

# Digital Storage Oscilloscopes

▶ TPS2012 • TPS2014 • TPS2024



## ▶ Features & Benefits

100 MHz and 200 MHz Bandwidths

Sample Rates Up to 2 GS/s Real-time

2 or 4 Fully Isolated and Floating Channels, Plus Isolated External Trigger

8 Hours of Continuous Battery Operation with Two Batteries Installed, Hot-swappable for Virtually Unlimited Freedom from an AC Power Source

Optional Power Application Software Offers the Broadest Range of Power Measurements at its Price Point

Quickly Document and Analyze Measurement Results with OpenChoice® Software or Integrated CompactFlash Mass Storage

FFT Standard on All Models

Advanced Triggers to Quickly Capture the Event of Interest

Easily Operate the Oscilloscope with Traditional, Analog-style Knobs and Multi-language User Interface

Simplify Setup and Operation with Autoset Menu, Autorange, Waveform and Setup Memories, and Built-in, Context-sensitive Help

Adjust the Oscilloscope to Your Operating Environment with Backlit Menu Buttons/ Display and Brightness/ Contrast Controls

11 Automatic Measurements

## ▶ Applications

Industrial Power Design, Troubleshooting, Installation, and Maintenance

Advanced Electronics Design, Troubleshooting, Installation, and Maintenance

Automotive Design and Test Education

## TPS2000 Series Oscilloscopes Deliver Powerful Productivity from Bench to Field

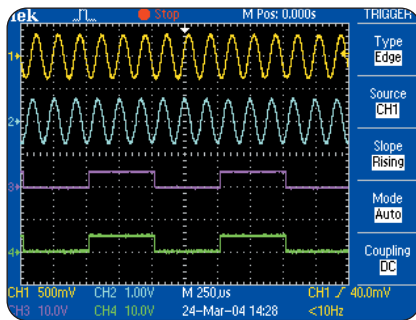
As an engineer or technician, you must often make floating, or differential, measurements. You face faster edges and clocks due to the migration of higher performance technologies to widely implemented electronic systems and subsystems, with the pressure to conform to customer specifications or industry requirements.

And you may need to develop and test designs in a variety of challenging environments that demand versatility.

You can quickly tackle these tough challenges to speed the design, troubleshooting, installation, and maintenance of components and systems with the world's first 4-isolated-channel, full featured, battery-powered oscilloscope – the TPS2000 Series.

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▶ *Four IsolatedChannel™ inputs and isolated external trigger input for quick, accurate, affordable floating and differential measurements.*

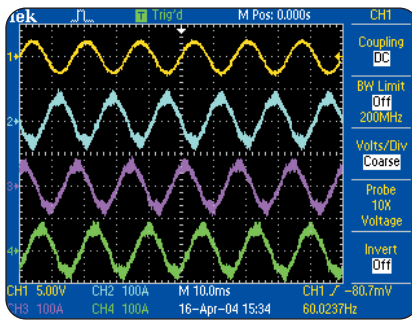
## Make Floating and Differential Measurements - Quickly, Accurately, Affordably

Make floating and differential measurements much more quickly and accurately, and speed verification of power supply performance, complex control circuits and the effects of neutral current for differential voltages, up to 30 V<sub>RMS</sub> floating on four channels simultaneously, when the TPS2000 Series is paired with its standard P2220 passive probe.

Easily perform these measurements up to 600 V<sub>RMS</sub> CAT II (or 300 V<sub>RMS</sub> CAT III) floating when the oscilloscope is coupled with its optional P5120 passive, high-voltage probe.

Accurately characterize rise and fall times and other waveform parameters in circuits with different low levels or ground references, while removing ground loop interference, with just 37 pf capacitance to chassis on each of four isolated channels.

Innovative IsolatedChannel™ technology makes these measurements possible – all designed with your safety in mind.



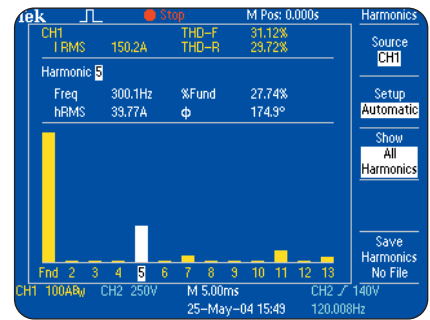
▶ *Perform three-phase power measurements of variable frequency drives.*

## Speed the Design and Test of Industrial Power Systems and Subsystems

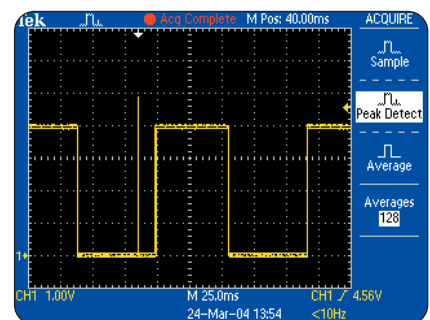
The TPS2000 Series easily addresses the unique challenges that plague industrial power designers and technicians. You regularly confront high voltages and currents, and must often make potentially hazardous floating measurements. With the TPS2000 Series' power bundle (TPS2PBND), which includes the P5120 passive, high-voltage probes and TPS2PWR1 power measurement and analysis software, you can use a single instrument to make a broad range of measurements.

Easily evaluate these high voltages and currents, or debug power electronics control circuits, with differential voltages up to 600 V<sub>RMS</sub> CAT II (or 300 V<sub>RMS</sub> CAT III) floating. Accurately measure three-phase power and circuits with different low levels or ground references.

Quickly perform a broad range of power-specific measurements, such as switching loss, harmonic distortion measurements to the 50th harmonic, and dv/dt and di/dt cursor measurements.



▶ *Conduct harmonic distortion measurements with TPS2PWR1 software.*



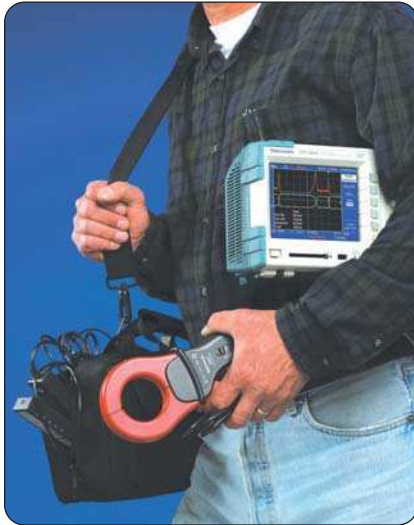
▶ *Capture elusive glitches – the first time – with digital real-time (DRT) sampling technology.*

## Quickly Debug and Characterize Signals with DRT Sampling Technology

Characterize a wide range of signal types on four channels simultaneously with the TPS2000 Series' unique digital real-time (DRT) sampling technology. This acquisition technology makes it possible to capture high-frequency information, such as glitches and edge anomalies, that eludes other oscilloscopes in its class, so that you can be sure to get a complete view of your signal to speed debug and characterization.

## Easily Analyze and Document Your Measurement Results

Quickly reveal signal interference, cross-talk and the effects of vibration with frequency domain analysis using the TPS2000 Series' standard Fast Fourier Transform (FFT) feature. Easily analyze and document your measurement results with integrated CompactFlash mass storage or OpenChoice® software.



▶ Easily correlate your measurements between bench, lab and field with the TPS2000 Series' portability.



▶ Harness the power of virtually unlimited freedom from an AC power source with hot-swappable batteries.



▶ Easily use the oscilloscope even in environments that challenge operation, with features such as analog-style knobs per channel, backlit menu buttons, and brightness/contrast controls.

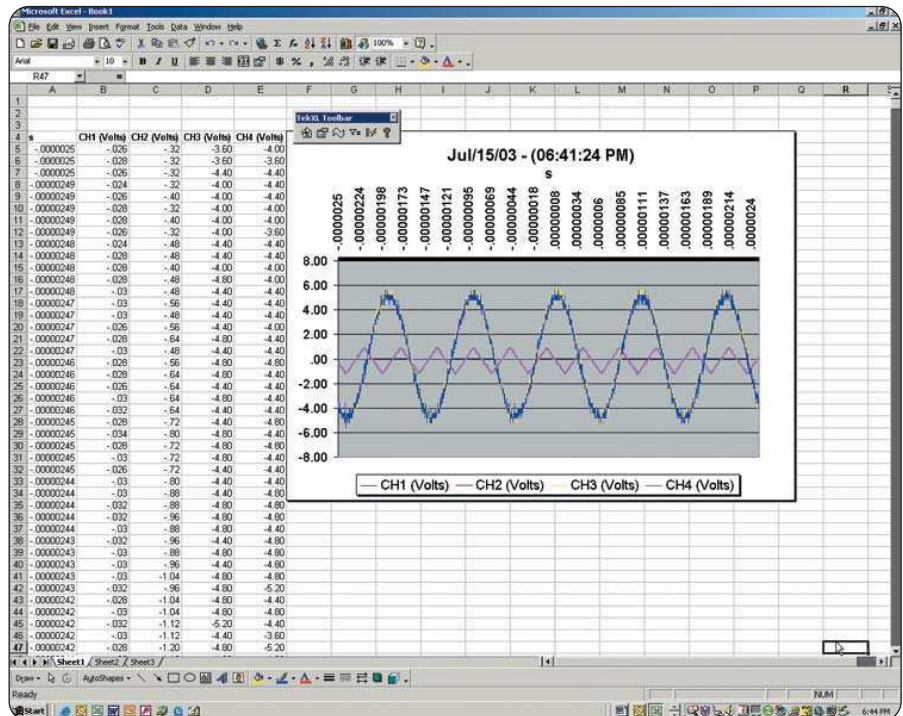
## Correlate Your Measurements from Bench to Lab to Field\*

Use the TPS2000 Series on your bench, in the lab, or in the field, with the industry's longest continuous battery life – 8 hours and beyond – in a highly mobile package. Harness the power of virtually unlimited freedom from an AC power source with hot-swappable batteries. Easily correlate measurements between bench, lab, and field with its portability.

## Optimize Your Productivity with Versatility

Intuitively operate the oscilloscope with familiar, analog-style knobs per channel. Reduce your measurement time with features like autoset, autorange, automatic measurements, 10X to 1000X vertical position control, probe check wizard, and context-sensitive help. Effectively work in a variety of challenging environments – from bright daylight to dimly lit areas – using backlit menu buttons and brightness/contrast controls.

\* Please refer to Environmental and Safety specifications.



▶ Speed documentation and analysis of measurements results with OpenChoice® software and integrated CompactFlash mass storage.

# Digital Storage Oscilloscopes

► TPS2012 • TPS2014 • TPS2024

## ► Characteristics

### ► TPS2000 Series Electrical Characteristics

Feature	TPS2012	TPS2014	TPS2024
Isolated Channels	2	4	4
Bandwidth* <sup>1</sup> (MHz)	100	100	200
Sample Rate (GS/s) Per Channel	1.0	1.0	2.0
Record Length	2.5 K points		
Display (1/4 VGA LCD)	Color		
Battery Operation	Capacity for two hot-swappable battery packs. One standard battery pack offers 4 hours of battery operation. Optional second battery pack extends battery operation to 8 hours. Continuous battery operation is possible by hot-swapping charged batteries		
Automatic Measurements	11		
Isolated External Trigger Input (Impedance Isolated)	Yes		
Vertical Resolution	8-bits (normal or with averaging)		
Vertical Sensitivity	2 mV to 5 V/div on all models with calibrated fine adjustment		
DC Vertical Accuracy	±3%		
Vertical Zoom	Vertically expand or compress a live or stopped waveform		
Max Input Voltage (1 M $\Omega$ ) <sup>2</sup>	300 V <sub>RMS</sub> CAT II at BNC signal to BNC shell, 1000 V <sub>RMS</sub> CAT II at probe tip to earth ground with optional P5120 passive, high-voltage probe		
Float Voltage <sup>2</sup>	600 V <sub>RMS</sub> CAT II or 300 V <sub>RMS</sub> CAT III BNC shell to earth ground, 1200 V <sub>RMS</sub> CAT II between any two channel commons with each of the channel commons not being more than ±600 V <sub>RMS</sub> from earth ground		
Position Range	2 mV to 200 mV/div ±2 V; >200 mV to 5 V/div ±50 V		
Bandwidth Limit	20 MHz		
Linear Dynamic Range	±5 div		
Time Base Range	5 ns to 50 s/div	5 ns to 50 s/div	2.5 ns to 50 s/div
Time Base Accuracy	50 ppm		
Input Impedance	1 M $\Omega$ ±2 % in parallel with 20 pF		
Input Coupling	AC, DC, GND		
Horizontal Zoom	Horizontally expand or compress a live or stopped waveform		
FFT	Standard		
RS-232, Centronics – Parallel Ports	Standard		
PC Connectivity	Standard		
Integrated CompactFlash Mass Storage	Standard		
Power Measurements	Optional package that offers instantaneous power waveform analysis, waveform analysis, harmonics analysis, switching loss, phase angles, dv/dt and di/dt cursors		

\*1 Bandwidth is 20 MHz at 2 mV/div, all models. Bandwidth is 200 MHz typical at 5 mV/div, 200 MHz models only. Bandwidth is 200 MHz typical between 40 °C and 50 °C, 200 MHz models only.

\*2 Please refer to Environmental and Safety specifications.

## Acquisition Modes

**Peak Detect** – High frequency and random glitch capture. Captures glitches as narrow as 12 ns typical using acquisition hardware at all time/div settings from 5  $\mu$ s/div to 50 s/div.

**Sample** – Sample data only.

**Average** – Waveform averaged, selectable: 4, 16, 64, 128.

**Single Sequence** – Use the Single Sequence button to capture a single triggered acquisition sequence at a time.

**Scan/Roll Mode** – At acquisition time base settings of  $\geq 100$  ms/div.

## Trigger System (Main Only)

**Trigger Modes** – Auto, Normal, Single Sequence.

## Trigger Types

**Edge (rising or falling)** – 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 line, odd/even or all fields from composite video, or broadcast standards (NTSC, PAL, SECAM).

**Pulse Width (or Glitch)** – Trigger on a pulse width less than, greater than, equal to, or not equal to a selectable time limit ranging from 33 ns to 10 sec.

## Trigger Source

**2-channel models** – CH1, CH2, Ext, Ext/5, Ext/10.

**4-channel models** – CH1, CH2, CH3, CH4, Ext, Ext/5, Ext/10.

## Trigger View

Displays trigger signal while trigger view button is depressed.

## Trigger Signal Frequency Readout

Provides a frequency readout of the trigger source with 6-digit resolution.

## Cursors

**Types** – Voltage, Time.

**Measurements** –  $\Delta T$ ,  $1/\Delta T$  (frequency),  $\Delta V$ ,  $dv/dt^{*3}$ ,  $di/dt^{*3}$ .

\*3Requires TPS2PWR1 power application package.

## ▶ Autoset Menu for Multiple Signal Types

Signal Type	Autoset Menu Choices
Square wave	Single-cycle, Multi-cycle, Rising or Falling Edge
Sine Wave	Single-cycle, Multi-cycle, FFT Spectrum
Video (NTSC, PAL, SECAM)	Video (NTSC, PAL, SECAM) Field: All, Odd, or Even Line: All or Selectable Line Number

## ▶ Nonvolatile Storage

Nonvolatile Storage	Standard (with CompactFlash Mass Storage)
Reference Waveform Display	Two 2500 point reference waveforms
Waveform Storage	96 or more reference waveforms per 8 MB
Setups	4000 or more front panel setups per 8 MB
Screen Images	128 or more screen images per 8 MB (the number of images depends on file format selected)
Save All	12 or more Save All operations per 8 MB. A single Save All operation creates 2 to 9 files (setup, image, plus one file for each displayed waveform)

## Measurement System

**Automatic Waveform Measurements** – Period, Frequency, +Width, –Width, Rise time, Fall time, Max, Min, Peak-to-Peak, Mean, Cycle RMS.

## Waveform Processing

**Operators** – Add, Subtract, Multiply, FFT.

**FFT** – Windows: Hanning, Flat Top, Rectangular; 2048 sample points.

## Sources

2-channel models: CH1 – CH2, CH2 – CH1, CH1 + CH2, CH1 x CH2.

4-channel models: CH1 – CH2, CH2 – CH1, CH3 – CH4, CH4 – CH3, CH1 + CH2, CH3 + CH4, CH1 x CH2, CH3 x CH4.

**Autoset Menu** – Single-button, automatic setup of all channels for vertical, horizontal and trigger systems, with undo autoset.

**Autorange** – Allows the user to adjust waveforms on the oscilloscope screen and change test points without resetting the oscilloscope.

## Display Characteristics

**Display** – 1/4 VGA, passive color LCD with color on black background with adjustable multi-level contrast and brightness controls.

**Interpolation** –  $\text{Sin}(x)/x$ .

**Display Types** – Dots, vectors.

**Persistence** – Off, 1 sec, 2 sec, 5 sec, infinite.

**Format** – YT and XY.

## I/O Interface

**Printer Port (standard)** – Centronics-type Parallel.

Graphics File Formats – TIFF, PCX (PC Paint Brush), BMP (Microsoft Windows), EPS (Encapsulated Postscript) and RLE.

Printer Formats – Bubble Jet, DPU-411, DPU-412, DPU-3445, Thinkjet, Deskjet, Laser Jet, Epson Dot (9- or 24-pin), Epson C60, Epson C80.

Layout – Landscape and Portrait.

**RS-232 Port (standard)** – 9-pin DTE.

**RS-232 Programmability** – Full talk/listen modes. Control of all modes, settings and measurements. Baud rate up to 19,200.

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## Mass Storage CompactFlash Memory –

Accepts any Type 1 CompactFlash card, up to and including 1 GB (card not included).

## Built-in Clock/Calendar

## OpenChoice® PC Communications Software –

Seamless connection from oscilloscope to PC through RS-232.

Transfer and save settings, waveforms, measurements, and screen images.

Includes a Windows desktop data transfer application in addition to convenient Microsoft Word and Excel Toolbar Add-ins.

## Environmental and Safety

### Temperature –

Operating: 0 °C to +50 °C.

Non-operating: –40 °C to +71 °C.

### Humidity –

TPS2000 Series oscilloscopes are not intended for use in wet or damp conditions.

### Operating:

high: 50 °C / 60% RH.

low: 30 °C / 90% RH.

### Non-Operating:

high: 55 °C to 71 °C / 60% RH max wet bulb.

low: 30 °C to 0 °C / < 90% RH max wet bulb.

### Altitude –

Operating: up to 3,000 m.

Non-operating: 15,000 m.

**Pollution Degree 2 –** Do not operate in an environment where conductive pollutants may be present (as defined in IEC61010-1:2001).

**Enclosure Rating – IP30:** when the CompactFlash card and power analysis software are installed (as defined in IEC60529:2001).

## Electromagnetic Compatibility –

Meets the intent of Directive 89/336/EEC. Meets or exceeds: Australian EMC Framework, demonstrated per Emission Standard AS/NZS 2064.1/2.

## General Certifications –

Russian GOST EMC regulations; Chinese Metrology Certification (CMC).

## Safety – UL61010-1: 2004. CAN/CSA22.2

No. 1010.1: 2004. EN61010-1: 2001.

Do not float the P2220 probe common lead to >30 V<sub>RMS</sub>. Use the P5120 (floatable to 600 V<sub>RMS</sub> CAT II or 300 V<sub>RMS</sub> CAT III) or similarly rated passive, high-voltage probe or an appropriately rated high-voltage, differential probe when floating the common lead above 30 V<sub>RMS</sub>, subject to the ratings of such high-voltage probe.



► *Versatile Hanger.*



► *Battery/Charger.*

## CAT Ratings

### Overvoltage Categories

Category	Examples of Products in this Category
CAT III	Distribution-level mains, fixed installation
CAT II	Local-level mains, appliances, portable equipment
CAT I	Signal levels in special equipment or parts of equipment, telecommunications, electronics

### Materials –

TPSBAT battery contains less than 8 grams equivalent Lithium.

## Physical Characteristics

INSTRUMENT		
Dimensions	mm	in.
Width	336.0	13.24
Height	161.0	6.33
Depth	130.0	5.10
Weight	kg	lbs.
Instrument only	2.7	6.0
with 1 battery	3.2	7.0
with 2 batteries	3.7	8.0
INSTRUMENT SHIPPING		
Package Dimensions	mm	in.
Width	476.2	18.75
Height	266.7	10.50
Depth	228.6	9.00



► *P2220 Probe.*

## ► Ordering Information

### TPS2012, TPS2014, TPS2024

Digital Storage Oscilloscopes.

### Standard Accessories

**Probes –** P2220 200 MHz, 1X/10X switchable passive probe (one per channel).

**Battery (1) –** Lithium-Ion battery with fuel gauge for 4-hour battery life. Two batteries required for 8 hours continuous battery operation.

### TDSPCS1 OpenChoice

**PC Connectivity Software –** A collection of programs that enable fast and easy communication between MS Windows PCs and TPS2000 Series oscilloscopes.

**Documentation –** 1 each set of instruction manuals (see below for the appropriate language manual part number).

AC Adapter with Power Cord.

NIM/NIST-Traceable Certificate of Calibration.

Front Protective Cover.



▶ *Soft Carrying Case.*



▶ *P5120 Probe.*



▶ *Current Probes.*

## Recommended Accessories

**TPS2PBND** – Power bundle for TPS2000 Series oscilloscopes. Includes (4) P5120 passive, high-voltage probes and TPS2PWR1 power measurement and analysis software.

**TPS2PWR1** – Power measurements application package. Instantaneous power waveform analysis, waveform analysis, harmonics analysis, switching loss, phase angles, dv/dt and di/dt cursors.

**WSTRO** – WaveStar™ software; Windows 98/2000/ME/NT 4.0 application for waveform capture, analysis, documentation and control from your PC. Provides enhanced oscilloscope data measurement, analysis, remote setup and charting features.

**TPSBAT** – Additional battery.

**TPSCHG** – Battery charger.

**AC2100** – Soft case for carrying instrument.

**HCTEK321** – Hard case for carrying instrument.

**343-1689-00** – Versatile hanger.

**Service Manual** – English only (P/N 071-1465-xx).

**Programmer Manual** – English only (P/N 071-1075-xx).

**156-9413-00** – CompactFlash memory card, 32 MB or more.

## Recommended Probes

**A621** – 2000 A, 5 to 50 kHz AC current probe/BNC.

**A622** – 100 A, 100 kHz AC/DC current probe/BNC.

**P5120** – Passive high-voltage probe (1000 V CAT II tip to ground; 600 V CAT II reference to earth ground).

**P5205** – High-voltage active differential probe (1300 V<sub>pk-pk</sub>, 100 MHz). (1103 power supply required).

**P5210** – High-voltage active differential probe (5600 V<sub>pk-pk</sub>, 50 MHz). (1103 power supply required).

**CT2** – 2.5 A, 200 MHz AC current probe.

**CT4** – AC current probe up to 2000 A<sub>pk-pk</sub>. (TCP202 and 1103 power supply required.)

**TCP202** – 15 A, 50 MHz AC/DC current probe. (1103 power supply required.)

**TCP303/TCPA300** – 15 A, 15 MHz AC/DC current probe/amplifier.

**TCP305/TCPA300** – 50 A, 50 MHz AC/DC current probe/amplifier.

**TCP312/TCPA300** – 30A, 100 MHz, DC/AC current probe/amplifier.

**TCP404XL/TCPA400** – 500 A, 2 MHz AC/DC current probe/amplifier.

## International Power Plugs

**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. A99** – No power cord or AC adapter.

## Accessory Cables

**RS-232, 9-Pin female to 25-Pin male, 4.6 m (15 ft.), for Modems** – Order 012-1241-00.

**RS-232, 9-Pin female to 9-Pin female, null modem, for computers** – Order 012-1651-00.

**RS-232, 9-Pin female to 25-Pin female, null modem, for computers** – Order 012-1380-00.

**RS-232, 9-Pin female to 25-Pin male, null modem, for printers** – Order 012-1298-00.

**Centronics, 25-Pin male to 36-Pin Centronics, 2.4 m (8 ft.), for Parallel Printer Interfaces** – Order 012-1214-00.

## International User Manual Language Options

**Opt. L0** – English (071-1441-xx).

**Opt. L1** – French (071-1442-xx).

**Opt. L2** – Italian (071-1443-xx).

**Opt. L3** – German (071-1444-xx).

**Opt. L4** – Spanish (071-1445-xx).

**Opt. L5** – Japanese (071-1446-xx).

**Opt. L6** – Portuguese (071-1447-xx).

**Opt. L7** – Simplified Chinese (071-1448-xx).

**Opt. L8** – Traditional Chinese (071-1449-xx).

**Opt. L9** – Korean (071-1450-xx).

**Opt. LR** – Russian (071-1451-xx).

Translated front panel overlay included with its respective user manual.

## Warranty Information

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

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## Speed Product Development with Best-in-class Price/Performance

Tektronix' extensive portfolio of proven, state-of-the-art stimulus, probing, acquisition and analysis tools simplify and speed each phase of product design – from power-on and verification, through debug and validation, to characterization and test – to enable you to race products to your customers when they need them, if not before.



## Tektronix Support Completes the Solution

Anytime you need support, anywhere in the world, depend on Tektronix Support to give you the lowest possible exposure to inconvenience, delay, or disruption of operations.

[www.tektronix.com/support](http://www.tektronix.com/support)

- ▶ Unsurpassed technical expertise and experience with 24-hour response to technical questions
- ▶ Industry-leading turn-around service time
- ▶ 90-day unconditional service warranty
- ▶ No fine print, no exclusions, no surprises
- ▶ Global support in more than 50 countries

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04/05 TNWOW

3MW-17750-3