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# 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

AC/DC measurement capabilities

- 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 [1] (TCP404XL) (500 A DC Continuous)

### Key features

- 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 Ω, noncompatible probe type
- 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 ≥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/

[1] Derated with duty cycle

[2] Requires a TDS TEKSCOPE oscilloscope or a TekConnect oscilloscope with TCA-BNC adapter

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 are guaranteed unless noted otherwise. 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) | ≤75 $\mu A_{RMS}$ | ≤1.25 $mA_{RMS}$ | ≤2.5 $mA_{RMS}$ | ≤250 $mA_{RMS}$ |
| 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

| | TCP312A w/ TCPA300 | TCP305A w/ TCPA300 | TCP303 w/ TCPA300 | TCP404XL w/ TCPA400 |
|---|---|---|---|---|
| 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 | 9.14 cm (3.6 in) |
| Height | 16.7 cm (6.6 in) |
| Weight | 1.14 kg (2.5 lb) |

### Probes

| | TCP305A/TCP312A | TCP303 | TCP404XL |
|---|---|---|---|
| Length | 14.99 cm (5.86 in) | 26.8 cm (10.55 in) | 26.8 cm (10.55 in) |
| Width | 1.59 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 (0.197 in) | 5.0 mm (0.197 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

| TCP312A | TCP305A | TCP303 | TCP404XL |
|---|---|---|---|
| 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**

**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

# Ordering information

## Models

**Probes**

**TCP312A Probe** AC/DC current, DC to 100 MHz; 30 A DC (Requires TCPA300 amplifier)

**TCP305A 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 TCP300/400 probes include: compliance and safety instructions, certificate of traceable calibration.

**Amplifiers**

| | |
|---|---|
| **TCPA300 Amplifier** | AC/DC current probe, DC to 100 MHz, (Requires TCP305A or TCP312A 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, compliance and safety instructions, TEKPROBE interface cable, certificate of traceable calibration.

## Recommended accessories

| | |
|---|---|
| **Cover, large probe protective; (for TCP303, TCP404XL)** | 016-1924-00 |
| **Case, transit; current measurement systems** | 016-1922-00 |
| **50 Ω feedthrough termination** | 011-0049-02 |
| **50 Ω BNC-to-BNC coaxial cable** | 012-0117-00 |
| **TEKPROBE interface cable, TCPA300 or TCPA400 amplifier to TDS series oscilloscopes** | 012-1605-00 |
| **Current loop, 1 turn, 50 Ω, BNC connector (for TCP305A, TCP312A, TCP202A)** | 067-2396-00 |
| **Current loop, 1 turn, 50 Ω, BNC connector (for TCP303, TCP404XL)** | 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 ISO 14001:2015 and ISO 9001:2015 certified by DEKRA.

**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 (120) 441 046
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**Balkans, Israel, South Africa and other ISE Countries** +41 52 675 3777
**Canada** 1 800 833 9200
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