

# AC/DC Current Measurement Systems

## TCPA300, TCP312A, TCP305A, TCP303, TCPA400, TCP404XL Datasheet



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.

### Key performance specifications

- DC - 100 MHz, Current Probe Amplifier (TCPA300) uses:
  - DC - 100 MHz, 30 A DC (TCP312A)
  - DC - 50 MHz, 50 A DC (TCP305A)
  - DC - 15 MHz, 150 A DC (TCP303)
- DC - 50 MHz, Current Probe Amplifier (TCPA400) Uses:
  - DC - 2 MHz, 750 A DC <sup>1</sup> (TCP404XL) (500 A DC Continuous)

### Key features

- Automatic scaling and units <sup>2</sup> - 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  $\Omega$ , noncompatible probe type

<sup>1</sup> Derated with duty cycle

<sup>2</sup> Requires a TDS TEKSCOPE oscilloscope or a TekConnect oscilloscope with TCA-BNC adapter

- Low DC drift and noise allows improved low-level current measurements
- 3rd party safety certification

### Applications

- Development and analysis solutions for designers, installers, and service personnel in telecom, 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)

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

The TCPA300 amplifier, when used with TCP312A, TCP305A, 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 TCP312A 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.

## Specifications

All specifications apply to all models unless noted otherwise.

### Model overview

|  | TCP312A w/ TCPA300  | TCP305A w/ TCPA300  | TCP303 w/ TCPA300                                      | TCP404XL w/ TCPA400  |
|--|---|---|--|--|
| Bandwidth  | DC – 100 MHz  | DC – 50 MHz   | DC – 15 MHz  | DC – 2 MHz   |
| Rise time  | ≤3.5 ns   | ≤7 ns   | ≤23 ns   | ≤175 ns  |
| DC accuracy  | ±3% of reading  | ±3% of reading  | ±3% of reading   | ±3% of reading   |
| Accuracy, typical  | DC: ±1% of reading<br>DC to 60 Hz, ≤5 A: ±1%<br>60 Hz – 5 kHz, ≤5 A: ±1.5%<br>DC – 5 kHz, >5 A: ±1.5% | DC: ±1% of reading<br>DC to 60 Hz, ≤5 A: ±1%<br>60 Hz – 5 kHz, ≤5 A: ±1.5%<br>DC – 5 kHz, >5 A: ±1.5% | DC: ±1% of reading                                     | DC: ±1% of reading   |
| Lowest measurable current (at ±3% accuracy at DC)<br>Scope set to 1 mV/div and 20 MHz BW limited | 1 mA  | 5 mA  | 5 mA   | 1 A  |
| Maximum Amp-Second product, typical (based on amplifier range setting)                           | 50 A*μS – 1 A/V<br>500 A*μS – 10 A/V  | 500 A*μS – 5 A/V<br>NA – 10 A/V   | 3,000 A*μS – 5 A/V<br>15,000 A*μS – 50 A/V             | NA – 1 A/mV  |
| Maximum wire voltage   |   |   |  |  |
| Bare   | 150 V CAT II  | 150 V CAT II  | 600 V CAT I & II                                       | 600 V CAT I & II   |
| Insulated  | 300 V CAT II  | 300 V CAT II  | 300 V CAT III  | 300 V CAT III  |
| AC-coupling low-frequency Bandwidth, typical (Low pass – 3 dB point)                             | <7 Hz   | <7 Hz   | <7 Hz  | <7 Hz  |
| Displayed RMS noise, typical (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 (to output BNC)   | 17 ns   | 19 ns   | 40 ns  | 80 ns  |
| Insertion impedance  | 0.11 Ω at 1 MHz<br>0.12 Ω at 10 MHz<br>0.35 Ω at 50 MHz<br>0.7 Ω at 100 MHz                           | 0.02 Ω at 1 MHz<br>0.1 Ω at 10 MHz<br>0.35 Ω at 50 MHz  | 0.01 Ω at 1 MHz<br>0.025 Ω at 5 MHz<br>0.1 Ω at 15 MHz | 0.1 m Ω at 10 kHz<br>0.6 m Ω at 100 kHz<br>8 m Ω at 1 MHz<br>16 m Ω at 2 MHz |

## Characteristics

### Maximum current ratings

#### High-current sensitivity

|                  | TCP312A w/ TCPA300 | TCP305A w/ TCPA300 | TCP303 w/ TCPA300 | TCP404XL w/ TCPA400 |
|------------------|--------------------|--------------------|-------------------|---------------------|
| Range            | 10 A/V             | 10 A/V             | 50 A/V            | 1 A/mV              |
| DC (continuous)  | 30 A               | 50 A               | 150 A             | 500 A (750 A)       |
| RMS (sinusoidal) | 21.2 A             | 35.4 A             | 150 A             | 500 A               |
| Peak             | 50 A               | 50 A               | 500 A             | 750 A               |

#### Low-current sensitivity

|                  |       |        |        |     |
|------------------|-------|--------|--------|-----|
| Range            | 1 A/V | 5 A/V  | 5 A/V  | 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             | 50 A  | 50 A   | 500 A  | N/A |

## Physical characteristics

### Amplifiers

| TCPA300/TCPA400 |                  |
|-----------------|------------------|
| Length          | 17.3 cm (6.8 in) |
| Width           | 16.7 cm (6.6 in) |
| Height          | 9.14 cm (3.6 in) |
| Weight          | 1.14 kg (2.5 lb) |

### Probes

|        | TCP305A/TCP312A   | TCP303             | TCP404XL           |
|--------|-------------------|--------------------|--------------------|
| Length | 20 cm (7.77 in)   | 26.8 cm (10.55 in) | 26.8 cm (10.55 in) |
| Width  | 6 cm (0.625 in)   | 4.1 cm (1.60 in)   | 4.1 cm (1.60 in)   |
| Height | 3.2 cm (1.25 in)  | 15.6 cm (6.13 in)  | 15.6 cm (6.13 in)  |
| Weight | 0.15 kg (0.33 lb) | 0.66 kg (1.45 lb)  | 0.88 kg (1.90 lb)  |

### Maximum conductor size

|                  | TCP312A | TCP305A          | TCP303                        | TCP404XL                      |
|------------------|---------|------------------|-------------------------------|-------------------------------|
| 5.0 mm (0.15 in) |         | 5.0 mm (0.15 in) | 21 mm x 25 mm (0.83 x 1.0 in) | 21 mm x 25 mm (0.83 x 1.0 in) |

### Cable length

|               |               |               |              |
|---------------|---------------|---------------|--------------|
| 1.5 m (60 in) | 1.5 m (60 in) | 2 m (78.7 in) | 8 m (315 in) |
|---------------|---------------|---------------|--------------|

## EMC environment and safety

### Safety compliance

|                           | TCP312A/305A probe and amplifier                         | Amplifiers                  | TCP303/404XL probe and amplifier           |
|---------------------------|--|-----------------------------|--|
| U.S. NRTL listing         | UL61010-2-032, UL61010-1                                 | UL3111-1, first edition     | UL3111-2-032, UL3111-2-031; UL3111-1       |
| Canadian certification    | CAN/CSA C22.2 No. 61010-1, CAN/CSA C22.2 No. 61010-2-032 | CAN/CSA C22.2 No. 1010.1-92 | CAN/CSA C22.2 No. 1010.1-92                |
| European Union compliance | EN61010-1, EN61010-2-032                                 | EN61010-1:2001              | EN61010-1/A2, EN61010-2-031, EN61010-2-032 |
| Other                     |  |                             | IEC61010-2-032                             |

### Electromagnetic compatibility, amplifiers only

EC Council Directive 89/336/EEC, FCC Part 15, Subpart B Class A, AS/NZS 2064.1/2.

## EMC environment and safety

### Temperature

|                     |                                     |
|---------------------|-------------------------------------|
| <b>Operating</b>    | 0 °C to +50 °C (32 °F to 122 °F)    |
| <b>Nonoperating</b> | -40 °C to +75 °C (-40 °F to 167 °F) |

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### Humidity

|                     |   |
|---------------------|---|
| <b>Operating</b>    | 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) |
| <b>Nonoperating</b> | 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) |

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### Altitude

|                     |                               |
|---------------------|-------------------------------|
| <b>Operating</b>    | 2000 m (6800 ft.) maximum     |
| <b>Nonoperating</b> | 12,192 m (40,000 ft.) maximum |

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## Ordering information

### Models

#### Probes

|                       |  |
|-----------------------|--|
| <b>TCP312A Probe</b>  | AC/DC current, DC to 100 MHz; 30 A DC (Requires TCPA300 amplifier)                                   |
| <b>TCP305A Probe</b>  | AC/DC current, DC to 50 MHz; 50 A DC (Requires TCPA300 amplifier)                                    |
| <b>TCP303 Probe</b>   | AC/DC current, DC to 15 MHz; 150 A DC (Requires TCPA300 amplifier)                                   |
| <b>TCP404XL Probe</b> | AC/DC current, DC to 2 MHz; 500 A DC (750 A DC derated with duty cycle) (Requires TCPA400 amplifier) |

#### Amplifiers

|                          |  |
|--------------------------|--|
| <b>TCPA300 Amplifier</b> | AC/DC current probe, DC to 100 MHz, (Requires TCP305A or TCP312A or TCP303 probes) |
| <b>TCPA400 Amplifier</b> | AC/DC current probe, DC to 50 MHz, (Requires TCP404XL probe)                       |

## Recommended accessories

|   |             |
|---|-------------|
| <b>Cover, large probe protective; (for TCP303, TCP404XL)</b>                              | 016-1924-00 |
| <b>Case, transit; current measurement systems</b>   | 016-1922-00 |
| <b>50 Ω feedthrough termination</b>   | 011-0049-02 |
| <b>50 Ω BNC-to-BNC coaxial cable</b>  | 012-0117-00 |
| <b>TEKPROBE interface cable, TCPA300 or TCPA400 amplifier to TDS series oscilloscopes</b> | 012-1605-00 |
| <b>Current loop, 1 turn, 50 Ω, BNC connector (for TCP305A, TCP312A, TCP202A)</b>          | 067-2396-00 |
| <b>Current loop, 1 turn, 50 Ω, BNC connector (for TCP303, TCP404XL)</b>                   | 015-0601-50 |

**TCPA300/TCPA400 amplifier calibration adapter** 174-4765-00

**Power measurements deskew fixture for TCP202A, TCP305A, TCP312A, TCP303 probes** 067-1478-00

## Warranty

One year parts and labor.

## Power requirements

**Amplifiers** 90 V to 264 V, 47 to 440 Hz, 50 W; Maximum CAT II (auto switch)

**Probes** TCP312A, TCP305A, TCP303 probes require a TCPA300 Amplifier; TCP404XL probe requires a TCPA400 Amplifier

## Options

### Power plug options

**Opt. A0** North America power plug (115 V, 60 Hz)  
**Opt. A1** Universal Euro power plug (220 V, 50 Hz)  
**Opt. A2** United Kingdom power plug (240 V, 50 Hz)  
**Opt. A3** Australia power plug (240 V, 50 Hz)  
**Opt. A5** Switzerland power plug (220 V, 50 Hz)  
**Opt. A6** Japan power plug (100 V, 50/60 Hz)  
**Opt. A10** China power plug (50 Hz)  
**Opt. A11** India power plug (50 Hz)  
**Opt. A12** Brazil power plug (60 Hz)  
**Opt. A99** No power cord

### ServiceOptions

**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 Opt. C3)  
**Opt. D5** Calibration Data Report 5 Years (with Opt. C5)  
**Opt. R3** Repair Service 3 Years (including warranty)  
**Opt. R3DW** Repair Service Coverage 3 Years (includes product warranty period). 3-year period starts at time of instrument purchase  
**Opt. R5** Repair Service 5 Years (including warranty)  
**Opt. R5DW** Repair Service Coverage 5 Years (includes product warranty period). 5-year period starts at time of instrument purchase  
**Opt. SILV400** Standard warranty extended to 5 years (TCP305A, TCP312A, TCPA300, TCPA400 )  
**Opt. SILV600** Standard warranty extended to 5 years (TCP303, TCP404XL)



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

**ASEAN / Australasia** (65) 6356 3900  
**Belgium** 00800 2255 4835\*  
**Central East Europe and the Baltics** +41 52 675 3777  
**Finland** +41 52 675 3777  
**Hong Kong** 400 820 5835  
**Japan** 81 (3) 6714 3010  
**Middle East, Asia, and North Africa** +41 52 675 3777  
**People's Republic of China** 400 820 5835  
**Republic of Korea** 001 800 8255 2835  
**Spain** 00800 2255 4835\*  
**Taiwan** 886 (2) 2722 9622

**Austria** 00800 2255 4835\*  
**Brazil** +55 (11) 3759 7627  
**Central Europe & Greece** +41 52 675 3777  
**France** 00800 2255 4835\*  
**India** 000 800 650 1835  
**Luxembourg** +41 52 675 3777  
**The Netherlands** 00800 2255 4835\*  
**Poland** +41 52 675 3777  
**Russia & CIS** +7 (495) 6647564  
**Sweden** 00800 2255 4835\*  
**United Kingdom & Ireland** 00800 2255 4835\*

**Balkans, Israel, South Africa and other ISE Countries** +41 52 675 3777  
**Canada** 1 800 833 9200  
**Denmark** +45 80 88 1401  
**Germany** 00800 2255 4835\*  
**Italy** 00800 2255 4835\*  
**Mexico, Central/South America & Caribbean** 52 (55) 56 04 50 90  
**Norway** 800 16098  
**Portugal** 80 08 12370  
**South Africa** +41 52 675 3777  
**Switzerland** 00800 2255 4835\*  
**USA** 1 800 833 9200

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

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