

# Digital Phosphor Oscilloscopes

## TDS3000C Series Datasheet



The TDS3000C Series provides you with the performance you need at a price you can afford. Bandwidths range from 100 MHz to 500 MHz, with up to 5 GS/s sample rates for accurate representation of your signal.

### Notice to EU customers

This product is not updated to comply with the RoHS 2 Directive 2011/65/EU and will not be shipped to the EU. Customers may be able to purchase products from inventory that were placed on the EU market prior to July 22, 2017 until supplies are depleted. Tektronix is committed to helping you with your solution needs. Please contact your local sales representative for further assistance or to determine if alternative product(s) are available. Tektronix will continue service to the end of worldwide support life.

### Key performance specifications

- 100 MHz, 300 MHz, and 500 MHz bandwidth models
- 2 or 4 analog channel models
- Sample rates up to 5 GS/s real time on all channels
- 10k record length on all channels
- 3,600 wfms/s continuous waveform capture rate
- Suite of advanced triggers

### Key features

- Front-panel USB host port for easy storage and transfer of measurement data
- 25 automatic measurements

- FFT standard
- Multiple language user interface
- WaveAlert® automatic waveform anomaly detection
- TekProbe® interface supports active, differential, and current probes for automatic scaling and units

### Portable design

- Lightweight design (only 7 lb./3.2 kg) for easy transport
- Optional internal battery operation provides up to three hours without line power

### Application modules for specialized analysis

- Advanced analysis module
- Limit testing module
- Telecommunications mask testing module
- Extended video module

### Applications

- Digital design and debug
- Video installation and service
- Power supply design
- Education and training
- Telecommunications mask testing
- Manufacturing test
- General bench testing

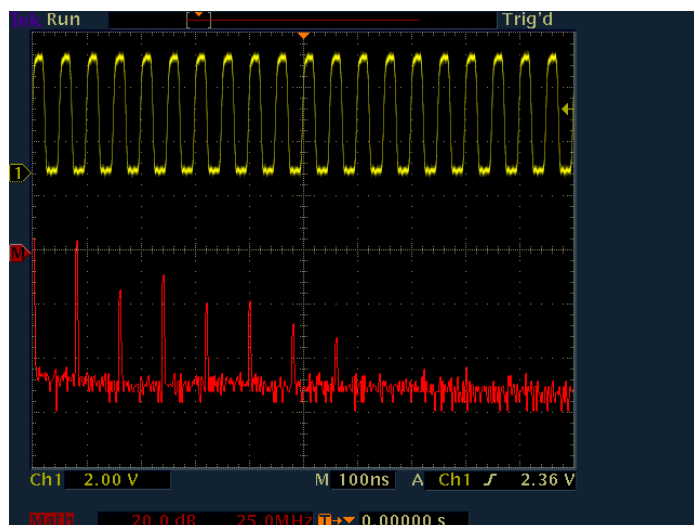
## DPOs provide greater level of insight into complex signals

The TDS3000C Series offers fast waveform capture rates on a continuous basis that save you time by quickly revealing the nature of faults, so advanced triggers can be applied to isolate them.

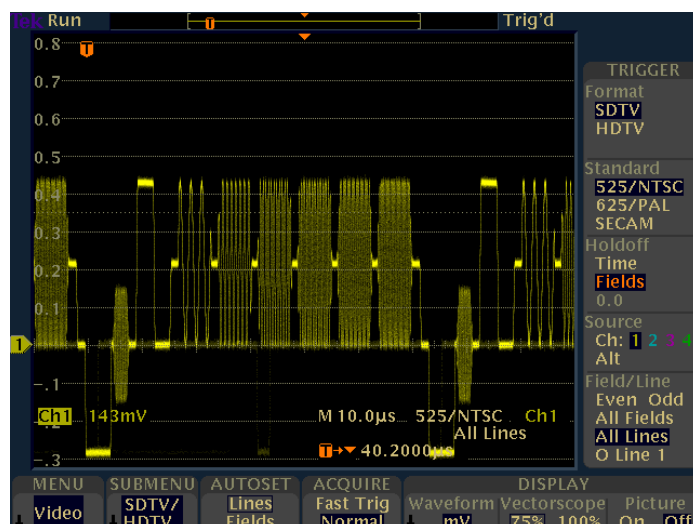
Real-time intensity grading highlights the details about the history of a signal's activity, making it easier to understand the characteristics of the waveforms you've captured. Unlike other comparable oscilloscopes, the history remains even after the acquisition has been stopped.

## Quickly debug and characterize signals with DRT sampling technology and $\sin(x)/x$ interpolation

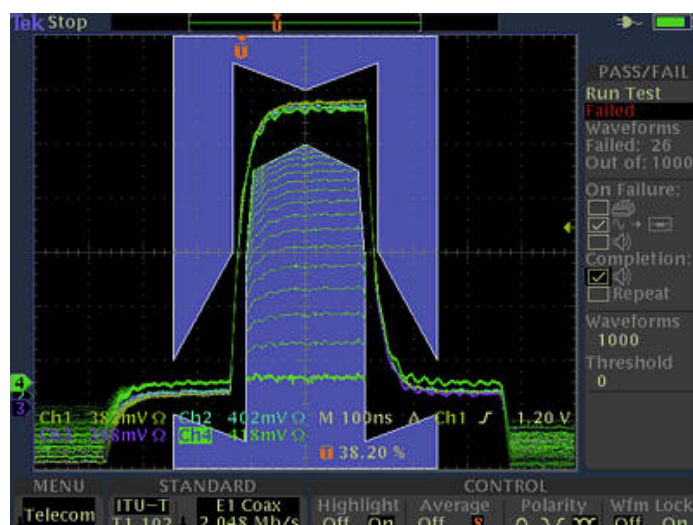
The TDS3000C Series combines unique digital real-time (DRT) sampling technology with  $\sin(x)/x$  interpolation to allow you to accurately characterize a wide range of signal types on all channels simultaneously. With the TDS3000C Series there is no change in sampling rate when additional channels are turned on, unlike other comparable oscilloscopes. This sampling technology makes it possible to capture high-frequency information, such as glitches and edge anomalies, that elude other oscilloscopes in its class, while  $\sin(x)/x$  interpolation ensures precise reconstruction of each waveform.



Look for unintentional circuit noise with the TDS3000C series' FFT capability.



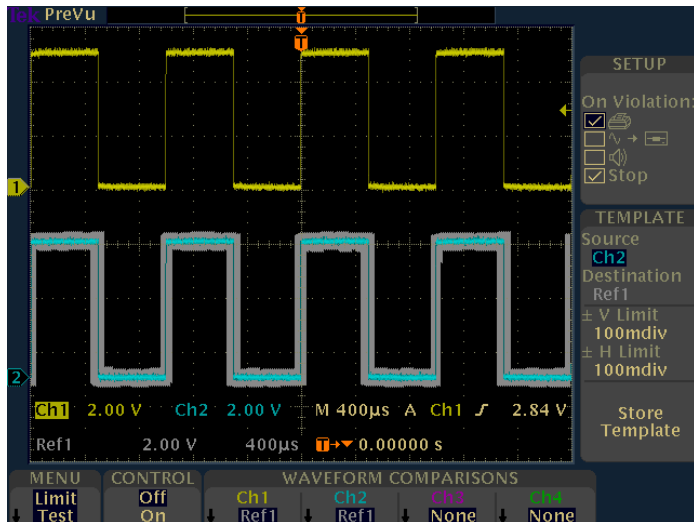
Custom video triggering allows the TDS3000C Series to trigger on standards such as RS-343 (26.2 kHz scan rate).



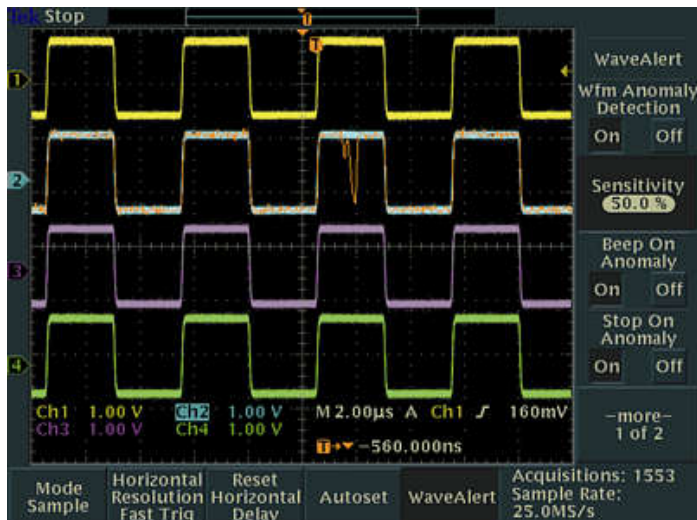
The TDS3000C Series provides breakthrough test speeds for telecommunications line card testing. The telecom QUICKMENU puts all the commonly used telecom test functions on a single menu.

## Easy to setup and use

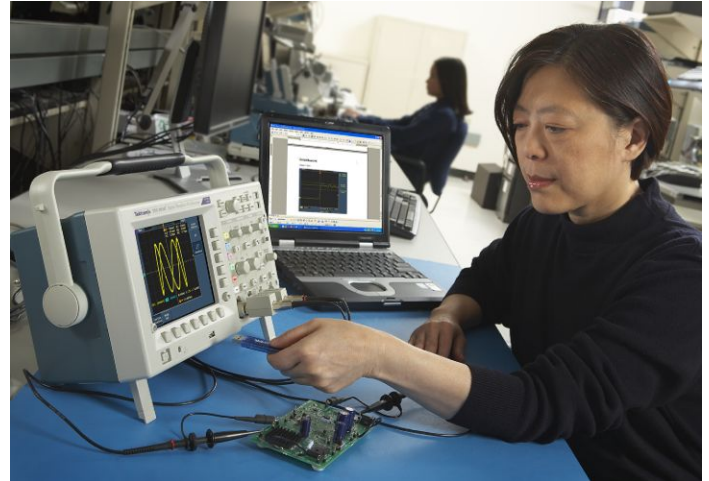
When working under tight deadlines, you need your oscilloscope to be intuitive; you want to minimize time spent learning and relearning how to use it. The TDS3000C Series oscilloscopes help reduce your learning curve. Simple navigation and dedicated front-panel controls get you to where you want to be quickly, so that you spend less time learning and more time on the task at hand.



The TDS3000C series with the TDS3LIM module is ideal for manufacturing test applications where fast Go/No-Go decisions are required.



WaveAlert waveform anomaly detection alerts you to any waveform that deviates from the "normal" input such as the glitch on channel 2.



Easily transfer, document, and analyze data on your PC.

## Simple documentation and analysis

The TDS3000C Series comes equipped with a USB host port so you can easily store and transfer measurement information to your PC.

OpenChoice® PC Communication Software allows you to simply pull screen images and waveform data into a standalone desktop application or directly into Microsoft Word and Excel.

If you prefer not to use a PC for analysis, the TDS3000C Series comes standard with 25 automatic measurements, waveform add, subtract, divide, and multiply math functions, and Fast Fourier Transform (FFT). Unlike other comparable oscilloscopes, the TDS3000C Series math and measurement allows you to use the full acquisition record length or isolate a specific occurrence within an acquisition.

## Instrument control

Utilizing the built-in ethernet port, e\*Scope web-based remote control allows you to control TDS3000C series oscilloscope from anywhere, using the internet and your PC.

Work where you need to

The TDS3000C Series packs the power of a DPO in a compact design that is only 5.9 in. (149 mm) deep, freeing up valuable benchtop space. And when you need to move your oscilloscope to another lab, its portable 7 lb. (3.2 kg) design makes for easy transport.

If your work demands even more mobility, then the optional battery pack will give you up to three hours of operation without line power.



TDS3BATC provides you with up to three hours of portable battery operation.

Specifications

All specifications are guaranteed unless noted otherwise. All specifications apply to all models unless noted otherwise.

|                             | TDS3012C   | TDS3014C  | TDS3032C | TDS3034C | TDS3052C | TDS3054C |
|-----------------------------|------------|-----------|----------|----------|----------|----------|
| Input channels              | 2          | 4         | 2        | 4        | 2        | 4        |
| Bandwidth                   | 100 MHz    | 100 MHz   | 300 MHz  | 300 MHz  | 500 MHz  | 500 MHz  |
| Rise time (typical)         | 3.5 ns     | 3.5 ns    | 1.2 ns   | 1.2 ns   | 0.7 ns   | 0.7 ns   |
| Sample rate on each channel | 1.25 GS/s  | 1.25 GS/s | 2.5 GS/s | 2.5 GS/s | 5 GS/s   | 5 GS/s   |
| Record length               | 10 kpoints |           |          |          |          |          |

Vertical system

|                           |                                                    |          |                 |                 |                 |                 |
|---------------------------|----------------------------------------------------|----------|-----------------|-----------------|-----------------|-----------------|
| Hardware bandwidth limits | TDS3012C                                           | TDS3014C | TDS3032C        | TDS3034C        | TDS3052C        | TDS3054C        |
|                           | 20 MHz                                             | 20 MHz   | 20 MHz, 150 MHz | 20 MHz, 150 MHz | 20 MHz, 150 MHz | 20 MHz, 150 MHz |
| Input coupling            | AC, DC, GND                                        |          |                 |                 |                 |                 |
| Input impedance           | 1 M $\Omega$ in parallel with 13 pF or 50 $\Omega$ |          |                 |                 |                 |                 |
| Input sensitivity range   |                                                    |          |                 |                 |                 |                 |
| 1 M $\Omega$              | 1 mV/div to 10 V/div                               |          |                 |                 |                 |                 |
| 50 $\Omega$               | 1 mV/div to 1 V/div                                |          |                 |                 |                 |                 |
| Vertical resolution       | 9 bits                                             |          |                 |                 |                 |                 |
| Maximum input voltage     |                                                    |          |                 |                 |                 |                 |
| 1 M $\Omega$              | 150 V <sub>RMS</sub> with peaks at $\leq$ 400 V    |          |                 |                 |                 |                 |
| 50 $\Omega$               | 5 V <sub>RMS</sub> with peaks at $\leq$ 30 V       |          |                 |                 |                 |                 |

**Vertical system**

DC gain accuracy  $\pm 2\%$

Position range  $\pm 5$  div

**Horizontal system**

| Seconds/division range | TDS3012C     | TDS3014C     | TDS3032C     | TDS3034C     | TDS3052C     | TDS3054C     |
|------------------------|--------------|--------------|--------------|--------------|--------------|--------------|
|                        | 4 ns to 10 s | 4 ns to 10 s | 2 ns to 10 s | 2 ns to 10 s | 1 ns to 10 s | 1 ns to 10 s |

Time base accuracy  $\pm 20$  ppm over any 1 ms time interval

**Trigger system**

Trigger modes Auto (supports Roll Mode for 40 ms/div and slower), Normal, Single Sequence

B trigger Trigger after time or events

Trigger after time range 13.2 ns to 50 s

Trigger after events range 1 to 9,999,999 events

**Trigger types**

|                         |                                                                                                                                                                        |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Edge                    | Conventional level-driven trigger. Positive or negative slope on any channel. Coupling selections: AC, DC, Noise Reject, HF Reject, LF Reject                          |
| Video                   | Trigger on all lines or individual lines, odd/even or all fields on NTSC, PAL, SECAM                                                                                   |
| Extended video          | Trigger on specific lines in broadcast and non-broadcast (custom) standards and on analog HDTV formats (1080i, 1080p, 720p, 480p). Requires TDS3VID application module |
| Pulse width (or glitch) | Trigger on a pulse width $<$ , $>$ , $=$ , $\neq$ to a selectable time limit ranging from 39.6 ns to 50 s                                                              |
| Runt                    | Trigger on a pulse that crosses one threshold but fails to cross a second threshold before crossing the first again                                                    |
| Rise/fall time          | Trigger on pulse edge rates that are either faster or slower than a set rate. Edges can be rising, falling, or either                                                  |
| Pattern                 | Specifies AND, OR, NAND, NOR when true or false for a specific time                                                                                                    |
| State                   | Any logic state. Triggerable on rising or falling edge of a clock. Logic triggers can be used on combinations of 2 inputs (not 4)                                      |
| Comm                    | Provides isolated pulse triggering required to perform DS1/DS3 telecommunications mask testing per ANSI T1.102 standard. Requires TDS3TMT application module           |
| Alternate               | Sequentially uses each active channel as a trigger source                                                                                                              |

**Acquisition system**

DPO Captures and displays complex waveforms, random events and subtle patterns in actual signal behavior. DPOs provide 3 dimensions of signal information in real time: Amplitude, time, and the distribution of amplitude over time

Sample Sample data only

Average Waveform averaged, selectable from 2 to 512

Envelope Min-max values acquired over one or more acquisitions

Peak detect High-frequency and random glitch capture. Captures glitches as narrow as 1 ns (typical) using acquisition hardware at all time base settings

## Acquisition system

|                        |                                                                                                                                         |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| <b>WaveAlert®</b>      | Monitors the incoming signals on all channels and alerts the user to any waveform that deviates from the normal waveform being acquired |
| <b>Single sequence</b> | Use the Single Sequence button to capture a single triggered acquisition sequence at a time                                             |

## Waveform measurements

|                               |                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Cursors</b>                | Amplitude, time                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Automatic measurements</b> | Display any four measurements from any combination of waveforms. Or display all measurements with measurement snapshot feature. Measurements include Period, Frequency, +Width, -Width, Rise time, Fall time, +Duty cycle, -Duty cycle, +Overshoot, High, Low, Max, Min, Peak-to-peak, Amplitude, Mean, Cycle mean, RMS, Cycle RMS, Burst width, Delay, Phase, Area <sup>1</sup> , Cycle Area <sup>1</sup> |
| <b>Measurement statistics</b> | Mean, Min, Max, Standard deviation. Requires TDS3AAM application module                                                                                                                                                                                                                                                                                                                                    |
| <b>Thresholds</b>             | User-definable thresholds for automatic measurements; settable in percent or voltage                                                                                                                                                                                                                                                                                                                       |
| <b>Gating</b>                 | Isolate a specific occurrence within an acquisition to take measurements, using either the screen or cursors                                                                                                                                                                                                                                                                                               |

## Waveform math

|                      |                                                                                                                                                                                                                                                                                                        |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Arithmetic</b>    | Add, subtract, multiply, and divide waveforms                                                                                                                                                                                                                                                          |
| <b>FFT</b>           | Spectral magnitude. Set FFT vertical scale to Linear RMS or dBV RMS, and FFT window to Rectangular, Hamming, Hanning, or Blackman-Harris                                                                                                                                                               |
| <b>Advanced math</b> | Integrate, differentiate, define extensive algebraic expressions including analog waveforms, math functions, scalars, up to two user-adjustable variables and results of parametric measurements. For example: $(\text{Intg}(\text{Ch1} - \text{Mean}(\text{Ch1})) \times 1.414 \times \text{VAR1})^2$ |

## Waveform processing

|                |                                                                                                                               |
|----------------|-------------------------------------------------------------------------------------------------------------------------------|
| <b>Autoset</b> | Single-button, automatic setup of all channels for vertical, horizontal and trigger systems, with undo autoset                |
| <b>Deskew</b>  | Channel-to-channel deskew $\pm 10$ ns may be manually entered for better timing measurements and more accurate math waveforms |

## Display system

|                           |                                                                                                                                        |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| <b>Display type</b>       | 6.5 in. (165.1 mm) liquid-crystal TFT color display                                                                                    |
| <b>Display resolution</b> | 640 horizontal $\times$ 480 vertical pixels (VGA)                                                                                      |
| <b>Interpolation</b>      | $\text{Sin}(x)/x$                                                                                                                      |
| <b>Waveform styles</b>    | Dots, vectors, variable persistence, infinite persistence                                                                              |
| <b>Graticules</b>         | Full, grid, crosshair, and frame. NTSC, PAL, SECAM, and vectorscope (100% and 75% color bars) with optional TDS3VID application module |
| <b>Format</b>             | YT, XY, and Gated XYZ (XY with Z-axis blanking available on 4-channel instruments only)                                                |

<sup>1</sup> Requires TDS3AAM application module.

<sup>2</sup> Requires TDS3AAM application module.

## Input/output ports

|                        |                                                                                                                                                                         |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ethernet port          | RJ-45 connector, supports 10Base-T LAN                                                                                                                                  |
| USB port               | Front-panel USB 2.0 host port. Supports USB flash drive                                                                                                                 |
| GPIB port              | Full talk/listen modes, setting and measurements.<br>(Optional with TDS3GV Communications Module)                                                                       |
| RS-232C port           | DB-9 male connector, full talk/listen modes; control of all modes, settings and measurements<br>Baud rates up to 38,400<br>(Optional with TDS3GV Communications Module) |
| VGA video              | DB-15 female connector, monitor output for direct display on large VGA-equipped monitors<br>(Optional with TDS3GV communications module)                                |
| External trigger input | BNC connector, input impedance >1 MΩ in parallel with 17 pF; max input voltage is 150 V <sub>RMS</sub>                                                                  |

## Power source

|                         |                                                                           |
|-------------------------|---------------------------------------------------------------------------|
| AC line power           |                                                                           |
| Source voltage          | 100 V <sub>RMS</sub> to 240 V <sub>RMS</sub> ±10%                         |
| Source frequency        | 45 Hz to 440 Hz from 100 V to 120 V<br>45 Hz to 66 Hz from 120 V to 240 V |
| Power consumption       | 75 W maximum                                                              |
| Battery power           | Requires TDS3BATC, rechargeable lithium ion battery pack                  |
| Operating time, typical | 3 hours                                                                   |

## Physical characteristics

|            |        |       |        |
|------------|--------|-------|--------|
| Dimensions |        | mm    | inches |
|            | Width  | 375.0 | 14.8   |
|            | Height | 176.0 | 6.9    |
|            | Depth  | 149.0 | 5.9    |

|        |                  |     |     |
|--------|------------------|-----|-----|
| Weight |                  | kg  | lb. |
|        | Instrument only  | 3.2 | 7.0 |
|        | with accessories | 4.5 | 9.8 |

|                    |        |       |        |
|--------------------|--------|-------|--------|
| Package dimensions |        | mm    | inches |
|                    | Width  | 502.0 | 19.8   |
|                    | Height | 375.0 | 14.8   |
|                    | Depth  | 369.0 | 14.5   |

|                    |        |       |        |
|--------------------|--------|-------|--------|
| Rackmount (RM3000) |        | mm    | inches |
|                    | Width  | 484.0 | 19.0   |
|                    | Height | 178.0 | 7.0    |
|                    | Depth  | 152.0 | 6.0    |

## EMC, environment and safety

|                                      |                                                                                                                                                                                                                                                              |
|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Temperature</b>                   |                                                                                                                                                                                                                                                              |
| Operating                            | 0 °C to +50 °C                                                                                                                                                                                                                                               |
| Non-operating                        | -40 °C to +71 °C                                                                                                                                                                                                                                             |
| <b>Humidity</b>                      |                                                                                                                                                                                                                                                              |
| (Operating and non-operating)        |                                                                                                                                                                                                                                                              |
| At or below +30 °C                   | Up to 95% RH                                                                                                                                                                                                                                                 |
| +30 °C up to +50 °C                  | Up to 45% RH                                                                                                                                                                                                                                                 |
| <b>Altitude</b>                      |                                                                                                                                                                                                                                                              |
| Operating                            | To 3,000 meters                                                                                                                                                                                                                                              |
| Non-operating                        | 15,000 meters                                                                                                                                                                                                                                                |
| <b>Electromagnetic compatibility</b> | Meets or exceeds EN61326 Class A, Annex D radiated and conducted emissions and immunity; EN6100-3-2 AC Powerline Harmonic Emissions; EN6100-3-3 Voltage Changes, Fluctuation, and Flicker; FCC 47 CFR, Part 15, Subpart B, Class A; Australian EMC framework |
| <b>Safety</b>                        | UL61010B-1, CSA1010.1, IEC61010-1, EN61010-1                                                                                                                                                                                                                 |

## Ordering information

### TDS3000C family

|          |                                |
|----------|--------------------------------|
| TDS3012C | 100 MHz, 2 channels, 1.25 GS/s |
| TDS3014C | 100 MHz, 4 channels, 1.25 GS/s |
| TDS3032C | 300 MHz, 2 channels, 2.5 GS/s  |
| TDS3034C | 300 MHz, 4 channels, 2.5 GS/s  |
| TDS3052C | 500 MHz, 2 channels, 5 GS/s    |
| TDS3054C | 500 MHz, 4 channels, 5 GS/s    |

Please specify a language option and a power plug option from the lists that follow.

## Standard accessories

### Probes

|        |                                            |
|--------|--------------------------------------------|
| P6139B | 500 MHz 10x passive probe, one per channel |
|--------|--------------------------------------------|

### Accessories

|                                      |                                                                                                                                                                                     |
|--------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Front protective cover               |                                                                                                                                                                                     |
| Accessory tray                       |                                                                                                                                                                                     |
| Documentation CD                     | Contains User Manuals in all languages                                                                                                                                              |
| Front panel overlay                  | Translated front panel overlay. Specify language option.                                                                                                                            |
| Installation and Safety Manual       |                                                                                                                                                                                     |
| Power cord                           | Specify power plug option.                                                                                                                                                          |
| OpenChoice® PC connectivity software | Enables fast and easy communication between Windows PC and the TDS3000C Series through LAN, GPIB, or RS-232. Transfer and save settings, waveforms, measurements, and screen images |
| Traceable Certificate of Calibration | NIM/NIST                                                                                                                                                                            |

### Warranty

Three year warranty covering all labor and parts, excluding probes and accessories

## Instrument 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. A4  | North America 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                            |

## Language options

|          |                            |
|----------|----------------------------|
| Opt. L0  | English manual             |
| Opt. L1  | French manual              |
| Opt. L2  | Italian manual             |
| Opt. L3  | German manual              |
| Opt. L4  | Spanish manual             |
| Opt. L5  | Japanese manual            |
| Opt. L6  | Portuguese manual          |
| Opt. L7  | Simplified Chinese manual  |
| Opt. L8  | Traditional Chinese manual |
| Opt. L9  | Korean manual              |
| Opt. L10 | Russian manual             |
| Opt. L99 | No manual                  |

Language options include translated front-panel overlay for the selected language(s).

## Service options

| Available at time of purchase |                                                                                                                                  |
|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| Opt. D1                       | Calibration data report                                                                                                          |
| Opt. R5                       | Repair service - 5 year                                                                                                          |
| Available after purchase      |                                                                                                                                  |
| TDS30xxC-R5DW                 | Repair service coverage 5 years (includes product warranty period); 5-year period starts at time of customer instrument purchase |

## Recommended accessories

### Probes

|         |                                                      |
|---------|------------------------------------------------------|
| ADA400A | 100x, 10x, 1x, 0.1x high-gain differential amplifier |
| P5100A  | 2.5 kV, 100x high-voltage passive probe              |
| P5205A  | 1.3 kV, 100 MHz high-voltage differential probe      |
| P5210A  | 5.6 kV, 50 MHz high-voltage differential probe       |
| P6243   | 1 GHz, $\leq 1$ pF input C 10x active probe          |
| TCP202A | 50 MHz, 15 A AC/DC current probe                     |
| TCP303  | 15 MHz, 150 A current probe <sup>3</sup>             |
| TCP305A | 50 MHz, 50 A current probe <sup>3</sup>              |
| TCP312A | 100 MHz, 30 A current probe <sup>3</sup>             |
| TCPA300 | 100 MHz probe amplifier                              |

<sup>3</sup> Requires TCPA300 probe amplifier.

|                 |                                         |
|-----------------|-----------------------------------------|
| <b>TCPA400</b>  | 50 MHz probe amplifier                  |
| <b>TCP404XL</b> | 2 MHz, 500 A current probe <sup>4</sup> |

## Accessories

|                    |                                                                                                                                                                                      |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>TDS3GV</b>      | GPIO, VGA, RS-232 interface                                                                                                                                                          |
| <b>TDS3AAM</b>     | Advanced Analysis Module. Adds extended math capability, arbitrary math expressions, measurement statistics, and additional automated measurements                                   |
| <b>TDS3LIM</b>     | Limit Testing Module. Adds custom waveform limit testing capabilities                                                                                                                |
| <b>TDS3TMT</b>     | Telecom Mask Testing Module. Adds pass/fail compliance of ITU-T G.703 and ANSI T1.102 standards, custom mask testing, and more                                                       |
| <b>TDS3VID</b>     | Extended Video Analysis Module. Adds video quickmenu, autoset, hold, line count trigger, video picture mode, vectorscope <sup>5</sup> mode, HDTV format trigger graticules, and more |
| <b>TDS3BATC</b>    | Lithium-ion battery pack for up to 3 hours continuous operation without line power                                                                                                   |
| <b>TDS3ION</b>     | Battery charger                                                                                                                                                                      |
| <b>AC3000</b>      | Soft case for carrying instrument                                                                                                                                                    |
| <b>HCTEK4321</b>   | Hard plastic case for carrying instrument<br>(requires AC3000)                                                                                                                       |
| <b>RM3000</b>      | Rackmount kit                                                                                                                                                                        |
| <b>071-2507-xx</b> | Service manual (English only)                                                                                                                                                        |



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



Product(s) complies with IEEE Standard 488.1-1987, RS-232-C, and with Tektronix Standard Codes and Formats.

<sup>4</sup> Requires TCPA400 probe amplifier.

<sup>5</sup> Vectorscope does not support composite video.

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**Norway** 800 16098  
**Portugal** 800 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

**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.tek.com](http://www.tek.com).

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