



**TCPA300/400 Amplifiers and
TCP303/305A/312A/404XL Current Probes
Compliance and Safety Instructions**

www.tek.com



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

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Important safety information

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

To safely perform service on this product, additional information is provided at the end of this section. (See page 4, *Service safety summary*.)

General safety summary

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

TCPA300/400 only: This product shall be used in accordance with local and national codes.

For correct and safe operation of the product, it is essential that you follow generally accepted safety procedures in addition to the safety precautions specified in this manual.

The product is designed to be used by trained personnel only.

Only qualified personnel who are aware of the hazards involved should remove the cover for repair, maintenance, or adjustment.

Before use, always check the product with a known source to be sure it is operating correctly.

This product is not intended for detection of hazardous voltages.

Use personal protective equipment to prevent shock and arc blast injury where hazardous live conductors are exposed.

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.

When incorporating this equipment into a system, the safety of that system is the responsibility of the assembler of the system.

To avoid fire or personal injury

Use proper power cord. TCPA300/400 only: Use only the power cord specified for this product and certified for the country of use.

Do not use the provided power cord for other products.

Ground the product. TCPA300/400 only: This product is grounded through the grounding conductor of the 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, make sure that the product is properly grounded.

Power disconnect. TCPA300/400 only: The power cord disconnects the product from the power source. See instructions for the location. Do not position the equipment so that it is difficult to operate the power cord; it must remain accessible to the user at all times to allow for quick disconnection if needed.

Connect and disconnect properly. TCPA300/400 only: Do not connect or disconnect probes or test leads while they are connected to the circuit.

Use only current probes, test leads, and adapters supplied with the product, or indicated by Tektronix to be suitable for the product.

Observe all terminal ratings. TCPA300/400 only: To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

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

Do not operate without covers. Do not operate this product with covers or panels removed, or with the case open. Hazardous voltage exposure is possible.

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

Do not operate with suspected failures. TCPA300/400 only: If you suspect that there is damage to this product, have it inspected by qualified service personnel.

Disable the product if it is damaged. Do not use the product if it is damaged or operates incorrectly. If in doubt about safety of the product, turn it off and disconnect the power cord. Clearly mark the product to prevent its further operation.

Before use, inspect current probes, test leads, and accessories for mechanical damage and replace when damaged. Do not use probes or test leads if they are damaged, if there is exposed metal, or if a wear indicator shows.

Examine the exterior of the product before you use it. Look for cracks or missing pieces.

Use only specified replacement parts.

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

Do not operate in an explosive atmosphere.

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

Provide proper ventilation. TCPA300/400 only: Refer to the installation instructions in the manual for details on installing the product so it has proper ventilation.

Slots and openings are provided for ventilation and should never be covered or otherwise obstructed. Do not push objects into any of the openings.

Probes and test leads

Before connecting probes or test leads to the TCPA300/400, connect the power cord from the power connector to a properly grounded power outlet.

Keep fingers behind the protective barrier, protective finger guard, or tactile indicator on the probes.

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

Use only correct Measurement Category (CAT), voltage, temperature, altitude, and amperage rated probes, test leads, and adapters for any measurement.

Beware of high voltages. Understand the voltage and current ratings for the probe you are using and do not exceed those ratings.

The voltage rating for the TCPA300/400 depends on the probe and your application. Refer to the Specifications section of the manual for more information.

Connect and disconnect properly. TCP303/305A/312A/404XL only: Connect the probe output to the measurement product 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 product.

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

TCPA300/400 only: Connect the probe reference lead to earth ground only.

Do not connect a current probe to any wire that carries voltages or frequencies above the current probe voltage rating.

Inspect the probe and accessories. Before each use, inspect probe and accessories for damage (cuts, tears, or defects in the probe body, accessories, or cable jacket). Disable and do not use the current probe if it is damaged. Do not use the product if it is damaged or operates incorrectly.

Examine the exterior of the current probe before you use it. Look for cracks or missing pieces.

Use only specified replacement parts.

Service safety summary

The *Service safety summary* section contains additional information required to safely perform service on the product. Only qualified personnel should perform service procedures. Read this *Service safety summary* and the *General safety summary* before performing any service procedures.

To avoid electric shock. Do not touch exposed connections.

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 product power and disconnect the power cord from the mains power before removing any covers or panels, or opening the case for servicing.

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.

Verify safety after repair. Always recheck ground continuity and mains dielectric strength after performing a repair.

Terms in this manual

These terms may appear in this manual:



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



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

Symbols and terms on the product

These terms may appear on the product:

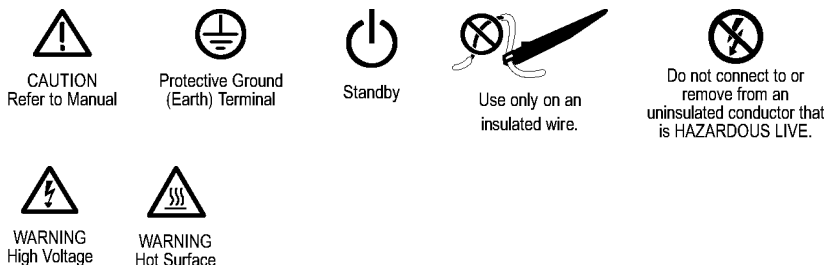
- DANGER indicates an injury hazard immediately accessible as you read the marking.
- WARNING indicates an injury hazard not immediately accessible as you read the marking.
- CAUTION indicates a hazard to property including the product.



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

Amplifiers

The following symbol(s) may appear on the TCPA300/400 amplifiers:



Probes

The following symbol(s) may appear on the TCP303/305A/312A/404XL current probes:



Compliance information

This section lists the EMC (electromagnetic compliance), safety, and environmental standards with which the instrument complies. This product is intended for use by professionals and trained personnel only; it is not designed for use in households or by children.

Questions about the following compliance information may be directed to the following address:

Tektronix, Inc.
PO Box 500, MS 19-045
Beaverton, OR 97077, USA
www.tek.com

EMC compliance (TCPA300/400 only)

EU EMC Directive Meets intent of Directive 2014/30/EU for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:

EN 61326-1, EN 61326-2-1. EMC requirements for electrical equipment for measurement, control, and laboratory use. ^{1 2 3 4}

- CISPR 11. Radiated and conducted emissions, Group 1, Class A
- IEC 61000-4-2. Electrostatic discharge immunity
- IEC 61000-4-3. RF electromagnetic field immunity
- IEC 61000-4-4. Electrical fast transient/burst immunity
- IEC 61000-4-5. Power line surge immunity
- IEC 61000-4-6. Conducted RF immunity
- IEC 61000-4-11. Voltage dips and interruptions immunity

EN 61000-3-2. AC power line harmonic emissions

EN 61000-3-3. Voltage changes, fluctuations, and flicker

- ¹ This product is intended for use in nonresidential areas only. Use in residential areas may cause electromagnetic interference.
- ² Emissions which exceed the levels required by this standard may occur when this equipment is connected to a test object.
- ³ Equipment may not meet the immunity requirements of applicable listed standards when test leads and/or test probes are connected due to coupling of electromagnetic interference onto those leads/probes. To minimize the influence of electromagnetic interference, minimize the loop area between the unshielded portions of signal and associated return leads, and keep leads as far away as possible from electromagnetic disturbance sources. Twisting unshielded test leads together is an effective way to reduce loop area. For probes, keep the ground

return lead as short as possible and close to the probe body. Some probes have accessory probe tip adapters to accomplish this most effectively. In all cases, observe all safety instructions for the probes or leads used.

- 4 For compliance with the EMC standards listed here, high quality shielded interface cables that incorporate low impedance connection between the cable shield and the connector shell should be used.

EMC compliance Meets the intent of Directive 2014/30/EU for Electromagnetic Compatibility when it is used with the product(s) stated in the specifications table. Refer to the EMC specification published for the stated products. May not meet the intent of the directive if used with other products.

**Australia / New Zealand
EMC** Complies with the EMC provision of the Radiocommunications Act per the following standard, in accordance with ACMA:

- EN 61326-1 and EN 61326-2-1. Radiated and Conducted Emissions, Group 1, Class A.

Safety compliance

This section lists the safety standards with which the product complies and other safety compliance information.

EU low voltage directive Compliance was demonstrated to the following specification as listed in the Official Journal of the European Union:

Low Voltage Directive 2014/35/EU.

- EN 61010-1. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements.
- EN 61010-2-032. (TCP303/305A/312A/404XL only) Particular requirements for handheld current clamps for electrical measurement and test equipment.

U.S. nationally recognized testing laboratory listing

- UL 61010-1. (TCPA300/400 and TCP305A/312A only) Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements.
- UL 3111-1. (TCP303/404XL only) Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements.
- UL 61010-2-032. (TCP305A/312A only) Particular requirements for handheld current clamps for electrical measurement and test equipment.
- IEC 3111-2-032. (TCP303/404XL only) Particular requirements for handheld current clamps for electrical measurement and test equipment.

- Canadian certification**
- CAN/CSA-C22.2 No. 61010-1. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements.
 - CAN/CSA-C22.2 No. 61010-2-032. (TCP305A/312A only) Particular requirements for handheld and hand manipulated current sensors for electrical measurement and test equipment.

- Additional compliances**
- IEC 61010-1. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements.
 - IEC 61010-2-032. (TCP303/305A/312A/404XL only) Particular requirements for handheld current clamps for electrical measurement and test equipment.

Equipment type Test and measuring equipment.

Safety class TCPA300/400 only: Class 1 – grounded product.

- Pollution degree descriptions**
- 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 rating Pollution degree 2 (as defined in IEC 61010-1). Rated for indoor, dry location use only.

IP rating IP20 (as defined in IEC 60529).

Measurement and overvoltage category descriptions

Measurement terminals on this product may be rated for measuring mains voltages from one or more of the following categories (see specific ratings marked on the product and in the manual).

- Category II. Circuits directly connected to the building wiring at utilization points (socket outlets and similar points).
- Category III. In the building wiring and distribution system.
- Category IV. At the source of the electrical supply to the building.

NOTE. Only mains power supply circuits have an overvoltage category rating. Only measurement circuits have a measurement category rating. Other circuits within the product do not have either rating.

Mains overvoltage category rating

TCPA300/400 only: Overvoltage category II (as defined in IEC 61010-1).

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).

Operating considerations

Environmental

Characteristic	Probes and amplifiers
Temperature	
Operating	0 to +50 °C (32 to 122 °F)
Nonoperating	-40 to +75 °C (-40 to 167 °F)
Humidity	
Operating	5 to 95% R.H. to +30 °C (86 °F) 5 to 85% R.H. +30 to +50 °C (86 to 122 °F)
Nonoperating	+30 to +46 °C (+86 to +115 °F) 0-90% RH
Altitude	
Operating	Up to 2000 m (6,560 ft.)
Nonoperating	Up to 12,192 m (40,000 ft.)
Pollution degree	2, Indoor use only

TCPA300 and TCPA400 power

Characteristic	TCPA300 and TCPA400 amplifiers
Input voltage	100–240 VAC, 47 Hz to 440 Hz, single phase
Maximum power	50 watts maximum

TCP312A and TCP305A probes

Characteristic	TCP312A probe	TCP305A probe
Input current	0–50 A (Peak pulse)	0–50 A DC (Peak pulse)
Maximum input current ratings	10 A/V Range:	10 A/V Range:
	30 ADC (Continuous)	50 ADC (Continuous)
	21 A _{RMS} (Sinusoidal)	35 A _{RMS} (Sinusoidal)
	50 Apk (Peak pulse)	50 Apk (Peak pulse)
	1 A/V Range:	5 A/V Range:
	5 ADC (Continuous)	25 ADC (Continuous)
	3.5 A _{RMS} (Sinusoidal)	17.7 A _{RMS} (Sinusoidal)
	50 Apk (Peak pulse)	50 Apk (Peak pulse)
Maximum voltage on bare wire	150 V CAT II	150 V CAT II
Maximum Amp·Second product	1 A/V - 50 A·μs	5 A/V - 500 A·μs
	10 A/V - 500 A·μs	10 A/V - NA

TCP303 and TCP404XL probes

Characteristic	TCP303 probe	TCP404XL probe
Input current	0–500 A DC (Peak pulse)	0–750 A DC (Peak pulse)
Maximum input current ratings	50 A/V Range: 150 ADC (Continuous) 150 A _{RMS} (Sinusoidal) ¹ 500 Apk (Peak pulse) 5 A/V Range: 25 ADC (Continuous) 17.7 A _{RMS} (Sinusoidal) 500 Apk (Peak pulse)	1 A/mV Range: 500 ADC (Continuous) 750 ADC (Noncontinuous) ² 500 A _{RMS} (Sinusoidal) 750 Apk (Peak pulse)
Maximum voltage on bare wire	600 V _{RMS} CAT I & II	600 V _{RMS} CAT I & II
Maximum Amp·Second product	5 A/V - 3000 A·μs 50 A/V - 15000 A·μs	NA

¹ Control box derated to 100 Arms above 40 °C

² WARNING: To reduce the risk of fire or burn, refer to *TCP404XL Maximum Measurement Times* for intermittent operation in the *TCPA300/400 Amplifiers and TCP300A/400 Series Current Probes User Manual*, Tektronix part number 077-1183-xx, for maximum currents and duty cycles before use.

Product documentation

The following table lists the user documentation available for the products covered by this document. These documents can be downloaded from the Tektronix website (www.tek.com/downloads).

Document	Language	Tektronix part number
TCPA300/400 Amplifiers and TCP303/305A/312A/404XL Current Probes Compliance and Safety Instructions (this document)	English	071-3643-xx
TCPA300/400 Amplifiers and TCP300A/400 Series AC/DC Current Probes User Manual	English	077-1183-xx
	Japanese	077-1184-xx
	Russian	077-0322-xx
TCPA300/400 Amplifiers and TCP300A/400 Series AC/DC Current Probes Service Manual	English	077-0323-xx

Installation

The TCPA300 and TCPA400 current probe amplifiers let you use one probe to simultaneously measure AC and DC current. The amplifiers convert the sensed current into a proportional voltage signal that you can measure directly with an oscilloscope. The amplifiers and associated probes provide these features:

- Simultaneous DC and AC current measurements up to 750 A peak
- High sensitivity
- One-button autobalancing and probe degaussing
- No adjustments needed to match a current probe to an individual amplifier
- AC or DC coupling of signal
- Direct scaling and unit readout on compatible TEKPROBE level II oscilloscopes

Standard accessories

The following accessories are shipped with the amplifiers and probes.

Amplifiers The following accessories are shipped with the TCPA300 and TCPA400 amplifiers.

- Power Cord (customer-chosen option)
- TEKPROBE Interconnect Cable
- Certificate of Traceable Calibration

Probes When you order a current probe, you will receive these accessories:

- Probe cover (TCP303 and TCP404XL only)
- Probe ground lead, 6 inch length (TCP305A and TCP312A only)
- Instruction Sheet
- Certificate of Traceable Calibration

Optional accessories

You can order the following optional accessories for the amplifiers and probes.

- One-turn 50 Ω HF current loop. Two versions are available; one for each style of probe. The current loops are used in the performance verification procedures for checking the performance of the TCPA300 Amplifier and the compatible probes.
- 50 Ω feedthrough termination, 2 W (Tektronix part number 011-0049-xx)
- 50 Ω BNC-to-BNC coaxial cable (Tektronix part number 012-0117-xx)
- TCPA Calibration Adapter. Use the TCPA Calibration Adapter to verify the amplifier(s) performance independent of the current probes.
- Travel Case. The travel case includes room to store one amplifier and two current probes, along with related cables and adapters.
- Deskew Fixture. This fixture converts the PROBE COMPENSATION output or TRIGGER OUTPUT of the TDS5000 or TDS7000 into a set of test point connections that allow you a convenient way to compensate for timing differences between voltage and current probes.

System configuration

A complete current measurement system consists of a current probe amplifier, a compatible current probe, and an appropriate oscilloscope. (See Figure 1.)

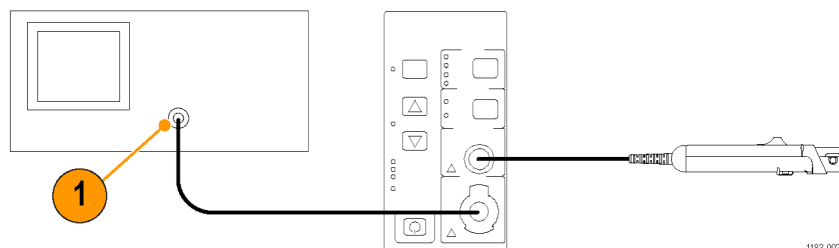


Figure 1: Typical TCPA300/400 current measurement system

1. 50 Ω oscilloscope input — use the supplied TEKPROBE Interface Cable or use a 50 Ω BNC cable, which is available as an optional accessory.

NOTE. If the oscilloscope only has a high-impedance input, you will need to add a 50 Ω termination, which is available as an optional accessory.

TCPA300 and TCPA400 amplifiers

The amplifier amplifies the current sensed by the probe and converts the current to a proportional voltage that is displayed on an oscilloscope or other similar measuring device.

Current probes

The following Tektronix current probes are compatible with the TCPA300 Amplifier:

- TCP312A (30 A, 100 MHz)
- TCP305A (50 A, 50 MHz)
- TCP303 (150 A, 15 MHz)

The following Tektronix current probe is compatible with the TCPA400 Amplifier:

- TCP404XL (750 A ¹, 2 MHz)

¹ 500 A continuous, 750 A DC derated with duty cycle

Oscilloscope

An oscilloscope displays the output from the current measuring system. A 50 Ω cable is included to connect the amplifier to the oscilloscope input channel. A TEKPROBE-to-TEKPROBE interface cable is also included for connecting to TEKPROBE level II oscilloscopes.

If the oscilloscope does not have an input that can be set to 50 Ω impedance, you need a feedthrough 50 Ω termination. This termination is available as a standard accessory with your TCPA300 and TCPA400 Current Probe Amplifiers.

Connect the amplifier to an oscilloscope

You will need an oscilloscope to display the TCPA300 and TCPA400 measurement output. To use the full dynamic range of the probe/amplifier combination, the oscilloscope must be capable of displaying a vertical scale factor of 1 mV/div to 1 V/div.

If you are using a TEKPROBE II-compatible oscilloscope, use the supplied TEKPROBE-to-TEKPROBE interface cable to connect the amplifier OUTPUT connector to your oscilloscope. Otherwise, use a 50 Ω BNC cable (available as an optional accessory) to connect the amplifier OUTPUT connector to your oscilloscope. (See Figure 1 on page 13.)

The input impedance of the oscilloscope channel must be 50 Ω , or you will encounter slowed pulse response, increased aberrations, or incorrect DC measurement amplitudes. If your oscilloscope provides only 1 M Ω inputs, you need to attach a 50 Ω feed-through termination (available as an optional accessory) between the oscilloscope input and the BNC cable. Do not install this termination at the amplifier end of the BNC cable.

To utilize the full bandwidth capability of the TCPA300 and TCPA400 and attached current probe, the oscilloscope bandwidth must be approximately five times that of the current probe. For example, when using a TCP312A Current Probe, the oscilloscope bandwidth must be at least 500 MHz. When using a TCP305A Current Probe, the oscilloscope bandwidth must be at least 250 MHz.

After you have connected the amplifier to the oscilloscope, allow the equipment to warm up to a stable temperature; usually 20 minutes is required.

NOTE. *To obtain accurate measurements, the input impedance of your oscilloscope must be 50 Ω . Make sure your amplifier OUTPUT is connected to an oscilloscope input using a 50 Ω BNC cable, and that the oscilloscope input is set to 50 Ω impedance.*

Power on the amplifier

1. Connect the power cord to the power input connector on the rear of the amplifier, and then connect the power cord to your local mains supply (100 VAC to 240 VAC, 50 Hz to 400 Hz).
2. To allow for proper ventilation, place the rear panel of the amplifier at least 2 inches away from any obstructions. Set the amplifier on the bottom rubber feet, and keep papers and other items away from the bottom of the amplifier which could restrict airflow and cause overheating.
3. Press the ON/STANDBY button on the amplifier front panel. The amplifier goes through a self-test and cycles the front-panel LEDs.

NOTE. *The amplifier stores the power state it is in when the power cord is unplugged. If you do not put the amplifier into STANDBY mode before unplugging it, the amplifier will power on immediately when you plug it in again.*

4. Degauss the probe before taking measurements. For more information, refer to the *TCPA300/400 Amplifiers and TCP300A/400 Series Current Probes User Manual*, Tektronix part number 077-1183-xx, for additional instructions on degaussing and performing a functional check.

NOTE. *The amplifier stores the power state it is in when the power cord is unplugged. If you do not put the amplifier into STANDBY mode before unplugging it, the amplifier will power on immediately when you plug it in again.*

When you connect a probe to the amplifier, the amplifier uses detection circuitry to indicate probe conditions such as noncompatible probe type and probe open.

Connect the probe to the amplifier

To connect a current probe to the amplifier input connector, do the following and refer to the illustration. (See Figure 2.)

1. To connect the probe, align the red dots.
2. Push the probe connector in. Do not twist the connector.
3. To disconnect the probe, pull back the collar.
4. Pull out the connector.

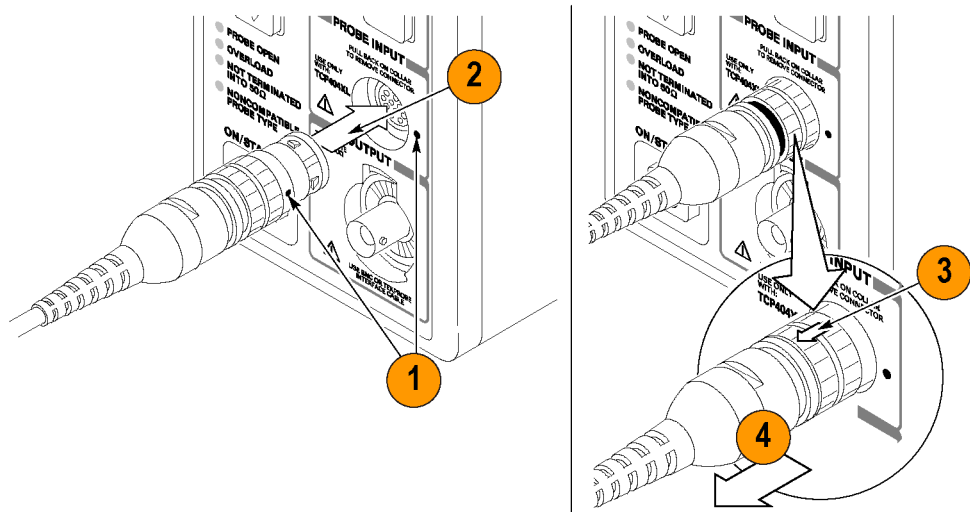


Figure 2: Connecting and disconnecting a current probe to the amplifier



CAUTION. Handle current probes with care. Do not drop a probe or subject it to impact, or the core may crack.

Do not connect or disconnect a current probe while the probe is clamped around a live conductor, or the probe may suffer electrical damage.

If you connect a probe to the wrong amplifier, (for example, a TCP312A to a TCPA400), the NONCOMPATIBLE PROBE TYPE LED illuminates. Disconnect the probe and use the correct amplifier. The TCPA400 amplifier accepts TCP3XXA probes, but will only operate properly with TCP4XX probes.

Each current probe is calibrated before it is shipped, and should not require further adjustment. If a probe requires adjustment, information is available in the service manual. The adjustment procedure must be performed only by qualified service personnel. Contact your nearest Tektronix Service Center if you need more assistance.

Operate the amplifier

The TCPA300 and TCPA400 front-panel controls and connectors function as described below. Some seldom-used functions do not appear in the illustration. These functions are discussed in the product user manual.

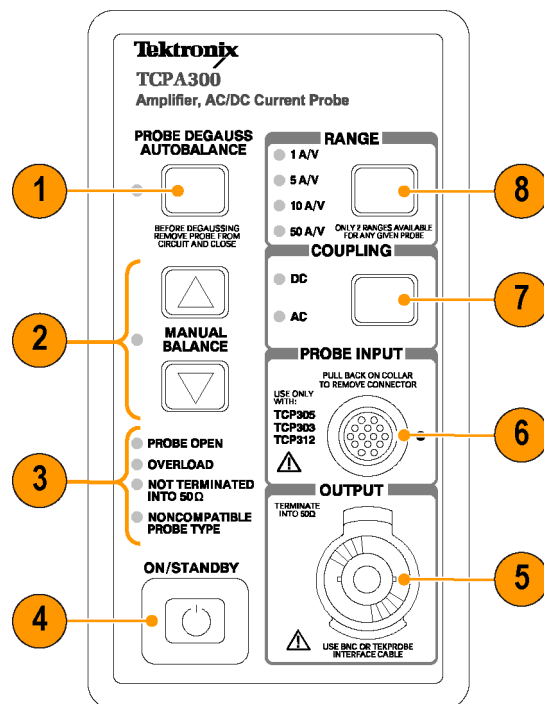


Figure 3: Amplifier front panel (TCPA300 shown)

1. The PROBE DEGAUSS AUTOBALANCE button removes residual magnetism from the attached current probe. A multi-color LED indicates the status of the degauss circuit.
2. The MANUAL BALANCE buttons allow you to fine-adjust DC offset from the amplifier. The adjacent LED lights when one of the buttons has been pressed.
3. The four probe error lights indicate the following faults: PROBE OPEN, OVERLOAD (current or temperature), NOT TERMINATED INTO 50 Ω and NONCOMPATIBLE PROBE TYPE.
4. The ON/STANDBY button turns on power to the amplifier.
5. The TCPA300 and TCPA400 output appears at the OUTPUT connector. Connect this to a 50 Ω input of your oscilloscope.

6. The current probes connect to the TCPA300 and TCPA400 at the PROBE INPUT connector.
7. The COUPLING button selects AC or DC probe coupling, as indicated by the LEDs.
8. The RANGE button toggles between the two scale factors that are available for the attached probe (TCPA300 only). LEDs indicate the selected range.

LED indicators

Indicators	Function
PROBE OPEN	<p>When lit, this LED indicates that the current probe is unlocked. You must have the probe slide locked to degauss the probe or to accurately measure current.</p> <p>CAUTION: To reduce risk of fire when using bare conductors, ensure that the probe slide is locked before you apply power to the circuit.</p>
OVERLOAD	<p>When lit, this LED indicates different overload conditions. (See page 19, <i>Overload conditions</i>.)</p>
NOT TERMINATED INTO 50 Ω	<p>When lit, this LED indicates that the TEKPROBE Interface cable or BNC cable from the OUTPUT of the amplifier is not connected to a 50 Ω input on the oscilloscope. Switch the termination setting on the oscilloscope to 50 Ω, or use a 50 Ω termination on the oscilloscope input.</p> <p>NOTE. NOT TERMINATED INTO 50 Ω is only detected during the DEGAUSS AUTOBALANCE operation.</p>
NONCOMPATIBLE PROBE TYPE	<p>When lit, this LED indicates that the probe that is connected to the amplifier is not designed to work with the amplifier. TCP3XX probes only work with the TCPA300 Amplifier, and the TCP404XL probe only works with the TCPA400 Amplifier.</p>

Overload conditions

LED color	Overload condition	Recommended action ¹
Solid red	Measured continuous current is exceeding the continuous current limit of the probe.	Disconnect the probe from the current source. Reduce the current source amplitude or use a higher probe current range or a higher-rated current probe.
Flashing red	Measured current waveform has pulses that are exceeding the limits of the probe.	
Solid orange	The operating temperature of the probe or the amplifier has been exceeded.	Disconnect the probe from current source and allow time for the probe head and amplifier to cool. Shorten the measurement time duration or use a higher-rated current probe.
Flashing red and orange	Both temperature and current limits have been exceeded.	
All LEDs flashing	Probe & amplifier thermal shutdown has occurred.	Disconnect the probe from the current source. Power-cycle the amplifier and let the probe and amplifier adequately cool down (typically 15 minutes) before taking measurements again. Shorten the measurement time duration or use a higher-rated current probe.

¹ Since current overloads can magnetize the probe, always degauss the probe after an overload condition. Temperature shifts can also affect the probe accuracy; degauss the probe if the probe head or amplifier temperature changes more than 5 °C.



WARNING. *To avoid personal injury or equipment damage, do not exceed the specified electrical limits of the TCPA300 and TCPA400 Amplifiers or any applicable probe accessories.*

Operate the current probe

Basic operation

1. Connect the probe to the amplifier. (See page 16, *Connect the probe to the amplifier.*)
2. TCP305A and TCP312A only: If desired, install the ground lead to the probe. (See page 25, *Use the ground lead.*)
3. Degauss the probe. (See page 24, *Degauss and autobalance the current probe.*)



CAUTION. *To prevent inaccurate measurements, always degauss the current probe before taking measurements.*

4. Insert a conductor into the probe. (See page 21, *Operate the current probe slide.*)
5. Observe the amplifier and oscilloscope to make measurements.

Operation precautions



WARNING. *To prevent risk of electric shock or burn, keep your hands behind the tactile barrier which indicates the limit of safe access.*



CAUTION. *To prevent risk of fire, do not connect or disconnect the current probe to or from a live, uninsulated conductor. The core is not insulated. When you test uninsulated circuits, remove power before you connect or disconnect the probe.*



WARNING. *These probes are not rated for bare-wire voltages above 150 V Cat II, and insulated-conductor voltages above 300 V Cat II. To reduce risk of electric shock, do not take measurements with these probes on circuits with voltages above these limits.*

NOTE. *An insulated conductor is any conductor that is surrounded by an insulating material that is capable of isolating the voltage present on the conductor. Lacquer coatings like those typically found on transformer windings do not provide sufficient, reliable insulation for use with current probes. The lacquer coating can be easily nicked or damaged, which compromises the insulating capabilities of the lacquer coating.*

CAUTION. To prevent damage to the TCP305A & TCP312A probes, do not drop the probe, subject it to physical shock or rapid temperature changes, and do not insert insulated conductors larger than 5.0 mm (0.2 in) into the probe jaw or damage may result. If the slider will not close around the conductors, do not force the slide closed; either reduce the number of conductors, or use a smaller conductor, if possible, without exceeding the amperage rating of the wire.

CAUTION. To reduce risk of fire, do not connect or disconnect the current probe to or from a live, uninsulated conductor. The core is not insulated. Always remove power before you connect or disconnect the probe to or from bare conductors.

To improve EMI rejection at high frequencies, use the optional ground lead. Refer to the *TCPA300/400 Amplifiers and TCP300A/400 Series Current Probes User Manual*, Tektronix part number 077-1183-xx, for additional instructions.

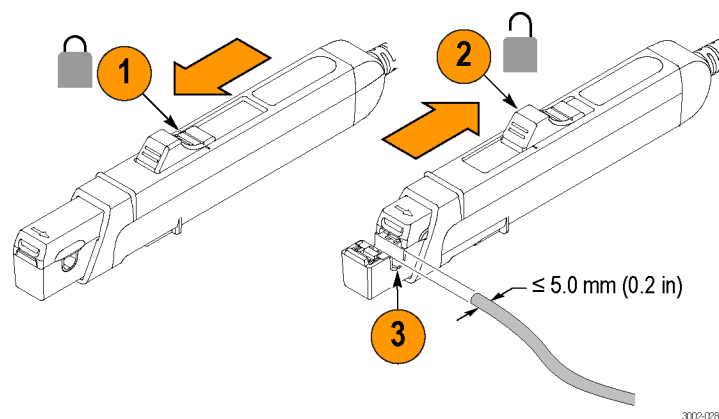
Operate the current probe slide

The current probes each have a slide mechanism that opens and closes the probe jaw. This allows you to clamp the probe around a conductor under test. The slide must be locked closed to accurately measure current or to degauss the probe. If a probe is unlocked, the PROBE OPEN indicator on the amplifier will light.

The current probes can be used to measure current on uninsulated wires. However, the circuit must be de-energized when connecting or removing the current probe.

TCP305A and TCP312A slide operation

The slide operation of the TCP305A and TCP312A current probes is shown in the following illustration.




To operate the probe:

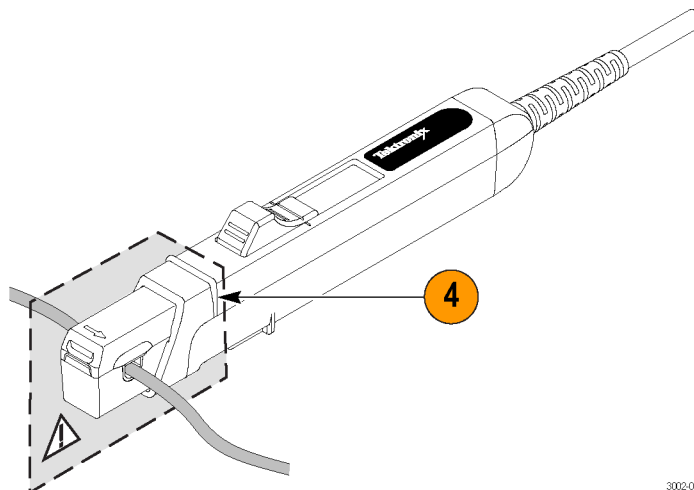
1. To close (lock) the probe, push the slide forward until the detent snaps into place.

NOTE. *The slider must be in the closed (locked) position to degauss the probe.*


2. To open (unlock) the probe, pull the slide back until the jaw is open.
3. Insert a 5 mm (0.2 in) diameter maximum conductor size into the jaw.

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

4. Close the jaw around the conductor and lock the slider. When you are taking measurements, keep your fingers behind the demarcations on the probe, and away from the shaded area shown below.

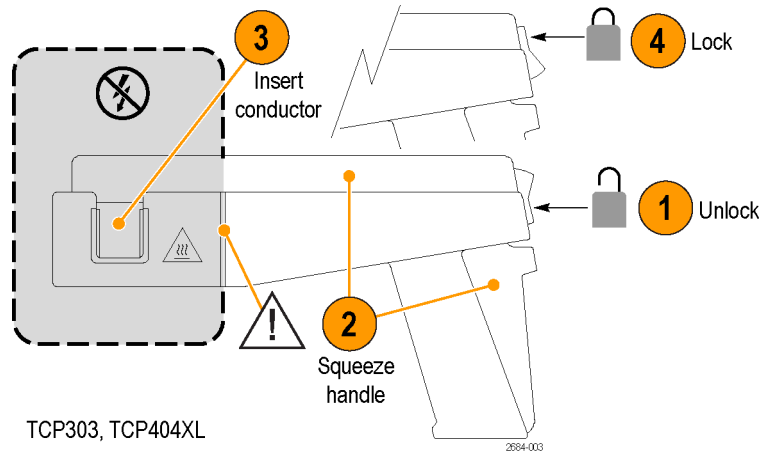


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 **WARNING.** *Do not connect the current probe to any wire that carries voltages or currents that exceed the rating of the probes.*

TCP303 and TCP404XL slide operation

The slide operation of the TCP303 and TCP404XL current probes is shown in the following illustration.



To operate the probe:

1. Press the bottom of the lock button to unlock the probe.
2. Squeeze the handle until the core is open.
3. Insert a 5 mm (0.2 in) diameter maximum conductor size into the jaw.



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

4. To close and lock the probe, release the squeeze handle and press the top of the lock button. When you are taking measurements, keep your fingers behind the demarcations on the probe, and away from the shaded area shown above.



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

Degauss and autobalance the current probe

Degauss the probe to remove any residual magnetization from the probe core. Such residual magnetization can induce measurement error. Autobalancing removes unwanted DC offsets in the amplifier circuitry. Failure to degauss the probe is a leading cause of measurement errors. The DEGAUSS LED flashes until you degauss the probe.

To degauss the probe, disconnect the probe from the test circuit, or ensure that the conductor under test has no power, close and lock the slide, and then press the amplifier PROBE DEGAUSS AUTOBALANCE button on the front panel of the amplifier. To maintain measurement accuracy, degauss your probe in each of these cases:

- After you turn on the amplifier 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 connect a new probe.
- Whenever you subject the probe to a strong external magnetic field.
- Periodically during normal use.

To degauss and autobalance a current probe, perform these steps:

1. Verify that the current probe is connected to the amplifier.
2. Remove the current probe from the conductor under test.
3. Lock the probe slide closed.
4. Press the amplifier PROBE DEGAUSS AUTOBALANCE button.
5. Wait about five seconds for the degauss procedure to complete.

The **PROBE DEGAUSS AUTOBALANCE** LED glows green when the operation has successfully completed. If the LED is blinking orange, the degauss operation is still in progress. If the LED is red, the operation failed, and the cause of the failure needs to be found and fixed. (See page 17, *Operate the amplifier.*)

NOTE. *The degauss procedure will fail if the amplifier is not properly connected to an oscilloscope having 50 Ω input impedance. If this occurs, the NOT TERMINATED INTO 50 Ω LED lights on the amplifier front panel.*

After you have completed the oscilloscope adjustments and the amplifier degauss/autobalance procedure, your system is ready to measure current.

Use the ground lead

The TCP305A and TCP312A probes include a 6-inch ground lead. The 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 shielding. The ground lead clips onto the ground connector on the bottom of the probe.

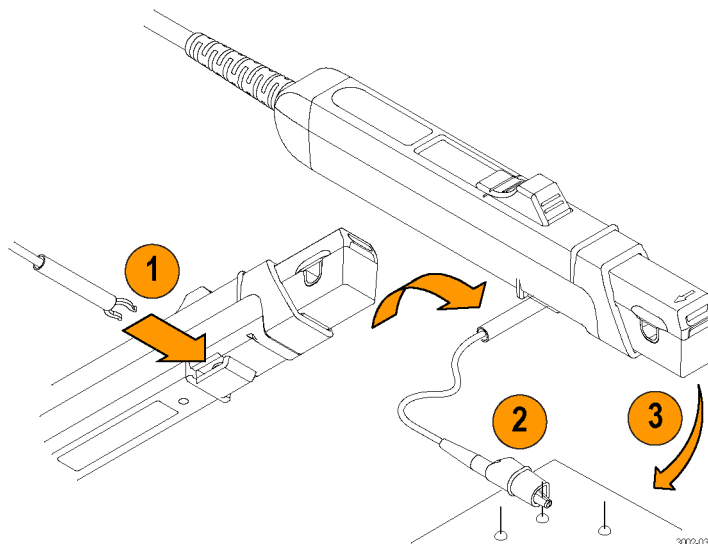


Figure 4: Connecting the ground lead

The ground lead on the current probes is intended to be used in high dV/dt environments. The probes have a grounded shield between the conductor under test and the current sense transformer. Any capacitively-coupled current will then flow in the ground instead of the transformer windings.

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 at high frequencies (2 MHz and above). This will reduce ringing and help bypass capacitively-coupled RF currents which can flow into the probe cable. 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.

Make DC current measurements

To measure DC current, first degauss the probe. (See page 24, *Degauss and autobalance the current probe.*)

1. Verify that the amplifier and the oscilloscope input coupling are set to DC, and the input impedance is set to 50 Ω .
2. Lock the probe closed without a conductor passing through it.
3. Adjust the ground reference of the oscilloscope to move the trace to the desired graticule line.
4. Press the amplifier PROBE DEGAUSS AUTOBALANCE button.

The NOT TERMINATED INTO 50 Ω LED is lighted if impedance is not 50 Ω . If this is the case, make necessary changes. (For example, use a 50 Ω termination.)

5. After the degauss/autobalance routine completes, adjust the ground reference (if necessary) using the amplifier **MANUAL BALANCE** controls.



WARNING. *The current probes can be used to measure current on uninsulated wires. However, the circuit must be de-energized when connecting or removing the current probe.*

The current probe is shown connected to a power supply line. (See Figure 5.)

Notice that the probe arrow points toward the negative terminal of the power supply to conform to the conventional current flow of positive (+) to negative (-). To measure DC current, perform these steps:

1. Open the probe slide, place the probe around the conductor under test, and then lock the slide.
2. For correct measurement polarity, make sure the probe arrow is pointing in the direction of conventional (positive to negative) current flow. Reversing the flow will display the current waveform upside-down on the oscilloscope.
3. Adjust the oscilloscope time base, trigger, and gain as needed.

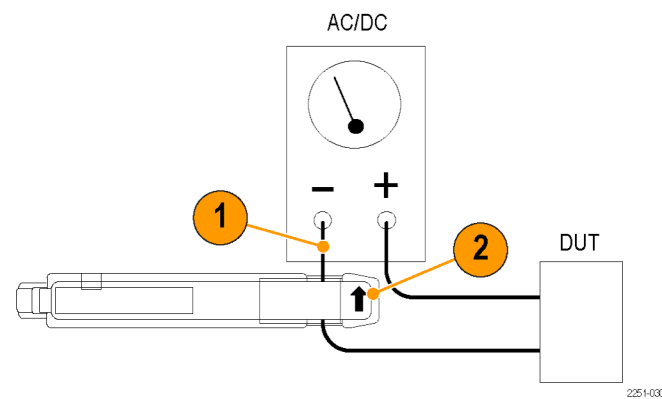


Figure 5: Arrow on current probe indicates conventional current flow

Make AC current measurements

To measure AC current only, and remove the DC component of the current being measured, follow the instructions below. These are identical to the instructions for DC current measurements except that the amplifier coupling in step 2 is set to AC.

1. Verify that the oscilloscope input coupling is set to DC, and the input impedance is set to 50 Ω . (The NOT TERMINATED INTO 50 Ω LED on the amplifier is lit if impedance is not 50 Ω .)
2. Verify that the amplifier input coupling is AC.
3. Adjust the ground reference of the oscilloscope to move the trace to the desired graticule line.
4. Lock the probe closed without a conductor passing through it, and then press the amplifier PROBE DEGAUSS AUTOBALANCE button.



WARNING. *The current probes can be used to measure current on uninsulated wires. However, the circuit must be de-energized when connecting or removing the current probe.*

5. Open the probe slide, place the probe around the conductor under test, and then lock the slide. For correct measurement polarity, make sure the probe arrow is pointing in the direction of conventional (positive to negative) current flow. Reversing the flow will invert the displayed current waveform on the oscilloscope.

NOTE. *Even when making AC current measurements, leave the oscilloscope coupling on DC. Change only the amplifier coupling to AC. Using the oscilloscope AC coupling may cause the amplifier to exceed its output dynamic range.*

6. Adjust the oscilloscope time base and trigger as needed.