PicoScope 9201
Sampling Oscilloscope

with 12 GHz analog bandwidth
Introduction

The PicoScope 9201 – a fast PC Sampling Oscilloscope

- Designed for analysing repetitive signals
- Uses sequential equivalent-time sampling technology

The instrument provides fast acquisition and repeatable waveform performance analysis with:

- Automated direct and statistical measurements
- Markers
- Histograms
- Math and FFT analysis
- Colour-graded display
- Parametric limit testing
- Eye diagram measurements
- Mask template testing

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input channels</td>
<td>2</td>
</tr>
<tr>
<td>Channel bandwidth</td>
<td>12 GHz</td>
</tr>
<tr>
<td>Trigger bandwidth</td>
<td>10 GHz</td>
</tr>
<tr>
<td>ADC</td>
<td>16-bit</td>
</tr>
<tr>
<td>Equivalent-time sampling rate</td>
<td>5 TS/s</td>
</tr>
<tr>
<td>Time resolution</td>
<td>200 fs</td>
</tr>
<tr>
<td>Fastest timebase</td>
<td>20 ps/div</td>
</tr>
<tr>
<td>Vertical accuracy</td>
<td>2%</td>
</tr>
<tr>
<td>Horizontal accuracy</td>
<td>0.4%</td>
</tr>
<tr>
<td>Acquisition speed</td>
<td>200 kS/s</td>
</tr>
</tbody>
</table>
Structure of the PicoScope 9201

The PicoScope 9201 connects to your PC
to give you all the power of a stand-alone instrument
PicoScope 9201 Features

VERTICAL
- DC to 12 GHz bandwidth
- 29.2 ps rise time
- Two channels
- ±2 % vertical gain accuracy
- 16-bit vertical resolution
- <2.5 mV RMS noise
- ±1 V input range

HORIZONTAL
- Dual timebase 20 ps/div to 2 ms/div
- 0.4% + 15 ps time interval accuracy
- <200 fs sampling interval
- Up to 4 k-point/channel buffer size

TRIGGER
- DC to 1 GHz full direct trigger
- 10 GHz prescaled trigger
- <3.5 ps RMS jitter

OPERATIONAL
- Power consumption: 15 W max
- Weight: 1 kg
- Size: W170 x H40 x D255 mm

DISPLAY, MEASUREMENTS and ANALYSIS
- Infinite and variable persistence
- Grey scaling and colour grading
- High-resolution cursors, automatic waveform measurements, statistics and pass / fail limit tests
- Waveform processing including FFT with five FFT windows
- Statistical analysis with time and voltage histograms
- Automated mask testing with standard and custom masks
- Eye diagram measurements

UTILITY
- Autoscale
- Automatic calibration
- Windows NT / 2000 / XP
- Intuitive graphical user interface
- Built-in information system using Windows Help
## PicoScope 9201 Applications

### SIGNAL ANALYSIS
- Electrical standards compliance testing
- Spectrum analysis
- Statistical analysis
- Eye-diagram analysis

### TIMING ANALYSIS
- Automatic parametric measurements
- Pulsed RF switches
- Compliance testing

### R & D
- Microwave & RF characterisation
- High-energy physics
- Digital design
- Informative waveform displays

### HIGH-SPEED DIGITAL COMMUNICATIONS
- Design and verification of telecom and datacoms elements
- Manufacturing and testing for ITU / ANSI conformance

### SEMICONDUCTOR TESTING
- Microwave & RF characterisation
- High-energy physics
- Digital design
- Informative waveform displays

### MANUFACTURING
- Limit and mask testing
- Testing for ITU / ANSI conformance
- Automatic test systems
- Auto-calibration routine
Sequential Sampling

The PicoScope 9201 uses digital sequential sampling technology to acquire and display high-bandwidth waveforms.

A sampling oscilloscope does not continuously monitor the input signal applied to the channel, but looks at it only at discrete points in time. At each point, the oscilloscope samples the signal and stores a replica of the input voltage on an input sampling capacitor.

Sequential sampling means:
- Used with repetitive signals, NRZ or RZ
- Wide-bandwidth applications (> 10 GHz)
- One sample is taken for each trigger
- Multiple trigger events build up waveform
- No pre-trigger information
The PicoScope 9201 has an intuitive Windows graphical user interface, so you won’t have to spend a lot of time learning to use the instrument. Pull-down menus give you easy access to advanced features, and icons provide quick access to an extensive set of common tests and measurements.
The PicoScope 9201 includes a 2-channel sampler. This sampler is designed for precise measurements on high-speed, low-amplitude signals and low-loss testing in applications such as microwave systems research and development, digital device characterisation, and high-speed digital communications circuit design. It provides an acquisition rise time of 29.2 ps, with a typical 12-GHz equivalent bandwidth, and maximum RMS noise of 2.5 mV to ensure clean, undistorted signals. The electrical channel has both a 12 GHz mode for better waveform fidelity, and an 8 GHz mode for optimum noise performance.

Key specifications:

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of channels</td>
<td>2 (simultaneous acquisition)</td>
</tr>
<tr>
<td>Bandwidth (-3dB)</td>
<td>DC to 12 GHz (full BW)</td>
</tr>
<tr>
<td></td>
<td>DC to 8 GHz (narrow BW)</td>
</tr>
<tr>
<td>Rise time (10%-90%)</td>
<td>≤29.2 ps (full BW)</td>
</tr>
<tr>
<td></td>
<td>≤43.8 ps (narrow BW)</td>
</tr>
<tr>
<td>RMS noise (maximum)</td>
<td>≤2.5 mV (full BW)</td>
</tr>
<tr>
<td></td>
<td>≤2 mV (narrow BW)</td>
</tr>
<tr>
<td>Maximum operating input voltage</td>
<td>1.0 V p-p on ±1 V range</td>
</tr>
<tr>
<td>Maximum safe input voltage</td>
<td>16 dBm, or ±2 V (dc + peak ac)</td>
</tr>
<tr>
<td>Nominal input impedance</td>
<td>(50 ± 1) Ω</td>
</tr>
<tr>
<td>Input connectors</td>
<td>SMA, 3.5 x 1.52 (f)</td>
</tr>
</tbody>
</table>
Electrical Rise Time Measurement Error vs. Oscilloscope Bandwidth

When the scope bandwidth (BW) is:

<table>
<thead>
<tr>
<th>Rise time slowing error is:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equal to signal edge BW</td>
</tr>
<tr>
<td>Twice as fast as signal edge BW</td>
</tr>
<tr>
<td>Three times as fast as signal edge BW</td>
</tr>
<tr>
<td>Five times as fast as signal edge BW</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>When the scope bandwidth (BW) is:</th>
<th>Rise time slowing error is:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equal to signal edge BW</td>
<td>▲ 41%</td>
</tr>
<tr>
<td>Twice as fast as signal edge BW</td>
<td>▲ 12%</td>
</tr>
<tr>
<td>Three times as fast as signal edge BW</td>
<td>▲ 5%</td>
</tr>
<tr>
<td>Five times as fast as signal edge BW</td>
<td>▲ 2%</td>
</tr>
</tbody>
</table>
The timebase allows you to control the horizontal display through the Main, Intensified, Delayed or Dual Delayed timebases, and also the TIME / DIV and DELAY functions.

The Units function of the PicoScope 9201 timebase lets you set the instrument timebase to:

- Basic time units (second)
- Bit period (data rate)

Bit period units provide an easy and intuitive way to display digital communication signals.

- Timebase:
  20 ps/div to 2 ms/div
- Delta time accuracy:
  ± 0.4 % of reading ± 15 ps ± 100 ppm of delay setting (typical)

A 2.5 Gbps eye diagram displayed with dual-intensified time base
Timebase Windowing

The Timebase Windowing function is similar to the delayed or dual delayed sweep on analog oscilloscopes because it turns on an expanded time base. Expanded timebase allows you to pinpoint and to horizontally expand a portion (or two portions) of the signal for a more detailed or high-resolution analysis.

Left picture shows a waveform acquired with Intensified Time Base

Right picture shows the same waveform acquired with Dual Delay Time Base. Measured Pulse Width = 50.3 ns
Direct Trigger

The power of wide-bandwidth sampling oscilloscopes is largely useless without fast, low-jitter triggering.

The PicoScope 9201 is equipped with built-in direct trigger for signals up to 1 GHz repetitive rates without using an external trigger unit.

Key specifications of Direct Trigger:

- DC to 1 GHz trigger bandwidth
- 100 mV p-p DC to 100 MHz, 400 mV p-p at 1 GHz sensitivity
- <3.5 ps max RMS jitter
Direct Trigger Jitter

Timing inaccuracy leads to waveform jitter.

RMS Direct Trigger
Maximum jitter:
3.5 ps + 20 ppm of delay

Typical picture showing 3.33 ps RMS Direct Trigger jitter with a 1-GHz sine wave signal
The PicoScope 9201’s HF (prescaled) trigger is an AC-coupled 10-GHz prescaler for triggering on high-speed data without cumbersome manual adjustment.

The heart of the trigger is a low-noise GaAs frequency divider. Low RMS jitter <3.5 ps typ. is possible.

A 10 GHz sine-wave signal with prescaled trigger
HF Trigger Jitter

Timing inaccuracy leads to waveform jitter.

Max RMS HF Trigger jitter: 3.5 ps

A typical picture showing 3.03 ps RMS HF trigger jitter with 10-GHz sine wave signal
Averaging Reduces Noise

Averaging is often used to eliminate random noise on the display and increase resolution and accuracy of measurements. If a waveform is buried in noise, averaging can be used to extract a signal from the noise, as shown in this illustration.

Averaging allows you to measure even noisy signals to less than 0.5 ps standard deviation enabling extreme accuracy when you need it most.

The PicoScope 9201 uses three averaging algorithms:
- Stable average
- Multiple average
- Median average
The number of samples that form a trace is called the buffer size. The greater the amount of sampled data that is available for analysis or measurements, the greater the buffer size. Buffer size in the PicoScope 9201 can be selected from 32 to 4096 samples in multiples of two.

Buffer size is set independently for each channel.

- Equivalent sample rate and buffer size work together. If you combine a small buffer size with a high equivalent sample rate, you will have a very fast throughput (display update rate) but very little data in the channel memory.

- If more data points need to be acquired, a waveform stored with a large buffer size takes longer to construct than one with a small buffer size. However, a large buffer size produces a waveform with higher horizontal resolution, so a trade-off exists between throughput and resolution.

PicoScope 9201 traces with buffer size of 32 (top) and 512 (bottom)
The PicoScope 9201’s colour GUI dedicates a different colour to each trace and its associated readouts to simplify the viewing of complex signals on multiple channels.
Informative Waveform Display: Grey Scaling

When you select Grey Scaling mode, a single colour is assigned. As a persistence data map develops, different intensities of that colour are assigned to the range between a minimum and a maximum population.

The maximum population automatically gets the highest colour intensity, the minimum population gets the lowest colour intensity, and intermediate populations get intensities in between these extremes.

- The information in the lower populations (for example, down at the noise level) could be of greater interest to you than the rest.
- The Grey Scale persistence view highlights the distribution of data so that you can examine it in detail.

Get valuable insight into your device behavior with the Grey Scaling display. View pattern dependencies and different rare versus common events.
Informative Waveform Display: Colour Grading

The accumulated points are colour-graded (shaded with different colours) to indicate the density of the points, and a colour-graded database is built.

How it works

Colour Grading operates over the graticule area. Behind each pixel is a 16-bit counter. Each time a pixel is hit by data, the counter for that pixel is incremented. Each colour used for the colour grade mode represents a range of data counts. As the total count increases, the range of hits represented by each colour also increases. The maximum count for each counter is 65,535.

- Five colours are used. Each colour represents a range of counts. The colours can be changed from the Colour Grade menu.

Uses

Histograms, mask testing, statistical measurements, eye diagrams, and generally providing more visual information about the waveforms.
X-Y Display Format

Three Format menus determine how the instrument draws waveforms:

- The YT format is the normal time (on the horizontal axis) versus voltage (on the vertical axis).
- The XY format displays the voltages of two waveforms against each other. Source 1’s amplitude is plotted on the horizontal X axis and Source 2’s amplitude is plotted on the vertical Y axis.
- The XY & YT format displays the YT format above the XY format.

You can use the XY format to:

- Compare frequency and phase relationships of two signals
- Display strain vs. displacement, flow vs. pressure, volts vs. current, or voltage vs. frequency
Waveform Manipulation

There are two features that can simplify your work with waveforms:

- Direct manipulation
- Zoom

Direct manipulation

Use the mouse to click and drag:

- Ground Reference Indicator
- Waveform to new vertical positions, which changes the vertical offset, or to new horizontal positions, which changes the horizontal position or delay value.

Zoom

- Draw a box around the section of the waveform you want to expand
  - then click inside the box
Familiar File Management

The standard Windows user interface allows you to save and recall on the PC’s hard disk:

- Waveforms in various formats
- Waveform database
- Scope setups
- Screen images

Saving to waveform file

Recalling waveform database

Recalling setups
Clicking the Copy button copies the program window to the Windows clipboard. You can paste copied information in such Windows programs as Word, Corel Draw and Paint.

Use the Copy function to add screen shots from the PicoScope 9201 to your documentation.
Autoscale

- Get waveform on screen quickly with the Autoscale button.
- Autoscale adjusts the oscilloscope to display a stable trace of usable size and amplitude. The Autoscale feature of the PicoScope 9201 can quickly give you a stable, meaningful trace display.

The Autoscale function can find repetitive signals with:

- Frequency greater than 1 kHz
- Duty cycle greater than 1%
- Vertical amplitude greater than 50 mV p-p
- Trigger amplitude greater than 200 mV p-p

When you click the Autoscale button, you tell the PicoScope 9201 to examine the signal and adjust the following controls for optimum display:

- Vertical scale and offset
- Timebase scale and delay
- Trigger level, if appropriate to that trigger source
# Measurements and Tests

## Types of Measurements

<table>
<thead>
<tr>
<th>Graticule Measurements</th>
<th>Marker Measurements</th>
<th>Pulse Measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 by 8 display graticule with Grid, Axes, Frame and Off options</td>
<td>Two X, Y, or XY markers provide absolute, delta or ratiometric measurements</td>
<td>19 Amplitude, 29 Timing and 5 FFT measurements can be performed automatically</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NRZ Eye Measurements</th>
<th>RZ Eye Measurements</th>
<th>Histogram Measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement list includes 42 NRZ eye parameters</td>
<td>43 automatic measurements are built for characterisation of RZ signals</td>
<td>Up to 15 statistical measurements of vertical and horizontal histograms</td>
</tr>
</tbody>
</table>

## Types of Measurement Test

<table>
<thead>
<tr>
<th>Limit Test</th>
<th>Mask Test</th>
<th>Mask Margin Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allows you to automatically compare up to 4 measurement results with pass or fail limits</td>
<td>Standard, auto or custom masks can be used for mask test</td>
<td>Test is used to determine the margin of compliance for a standard or scaled mask</td>
</tr>
</tbody>
</table>
Markers are movable lines on the display that provide Customized Measurements. You set the marker’s values by positioning them on the display. Their actual value, however, comes from internal data. This makes marker measurements more precise than graticules.

Marker measurements:
- Absolute vertical (voltage)
- Ratiometric vertical (voltage)
- Absolute horizontal (timing)
- Ratiometric horizontal (timing)

Best marker resolution:
- Voltage: 50 µV
- Time interval: 0.2 ps

Markers measure timing shift of 2.5-GHz signals with 1-ps resolution.
The PicoScope 9201 provides accurate Automatic Measurements. They make the measurement process fast and easy while reducing human errors, so are particularly essential for repetitive test. All measurements conform to the IEEE standards. Measurements cover Voltage, Timing and FFT.

19 Amplitude Measurements are made on vertical parameters. They typically measure voltage. They are:
- Maximum
- Top
- Middle
- ac RMS
- Cycle Mean
- Cycle Area
- Gain
- Minimum
- Base
- Mean
- Area
- Cycle dc RMS
- Cycle ac RMS
- Pos. Overshoot
- Neg. Overshoot

29 Timing Measurements are made on horizontal parameters. They typically measure seconds or hertz. The main ones are:
- Period
- Neg. Width
- Pos. Duty Cycle
- Neg. Duty Cycle
- Pos. Crossing
- Neg. Crossing
- Time@Maximum
- Time@Minimum
- Frequency
- Rise Time
- Neg. Duty Cycle
- Burst Width
- Cycles
- Pos. Width
- Fall Time
- Pos Crossing
- Delay

5 FFT Measurements are made on both vertical and horizontal parameters. They typically measure volts and hertz. They are:
- FFT Magnitude
- FFT Delta Magnitude
- THD
- FFT Frequency
- FFT Delta Frequency

The PicoScope 9201 measures up to 10 parameters simultaneously on 8 sources with maximum time resolution of 0.2 ps and 2% vertical accuracy.
The PicoScope 9201 measures up to 4 statistics parameters simultaneously.

The Statistics function calculates the following values of the automatic measurement results:
- Minimum
- Maximum
- Mean
- Standard Deviation
- Current Value
- Amount of measurements

Minimum and maximum are the absolute extremes of the automatic measurements. Mean and standard deviation calculate the mean and standard deviation of the automatic measurement results. Mean is the statistical average of all results for a particular measurement. Standard deviation measures the dispersion of those measurement results.
The PicoScope 9201 supports up to four simultaneous mathematical combinations and functional transformations of the acquired waveforms. You can select any of the maths functions as a mathematical operator to act on the operand or operands. A waveform maths operator is a mathematical function that requires either one or two sources.

The operators that involve two waveform sources are:
- Add
- Subtract
- Multiply
- Divide
- Subtract
- Multiply

The operators that involve one waveform source are:
- Invert
- Absolute
- Exponent (e)
- Exponent (10)
- Logarithm (e)
- Logarithm (10)
- Differentiate
- Integrate
- Inverse FFT
- Linear interpolation
- Smoothing
- sin(x)/x interpolation
- Trend
- Interpolation

An example of PicoScope 9201 Maths Functions:
- F1=Ch1+Ch2
- F2=Ch1-Ch2
- F3=Diff(Ch1)
- F4=Inv(Ch2)
The maths option of the PicoScope 9201 includes FFT capabilities for examining the harmonic content of high-frequency signals. You can perform an FFT on any waveform. The buffer size for the waveform can be up to a maximum of 4096 points.

Use the FFT function to:
- Find crosstalk problems when interfering signal is in phase with trigger
- Find distortion problems in analogue waveforms caused by non-linear amplifiers
- Adjust filter circuits designed to filter out certain harmonics in a waveform

To compensate for some of the limitations of FFT analysis, you can use windowing. The window type defines the bandwidth and shape of the equivalent filter associated with the FFT processing.

The PicoScope 9201 supports six types of windows:
- Rectangular FFT window, which does not taper the time domain data
- Five tapering FFT windows of different shapes –
  - Hamming window
  - Hanning window
  - Flattop window
  - Blackman-Harris window
  - Kaiser-Bessel window

FFT analysis provides an extra dimension of performance with simultaneous displays in the time and frequency domain. The picture shows an example of an FFT made with a 38-MHz pulse with near 50 % duty cycle.
**Trend Function**

**Trend** is a maths function that represents the evolution of timing parameters using a line graph whose vertical axis is the value of the parameter and whose horizontal axis is the order in which the values were acquired.

The PicoScope 9201 makes period measurements of pulses. The trend of the period measurement is displayed as a maths function. The amplitude measurement of the trend function gives the evolution of the period value.
**Vertical Histogram**

**Histogram statistics:**
- Scale lists the display scale in hits per division or dB per division
- Offset lists the offset in hits or dB. Offset is the number of hits or dB at the bottom of the display, as opposed to the center of the display.
- Hits in Box - The total number of samples included in the histogram box
- Waveforms - Displays the number of waveforms that have contributed to the histogram
- Peak Hits - The number of hits in the histogram’s greatest peak
- Pk – Pk - The width of the histogram
- Median - 50% of the histogram samples are above the median and 50% are below the median
- Mean - Mean is the average value of all the points in the histogram
- StdDev - The Standard deviation ($\sigma$) value of the histogram
- $\mu \pm 1$ StdDev, $\mu \pm 2$ StdDev, $\mu \pm 3$ StdDev - The percentage of points that are within $\pm 1\sigma$, $\pm 2\sigma$, or $\pm 3\sigma$ of the mean value

- A histogram is a probability distribution that shows, within a user-definable histogram window, the distribution of acquired data from a source.
- The information gathered by the histogram is used to perform statistical analysis on the source. The most common use for vertical histograms is measuring and characterizing noise on displayed waveforms.

![An example of Vertical Histogram Measurement](image)
**Vertical Histograms** are most commonly used for measuring and characterizing noise on displayed waveforms.

Picture shows PicoScope 9201 noise level measurement with Vertical Histogram

Sizing the histogram window to a narrow portion of time and observing a vertical histogram that measures the noise on an edge.
A histogram is a probability distribution that shows, within a user-definable histogram window, the distribution of data acquired from a source. The information gathered by the histogram is used to perform statistical analysis on the source. The most common use for horizontal histogram is measuring and characterizing jitter on displayed waveforms.

Histogram statistics:
- Scale - the display scale in hits per division or dB per division
- Offset - the offset in hits or dB. Offset is the number of hits or dB at the bottom of the display, as opposed to the center of the display.
- Hits in Box - the total number of samples included in the histogram box
- Waveforms - the number of waveforms that have contributed to the histogram
- Peak Hits - the number of hits in the histogram's greatest peak
- Pk – Pk - the width of the histogram
- Median - 50% of the histogram samples are above the median and 50% are below the median
- Mean - the average value of all the points in the histogram
- StdDev - the standard deviation (σ) of the histogram
- μ ± 1 StdDev, μ ± 2 StdDev, μ ± 3 StdDev - the percentage of points that are within ±1σ, ±2σ, or ±3σ of the mean value

An example of jitter measurement with horizontal histogram.
Among other things, jitter is caused by:

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal noise</td>
<td>Random and ever-changing, always Gaussian</td>
</tr>
<tr>
<td>Upstream reference clocks</td>
<td>From power supplies and oscillators, with harmonic content</td>
</tr>
<tr>
<td>Injected noise (EMI/RFI)</td>
<td>Cabling or wiring, from distance sources</td>
</tr>
<tr>
<td>Circuit instabilities</td>
<td>Loop bandwidth, dead-band oscillations</td>
</tr>
</tbody>
</table>

Types of jitter:
- Period jitter
- Cycle-to-cycle jitter
- Delay jitter
- Time interval error
- Clock jitter
- Data jitter

Eye-crossing jitter can be quantified with a horizontal histogram. Here are two examples of an NRZ eye pattern with jitter histogram.
Histogram Measurements of Eye Diagrams

The PicoScope 9201 quickly measures all parameters of a vertical histogram for a 2.5-Gbit Eye Diagram.

The PicoScope 9201 quickly measures all parameters of a horizontal histogram with the same 2.5-Gbit Eye Diagram.
Building an Eye Diagram

The process of building an eye diagram includes serial acquisitions of the waveform database.

The eye diagram is valuable for giving a comprehensive view of all signal integrity faults (except clock jitter):

- Noise
- Jitter
- Reflections
- Ringing
- Inter-symbol interference
- Power and ground coupling

Eye diagram problems with sequential sampling oscilloscope:

- It is not possible to resolve pattern dependencies
- Averaging is not available
- Input dynamic range is less than that of a standard oscilloscope
- Random noise and pattern dependent. Deterministic errors mask each other.
A Typical PicoScope 9201 Eye Diagram with Mask, Margins and Histogram

- Customisable mask with margins
- Histogram window
- 2.5-Gb/s eye diagram
- Using histogram on the eye crossing to characterise jitter
- Histogram measurement results
The PicoScope 9201 quickly measures 42 fundamental parameters used to characterise non-return-to-zero (NRZ) signals. Up to four parameters can be measured simultaneously.

The PicoScope 9201 displaying 4 automatic measurements on a 2.5-Gbit NRZ eye diagram
Examples of NRZ Measurements

- Measurement of 622-Mbit eye diagram
- Measurement of 1.25-Gbit eye diagram
- Measurement of 2.5-Gbit eye diagram
The PicoScope 9201 quickly measures 43 fundamental parameters used to characterise return-to-zero (RZ) signals. Up to four parameters can be measured simultaneously.
Mask Test

For eye-diagram masks, such as those specified by the SONET and SDH standards, the PicoScope 9201 supports on-board mask drawing for visual comparison. The display can create grey-scaled or colour-graded displays to aid in analysing noise and jitter in eye-diagrams.

Mask test quickly characterises:

- Noise
- Jitter
- Aberrations
- Rise time
- Fall time

The on-board mask drawing capability allows simple, operator-independent visual comparison of signal with standard mask.

SONET/SDH (OC64/STM16) signal compared with the standard mask, showing a compliant waveform.
Creating Custom Mask

How PicoScope 9201 builds a custom mask for NRZ waveform

1. Create the top polygon of the mask
2. Create the centre polygon of the mask
3. Create the bottom polygon of the mask
4. Create full mask
5. Perform mask test
Mask margins are used to determine the margin of compliance for a standard or scaled mask. The PicoScope 9201 goes beyond basic testing with mask margin analysis for process monitoring.

Mask hits/failures are easily viewed with red pixels.

Mask test results show:
- Total waveforms
- Failed samples
- Mask hits
- Mask margin value
- Margin hits
- Margin hits in polygon

Mask margins are used to determine the margin of compliance for a standard 2.5 Gbps STM16/OC48 eye diagram or scaled mask.
Mask Test Examples

Mask test and 20% margin test performed for a standard 2.5 Gbps STM16/OC48 eye diagram

Mask test and 20% margin test performed for a standard 9.5 Gbps STM64/OC192 eye diagram
The PicoScope 9201 offers fully automatic pass-fail limit testing.

You can build a limit template from acquired waveforms or download a template from disk.

Using a reference waveform method (Automask), masks are constructed by adding a DELTA X and DELTA Y tolerance around a reference waveform. This method is simple to use, though not as flexible as the polygon method.

Mask test results show:
- Total waveforms
- Failed samples
- Hits in polygon

The PicoScope 9201’s automatic, on-the-fly limit testing makes manufacturing pass-fail testing simple.
Thank you for watching!