pico® Technology

PicoScope® 9300 Series

THE NEW FACE OF SAMPLING OSCILLOSCOPES

20 GHz bandwidth
17.5 ps rise time

A LONG LIST OF FEATURES

1 MS/s sequential sampling - the industry's fastest
NRZ and RZ eye plots and measurements
Serial data mask library and local editing
Waveform and statistical measurement
Time and voltage histograms
Mathematics, FFT and custom formula
Intuitive Microsoft Windows® user interface
ActiveX automation

APPLICATIONS

Serial data pre-compliance testing
Telecom service and manufacturing
High-resolution timing analysis
Digital system design and characterization
Automated pass/fail mask test
Fast pulse and logic characterization

16-bit 1 MS/s sampler	Built-in pulse and clock generator	60 dB dynamic range	2 input channels	15 TS/s effective sampling rate	40 µV resolution
Dual timebase from 5 ps/div	2.5 GHz full-function trigger, 14 GHz prescaled	Clock recovery to 11.3 Gb/s	±1 V input range	64 fs effective resolution	1 ps deskew resolution

www.picotech.com

20 GHz bandwidth

The PicoScope 9300 Series oscilloscopes use triggered sequential sampling to capture high-bandwidth repetitive or clock-derived signals without the expense or jitter of a very high-speed clocked sampling system such as a real-time oscilloscope. The 20 GHz bandwidth allows measurement of 17.5 ps transitions, while the very low sampling jitter enables a time resolution as short as 0.064 ps. The sequential sampling rate of 1 MS/s, unsurpassed by any other sampling oscilloscope, allows the fast building of waveforms, eye diagrams and histograms.

2.5 GHz full-function direct external trigger

The scopes are equipped with a built-in direct external trigger for signals up to 2.5 GHz repetition rate.

14 GHz prescaled trigger

Trigger bandwidth is extended to 14 GHz via a built-in prescale frequency divider for the external trigger.

Built-in 11.3 Gb/s clock data recovery trigger

To support serial data applications in which the data clock is not available as a trigger, the PicoScope 9302 includes a clock recovery module to regenerate the data clock from the incoming serial data. A divider accessory kit is included to route the signal to both the clock recovery and oscilloscope inputs.

Multiple sampling modes

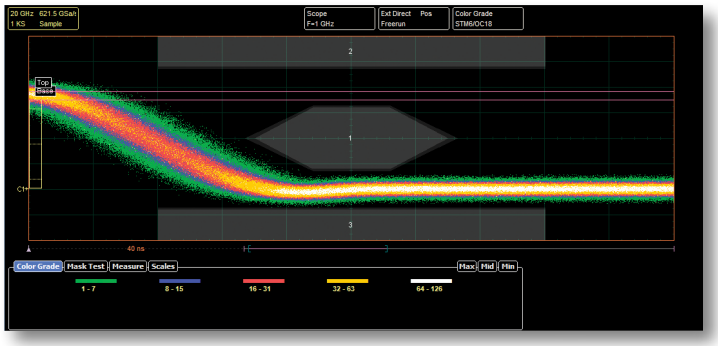
Sequential time sampling (STS) mode. The oscilloscope samples after each trigger event with a regularly incrementing delay derived from an internal triggerable oscillator. Jitter is 1.8 ps typical, 2.0 ps maximum. The 1 MS/s sampling rate, the highest of any sampling scope, builds waveforms and persistence displays faster.

Eye mode. A variation of STS mode in which sampling is controlled by the external prescaled trigger. Jitter is reduced even with long time delays.

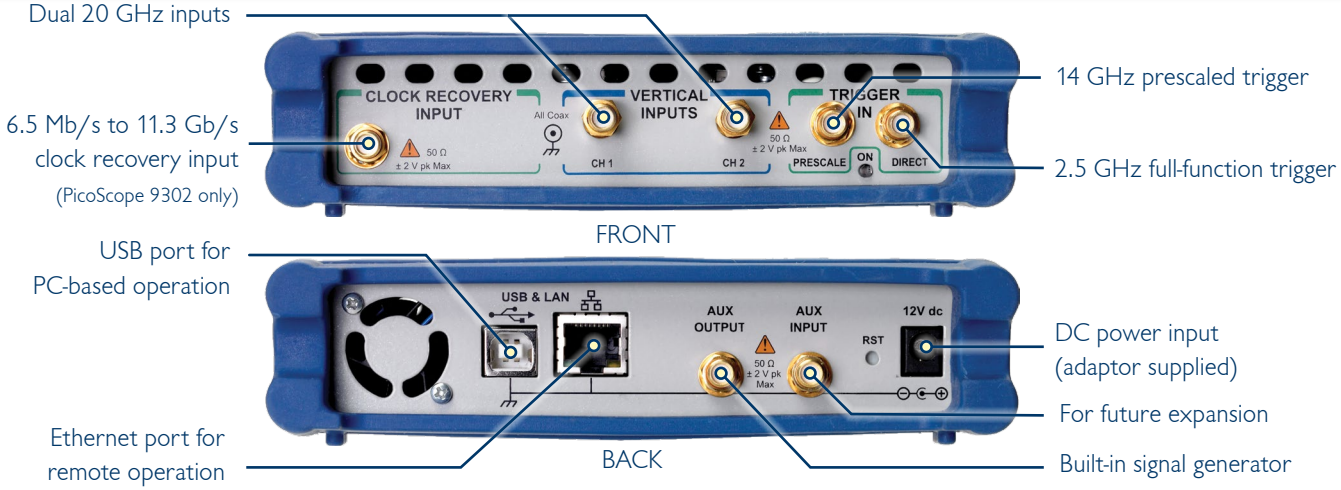
Real-time, random equivalent time sampling and roll modes. See *Real-time (DSO) modes*.

Pattern sync trigger and eye line mode

The pattern sync trigger, derived from bit rate, pattern length, and trigger divide ratio, can build up an eye pattern from any specified group of bits in a sequence.



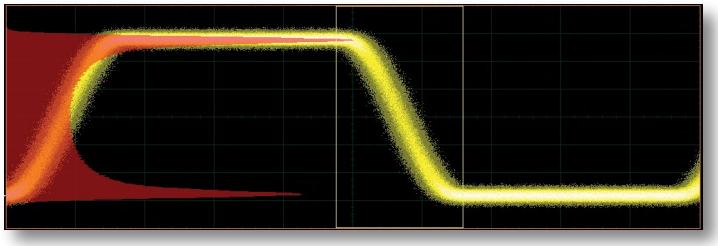
PicoScope 9300 Series inputs and outputs

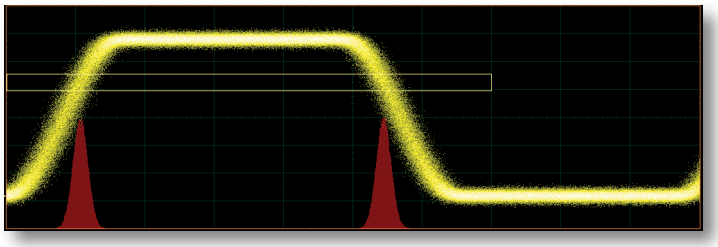


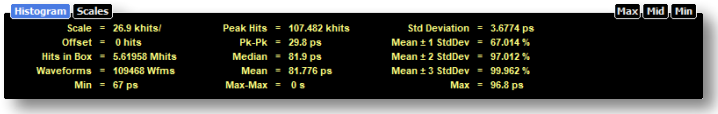
Histogram analysis

A histogram is a probability graph that shows the distribution of acquired data from a source within a user-definable window. The information gathered by the histogram is used to perform statistical analysis on the source.

Histograms can be constructed on waveforms on either the vertical or horizontal axes. The most common use for a vertical histogram is measuring and characterising noise and pulse parameters, while the most common use for a horizontal histogram is measuring and characterizing jitter.





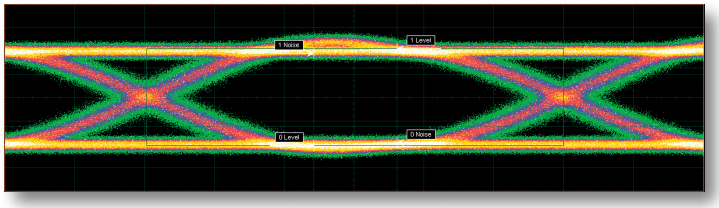


Eye-diagram analysis

The PicoScope 9300 Series scopes quickly measure more than 30 fundamental parameters used to characterize non-return-to-zero (NRZ) signals and return-to-zero (RZ) signals. Up to ten parameters can be measured simultaneously, with statistics also shown.

The measurement points and levels used to generate each parameter can be shown dynamically.

Eye diagram analysis can be made even more powerful with the addition of mask testing, as described opposite.



Compact, portable USB instruments

These units occupy very little space on your workbench and are small enough to carry with your laptop for on-site testing, but that's not all. Instead of using remote probe heads attached to a large bench-top unit, you can now position the scope right next to the device under test. Now all that lies between your scope and the DUT is a short, low-loss coaxial cable!

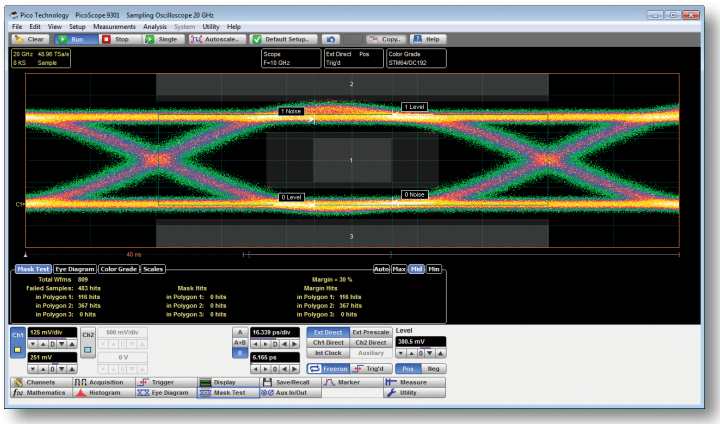
Everything you need is built into the oscilloscope, with no expensive hardware or software add-ons to worry about.

Mask testing

Eye-diagram masks are used to give a visual indication of deviations from a standard waveform. There is a library of built-in masks (listed below), and custom masks can be automatically generated and modified using the graphical editor. A specified margin can be added to any mask to enable stress-testing.

The display can be grey-scaled or colour-graded to aid in analyzing noise and jitter in eye diagrams. There is also a statistical display showing the number of failures in both the original mask and the margin.

The extensive menu of built-in test waveforms is invaluable for checking your mask test setup before using it on live signals.

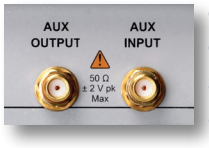


Mask test features
Failure count
Built-in standard test waveforms
User-defined margins
Stop on fail
Count fails

167 comms masks from 1.54 Mb/s to 12.5 Gb/s 11 comms standards	
11	**SONET/SDH:** OC1/STM0, OC3/STM1, OC9/STM3, OC12/STM4, OC18/STM6, OC24/STM8, OC48/STM16, FEC2666, OC192/STM64, FEC1066, FEC1071 ...
10	**Ethernet:** 1.25 Gb/s, Gb, 2xGb, 3.125 Gb/s, 10GbE ...
31	**Fibre Channel:** FC133, FC266, FC531, FC1063, FC2125, FC4250, 10x FC ...
41	**PCI Express:** 2.5 G, 5.0 G ...
16	**InfiniBand:** 2.5 G, 5.0 G ...
4	**XAUI:** 3.125 Gb/s ...
9	**RapidIO:** 1.25 Gb/s, 2.5 Gb/s, 3.125 Gb/s ...
24	**SATA:** 1.5 G, 3.0 G ...
14	**ITU G.703:** DS1, 2 Mb, DS2, 8 Mb, 34 Mb, DS3, 140 Mb, 155 Mb ...
7	**ANSI T1.102:** DS1, DS2, DS3, STS1 Eye, STS1 Pulse, STS3 ...
1	G.984.2: 3.125 Gb/s

Built-in signal generator

The scope can generate industry-standard or custom signals including DC, pulse and pseudo-random binary sequence. These

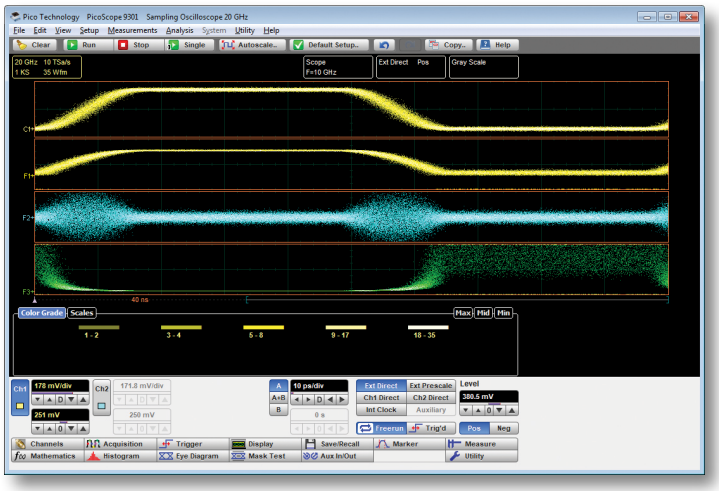


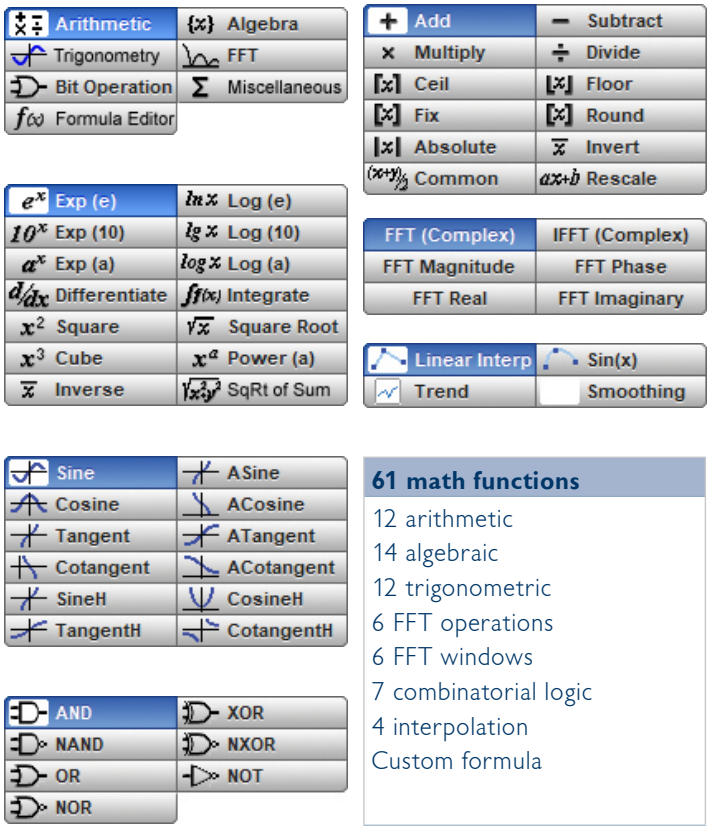
can be used to test the instrument's inputs, experiment with its features and verify complex set-ups such as mask tests. AUX OUTPUT can also be configured as a trigger output.

Powerful mathematical analysis

The PicoScope 9300 Series scopes support up to four simultaneous mathematical combinations and functional transformations of acquired waveforms.

You can select any of the mathematical functions to operate on either one or two sources. All functions can operate on live waveforms, waveform memories or even other functions. There is an equation editor for custom functions.





61 math functions

- 12 arithmetic
- 14 algebraic
- 12 trigonometric
- 6 FFT operations
- 6 FFT windows
- 7 combinatorial logic
- 4 interpolation
- Custom formula

Designed for ease of use

The PicoSample 3 software reserves as much space as possible for the most important information: your signal. Below that is a selection of the most important buttons. For more complex adjustments, a single mouse-click will display additional menus in left and right side panels. Most controls and numeric entry fields have keyboard shortcuts.

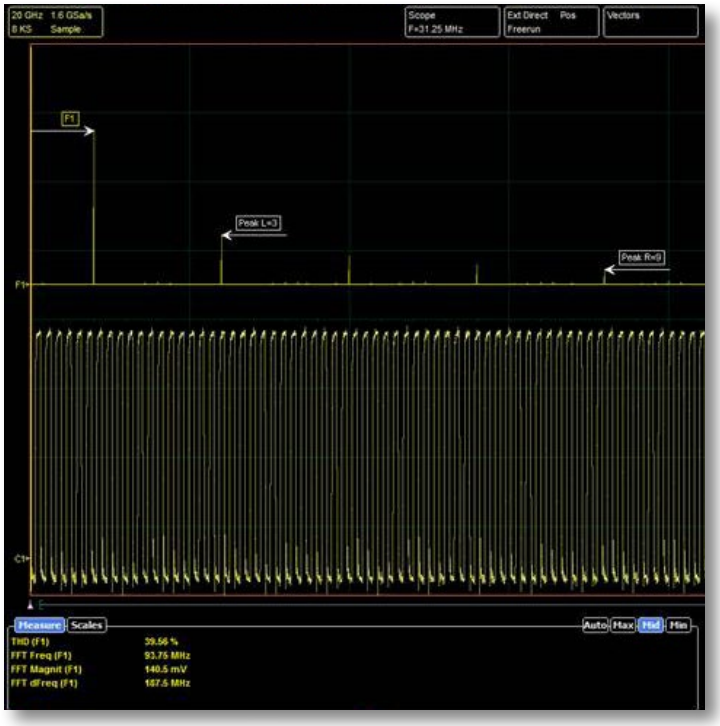
Hardware zoom using the dual timebase is made easy: simply use the mouse to draw a zoom box over a part of the waveform. You can still set up the timebase using manual controls if you prefer.

FFT analysis

All PicoScope 9300 Series oscilloscopes can calculate real, imaginary and complex Fast Fourier Transforms of input signals using a range of windowing functions. The results can be further processed using the math functions. FFTs are useful for finding crosstalk and distortion problems, adjusting filter circuits designed to filter out certain harmonics in a waveform, testing impulse responses of systems, and identifying and locating noise and interference sources.

6 windowing functions

- Rectangular
- Hamming
- Hann
- Flat-top
- Blackman- Harris
- Kaiser-Bessel



A choice of screen formats

When working with multiple traces, you can display them all on one grid or separate them into two or four grids. You can also plot signals in XY mode with or without additional voltage-time grids. The persistence display modes use color-coding or shading to show statistical variations in the signal.

Screen formats

- Auto
- Single YT
- Dual YT
- Quad YT
- XY
- XY + YT
- XY + 2 YT

Measurement of over 100 waveform parameters with and without statistics

The PicoScope 9300 Series scopes quickly measure well over 100 parameters, so you don't need to count graticules or estimate the waveform's position. Up to ten simultaneous measurements or four statistics measurements are possible. The measurements conform to IEEE standard definitions.

A dedicated frequency counter shows signal frequency at all times, regardless of measurement and timebase settings.

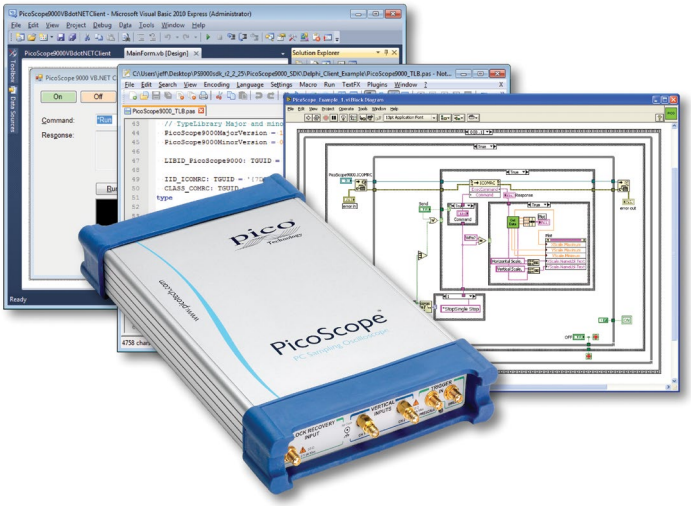
138 automatic measurements	
18	X (time) parameters
17	Y parameters
13	Channel to channel *with or without statistics*
15	NRZ Time
27	NRZ Y parameters *with or without statistics*
17	RZ time parameters
26	RZ Y parameters *with or without statistics*
5	FFT parameters

Software Development Kit

The PicoSample 3 software can be operated as a standalone oscilloscope program and as an ActiveX control. The ActiveX control conforms to the Windows COM model and can be embedded in your own software. Programming examples are provided in Visual Basic (VB.NET), LabVIEW and Delphi, but any programming language or standard that supports the COM standard can be used, including JavaScript and C.

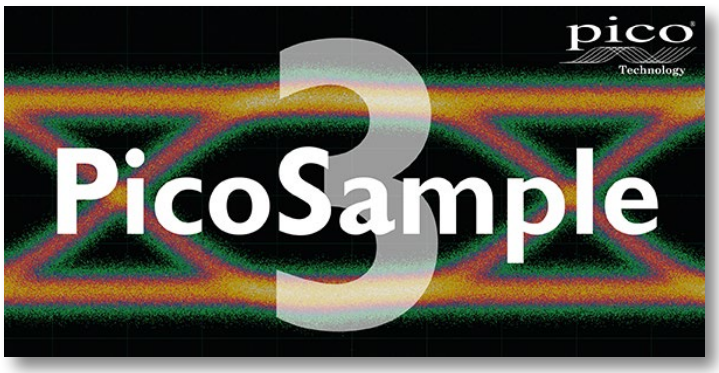
A comprehensive Programmer's Guide is supplied that details every function of the ActiveX control.

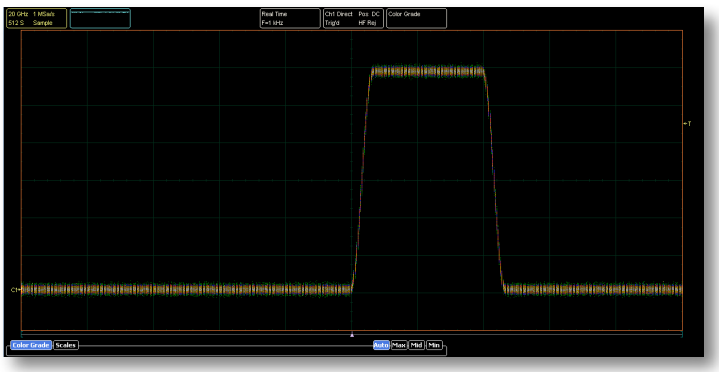
The SDK can control the oscilloscope over the USB or the LAN port.



Real-time (DSO) modes

Uniquely, there is a 100 MHz bandwidth trigger pick-off within the samplers. The PicoScope 9300 scopes can therefore operate similarly to a traditional DSO in roll, transient capture and ETS modes. Signals up to 100 MHz are conveniently displayed without the need for another oscilloscope.





X Parameters

Period	Neg Cross
Frequency	Burst Width
Pos Width	Cycles
Neg Width	Time@Max
Rise Time	Time@Min
Fall Time	Pos Jitter ppm
Pos DCycle	Pos Jitter rms
Neg DCycle	Neg Jitter ppm
Pos Cross	Neg Jitter rms

Y Parameters

Maximum	dc RMS
Minimum	Cycle dc RMS
Top	ac RMS
Base	Cycle ac RMS
Peak-Peak	Pos overshoot
Amplitude	Neg overshoot
Middle	Area
Mean	Cycle Area
Cycle Mean	

Trace-to-trace Parameters

Delay 1R-1R	Delay 1R-1F
Delay 1F-1R	Delay 1F-1F
Delay 1R-nR	Delay 1R-nF
Delay 1F-nR	Delay 1F-nF
Phase Deg.	Phase Rad.
Phase %	Gain
Gain dB	

PicoScope 9300 Series Specifications

VERTICAL	
Number of channels	2 (with selectable simultaneous or alternate acquisition)
Bandwidth	Full: DC to 20 GHz, Narrow: DC to 10 GHz
Pulse response rise time (10% to 90%, calculated)	Full bandwidth: 17.5 ps, Narrow bandwidth: 35 ps
RMS noise	Full bandwidth: < 1.5 mV typical, < 2 mV maximum Narrow bandwidth: < 0.8 mV typical, < 1.1 mV maximum
RMS noise with averaging	100 µV system limit, typical
Operating input voltage	1 V p-p with ±1 V range (with digital feedback, single-valued) ±400 mV relative to channel offset (without digital feedback, multi-valued)
Scale factors (sensitivity)	1 mV/div to 500 mV/div in 1-2-5 sequence with 0.5% fine increments
Resolution	40 µV/LSB
Accuracy	±2% of full scale ±2 mV over temperature range for stated accuracy
Nominal input impedance	(50 ± 1) Ω
Input connectors	2.92 mm (K) female, compatible with SMA and PC3.5
TIMEBASE (SEQUENTIAL TIME SAMPLING MODE)	
Ranges	5 ps/div to 3.2 ms/div (main, intensified, delayed, or dual delayed)
Delta time interval accuracy	For > 200 ps/div: ±0.2% of of delta time interval ± 12 ps For ≤ 200 ps/div: ±5% of delta time interval ± 5 ps
Time interval resolution	64 fs
Deskew	1 ps resolution, 100 ns max.
TRIGGER	
Trigger sources	All models: external direct, external prescaled, internal direct and internal clock triggers. PicoScope 9302 only: external clock recovery (CDR) trigger
External direct trigger bandwidth and sensitivity	DC to 100 MHz : 100 mV p-p; to 2.5 GHz: 200 mV p-p
External direct trigger jitter	1.8 ps (typ.) or 2.0 ps (max.) + 20 ppm of delay setting, RMS
Internal direct trigger bandwidth and sensitivity	DC to 10 MHz: 100 mV p-p; to 100 MHz: 400 mV p-p
Internal direct trigger jitter	25 ps (typ.) or 30 ps (max.) + 20 ppm of delay setting, RMS
External prescaled trigger bandwidth and sensitivity	1 to 14 GHz: 200 mV p-p to 2 V p-p
External prescaled trigger jitter	1.8 ps (typ.) or 2.0 ps (max.) + 20 ppm of delay setting, RMS
CLOCK RECOVERY AND PATTERN SYNC TRIGGER (PICOSCOPE 9302 ONLY)	
Clock recovery trigger data rate and sensitivity	6.5 Mb/s to 100 Mb/s: 100 mV p-p; to 11.3 Gb/s: 20 mV p-p
Pattern sync trigger clock frequency	10 MHz to 11.3 GHz with pattern length from 7 to 8 388 607 (2^{23}–1)
Recovered clock trigger jitter	1 ps (typ.) or 1.5 ps (max.) + 1.0% of unit interval, RMS
Maximum safe trigger input voltage	±2 V (DC + peak AC)
Input characteristics	50 ohm, AC coupled
Input connector	SMA (F)
ACQUISITION	
ADC resolution	16 bits
Digitizing rate	With digital feedback (single-valued): DC to 1 MHz; without (multi-valued): DC to 40 kHz
Acquisition modes	Sample (normal), average, envelope
Data record length	32 to 32 768 points (single channel) in x2 sequence
DISPLAY	
Styles	Dots, vectors, variable or infinite persistence, variable or infinite grey scaling, variable or infinite color grading
MEASUREMENTS AND ANALYSIS	
Markers	Vertical bars, horizontal bars (measure volts) or waveform markers
Automatic measurements	53 automatic pulse measurements, up to 10 at once
Histogram	Vertical or horizontal
Mathematics	Up to four math waveforms can be defined and displayed
FFT	Up to two FFTs simultaneously
Eye diagram	Automatically characterizes NRZ and RZ eye patterns based on statistical analysis of waveform
Mask test	Acquired signals are tested for fit outside areas defined by up to eight polygons. Standard or user-defined masks can be selected.
SIGNAL GENERATOR OUTPUT	
Modes	Pulse, NRZ/RZ (2^7–1 to 2^{15}–1 pattern length), 500 MHz clock, trigger out
Frequency range	8 ns to 524 µs period (pulse mode), 4 ns to 260 µs bit time (NRZ/RZ)
GENERAL	
Temperature range	Operating: +5 °C to +35 °C. For stated accuracy: within 2 °C of last autocal. Storage: −20 °C to +50 °C.
Calibration validity period	1 year
Power supply voltage	+12 V DC ± 5%
Power supply current	PicoScope 9301: 1.3 A max. PicoScope 9302: 1.5 A max.
Mains adaptor	Universal adaptor for PicoScope 9300 Series supplied
PC connection	USB 2.0 (compatible with USB 3.0 and USB 1.1)
LAN connection	10/100 Mbit/s
PC requirements	Windows XP (SP2), Windows Vista, Windows 7 or Windows 8 (not Windows RT); 32-bit or 64-bit
Dimensions	170 mm x 260 mm x 40 mm (W x D x H)
Weight	PicoScope 9301: 1.1 kg. PicoScope 9302: 1.2 kg.

More detailed specifications can be found in the *PicoScope 9300 Series User's Guide*, available from www.picotech.com.

PicoScope 9300 Series Sampling Oscilloscopes

Ordering information

Model	Channels	Clock recovery	PRBS trigger length	Interfaces	Kit items included (see below)	Order code	Price		
							GBP	USD	EUR
PicoScope 9301	2 × 50 Ω 2.92(f)	-	7 to 2^{23}–1	USB 2.0, LAN	1, 6(2), 7	PP890	9 088	14 995	10 996
PicoScope 9302	2 × 50 Ω 2.92(f)	11.3 Gb/s	7 to 2^{23}–1	USB 2.0, LAN	1, 5, 6(2), 7	PP891	11 512	18 995	13 930

PicoScope 9301

PicoScope 9302

Main package contents (kit 1)

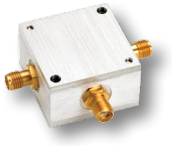
Description	Order code
PicoSample™ 3 software CD	DI100
Quick Start Guide	DO134
Power supply 12 V DC @ 3.5 A, universal input	PS010
USB 2.0 cable, 1.8 m	MI106
SMA/PC3.5/2.92 wrench	TA168
Storage and carry case	MI272

Passive probe (optional accessory)

Description	Order code	Price		
		GBP	USD	EUR
1.5 GHz 50 Ω passive probe, x10, SMA	TA061	199	328	241

PicoScope 9300 Series divider kit (kit 5)

These 50 Ω symmetrical power dividers are suitable for driving a main input channel and the clock recovery input of the PicoScope 9302 from a single source.



Description	Order code	Price		
		GBP	USD	EUR
2 x 3-resistor 6 dB power divider 18 GHz 50 Ω SMA (f-f-f) 4 x precision coaxial cable 30 cm 50 Ω SMA (m-m)	PP889	179	295	217

Connector saver adaptor (kit 6)

Description	Order code	Price		
		GBP	USD	EUR
Connector saver adaptor 18 GHz 50 Ω SMA	TA170	12	20	15

LAN cable (kit 7)

Description	Order code
LAN cable, 1 m	TA076

US dollar and GB pound prices are subject to exchange rate fluctuations.
Please contact Pico Technology for the latest prices before ordering.
Errors and omissions excepted.

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