with the P77DESKEW fixture between the USB connector on the fixture board and a USB connector on the host oscilloscope. Several white LEDs under the fixture Port1 and Port2 probe tip clamps will light up when the fixture is attached to USB power.
3. Connect an SMA cable from the FAST EDGE output connector on the oscilloscope to the A input of the Probe Deskew Fixture.



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.

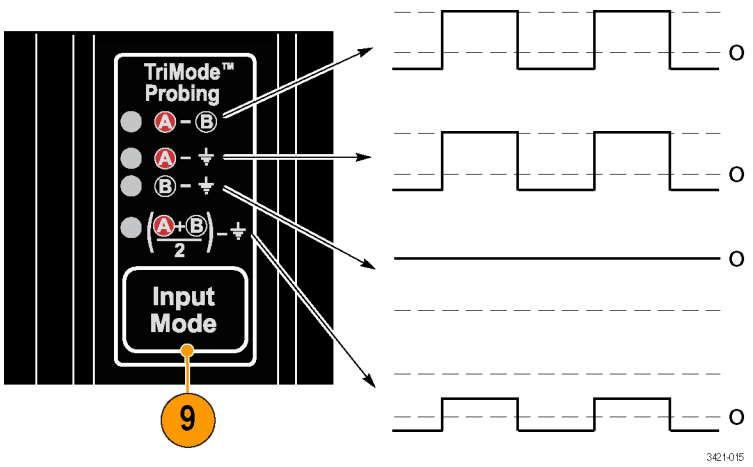
5. If a P77BRWSR tip is used instead of a solder-down tip to make connection to the Deskew Fixture, the TekFlex connector of the probe should first be connected to the P77BRWSR tip. The P77BRWSR tip inputs must then be pressed into place against the A and B signal traces on the P77DESKEW fixture board 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 procedure

6. Set the probe Input Mode to A-B.
7. Adjust the oscilloscope to display a stable waveform (or press the Autoset button). The FAST EDGE signal is a 1KHz 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.
8. 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.

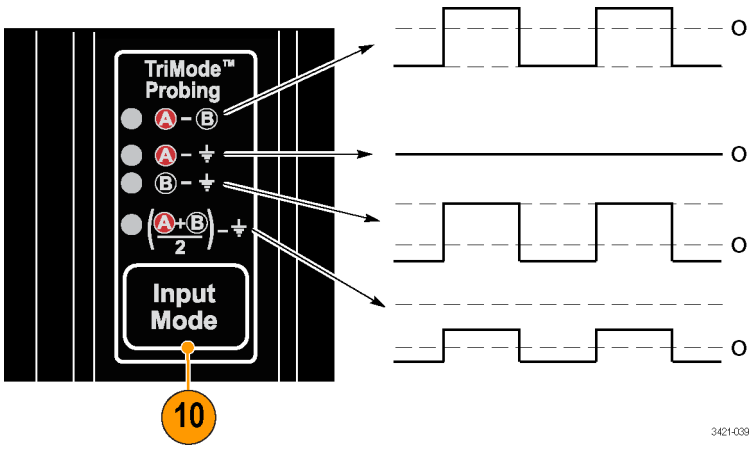
9. Cycle the Input Mode button through the remaining selections and compare the displayed waveforms to the waveform measured in step 8.

- A-B (the waveform from step 8)
- A-GND (same amplitude and polarity as measured in step 8)
- B-GND (the B input is grounded; no signal is measured)
- (A+B)/2- GND (half-amplitude, but the same polarity as measured in step 8)



10. Change the FAST EDGE cable connection in step 3 from the Deskew Fixture A input to the B input and repeat the displayed waveform checks in steps 7 to 9. The step 9 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 calibration

To maximize the amplitude accuracy of measurements made with a P7700 series probe, you should run a probe calibration routine on each channel that you use. The probe calibration operation minimizes measurement errors by optimizing the DC gain and offset of the probe. Individual calibration 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 3: Required equipment, DC calibration

Item Description	Performance Requirement	Recommended Example [1]
Oscilloscope	TekConnect Interface	Tektronix MSO/DPO70000C/70000DX
Probe tip	Solder tip or Browser tip	P77STFLXA [2]
Test fixture	Probe DC calibration fixture	067-4889-xx [3]
Coaxial cable	BNC, 50Ω, male-to-male	012-0208-xx [3]

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

2 P77STCABL and P77BRWSR are optional accessories

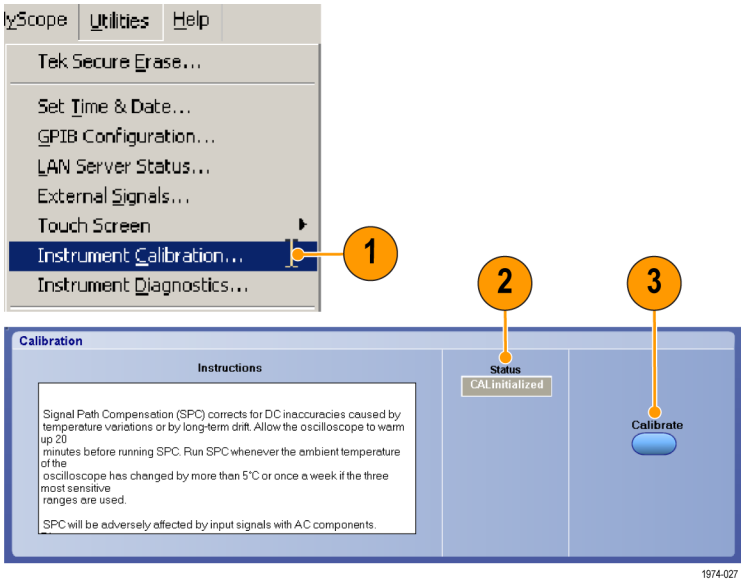
3 Standard accessory included with probe

Check the instrument calibration status

The Calibration Status of the instrument Signal Path Compensation test must be **Pass** for the probe calibration 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.

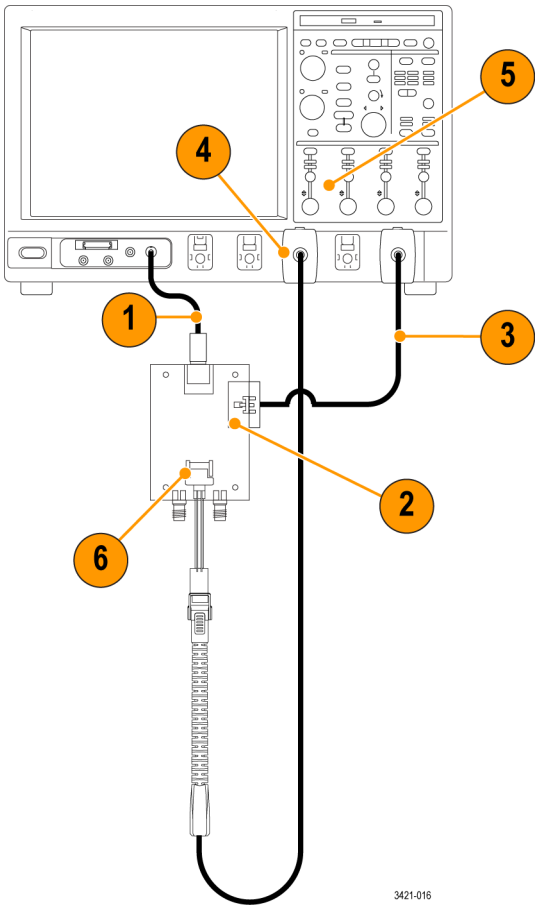
When the Signal Path compensation test status is **Pass**, continue calibrating the probe. (See page 14, *Calibrate the probe*.)



Calibrate 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 (1–4) of the oscilloscope. Allow the probe to warm up for 20 minutes.
5. Set the oscilloscope to display the channel.
6. 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.*



7. In the oscilloscope menu bar, select Vertical and then select Probe Cal.

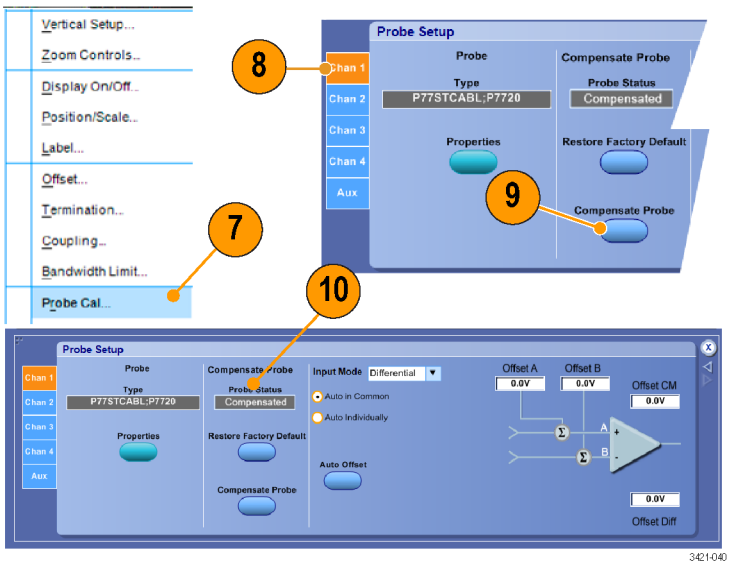
The Probe Setup dialog box appears.

The probe calibration routine runs, optimizing the probe to the oscilloscope for both probe attenuation settings.

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.*



9. When the calibration 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.

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.

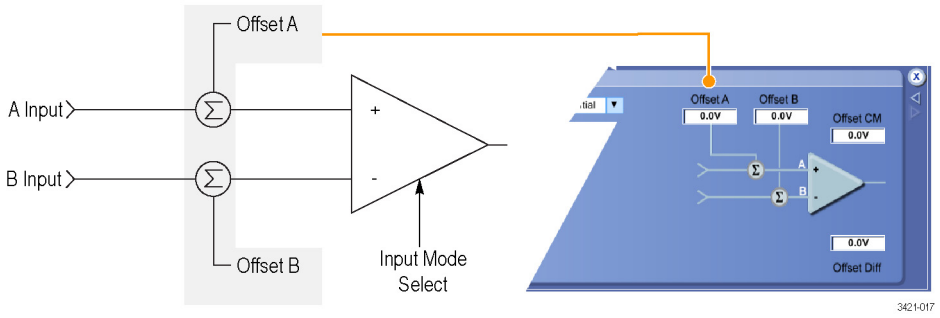
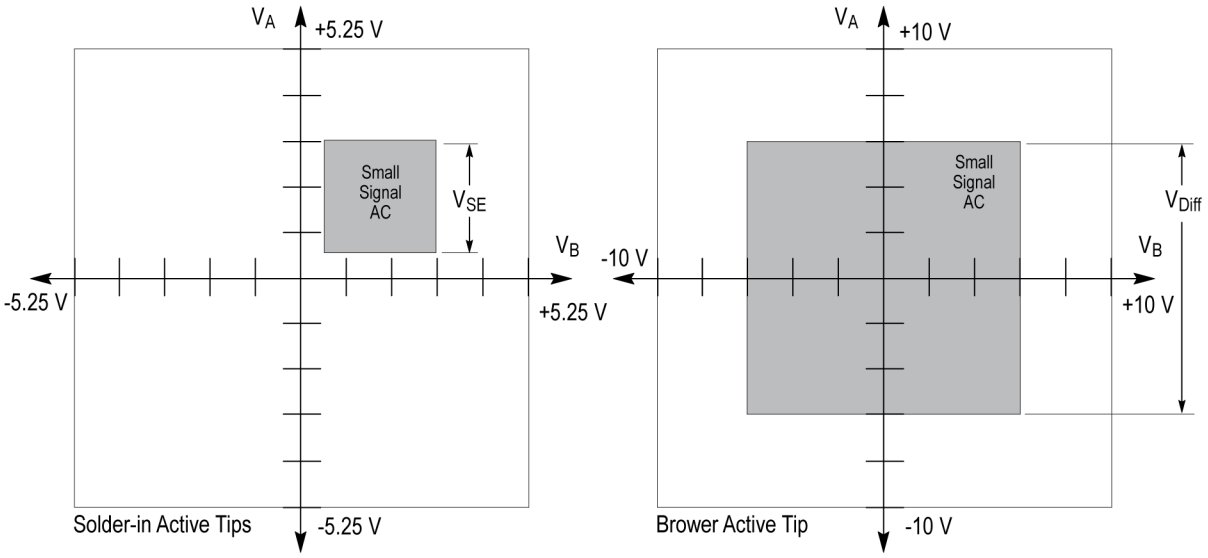


Figure 1: Simplified probe input model

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 rarge V_{Diff} - Differential dynamic rarge

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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 page 18, *Probe setup screen*.)

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.

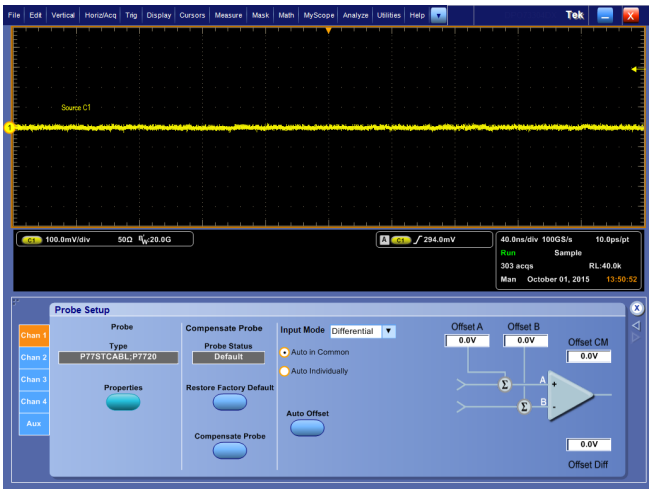


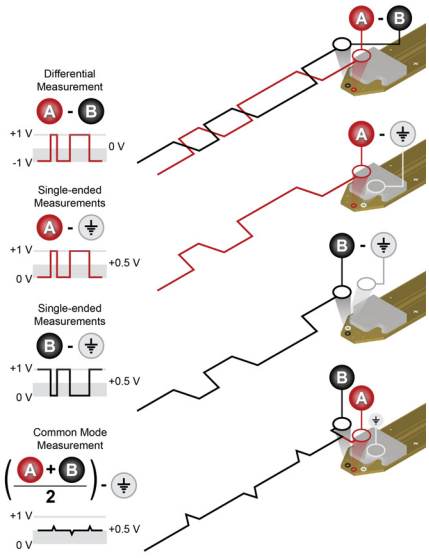
Figure 3: Probe setup screen

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 input 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 = Common + (Differential/2)
- B = Common – (Differential/2)

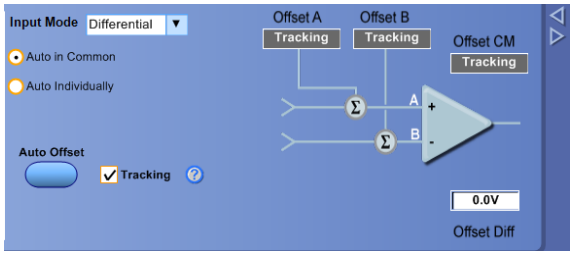
The oscilloscope vertical channel offset control also adjusts the selected Input mode offset voltage field.

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. Click this selection to select 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 Bis 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.

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.

P7700 Series probe architecture

The P7700 Series probe measurement setup, as shown in the simplified drawing below, requires a host TekConnect oscilloscope, a P7700 Series probe, and a P7700 Series active probe tip. 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.

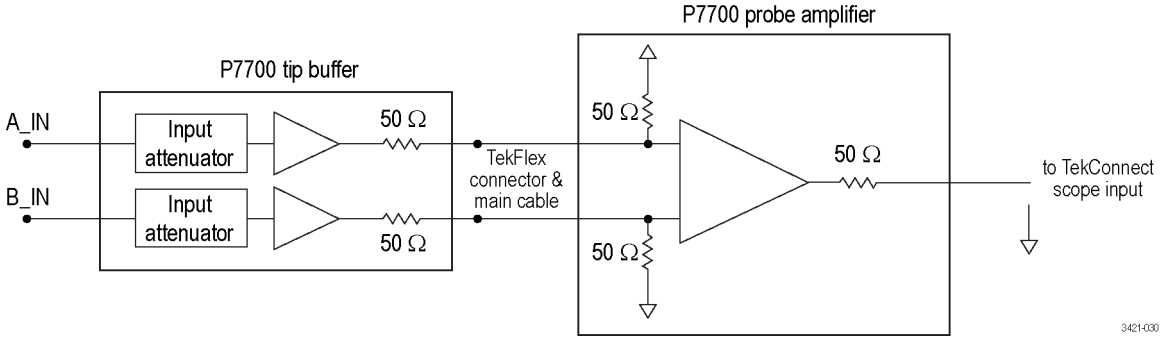


Figure 4: Simplified P7700 Series probe architecture diagram

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 attenution factor allows you to tradeoff dynamic range for noise performance.

The P7700 Series 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 in a P7700 Series probe 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 P7700 Series 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 web site 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.) 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.

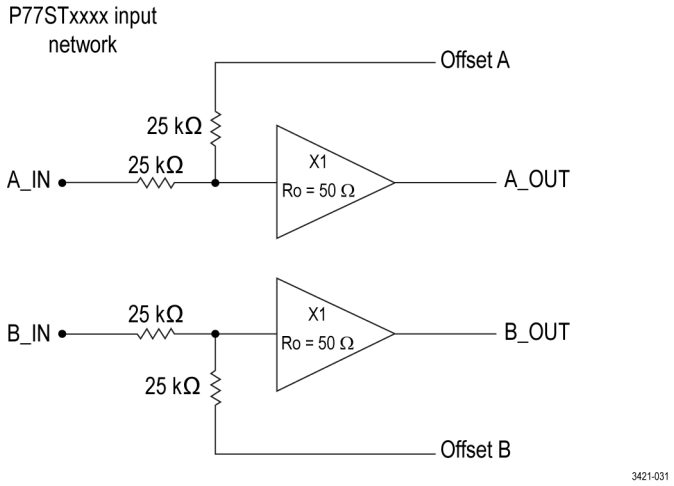


Figure 5: Simplified drawing of input attenuation factor of the P7700 Series buffers

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 kΩ 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, RS, much less than 25 kΩ.

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 kΩ 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 P7700 Series 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 P77BRWSR 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 P77BRWSR 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.)

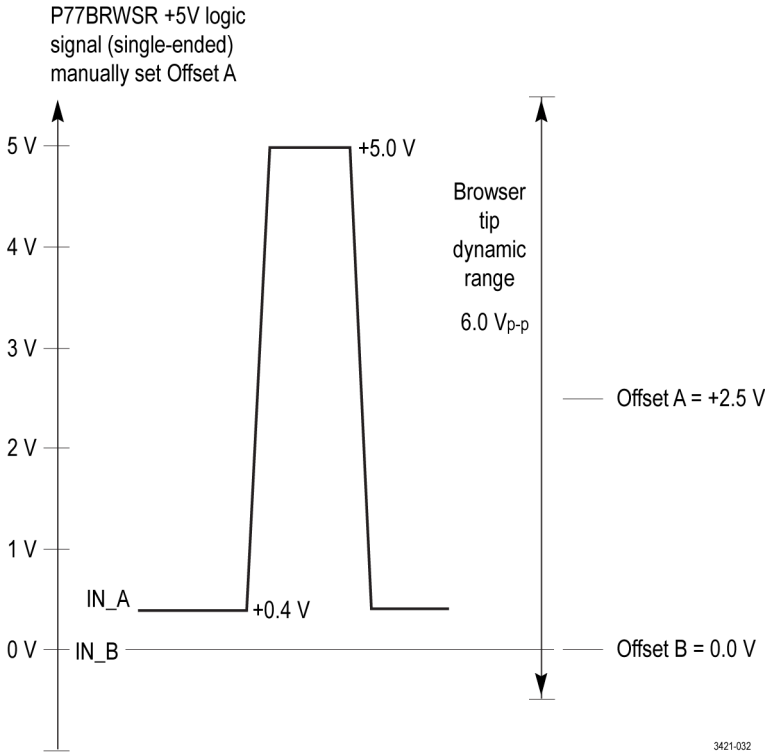


Figure 6: Proper configuration of the Differential Input mode signal and offset voltage

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

Temperature compensation

The P7700 Series 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

The P7700 Series probes contain S-parameter characterization data for the probe, which is downloaded to the attached oscilloscope when the probe is first connected. P7700 Series 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 kΩ and decreases with frequency above about 10 MHz to about 100 Ω above 10 GHz.

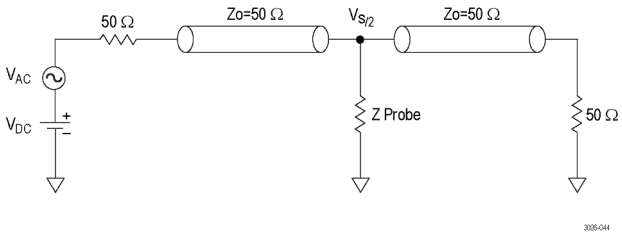


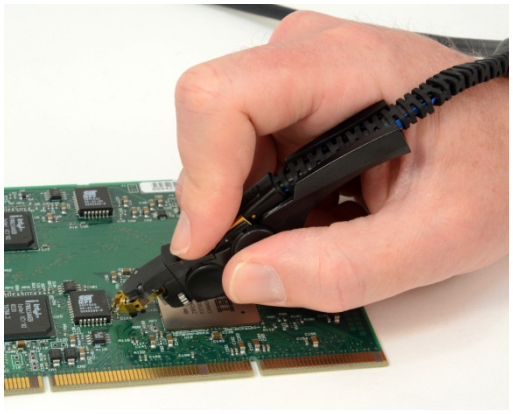
Figure 7: Solder tip measurement configuration

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 page 26, *Making single-ended measurements using the P77BRWSR differential probe tip*.)



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 page 43, *Browser tip replacement*.)

Flex circuit based solder tips

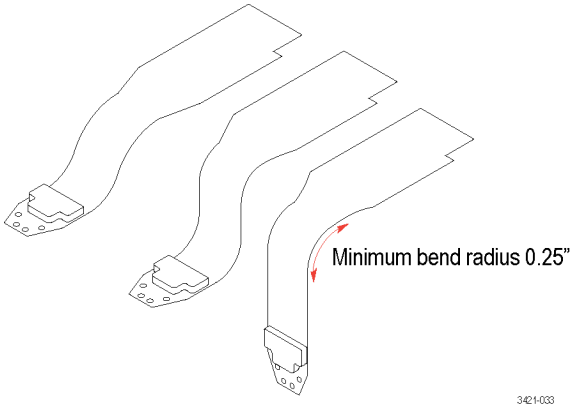
The flex circuit based solder tips are connected to the circuit using thin (38 AWG) wire connected to the vias on the tip. The steps to follow when soldering the tip to the circuit are shown in the soldering procedure section below.

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.

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.



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.*

Tip soldering

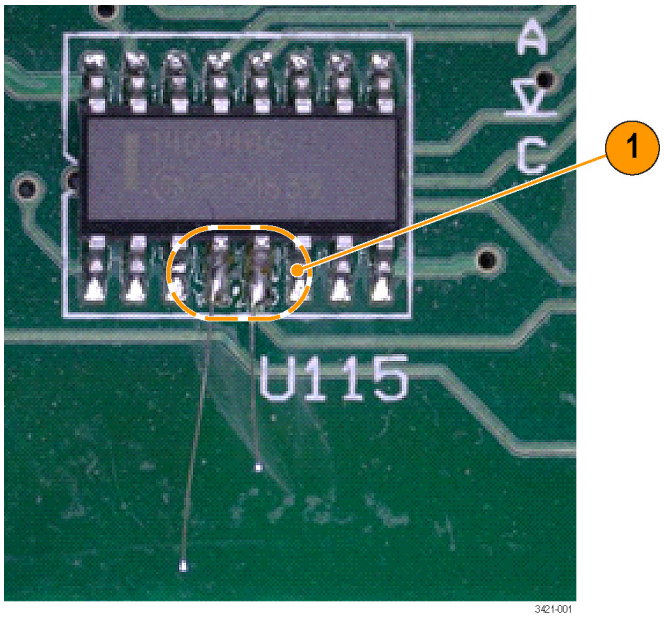
CAUTION. *This procedure uses equipment at high temperature. Avoid touching hot surfaces.*

Recommended equipment.

- Lead-free solder
- 4 mil diameter (38AWG) 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.

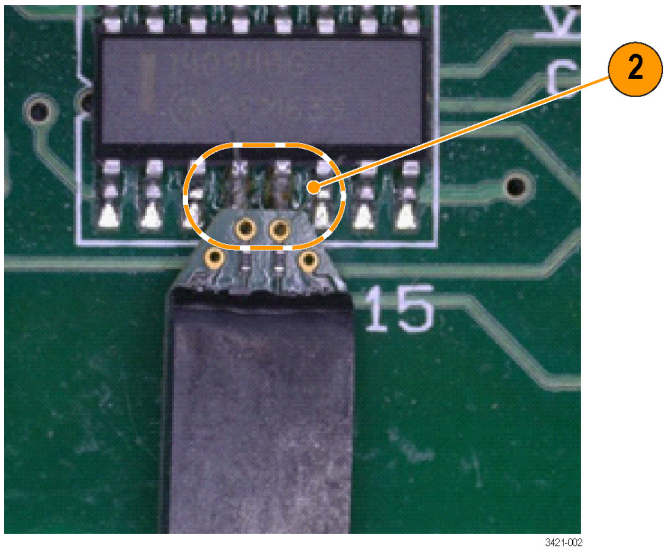
1. Solder wires to the test points. Cut wires with different lengths. This will make it easier to thread the wires onto the solder tips.



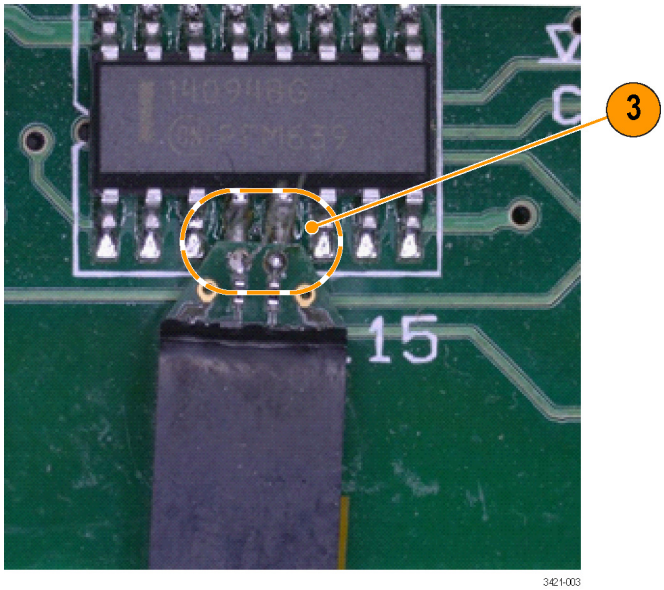
2. Thread tip onto wires. The two middle vias are the A(+) and B(-) inputs of the tip.

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.

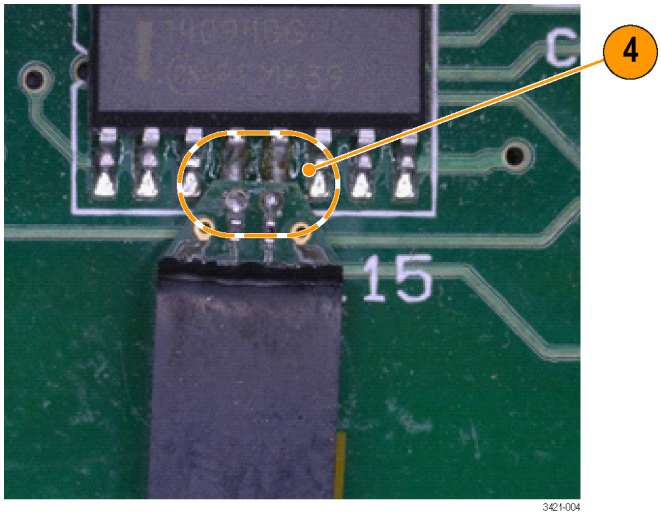
NOTE. *The double-sided foam tape is only good for one use. For maximum strain relief, always use a fresh piece of tape each time you attach a tip.*



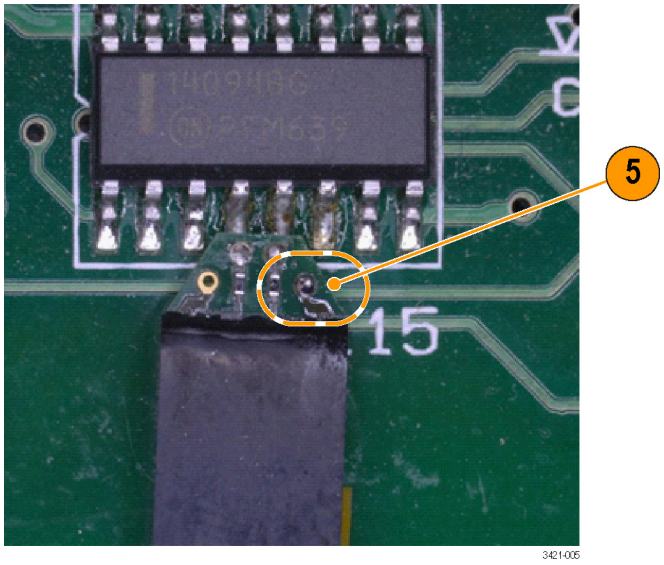
3. With the tip in position, quickly solder the wires to the vias. If the soldering iron is left too long on the tip, it may cause the 0201 input resistors to reflow and move.



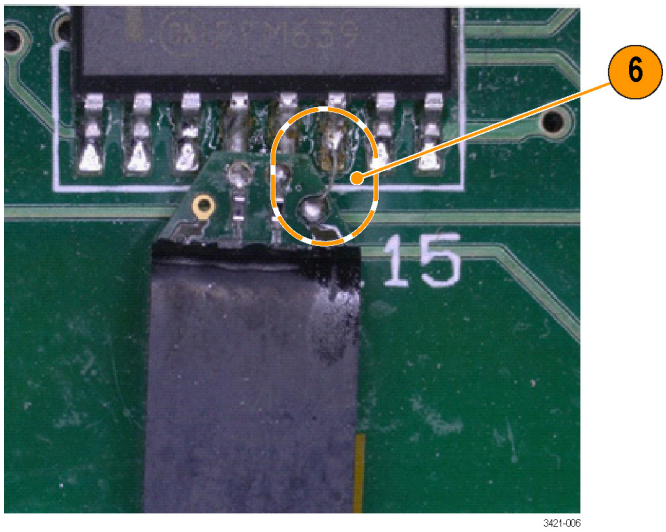
4. Trim wires flush with the board on the probe tip.



5. Attach the ground wire for TriMode input to the P7700 probe. First add solder to the test point and the nearest ground via on the solder tip.

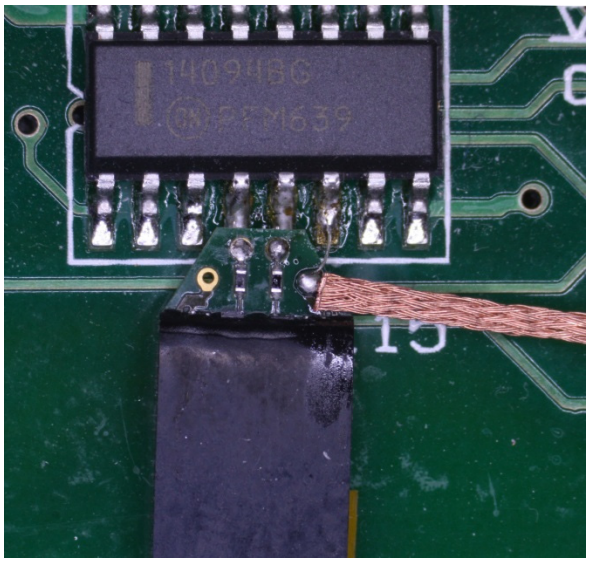


6. Second, solder a short piece of wire between the ground via on the tip and the ground test point. This configuration optimizes the performance of the probe for differential measurements. Longer wires on the ground path will have an impact on Single-Ended Mode and Common Mode performance. If there 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.

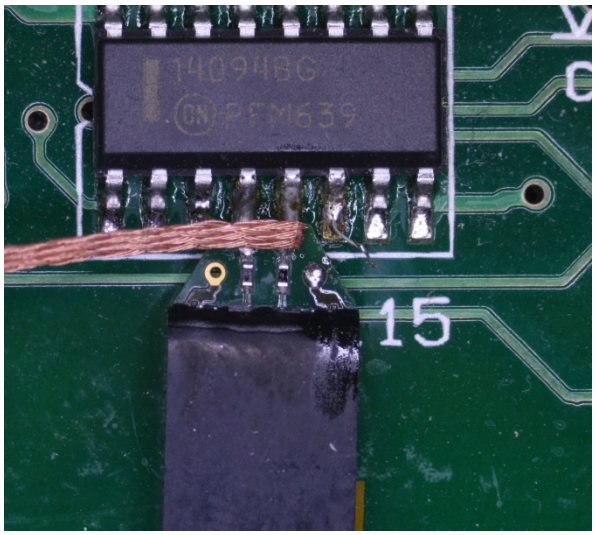


Tip unsoldering procedure.

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.

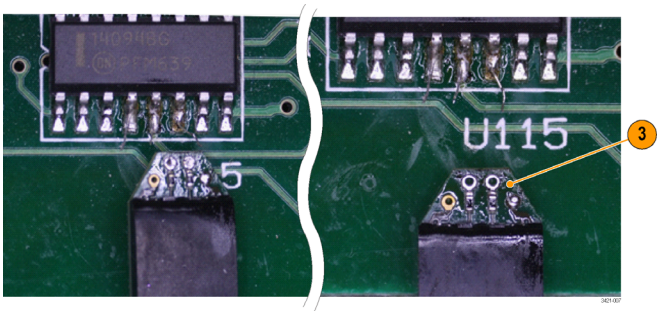


2. Use the solder-wick to remove excess solder from the input vias. Again, be careful not to place the solder-wick too close to the input resistors.



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 wires 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.

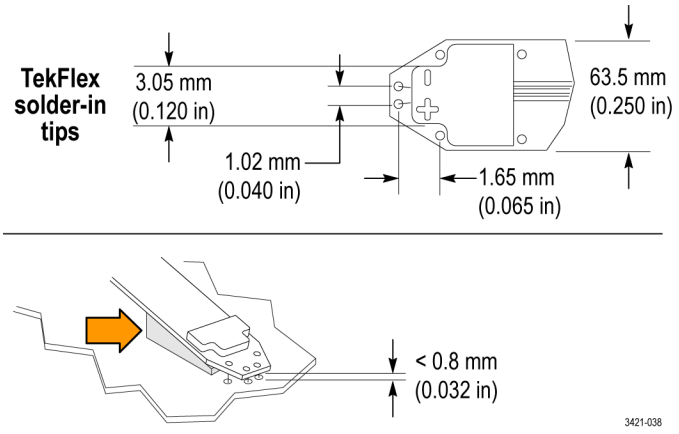
Care of P77STFLXA tips

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

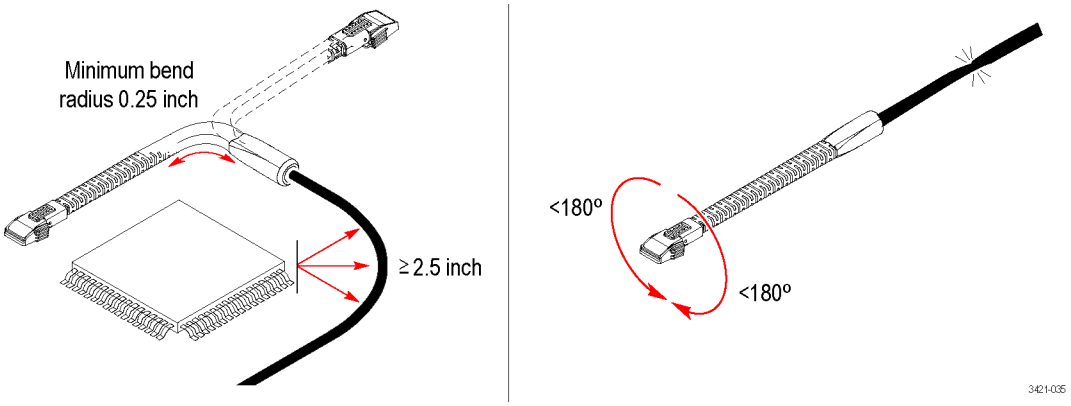
The dimensions of the solder tip connections are provided here for reference. You can also design the tip footprint into your circuit board layout for easier test connections.



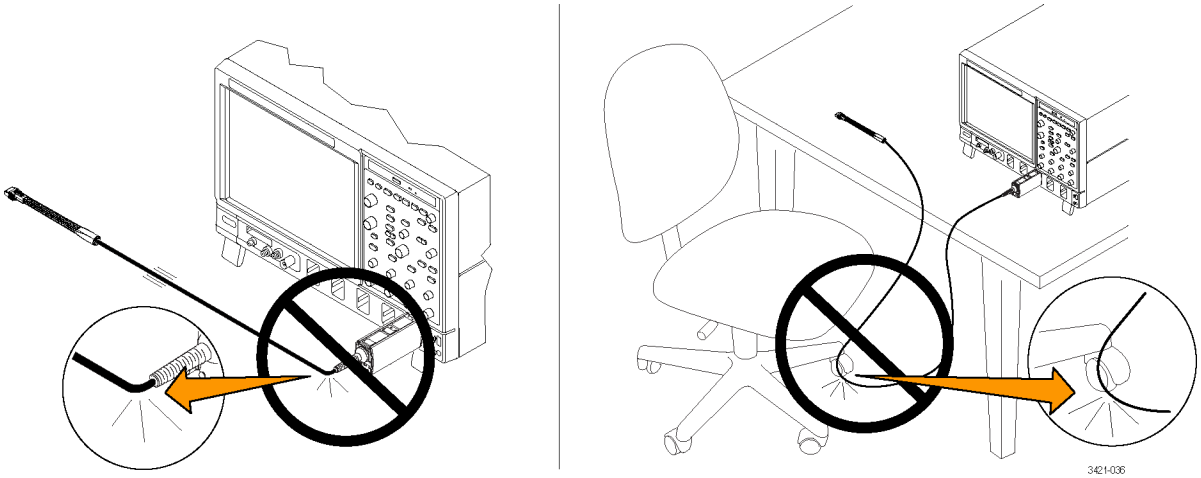
Probe handling best practices

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.



- 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.

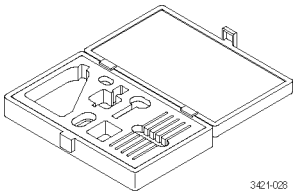
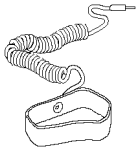


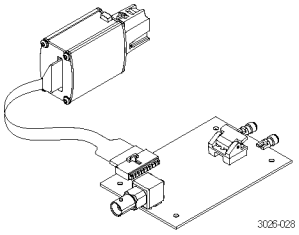
Accessories and options

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.

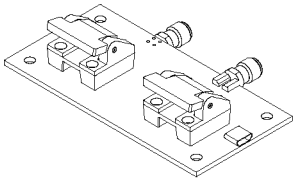
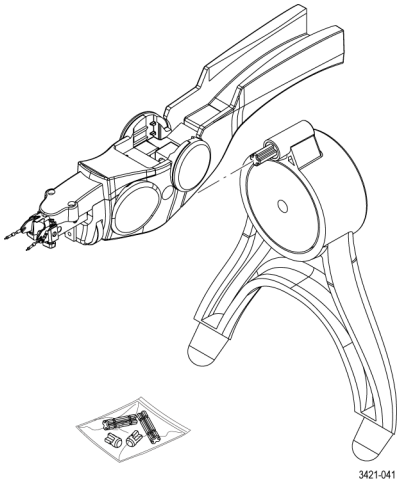
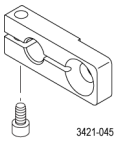
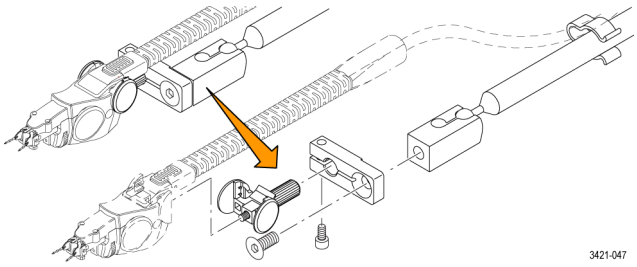
Standard accessories

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
	016-1948-xx	■ Color bands
	121-1003-xx	■ Magnetic bar
	129-1867-xx (.450” ID) and 129-1857-xx (.270” ID)	■ Metal cable bands
	017-0103-xx	■ Wire kit (38 AWG, 4 mil)
	071-7386-xx	■ Accessory re-order and info card
	006-3415-xx	**Antistatic wrist strap.** When you use the probe, always work at an antistatic work station and wear the antistatic wrist strap.
	–	**Calibration certificate.** A certificate of traceable calibration is provided with every probe.
	–	**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.

Standard accessory	Reorder part number and quantity	Description
	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).
	067-4889-xx	**DC probe calibration fixture.** Use this fixture to perform a DC compensation with the host instrument.

Optional accessories

Optional accessory	Part and description
	P77STCABL, Solder-in active tip This tip provides a soldered, multi-point connection that supports full TriMode measurement capabilities at full probe bandwidth.
	Flex circuit based solder tips These tips use flex circuit material and provide soldered, multi-point connections. They supports full TriMode measurement capabilities and full probe bandwidth.
 3421-029	P77DESKEW, Deskew fixture Use this fixture to deskew up to 2 probes at once or to perform a probe functional check. A USB power cable is provided.
 3421-041	P77BRWSR, Browser accessory includes these items: ■ **Browser wand.** Extends the length of the browser for a more comfortable grip. (Part number 020-3160-xx.) ■ **Browser hands-free tripod.** Holds the browser on a test point without the need to use your hands. (Part number 020-3161-xx.) ■ **Browser replacement tips.** Use to repair any browser tips that are broken with use. (Part number 020-3162-xx.) ■ **Adapter attachment.** Attaches the browser to the hands-free tri-pod or other holders. ■ **Ground lead.** Attaches the browser to a circuit ground if necessary. The browser accessories can be stored in the TekFlex accessories box that comes standard with every P7700 series probe.
 3421-045	407-6019-xx, Probe adapter Use this accessory to attach the browser to the PPM203B. probe arm/positioner
 3421-047	

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.

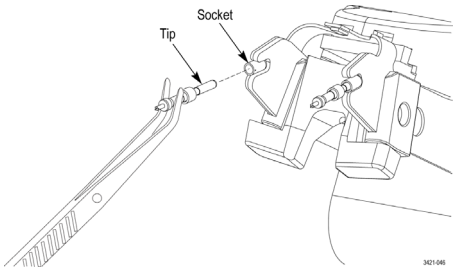
Instrument	Firmware Version
MSO/DSA/DPO70000C Series oscilloscope	V 7.6 or higher
DSA/DPO70000D Series oscilloscope	V 7.6 or higher
MSO/DPO70000DX Series oscilloscope	V 7.6 or higher
DSO70000SX Series oscilloscopes	V 10.4 or higher

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.*

Although the P77BRWSR's tips are design to withstand up to 4 lbs (1.8 kg.), they 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 WARNING 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 page 9, *Functional check*.) 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 swtich 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 page 12, *TriMode probe DC calibration*.)
- 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 page 9, *Functional check*.)

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 page 38, *Probe handling best practices*.)

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 benzine, benzene, toluene, xylene, acetone, or similar solvents.

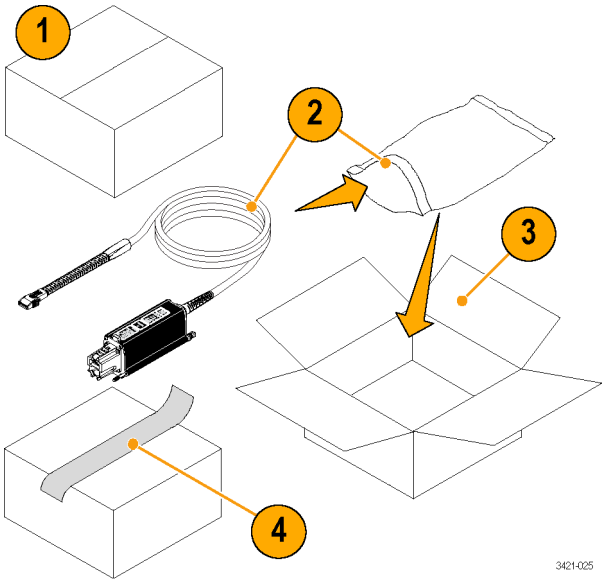
Clean the exterior surfaces of the probe with a dry, lint-free cloth or a soft-bristle brush. If dirt remains, use a soft cloth or swab dampened with a 75% isopropyl alcohol solution and rinse with deionized water. A swab is useful to clean narrow spaces on the probe; use only enough solution to dampen 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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