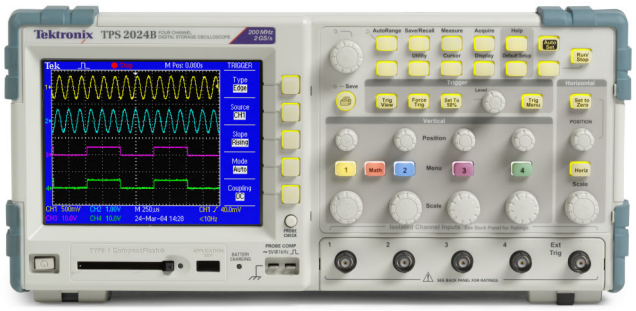
Digital Storage Oscilloscopes

TPS2012B • TPS2014B • TPS2024B Datasheet



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 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 Multilanguage 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

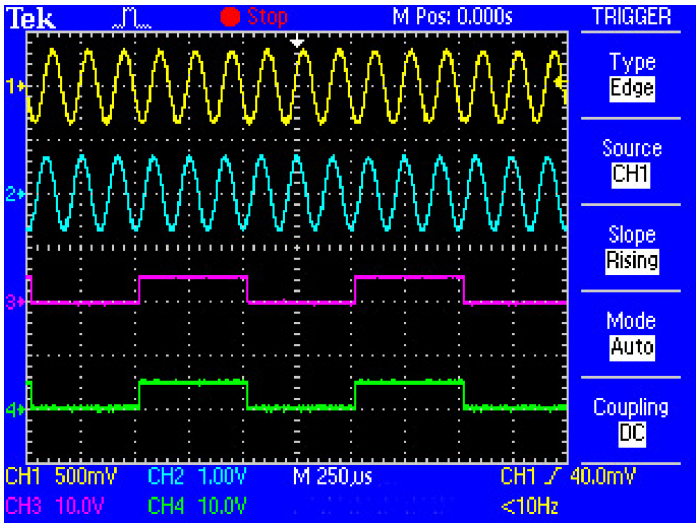
Applications

- Industrial Power Design, Troubleshooting, Installation, and Maintenance
- Advanced Electronics Design, Troubleshooting, Installation, and Maintenance
- Automotive Design and Test
- Education

TPS2000B Series Oscilloscopes for Powerful Productivity from Bench to Field

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.

Tektronix®

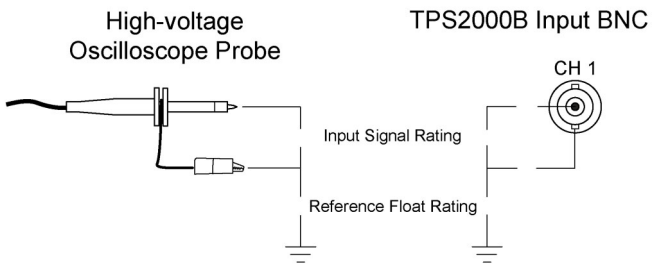


Four IsolatedChannel™ inputs and isolated external trigger input for quick, accurate, affordable floating and differential measurements.

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.



Input signal and float voltage maximum safety ratings.

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. Optional P5122 probes, when coupled with the TPS2000B, are suitable for making measurements on 480 V_{RMS} devices in Category II environments, with a maximum float voltage of up to 600 V_{RMS} relative to earth ground. With the optional P5120 probe the TPS2000B can measure up to 800 V_{p-p}, with a maximum float voltage within 600 V_{RMS} of ground. With the optional P5120 probe the TPS2000B can measure up to 800 V_{p-p} with a maximum float voltage within 600 V_{RMS} of ground. The P5120 is the best choice for making AC-coupled ripple measurements on high-voltage DC power supplies.

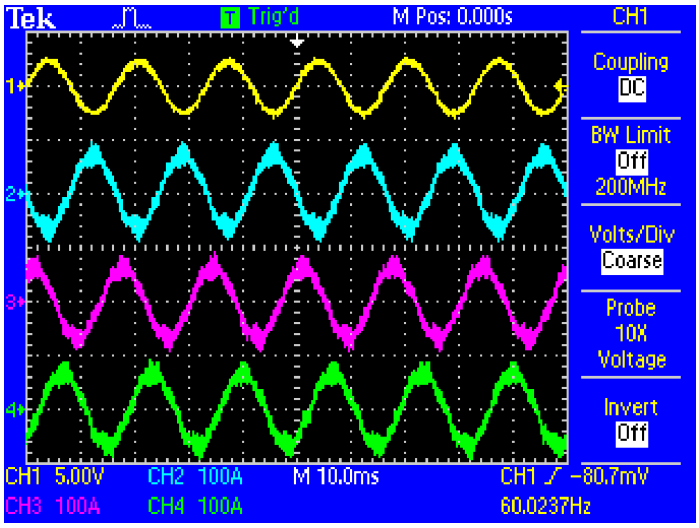
Please see “Characteristics” for complete safety ratings and specifications.

Selecting the Right Probes for the Job

Scope/Probe (Attenuation)	Maximum Safety Ratings		TPS2000B Viewable Signal	
	Reference Float Safety Rating*1	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) TPP0201 (200 MHz)	30 V_{RMS}	300 V_{RMS} CAT II	400 V_{p-p}	141 V_{RMS}
P5120 (20X)	600 V_{RMS} CAT II	1000 V_{RMS} CAT II	800 V_{p-p}	282 V_{RMS}
P5122*2 (100X)	600 V_{RMS} CAT II	1000 V_{RMS} CAT II	2828 V_{p-p}	1000 V_{RMS}

*1 Passive probe reference leads have no attenuation so any working voltage or over-voltage transients pass straight through to the scope reference. Thus, a passive probe reference float rating can never exceed the scope reference float rating.

*2 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.



Perform three-phase power measurements of variable frequency drives.

Conduct harmonic distortion measurements with TPS2PWR1 software.

Speed the Design and Test of Industrial Power Systems and Circuits

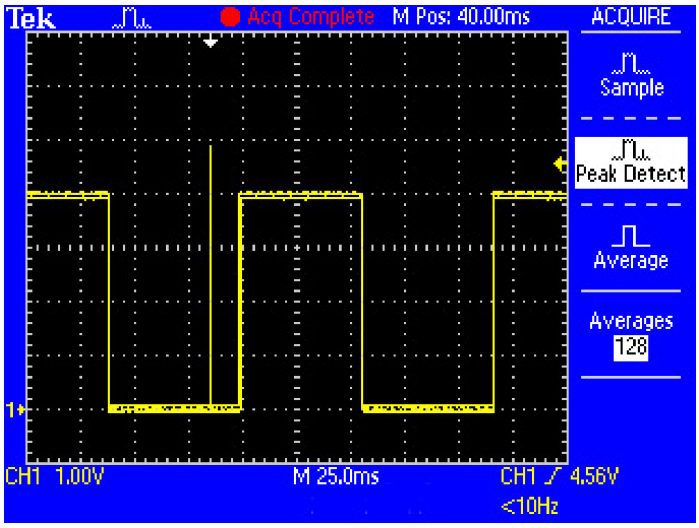
From mobile phones to industrial motor drives, power conversion technology has enabled significant advances in size, performance, and energy efficiency. But even the most basic task of viewing a converter's input and output is complicated by multiple voltage references. Multiple references also make 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.

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 TPS2PBND combines four P5120 20X passive, high-voltage probes with TPS2PWR1 power application software. The TPS2PBND2 combines four P5122 100X passive, high-voltage probes with the power application software.



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

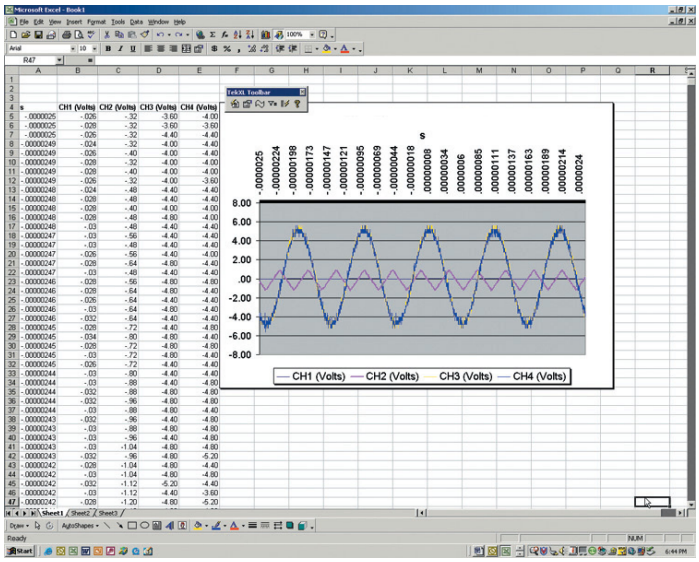
Quickly Debug and Characterize Signals with DRT Sampling Technology

Characterize a wide range of signal types on 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.

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



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

Series also ships with a free copy of the special Tektronix Edition of National Instrument's 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.

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.

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

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

Correlate Your Measurements from Bench to Lab to Field*[4]

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

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.

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.

*[4] Please refer to Environmental and Safety specifications.

Enjoy 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 and backlit menu buttons.

Characteristics

TPS2000B Series Electrical Characteristics

Feature	TPS2012B	TPS2014B	TPS2024B
Isolated Channels	2	4	4
Bandwidth*[5] (MHz)	100	100	200
Sample Rate (GS/s) per Channel	1.0	1.0	2.0
Record Length	2.5k 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 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		
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 MΩ ±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		

*[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.

Acquisition Modes

Mode	Description
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
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 ≥100 ms/div

Trigger System (Main Only)

Characteristic	Description
Trigger Modes	Auto, Normal, Single Sequence

Trigger Types

Trigger	Description
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

Characteristic	Description
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

Characteristic	Description
Types	Voltage, Time
Measurements	ΔT, 1/ΔT (frequency), ΔV, dv/dt*[6], di/dt*[6]

Measurement System

Characteristic	Description
Automatic Waveform Measurements	Period, Frequency, +Width, –Width, Rise Time, Fall Time, Max, Min, Peak-to-Peak, Mean, Cycle RMS

Waveform Processing

Characteristic	Description
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
Autoset Menu	Single-button, automatic setup of all channels for vertical, horizontal, and trigger systems, with undo autoset
Autorange	Allows the user to change test points without resetting the oscilloscope

Autoset Menu for Multiple Signal Types

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

Nonvolatile Storage

Characteristic	Description
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)

Display Characteristics

Characteristic	Description
Display	1/4 VGA Active TFT Color LCD display
Interpolation	Sin (x)/x
Display Types	Dots, vectors
Persistence	Off, 1 sec, 2 sec, 5 sec, Infinite
Format	YT and XY

I/O Interface

Characteristic	Description
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
Mass Storage CompactFlash® Memory	Accepts any Type 1 CompactFlash® card, up to and including 2 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
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

*6 Requires TPS2PWR1 power application package.

Environmental and Safety

Characteristic	Description
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 m
Nonoperating	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
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, P5120 (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}

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**	**lb.**
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

Ordering Information

TPS2012B, TPS2014B, TPS2024B

Digital Storage Oscilloscopes.

Standard Accessories

Accessory	Description
Probes	TPP0101 100 MHz, 10X passive probe for TPS2012B and TPS2014B; TPP0201 200 MHz, 10X passive probe for TPS2024B; one probe per channel standard
Battery (1)	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	A cable to connect to a PC USB port through the RS-232 port on the backside of the scope
OpenChoice® PC Connectivity Software	A collection of programs that enable fast and easy communication between MS Windows PCs and TPS2000B Series oscilloscopes
NI SignalExpress™ Tek Edition Software	A program that enables easy communication between PC-based NI SignalExpress software and TPS2000B Series oscilloscopes
Documentation	User Manual (please see below for available language options)
AC Adapter with Power Cord	
NIM/NIST-Traceable Certificate of Calibration	
Front Protective Cover	

Recommended Accessories

Accessory	Description
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
WSTRO	WaveStar software; Microsoft Windows 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
HCTEK4321	Hard case for carrying instrument (requires AC2100)
077-0447-xx	Service Manual – English only
077-0444-xx	Programmer Manual – English only

Recommended Probes

Accessory	Description
A621	2000 A, 5-50 kHz AC current probe/BNC
A622	100 A, 100 kHz AC/DC current probe/BNC
P5122*2	200 MHz passive 100X high-voltage probe
P5205	High-voltage active differential probe (1300 V_{p-p}, 100 MHz) (1103 power supply required)
P5210	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

*2 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.

International Power Plugs

Option	Description
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. A11	India power
Opt. A12	Brazil power
Opt. A99	No power cord or AC adapter

Accessory Cables

Cable	Description
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
012-1214-xx	Centronics, 25-Pin Male to 36-Pin Centronics, 2.4 m (8 ft.), for parallel printer interfaces

International User Manual Language Options

Translated front-panel overlay included with its respective user manual.

Option	Description
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. L10	Russian (071-1451-xx)

Service Options

Option	Description
Opt. SILV200	Standard Warranty Extended to 5 Years

Warranty Information

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

Speed Product Development with Best-in-Class Price/Performance

The extensive Tektronix 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

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

Contact Tektronix:

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South Africa +41 52 675 3777

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Sweden 00800 2255 4835*

Switzerland 00800 2255 4835*

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United Kingdom & Ireland 00800 2255 4835*

USA 1 800 833 9200

* 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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