Tektronix®

TCP0030A
120 MHz, 30 Amp AC/DC Current Probe
Instruction Manual

www.tek.com

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Contacting Tektronix

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P.O. Box 500
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.

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.

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

General safety summary v
Service safety summary viii
Compliance Information ix
Safety Compliance ix
Environmental Considerations xiii
Preface xiv
Documentation xiv
Conventions Used in this Manual xiv
Returning the Probe for Servicing xv
Key Features 1
Installation 2
Degauss the Probe 3
Controls and Indicators 5
Probe Slider and Conductor Jaw 5
Control Box 8
Functional Check 17
Basic Operation 18
Application Examples 20
Inductance Measurements 21

Measuring Inductor Turns Count 24
Probing Principles 26
Degaussing a Probe with an Unpowered Conductor in the Jaws 26
Measuring Differential Current 27
Extending Current Range 29
Increasing Sensitivity 32
Common Mode Noise/Magnetic Field Errors 33
AC and DC Coupling 34
Maximum Current Limits 35
Accessories and Options 39
Optional Accessories 41
Options 44
Specifications 45
Warranted Characteristics 45
Typical Characteristics 46
Nominal Characteristics 52
Performance Verification 53
Equipment Required 54
Making the DC Current Loop 55
Equipment Setup 56
DC Gain Accuracy 57
Rise Time and Bandwidth 61
Test Record 63

Adjustments 64
Equipment Required 64
Equipment Setup 64
DC Gain Accuracy 65
High Frequency Response 67
Maintenance 68
Troubleshooting 68
Cleaning 70
Index

General safety summary

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

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

Only qualified personnel should perform service procedures.

To avoid fire or personal injury

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

Connect and disconnect properly. De-energize the circuit under test before connecting or disconnecting the current probe.

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.

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 connect a current probe to any wire that carries voltages above the current probe voltage rating.

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



Earth Terminal



Do not connect to or remove from an uninsulated conductor that is HAZARDOUS LIVE.

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.

Compliance Information

This section lists the EMC (electromagnetic compliance), safety, and environmental standards with which the instrument complies.

Safety Compliance

EC Declaration of Conformity – Low Voltage

Compliance was demonstrated to the following specification as listed in the Official Journal of the European Communities:

Low Voltage Directive 2006/95/EC.

- EN 61010-1: 2001. Safety requirements for electrical equipment for measurement control and laboratory use.
- EN 61010-2-032: 2002. Particular requirements for handheld current clamps for electrical measurement and test equipment.

U.S. Nationally Recognized Testing Laboratory Listing

- UL 61010-1:2004, 2nd Edition. Standard for electrical measuring and test equipment.
- IEC 61010-2-032:2002. Particular requirements for handheld current clamps for electrical measurement and test equipment.

Canadian Certification

- CAN/CSA-C22.2 No. 61010-1:2004. Safety requirements for electrical equipment for measurement, control, and laboratory use. Part 1.
- CAN/CSA-C22.2 No. 61010-2-032-04, 2nd Edition. Particular requirements for handheld and hand-manipulated current sensors for electrical measurement and test equipment.

Additional Compliances

- IEC 61010-1: 2001. Safety requirements for electrical equipment for measurement, control, and laboratory use.
- IEC 61010-031: 2002. Particular requirements for handheld probe assemblies for electrical measurement and test equipment.
- IEC 61010-2-032: 2002. Particular requirements for handheld current clamps for electrical measurement and test equipment.

Equipment Type

Test and measuring equipment.

Pollution Degree Description

A measure of the contaminants that could occur in the environment around and within a product. Typically the internal environment inside a product is considered to be the same as the external. Products should be used only in the environment for which they are rated.

- Pollution Degree 1. No pollution or only dry, nonconductive pollution occurs. Products in this category are generally encapsulated, hermetically sealed, or located in clean rooms.
- Pollution Degree 2. Normally only dry, nonconductive pollution occurs. Occasionally a temporary conductivity that is caused by condensation must be expected. This location is a typical office/home environment. Temporary condensation occurs only when the product is out of service.
- Pollution Degree 3. Conductive pollution, or dry, nonconductive pollution that becomes conductive due to condensation. These are sheltered locations where neither temperature nor humidity is controlled. The area is protected from direct sunshine, rain, or direct wind.
- Pollution Degree 4. Pollution that generates persistent conductivity through conductive dust, rain, or snow. Typical outdoor locations.

Pollution Degree

Pollution Degree 2 (as defined in IEC 61010-1). Note: Rated for indoor use only.

Installation (Overvoltage) Category Descriptions

Terminals on this product may have different installation (overvoltage) category designations. The installation categories are:

- Measurement Category IV. For measurements performed at the source of low-voltage installation.
- Measurement Category III. For measurements performed in the building installation.
- Measurement Category II. For measurements performed on circuits directly connected to the low-voltage installation.
- Measurement Category I. For measurements performed on circuits not directly connected to MAINS.

Overvoltage Category

Overvoltage Category II (as defined in IEC 61010-1)

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 2002/96/EC and 2006/66/EC on waste electrical and electronic equipment (WEEE) and batteries. For information about recycling options, check the Support/Service section of the Tektronix Web site (www.tektronix.com).

Preface

This manual describes the installation and operation of the TCP0030A current probe. Basic probe operations and concepts are presented in this manual. You can also access the Tektronix Web site for this document and other related information.

Documentation

To read about	Use these documents *
TCP0030A Probe: 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.

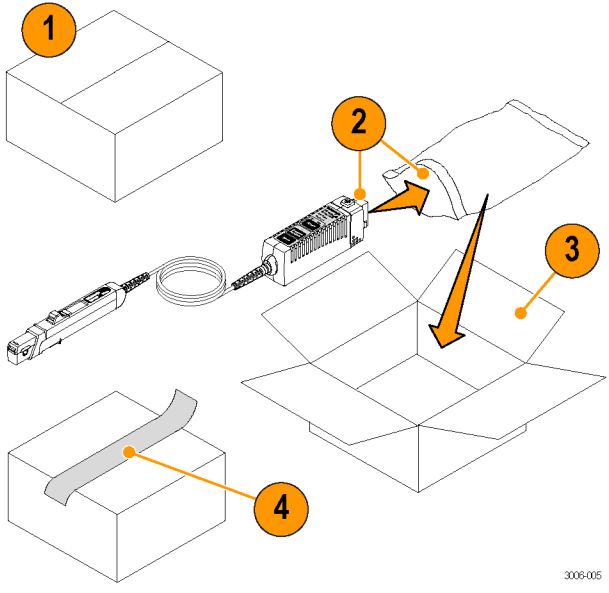


Returning the Probe for Servicing

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

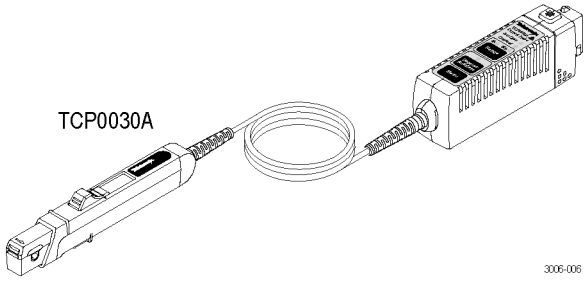
1. Use a corrugated cardboard shipping carton having inside dimensions at least one inch greater than the probe dimensions. The box should have a carton test strength of at least 200 pounds.
2. Put the probe into an antistatic bag or wrap it to protect it from dampness.
3. Place the probe into the box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

You can use the TCP0030A current probe to make accurate measurements from DC to 120 MHz. The probe combines proven Hall-effect technology with the Tektronix TekVPI oscilloscope interface. Key features include:

- Bandwidth ≥ 120 MHz, rise time ≤ 3.05 ns
- AC/DC Measurement capability
- 50 A peak pulse current (pulse widths <10 µs)
- 5 A and 30 A range settings
- 1 mA sensitivity (on TekVPI oscilloscopes that support the 1 mV/div setting)
- 1% DC Accuracy (typical)
- One-button degauss/autozeroing
- Probe control through the TekVPI oscilloscope menus or remotely through the oscilloscope
- Direct scaling and unit readout on host instruments
- AC coupling (on TekVPI oscilloscopes that support AC coupling)



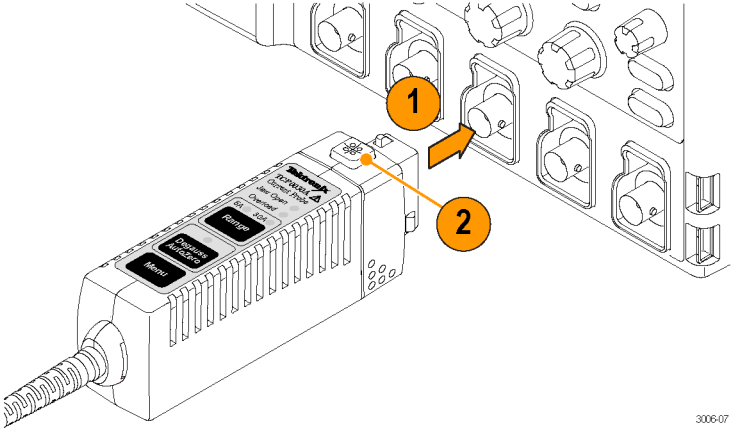
Installation

CAUTION. *The probe head is a precision assembly. Do not drop the probe or subject it to physical shock, strain, or sudden changes in ambient conditions. Do not insert conductors larger than 5.0 mm (0.20 in) diameter into the probe jaw. Damage to the probe may result.*

Connect to the Host Instrument

1. Slide the probe into the TekVPI receptacle. The probe snaps in when fully engaged.
2. To disconnect, press the latch button and pull the probe away from the instrument.

When the probe is connected, the host instrument reads information from the probe and identifies the device. All of the probe LEDs light briefly for a quick visual check.



Degauss the Probe

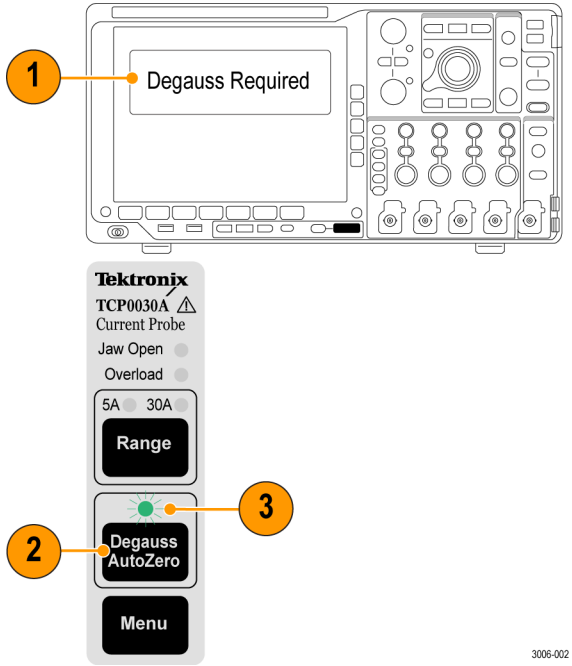
1. After the probe is identified by the host instrument, the screen display prompts you to run a degauss routine.

   The multicolor Degauss/AutoZero status LED on the probe also indicates that a degauss is needed, by flashing red.

2. To degauss the probe, first verify that the probe jaw is closed, and then press the **Degauss/AutoZero** button on the probe or in the Degauss window on the host instrument.

NOTE. The DC gain and offset errors are not guaranteed when this LED flashes red.

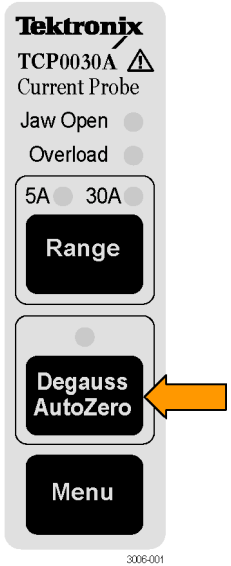
3. The multicolor Degauss/AutoZero status LED glows green to indicate a successful degauss routine was run, and that the probe is in normal operating mode.



Quick Tip

To maintain measurement accuracy, degauss your probe in each of these cases:

- After you turn on the measurement system and allow a 20-minute warm-up period
- Before you connect the probe to a conductor
- Whenever a current or thermal overload condition occurs
- Whenever you subject the probe to a strong external magnetic field

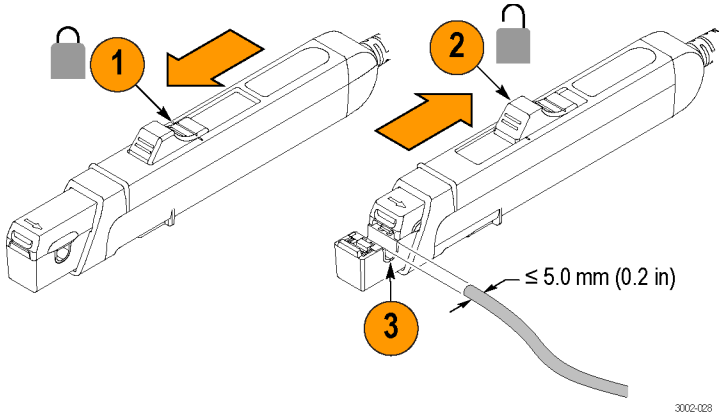


Controls and Indicators

Probe Slider and Conductor Jaw

1. When the slider is in the locked position, you can degauss the probe and take measurements.
2. Move the slider to the unlocked position to insert and remove conductors to and from the conductor jaw.
3. The jaw can accept a 5 mm (0.2 in) diameter maximum conductor size.

WARNING. *To prevent probe damage, do not force conductors larger than 5 mm (0.2 in) diameter into the jaw.*

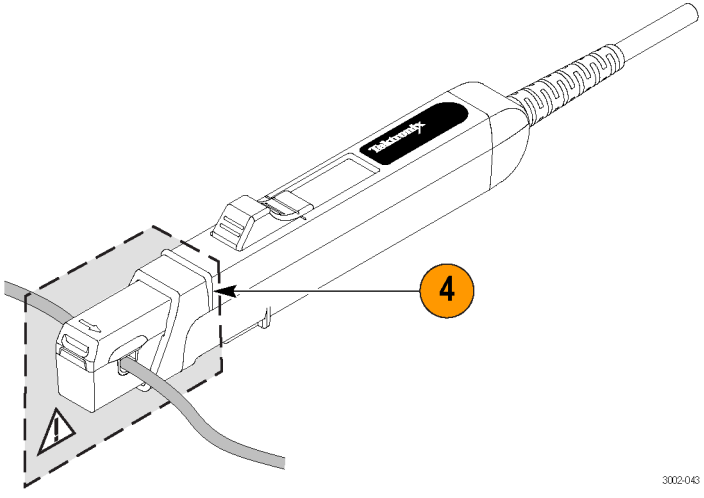


4. Safe handling zone – keep fingers behind demarcations when taking measurements.

WARNING. *To avoid electrical shock, do not access the area beyond the safe handling zone (indicated by the shaded area) when you take measurements.*

WARNING. *To prevent probe damage, do not drop the probe or subject it to impact.*

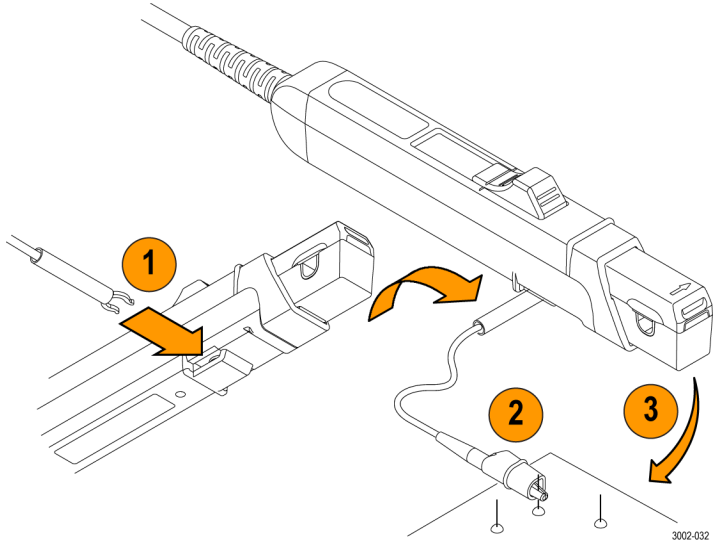
WARNING. *Do not connect the current probe to any wire that carries voltages or currents that exceed the rating of the probes.*



Ground Lead

Use the ground lead to improve EMI rejection at high frequencies.

1. Clip the ground lead to the ground post at the bottom of the probe head.
2. Connect the alligator end of the clip to the circuit ground.
3. Clamp the probe around the circuit conductor.



Control Box

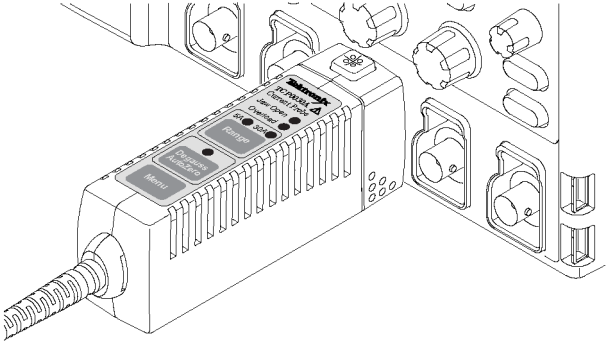
The probe function buttons and LED status indicators are located on the top of the control box, and are described in the following pages.

When the probe is first plugged in, all of the indicator LEDs light briefly, and then the Degauss/AutoZero LED flashes to alert you to degauss the probe.

One of the Range LEDs remains lit to indicate the current range selected.

NOTE. *The probe will retain the range state and will restore it when it is power cycled.*

The Jaw Open LED will also remain lit if the probe slider is unlocked.

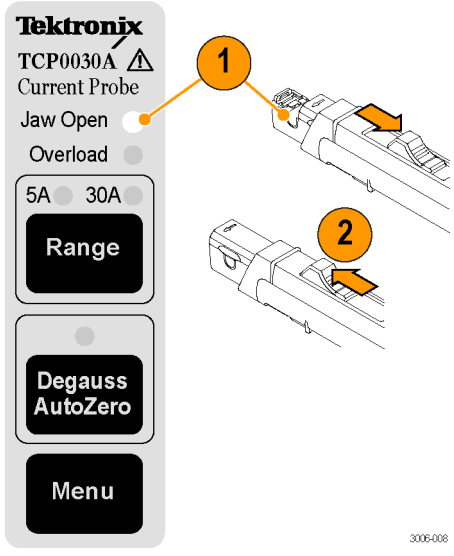


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Jaw Open LED

1. If the Jaw Open LED glows, the probe slider is unlocked.
2. Close the probe slider to accurately measure current or to degauss the probe.

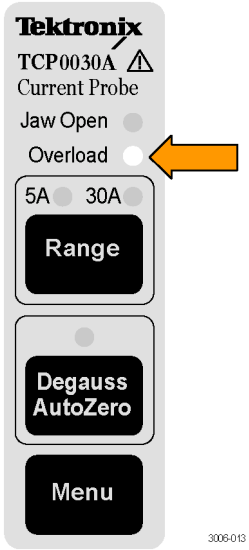
CAUTION. *Do not measure conductors larger than 5.0 mm (0.20 in) diameter. Damage to the probe jaws may result.*



Overload LED

The multicolor Overload LED alerts you that the probe specifications are being exceeded. When the LED:

- Glows red, the maximum input continuous current limit has been exceeded
- Glows orange, the safe operating temperature of the probe has been exceeded
- Flashes red and orange, both the maximum input continuous current limit and the safe operating temperature of the probe have been exceeded



CAUTION. *Do not subject the probe to conditions that cause the Overload LED to light for extended periods.*

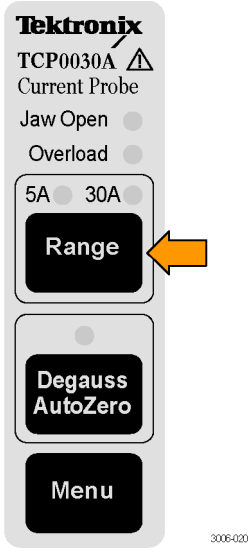
Quick Tip

- An input current overload can magnetize the probe. Always degauss the probe after an overload.

Range Button

Press the **Range** button to select between the 5 A and 30 A current range settings.

The green LEDs indicate the range selected. The range and units are also displayed on the oscilloscope screen.



Degauss/AutoZero

When the multicolor Degauss/AutoZero status LED flashes red, you must degauss the probe.

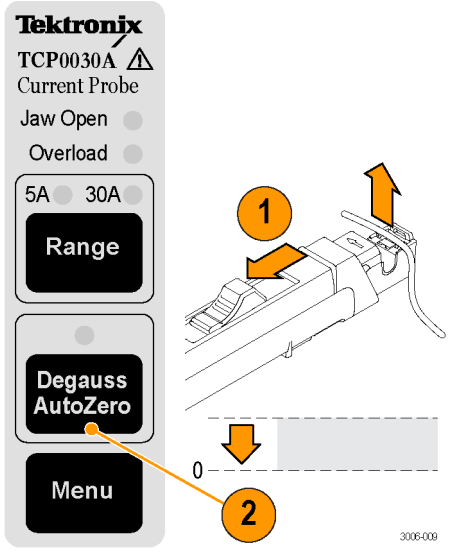
If the LED flashes orange, you should degauss the probe. The DC gain and offset errors are not guaranteed when this LED flashes orange.

The Degauss/AutoZero function also clears (AutoZeroes) any DC offset in the probe.

To degauss the probe, do the following:

1. Disconnect the probe from the current source and then close the slider.
2. Press the **Degauss/AutoZero** button to initiate the degauss routine.

   The LED glows green after successfully completing the Degauss/AutoZero routine.



Menu Button

Press the Menu button on the TCP0030A probe to access additional probe functions, such as probe offset and deskew.

The following menus may appear on the oscilloscope screen, depending on the model. An MSO/DPO4000 series oscilloscope is used in this example.

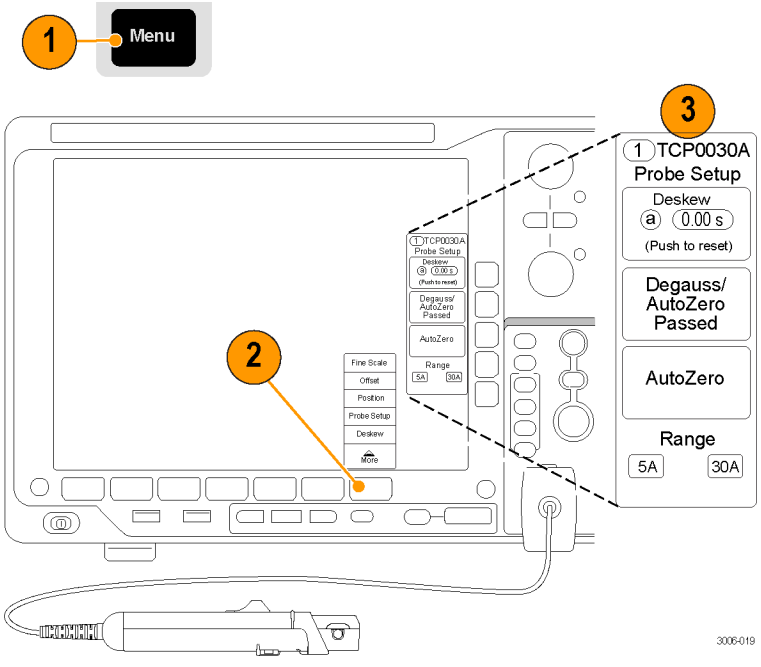
1. Press the **Menu** button on the probe.

   The lower-bezel menu appears at the bottom of the screen, above the lower-bezel buttons.

2. Press the **More** button on the oscilloscope to scroll through the lower-bezel menu.

3. As each lower-bezel menu item is highlighted, a side-bezel menu appears for that function, next to the right-bezel buttons. The Probe Setup menu is shown here.

4. Press the probe **Menu** button again to close the menu.



Menu-Driven Probe Functions

The following probe functions are available through menu screens on many Tektronix oscilloscopes. An MSO/DPO4000 series oscilloscope is used in these examples.

Fine Scale. This feature allows you to adjust the vertical mA/div setting to a custom scale that is between the fixed 1–2–5 scales on many oscilloscopes.

For example, to display a 320 mA signal over exactly 8 vertical divisions (40 mA/div), first set the fixed scale to 50 mA/div. Next, select Fine Scale from the lower-bezel menu and then use the Multipurpose knob to adjust the Fine Scale down to 40 mA/div, as displayed on-screen.

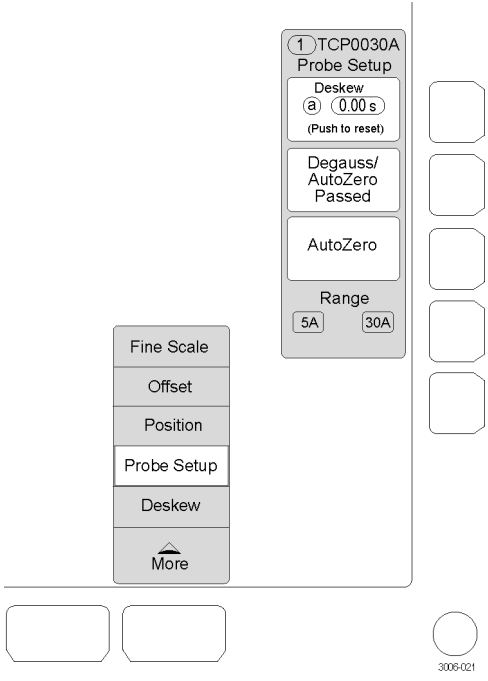


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Offset and Position. Each of these selections allow you to adjust that parameter and to return the value to zero by pressing a side-bezel button.

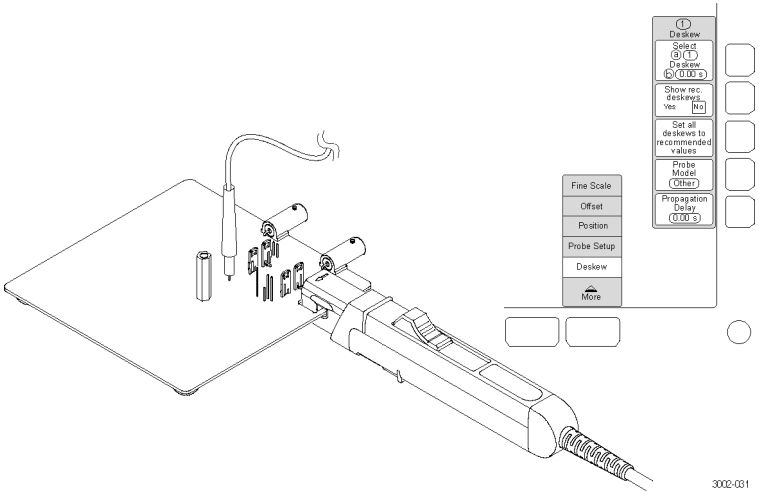
Probe Setup. The Probe Setup menu displays probe settings and functional buttons.

Use the side-bezel buttons to initiate routines such as Degauss and Deskew. The buttons also display the degauss status of the probe.



Deskew. To deskew the TCP0030A probe to other probes, select this function and connect the probes to the optional deskew fixture. (See page 43, *Deskew/Calibration Fixture*.)

The deskew procedure measures the channel-to-channel delay time, including the probes, and provides manual and automatic steps to align the delay (skew). Refer to your oscilloscope manual or deskew fixture documentation for instructions.



Functional Check

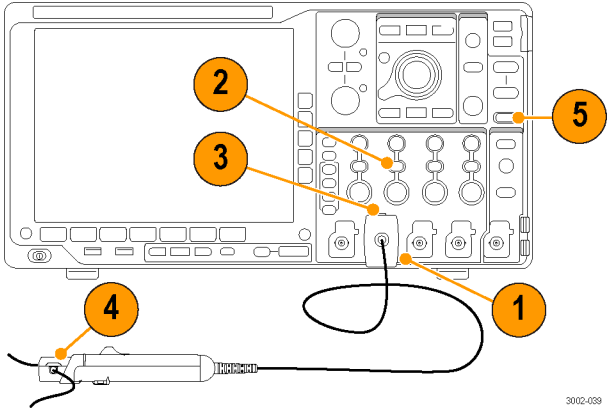
The following procedure checks that your probe is functioning properly. To verify that your probe meets the warranted specifications, refer to the *Performance Verification* procedures. (See page 53.)

CAUTION. *The probe jaw opening accommodates insulated conductors with a diameter of 5 mm (0.20 in) or less. Do not insert conductors larger than 5 mm (0.20 in) diameter into the probe jaw. Damage to the probe may result.*

To check that your probe functions correctly, do the following:

1. Connect the probe to any channel of the oscilloscope.
2. Set the oscilloscope to display the probe channel.
3. Press the Degauss/AutoZero button.
4. Clamp the probe to your circuit.
5. Adjust the oscilloscope or use the Autoset function to display a stable waveform.

   When you see a stable waveform, your probe is functioning correctly.



Basic Operation

CAUTION. *Do not force conductors larger than 5.0 mm (0.20 in) diameter into the probe jaws. Damage to the probe may result.*

The mating surfaces of the probe head transformer are precision-polished and should be handled with care. Measurements may be degraded by dirt on the mating surfaces of the probe head transformer. Refer to the Maintenance section of this manual for information on how to properly clean the probe head transformer surfaces.

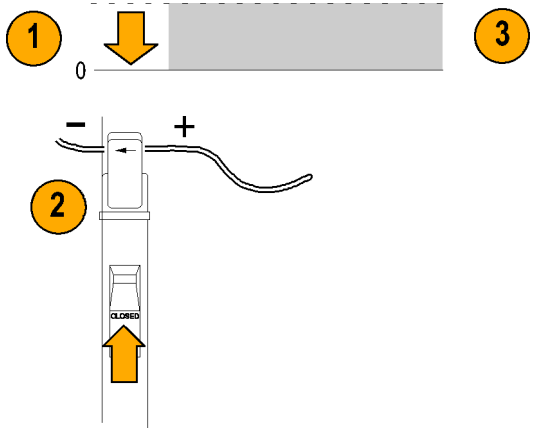
1. Check the oscilloscope display before connecting the probe to a conductor.

   If there is a DC offset, degauss the probe. (See page 3, *Degauss the Probe*.)

2. Close and lock the probe jaw over the conductor.

   For correct polarity reading, connect the probe so that the current flow, from positive to negative, is aligned with the arrow on the probe jaw.

3. Read the measurement on the oscilloscope display.



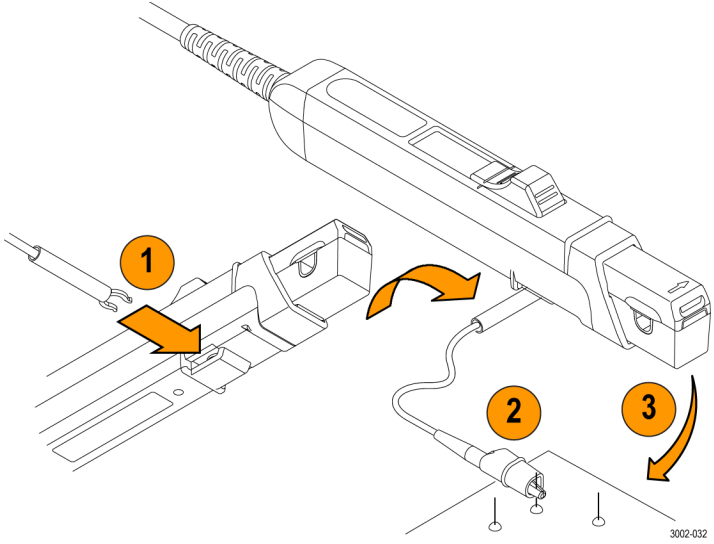
Grounding the Probe

The 6-inch ground lead grounds the shield around the probe transformer at the probe end of the cable. This allows you to move the ground connection closer to the circuit you are measuring, thereby improving high frequency response.

When you take high frequency measurements, connect the probe ground lead to the probe ground connector and attach the alligator clip directly to RF ground to improve EMI rejection.

In some cases, it may be helpful to move the ground lead or reposition the probe away from noise sources in the circuit under test.

1. Clip the ground lead to the ground post at the bottom of the probe head.
2. Connect the alligator end of the clip to the circuit ground.
3. Clamp the probe around the circuit conductor.



Application Examples

This section explains ways to use your probe in common troubleshooting tasks and how to extend the use of your measurement system.

Inductance Measurements

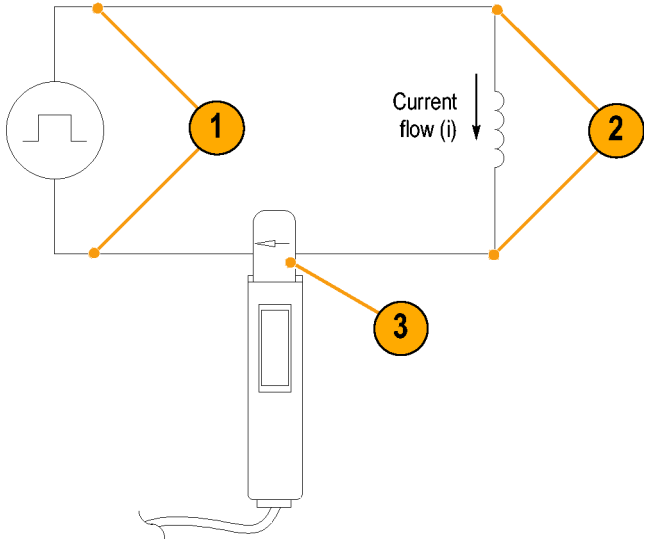
You can use the current probe to measure the inductance of coils that have either a low-impedance or high-impedance pulse source of a known value.

Low-Impedance Pulse Sources

This figure shows a constant-voltage pulse generator of extremely low output impedance connected to an inductor that has low resistance.

1. Connect the inductor across the output terminals of the pulse generator.
2. Maintain a constant voltage across the inductor.
3. Clamp the current probe over one of the source leads.

NOTE. *If the probe impedance is a significant part of the total circuit inductance, measurement accuracy will be affected. Refer to the probe specifications for probe insertion impedance.*



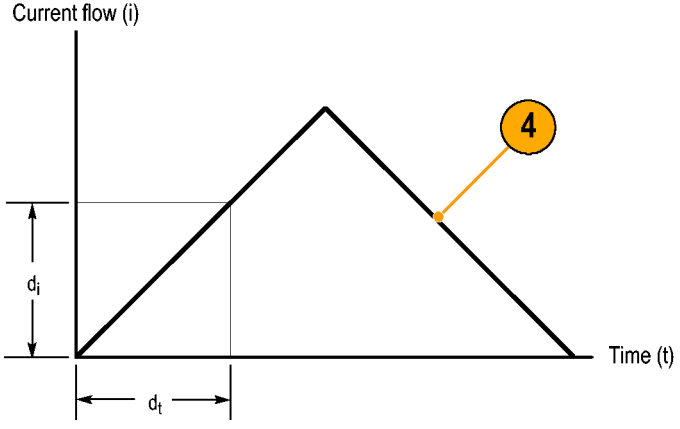
4. Measure the current ramp. The inductance is effectively defined by the slope of the current ramp shown here.

5. Calculate the inductance using the following formula:

$$L = \frac{-E}{\frac{di}{dt}}$$

where:

L is the inductance in henries,
E is the voltage of the pulse generator,
dt is the change in time, and
di is the change in current.



High-Impedance Pulse Sources

If the pulse source has a higher impedance of known resistance, such that the output voltage drops as the current increases, the inductance of a coil can be calculated by the time constant of the charge curve.

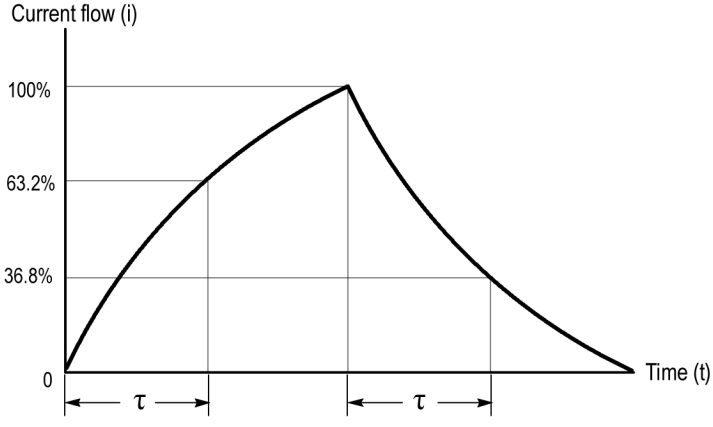
The current ramp shows how the values for the inductance formula are obtained.

Use this formula to calculate the inductance based on the current measurement:

$$L = \tau R$$

where:

L is the inductance in henries,
τ is the time required for the current to rise or fall 63.2% of the total current value, and
R is the source resistance of the pulse generator.



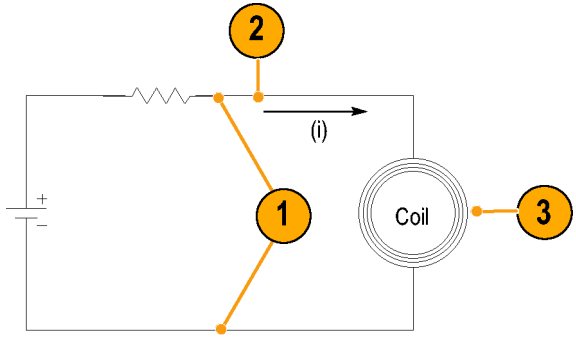
Measuring Inductor Turns Count

To obtain an approximate turns count of an inductor, do the following:

1. Connect the inductor to a current limited source, as shown.
2. Measure the input current on one of the inductor leads.
3. Clamp the current probe around the inductor and note the current value.

The number of turns is equal to the ratio of coil current to input current.

The accuracy of this method is limited by the current measurement accuracy.



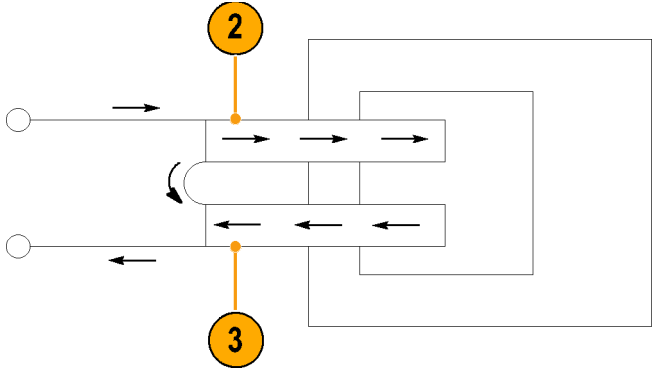
For a more precise turns count, you need a coil with a known number of turns to use as a reference. Do the following:

1. Repeat steps 1 and 2 above and make the following changes:
2. Insert the reference coil into the current probe.
3. Insert the test coil into the current probe so that the currents oppose each other as shown. You must observe the polarity of coil current to determine whether the test coil has less or more turns than the reference coil. The turns are calculated by using the formula:

$$N_2 = N_1 \times (I_m \div I_1)$$

where:

N_2 is the number of turns in the test coil,
N_1 is the number of turns in the reference coil,
I_m is the measured coil current, and
I_1 is the input current.



Probing Principles

The following information is provided to help you use the full potential of your current probe.

Degaussing a Probe with an Unpowered Conductor in the Jaws

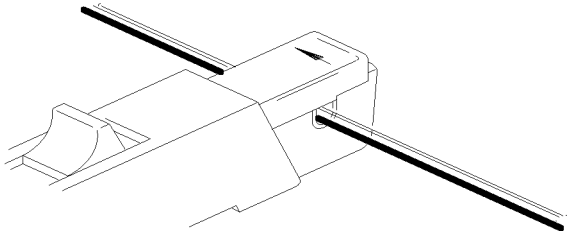
You can degauss your current probe while a conductor of an unpowered circuit is clamped in the jaws. The advantage of degaussing with an unpowered circuit is that any offset from stray DC magnetic fields is compensated. Degaussing with the conductor in the probe jaws eliminates the need to manually remove the probe.

NOTE. *Be certain that the conductor in the probe jaws is completely unpowered. Any current flowing through the conductor will cause a residual offset in the current probe and may cause an inaccurate measurement or an error condition.*

The impedance of your circuit must be higher than 10 mΩ for the degauss procedure to work. (The probe core will not saturate with a circuit impedance of less than 10 mΩ). While degauss occurs, the probe will induce approximately 50 mVp-p, into 50 Ω with a frequency of 190 Hz. Your circuit must be able to absorb this induced voltage. With low impedance circuits, several amperes may be induced in the circuit being measured. This may be of concern when you are using very small conductors.

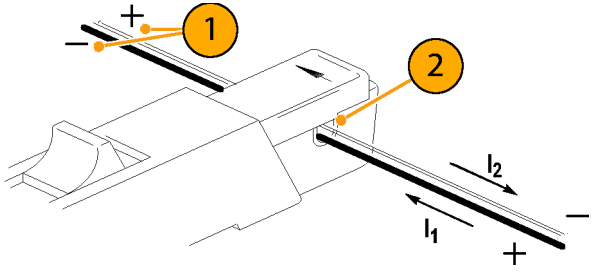
Measuring Differential Current

To simplify your differential or null current measurements, you can place two conductors in one current probe.



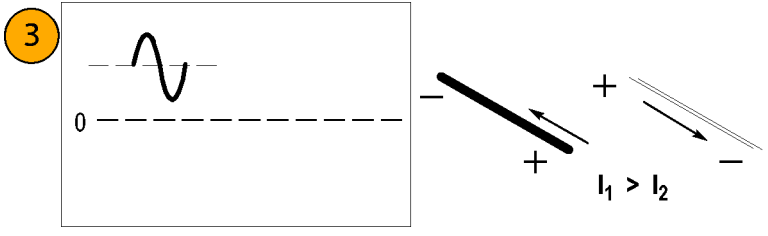
WARNING. *Do not force the slide closed. Damage to the probe may result. If you cannot close the slide around the conductor(s), either reduce the number of conductors you are measuring, or, if possible, take your measurement on a smaller conductor.*

1. Orient the two conductors under test so that the polarities (+ and –) oppose each other.
2. Clamp the current probe around the two conductors. Be careful not to pinch a conductor in the probe jaws.

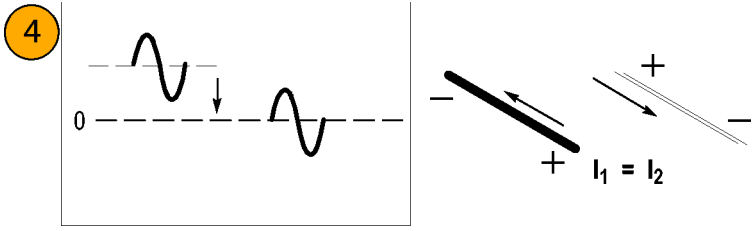


3. Measure the current.

   Conventional current flows from positive to negative. A waveform above the baseline indicates that the conductor with the conventional current flow in the direction of the probe arrow is carrying the greater current.



4. To adjust for a current null, adjust the current in one of the conductors until the displayed measurement is zero.



Extending Current Range

If your measurement exceeds the maximum current rating of the connected probe, you can extend the AC and DC current ranges without exceeding specified limits by using the following methods.

WARNING. *To avoid personal injury or equipment damage, do not exceed the specified electrical limits of the probe or any applicable accessories. When using multiple conductors, do not exceed current limits on either conductor.*

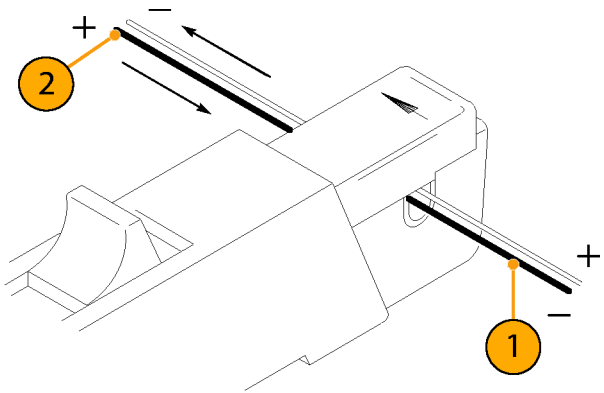
Extending DC Range

If you want to measure a low-amplitude AC component that is superimposed on an extremely large steady-state DC component (such as in a power supply), or if you want to extend the DC current range of your probe, you can add offset (bucking) current with a second conductor.

WARNING. *Do not put more than one uninsulated conductor at a time in the probe jaws. An uninsulated conductor is any conductor without insulation or without insulation rated for the voltage present on the conductor under test.*

To supply additional bucking current:

1. Place a second conductor that has a pure DC component of known value in the probe jaw with the conductor under test.
2. Orient the second conductor so that the bucking current flows in the opposite direction of the DC flow in the conductor under test.
3. To determine measurement values, add the value of the bucking current to the displayed measurement.



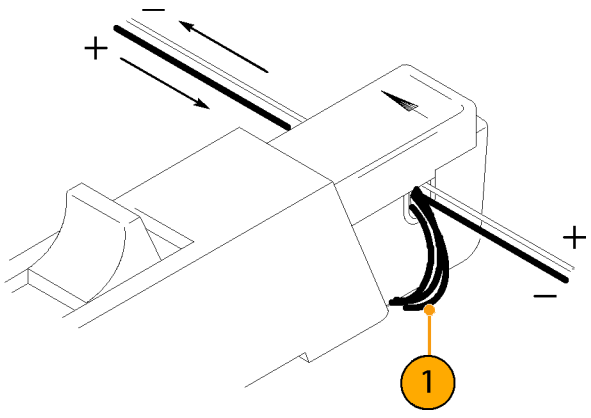
NOTE. *Adding a second conductor to the probe increases the insertion impedance and reduces the upper bandwidth limit of the probe. Winding multiple turns further increases the insertion impedance, further reducing the upper bandwidth limit.*

To increase the value of the bucking current:

1. Wind multiple turns of the second conductor around the probe.

   The bucking current is equal to the current flowing in the conductor, multiplied by the number of turns wound around the probe.

For example, if the second conductor has a current of 100 mA DC and is wrapped around the probe five times, the DC bucking current is 100 mA multiplied by 5, or 500 mA DC.

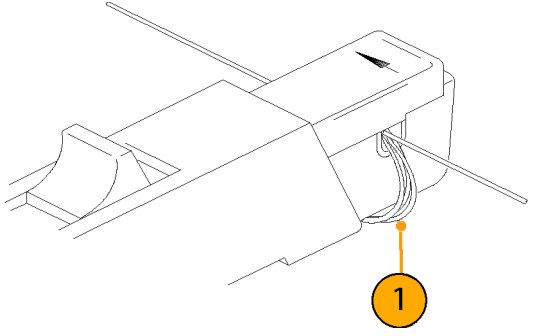


Increasing Sensitivity

If you are measuring DC or low-frequency AC signals of very small amplitudes, you can increase measurement sensitivity of your current probe by doing the following:

1. Wind several turns of the conductor under test around the probe as shown. The signal is multiplied by the number of turns around the probe.
2. To obtain the actual current value, divide the displayed amplitude by the number of turns.

For example, if a conductor is wrapped around the probe three times and the oscilloscope shows a reading of 3 mA DC, the actual current flow is 3 mA divided by 3, or 1 mA DC.

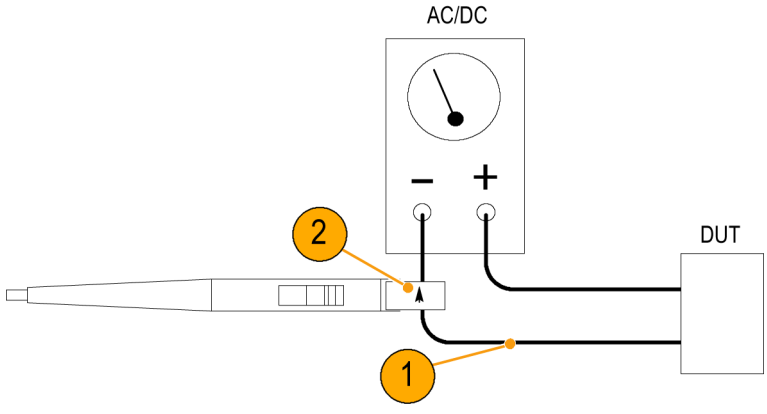


NOTE. *Winding more turns around the probe increases the insertion impedance and reduces the upper bandwidth limit of the probe.*

Common Mode Noise/Magnetic Field Errors

Common-mode noise at high frequencies and strong magnetic fields on the supply side of your circuit can cause measurement errors. To avoid this:

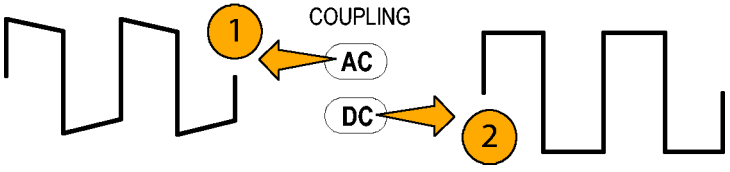
1. Measure on the low or ground side of your circuit.
2. Orient the probe to measure conventional current flow.



AC and DC Coupling

You can couple the signal input to the oscilloscope with either DC or AC coupling. DC coupling shows both the DC and AC measurement components. AC coupling removes the DC component from the displayed signal.

1. This low-frequency square wave is displayed using AC coupling. The signal exhibits low-frequency rolloff.
2. Press the DC Coupling button to display the waveform as truly square.

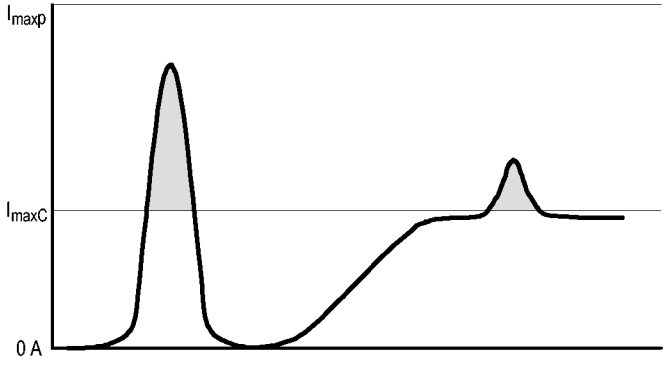


CAUTION. *When you use AC coupling, make sure that the input DC current does not exceed the probe specifications.*

Maximum Current Limits

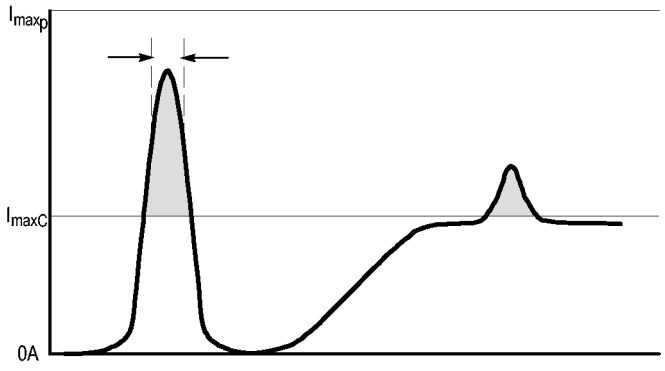
Current probes have three maximum current ratings: pulsed, continuous, and Ampere-second product. Exceeding any of these ratings can saturate the probe core, which magnetizes the core and causes measurement errors. Refer to the specifications for the maximum current ratings of the probe. (See Table 2 on page 46.)

- Maximum Pulsed Current (I_{maxP}) is the maximum peak value of pulsed current the probe can accurately measure, regardless of how short (within bandwidth limitations) the pulse duration is.
- Maximum Continuous Current (I_{maxC}) is the maximum current that can be continuously measured at DC or at a specified AC frequency. The maximum continuous current value is derated with frequency; as the frequency increases, the maximum continuous current rating decreases.



- Ampere-Second Product is the maximum width of pulsed current that you can measure when the pulse amplitude is between the maximum continuous and maximum pulsed current specifications. The maximum continuous specification varies by frequency.

To determine if your measurement exceeds the Ampere-second product, you must first determine the maximum allowable pulse width or maximum allowable pulse amplitude, as described in the following section.



NOTE. *Always degauss the probe after measuring a current that exceeds the maximum continuous current, maximum pulsed current, or Ampere-second product rating of the probe. Exceeding these ratings can magnetize the probe and cause measurement errors.*

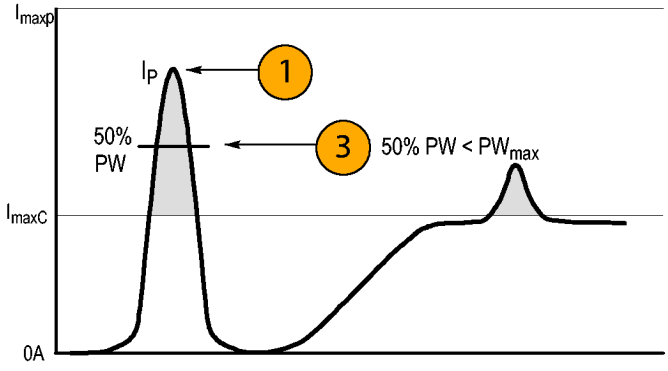
Maximum Allowable Pulse Width

To determine the maximum allowable pulse width do the following:

1. Measure the peak current of the pulse.
2. Divide the Ampere-second (or Ampere-microsecond) specification for the range setting of the TCP0030A probe by the measured peak current of the pulse:

   $$\frac{A \cdot \mu s}{I_P} = PW_{max}$$

   The quotient is the maximum allowable pulse width (PW_{max}).
3. Check that the pulse width at the 50% point of the measured signal is less than the calculated maximum allowable pulse width (PW_{max}).



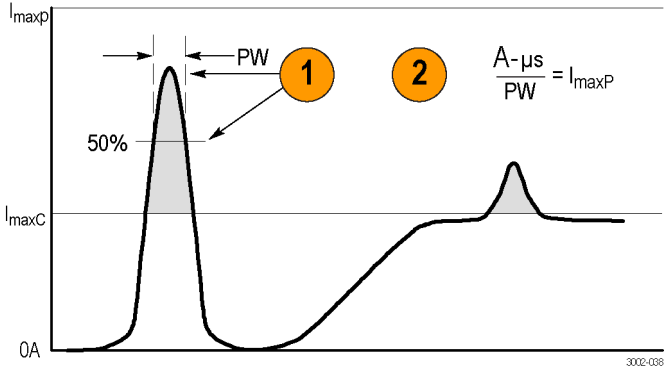
Maximum Allowable Pulse Amplitude

To determine the maximum allowable pulse amplitude do the following:

1. Measure the pulse width at the 50% points.
2. Divide the Ampere-second (or Ampere-microsecond) specification for the range setting of the TCP0030A probe by the pulse width.

   The quotient is the maximum allowable pulse amplitude; the peak amplitude of the measured pulse must be less than this value.

For example, the TCP0030A probe has a maximum Ampere-second product of 500 A-µs in the 30 A range setting. If a pulse measured with the probe has a width of 11 µs, the maximum allowable peak current would be 500 A-µs divided by 11 µs, or 45.5 A.



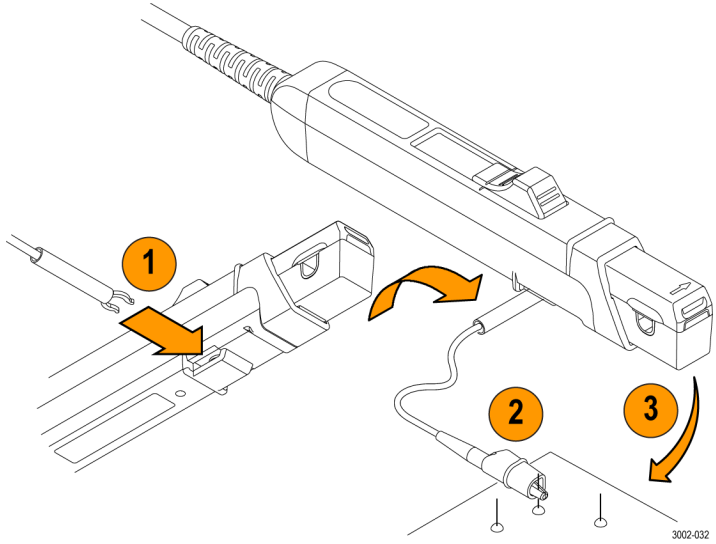
Accessories and Options

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.

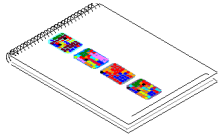
Probe Ground Lead

1. Fasten the small clip to the ground stub on the probe body.
2. Clip the alligator clip to your circuit.
3. Attach the probe to your circuit.

Reorder Tektronix part number 196-3521-xx, qty. 1.



Instruction Manual



The instruction manual provides operating and maintenance instructions.

Reorder Tektronix part number: 071-3006-xx

Manuals in the languages listed below are available for this product. Other languages may also be available; check the Tektronix Web site at www.tektronix.com/manuals.

- Japanese
- Simplified Chinese

Optional Accessories

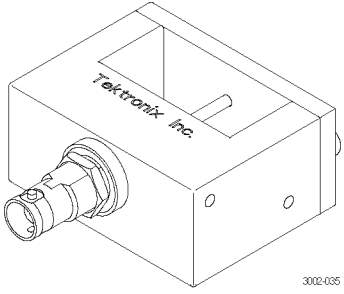
This section lists the optional accessories that are available for the probe.

Current Loop

Use the 1-turn, 50 Ω current loop for the performance verification procedures. The BNC connector allows for easy connections to current sources.

To use the current loop, follow the procedure for the specific task that you are performing.

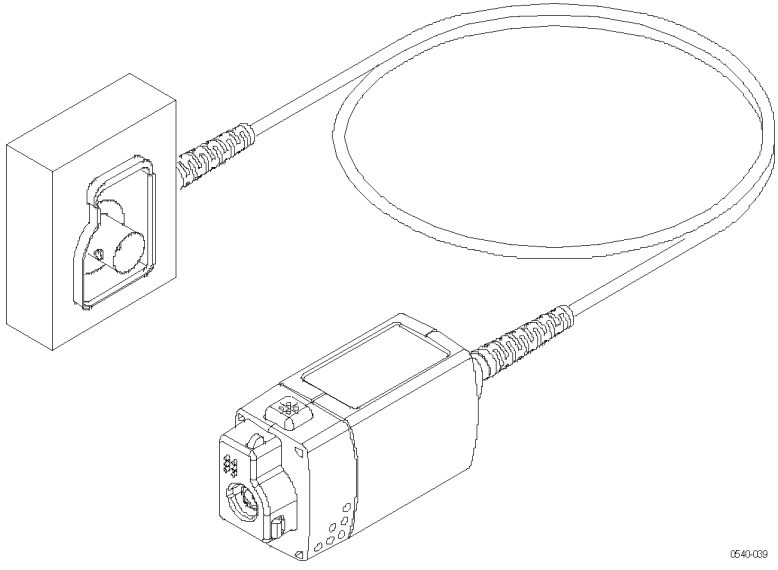
Order Tektronix part number: 067-2396-xx



TekVPI Calibration Fixture

This calibration fixture is required to complete a performance verification and gain accuracy adjustment procedures on the probe. It provides power to the probe and routes the probe output signal out through an SMA connector on the back of the fixture. The signal can then be measured with another instrument, such as a precision DMM, to check and adjust the gain accuracy of the probe.

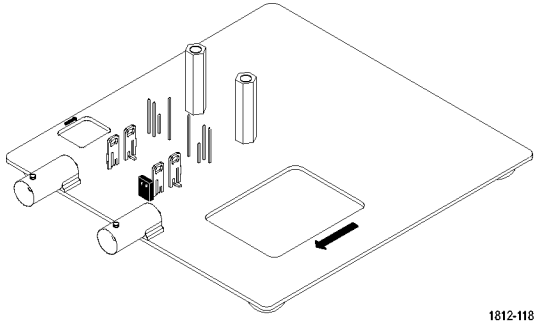
Order Tektronix part number 067-1701-xx.



Deskew/Calibration Fixture

Connect this fixture to host instruments that support the probe calibration or deskew procedures. The deskew procedures compensate for gain errors and timing differences between current and voltage probes. Refer to your oscilloscope manual or fixture documentation for instructions.

Reorder Tektronix part number: 067-1686-xx



1812-118

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

Specifications

The specifications in the tables in this section are valid under the following conditions:

- The probe has been calibrated at an ambient temperature of 23 °C ±5 °C.
- The probe is connected to a host instrument with an input impedance of 1 MΩ.
- The probe 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).

Specifications for the TCP0030A current probe 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.

Table 1: Warranted electrical characteristics

Characteristic	Description
✓ DC gain accuracy	<3% (typical <1% at +23 °C, ±5 °C)
✓ Rise time (10% to 90%)	≤3.05 ns
Bandwidth	DC to 120 MHz

Typical Characteristics

Typical characteristics describe typical but not guaranteed performance.

Table 2: Typical electrical characteristics

Characteristic	Description
Maximum continuous current – DC and low frequency	5 A Range: 5 A RMS 30 A Range: 30 A RMS (42.4 A peak) (See Figure 3 on page 49.)
Maximum peak current	50 A maximum peak pulse (See Figure 3 on page 49.)
Displayed RMS noise	≤75 µA RMS. (Limit measurement bandwidth to 20 MHz)
Insertion impedance	(See Figure 2 on page 48.)
Signal delay	~14.5 ns
Maximum voltage on bare wire	150 V CAT II
Maximum Amp·Second product	5 A range: 50 A·µs 30 A range: 500 A·µs

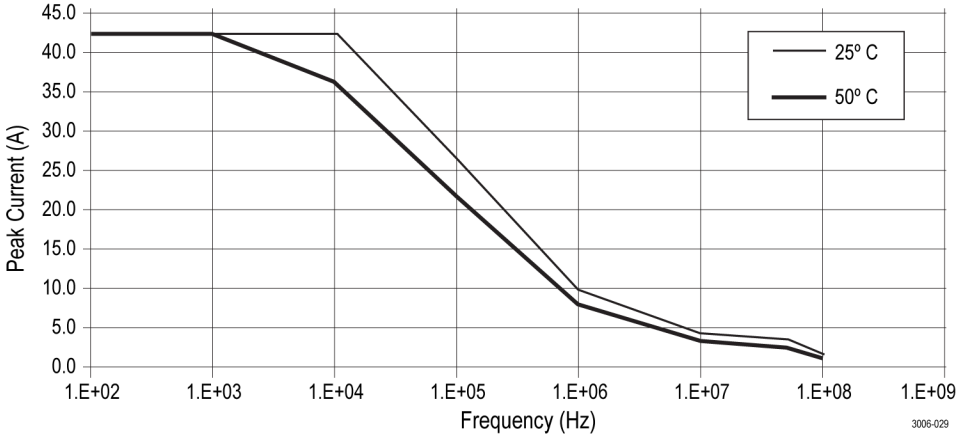


Figure 1: Frequency derating (peak current versus frequency)

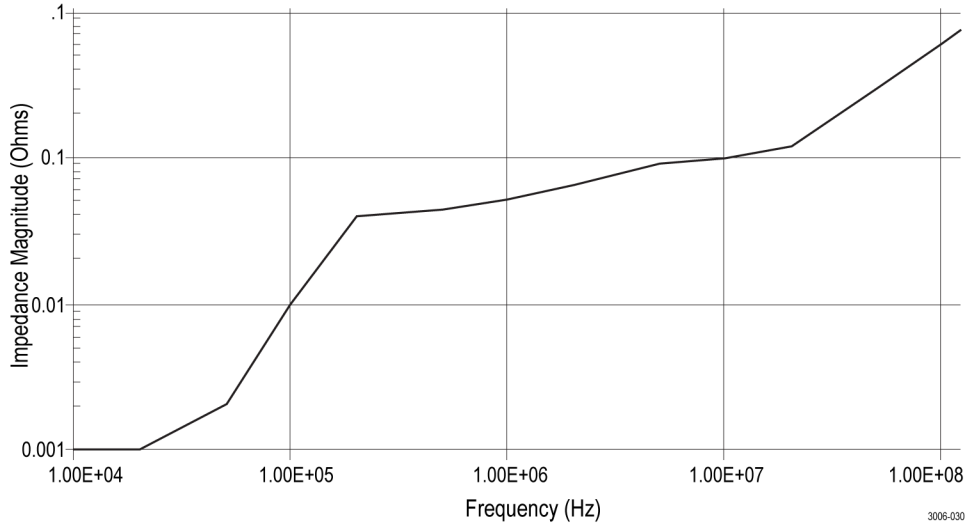


Figure 2: Typical input impedance versus frequency

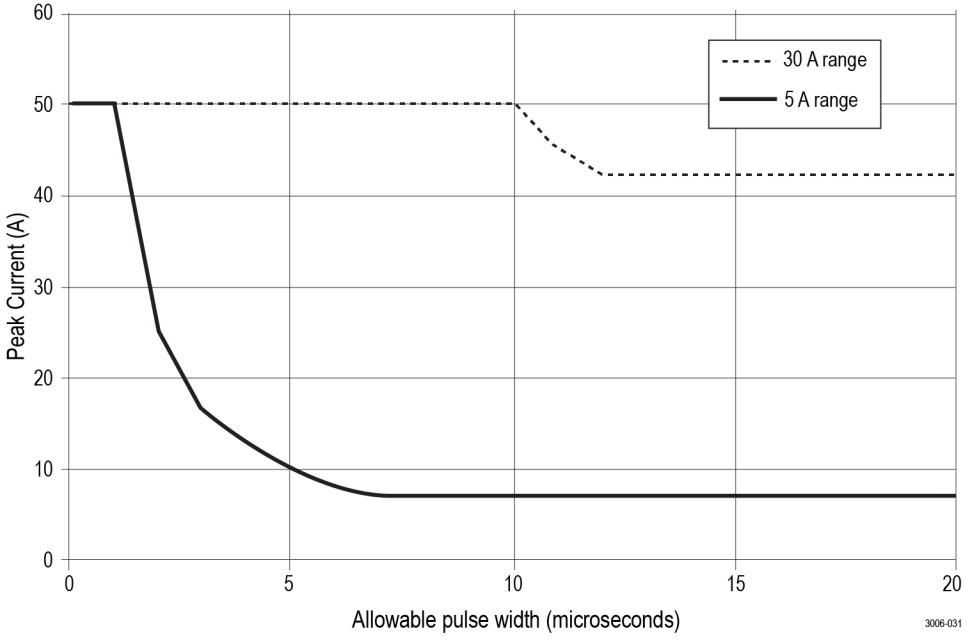


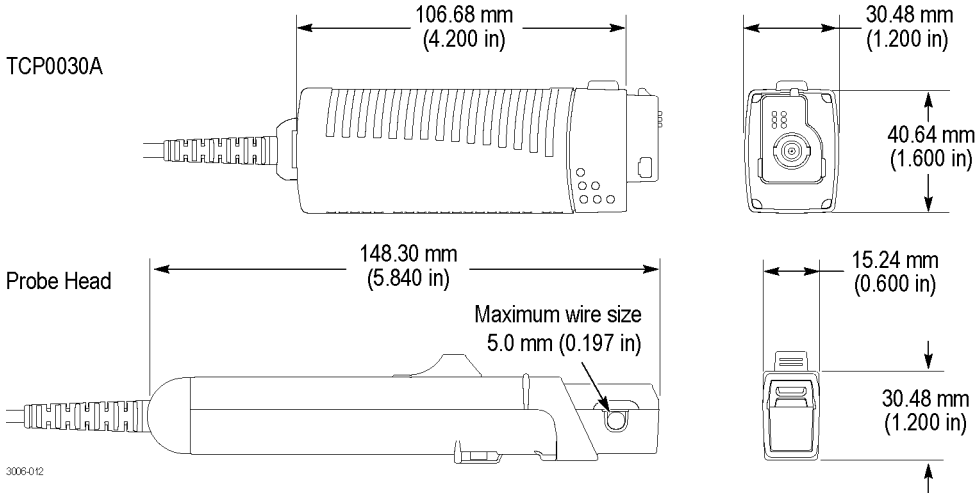
Figure 3: Maximum peak pulse versus pulse width

Table 3: Environmental characteristics

Characteristic	Description
Temperature	Operating: 0 to +50 °C (+32 to +122 °F) Nonoperating: -40 to +75 °C (-40 to +167 °F)
Humidity	Operating: 5-95% RH, tested up to +30 °C (+86 °F) 5-85% RH, tested at +30 °C to +50 °C (+86 °F 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 °F to +167 °F)
Altitude	Operating: Up to 3000 meters (10,000 feet) Nonoperating: Up to 12,192 meters (40,000 feet)

Table 4: Typical mechanical characteristics

Characteristic	Description
Dimensions, compensation box	107 mm × 30.5 mm × 41 mm (4.2 in × 1.2 in × 1.6 in)
Dimensions, probe head	148.3 mm × 15.2 mm × 30.5 mm (5.8 in × 0.6 in × 1.2 in)
Dimensions, cable length	2 m (79 in) (from the probe head to the compensation box)
Unit weight	700 g (1.5 lbs) (probe, accessories, and packaging)


TCP0030A
106.68 mm
(4.200 in)
30.48 mm
(1.200 in)
40.64 mm
(1.600 in)
Probe Head
148.30 mm
(5.840 in)
Maximum wire size
5.0 mm (0.197 in)
15.24 mm
(0.600 in)
30.48 mm
(1.200 in)
3006-012

Nominal Characteristics

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

Table 5: Nominal electrical characteristics

Characteristic	Description
Input coupling	DC
Current ranges	5 A and 30 A
Termination	Terminate output into 1 MΩ
Compatibility	Oscilloscopes equipped with the TekVPI interface

Performance Verification

The procedures that follow verify the warranted specifications of the probe, listed below. The recommended calibration interval is one year.

- DC gain accuracy
- Rise time
- Bandwidth

Perform the following verification procedures in the order listed.

Equipment Required

The equipment required for the performance verification procedure is listed below. (See Table 6.)

Table 6: Test equipment

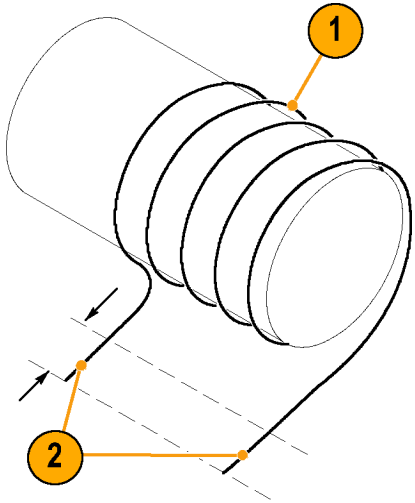
Description and quantity	Performance requirement	Recommended example [1]
Oscilloscope	TekVPI interface, 500 MHz or greater bandwidth	Tektronix DPO4000
High amplitude pulse generator	Risetime <500 ps, pulse width >100 ns, amplitude >10 Vpp into 50 Ω	Picosecond Labs 2600C
Calibrator	DCV: 0.2% accuracy, 0 to ±1.5 V, square wave output ACA: 0.25% accuracy, 0 to ±6 A, square wave output	Fluke 9100
DMM	≥2 volt range, ≥1% accuracy	Keithley 2700
TekVPI Calibration/Verification adapter	TekVPI interface	067-1701-xx (See page 42.)
DC current loop	5 turns 18 AWG coated wire on 3 inch form	See instructions that follow
HF current loop	50 Ω ±0.5%, BNC male	067-2396-xx
Adapter	BNC-to-dual banana	103-0090-xx
Adapter	SMA male-to-BNC female	015-1018-xx
BNC cable	50 Ω, 0.76 m (30 in) length	012-0117-xx
Test leads (2)	Banana plug to clip leads	Keithley 1681

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

Making the DC Current Loop

Construct the loop using #18 coated wire and a cylindrical form approximately 3 inches in diameter:

1. Wind *exactly* 5 turns of #18 coated wire around the form.
2. Scrape about a half-inch of coating off of the ends of the wire.

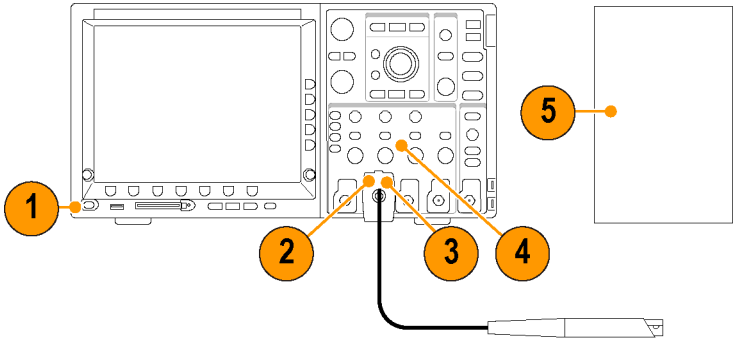


NOTE. *Ensure that the current loop has exactly 5 turns. A significant error will result for each turn variance from 5 turns.*

Equipment Setup

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

1. Turn on the oscilloscope.
2. Connect the probe to any channel (1–4) of the oscilloscope.
3. Close the probe slider and then press the Degauss/AutoZero button.
4. Set the oscilloscope coupling to DC.
5. Power on the current source and the pulse generator.
6. Allow 20 minutes for the equipment to warm up.
7. Photocopy the test record and use it to record the test results. (See page 63.)

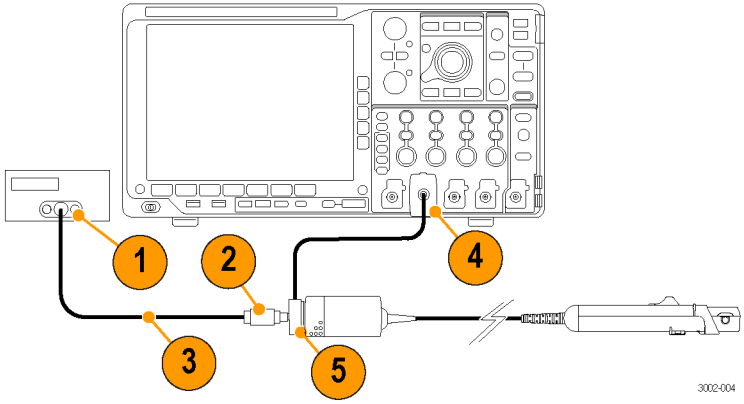


DC Gain Accuracy

This test checks the DC gain accuracy of the probe. If the measurements are out of the specified limits in the test record, refer to the *Adjustments* section. (See page 64.)

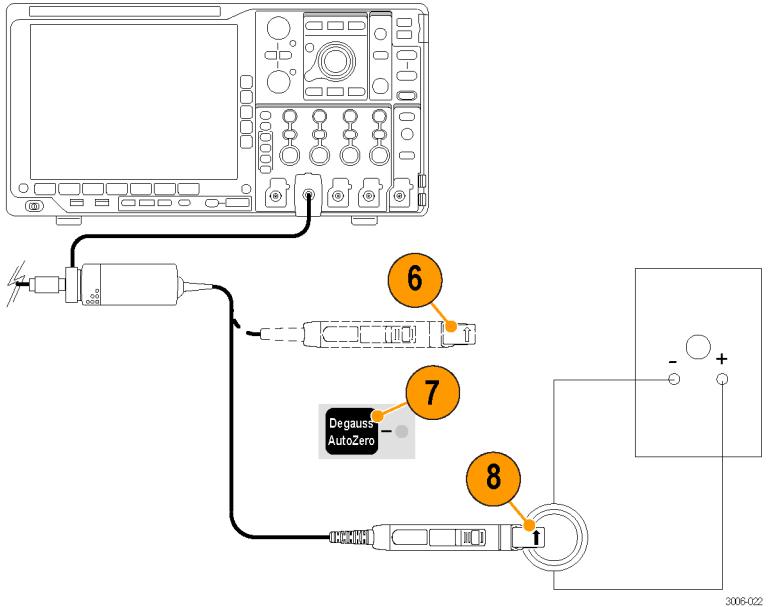
1. Connect a BNC-to-Dual Banana adapter to the digital multimeter (DMM) input.
2. Connect the SMA M-to-BNC F adapter to the SMA output of the TekVPI Calibration/Verification adapter.
3. Connect the BNC cable between the BNC adapter on the TekVPI Calibration/Verification adapter and the BNC adapter attached to the DMM.
4. Connect the TekVPI Calibration/Verification adapter to any channel (1–4) of the oscilloscope.
5. Connect the probe to the TekVPI Calibration/Verification adapter.

NOTE. *The adapter is only used to supply power to the probe; measurements are taken on the DMM.*



6. Do not clamp the current probe around any conductor, but make sure the jaw is in the locked position.
7. Degauss the probe by pressing the Degauss/AutoZero button.
8. Connect the 5-turn current loop to the current source, and then clamp the current probe around the current loop as shown.

   The arrow indicator on the probe should point away from the (+) terminal of the current source.



5 A Range Test

9. Set the current source output to +0.50 A DC.

10. Set the DMM to measure DC volts, on ≥2 volt range (or use Autoset).

11. Set the probe to the 5 A range.

12. Enable the output of the current source.

13. Record the exact measurement of the DMM as M1.

14. Set the current source output to -0.50 A.

15. Record the exact measurement of the DMM as M2.

16. Compute the % Error using the measured amplitude values and the formula shown.

Test current = ±2.500 A (±0.50 A source output x 5 coil turns)

Expected output voltage (Ve) = 2.50 V

$$\%Error = \frac{[\,(M1 - M2) - 2\,Ve]}{2\,Ve} \times 100$$

Example:

$$\frac{[(2.50\,V - (-2.55\,V)) - 2\,(2.50\,V)]}{5.0\,V} \times 100 = 1.0\%$$

30 A Range Test

17. Set the current source output to +3.00 A.

18. Set the probe to the 30 A range.

19. Record the exact measurement of the DMM as M1.

20. Set the current source output to -3.00 A.

21. Record the exact measurement of the DMM as M2.

22. Compute the % Error using the measured amplitude values and the formula shown.

23. Record the computed %Error values in the Test Record.

24. Disable the calibrator output.

Test current = ±15.00 A (±3.00 A source output x 5 coil turns)

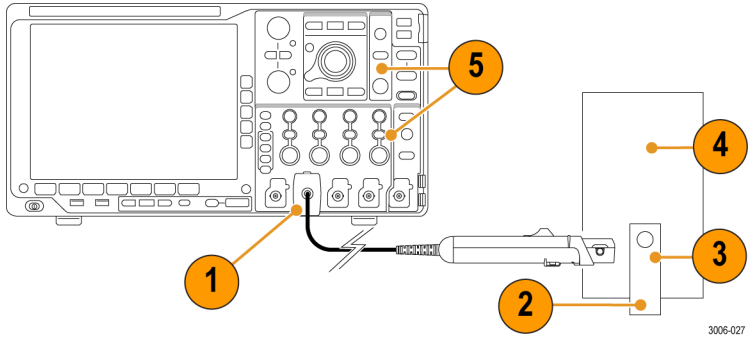
Expected output voltage (Ve) = 1.50 V

$$\%Error = \frac{[(M1 - M2) - 2Ve]}{2Ve} \times 100$$

Rise Time and Bandwidth

This procedure verifies that the probe meets the rise time specification on both of the current ranges. The bandwidth of the probe is then calculated using the measured probe rise time.

1. Connect the probe to any channel (1–4).
2. Connect the BNC cable to the output of the pulse generator, using a BNC-to-SMA adapter if necessary.
3. Connect the other end of the BNC cable to the HF current loop.
4. Set the pulse generator output and pulse width to maximum (0 dB, 100 ns duration).
5. Set the oscilloscope:
   - Vertical sensitivity to 200 mA/div
   - Horizontal to 2 ns/div
   - Trigger at 50%
   - Averaging on (32)
   - Coupling to DC
   - To measure Rise Time

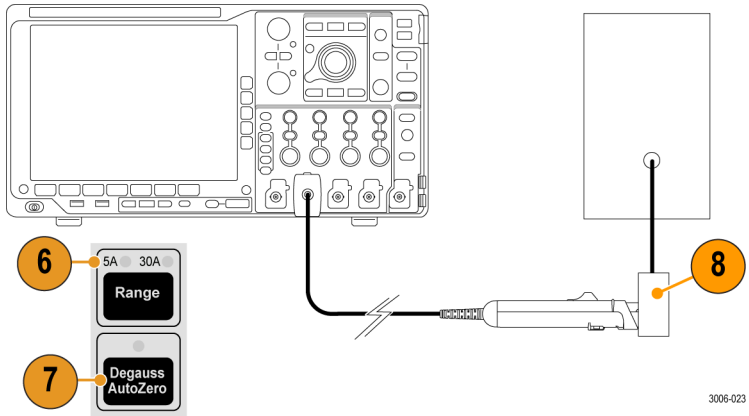


6. Set the probe range to the 5 A setting.
7. Degauss the probe.
8. Clamp the current probe around the HF current loop. Verify that the arrow-shaped indicator on the probe points away from the pulse generator.
9. Record the rise time measurement in the Test Record.

NOTE. If the measured rise time is out of tolerance, you may be able to readjust it. (See page 64, Adjustments.)

10. Calculate the probe bandwidth using the measured rise time in the following formula:
11. Record the calculated bandwidth value in the test record.
12. Set the probe range to the 30 A setting and set the vertical sensitivity to 200 mA/div.
13. Remove the probe from the current loop and then repeat steps 7 through 11.

End of procedures.



$$BW = \frac{0.37}{t_r}$$

Test Record

Probe Model/Serial Number: Certificate Number:

Temperature: RH %:

Date of Calibration: Technician:

Performance test	Range	Test Current	Expected output	Minimum	Incoming	Outgoing	Maximum
DC Gain Accuracy	5 A	±2.5 A	±2.50 V	-3%			+3%
	30 A	±15 A	±1.50 V	-3%			+3%
Rise time	5 A	~1 A	≤3.05 ns	NA			3.05 ns
	30 A	~1 A	≤3.05 ns	NA			3.05 ns
Bandwidth	5 A	NA	>120 MHz	120 MHz			NA
	30 A	NA	>120 MHz	120 MHz			NA

Adjustments

The procedures that follow describe adjustments to the probe to bring the performance within the warranted specifications.

- DC gain accuracy
- Rise time/aberrations

Equipment Required

Refer to the *Performance Verification* procedure for the equipment required. You also need an insulated, flat-bladed adjustment tool. The tool is available from Tektronix; order part number 003-1433-00.

Equipment Setup

Refer to the *Performance Verification* procedure for the equipment setup.



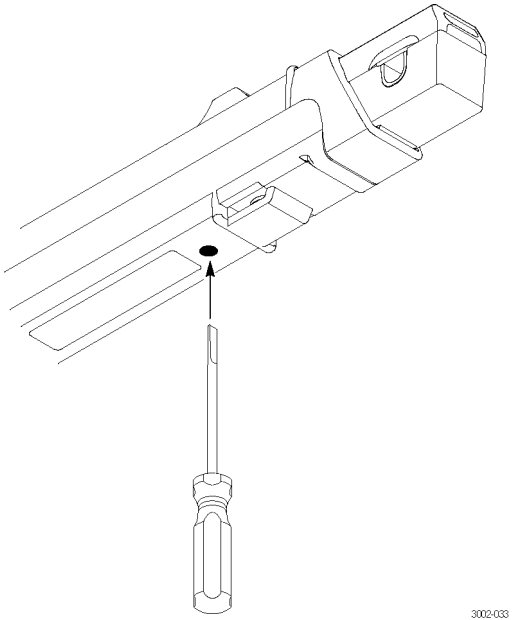
CAUTION. *To avoid ESD damage to the probe, use an antistatic wrist strap and work at a static-approved workstation when handling the probe*

DC Gain Accuracy

This procedure describes the DC gain accuracy adjustments for the probe. You must first adjust the 5 A range, and then adjust 30 A range, in that order.

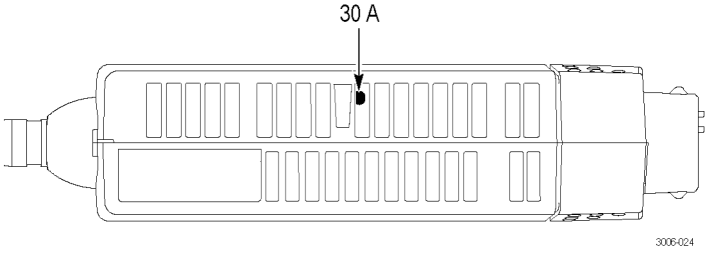
Adjust the 5 A Range

1. Complete the *DC Gain Accuracy* test in the *Performance Verification* procedure. (See page 57, *DC Gain Accuracy*.) If the measurements fall outside the test limits, proceed to the next step.
2. Set the calibrator output to 0.5 A.
3. Adjust the 5 A DC gain control in the probe head to display 2.50 V, ±0.075 V on the DMM.



Adjust the 30 A Range

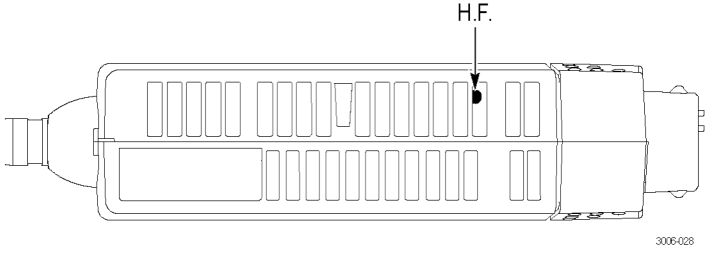
4. Set the probe range to 30 A.
5. Set the calibrator output to 3.0 A.
6. Adjust the 30 A DC gain control in the probe compensation box to display 1.50 V, ±0.045 V on the DMM.
7. Disconnect the probe from the current source.



High Frequency Response

Use this procedure to bring the rise time of the probe to within the warranted specifications. This adjustment also affects the aberrations on the probe output waveform, so for each current range, you may need to optimize the final adjustment between the two characteristics.

1. Complete the *Rise Time and Bandwidth* test in the *Performance Verification* procedure. If the measurements fall outside the test limits, proceed to the next step.
2. Set the Range to 5 A.
3. Adjust the H.F. control to optimize the rise time and aberrations.
4. Set the Range to 30 A and repeat step 3.
5. Check that the probe response is optimized for both ranges.



Maintenance

This section contains maintenance information for your probe.

Troubleshooting

The TCP0030A current probe is designed to work with all TekVPI-interface oscilloscopes and adapters. The LEDs on the probe alert you to error or status conditions affecting the probe. If the probe LEDs do not light as expected, or if some of the probe features do not work properly, an error condition may exist. See the following table.

Table 7: Probe troubleshooting

Symptom	Possible cause
LEDs on the probe flash or remain on:	
Jaw Open	Continuous red: The conductor jaw is unlocked. Move the slider forward to lock the jaw closed.
Overload	Flashing: An intermittent, repetitive overload is present on the probe. Remove the probe from the current source. (See page 29, *Extending Current Range*.)
	Continuous red: The measured current exceeds the limit of the probe. Remove the probe from the current source. (See page 29, *Extending Current Range*.)
Degauss/AutoZero	Flashing red: The probe requires degaussing. Degauss the probe.
	Flashing red/green: The probe is performing the degauss routine.
	Continuous green: The probe is degaussed and ready for use.

Table 7: Probe troubleshooting (cont.)

Symptom	Possible cause
LEDs on the probe do not light	The oscilloscope channel may be bad: Try another channel or another oscilloscope. All LEDs should light briefly and then the Degauss/AutoZero LED should flash. If the probe functions correctly on another channel or oscilloscope, the contacts on the input channel that exhibits the problem may need to be cleaned. Refer to your oscilloscope manual for the proper cleaning procedure. If the probe does not work on another channel or oscilloscope, the probe is defective, and must be returned to Tektronix for repair.
An error message displays on the oscilloscope	The message will describe the cause and solution. For example, if the *Probe degauss needed* message appears, perform the degauss procedure.

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 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 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.

Index

A

AC coupling, 34
Accessories
    optional, 41
    standard, 39
Adjustments, 64
Amp-second product, 36

B

Bucking current, 29
Button
    menu, 13

C

Cleaning, 70
Common mode noise, 33
Connect the probe, 2
Coupling modes, 34
Current limitations
    amp-second product, 36
    maximum continuous, 35
    maximum pulsed, 35
Current loop, 55

D

Damage
    ESD, 2
DC
    coupling, 34
    gain accuracy adjustment, 65
    gain accuracy check, 57
Degaussing, 3
    while connected to a conductor, 26
Deskew
    menu, 16
Differential current, 27
Documentation, xiv

E

Equipment required
    performance verification, 54
Equipment setup, 56
ESD damage, 2
Extending the current range of the probes, 29

F

Features, 1
Fine Scale
    menu, 14
Frequency derating, 35

G

Grounding the probe, 19

I

Increasing bucking current, 29
Increasing probe sensitivity, 32
Indicators, 8

J

Jaw, 5
Jaw damage, 17

L

LEDs, flashing, 68

M

Magnetic field errors, 33
Maintenance, 68
Maximum
    allowable pulse amplitude, 38
    allowable pulse width, 37
    continuous current rating, 35
    pulsed current rating, 35
Measuring current
    current nulls, 27
    differential current, 27
Menu button, 13
Menu-driven probe functions, 14

N

Null current, 27

O

Offset
    menu, 14
Options, 44

P

Performance verification, 53
Position
    menu, 14
Probe
    controls and indicators, 8
    coupling, 34
    extending the current range, 29
    increasing the current limit, 29
    maximum current limits, 35
    saturation, 35
    setup menu, 15

R

Record, test, 63
Related documentation, xiv
Rise time check, 61

S

Safety Summary, v
Service options, 44
Slider and conductor jaw, 5
Specifications, 45
    nominal, 52
    typical, 46
    warranted, 45

T

TekVPI, 2
Test record, 63
Troubleshooting, 68