



TAP2500, TAP3500, and TAP4000
2.5 GHz, 3.5 GHz, and 4 GHz Probes
Instruction Manual



071-1836-02





**TAP2500, TAP3500, and TAP4000
2.5 GHz, 3.5 GHz, and 4 GHz Probes
Instruction Manual**

www.tek.com

071-1836-02

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Contacting Tektronix

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Beaverton, OR 97077
USA

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.

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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.

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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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General safety summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it.

To avoid potential hazards, use this product only as specified.

Only qualified personnel should perform service procedures.

While using this product, you may need to access other parts of a larger system. Read the safety sections of the other component manuals for warnings and cautions related to operating the system.

To avoid fire or personal injury

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

Connect and disconnect properly. Connect the probe output to the measurement instrument before connecting the probe to the circuit under test. Connect the probe reference lead to the circuit under test before connecting the probe input. Disconnect the probe input and the probe reference lead from the circuit under test before disconnecting the probe from the measurement instrument.

Ground the product. This product is indirectly grounded through the grounding conductor of the mainframe power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, ensure that the product is properly grounded.

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

Connect the probe reference lead to earth ground only.

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

Do not operate without covers. Do not operate this product with covers or panels removed.

Do not operate with suspected failures. If you suspect that there is damage to this product, have it inspected by qualified service personnel.

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

Do not operate in wet/damp conditions.

Do not operate in an explosive atmosphere.

Keep product surfaces clean and dry.

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.

The following symbol(s) may appear on the product:



CAUTION
Refer to Manual

Service safety summary

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

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

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

Use care when servicing with power on. Dangerous voltages or currents may exist in this product. Disconnect power, remove battery (if applicable), and disconnect test leads before removing protective panels, soldering, or replacing components.

To avoid electric shock, do not touch exposed connections.

Environmental Considerations

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

Restriction of hazardous substances

Complies with RoHS2 Directive 2011/65/EU.

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 TAP2500, TAP3500, and TAP4000 active probes. Basic probe operations and concepts are presented in this manual. The DPO7000 series oscilloscope and the TAP2500 probe is used in all illustrations in this manual, unless noted otherwise. You can access this document and other related information from the Tektronix Web site.

Documentation

| To read about | Use these documents * |
|--|---|
| TAP2500, TAP3500, and TAP4000 Probes: First Time Operation, Functional Check, Operating Basics, Specifications, Performance Verification | Read this Instruction Manual. |
| In-depth oscilloscope operation, user interface help, GPIB commands | Access the online help from the Help menu on the host instrument. |

* To access the documentation that is installed on your instrument, click **Start** in the taskbar and select **Programs > TekApplications**.

Conventions used in this manual

The following icon is used throughout this manual to indicate a step sequence.

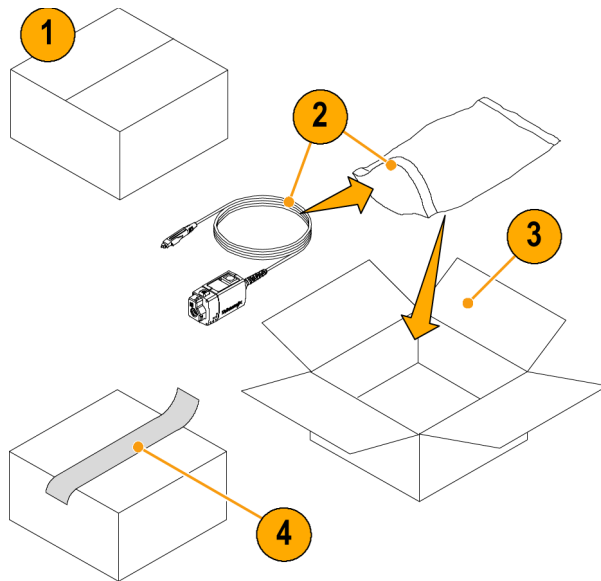


Returning the probe for servicing

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

Preparation for Shipment

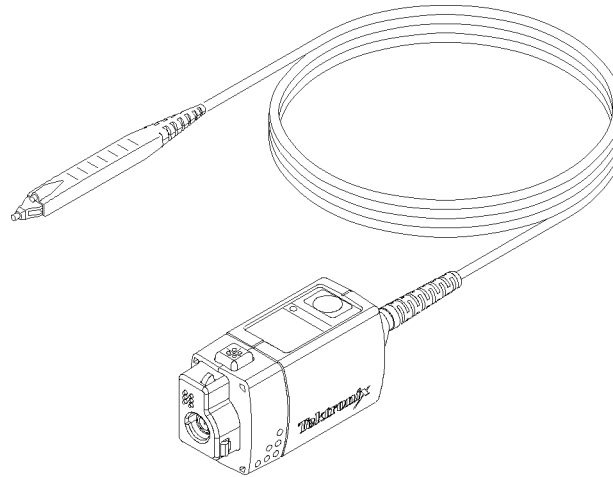
1. Use a corrugated cardboard shipping carton having inside dimensions at least one inch greater than the probe dimensions. The box should have a carton test strength of at least 200 pounds.
2. Put the probe into an antistatic bag or wrap it to protect it from dampness.
3. Place the probe into the box 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.



Key features

The TAP2500, TAP3500, and TAP4000 active probes enable you to make accurate measurements with minimal circuit loading from DC to 2.5 GHz, 3.5 GHz, and 4 GHz respectively, using oscilloscopes featuring the new Tektronix TekVPI oscilloscope interface. Key features include:

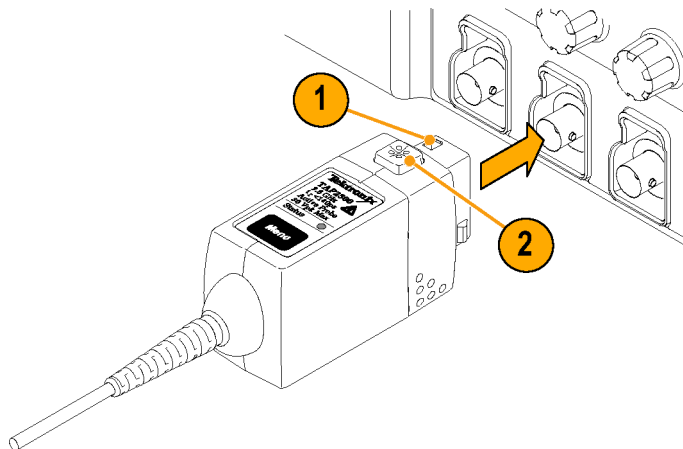
- Bandwidth
 - DC to ≥ 2.5 GHz (TAP2500)
 - DC to ≥ 3.5 GHz (TAP3500)
 - DC to ≥ 4 GHz (TAP4000)
- ± 4 Volts Dynamic Range with ± 10 volt offset capability
- 10X Attenuation
- 40 k Ω Input Resistance
- < 0.8 pF Input Capacitance
- TekVPI Interface
- Small, low-mass probe head for probing dense circuitry



Installation

Connecting to the host instrument

1. Slide the probe into the TekVPI receptacle.
The probe snaps when fully engaged.
When the probe is connected, the host instrument reads information from the probe and identifies the device.
2. To disconnect, press the latch release button and pull away from the instrument.

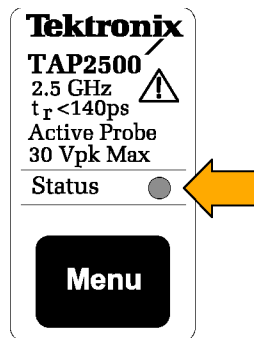


Probe controls and indicators

Status LED

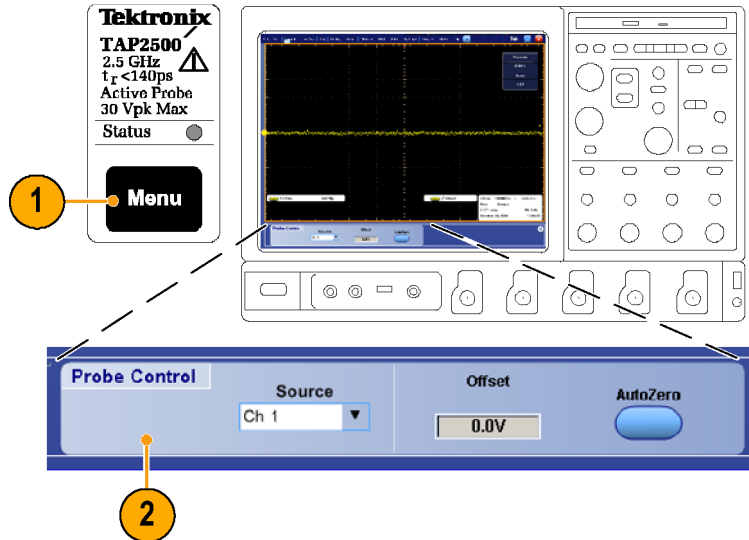
When the probe is powered on, the multicolor Status LED:

- Glows green after successfully completing the power-on self test routine. The probe is in normal operating mode.
- Glows red if an error condition exists. (See page 60, *Error condition*.)



Menu button

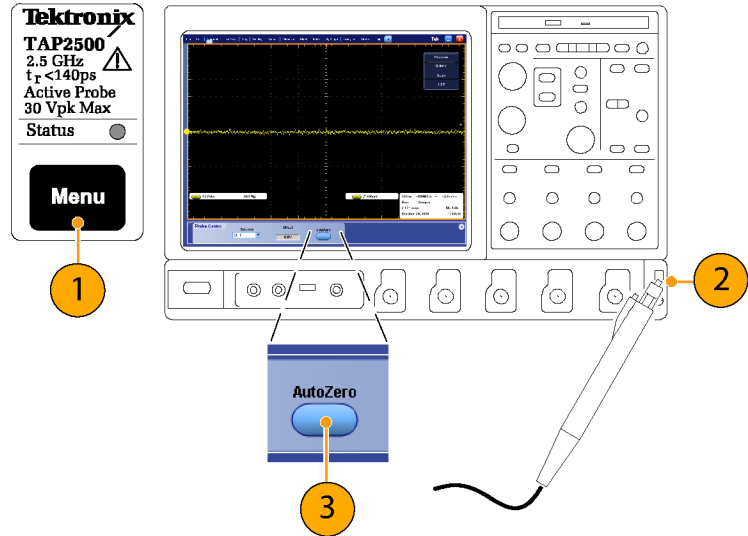
1. Press the probe **Menu** button to display the Probe Control screen on the oscilloscope.
2. Use the touch-screen buttons on the instrument to set the probe parameters.
3. Press the probe **Menu** button again to close the Probe Control screen.



AutoZero

We recommend that you run the probe AutoZero routine:

- After the 20 minute warm-up period
 - When the operating temperature of the probe changes by $\pm 5\text{ }^{\circ}\text{C}$
1. Press the probe **Menu** button to display the Probe Control screen on the oscilloscope.
 2. Short the probe tip to ground.
 3. Press the **AutoZero** button on the instrument to execute the AutoZero routine.



Functional check

Use the following procedure to check that your probe is functioning properly. To verify that your probe meets the warranted specifications, refer to the *Performance Verification* procedures. (See page 45.)

Required equipment

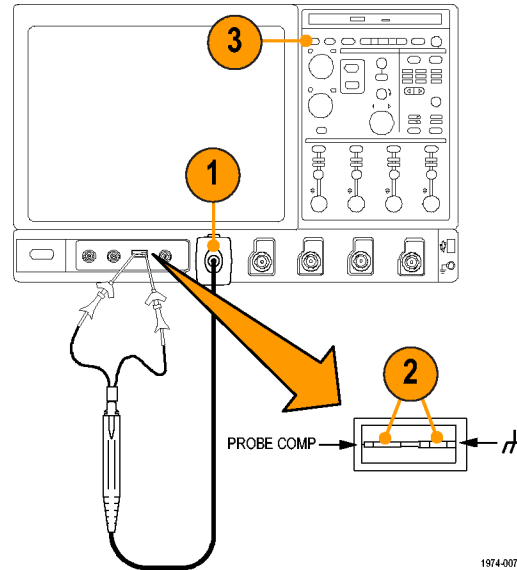
| Description and quantity | Performance requirement | Recommended example ¹ |
|---------------------------|---|--|
| Oscilloscope | TekVPI Interface | Tektronix DPO7000 Series Tektronix 5 Series MSO Tektronix 6 Series MSO |
| Y-Lead adapter | 0.25-in square pins for probe tip connections | 196-3457-XX ² |
| SMT KlipChip adapters (2) | 0.25-in square pins-to-mini clips | 206-0569-XX ² |

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

² Standard probe accessory

Signal

1. Connect the probe to any channel of the oscilloscope and set the oscilloscope to display that channel.
2. Use the Y-lead Adapter and two SMT KlipChips to connect the probe tip to the PROBE COMP terminals on the oscilloscope.
3. Press **AUTOSET** (or adjust the oscilloscope) to display the calibration waveform. A stable waveform indicates that your probe is functioning correctly.



Calibration

The probe calibration routine minimizes your measurement errors by optimizing the gain and offset of the probe and oscilloscope combination. We recommend that you repeat the probe calibration on each channel that you use. Individual calibration constants are stored for each probe on each channel.

Prerequisites

The equipment must be warmed up for 20 minutes, and the calibration status of the host instrument must be pass.

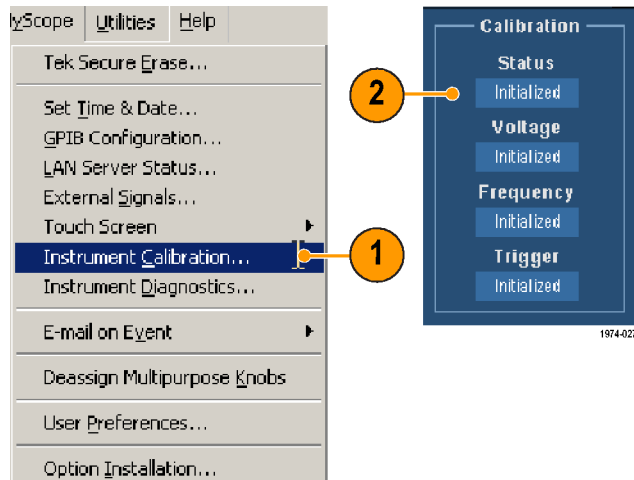
Required equipment

The required equipment for calibration is the same as for the functional check. (See page 6, *Required equipment*.)

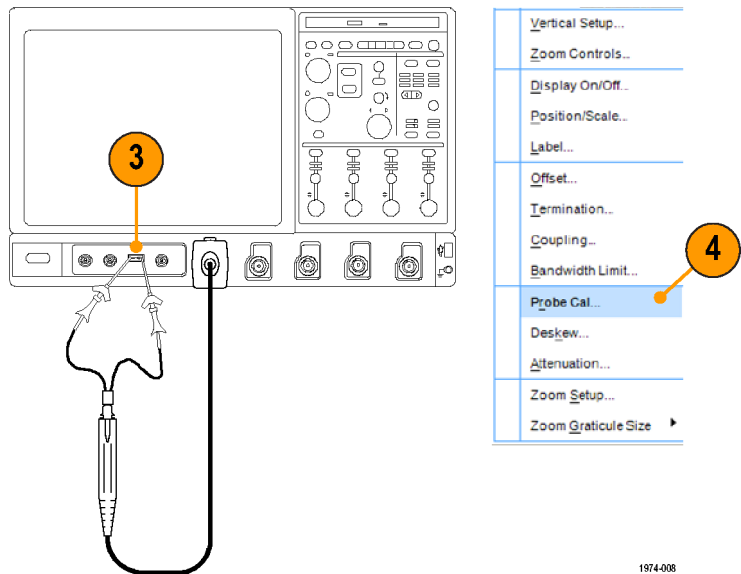
Test procedure

Check the Calibration Status of the instrument:

1. From the Utilities menu, select **Instrument Calibration**.
2. In the Calibration box, check that **Pass** is displayed in the Status field. If it is not, disconnect all probes and signal sources from the oscilloscope, and run the Signal Path Compensation routine (see next step).



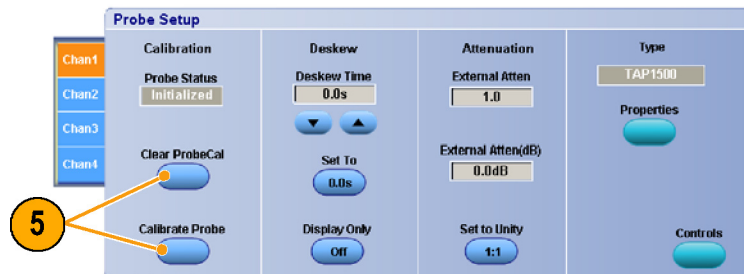
3. Connect the probe to the oscilloscope PROBE COMP connector as shown.
4. From the Vertical menu, select **Probe Cal.**



1974-008

- When the Probe Setup screen appears, select **Clear ProbeCal**, and then select **Calibrate Probe**.

The probe calibration routine begins. When the routine completes, a notifier appears. Close the notifier and begin using your probe.



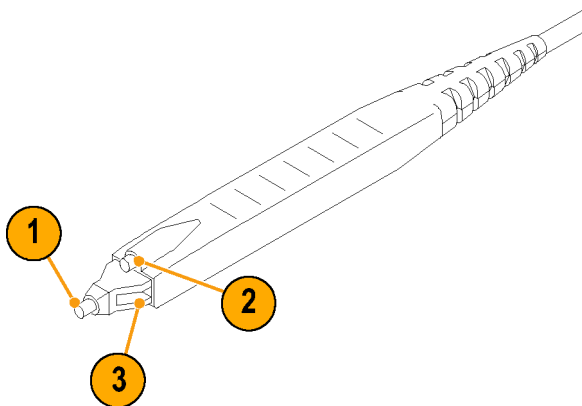
Basic operation

Follow these operating guidelines to get the best performance from your probe.

Probe head assembly

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

1. The probe tip socket is sized to easily press onto 0.025-inch pins for direct access.
2. The ground socket provides a short ground path for high-fidelity ground connections.
3. The stabilization notch permits you to use adjacent pins to reduce stresses on the probe and pins.



Probe input

The probe is electrically protected against static voltage. However, applying voltages above its design limits may damage the probe tip amplifier. (See Figure 1 on page 14.)

Input Linear Dynamic Range

The probe head amplifier used by the probe has a limited linear operating range. To keep the input linearity error less than 1% you must limit the signal input voltage to ± 4 V (including any DC offset).

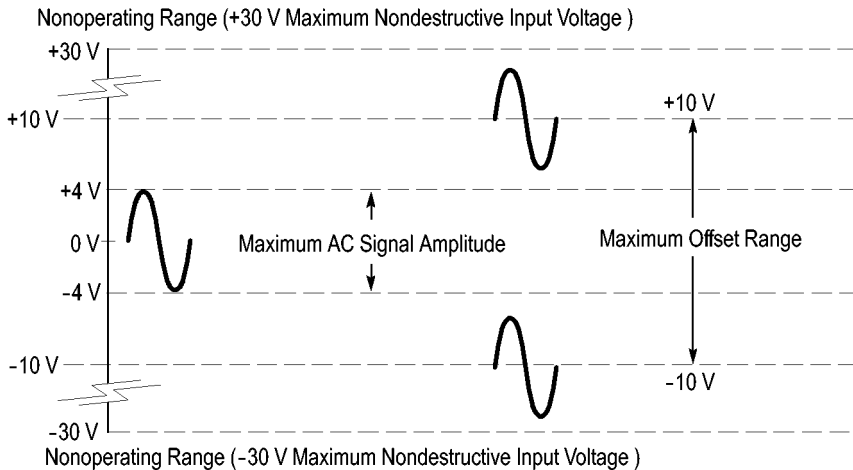


Figure 1: Dynamic and Offset Limitations

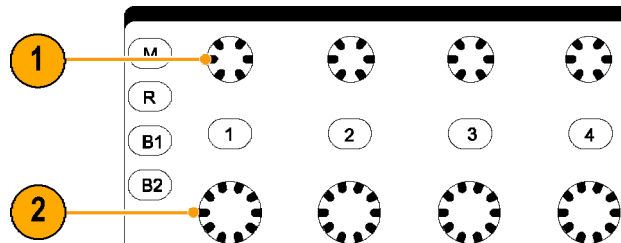
Probe offset

The probe offset is adjustable for operation within the linear range of the probe, and to increase the sensitivity of the probe at higher DC measurement voltages. Using the offset to cancel DC signal components enables optimal probe performance. (See Figure 1 on page 14.)

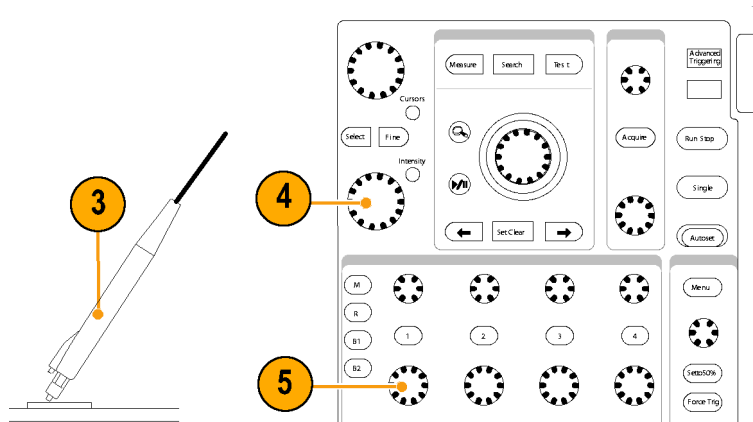
NOTE. See your oscilloscope manual for specific instructions on using the offset control.

To set the probe offset, follow these steps:

1. Use the vertical position control to set a zero reference level on the oscilloscope display.
2. Set the oscilloscope coupling to **DC** and 5 V/div. This sets the oscilloscope to display the full offset dynamic range of the probe.



3. Attach the probe to the circuit.
4. Adjust the probe offset to bring the trace to the oscilloscope zero reference.
5. Change the volts/division setting to the desired range, adjusting the offset to keep the trace on the zero reference level.



NOTE. The probe has a ± 10 V offset range. The linear operating range is ± 4 V. (See Figure 1 on page 14.) If cursors are used on the oscilloscope, the zero reference will be at the probe offset voltage. When you adjust the probe offset with no signal applied to the probe input, the output range is ± 4 V, (the linear operating range of the probe), not the ± 10 V offset range of the probe. However, when you apply ± 10 V to the probe input, the probe offset control can zero this offset.

Accessories and options

This section lists the standard accessories and provides information on how to use the accessories. Specifications are provided where appropriate so that you can choose the accessory that best fits your needs. In some cases, reorder kit quantities differ from the actual number of accessories included with the probe.

Using standard accessories

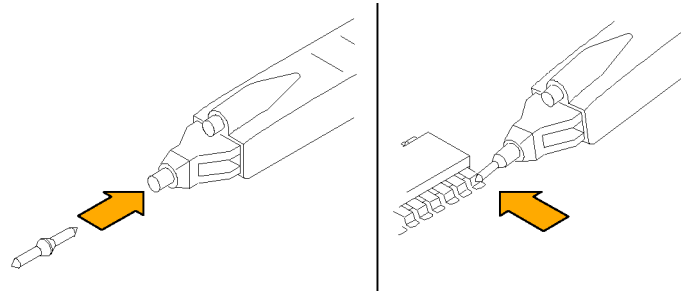
Push-in probe tip

Use the push-in probe tip for general purpose probing by hand. You can also use the push-in probe tip with the other socketed leads and adapters.

Push the tip into the socket until it is seated. Either end of the tip may be used. *Do not force the tip.* Also, be careful not to injure yourself on the sharp point.

Reorder Tektronix part number:

131-5638-11 qty. 10



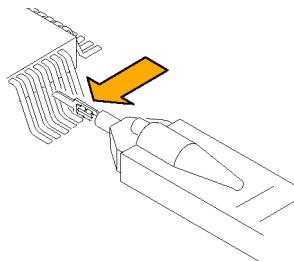
SureToe Adapter

The SureToe adapter is a pointed probe tip useful for probing in dense circuitry. Attach the SureToe adapters the same way as the push-in probe tips.

Do not force the adapter. Also, be careful not to poke yourself with the sharp probe tip. SureToe adapters can be used with any of the socketed accessory leads. Four SureToe adapters are included with the probe.

Reorder Tektronix part number:

131-6254-XX qty. 4



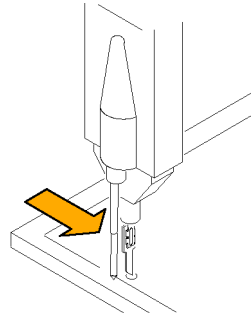
Pogo Pin Ground

Use the low-inductance ground pogo pin to substantially reduce ground lead inductance and to easily move the probe to different points on the circuit under test.

To attach, press the pogo pin into the probe head ground socket. To maintain signal fidelity while probing, use as short a ground path as possible. (See page 30, *Ground lead length*.)

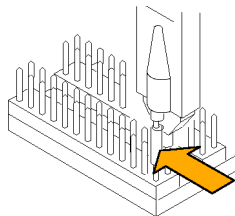
Reorder Tektronix part number:

016-1772-10 qty. 10



Square Pin Socket

The square pin socket is ideal for use with signal/ground pairs on 0.100-inch square header pins. Attach the socket by gently pressing it into the ground socket on the probe head.



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

Reorder Tektronix part number:

016-1773-10 qty. 10

Customizable Ground Lead

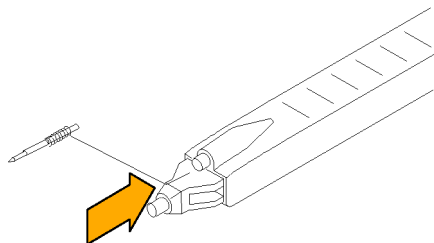
You can bend or shorten this ground lead.

Cut the tip of the ground lead wire at a 30° to 60° angle to ease insertion into the ground socket of the probe.

To maintain signal fidelity while probing, use as short a ground path as possible. (See page 30, *Ground lead length*.)

Reorder Tektronix part number:

196-3482-XX qty. 5



Right-Angle Adapter

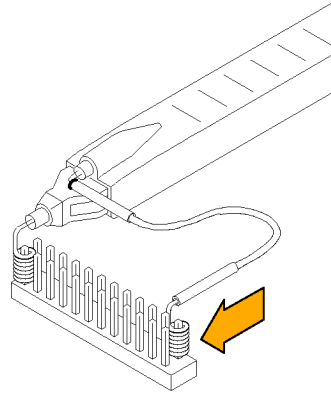
Use the right-angle adapter for low-profile probing of 0.025-inch square pins. The right-angle adapter allows the probe to lie flat against a circuit board, enabling you to probe in tight areas such as between circuit cards.

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

Attach the right-angle adapter the same way as the push-in probe tip.

Reorder Tektronix part number:

016-1774-XX qty. 10



Y-Lead Adapter and Ground Leads

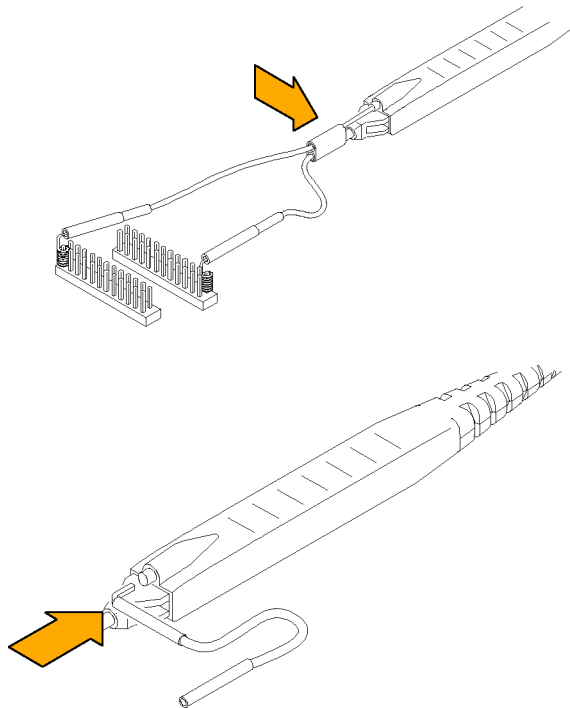
Use the Y-lead adapter to extend the reach of the probe and ground. The Y-lead adapter accepts any of the probe tips or adapters, and can be pushed directly onto 0.025 inch square pins.

Use the ground leads for general, lower-frequency probing. The socketed end of the leads may be connected to any of the probe tips and adapters, or fitted onto 0.025-inch square pins.

When selecting the grounding connection, maintain as short a ground path as possible. (See page 30, *Ground lead length*.)

Reorder Tektronix part number: 196-3456-XX
Kit includes:

- Y-lead adapter, qty. 2
- Three-in ground leads, qty. 3

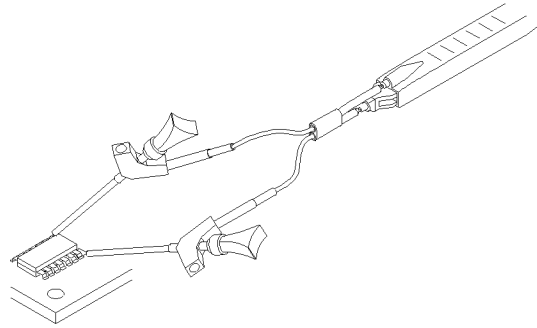


SMT KlipChip Adapter

Use the SMT KlipChip test clips to access fragile, dense circuitry. KlipChip test clips can be connected to the Y-lead or ground leads. Simply press the lead socket into the KlipChip handle.

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

Reorder Tektronix part number:
206-0569-XX qty. 1

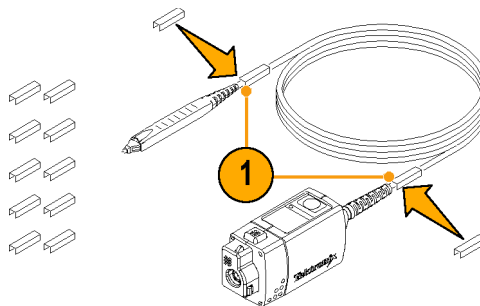


Color Band Kit (five colored pairs)

1. Attach one band to the probe cable and another one of the same color near the probe compensation box.
2. Connect the probe to the channel that matches the color of the band.

Reorder Tektronix part number:

016-1315-XX qty. Set of 5 colors



Antistatic Wrist Strap

When using the probe, always work at an antistatic work station and wear the antistatic wrist strap.

Reorder Tektronix part number:
006-3415-XX

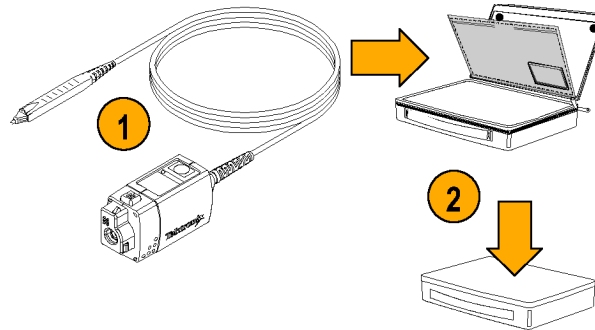


Pouch, nylon carrying case with inserts

Use the carrying case to hold the probe, the accessories, and the instruction manual.

1. Place the probe, accessories, and manual in the carrying case.
2. Close the carrying case to transport the accessories to another location or for storage.

Reorder Tektronix part number:
016-1952-XX



Instruction manual

The instruction manual provides instructions for operating and maintaining the TAP2500, TAP3500, and TAP4000 active probes. Store the instruction manual in the probe case for easy reference.



Tektronix part number:

- 071-1836-XX (English)
- 071-1884-XX (Japanese)
- 071-1885-XX (S. Chinese)
- 077-0290-XX (Russian)

Optional accessories

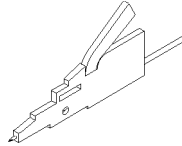
This section lists the optional accessories that you can purchase to help you with your probing tasks.

IC Micro-Grabber

Use the IC Micro-Grabber to probe the leads on integrated circuits that are surface-mounted.

Order Tektronix part number:

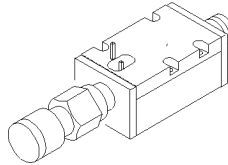
013-0309-XX qty. 2



SMA-to-Probe Tip Adapter

Use the adapter to connect the probe to SMA cables and for calibration and performance verification. The adapter includes a 50 Ω SMA termination.

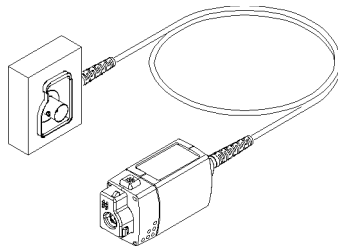
Order Tektronix part number: 015-0678-XX



TekVPI Calibration Fixture

The calibration fixture is required to do a performance verification on the probe. It provides an SMA connector in the probe signal path for internal probe measurements.

Order Tektronix part number: 067-1701-XX



Options

Service Options

- **Option CA1.** Provides coverage for a single Calibration Event
- **Option C3.** Calibration Service 3 years
- **Option C5.** Calibration Service 5 years
- **Option D1.** Calibration Data Report
- **Option D3.** Calibration Data Report, 3 years (with Option C3)
- **Option D5.** Calibration Data Report, 5 years (with Option C5)
- **Option R3.** Repair Service 3 years
- **Option R5.** Repair Service 5 years

Manual Options

- **Option L0.** English language Instruction Manual
- **Option L5.** Japanese language Instruction Manual
- **Option L7.** Simplified Chinese language Instruction Manual

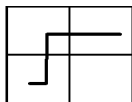
Probing principles

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

Ground lead length

When you are probing a circuit, you should always use as short a ground lead as possible between the probe head and circuit ground. (See the illustration for the effects of lead length on waveform distortion.)

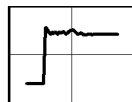
The series inductance added by the probe tip and ground lead can result in a resonant circuit; this circuit may cause parasitic ringing within the bandwidth of your oscilloscope.



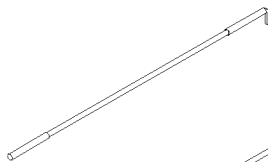
Low-inductance Ground



(~ 20 nH)



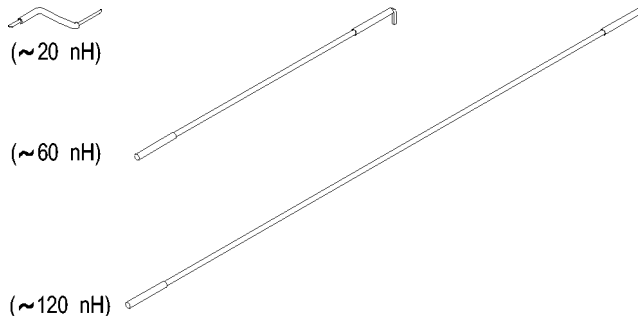
Three-inch Ground



(~ 60 nH)



Six-inch Ground



(~ 120 nH)

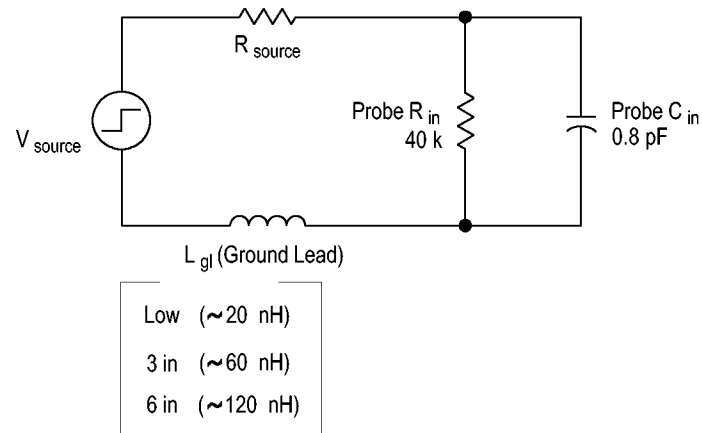
Ground lead inductance

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

You can determine if ground lead effects may be a problem in your application if you know the self-inductance (L) and capacitance (C) of your probe and ground lead. Calculate the approximate resonant frequency (f_0) at which this parasitic circuit will resonate with the following formula: $f_0 = \frac{1}{2\pi\sqrt{LC}}$

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

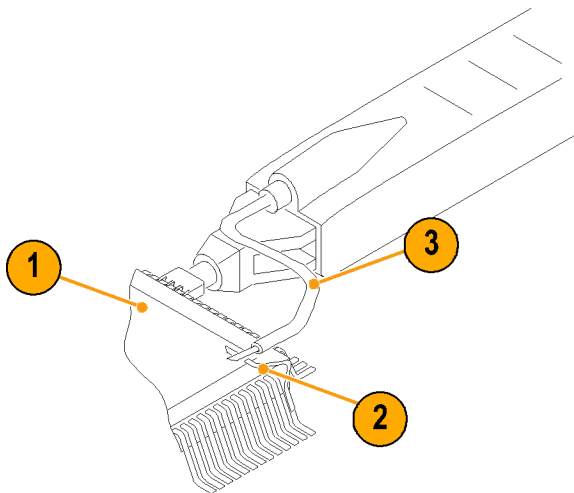
The low-inductance ground contacts described in *Accessories* can help you reduce the effects of ground lead inductance on your measurements.



Low-inductance grounding

Use a ground plane on the package to make probing the package easier, and to avoid adding unnecessary ground lead length and distortion:

1. Attach a small piece of copper clad on top of the package.
2. Connect the copper clad to the package ground connection.
3. Use the low-inductance ground lead to keep the ground lead length as short as possible.



Quick tip

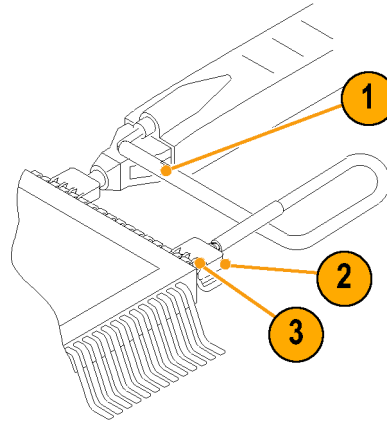
This method is very useful when making many measurements on the same package.

SureFoot™ Grounding

If you cannot use the low-inductance grounding method recommended, the probe may be grounded to the package under test using a SureFoot adapter.

1. Connect a short ground lead to the probe.
2. Attach a SureFoot adapter at the end of the ground lead.
3. Connect the SureFoot adapter directly to the package ground.

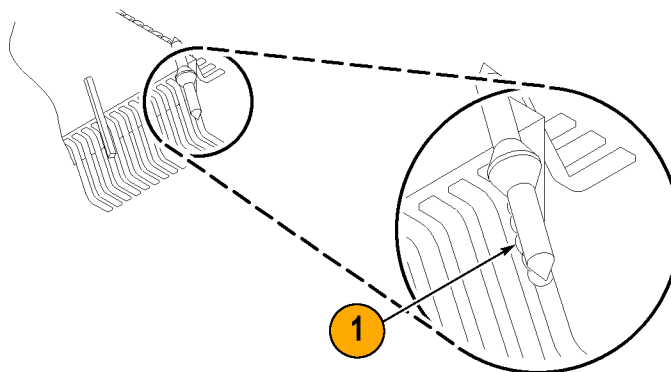
This method is preferred over using an adjacent circuit ground because it is the shortest ground path possible.



Probe tip test points

The push-in probe tip or a 0.025-inch square pin can be soldered into a circuit to be used as a temporary test point:

1. Solder the tip onto a lead or pin with a low-power soldering iron.
2. Press the probe head onto the tip to take a measurement.
3. Pull the probe head off when you are done.



Quick tip

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

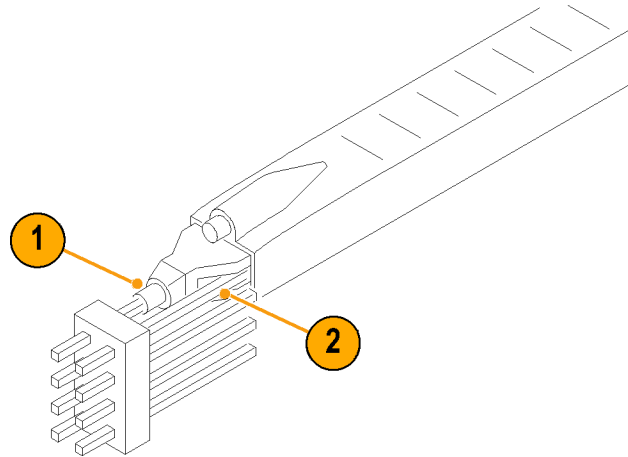
NOTE. Do not use pieces of solid-core copper wire as test points. If the wire breaks off in the probe tip socket, it may be impossible to remove the wire, and it will prevent insertion of other accessory tips.

Probe tip stabilization

The probe head has a stabilizing notch for use with 0.100 inch-spaced header pins:

1. Press the probe onto the header pin.
2. Insert the stabilizing notch of the probe onto an adjacent pin. This prevents unnecessary force from being applied directly to the probe tip or pins.

The signal-ground adapter can rest on the stabilized pin without a risk of its moving out of place.



Specifications

The specifications are valid under the following conditions:

- The probe has been calibrated at an ambient temperature of $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$.
- The probe is connected to a host instrument with an input impedance of $50\ \Omega$.
- The probe and oscilloscope must have a warm-up period of at least 20 minutes and be in an environment that does not exceed the limits described. (See Table 1.)
- The Signal Path Compensation (SPC) has been run on the oscilloscope before testing the probe specifications.

Specifications for the TAP2500, TAP3500, and TAP4000 active probes fall into three categories: warranted, typical, and nominal characteristics.

Warranted characteristics

Warranted characteristics describe guaranteed performance within tolerance limits or certain type-tested requirements. Warranted characteristics that have checks in the *Performance Verification* section are marked with the ✓ symbol. The Warranted, Typical, and Mechanical characteristics apply to the TAP2500, TAP3500, and TAP4000 probes unless noted otherwise.

Table 1: Warranted electrical characteristics

| Characteristic | Description |
|--|---|
| ✓ DC attenuation accuracy (probe only) | 10:1 ±2% (excludes offset error) |
| ✓ Rise time (probe only) | ≤140 ps (TAP2500) ≤130 ps (TAP3500) |
| Temperature | Operating: 0 to +50 °C (+32 to +122 °F), Nonoperating: -40 to +71 °C (-40 to +160 °F) |
| Humidity | Operating: 5-95% RH, tested up to +30 °C (+86 °F) 5-85% RH, tested at +30 °C to +50 °C (+86 to +122 °F) Nonoperating: 5-95% RH, tested up to +30 °C (+86 °F) 5-85% RH, tested at +30 °C to +75 °C (+86 to +167 °F) |
| Altitude | Operating: Up to 3000 meters (9,843 feet), Nonoperating: Up to 12,000 meters (39,370 feet) |

Typical characteristics

Typical characteristics describe typical but not guaranteed performance.

Table 2: Typical electrical characteristics

| Characteristic | Description |
|---------------------------------------|--|
| Rise time (probe only) | ≤ 115 ps (TAP4000) |
| Bandwidth (probe only) | DC to ≥ 2.5 GHz (TAP2500) DC to ≥ 3.5 GHz (TAP3500) DC to ≥ 4 GHz (TAP4000) |
| Input resistance | 40 k Ω |
| Input capacitance | ≤ 0.8 pF |
| Input signal range | -4.0 V to +4.0 V |
| Input offset range | -10.0 V to +10.0 V |
| Output Zero | ± 10 mV or less displayed on screen |
| Maximum non destructive input voltage | ± 30 V _(DC + peak AC) |
| Linearity | $\pm 0.1\%$ or less over a dynamic range of -3.75 V to +3.75 V $\pm 1.0\%$ or less over a dynamic range of -4.0 V to +4.0 V. |
| DC offset drift | 1.5 mV/ $^{\circ}$ C or less displayed on screen |
| Signal delay | 5.3 ns ± 0.2 ns |

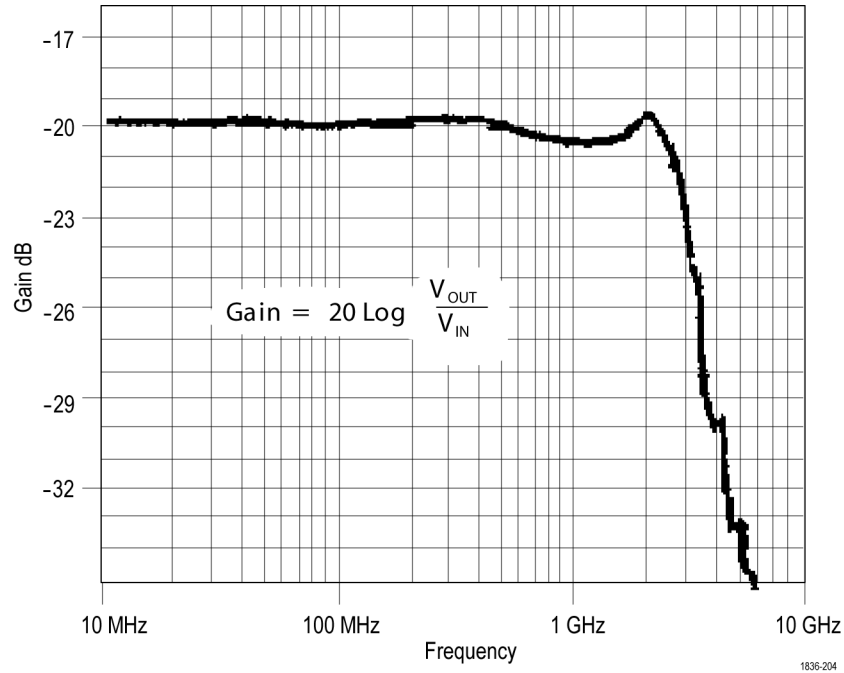


Figure 2: TAP2500 Typical bandwidth

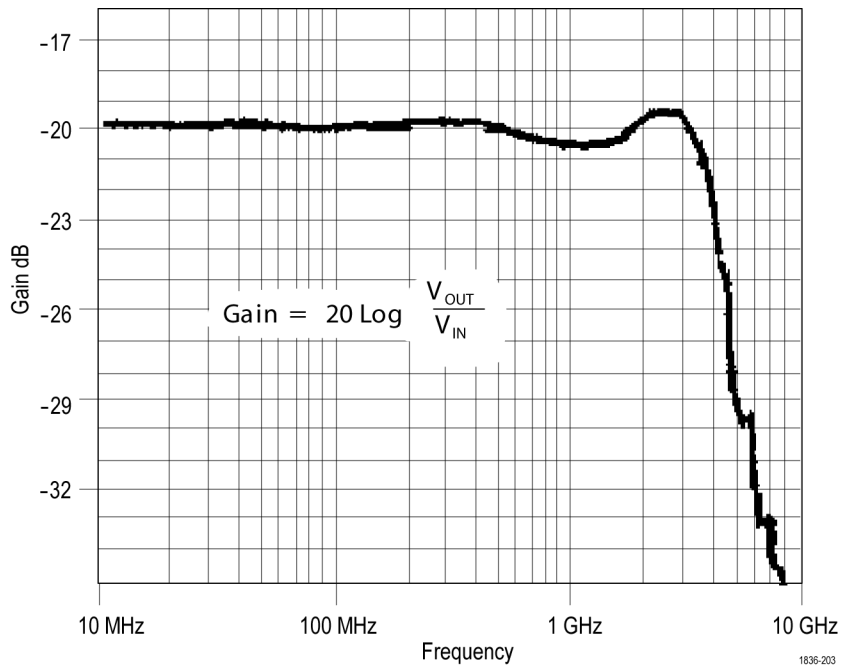


Figure 3: TAP3500 Typical bandwidth

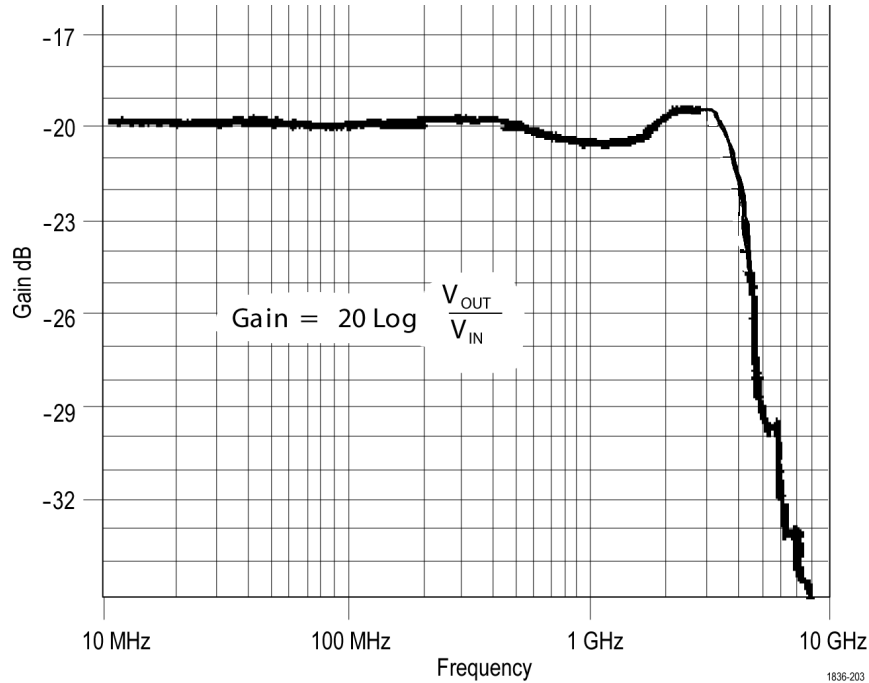


Figure 4: TAP4000 Typical bandwidth

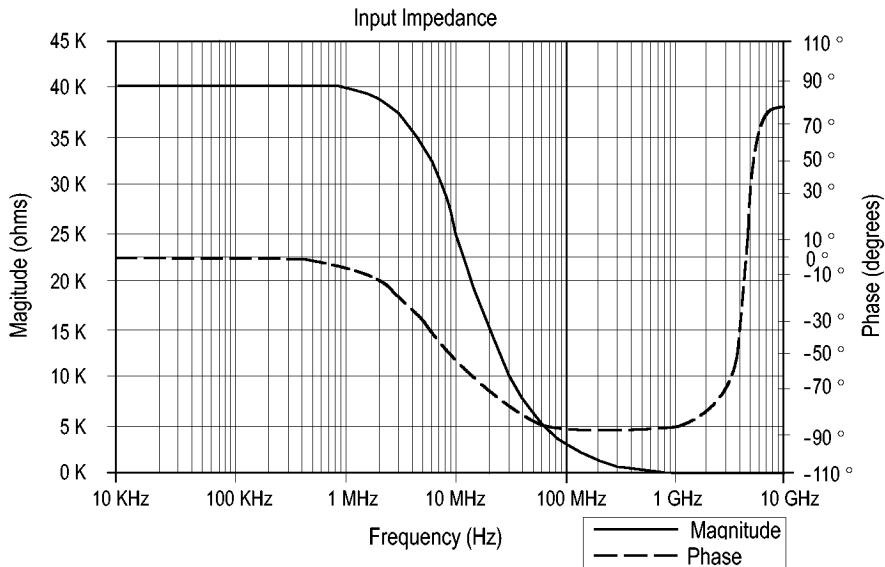
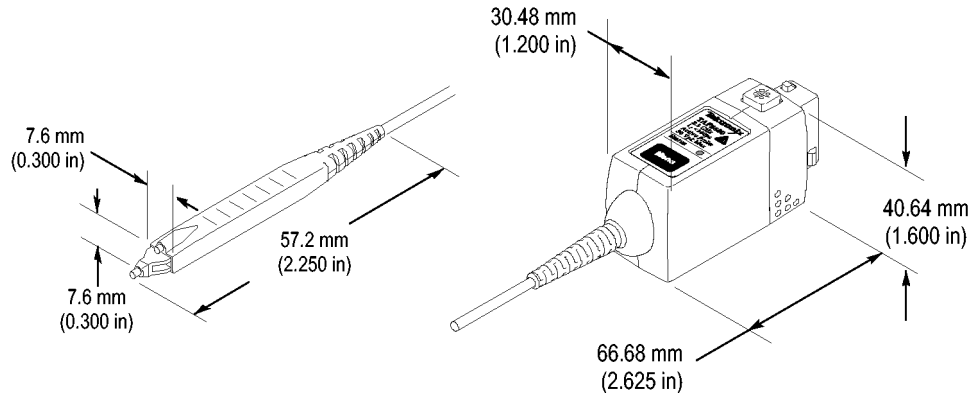


Figure 5: Typical input impedance and phase versus frequency

Table 3: Typical mechanical characteristics

| Characteristic | Description |
|------------------------------|--|
| Dimensions, compensation box | 107 mm × 41 mm × 26 mm (4.2 in × 1.6 in × 1.0 in) |
| Dimensions, probe head | 19.43 mm × 3.30 mm × 7.6 mm (0.765 in × 0.130 in × 0.300 in) |
| Dimensions, cable length | 1.3 m (51 in) (from the probe head to the compensation box) |
| Unit weight | 1.55 kg (3.44 lbs) (probe, accessories and packaging) |



Nominal characteristics

Nominal characteristics describe guaranteed traits, but the traits do not have tolerance limits.

Table 4: Nominal electrical characteristics

| Characteristic | Description |
|-----------------------|--|
| Input coupling | DC |
| Termination | Terminate output into 50 Ω |
| Compatibility | Oscilloscopes equipped with the TekVPI interface |
| Pollution Degree | 2, Indoor use only |

Performance verification

The procedures that follow verify the warranted specifications of the probe. The recommended calibration interval is one year. Perform the verification procedures in the order listed.

Equipment required

The following equipment is required for the performance verification procedures.

Table 5: Test equipment

| Description and quantity | Performance requirement | Recommended example ¹ |
|---|---|--|
| Oscilloscope | TekVPI Interface | Tektronix DPO7000 Series Tektronix 6 Series MSO |
| Sampling oscilloscope | ≥12.5 GHz bandwidth | Tektronix TDS8000 Series Tektronix DSA8300 |
| Sampling module | ≥12.5 GHz bandwidth | Tektronix 80E0X |
| Sampling module | TDR output: 250 mV step, <30 ps rise time | Tektronix 80E04 |
| TekVPI Calibration/Verification adapter | TekVPI Interface | 067-1701-XX |
| DC voltage source | -1.0 to +1.0 VDC, 0.2% accuracy | Wavetek 9100 |
| Digital multimeter (DMM) | Resistance, 0.1% accuracy | Keithley 2700 |
| HF Probe Tip adapter | Probe tip adapter with 50 Ω termination | 015-0678-00 |

Table 5: Test equipment (cont.)

| Description and quantity | Performance requirement | Recommended example ¹ |
|--------------------------------|---|----------------------------------|
| SMA M-to-BNC F adapter | SMA male-to-BNC female | 015-0554-00 |
| BNC-to-dual banana adapter (2) | | 103-0090-00 |
| BNC cable | 50 Ω , 0.76 m (30 in) length | 012-0117-00 |
| SMA cable (2) | Male-to-Male SMA cable | 012-0649-00 |
| Precision termination | 50 Ω , 0.1%, 0.5 W | 011-0129-00 |
| Y-Lead adapter | 0.25-in square pins for probe tip connections | 196-3457-xx ² |
| SMT KlipChip adapters (2) | 0.25-in square pins-to-mini clips | 206-0569-xx ² |
| SMA torque wrench | 5/16-in, 7 in-lb. | |
| SMA adapter wrench | 7/32-in | |

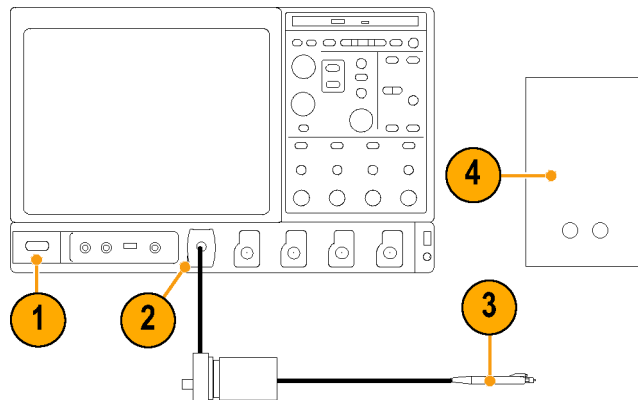
¹ Nine-digit part numbers (xxx-xxxx-xx) are Tektronix part numbers.

² Standard accessories included with the probe.

Equipment setup

Use the following procedure to set up and warm up the equipment to test the probe.

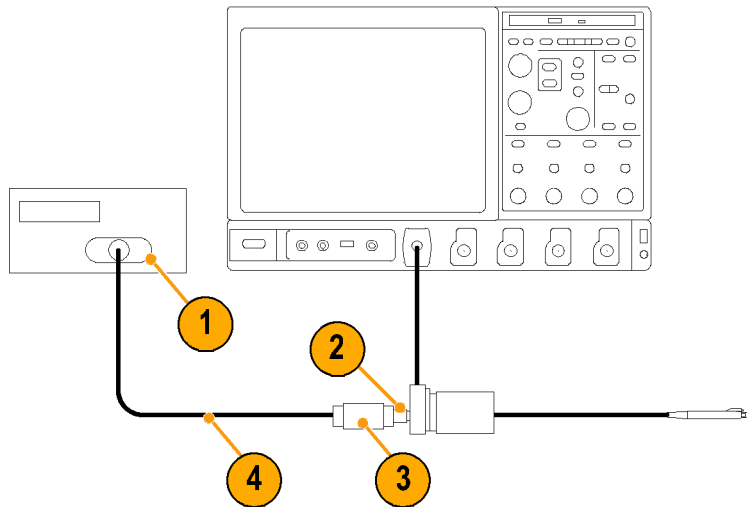
1. Turn on the TekVPI oscilloscope.
2. Connect the TekVPI Calibration/Verification adapter to the oscilloscope.
3. Connect the probe to the TekVPI Calibration/Verification adapter and verify that the Status LED on the probe turns green.
4. Turn on the remaining test equipment.
5. Allow 20 minutes for the equipment to warm up.
6. Photocopy the test record and use it to record the test results. (See page 59, *Test record*.)



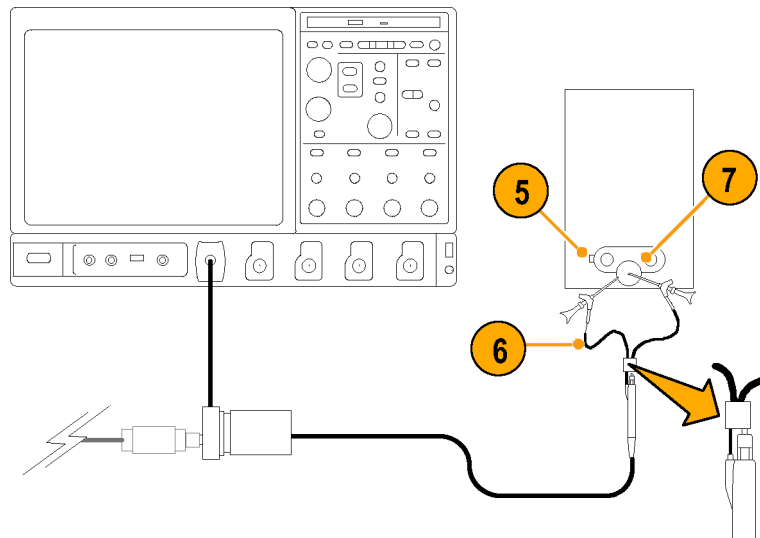
DC gain accuracy

This test checks the DC gain accuracy of the probe.

1. Connect the BNC-to-dual banana adapter to the DMM input.
2. Connect the SMA M-to-BNC F adapter to the SMA output of the TekVPI Calibration/Verification adapter.
3. Connect the precision termination to the BNC end of the SMA M-to-BNC F adapter.
4. Connect the BNC cable between the precision termination and the BNC-to-dual banana adapter attached to the DMM.



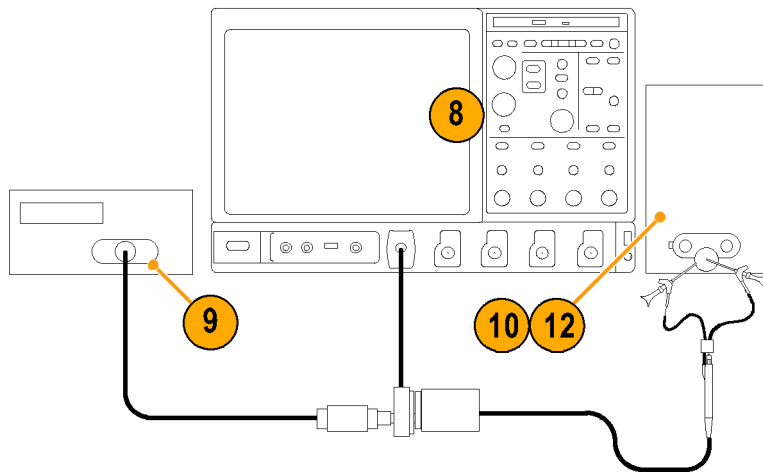
5. Connect the second BNC-to-dual banana adapter to the output of the DC voltage source.
6. Connect the Y-lead adapter and KlipChip adapters to the probe input.
7. Attach the KlipChip adapters to the BNC-to-dual banana adapter connected to the DC voltage source. Make sure the polarity is correct-ground to outer shield and probe input to center conductor.



8. Set oscilloscope offset to 0.0 V.
9. Set the DMM to DCV.
10. Press the REL (relative) button to Zero the DMM.
11. Set the DC voltage source to +1.00 VDC and enable the output.
12. Record the DMM measurement in the test record.
13. Set the DC voltage source to -1.00 VDC.
14. Record the DMM measurement in the test record.

NOTE. An unacceptable error value may result if a precision $50\ \Omega$ termination is not used for the recommended termination, or if the oscilloscope offset is not set to zero.

15. Leave the TekVPI Calibration/Verification adapter and probe connected the oscilloscope to keep the probe warm.



Rise time

This procedure verifies that the probe meets the rise time specification. Two rise times are measured; the test system alone, and then the test system with the probe included. The probe rise time is calculated using the two measurements.

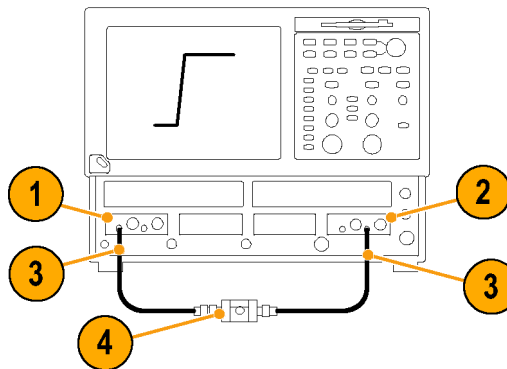
This test uses the TDR function of the 80E04 sampling head as a fast rise time signal source. A second 80E0X sampling head is used to take the measurements. Although the following procedure assigns the TDR and measurement functions to specific oscilloscope channels, any channels can be used. However, the TDR function is only available on 80E04 sampling heads.



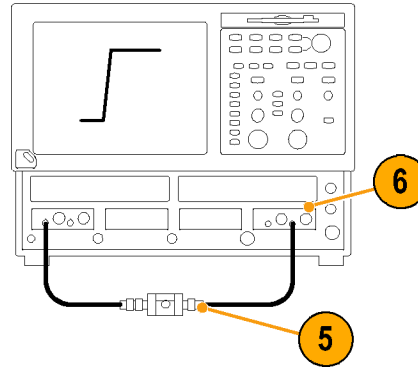
CAUTION. *To prevent damage, use care when working with SMA connectors: support equipment to avoid mechanical strain on the connectors, and when tightening connections, use a torque wrench to 7.5 in-lbs.*

Test system rise time

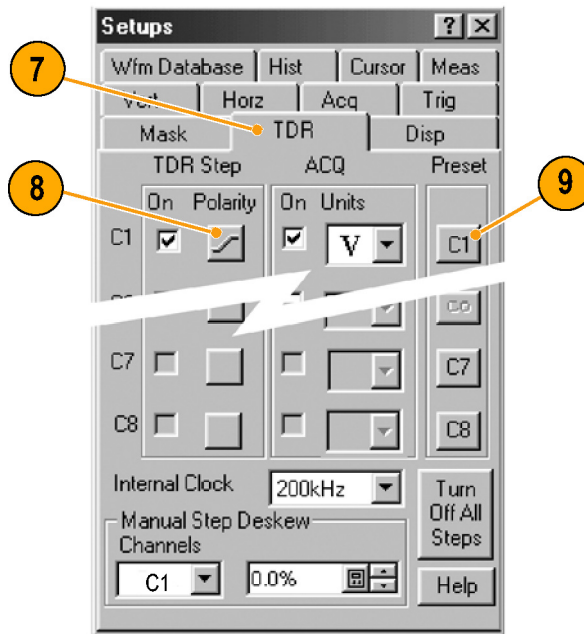
1. Connect the 80E04 sampling head to Channel1 of the sampling oscilloscope.
2. Connect the 80E0X sampling head to Channel8 of the sampling oscilloscope.
3. Connect SMA cables to Channels 1 and 8.
4. Connect the SMA cable from Channel 1 to the HF Probe Tip adapter.



5. Remove the 50 Ω termination from the HF Probe Tip adapter and connect the SMA cable from Channel 8 to the adapter.
6. Turn on Channel 8 and set the vertical scale to 50 mV/div.



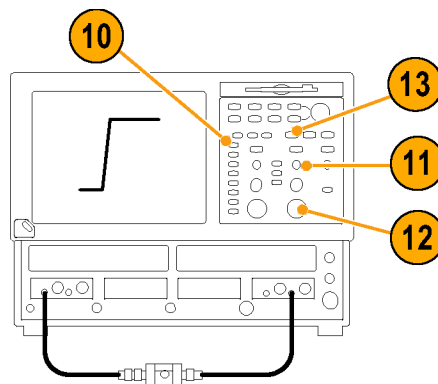
7. Set the Channel 1/2 sampling head to TDR mode: Press the **SETUP DIALOGS** button and select the TDR tab.
8. Set the Channel 1 (**C1**) **Polarity** to positive (rising).
9. Set the **Preset** of Channel 1 on.
TDR Preset sets Internal Clock in the Trigger menu, turns on the TDR Step in the TDR Setups menu, turns on the channel and selects the acquisition Units in the TDR Setups menu, and sets the horizontal scale, position, and reference.
The sampling module will turn on a red light next to the SELECT channel button, indicating that TDR is activated for that channel.



10. Turn off the display for Channel 1 so that only Channel 8 is shown on screen.
11. Adjust the oscilloscope horizontal and vertical position controls to display a signal similar to that shown.
12. Set the oscilloscope horizontal scale to 50 ps/div and center the waveform.

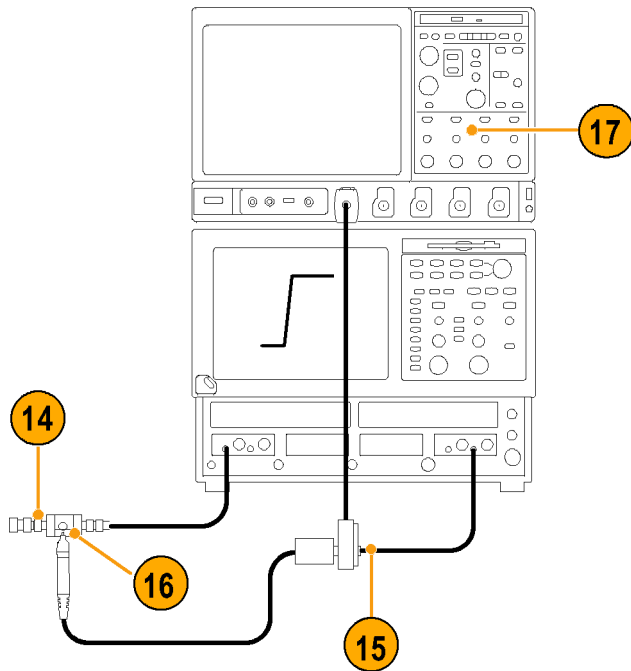
NOTE. Do not touch the HF Probe Tip adapter when making calibration measurements. Measurement accuracy is degraded when the probe tip adapter is handled.

13. Use the oscilloscope measurement capability to display rise time. Increase the stability of the pulse edge measurement by using averaging, if available. Rise time is determined from the 10% and 90% amplitude points on the waveform. Record the rise time as t_s .



Test system and probe rise time

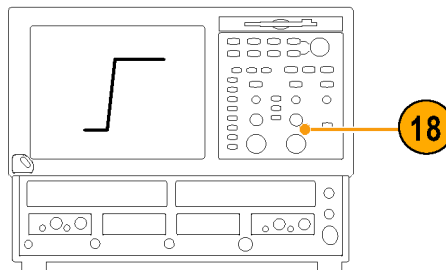
- 14. Disconnect the SMA cable from the Channel-8 side of the HF Probe Tip adapter and reconnect the 50 Ω SMA termination to the adapter.
- 15. Connect the SMA cable from Channel 8 of the sampling oscilloscope to the SMA connector on the TekVPI Calibration/Verification adapter.
- 16. Connect the probe to the HF Probe Tip adapter.
- 17. Set the TekVPI oscilloscope offset to 0.0 V.



NOTE. The following measurements are taken with the sampling oscilloscope. The TekVPI oscilloscope only provides power and offset to the probe.

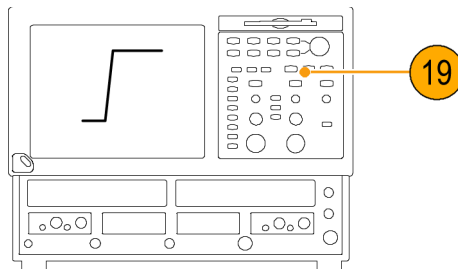
18. On the sampling oscilloscope, expand the horizontal scale to locate the step edge: Set the vertical scale to 5 mV/div, and adjust horizontal range to 100 ps/div while maintaining the edge view. For a more stable measurement display, turn averaging on.

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



19. Adjust the position controls on the sampling oscilloscope to display the entire leading edge waveform.

20. Use the measurement capability of the sampling oscilloscope to display rise time: Increase the stability of the pulse edge measurement by using averaging, if available. Rise time is determined from the 10% and 90% amplitude points on the waveform. Record the rise time as t_{s+p} .



21. Using the test system rise time (t_s) that you measured in step 13, and the test system and probe rise time (t_{s+p}) that you measured in step 20, calculate the probe-only rise time using the formula shown.

21

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

Example:

$$t_p = \sqrt{(125^2 - 28^2)} = \sqrt{125^2 - 28^2} = \sqrt{15625 - 784} = \sqrt{14841}$$

$$t_p = 128.8 ps$$

22. Check that the calculated rise time meets the probe specification.

23. Record the results on the test record.

Test record

Probe Model/Serial Number: _____ Certificate Number: _____
 Temperature: _____ RH %: _____
 Date of Calibration: _____ Technician: _____

| Performance test | Source voltage | Minimum | Measured | Calculated | Maximum |
|------------------|----------------|---------|----------|------------|---------|
| DC Gain Accuracy | +1.00 VDC | +98 mV | | NA | +102 mV |
| | -1.00 VDC | -102 mV | | NA | -98 mV |
| Rise Time | | | | | |
| (TAP2500) | NA | NA | NA | | 140 ps |
| (TAP3500) | NA | NA | NA | | 130 ps |
| (TAP4000) | NA | NA | NA | | 115 ps |

Maintenance

This section contains maintenance information for your probe.

Error condition

The TAP2500, TAP3500, and TAP4000 active probes are designed to work with all TekVPI-interface oscilloscopes and adapters. However, there may be some cases where all of the probe features may not work properly.

If the Status LED glows red during or after probe power on, an internal probe diagnostic fault exists. Disconnect and reconnect the probe to restart the power-on diagnostic sequence. If the Status LED continues to glow red, the probe is defective, and must be returned to Tektronix for repair.

Replacement parts

There are no user replaceable parts within the probe. Refer to *Accessories* for a list of replaceable accessories for your probe.

Cleaning

Protect the probe from adverse weather conditions. The probe is not waterproof.



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. A swab is useful for cleaning 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.

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