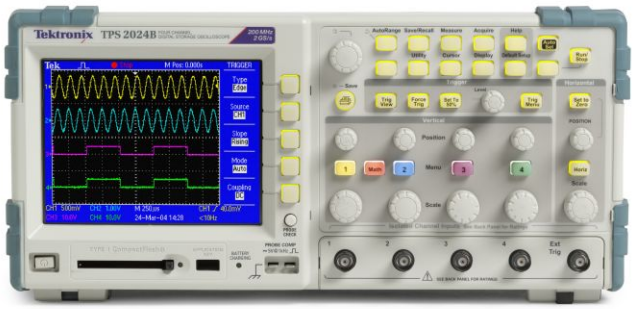
Digital Storage Oscilloscopes

TPS2000B Series Data Sheet



The TPS2000B Series offers a distinctive range of capabilities in an oscilloscope with controls and menus you will find familiar and easy to use. Available in 2- or 4-channel versions, the TPS2000B Series with IsolatedChannel™ technology provides isolation from ground and isolation between channels allowing you to take measurements with less worry about damaging circuitry. Battery power comes standard, making it a natural choice for field applications. For work on power electronics, optional software integrates commonly needed power system measurements into the instrument, speeding up power analysis and troubleshooting.

Key performance specifications

- 100 MHz and 200 MHz bandwidths
- 2 or 4 fully isolated and floating channels, plus impedance isolated external trigger input
- Sample rates up to 2 GS/s real time on all channels
- 2.5k point record length on all channels

Key features

- 8 hours of continuous battery operation with two batteries installed, hot swappable for virtually unlimited freedom from AC line power
- 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
- Traditional, analog-style knobs and multi-language user interface for easy operation
- Quick setup and operation with autoset menu, autorange, waveform and setup memories, and built-in, context-sensitive Help
- Backlit menu buttons for high visibility
- 11 of the most critical automatic waveform measurements

Applications

- Industrial power design, troubleshooting, installation, and maintenance
- Advanced electronics design, troubleshooting, installation, and maintenance
- Automotive design and test
- Education

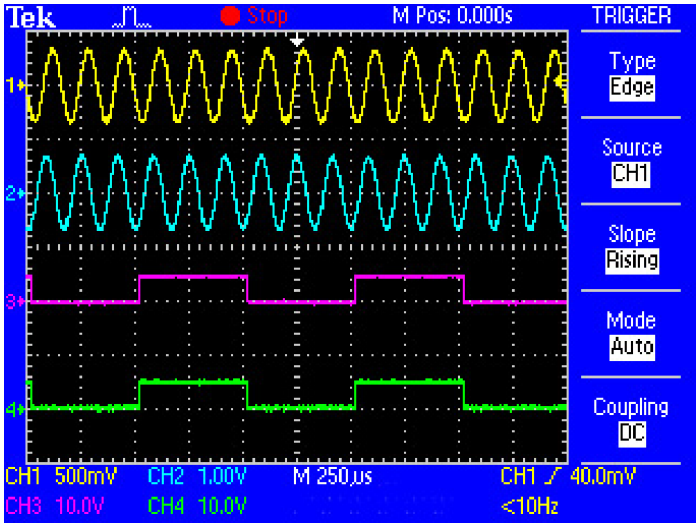
Make floating and differential measurements - quickly, accurately, affordably

Unintentionally grounding a circuit under test is a common cause of poor measurement results and circuit damage. Connecting two or more grounded probes can cause ground loops, and if the current is high enough can result in ruined components and equipment. Most importantly, taking floating measurements without the proper instruments and probes can pose a safety hazard.

Tektronix IsolatedChannel technology simplifies floating measurements. Unlike ground-referenced oscilloscopes, the TPS2000B input connector shells are isolated from each other and from earth ground. Within the specified 600 V_{RMS} maximum float voltage, IsolatedChannel technology keeps current from flowing between the TPS2000B input BNC shells or from any BNC shell to earth.

Tektronix®

Scope/Probe (Attenuation)	Maximum Safety Ratings		TPS2000 Viewable Signal	
	Reference Float Safety Rating	Input Signal Safety Rating	On-screen Peak-Peak Voltage (Sinusoid centered at 0 V)	On-screen RMS Voltage (Sinusoid centered at 0 V)
TPS2000B Input (1X)	600 V_{RMS}CAT II	300 V_{RMS}CAT II	40 V_{p-p}	14.1 V_{RMS}
TPP0101 (100 MHz)	30 V_{RMS}	300 V_{RMS}CAT II	400 V_{p-p}	141 V_{RMS}
TPP0201 (200 MHz)	30 V_{RMS}	300 V_{RMS}CAT II	400 V_{p-p}	141 V_{RMS}
P5150 (50X)	600 V_{RMS}CAT II	1000 V_{RMS}CAT II	2000 V_{p-p}	705 V_{RMS}
P5122 (100X)	600 V_{RMS}CAT II	1000 V_{RMS}CAT II	2828 V_{p-p}	1000 V_{RMS}



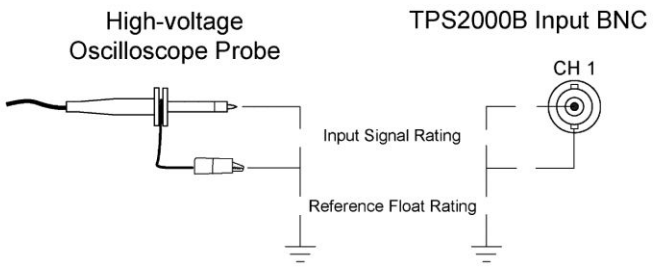
Four IsolatedChannel™ inputs and isolated external trigger input for quick, accurate, affordable floating and differential measurements.

Selecting the right probes for the job

Different passive probes are available, depending on your application. With the included TPP0101/TPP0201 passive probes, the TPS2000B can measure up to 400 V_{p-p}. However, to meet the safety rating of the TPP0101/TPP0201, the reference lead of the probe must be maintained within 30 V_{RMS} relative to ground. Because of this, the TPP0101/TPP0201 probes are well suited for working on digital and analog circuits in which the maximum voltage never exceeds 30 V_{RMS}.

Measurements on power conversion electronics usually require probes with higher voltage ratings. Tektronix offers two passive probes with insulation systems specifically designed for making floating measurements. With their 100X attenuation, and 1000 VRMS rating, the optional P5122 probes (when coupled with the TPS2000B) are suitable for making measurements on 480 VRMS devices in Category II environments, with a maximum float voltage of up to 600 VRMS relative to earth ground. With the optional P5150 probe, the TPS2000B can measure up to 2000 V_{p-p}, with a maximum float voltage within 600 V_{RMS} of ground. The P5150 is the best choice for making AC-coupled ripple measurements on high-voltage DC power supplies.

Please see "Characteristics" for complete safety ratings and specifications.



Input signal and float voltage maximum safety ratings.

Speed the design and test of industrial power systems and circuits

From mobile phones to industrial motor drives, power conversion technology has enabled significant advances in size, performance, and energy efficiency. But even the most basic task of viewing a converter's input and output is complicated by multiple voltage references. Multiple references also make it challenging to view signals from control circuits and power circuits at the same time. Using ground-referenced oscilloscopes in these applications, without appropriate differential probes, can damage circuits and produce bad measurements. For debugging power conversion electronics, IsolatedChannel technology reduces the risk of damage and unintended circuit interactions.

For performing power system measurements, TPS2PWR1 power application software is available as an option for the TPS2000B. It provides advanced power measurements right on the oscilloscope, at an entry-level price.

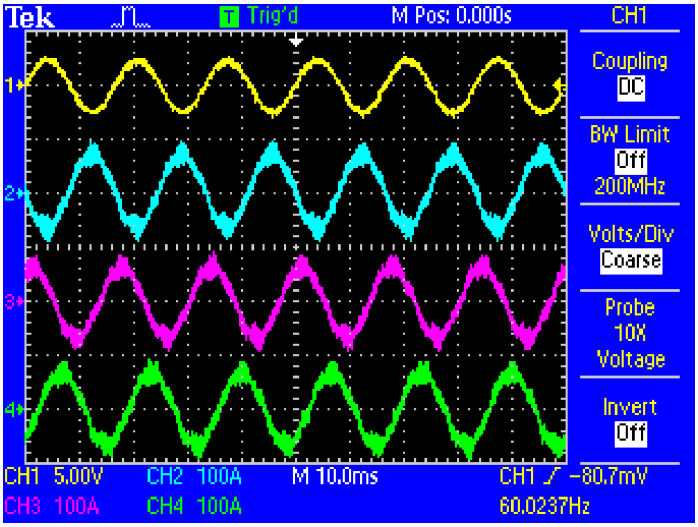


Conduct harmonic distortion measurements with TPS2PWR1 software.

For dialing in the performance of switching components, the power application software adds important measurements to the TPS2000B, including automatic switching loss, dv/dt, and di/dt cursor measurements.

For measurements on AC line voltage and for checking the impact on the power distribution system, the power application software shows harmonic content to the 50th harmonic, and provides phase, reactive power consumption, and power factor measurements. With the four-channel TPS2014B or TPS2024B, you can view three-phase voltages or currents.

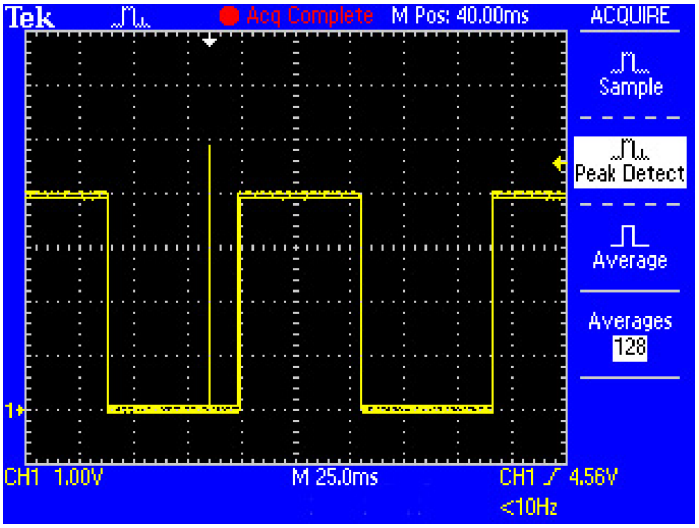
Two power "bundles" are available, combining probes and measurement software. Each package combines four probes with the TPS2PWR1 power application software, at prices that are lower than if purchased separately. The TPS2PBND2 combines four P5122 100X passive, high-voltage probes with the power application software.



Perform three-phase power measurements of variable frequency drives.

Quickly debug and characterize signals with DRT sampling technology

Characterize a wide range of signal types on up to four channels simultaneously with the TPS2000B Series Digital Real-Time (DRT) sampling technology. This acquisition technology makes it possible to capture high-frequency events, such as glitches and edge anomalies, that eludes other oscilloscopes in its class, so that you can be sure to get an accurate view of your signal.

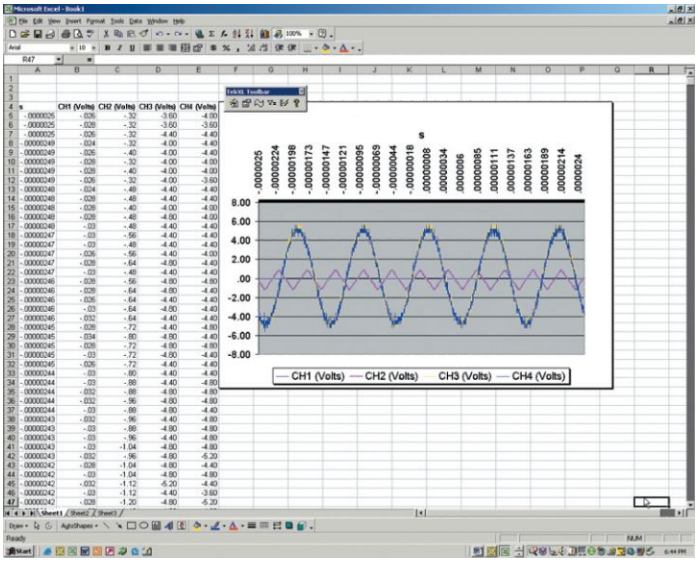


Capture elusive glitches – the first time – with Digital Real-Time (DRT) sampling technology.

Easily analyze and document your measurement results

Quickly reveal signal interference, crosstalk, and the effects of vibration with frequency domain analysis using the TPS2000B Series Fast Fourier Transform (FFT) feature. Then, easily document your measurement results with the integrated CompactFlash® mass storage.

To capture, save, and analyze your measurement results on your PC, the included OpenChoice® PC software can be used. Every TPS2000B Series also ships with a free copy of the special Tektronix Edition of the National Instrument LabVIEW SignalExpress™ software for basic instrument control, data logging, and analysis. The optional Professional Edition of SignalExpress offers over 200 built-in functions that provide additional signal processing, advanced analysis, sweeping, limit testing, and user-defined step capabilities.



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

SignalExpress supports the range of Tektronix bench instruments [3], enabling you to connect your entire test bench. You can then access the feature-rich tools packed into each instrument from one intuitive software interface. This allows you to automate complex measurements requiring multiple instruments, log data for an extended period of time, time-correlate data from multiple instruments, and easily capture and analyze your results, all from your PC. Only Tektronix offers a connected test bench of intelligent instruments to simplify and speed debug of your complex design.

Correlate your measurements from bench to lab to field

Use the TPS2000B 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. [4] Enjoy virtually unlimited freedom from an AC power source with hot-swappable batteries.



Easily correlate your measurements between bench, lab, and field with the highly portable TPS2000B Series.



Enjoy virtually unlimited freedom from an AC power source with hot-swappable batteries.

3 To see the full range of Tektronix instruments supported by the Tektronix Edition of NI LabVIEW SignalExpress, visit **www.tektronix.com/signalexpress**.

4 Please refer to Environmental and Safety specifications.

Optimize your productivity

The oscilloscope has a front-panel layout that most users will find familiar. Each channel has a dedicated set of scale and position controls. Reduce your measurement time with features like autoset, autorange, automatic measurements, probe check wizard, and context-sensitive help. Backlit menu buttons help you work in a variety of challenging environments - from bright daylight to dimly lit areas.



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

Performance you can count on

In addition to industry-leading service and support, every TPS2000B Series oscilloscope comes backed with a three-year standard warranty.

Specifications

All specifications apply to all models unless noted otherwise.

Model overview

	TPS2012B	TPS2014B	TPS2024B
Isolated channels	2	4	4
Bandwidth [5]	100 MHz	100 MHz	200 MHz
Rise time	3.5 ns	3.5 ns	2.1 ns
Sample rate per channel	1.0 GS/s	1.0 GS/s	2.0 GS/s
Record length	2.5k points	2.5k points	2.5k points

Vertical system

Record length 2.5k points

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

Maximum input voltage (1 MΩ) 300 V_{RMS} CAT II from BNC signal to BNC shell

Float voltage 600 V_{RMS} CAT II from BNC shell to earth ground

Position range 2 mV to 200 mV/div ±1.8 V

>200 mV to 5 V/div ±45 V

Bandwidth limit 20 MHz

Linear dynamic range ±5 div

Input impedance 1 MΩ ±2% in parallel with 20 pF

Input coupling AC, DC, GND

Horizontal system

Seconds/division range

TPS2012B	TPS2014B	TPS2024B
5 ns to 50 s/div	5 ns to 50 s/div	2.5 ns to 50 s/div

Time base accuracy 50 ppm

Horizontal zoom Horizontally expand or compress a live or stopped waveform

5 Bandwidth is 20 MHz at 2 mV/div, all models. For TPS2024B, 200 MHz bandwidth is typical at 5 mV/div. Bandwidth is 200 MHz at 10 mV/div and above, for operating temperatures from 0 °C to 40 °C. Bandwidth is 180 MHz for all V/div settings 10 mV/div and above, for operating temperatures from 0 °C to 50 °C.

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 input.
	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 s
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.

Acquisition system

Acquisition modes	
Sample	Sample data only
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 µs/div to 50 s/div
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 ≥100 ms/div.

Waveform measurements

Cursors	
Types	Voltage, time
Measurements	ΔT, 1/ΔT (frequency), ΔV, dv/dt [6], di/dt [6]
Automatic waveform measurements	Period, Frequency, +Width, -Width, Rise Time, Fall Time, Max, Min, Peak-to-Peak, Mean, Cycle RMS.
Power measurements	Optional package that offers instantaneous power waveform analysis, waveform analysis, harmonics analysis, switching loss, phase angles, dv/dt and di/dt cursors.

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 × CH2
4-channel models	CH1 - CH2, CH2 - CH1, CH3 - CH4, CH4 - CH3, CH1 + CH2, CH3 + CH4, CH1 × CH2, CH3 × CH4
Autorange	Allows the user to change test points without resetting the oscilloscope.

6 Requires TPS2PWR1 power application package.

Autoset menu

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

Square wave	Single cycle, multicycle, rising or falling edge
Sine wave	Single cycle, multicycle, FFT spectrum
Video (NTSC, PAL, SECAM)	Field: All, Odd, or Even Line: All or Selectable Line Number

Software

OpenChoice® Desktop	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 Word and Excel toolbar add-ins.

Display system

Display type	1/4 VGA Active TFT Color LCD display
Interpolation	Sin (x)/x
Waveform styles	Dots, vectors
Persistence	Off, 1 sec, 2 sec, 5 sec, infinite
Format	YT and XY
Horizontal zoom	Horizontally expand or compress a line or stopped waveform

Input/output ports

RS-232	
Port (standard)	9-pin DTE
Programmability	Full talk/listen modes. Control of all modes, settings, and measurements. Baud rate up to 19,200.
Printer port (standard)	
Graphics file formats	TIFF, PCS (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
Parallel port	Standard Centronics-type
Mass storage CompactFlash® memory	Accepts any Type 1 CompactFlash® card, up to and including 2 GB (card not included).
PC connectivity	Standard

Data storage

Nonvolatile storage CompactFlash® up to 2 GB

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).

Power source

Power source AC adapter with power cord

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

Physical characteristics

Dimensions

	mm	inches
Width	336.0	13.24
Height	161.0	6.33
Depth	130.0	5.10

Cooling clearance 2 in. (50 mm) required on left side and rear of instrument

Weight

	kg	lb.
Instrument only	2.7	6.0
with 1 battery	3.2	7.0
with 2 batteries	3.7	8.0

Package dimensions

	mm	inches
Width	476.2	18.75
Height	266.7	10.50
Depth	228.6	9.00

EMC, environment and safety

Temperature

Operating 0 °C to +50 °C

Nonoperating -40 °C to +71 °C

Humidity TPS2000B Series oscilloscopes are not intended for use in wet or damp conditions.

Operating High: 50 °C / 60% RH

Low: 30 °C / 90% RH

Nonoperating 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 meters
Non-operating	15,000 meters
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 or Exceeds: Australian EMC Framework, demonstrated per Emission Standard AS/NZS 2064.1/2
Safety	UL61010-1: 2004. CAN/CSA22.2 No. 1010.1: 2004. EN61010-1: 2001. Do not float the TPP0101/TPP0201 probe common lead to >30 V_{RMS}. Use the P5122, P5150 (floatable to 600 V_{RMS} CAT II) or similarly rated passive, high-voltage probe, or an appropriately rated high-voltage, differential probe when floating the common lead above 30 V_{RMS}.

Ordering information

TPS2000B Models

TPS2012B	100 MHz, 1 GS/s, 2.5k points, 2-channel digital storage oscilloscope
TPS2014B	100 MHz, 1 GS/s, 2.5k points, 4-channel digital storage oscilloscope
TPS2024B	200 MHz, 2 GS/s, 2.5k points, 4-channel digital storage oscilloscope

Standard accessories

Probes

One probe per channel standard.

TPP0101	100 MHz,10X passive probe for TPS2012B and TPS2014B
TPP0201	200 MHz,10X passive probe for TPS2024B

Accessories

--	Front protective cover
--	Printed user manual (English only)
--	Installation and safety manual
--	AC adapter with power cord
--	Lithium-ion battery with fuel gauge for 4-hour battery life. Two batteries required for 8 hours of continuous battery operation.
--	USB to RS-232 cable
--	OpenChoice® PC connectivity software
--	NI SignalExpress™ Tek Edition software
--	NIM/NIST-Traceable Certificate of Calibration

Warranty

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

Instrument options

Power cord and 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, 110/120 V, 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

Opt. SILV200	Standard warranty extended to 5 years

Probes and accessories are not covered by the oscilloscope warranty and Service Offerings. Refer to the datasheet of each probe and accessory model for its unique warranty and calibration terms.

Recommended accessories

Probes

Tektronix offers over 100 different probes to meet your application needs. For a comprehensive listing of available probes, please visit www.tektronix.com/probes.

A621	2000 A, 5-50 kHz AC current probe/BNC
A622	100 A, 100 kHz AC/DC current probe/BNC
P5122	200 MHz passive 100X high-voltage probe [7]
P5205A	High-voltage active differential probe (1300 V_{p-p}, 100 MHz) (1103 power supply required)
P5210A	High-voltage active differential probe (5600 V_{p-p}, 50 MHz) (1103 power supply required)
CT2	2.5 A, 200 MHz AC current probe
TCP202	15 A, 50 MHz AC/DC current probe (1103 power supply required)
TCP303/TCPA300	150 A, 15 MHz AC/DC current probe/amplifier
TCP305/TCPA300	50 A, 50 MHz AC/DC current probe/amplifier
TCP312/TCPA300	30 A, 100 MHz, DC/AC current probe/amplifier
TCP404XL/TCPA400	500 A, 2 MHz AC/DC current probe/amplifier

Accessories

TPS2PBND2	Power bundle for TPS2000B oscilloscopes. Includes (4) P5122 passive, 100X 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.
OpenChoice	The Tektronix OpenChoice Desktop free application lets you capture oscilloscope screen images, waveform data, and settings from a Microsoft Windows computer
TPSBAT	Additional battery
TPSCHG	Battery charger
AC2100	Soft case for carrying instrument
HCTEK4321	Hard case for carrying instrument (requires AC2100)
077-0447-xx	Service manual - English only
077-0444-xx	Programmer manual - English only

Cables

012-1241-xx	RS-232, 9-Pin Female to 25-Pin Male, 4.6 m (15 ft.), for modems
012-1651-xx	RS-232, 9-Pin Female to 9-Pin Female, null modem, for computers
012-1380-xx	RS-232, 9-Pin Female to 25-Pin Female, null modem, for computers
012-1651-xx	Centronics, 25-Pin Male to 36-Pin Centronics, 2.4 m (8 ft.), for parallel printer interfaces

7 The P5122 probe should not be used for AC-coupled measurements on signals with greater than 300 V DC offset. The P5120 is the recommended probe for measuring ripple on high-voltage DC supplies.

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.

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

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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.tektronix.com.

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