## PicoScope performance and reliability

With over 20 years' experience in the test and measurement industry, we know what's important in a new oscilloscope. The PicoScope 6000 Series scopes give you the best value for money of any oscilloscope, with outstanding bandwidth, sampling rate and memory depth specifications. These features are backed up by advanced software optimized with the help of feedback from our customers.

High bandwidth, high sampling rate

With 250 MHz to 500 MHz analog bandwidths complemented by a real-time sampling rate of 5 GS/s, the PicoScope 6000 Series scopes can display single-shot pulses with 200 ps time resolution. Equivalent time sampling (ETS) mode boosts the maximum sampling rate to 50 GS/s, giving an even finer timing resolution of 20 ps for repetitive signals.

Huge buffer memory
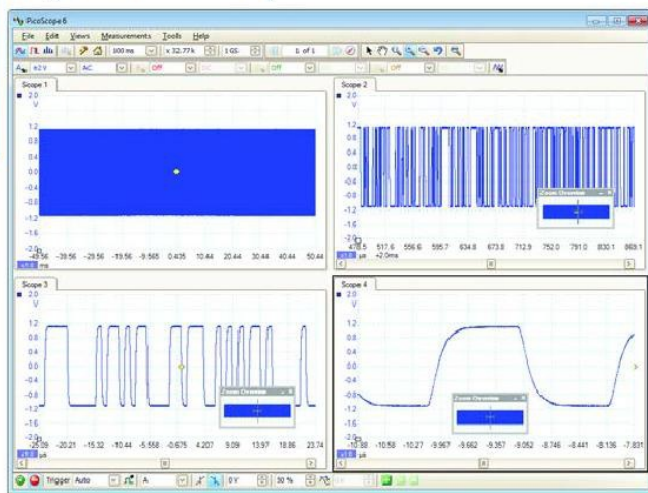
Deep memory allows you to zoom in ... and in ... and in

The PicoScope 6000 Series gives you the deepest buffer memory available as standard on any oscilloscope at any price. The SuperSpeed USB 3.0 interface ensures that the display is smooth and responsive even with long captures. Other oscilloscopes have high maximum sampling rates, but without deep memory they cannot sustain these rates on long timebases. The 2 gigasample buffer on the PicoScope 6404D can hold two 200 ms captures at the maximum sampling rate of 5 GS/s. To help manage all this data, PicoScope can zoom up to 100 million times using a choice of two zoom methods. There are zoom buttons as well as an overview window that lets you zoom and reposition the display by simply dragging with the mouse.
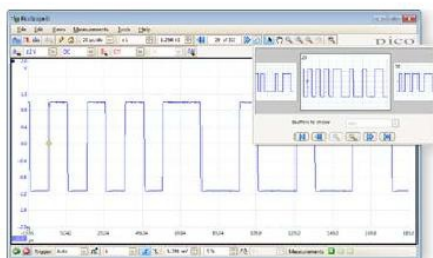

To help you find you way around the buffer memory, you can divide it into as many as 10,000 individually triggered segments. Use the visual buffer navigator to scan through the segments, or set up a mask to filter out the waveforms of interest.

Custom probe settings

The custom probes menu allows you to correct for gain, attenuation, offsets and nonlinearities of probes and transducers, or convert to different measurement units. Definitions for standard Pico-supplied probes are built in, but you can also create your own using linear scaling or even an interpolated data table.
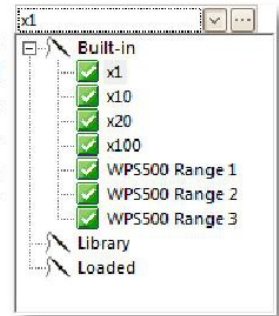
Arbitrary waveform and function generator
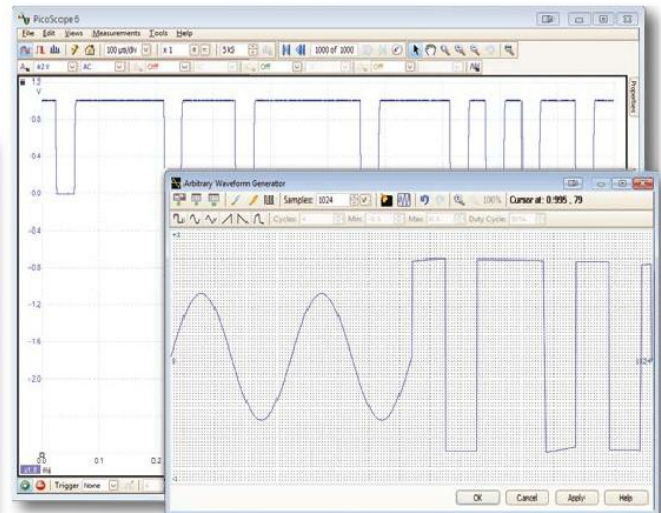
Every model includes a built-in DC to 20 MHz function generator with sine, square, triangle and DC waveforms. D models add a built-in 12 bit, 200 MS/s arbitrary waveform generator. You can import arbitrary waveforms from data files or create and modify them using the built-in graphical AWG editor.

Spectrum analyzer

With the click of a button, you can open a new window to display a spectrum plot of selected channels up to the full bandwidth of the oscilloscope. The spectrum view can optionally be displayed together with a time-domain view. A comprehensive range of settings give you control over the number of spectrum bands, window types and display modes.
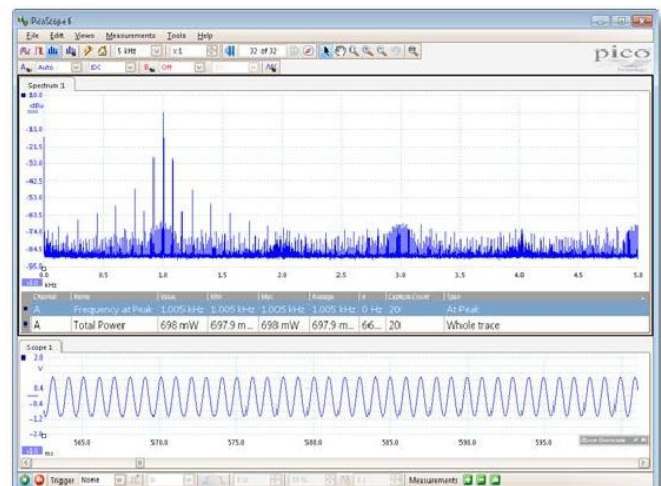
Color persistence modes

See old and new data superimposed, with new data in a brighter color or shade. This makes it easy to see glitches and dropouts and to estimate their relative frequency. Choose between analog persistence, digital color or custom display modes.

Mask limit testing

This feature is designed for production and debugging environments. Capture a signal from a known working system, and PicoScope will draw a mask around it with your specified vertical and horizontal tolerances. Connect the system under test, and 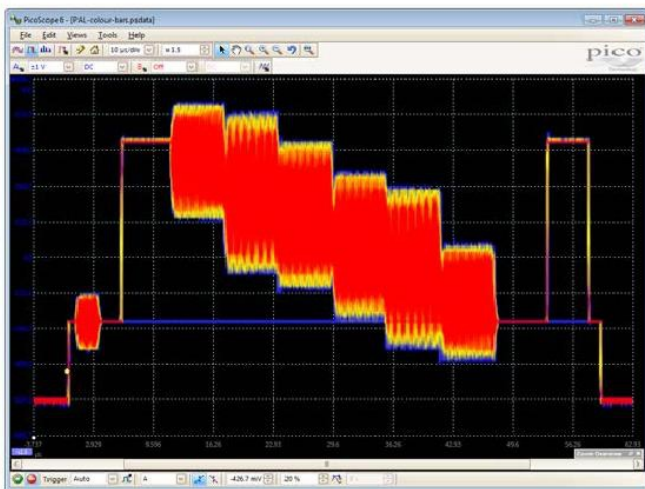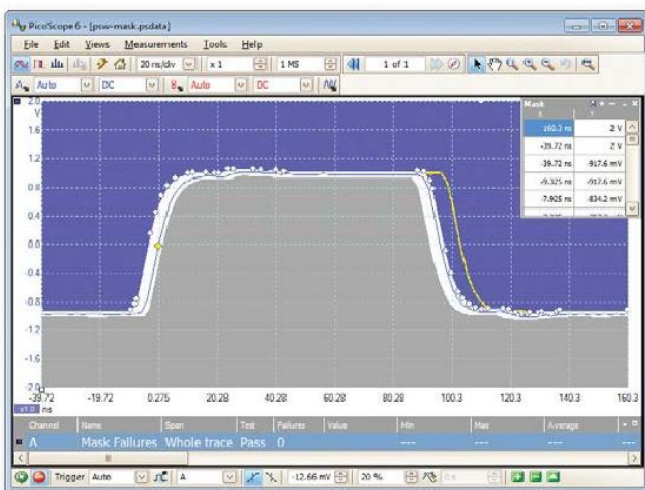PicoScope will highlight any parts of the waveform that fall outside the mask area. The highlighted details persist on the display, so the scope can catch intermittent glitches even while your attention is elsewhere. The measurements window counts the number of failures, and can display other measurements and statistics at the same time.

The numerical and graphical mask editors (both shown below) can be used separately or in combination, allowing you to enter accurate mask specifications or modify existing masks. You can import and export masks as files.

High-speed data acquisition

The drivers and software development kit supplied allow you to write your own software or interface to popular third-party software packages. If the 2 GS buffer memory of the PicoScope 6404D isn't enough, the drivers support data streaming, a mode that captures gap-free continuous data over the USB 3.0 port directly to the PC's RAM at over 150 MS/s and to solid-state disk at up to 78 MS/s. Rates are subject to PC specifications and application loading.

Serial data decoding
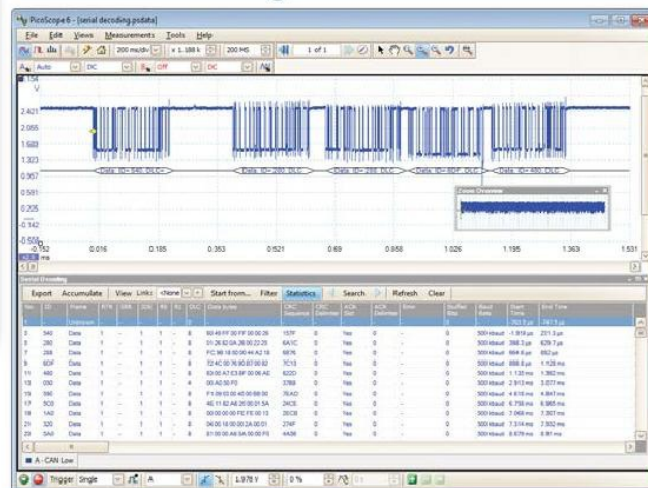
The PicoScope 6000 Series oscilloscopes are well-suited to serial decoding, with a deep memory buffer that allows them to collect long, uninterrupted sequences of data. This allows the capture of thousands of frames or packets of data over several seconds. The scopes can decode up to four buses simultaneously with independent protocol selection for each input channel.

Serial protocols
UART (RS-232)
SPI
I²C
I²S
CAN
LIN
FlexRay

PicoScope displays the decoded data in the format of your choice: **in view**, **in window**, or both at once.

- **In view** format shows the decoded data beneath the waveform on a common time axis, with error frames marked in red. You can zoom in on these frames to look for noise or distortion on the waveform.

- **In window** format shows a list of the decoded frames, including the data and all flags and identifiers. You can set up filtering conditions to display only the frames you are interested in, search for frames with specified properties, or define a start pattern that the program will wait for before it lists the data.

Analog and digital low-pass filtering

Each input channel has its own digital low-pass filter with independently adjustable cut-off frequency from 1 Hz to the full scope bandwidth. This enables you to reject noise on selected channels while viewing high-bandwidth signals on the others.

An additional selectable analog bandwidth limiter on each input channel can be used to reject high frequencies that would otherwise cause aliasing.
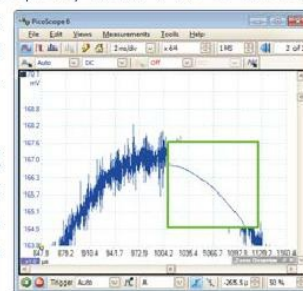
Digital triggering

Most digital oscilloscopes sold today still use an analog trigger architecture based on comparators. This can cause time and amplitude errors that cannot always be calibrated out. The use of comparators often limits the trigger sensitivity at high bandwidths.

In 1991 Pico pioneered the use of fully digital triggering using the actual digitized data. This technique reduces trigger errors and allows our oscilloscopes to trigger on the smallest signals, even at the full bandwidth. Trigger levels and hysteresis can be set with high precision and resolution.

Digital triggering also reduces rearm delay and this, combined with the segmented memory, allows the triggering and capture of events that happen in rapid sequence. At the fastest timebase you can use rapid triggering to collect 10,000 waveforms in under 10 milliseconds. The mask limit testing function can then scan through these waveforms to highlight any failed waveforms for viewing in the waveform buffer.

Advanced triggers

As well as the standard range of triggers found on most oscilloscopes, the PicoScope 6000 Series has a built-in set of advanced triggers to help you capture the data you need.
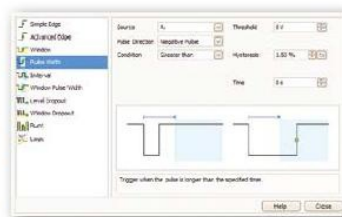
All triggering is digital, resulting in high threshold resolution with programmable hysteresis and optimal waveform stability.

Maths channels

With PicoScope 6 you can perform a variety of mathematical calculations on your input signals. You can calculate the sum, difference, product or inverse, or create your own custom function using standard arithmetic, exponential and trigonometric functions.
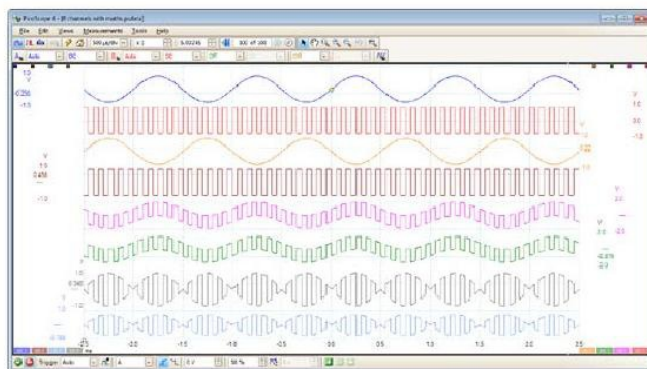
Automatic measurements

PicoScope allows you to automatically display a table of calculated measurements for troubleshooting and analysis.

Using the built-in measurement statistics you can see the average, standard deviation, maximum and minimum of each measurement as well as the live value.

You can add as many measurements as you need on each view. Each measurement includes statistical parameters showing its variability.

For information on the measurements available in scope and spectrum modes, see **Automatic Measurements** in the **Specifications** table.
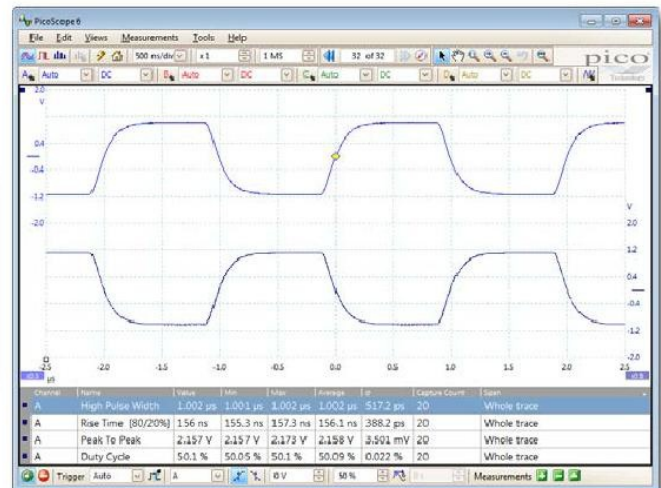
Channel	Name	Value	Min	Max	Average
A	High Pulse Width	1.002 µs	1.001 µs	1.002 µs	1.002 µs
A	Rise Time [80/20%]	156 ns	155.3 ns	157.3 ns	156.1 ns
A	Peak To Peak	2.157 V	2.157 V	2.173 V	2.158 V
A	Duty Cycle	50.1 %	50.05 %	50.1 %	50.09 %

15 scope mode measurements
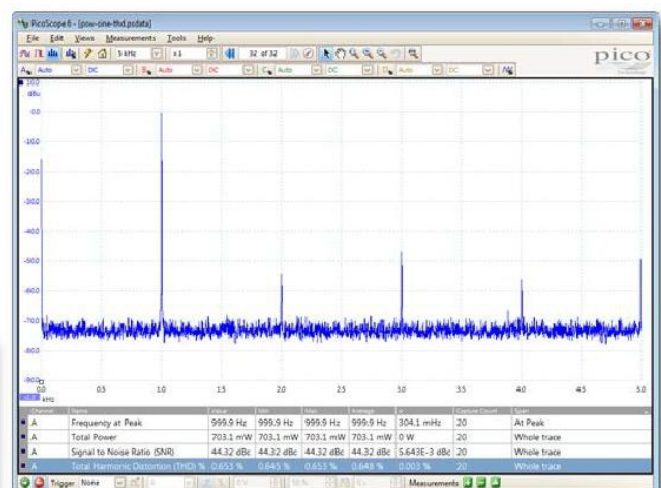
Channel	Name	Value	Min
A	Frequency at Peak	999.9 Hz	999.9 Hz
A	Total Power	703.1 mW	703.1 mW
A	Signal to Noise Ratio (SNR)	44.32 dBc	44.32 dBc
A	Total Harmonic Distortion (THD) %	0.653 %	0.645 %

11 spectrum mode measurements

High signal integrity

Most oscilloscopes are built down to a price; ours are built up to a specification.

Our engineers use careful front-end design and shielding to reduce noise, crosstalk and harmonic distortion. With decades of oscilloscope experience, we know how to design for optimal pulse response and bandwidth flatness.
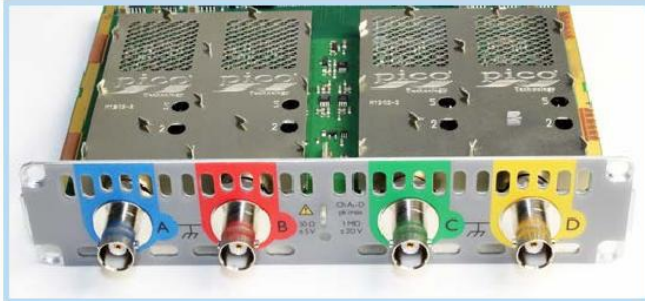
Hardware acceleration

On some oscilloscopes, enabling deep memory has a penalty: the screen update rate slows down and the controls become unresponsive as the processor struggles to cope with the amount of data. Thanks to the hardware acceleration inside PicoScope deep-memory oscilloscopes, you can collect waveforms containing hundreds of millions of samples while keeping fast screen update rates and a responsive user interface. Dedicated hardware inside the oscilloscope processes multiple streams of data in parallel to construct the waveform that will be displayed on the screen. This is done far faster than any PC processor could manage, and together with USB 3.0 SuperSpeed data transfer eliminates any bottlenecks between the oscilloscope and the PC.

For example, the scope may be set to capture 100 000 000 samples but the PicoScope display window may be only 1000 pixels wide. In this case, the scope intelligently compresses the data into 1000 blocks of 100 000 samples each. Unlike simple decimation, which throws away most of the data, PicoScope hardware acceleration guarantees that you see any high-frequency details such as narrow glitches, even when the display is zoomed out.

High-end features as standard

Buying a scope from some companies is a bit like buying a car. By the time you have added all the optional extras you need, the price has gone up considerably. With the PicoScope 6000 Series, high-end features such as mask limit testing, serial decoding, advanced triggering, measurements, math, XY mode, digital filtering, segmented memory and even a signal generator are all included in the price.

To protect your investment, both the PC software and firmware inside the unit can be updated. We have a long history of providing new features for free as software downloads. Other companies make vague promises about future enhancements but we deliver on our promises year after year. Users of our products reward us by becoming lifelong customers, frequently recommending us to their colleagues.

Probes included

Your PicoScope 6000 Series scope is supplied complete with four wideband, high-impedance probes. These probes have been designed for use with individual models of the PicoScope 6000 Series and are factory-compensated to match each scope's input characteristics. Each high-quality probe is supplied with a range of accessories for convenient and accurate high-frequency measurements.

A comprehensive range of alternative probes is also available.

Probe specifications	TA150	TA133
Attenuation	10:1	
Resistance at probe tip	10 MΩ	
Capacitance at probe tip	9.5 pF	
Scope input impedance	1 MΩ	
Compatibility	PicoScope 6402C/D, PicoScope 6403C/D	PicoScope 6404C/D
Bandwidth (3 dB)	350 MHz	500 MHz
Rise time (10% to 90%)	1 ns	700 ps
Compensation range	10 to 25 pF	
Safety standard	IEC/EN 61010-031	
Cable length	1.3 m	

Probe accessories included

TA133 and TA150

- Instruction manual
- Solid tip 0.5 mm
- Coding rings, 3 x 4 colors
- Ground lead 15 cm
- Ground spring 2.5 mm
- Trim tool
- Insulating cap 2.5 mm
- Sprung hook 2.5 mm

TA133 only

- Spring tip 0.5 mm
- Ground blade 2.5 mm
- 2 self-adhesive copper pads
- Protection cap 2.5 mm
- IC caps 0.5 to 1.27 mm pitch
- PCB adaptor kit 2.5 mm

PicoScope: The display can be as simple or as complex as you need. Begin with a single view of one channel, and then expand the display to include any number of live channels, math channels and reference waveforms.

Tools > Serial decoding: Decode multiple serial data signals and display the data alongside the physical signal or as a detailed table.

Tools > Reference channels: Store waveforms in memory or on disk and display them alongside live inputs. Ideal for diagnostics and production testing.

Tools > Masks: Automatically generate a test mask from a waveform or draw one by hand. PicoScope highlights any parts of the waveform that fall outside the mask and shows error statistics.

Channel options: Filtering, offset, scaling, resolution enhancement, custom probes and bandwidth limiter.

Auto setup button: Configures the timebase and voltage ranges for stable display of signals.

Trigger marker: Drag to adjust trigger level and pre-trigger time.

Oscilloscope controls: Controls such as voltage range, scope resolution, channel enable, timebase and memory depth are placed on the toolbar for quick access, leaving the main display area clear for waveforms.

Signal generator: Generates standard signals or (on selected scopes) arbitrary waveforms. Includes frequency sweep mode.

Waveform replay tools: PicoScope automatically records up to 10 000 of the most recent waveforms. You can quickly scan through to look for intermittent events, or use the **Buffer Navigator** to search visually.

Zoom and pan tools: PicoScope allows a zoom factor of several million, which is necessary when working with the deep memory of the 6000 Series scopes. Either use the zoom-in, zoom-out and pan tools, or click and drag in the zoom overview window for fast navigation.

Math channels: Combine input channels and reference waveforms using simple arithmetic, or create custom equations with trigonometric and other functions.

Views: PicoScope is carefully designed to make the best use of the display area. You can add new scope and spectrum views with automatic or custom layouts.

Rulers: Each axis has two rulers that can be dragged across the screen to make quick measurements of amplitude, time and frequency.

Ruler legend: Absolute and differential ruler measurements are listed here.

Movable axes: The vertical axes can be dragged up and down. This feature is particularly useful when one waveform is obscuring another. There's also an **Auto Arrange Axes** command.

Trigger toolbar: Quick access to main controls, with advanced triggers in a pop-up window.

Automatic measurements: Display calculated measurements for troubleshooting and analysis. You can add as many measurements as you need on each view. Each measurement includes statistical parameters showing its variability.

Zoom overview: Click and drag for quick navigation in zoomed views.

Spectrum view: View FFT data alongside scope view or independently.

	PicoScope 6402C	PicoScope 6402D	PicoScope 6403C	PicoScope 6403D	PicoScope 6404C	PicoScope 6404D
VERTICAL						
Input channels	4, BNC connectors, single-ended					
Analog bandwidth (-3 dB)*	250 MHz (200 MHz on ±50 mV range)		350 MHz (250 MHz on ±50 mV range)		500 MHz	
Bandwidth limiter	20 MHz, switchable		20 MHz, switchable		25 MHz, switchable	
Rise time (10% to 90%, calculated)	1.4 ns (50 mV range 1.8 ns)		1.0 ns (50 mV range 1.4 ns)		0.7 ns (all ranges)	
Input ranges (full scale)	±50 mV to ±20V, in 9 ranges (1 MΩ input), ±50 mV to ±5V, in 7 ranges (50 Ω input)					
Input sensitivity	10 mV/div to 4 V/div at x1 zoom (1 MΩ input), 10 mV/div to 1 V/div at x1 zoom (50 Ω input)					
Input coupling	AC (1 MΩ) or DC (1 MΩ or 50 Ω)					
Input characteristics	1 MΩ ± 1% ‖ 15 pF, or 50 Ω ± 2%				1 MΩ ± 1% ‖ 10 pF, or 50 Ω ± 2%	
Analog offset range	±50 to ±200 mV input ranges: ±0.5 V ±500 mV input range: ±2.5 V ±1 V " ±2.5 V ±2 V " ±2.5 V ±5 V " ±20 V (50 Ω: ±0.5 V) ±10 V " ±20 V ±20 V " ±20 V				±2 V ±10 V (50 Ω: ±5 V) ±10 V (50 Ω: ±4.5 V) ±10 V (50 Ω: ±3.5 V) ±35 V (50 Ω: ±0.5 V) ±30 V ±20 V	
DC accuracy	3% of full scale					
Overvoltage protection	±100 V to ground (1 MΩ inputs), 5.5 V RMS (50 Ω inputs)					

* Stated bandwidth is with supplied probes or at BNC when 50 Ω impedance selected

DYNAMIC PERFORMANCE						
Noise	200 µV RMS (50 mV range)				320 µV RMS (50 mV range)	
THD	−55 dB typical				−54 dB typical	
SFDR	60 dB typical				55 dB typical	
Crosstalk	17 000:1 typical at 20 MHz 1000:1 typical at full bandwidth				5600:1 typical at 20 MHz 560:1 typical at full bandwidth	

HORIZONTAL (TIMEBASE)						
Timebase ranges	1 ns/div to 5000 s/div (real-time sampling) 50 ps/div to 100 ns/div (equivalent-time sampling / ETS)					
Timebase accuracy	±2 ppm					
Timebase ageing	1 ppm per year					

ACQUISITION						
ADC resolution	8 bits (up to 12 bits using software resolution enhancement)					
Maximum real-time sampling rate	1 channel 5 GS/s 2 channels 2.5 GS/s** 4 channels 1.25 GS/s					
Maximum ETS rate	50 GS/s (any number of channels)					
Maximum streaming data rate (PicoScope 6)	10 MS/s					
Maximum streaming data rate (SDK)	Data transfer > 150 MS/s, streaming to SSD hard drive 78 MS/s (USB 3.0, PC-dependent, subject to application loadings)					
Buffer size (shared between active channels)	256 MS	512 MS	512 MS	1 GS	1 GS	2 GS
Buffer size (streaming mode)	100 MS in PicoScope software. Up to available PC memory when using SDK.					
Max. buffer segments (using PicoScope 6)	10 000					
Max. buffer segments (using SDK)	250 000	500 000	500 000	1 000 000	1 000 000	2 000 000

** To achieve 2.5 GS/s sampling rate in 2-channel mode, use channel A or B and channel C or D.

TRIGGERING						
Sources	Channels A to D, AUX					
Trigger modes	None, single, repeat, auto, rapid (segmented memory), ETS					
Advanced trigger types (real-time mode)	Edge, pulse width, window, window pulse width, dropout, window dropout, level, interval, logic level, runt pulse					
Trigger types (ETS mode)	Rising edge, falling edge					
Trigger sensitivity	1 LSB accuracy up to full bandwidth of scope					
Trigger level	Adjustable over whole of selected voltage range					
Maximum pre-trigger capture	100% of capture size					
Maximum post-trigger delay	4 billion samples					
Re-arm time	Less than 1 µs on fastest timebase					
Maximum trigger rate	Up to 10,000 waveforms in a 10 ms burst					
Trigger timing resolution	1 sample period					

AUX TRIGGER INPUT						
AUX trigger connector type	Rear panel BNC, shared with reference clock input					
Trigger types	Edge, pulse width, dropout, interval, logic					
Input characteristics	50 Ω ±1%, DC coupled					
Bandwidth	25 MHz					
Threshold range	±1 V					
Overvoltage protection	±5 V (DC + AC peak)					

REFERENCE CLOCK INPUT (SDK ONLY)						
Clock input characteristics	50 Ω, BNC, ±1 V, DC coupled					
Frequency range	5, 10, 20, 25 MHz, user-selectable					
Connector	Rear panel BNC, shared with AUX trigger					
Level	Adjustable threshold, ±1 V					
Overvoltage protection	±5 V					

	PicoScope 6402C	PicoScope 6402D	PicoScope 6403C	PicoScope 6403D	PicoScope 6404C	PicoScope 6404D
FUNCTION GENERATOR						
Standard signal frequency	DC to 20 MHz					
Standard output signals All models	Sine, square, triangle, DC					
D models only	Ramp, sinc, Gaussian, half-sine, white noise, PRBS					
Output frequency accuracy	Same as scope timebase accuracy					
Output frequency resolution	< 0.05 Hz					
Output voltage adjustment	Amplitude adjustment: ±2 V (4 V max. p-p) Offset adjustment: ±1 V Maximum combined output voltage: ±2.5 V					
DC accuracy	±1% of full scale					
Connector type	Rear panel BNC					
Output impedance	50 Ω					
Overvoltage protection	±5 V					
Sweep modes	Up, down, or dual, with selectable start/stop frequencies and increments					
Signal generator triggering	Scope, manual, or AUX input; programmable number of cycles from 1 to 1 billion					
ARBITRARY WAVEFORM GENERATOR (AWG)						
Buffer size	–	64 kS	–	64 kS	–	64 kS
Sample rate		200 MS/s		200 MS/s		200 MS/s
Resolution		12 bits		12 bits		12 bits
Bandwidth		20 MHz		20 MHz		20 MHz
PROBE COMPENSATION OUTPUT						
Impedance	600 Ω					
Frequency	1 kHz square wave					
Level	2 V pk-pk					
Overvoltage protection	±5 V (DC + AC peak)					
SPECTRUM ANALYZER						
Frequency range	DC to 250 MHz		DC to 350 MHz		DC to 500 MHz	
Display modes	Magnitude, average, peak hold					
Windowing functions	Rectangular, Gaussian, triangular, Blackman, Blackman-Harris, Hamming, Hann, flat-top					
Number of FFT points	Selectable power of 2 from 128 to 1 048 576					
MATH CHANNELS						
Functions	−x, x+y, x−y, x*y, x/y, x^y, sqrt, exp, ln, log, abs, norm, sign, sin, cos, tan, arcsin, arccos, arctan, sinh, cosh, tanh, freq, derivative, integral, min, max, average, peak, delay					
Operands	Input channels A to D, reference waveforms, time, π					
AUTOMATIC MEASUREMENTS						
Scope mode	AC RMS, true RMS, cycle time, DC average, duty cycle, falling rate, fall time, frequency, high pulse width, low pulse width, maximum, minimum, peak-to-peak, rise time and rising rate					
Spectrum mode	Frequency at peak, amplitude at peak, average amplitude at peak, total power, THD %, THD dB, THD+N, SFDR, SINAD, SNR and IMD					
Statistics	Minimum, maximum, average, and standard deviation					
SERIAL BUS DECODING						
Data formats	CAN, LIN, I²C, I²S, UART/RS-232, SPI, FlexRay					
MASK LIMIT TESTING						
Statistics	Pass/fail, failure count, total count					
DISPLAY						
Interpolation	Linear or sin(x)/x					
Persistence modes	Digital color, analog intensity, custom, or none					
GENERAL						
PC connectivity	USB 3.0 (USB 2.0 compatible)					
Exported data formats	Comma-separated values, tab-delimited, BMP, GIF, PNG, MATLAB 4 format					
Power requirement	12 V DC, 4 A max. AC adaptor and cable supplied					
Dimensions (inc. connectors & end caps)	170 x 255 x 40 mm				170 x 285 x 40 mm	
Weight	1 kg (approx. 2 lb 3 oz)				1.3 kg (approx. 2 lb 14 oz)	
Temperature range	Operating: 0 °C to 40 °C (20 °C to 30 °C for stated accuracy). Storage: −20 °C to +60 °C.					
Humidity range	Operating: 5% to 80% RH non-condensing. Storage: 5% to 95% RH non-condensing.					
Compliance	EU: EMC, LVD, RoHS, WEEE. USA: FCC Part 15 Subpart B					
Safety approvals	Designed to EN 61010-1:2010					
PC requirements	Microsoft Windows XP, Windows Vista, Windows 7, or Windows 8 (not Windows RT)					
Software included	PicoScope 6, Windows SDK and example programs					
Languages supported (software)	Simplified Chinese, Traditional Chinese, Czech, Danish, Dutch, English, Finnish, French, German, Greek, Hungarian, Italian, Japanese, Korean, Norwegian, Polish, Portuguese, Romanian, Spanish, Swedish, Turkish					
Languages supported (help)	English, French, German, Italian, Spanish					

Model selector

Model	Bandwidth	Buffer size	Signal generator	Arbitrary waveform generator
PicoScope 6402C	250 MHz	256 MS	✓	
PicoScope 6402D	250 MHz	512 MS	✓	✓
PicoScope 6403C	350 MHz	512 MS	✓	
PicoScope 6403D	350 MHz	1 GS	✓	✓
PicoScope 6404C	500 MHz	1 GS	✓	
PicoScope 6404D	500 MHz	2 GS	✓	✓

Have you seen the PicoScope 6407 Digitizer?

The PicoScope 6407 Digitizer has four 1 GHz inputs and a maximum sampling rate of 5 GS/s.

→ PicoScope 6407 Digitizer
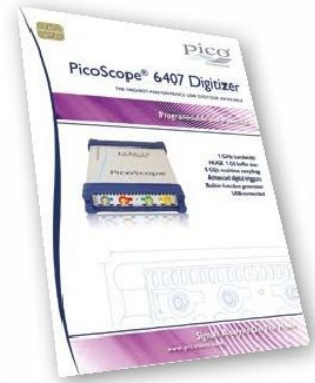
Product pack contents

- PicoScope 6000 Series oscilloscope
- Four factory-compensated probes
- USB cable
- Universal mains (AC) power supply
- Mains lead (power cord)
- Installation Guide
- Software and Reference CD
- Carrying case

Need more bandwidth?

For repetitive signals such as serial data streams, and characterization of cables and backplanes, the PicoScope 9000 Series Sampling Oscilloscopes deliver high specifications at low prices. Choose between the 12 GHz PicoScope 9200 Series and the 20 GHz PicoScope 9300 Series. TDR/TDT and optical models are also available.

→ PicoScope 9000 Series

Ordering information

Description
PP884 PicoScope 6402C 250 MHz Oscilloscope with probes
PP885 PicoScope 6402D 250 MHz Oscilloscope with AWG and probes
PP886 PicoScope 6403C 350 MHz Oscilloscope with probes
PP887 PicoScope 6403D 350 MHz Oscilloscope with AWG and probes
PP888 PicoScope 6404C 500 MHz Oscilloscope with probes
PP889 PicoScope 6404D 500 MHz Oscilloscope with AWG and probes
TA150 Replacement ×10 probe for PicoScope 6402C/D and 6403C/D
TA133 Replacement ×10 probe for PicoScope 6404C/D
TA065, TA066 and TA067 accessory packs for TA150 and TA133 probes

Prices exclude VAT and are correct at the time of publication. Please contact Pico Technology for the latest prices before ordering.

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