

# AC/DC Current Measurement Systems

TCPA300 • TCP312 • TCP305 • TCP303 • TCPA400 • TCP404XL Datasheet



- Status Indicators provide Visual Operating Status and Notification of Potential Error Conditions – Degauss, Probe Open, Overload, Not Terminated into 50  $\Omega$ , Noncompatible Probe Type
- 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)

## 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. 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.

\*1 Derated with duty cycle.

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

## 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

## Meets Today's AC/DC Current Measurement Applications

The TCPA300 amplifier, when used with TCP312, TCP305, or TCP303 probes, provides 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, MDO/MSO/DPO4000, MSO/DPO5000, and DPO7000 Series oscilloscopes, the TPA-BNC adapter is required).

The TCP300/TCP400 current measurement systems seamlessly integrate with your TDS Series oscilloscope.

Even non-TEKPROBE systems can use the TCPA300/400 Series to make proper current measurements by simply multiplying the measured output voltage on the oscilloscope by the TCPA300/400 Series range setting.

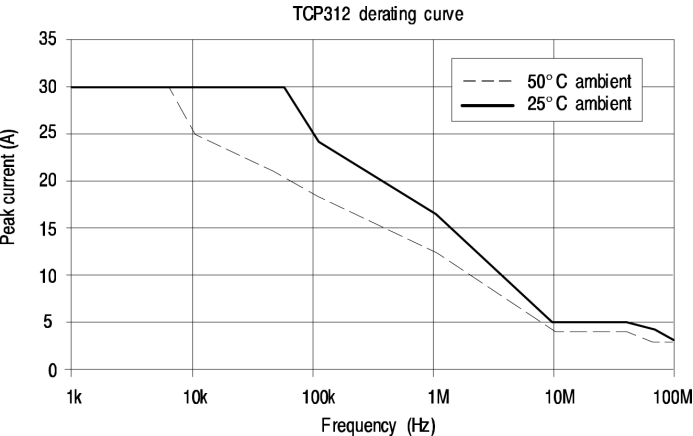
## Characteristics

Characteristic	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*3
Rise Time	$\leq 3.5$ 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*4)
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	N/A
RMS (Sinusoidal)	3.5 A	17.7 A	17.7 A	N/A
Peak Pulse	50 A	50 A	500 A	N/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
	Scope set to 1 mV/div and 20 MHz BW Limited		Scope set to 1 mV/div and 20 MHz BW Limited	
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

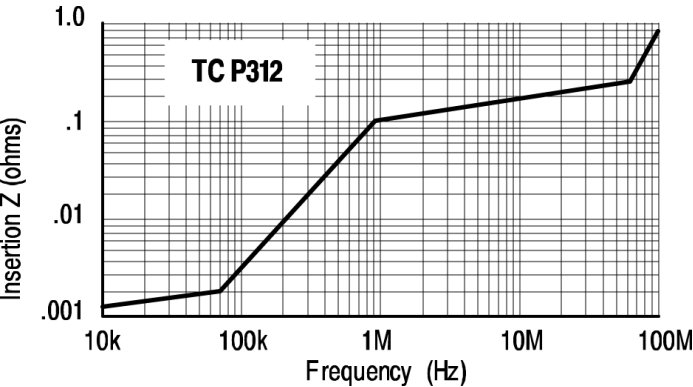
Characteristic	TCP312 w/ TCPA300	TCP305 w/ TCPA300	TCP303 w/ TCPA300	TCP404XL w/ TCPA400
<b>Typical</b>				
Maximum Amp-Second Product (Based on Amplifier Range setting)	50 A*μS – 1 A/V 500 A*μS – 10 A/V	500 A*μS – 5 A/V NA – 10 A/V	3,000 A*μS – 5 A/V 15,000 A*μS – 50 A/V	NA – 1 A/mV
AC-coupling Low-frequency Bandwidth (Low Pass – 3 dB point)	<7 Hz			
Displayed RMS Noise (at 20 MHz bandwidth limit)	≤250 μA <sub>RMS</sub>	≤1.25 mA <sub>RMS</sub>	≤2.5 mA <sub>RMS</sub>	≤250 mA <sub>RMS</sub>
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 × 25 mm (0.83 × 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 lb.)		0.66 kg (1.45 lb.)	0.88 kg (1.90 lb.)
<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 lb.)			

Characteristic	TCP312 w/ TCPA300	TCP305 w/ TCPA300	TCP303 w/ TCPA300	TCP404XL w/ TCPA400
<b>Environmental Characteristics</b>				
Temperature				
Operating	0 °C to +50 °C (32 °F to 122 °F)			
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)			
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			
Nonoperating	12,192 m (40,000 ft.) maximum			

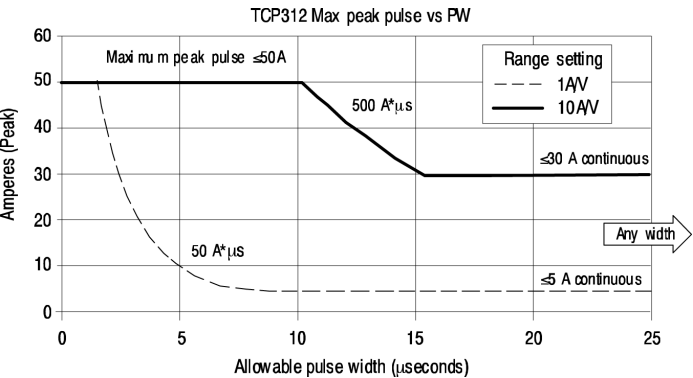
<sup>\*3</sup> Calculated from rise time.  
<sup>\*4</sup> Derated w/ duty cycle and frequency.



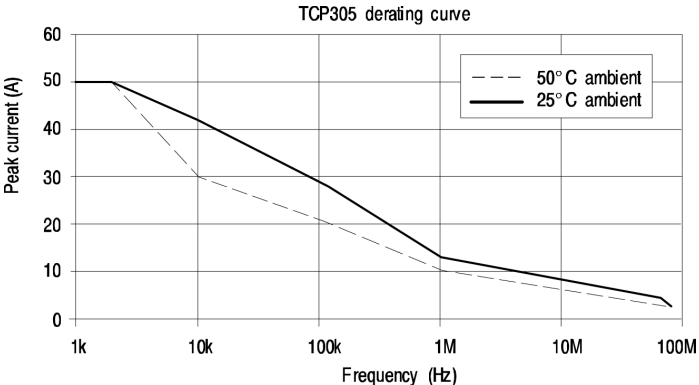
TCP312 Typical Peak Current Frequency Derating Curve.



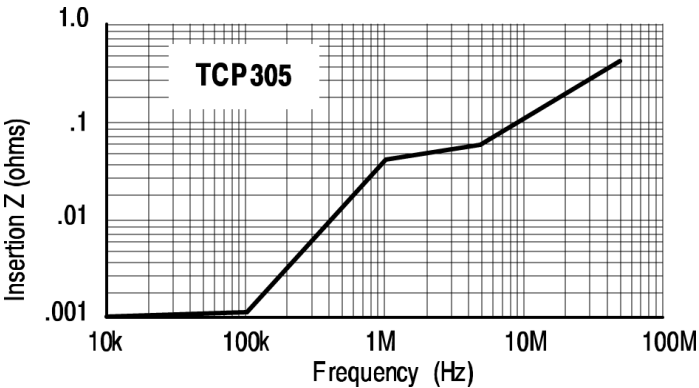
TCP312 Typical Insertion Impedance Curve.



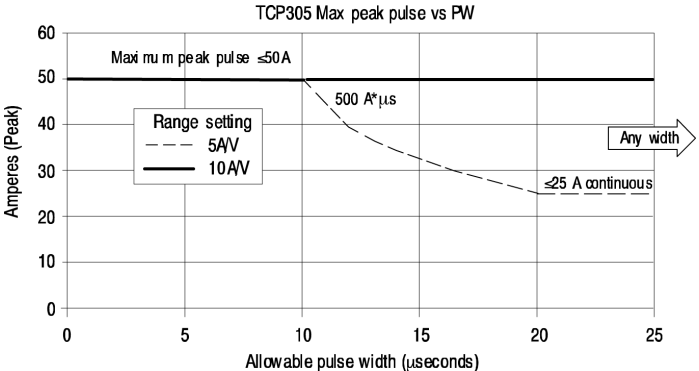
TCP312 Typical Specified Operating Area Characteristics.



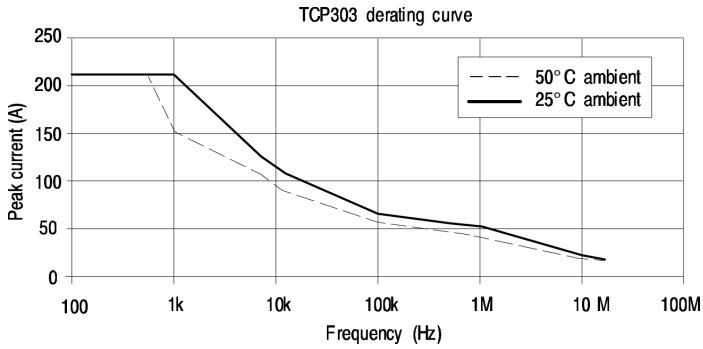
TCP305 Typical Peak Current Frequency Derating Curve.



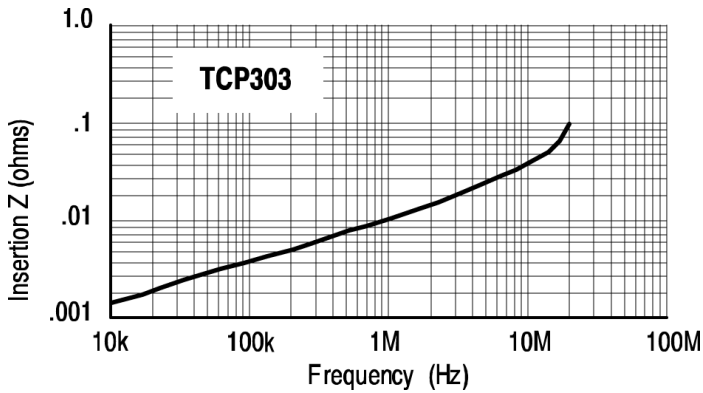
TCP305 Typical Insertion Impedance Curve.



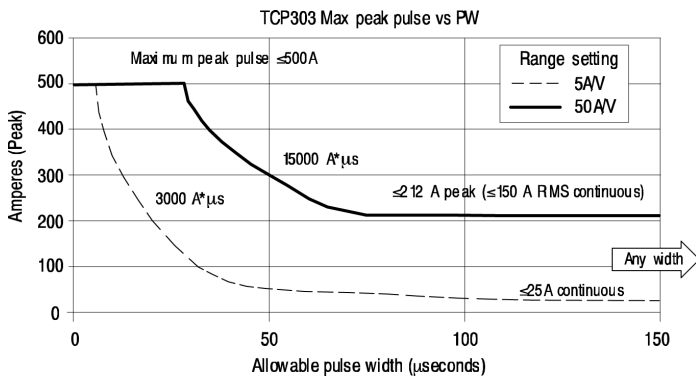
TCP305 Typical Specified Operating Area Characteristics.



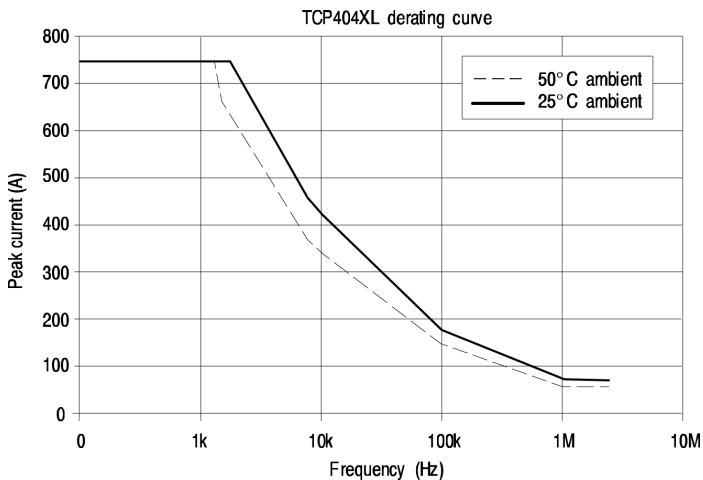
TCP303 Typical Peak Current Frequency Derating Curve.



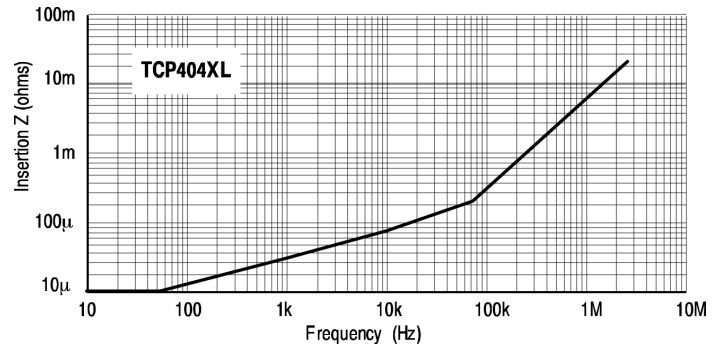
TCP303 Typical Insertion Impedance Curve.



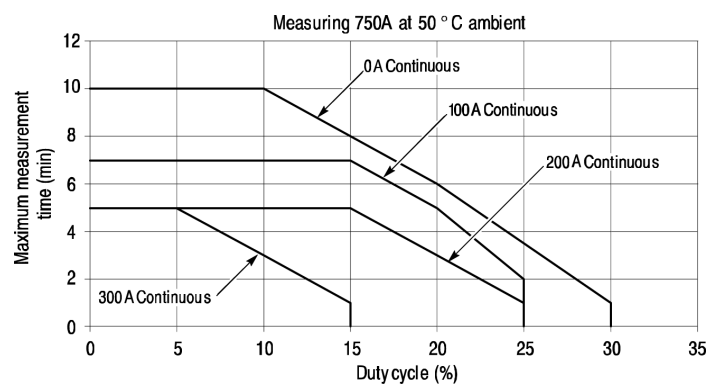
TCP303 Typical Specified Operating Area Characteristics.



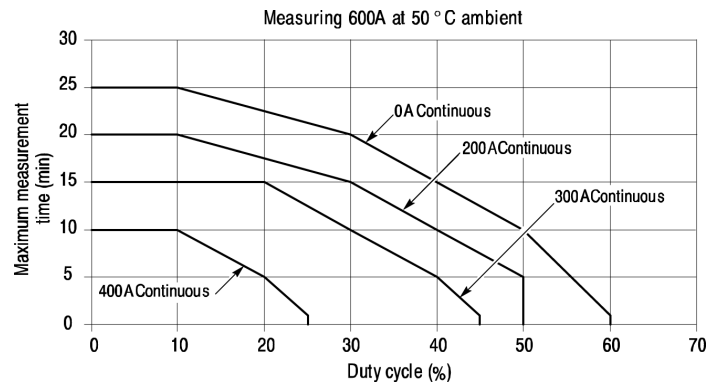
TCP404XL Typical Peak Current Frequency Derating Curve.



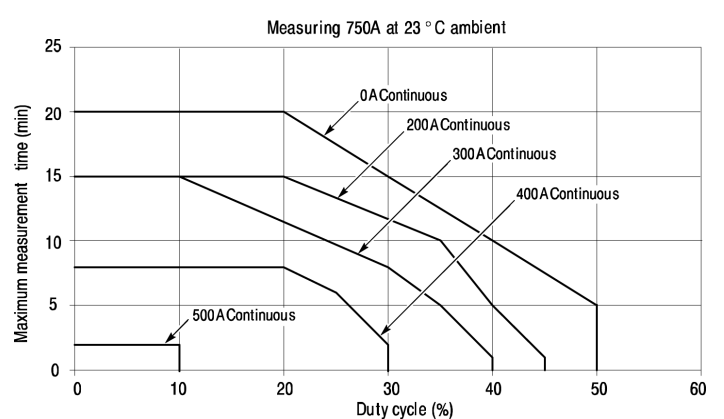
TCP404 Typical Insertion Impedance Curve.



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).

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

## Ordering Information

### Probes

Product	Description
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.

### Amplifiers

Product	Description
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  $\Omega$ ), 50  $\Omega$  feedthrough termination, Certificate of Traceable Calibration.

### TCPA300/TCPA400

#### Power Plug Options

Option	Description
Opt. A0	North America power
Opt. A1	Universal Euro power
Opt. A2	United Kingdom power
Opt. A3	Australia power
Opt. A5	Switzerland power
Opt. A6	Japan power
Opt. A10	China power
Opt. A11	India power
Opt. A12	Brazil power
Opt. A99	No power cord

#### Language Options

Option	Description
Opt. L0	English manual
Opt. L5	Japanese manual
Opt. L10	Russian manual
Opt. L99	No manual



Protective covers.

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

#### Service Options

Option	Description
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
Opt. SILV400	Standard Warranty Extended to 5 Years (TCP305, TCP312, TCPA300, and TCPA400)
Opt. SILV600	Standard Warranty Extended to 5 Years (TCP303 and TCP404XL)

#### Recommended Accessories

Accessory	Description
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 $\Omega$ Feedthrough Termination
012-0117-00	50 $\Omega$ 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 $\Omega$ , 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



Tektronix is registered to ISO 9001 and ISO 14001 by SRI Quality System Registrar.



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\* European toll-free number. If not accessible, call: +41 52 675 3777

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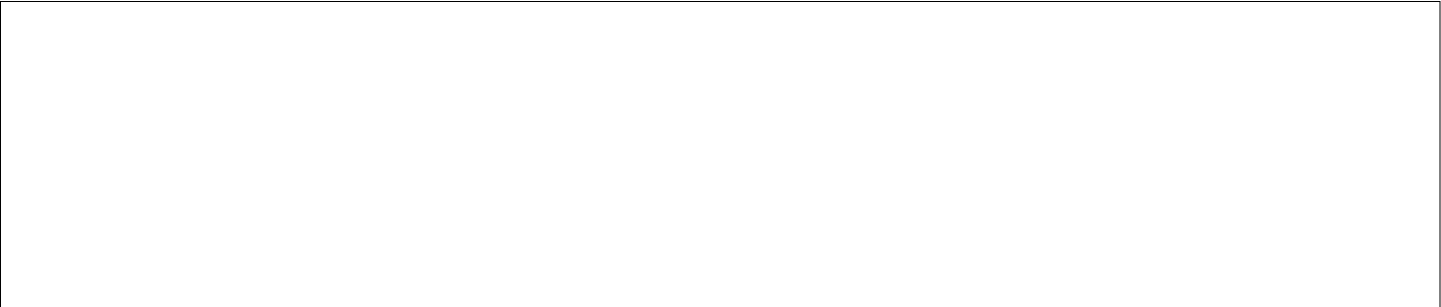
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