

# AC/DC Current Measurement Systems

TCPA300 • TCP312 • TCP305 • TCP303 • TCPA400 • TCP404XL Data Sheet



- Lower DC Drift and Noise Allows Improved Low-level Current Measurements
- Certified for use in U.S., Canada, and Europe. Complies with applicable IEC standards.

## Applications

- Development and Analysis Solutions for Designers, Installers, and Service Personnel in Telecomm, Data Comm, Computer, and Semiconductor Power Electronics Environments For:
  - Power Supplies (Switching and Linear)
  - Semiconductor Devices (SCRs, IGBTs, MOSFETs, CMOS, BJTs)
  - Power Inverters/Converters
  - Electronic Ballasts
  - Industrial/Consumer Electronics
  - Mobile Communications (Phone, Satellite, Relay Stations)
  - Motor Drives
  - Transportation Systems (Electronic Vehicles, Electric Trains, Locomotives, Avionics)

## Features & Benefits

- AC/DC Measurement Capabilities
- DC – 100 MHz, Current Probe Amplifier (TCPA300) Uses:
  - DC – 100 MHz, 30 A DC (TCP312)
  - DC – 50 MHz, 50 A DC (TCP305)
  - DC – 15 MHz, 150 A DC (TCP303)
- DC – 50 MHz, Current Probe Amplifier (TCPA400) Uses:
  - DC – 2 MHz, 750\*1 A DC (TCP404XL) (500 A DC Continuous)
- Automatic Scaling and Units\*2 – Oscilloscope On-Screen Readout of Magnitude and Amps Reduces Measurement Errors with No More Hand Calculations
- AC/DC Input Coupling
- Low Insertion Impedance Reduces Device Under Test Loading
- Split-Core Construction Allows Easy Circuit Connection
- Status Indicators Provide Visual Operating Status and Notification of Potential Error Conditions – Degauss, Probe Open, Overload, Not Terminated into 50 Ohm, Noncompatible Probe Type

## Increased performance and simplicity

The TCP300 and TCP400 series AC/DC Current Measurement family is a highly advanced current measurement system for today's current measurement needs. The split-core probes incorporate both transformer and Hall-effect technology to provide broad bandwidth measurement capabilities from DC up to 100 MHz at current levels as low as 1 milliamp to thousands of amps (when used with CT4 current transformer). When connected to Tektronix Oscilloscopes with TEKPROBE Level II, TekConnect (w/ TCA-BNC) or TekVPI (w/ TPA-BNC) interfaces, current measurements and calculations are simple and easy.

Additional measurement power is available with add-on software such as the TDSPWR2 power measurements package. With all this measurement power, current measurements have never been easier.

\*1 Derated with Duty Cycle

\*2 Requires a TDS TEKPROBE Oscilloscope or a TekConnect Oscilloscope with TCA-BNC

### Meets today's AC/DC current measurement applications

The TCPA300 amplifier, when used with TCP312, TCP305, or TCP303 probes, provide a wide range of current measurement capability and spans the gap between low-level milliamp measurements to very high current levels. These three probes provide current measurement capabilities of 30 A, 50 A, and 150 A DC continuous. For even higher current levels, the TCPA400 amplifier with the TCP404XL current probe measures 500 A DC continuous and 750 A DC continuous, derated with duty cycle.

Higher frequency performance is available with the TCP312 w/TCPA300 providing  $\geq 100$ -MHz bandwidth and a maximum current of 30 A DC.

### Measurement errors and manual calculations are now a thing of the past

With this new series of current measurement tools, automatic control and on-screen scaling and units is provided for users of Tektronix TDS3000,

TDS500, TDS600, TDS700, TDS5000, TDS6000, and TDS7000B series oscilloscope systems (the DPO3000, DPO4000, and DPO7000 series oscilloscopes, the TPA-BNC adapter is required).

The TCP300/TCP400 Current Measurement Systems seamlessly integrate with your TDS series oscilloscope and the TDSPWR2 software package to easily make those time-consuming power measurements and calculations for you.

Even non-TEKPROBE systems can use the TCPA 300/400 series to make proper current measurements by simply multiplying the measured output voltage on the oscilloscope by the TCPA 300/400 series range setting.

## Characteristics

	TCP312 w/ TCPA300	TCP305 w/ TCPA300	TCP303 w/ TCPA300	TCP404XL w/ TCPA400
Bandwidth (-3 dB)	DC – 100 MHz	DC – 50 MHz	DC – 15 MHz	DC – 2 MHz*1
Risetime	$\leq 3.5$ ns	$\leq 7$ ns	$\leq 23$ ns	$\leq 175$ ns
Maximum Current Ratings:				
High-Current Sensitivity Range	10 A/V Range	10 A/V Range	50 A/V Range	1 A/mV Range
DC (continuous)	30 A	50 A	150 A	500 A (750 A*2)
RMS (sinusoidal)	21.2 A	35.4 A	150 A	500 A
Peak Pulse	50 A	50 A	500 A	750 A
Low-Current Sensitivity Range	1 A/V Range	5 A/V Range	5 A/V Range	N/A
DC (continuous)	5 A	25 A	25 A	
RMS (sinusoidal)	3.5 A	17.7 A	17.7 A	
Peak Pulse	50 A	50 A	500 A	
DC Accuracy (Operating temp 0 °C to 50 °C)	$\pm 3\%$ of reading	$\pm 3\%$ of reading	$\pm 3\%$ of reading (10 °C to 50 °C) $+3\%/-6\%$ of reading (0 °C to $<10$ °C)	$\pm 3\%$ of reading
DC Accuracy, Typical (Operating temp 23 °C $\pm 5$ °C)	$\pm 1\%$ of reading	$\pm 1\%$ of reading	$\pm 1\%$ of reading	$\pm 1\%$ of reading
<b>Nominal</b>				
Maximum Bare Wire Voltage	For Use With Insulated Wires Only		600 V <sub>RMS</sub> CAT I & II 300 V <sub>RMS</sub> CAT III	
Lowest Measurable Current (at $\pm 3\%$ accuracy at DC)	1 mA	5 mA	5 mA	1 A
	<i>Scope Set To 1 mV/div and 20 MHz BW Limited</i>		<i>Scope Set To 1 mV/div and 20 MHz BW Limited</i>	
Insertion Impedance (See Curves Below)	0.08 $\Omega$ at 1 MHz 0.15 $\Omega$ at 10 MHz 0.27 $\Omega$ at 50 MHz 0.7 $\Omega$ at 100 MHz	0.035 $\Omega$ at 1 MHz 0.12 $\Omega$ at 10 MHz 0.4 $\Omega$ at 50 MHz	0.01 $\Omega$ at 1 MHz 0.025 $\Omega$ at 5 MHz 0.1 $\Omega$ at 15 MHz	0.1 m $\Omega$ at 10 kHz 0.6 m $\Omega$ at 100 kHz 8 m $\Omega$ at 1 MHz 16 m $\Omega$ at 2 MHz

	TCP312 w/ TCPA300	TCP305 w/ TCPA300	TCP303 w/ TCPA300	TCP404XL w/ TCPA400
<b>Typical</b>				
Maximum Amp-Second Product (Based on Amplifier Range setting)	50 A* $\mu$ S – 1 A/V 500 A* $\mu$ S – 10 A/V	500 A* $\mu$ S – 5 A/V NA – 10 A/V	3,000 A* $\mu$ S – 5 A/V 15,000 A* $\mu$ S – 50 A/V	NA – 1 A/mV
AC-Coupling Low-Frequency Bandwidth (Low Pass - 3 dB point)	<7 Hz			
Displayed RMS Noise (at 20-MHz Bandwidth Limit)	$\leq 250 \mu A_{RMS}$	$\leq 1.25 mA_{RMS}$	$\leq 2.5 mA_{RMS}$	$\leq 250 mA_{RMS}$
Signal Delay (Delay to Output BNC)	17 ns	19 ns	40 ns	80 ns
Inputs (probe amplifier)	1			
Probe Open Indicator	YES			
Overload Indicator	YES			
Termination Indicator	YES			
Noncompatible Probe Indicator	YES			
<b>Safety Certifications</b>				
U.S. NRTL Listing	UL3111-1 (Amplifier)		UL3111-2-032 ; UL3111-1 (Probe and Amplifier)	
Canadian Certification	CAN/CSA C22.2 No.1010.1 (Amplifier)		CAN/CSA C22.2 No.1010.2.032 CAN/CSA C22.2 No.1010.1 (Probe and Amplifier)	
European Union Compliance	EN61010-1/A2 (Amplifier)		EN61010-1/A2; EN61010-2-032 EN61010-1/A2 (Probe and Amplifier)	
Other	IEC61010-1/A2 (Amplifier)		IEC61010-2-032 IEC61010-1/A2 (Probe and Amplifier)	
Electromagnetic Compatibility	EC Council Directive 89/336/EEC, FCC Part 15, Subpart B Class A, AS/NZS 2064.1/2.			
Power Requirements (TCPA300/TCPA400 Amplifiers)	90 V to 264 V; 47 to 440 Hz; 50 W Maximum CAT II (Auto Switch)			
Power Requirements (Probes)	Requires TCPA300 Amplifier			Requires TCPA400 Amplifier
Probe Model	TCP312	TCP305	TCP303	TCP404XL
Warranty	1 Year			
<b>Probe Mechanical Characteristics</b>				
Probe Cable Length	1.5 meters (60 inches)		2 meters (78.7 inches)	8 meters (315 inches)
Probe Jaw Size (Max Conductor Size)	3.8 mm (0.15 inches)		21 mm $\times$ 25 mm (0.83 $\times$ 1.0 inches)	
Length	20 cm (7.87 inches)		26.8 cm (10.55 inches)	26.8 cm (10.55 inches)
Width	1.6 cm (0.625 inches)		4.1 cm (1.60 inches)	4.1 cm (1.60 inches)
Height	3.2 cm (1.25 inches)		15.6 cm (6.13 inches)	15.6 cm (6.13 inches)
Weight	0.15 kg (0.33 lbs.)		0.66 kg (1.45 lbs.)	0.88 kg (1.90 lbs.)
<b>TCPA300 and TCPA400 Mechanical Characteristics</b>				
Length	17.3 cm (6.8 inches)			
Width	16.7 cm (6.6 inches)			
Height	9.14 cm (3.6 inches)			
Weight	1.14 kg (2.5 lbs.)			

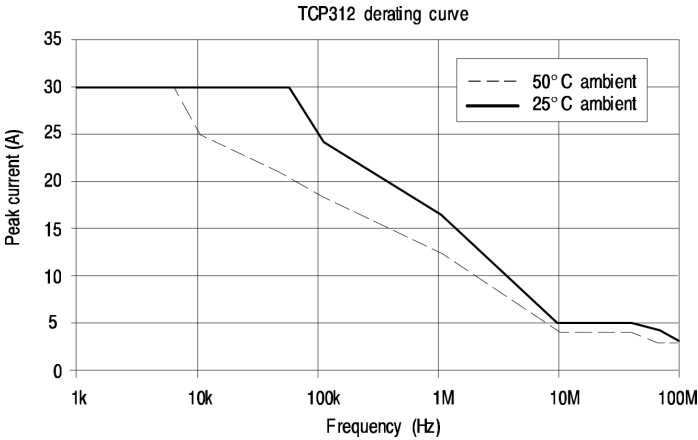
TCP312 w/ TCPA300      TCP305 w/ TCPA300      TCP303 w/ TCPA300      TCP404XL w/ TCPA400

**Environmental Characteristics**

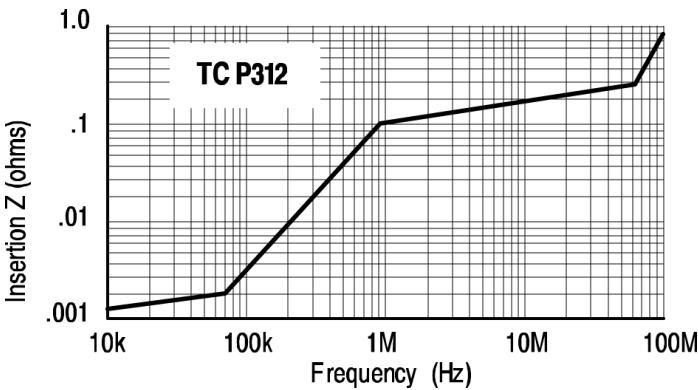
Temperature - Operating	0 °C to +50 °C (32 °F to 122 °F)
Temperature - Nonoperating	-40 °C to +75 °C (-40 °F to 167 °F)
Humidity – Operating	5% to 95% R.H. to +30 °C (86 °F) 5% to 85% R.H. +30 °C to +50 °C (86 °F to 122 °F)
Humidity – Nonoperating	5% to 95% R.H. to +30 °C (86 °F) 5% to 85% R.H. +30 °C to +75 °C (86 °F to 167 °F)
Altitude – Operating	2000 m (6800 ft.) maximum
Altitude – Nonoperating	12,192 m (40,000 ft.) maximum

\*1 Calculated from Risettime

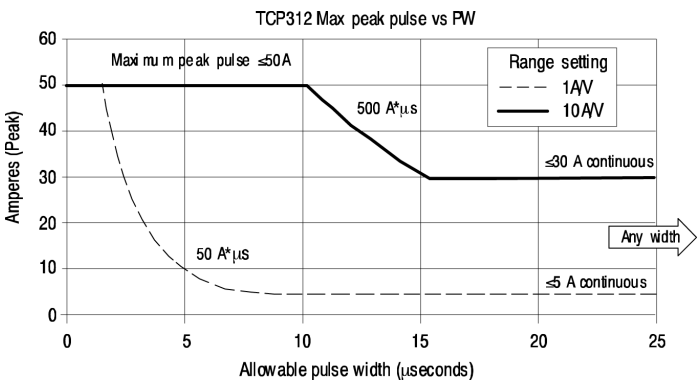
\*2 Derated w/ duty cycle and frequency



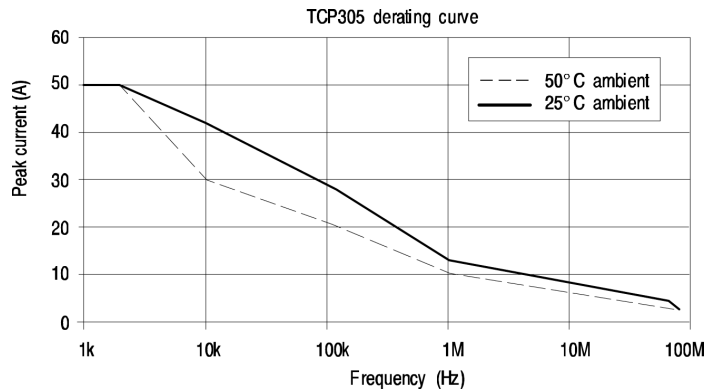
TCP312 Typical Peak Current Frequency Derating Curve



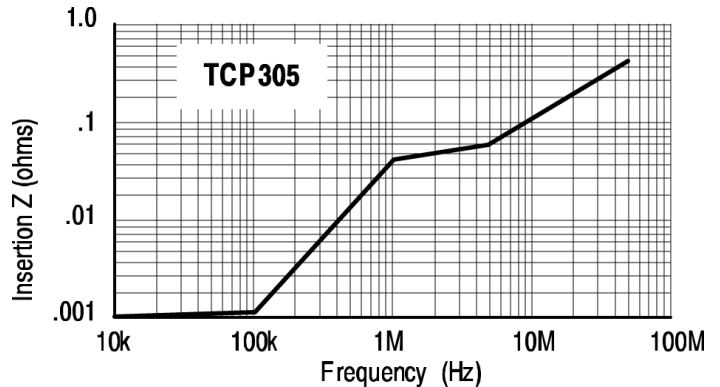
TCP312 Typical Insertion Impedance Curve



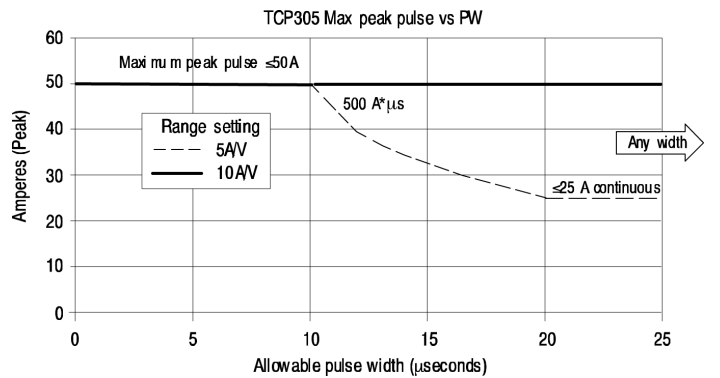
TCP312 Typical Specified Operating Area Characteristics



TCP305 Typical Peak Current Frequency Derating Curve

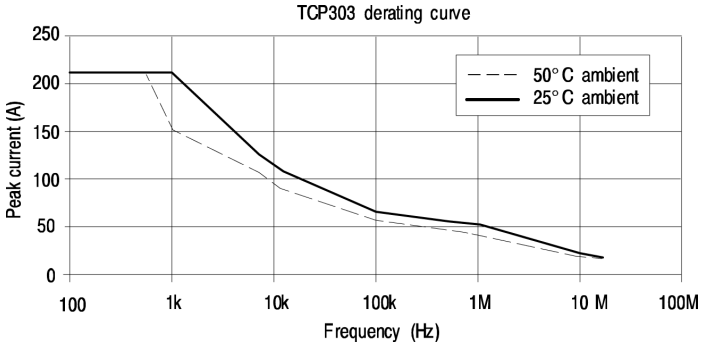


TCP305 Typical Insertion Impedance Curve

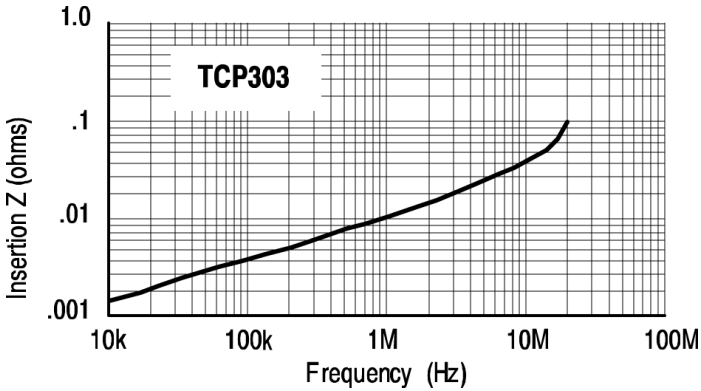


TCP305 Typical Specified Operating Area Characteristics

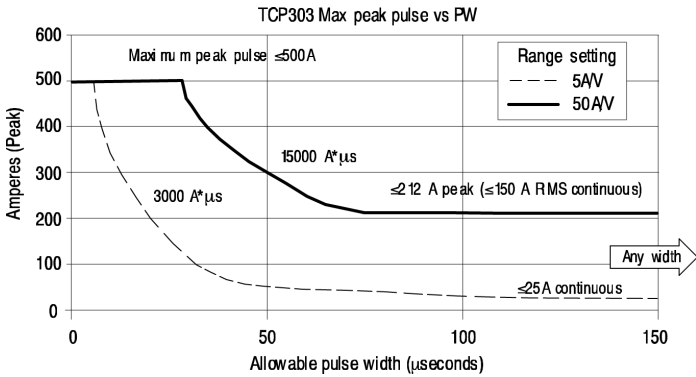
(Note: At 23 °C ambient , 600 A may be measured continuously with the TCP404XL probe.)



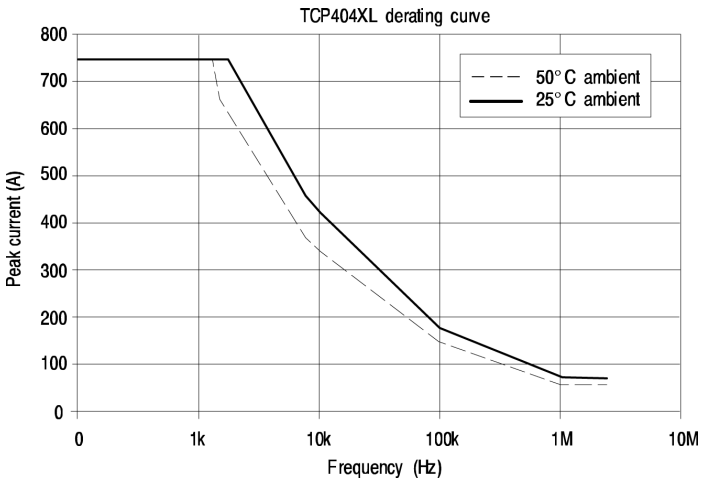
TCP303 Typical Peak Current Frequency Derating Curve



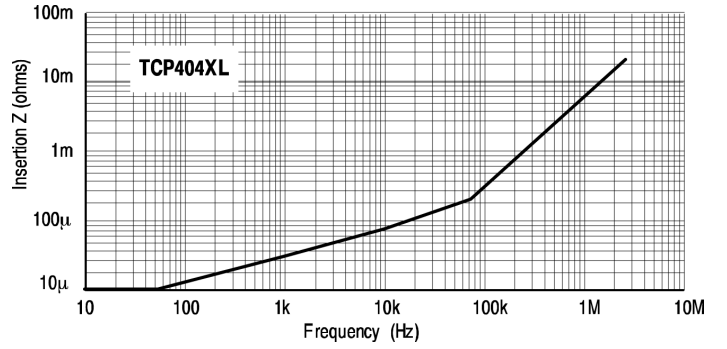
TCP303 Typical Insertion Impedance Curve



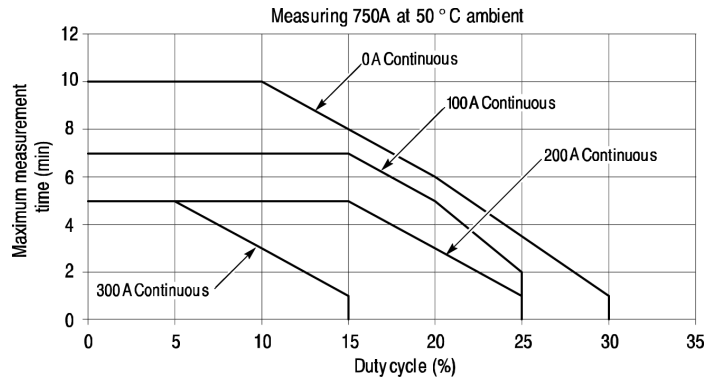
TCP303 Typical Specified Operating Area Characteristics



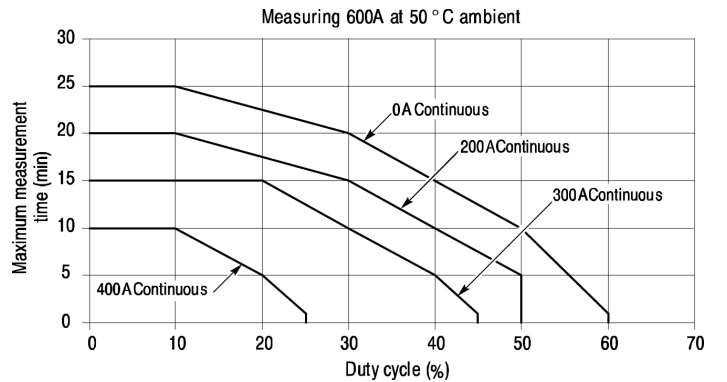
TCP404XL Typical Peak Current Frequency Derating Curve



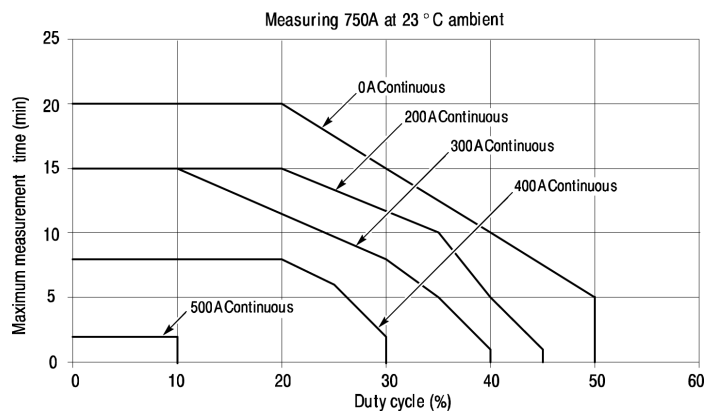
TCP404 Typical Insertion Impedance Curve



TCP404XL Maximum Current Measurement Time (750 A at 50 °C Ambient)



TCP404XL Maximum Current Measurement Time (600 A at 50 °C Ambient)



TCP404XL Maximum Current Measurement Time (750 A at 23 °C Ambient)

## Ordering Information

### TCP312

Probe; AC/DC Current, DC to 100 MHz; 30 A DC (Requires TCPA300 Amplifier)

### TCP305

Probe; AC/DC Current, DC to 50 MHz; 50 A DC (Requires TCPA300 Amplifier)

### TCP303

Probe; AC/DC Current, DC to 15 MHz; 150 A DC (Requires TCPA300 Amplifier)

### TCP404XL

Probe; AC/DC Current, DC to 2 MHz; 500 A DC (750 A DC Derated With Duty Cycle) (Requires TCPA400 Amplifier)

All TCP300/TCP400 Current Probes Include: AC/DC Current Probe; Instruction Sheet; Probe Cover; Certificate of Traceable Calibration

### TCPA300

Amplifier; AC/DC Current Probe, DC to 100 MHz, (Requires TCP305 or TCP312 or TCP303 Probes)

### TCPA400

Amplifier; AC/DC Current Probe, DC to 50 MHz, (Requires TCP404XL Probe)

All TCPA300/TCPA400 Current Probe Amplifiers Include: AC/DC Current Probe Amplifier; Instruction/Service Manual; TEKPROBE Interface Cable; Male to Male BNC cable (50 Ω); 50 Ω feed-through termination; Certificate of Traceable Calibration

## Options

### TCPA300/TCPA400

#### Power Plug Options

Opt. A1 – Euro Plug, 220 V, 50 Hz

Opt. A2 – UK Plug, 240 V, 50 Hz

Opt. A3 – Australian Plug, 240 V, 50 Hz

Opt. A5 – Swiss Plug, 220 V, 50 Hz

Opt. A6 – Japanese Plug, 100 V, 110/120 Volt, 60 Hz

Opt. AC – China Plug, 50 Hz

Opt. A99 – No Power Cord

#### Language Options

L5 – Japanese Manual

### All TCP300/TCPA300/TCP400/TCPA400 Series

#### Service Options

Opt. C3 – Calibration Service 3 Years

Opt. C5 – Calibration Service 5 Years

Opt. D1 – Calibration Data Report

Opt. D3 – Calibration Data Report 3 Years (with Option C3)

Opt. D5 – Calibration Data Report 5 Years (with Option C5)

Opt. R3 – Repair Service 3 Years

Opt. R5 – Repair Service 5 Years



Protective covers

## RECOMMENDED ACCESSORIES

**016-1923-00** – Cover, Small Probe Protective; (for TCP305, TCP312, A6302, A6302XL, A6312, TCP202)

**016-1924-00** – Cover, Large Probe Protective; (for TCP303, TCP404XL, A6303, A6303XL, A6304XL)

**016-1922-00** – Case, Transit; Current Measurement Systems

**011-0049-02** – 50 Ω Feed Through Termination

**012-0117-00** – 50 Ω BNC To BNC Coaxial Cable

**012-1605-00** – TEKPROBE Interface Cable, TCPA300 or TCPA400 Amplifier to TDS series oscilloscopes

**015-0601-50** – Current Loop, 1 Turn, 50 Ω, BNC Connector (for TCP305, TCP312, A6302, A6302XL, A6312, TCP202, TCP303, A6303, A6303XL)

**174-4765-00** – TCPA300/TCPA400 Amplifier Calibration Adapter

**067-1478-00** – Power Measurements Deskew Fixture, For TCP202, TCP305, TCP312, TCP303, A6302, A6312, A6303, Series Probes

**CT4** – AC Current Transformer, 20 kA (for use with TCP305, TCP312, TCP202, A6302, A6312)

**TDSPWR2** – Power Measurement and Analysis Software for TDS5000 and TDS7000 Series Oscilloscopes

**To order when purchasing oscilloscope:**

Order: TDS5052PW2, TDS5054PW2, TDS7054PW2, TDS7104PW2.

**To order as Upgrade:**

Order: TDS5UP PW2, TDS7UP PW2.



Product(s) are manufactured in ISO registered facilities.



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**For Further Information.** Tektronix maintains a comprehensive, constantly expanding collection of application notes, technical briefs and other resources to help engineers working on the cutting edge of technology. Please visit [www.tektronix.com](http://www.tektronix.com)



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