

## AC Current Probes

### CT1 · CT2 · CT6 Datasheet



#### Features and Benefits

- High Bandwidth
- Ultra-low Inductance
- Very Small Form Factor
- Characterize Current Waveforms up to <200 ps Rise Times
- Very Low Loading of Circuit Under Test
- Fits Into Dense, Closely-spaced Circuit Designs

#### Applications

- Data Storage Read Channel Design
- Silicon Characterization
- High-frequency Analog Design
- ESD Testing
- Signal Injection
- Differential Current Measurements
- Single-shot Low Rep-rate Pulse Measurements

- Propagation Delay Measurement

#### CT6 Current Probe

The CT6 is the newest addition to the Tektronix portfolio of high-frequency current probes. It is designed to meet the needs of high-speed circuit design and test applications which require ultra-high bandwidth, low inductance, and extremely small form factor. The CT6 provides up to 2 GHz bandwidth when used with high-bandwidth oscilloscopes such as the Tektronix TDS694C, TDS794D, and TDS7000 Series oscilloscopes or with other compatible 50  $\Omega$  input measuring instruments. Low inductance (<3 nH) assures that the loading effect of the CT6 on the circuit-under-test will be negligible, which is especially important for today's low-amplitude, high-speed circuit designs such as disk drive read/write preamplifiers. The probe is a closed-circuit design which will accept uninsulated wire sized up to 20 gauge. This product is exempt from CE mark by virtue of its 30 V voltage limit.

#### CT1-CT2 Current Probes

The CT1 and CT2 Current Probes are designed for permanent or semi-permanent in-circuit installation. Each probe consists of a current transformer and an interconnecting cable. The current transformers have a small hole through which a current carrying conductor is passed during circuit assembly.

The P6041 Probe Cable provides the connection between the CT1 and CT2 Current Transformers and a BNC oscilloscope input. A 50  $\Omega$  termination is required to terminate the cable when connected to a high-impedance (1 M $\Omega$ ) oscilloscope input. One probe cable can be used to monitor several current transformers that have been wired into a circuit.



CT1/CT2. Current Probes with P6041 BNC Probe Cable

### Miniature Construction

The CT1 and CT2 detachable cable design enables one or more probes to be located on circuit boards or in other limited space areas.

The CT6 offers the smallest form factor available, for measurement on ever-shrinking circuit boards and components. It is designed for temporary installation and does not incorporate removable cables, as the CT1 and CT2 do.

### Extendible Probe Length

Specified rise time and bandwidth are obtained when using the probe cables provided: The P6041 cable used with the CT1 and CT2 is 42 inches nominal. If additional length is required, the cables can be extended by using high-quality 50  $\Omega$  cable and suitable interface connectors. (Also see Special Probe Cables, Optional Accessories.) Long cables may degrade high-frequency response.

### High Sensitivity

The CT1 and CT6 provide an output of 5 mV for each milliamp of input current when terminated in 50  $\Omega$ . The CT2 provides 1 mV per milliamp when terminated in 50  $\Omega$ .

### Typical Systems

The CT1, CT2, and CT6 high-frequency current transformers are dynamic (i.e., non-DC) current measuring devices. They are typically used in conjunction with compatible high-bandwidth oscilloscopes and other instruments to observe and/or record high-frequency current waveforms. The CT1, CT2, and CT6 normally operate directly into 50  $\Omega$  scopes and other measuring device inputs.

The CT1 or CT2 can be used with 1 M $\Omega$  input systems; use the P6041 probe cable and terminate the output with a 50  $\Omega$  feed-through termination (see Optional Accessories).

In all cases, the CT1, CT2, and CT6 must work into 50  $\Omega$ s to obtain specified performance and sensitivity.

## Typical Measurement Applications

### Differential Current Measurements

Most true-differential voltage amplifiers have a maximum bandwidth of about 100 MHz. The CT1 or CT6 can make differential current measurements to 1 GHz and 2 GHz, respectively, by passing two wires carrying opposing currents through the same core. The displayed result is the difference current. The CT2 can perform the same function to 200 MHz.

In all cases, Derating with Frequency and Amp-second Product (Current-time Product) guidelines should not be exceeded. (See Characteristics.)

### Single-shot and Low Rep-rate Pulse Measurements

These common measurements are easy to make with the CT1, CT2, or CT6 provided that your signal fits within the Max Pulse Current and Amp-second Product (Current-time Product) guidelines for the specific current probe characteristics.

For example, the CT2 is rated at 36 A peak, with an Amp-second Product of  $50 \times 10^{-6}$  seconds (50 Amp-microseconds), therefore the CT2 can safely handle a 36 A peak pulse with a maximum width of 1.39 microseconds or lower amplitude pulses for longer pulse widths. The CT1, CT2, and CT6 all have low-frequency roll-off characteristics. Low-frequency "droop" will exhibit itself when the pulse width approaches the L/R time constant of the specific transformer.

### Propagation Delay Measurements

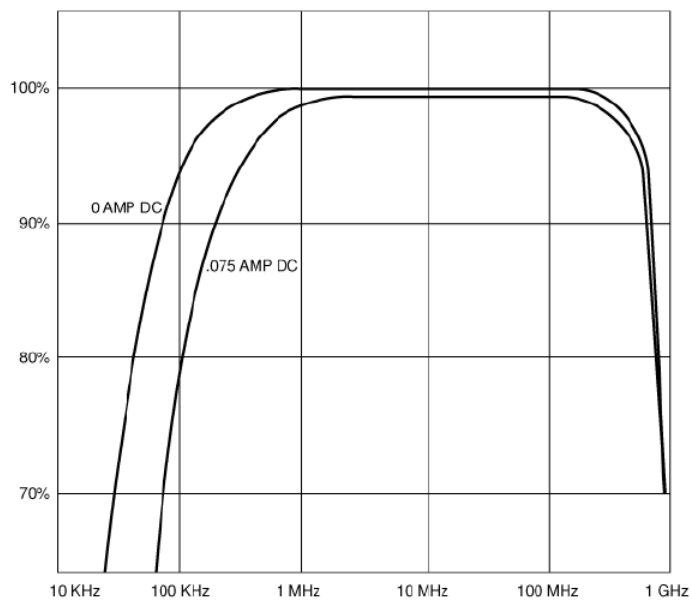
be used to measure propagation delay (transit time) between the input and output currents of high-frequency devices. The probe outputs are connected to the inputs of dual-channel real-time or sampling scopes. Verification of any Probe/Cable/Scope System mismatch can be obtained by passing the same signal current through both probes and observing total system delay difference, if any.

## Characteristics

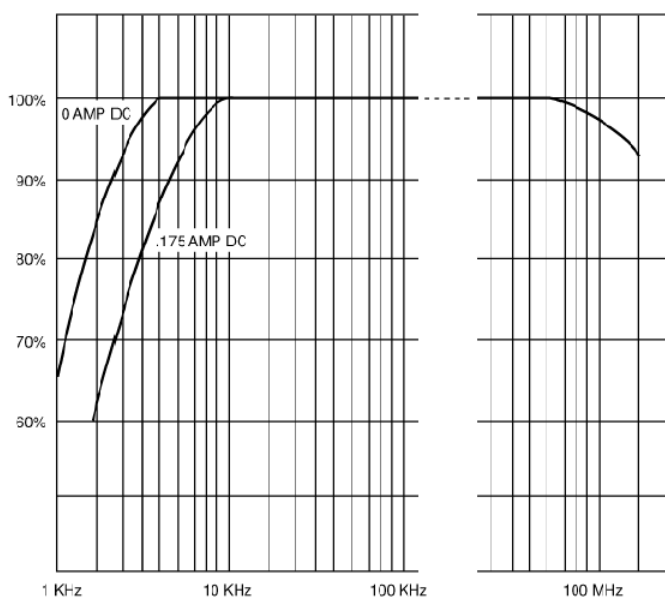
### CT1, CT2, and CT6 characteristics

| Characteristic                  | CT1                                           | CT2                                            | CT6                                              |
|---------------------------------|-----------------------------------------------|------------------------------------------------|--------------------------------------------------|
| Bandwidth (typical)             | 25 kHz to 1 GHz                               | 1.2 kHz to 200 MHz                             | 250 kHz to 2 GHz                                 |
| Rise Time                       | 350 ps                                        | 500 ps                                         | 200 ps                                           |
| Sensitivity (into 50 $\Omega$ ) | 5 mV/mA                                       | 1 mV/mA                                        | 5 mV/mA                                          |
| Accuracy                        | $\pm 3\%$                                     | $\pm 3\%$                                      | $\pm 3\%$                                        |
| Magnetizing Inductance          | 6 $\mu\text{H}$                               | 7 $\mu\text{H}$                                | 1 $\mu\text{H}$                                  |
| Leakage Inductance              | 2.4 nH                                        | 1 nH                                           | 1.5 nH                                           |
| Insertion Impedance:            |                                               |                                                |                                                  |
| at 10 MHz                       | <1 $\Omega$                                   | 0.1 $\Omega$                                   | 1.1 $\Omega$                                     |
| at 100 MHz                      | 2 $\Omega$                                    | 0.5 $\Omega$                                   | 1.3 $\Omega$                                     |
| at 1 GHz                        |                                               |                                                | 11.9 $\Omega$                                    |
| Max. Bare Wire Size             | #14 wire<br>1.78 mm (0.070 in.)               | #16 wire<br>1.32 mm (0.052 in.)                | #20 wire<br>0.8 mm (0.032 in.)                   |
| Max. Bare Wire Voltage:         |                                               |                                                |                                                  |
| RMS                             | 30 V <sub>ac</sub> , 40 V <sub>pk</sub>       | 30 V <sub>ac</sub> , 40 V <sub>pk</sub>        | 30 V <sub>RMS</sub> CAT I                        |
| Peak                            | 30 V<br>(<3.25% Duty Factor)                  | 30 V<br>(<3.25% Duty Factor)                   | 30 V                                             |
| DC                              | 30 V                                          | 30 V                                           | 30 V                                             |
| Max. Peak Pulse Current         | 12 A                                          | 36 A                                           | 6 A                                              |
| Max. Continuous Current (RMS)   | 450 mA                                        | 2.5 A                                          | 120 mA                                           |
| Amp-second Product              | $1 \times 10^{-6} \text{ A} \cdot \text{Sec}$ | $50 \times 10^{-6} \text{ A} \cdot \text{Sec}$ | $0.25 \times 10^{-6} \text{ A} \cdot \text{Sec}$ |
| L/R Time Constant (droop)       | >6.35 $\mu\text{s}$                           | >160 $\mu\text{s}$                             | 0.4 $\mu\text{s}$                                |
| Propagation Delay               | 5.4 ns                                        | 6.1 ns                                         | 5.2 ns                                           |

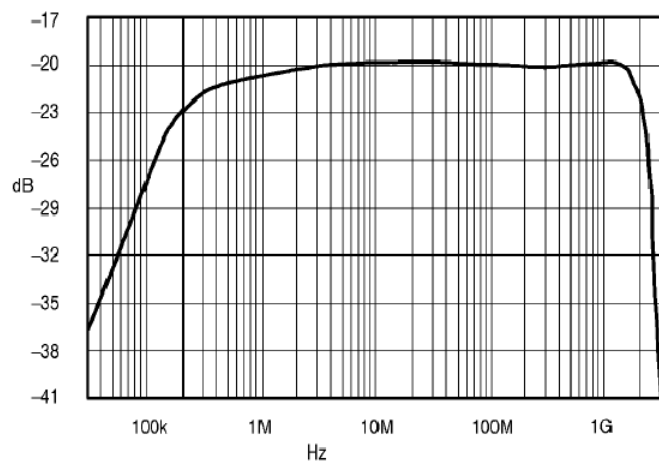
Table continued...



CT1 Typical Frequency Response



CT2 Typical Frequency Response



CT6 Typical Frequency Response

| Characteristic | CT1                             | CT2                             | CT6 |
|----------------|---------------------------------|---------------------------------|-----|
| Safety         | UL3111-2-032,<br>CSA1010.2.032, | UL3111-2-032,<br>CSA1010.2.032, | NA  |

| Characteristic | CT1                              | CT2                              | CT6 |
|----------------|----------------------------------|----------------------------------|-----|
|                | EN61010-2-032,<br>IEC61010-2-032 | EN61010-2-032,<br>IEC61010-2-032 |     |

## Ordering Information

### CT1

High-frequency Current Probe. Includes: Manual and P6041 Interconnect Cable.

### CT2

High-frequency Current Probe. Includes: Manual and P6041 Interconnect Cable.

### CT6

High-frequency Current Probe.

## Service

|                |                                                  |
|----------------|--------------------------------------------------|
| Opt. C3 –      | Calibration Service 3 Years                      |
| Opt. C5 –      | Calibration Service 5 Years                      |
| Opt. D1 –      | Calibration Data Report (CT6 only)               |
| 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                           |
| Opt. R5 –      | Repair Service 5 Years                           |
| Opt. SILV400 – | Standard Warranty Extended to 5 Years (CT6 Only) |

## CT1 or CT2 Recommended Accessories

Feed-through 50  $\Omega$  Termination Order 011-0049-02.

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## CT6 Standard Accessories

|                                        |                    |
|----------------------------------------|--------------------|
| SMA to BNC Adapter –                   | Order 015-0572-xx. |
| User Manual –                          | Order 071-0453-xx. |
| Color Cable Marker Bands –             |                    |
| Probe Holder –                         | Order 015-0682-xx. |
| Certificate of Traceable Calibration – |                    |
| Warranty –                             | One Year.          |



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