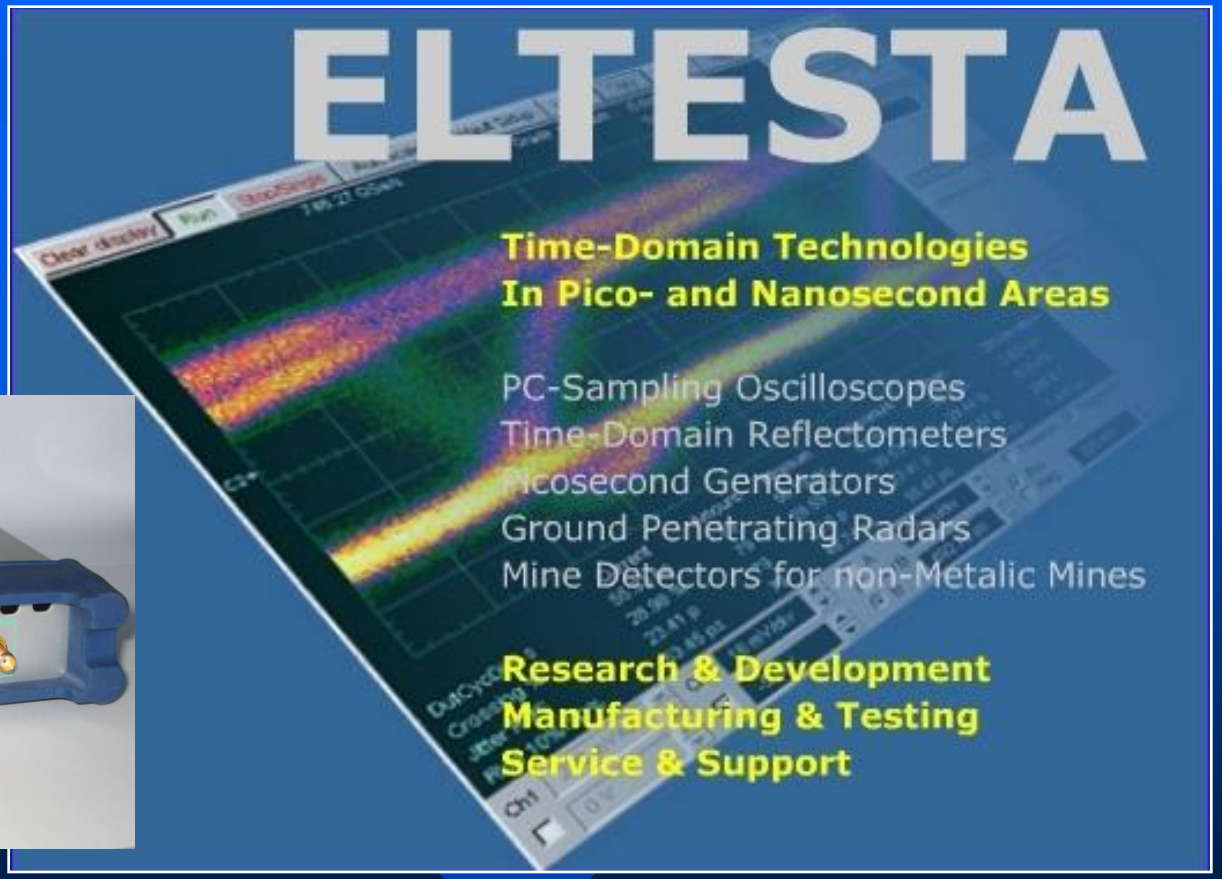
PicoScope 9201
Новый миниатюрный 12- ГГц стробоскопический осциллограф



Краткое описание

www.eltesta.com

Введение

Основные технические характеристики осциллографа PicoScope 9201

12 GHz Полоса пропускания	**16-bit** Разрядность АЦП	**2%** Верикальная и **0.4%** Горизонтальная погрешности измерения
10 GHz Диапазон частот синхронизации	**200 fs** Временное разрешение	**<2.5 mV** Среднеквадратический уровень шумов
1 mV/div Минимальная чувствительность	**20 ps/div** Минимальный коэффициент развертки	**<2.0 ps** Нестабильность синхронизации (*RMS*)

Стробоскопический осциллограф PicoScope 9201

PicoScope 9201 – это миниатюрный USB-осциллограф, с полосой пропускания до *12 GHz*, работающий в режиме последовательного стробирования в эквивалентном времени.

Прибор обеспечивает быстрый сбор данных, а также их измерения и обработку:

- *Прямые и статические измерения параметров сигналов*
- *Маркерные измерения*
- *Гистограммные измерения*
- *Математическую обработку сигналов, включая БПФ*
- *Импульную рфлектометрию*
- *Градацию цветом*
- *Допусковый контроль*
- *Масочные шаблоны*

PicoScope 9201: Основные возможности

ВЕРТИКАЛЬНЫЙ КАНАЛ

- Полоса пропускания: *12 GHz*
- Время нарастания ПХ: *29.2 ps*
- Два канала
- Погрешность измерения напряжения: *±2 %*
- Разрядность АЦП *16-Bit*
- Сренеквадратическое значение уровня шумов: *<2.5 mV*
- Емкость записи: до *4096 точек/канал*

ГОРИЗОНТАЛЬНЫЙ КАНАЛ

- Развертка: от *20 ps/div* до *2 ms/div*
- Погрешность измерения временных интервалов: *0.4%+15 ps*
- Интервал стробирования: *200 fs min*

СИНХРОНИЗАЦИЯ

- Прямой вход: 0 до *1 GHz*
- ВЧ вход: до *10 GHz*
- Нестабильность синхронизации (RMS): *<3.5 ps*

ЭКСПЛУАТАЦИОННЫЕ ХАРАКТЕРИСТИКИ

- Потребляемая мощноять: *15 W max*
- Масса: *1 kg*
- Габаритные размеры: *170x40x255 mm*

ОТОБРАЖЕНИЕ, ИЗМЕРЕНИЯ И ОБРАБОТКА СИГНАЛОВ

- Экранное накопление, градация серым и градация цветом
- Маркерные измерения
- Автоматические измерения 28 параметров со статистикой и допусковым контролем
- Мат. обработка сигналов, включая БПФ с пятью окнами БПФ
- Статистический анализ с помощью гистограмм
- Тест с помощью стандартных или заказных масок
- Измерения глаз-диаграмм
- Импульсная рефлектометрия для анализа характеристик линий передачи сигналов

СЕРВИСНЫЕ ФУНКЦИИ

- Автопоиск
- Автоматическая калибровка
- Интуитивный графический интерфейс пользователя Win NT/XP/2000
- Встроенный Windows Help

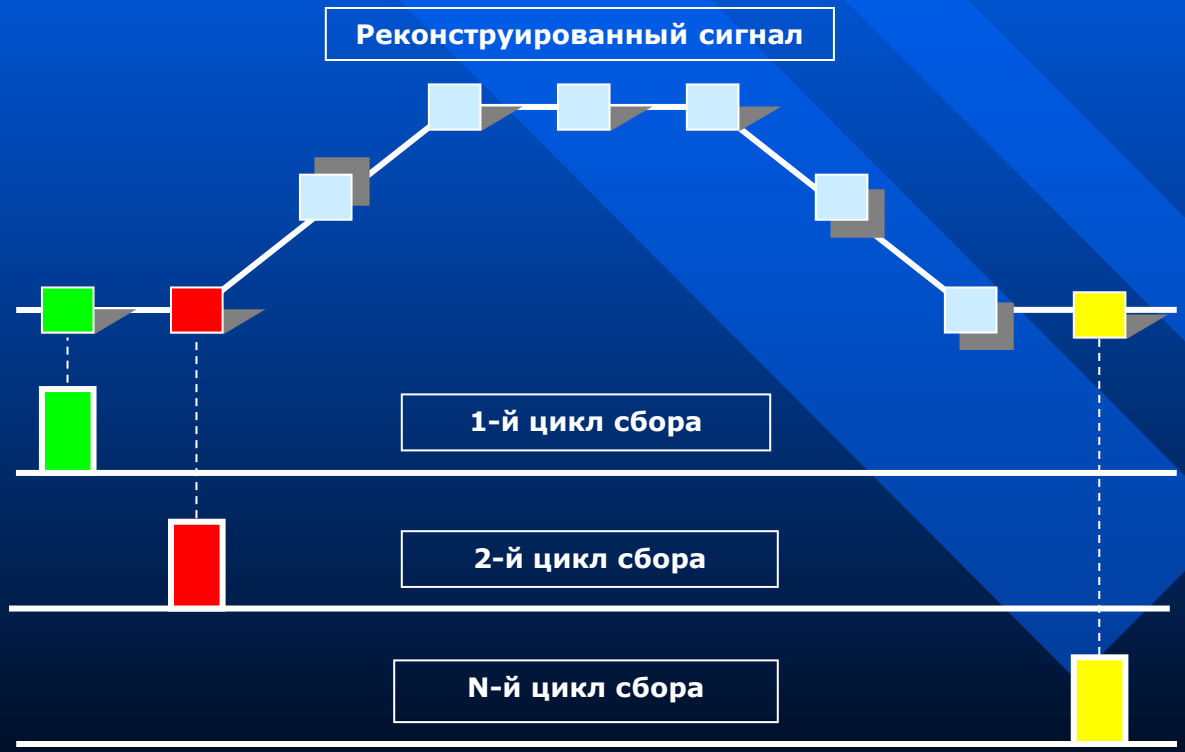
PicoScope 9201: Области применения

www.eltesta.com

Последовательное стробирование

Для сбора и отображения широкополосных сигналов осциллограф PicoScope 9201 использует принцип последовательного стробирования во временной области.

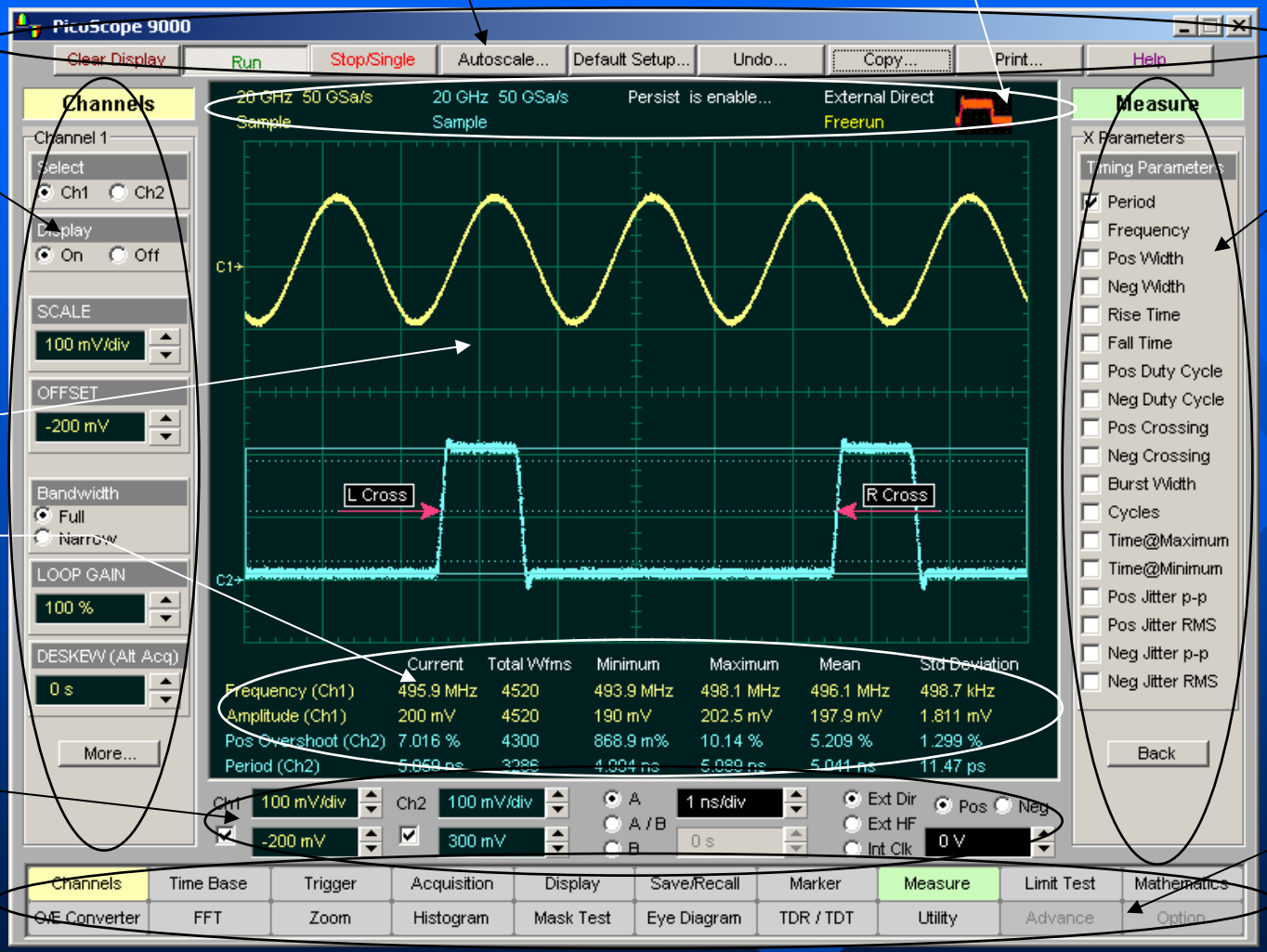
Стробоскопический осциллограф производит выборку мгновенного значения входного сигнала только в дискретных точках временной оси. Эти значения растягиваются на накопительной емкости смесителя, усиливаются, преобразуются в цифровой код, запоминаются и отображаются на экране ПК.



Последовательное стробирование означает:

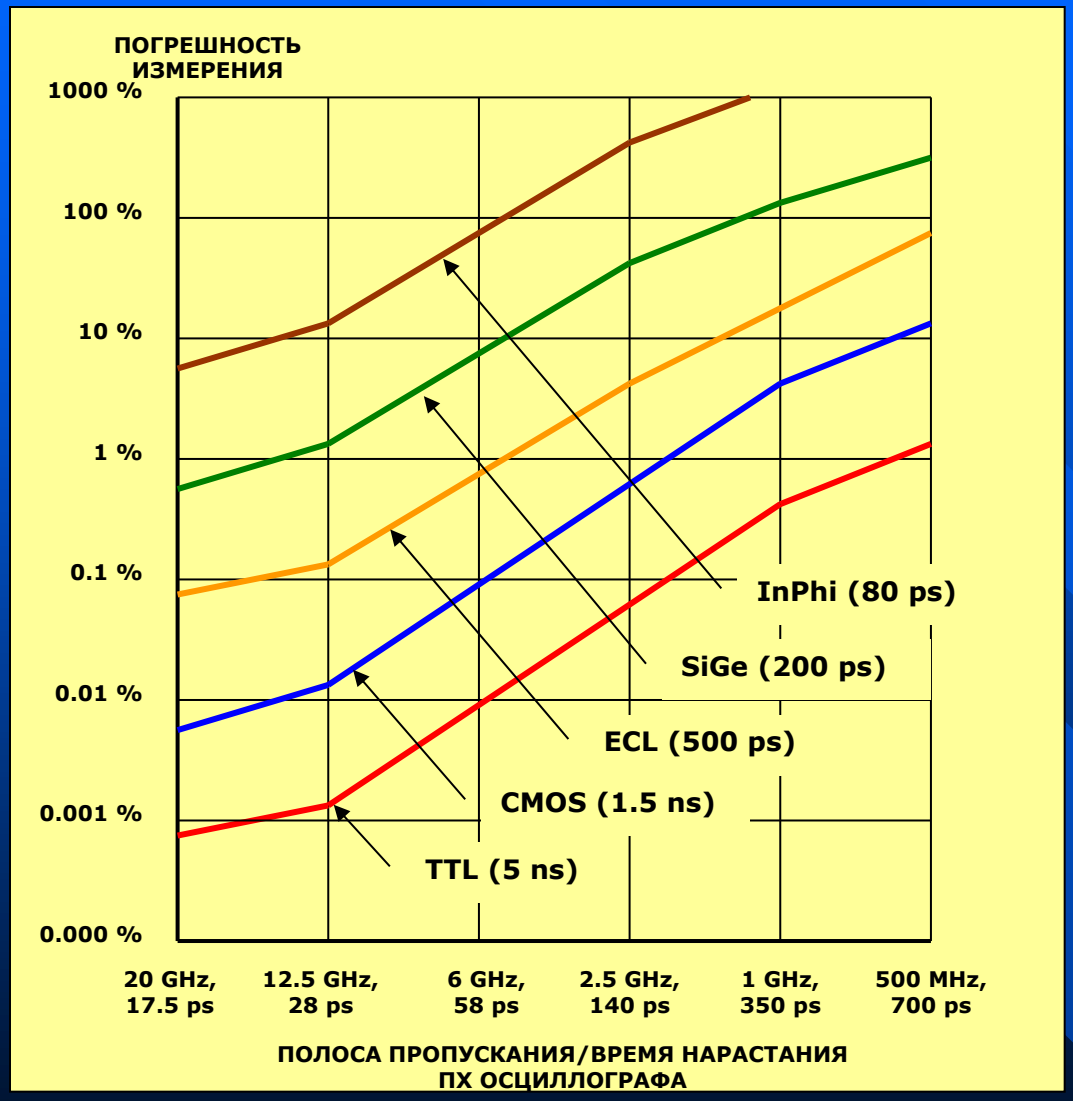
- **Широкую полосу пропускания *(> 1GHz)***
- **Измерение *только* повто-ряющихся сигналов**
- **Только *одна выборка* производится на каждый синхроимпульс**
- **Отсутствует возможность наблюдения сигнала *до запуска***

Интерфейс пользователя



Осциллограф PicoScope 9201 использует интуитивный графический интерфейс пользователя системы Windows, поэтому Вам не приходется тратить много времени на его изучение. Привычные и понятные меню обеспечивают простой доступ к большому количеству сервисных и измерительных функций.

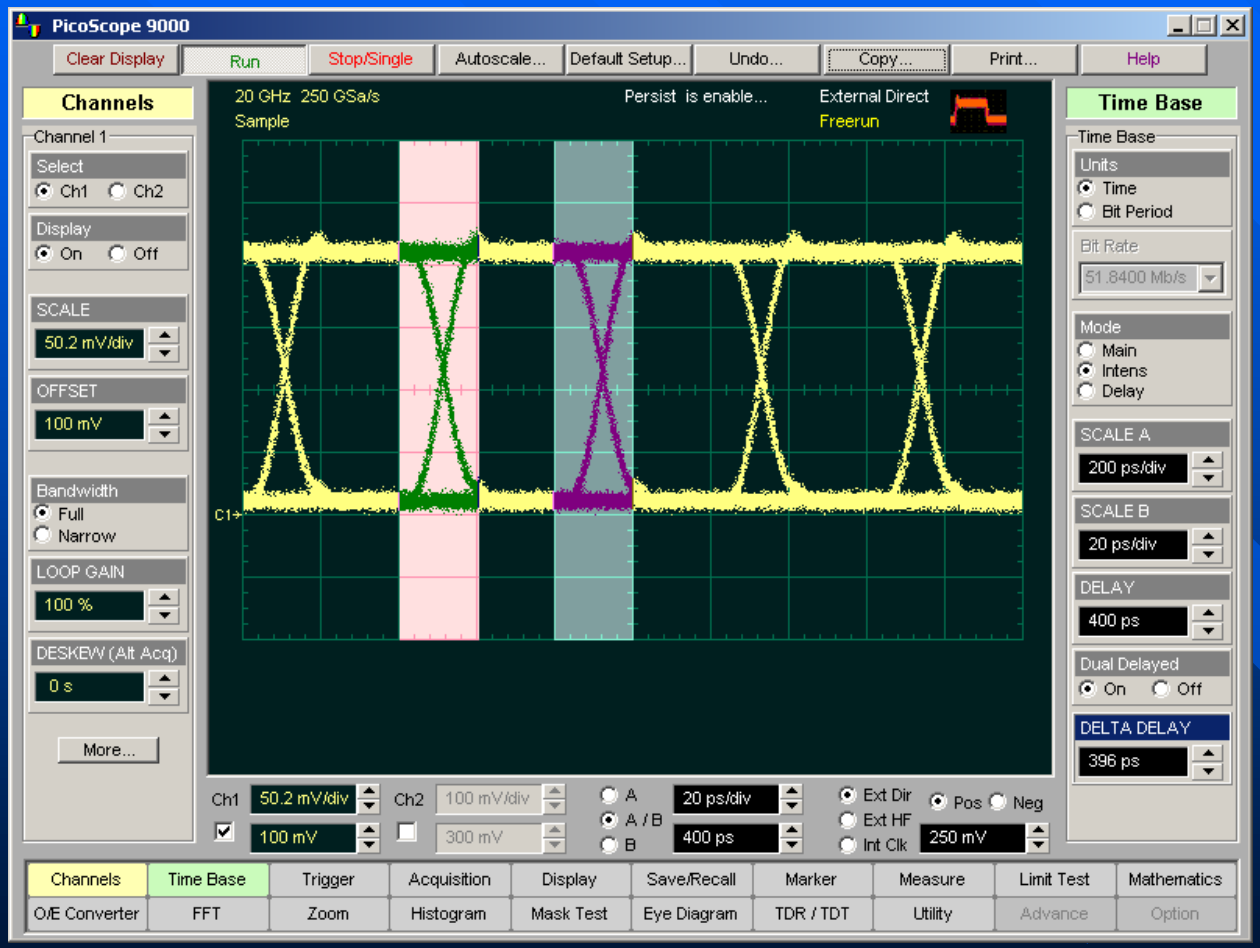
Погрешность временных измерений как функция полосы пропускания осциллографа



Если полоса пропускания осциллографа:	Увеличение фронта измеряемого сигнала составит:
Равна полосе частот, рассчитанной по фронту измеряемого сигнала	41%
В два раза выше полосы частот, рассчитанной по фронту измеряемого сигнала	12%
В три раза выше полосы частот, рассчитанной по фронту измеряемого сигнала	5%
В пять раз выше полосы частот, рассчитанной по фронту измеряемого сигнала	2%

Стробоскопическая развертка

Стробоскопическая развертка обеспечивает изменение временного масштаба и положения сигнала посредством основной, подсвеченной, задержанной или двойной задержанной разверток.



Пример глаз-диаграммы *2.5-Gbps* сигнала, отображенная в режиме с двумя зонами подсвета.

Функция единицы горизонтальной шкалы позволяет выбрать:

- **Единицу времени (секунда)**
- **Единицу расстояния (метр, фут, дюйм)**
- **Единицу периода потока**

Период потока удобен в качестве единицы горизонтальной шкалы при отображении цифровых коммуникацииооных сигналов, таких, как глаз-диаграмма.

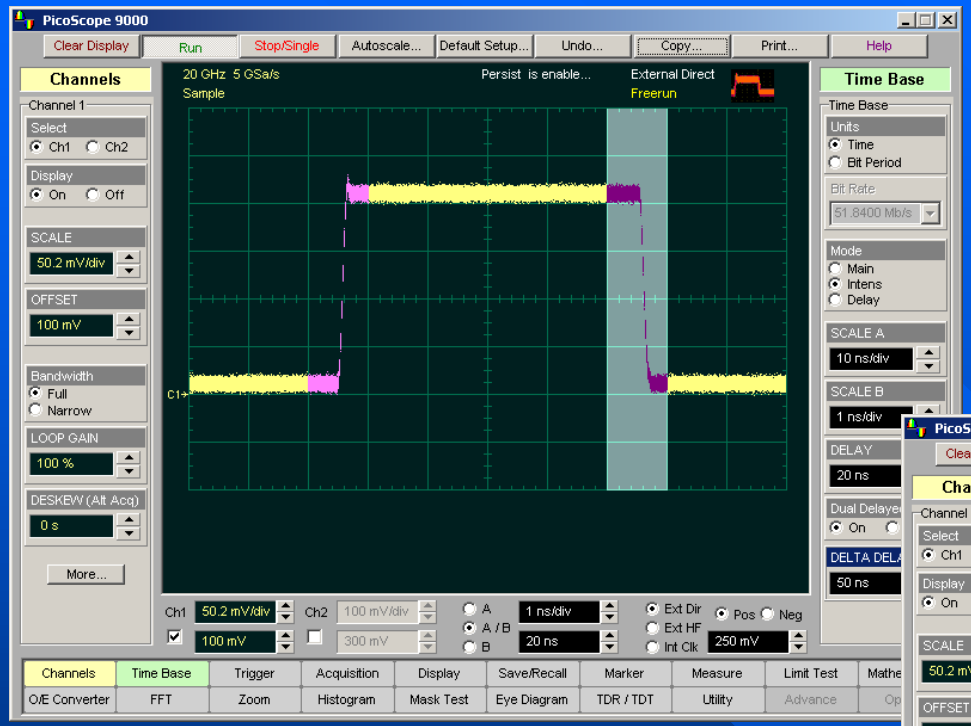
Коэффициенты развертки:

20 ps/div to 2 ms/div

Погрешность измерения временных интервалов:

± 0.4 % от полного номинала экрана ± 15 ps ± 100 ppm от установленой величины задержки

Time Base Windowing

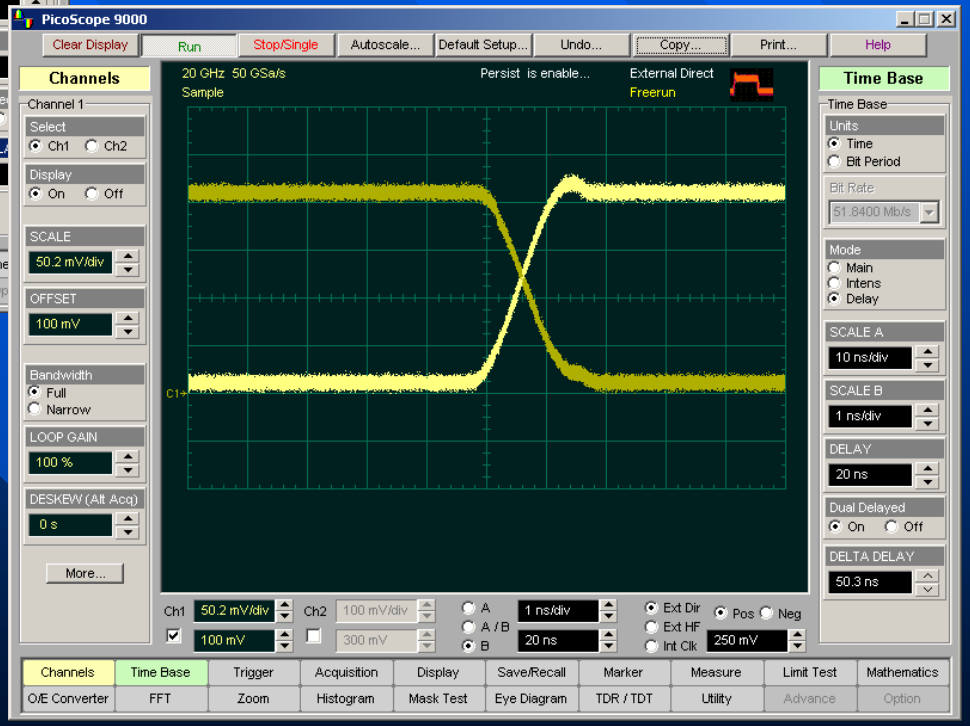


- The Time Base windowing function is similar to the delayed or dual delayed sweep on analog oscilloscopes because it turns on an expanded time base

- Expanded time base 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***



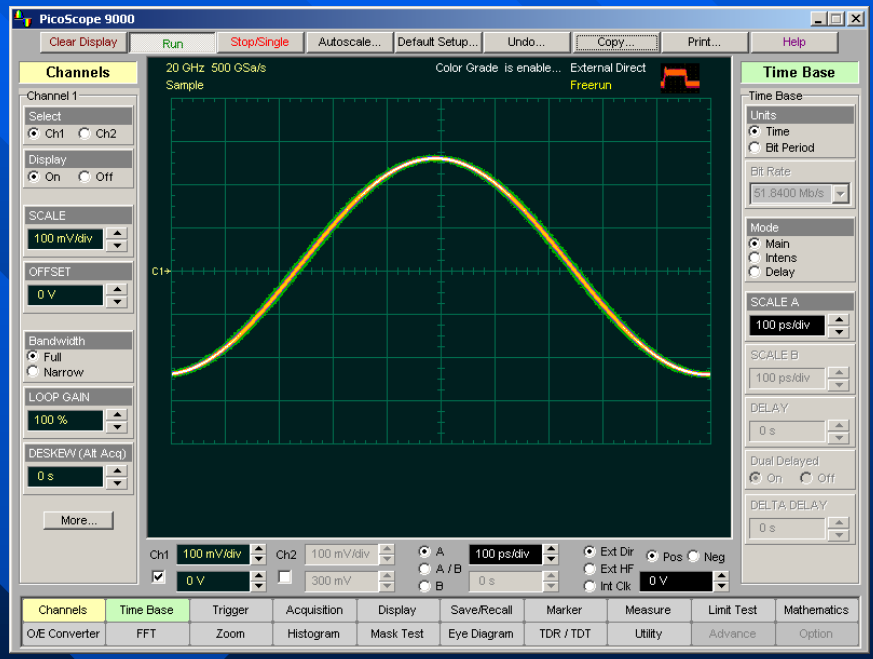
Синхронизация на прямом входе

Схема соединения приборов для проверки характеристик прямого входа синхронизации

Возможности стробоскопических осциллографов в значительной степени зависят от наличия широкополосной синхронизации с малым уровнем временной нестабильности. Осциллограф **PicoScope 9201** обеспечивает полную синхронизацию в полосе частот от 0 до ***1 GHz***.

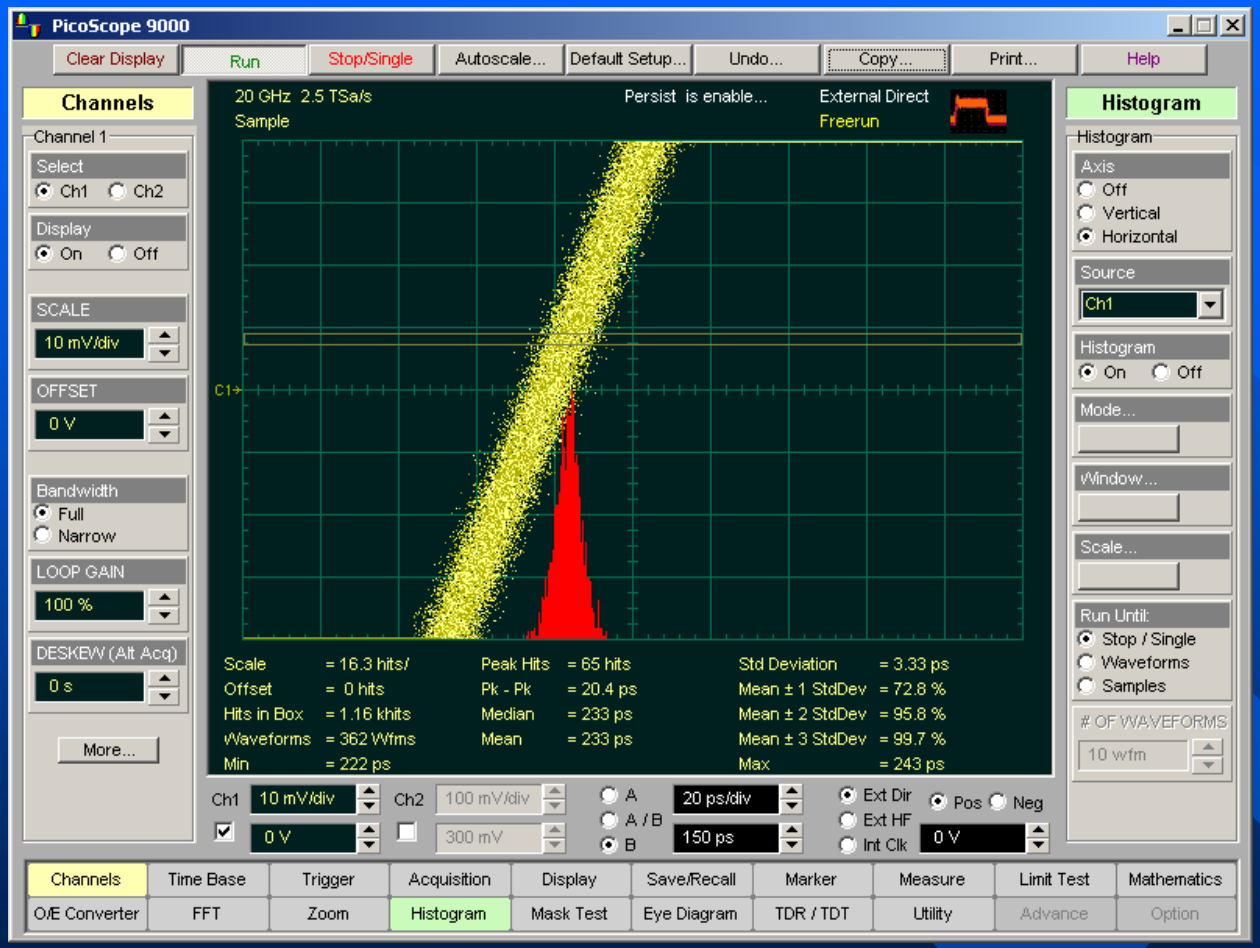
Основные характеристики прямого входа синхронизации:

- Диапазон частот от 0 до ***1 GHz***
- Чувствительность: ***100 mV p-p*** от 0 до ***100 MHz***, изменяется линейно до ***400 mV p-p*** на ***1 GHz***
- Масксимальное среднеквадратическое значение нестабильности синхронизации ***<3.5 ps***



Типичная осциллограмма ***1-GHz*** сигнала при использовании прямого входа синхронизации.

Direct Trigger Jitter



Timing accuracy leads to waveform jitter.

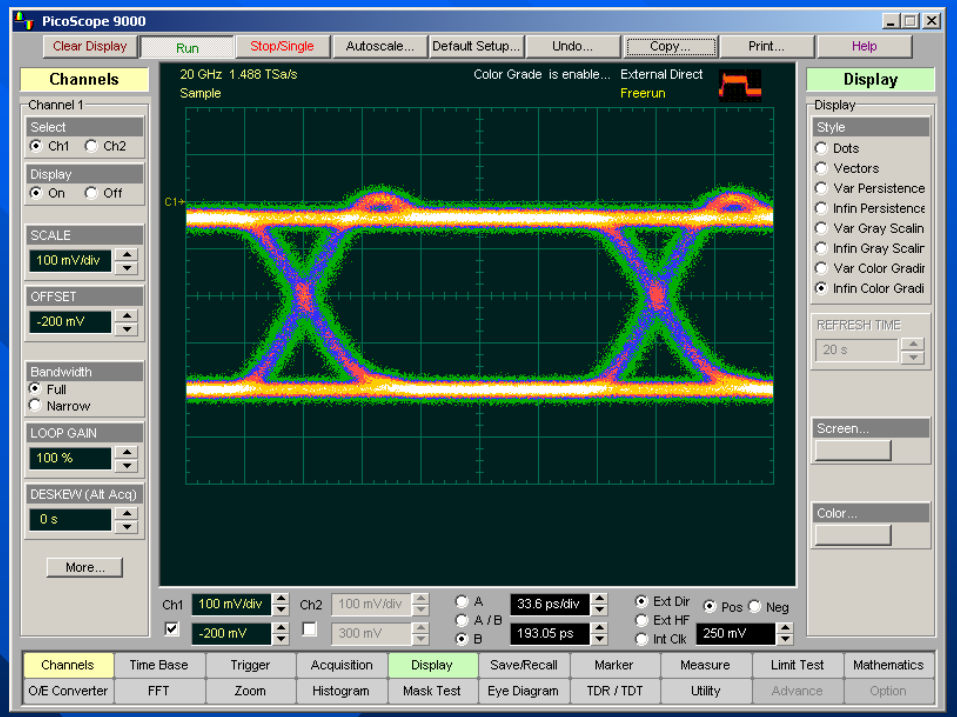
- **RMS Direct Trigger Jitter :**
  Max *3.5 ps + 20 ppm of Delay*

A typical picture showing *3.33 ps* RMS Direct Trigger Jitter with *1-GHz* sine wave signal.

HF Prescaled Trigger

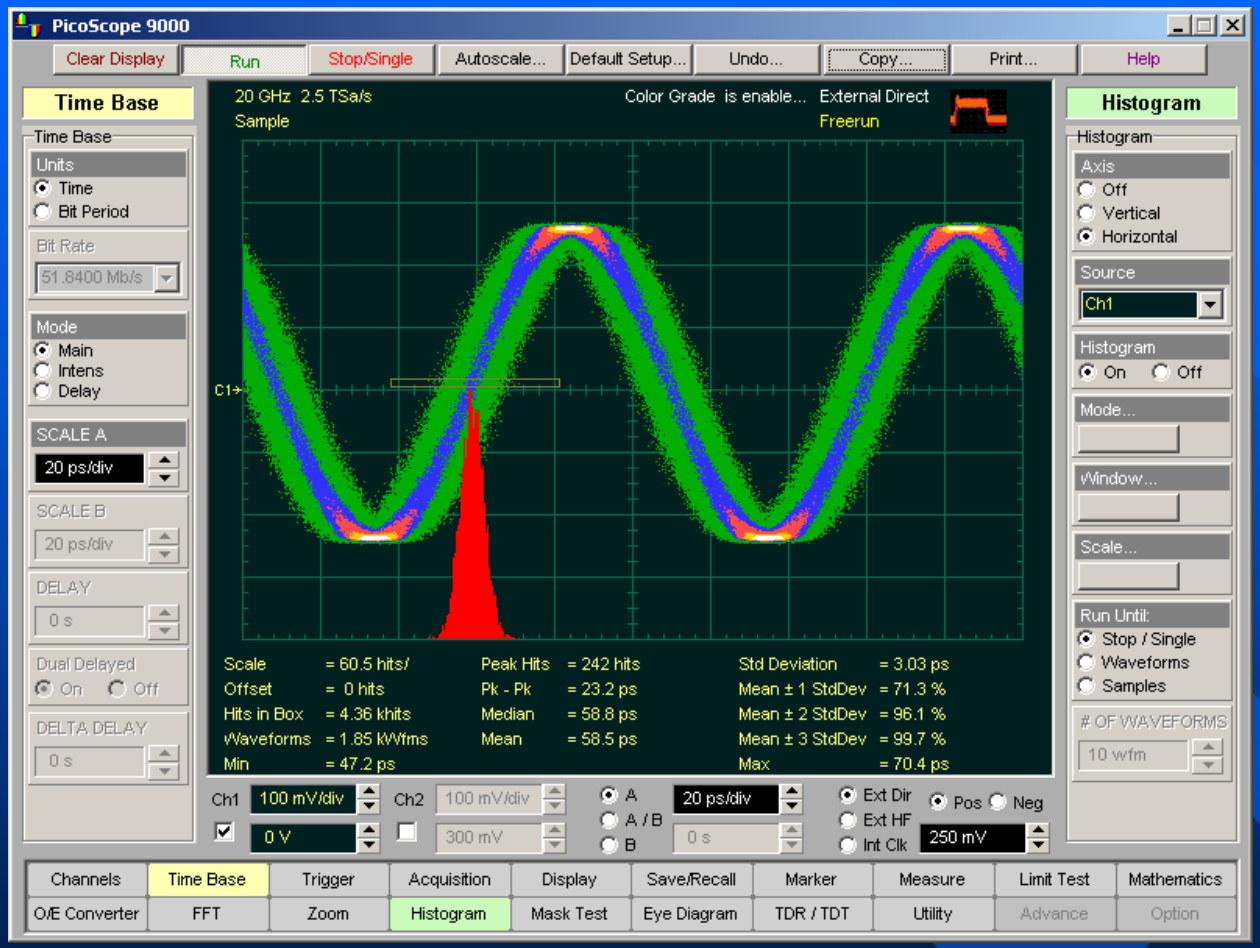
The PicoScope 9201's HF (Prescaled) trigger is an AC-coupled *10-GHz* prescaler for triggering on high-speed data without cumbersome manual adjustment.
The heart of the trigger is a low-noise GaAs frequency divider. Low RMS jitter *<3.5 ps typ* is available.

Equipment connections for Prescaled Trigger Test



A *5-Gbit* eye-diagram acquired witjh HF trigger mode.
Output: CML. Low-level.

HF Trigger Jitter



Timing accuracy leads to waveform jitter.

- **Max RMS HF Trigger Jitter: *3.5 ps***

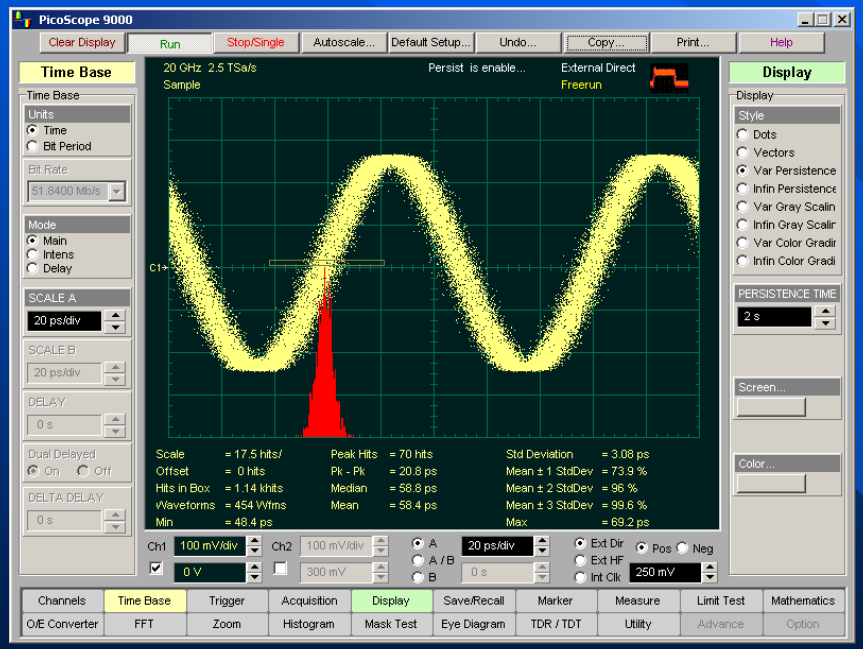
A typical picture showing *3.03 ps* RMS HF Trigger Jitter with *10-GHz* sine wave signal.

Averaging Reduces Noise

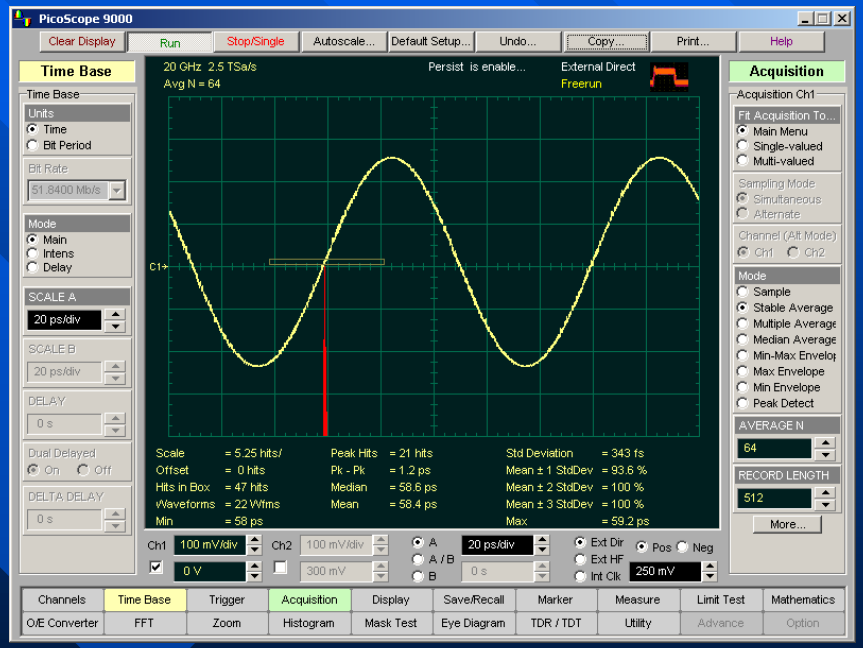
Averaging is often used eliminate random noise on the display and increase resolution and accuracy of measurements. If a waveform is "buried" in noise, averaging can be used to extract a signal from the noise as shown in this illustration.

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

- **The PicoScope 9201 used three averaging algorithms:**
  - **Stable Average**
  - **Multiple Average**
  - **Median Average**



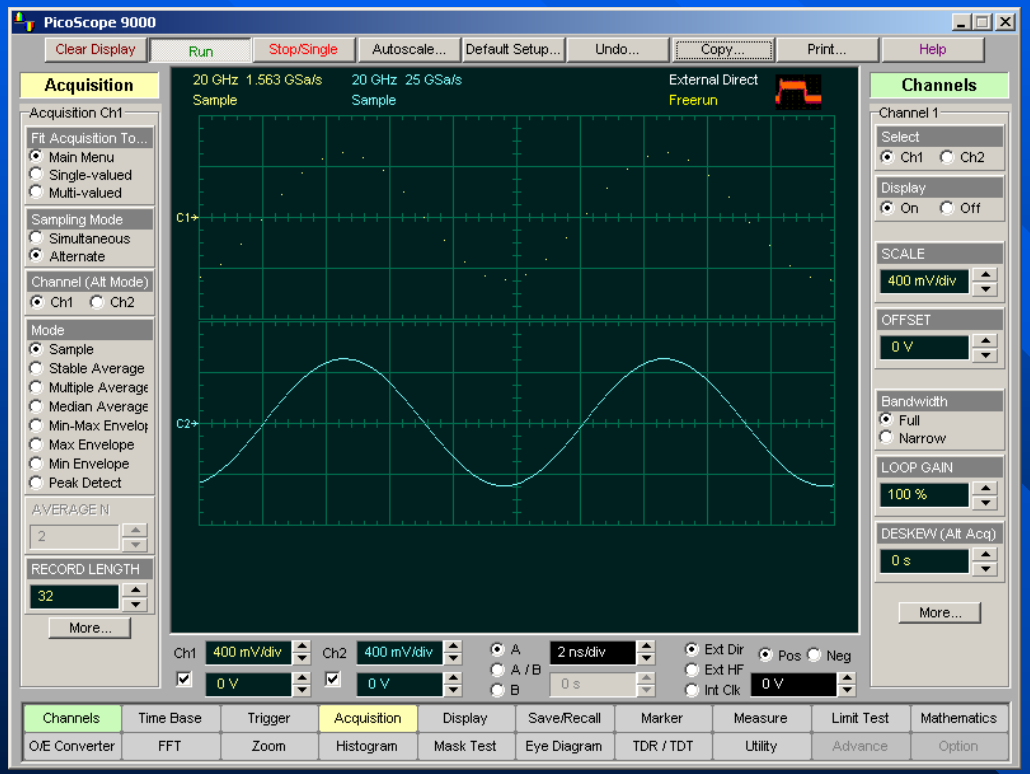
***10-GHz* signal with noise and jitter components**



The same *10-GHz* signal without noise and jitter components after deep averaging.

Record Length

The number of samples that form a trace is called Record Length (points per waveform). The greater the amount of sampled data that is available for analysis or measurements, the greater the record length. Record length in the PicoScope 9201 can be selected from *32* to *4096* samples by a multiple of two.



PicoScope 9201 traces with Record Length of *32* (top) and *512* (bottom) samples.

- **Record length sets independently for each channel.**
- **Equivalent sample rate and record length work together. If you combine a small record length memory depth 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 with a long record length takes longer to construct than one with a short record length. However, a long record length produces a waveform with higher horizontal resolution, therefore a trade off exists between throughput and resolution.**

Многоканальное отображение

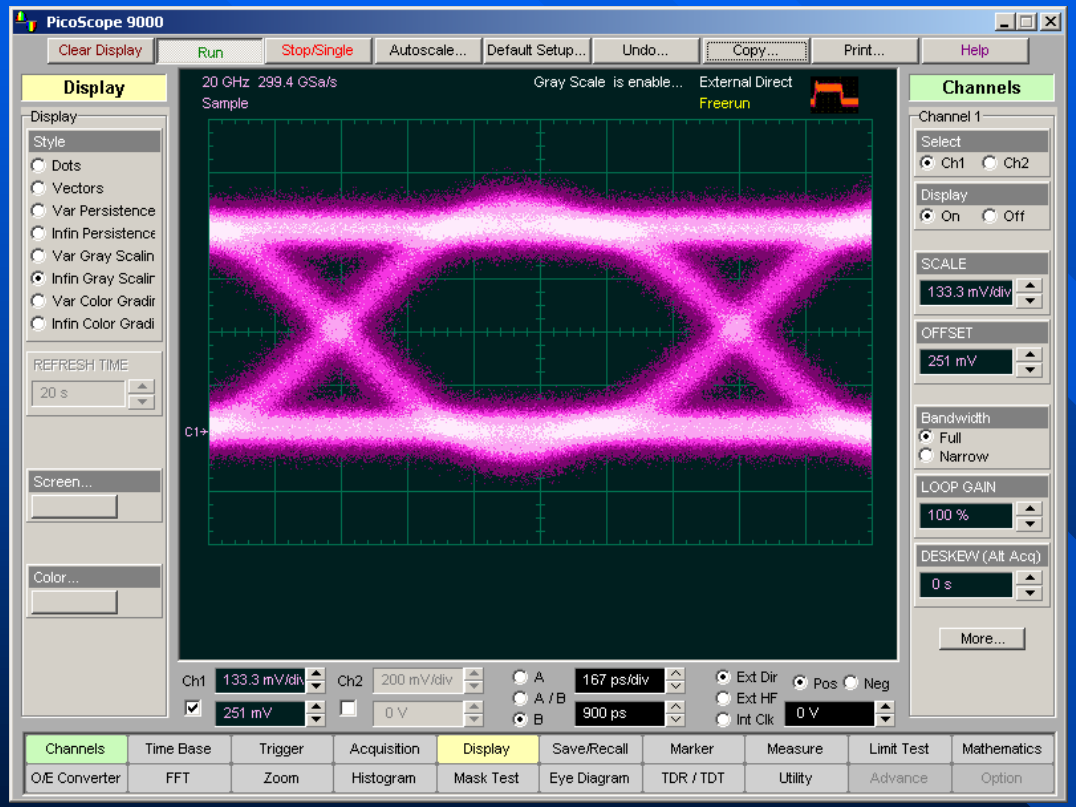
Осциллограф PicoScope 9201 позволяет отображать одновременно до восьми лучей. К таким лучам относятся: сигналы каждого из двух каналов, чеыре запомненных сигнала, четыре математические, а также две спектральные функции.

Осциллограмма отображения восьми независимых лучей на экране осциллографа PicoScope 9201

- **Интерфейс пользователя осциллографа PicoScope 9201 позволяет назначить различные цвета для каждого из отображаемых лучей.**
- **Установленные для этих лучей масштабы отображения и результаты измерений сигналов также отображаются соответствующим цветом.**

Informative Waveform Display: Grey Scaling

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

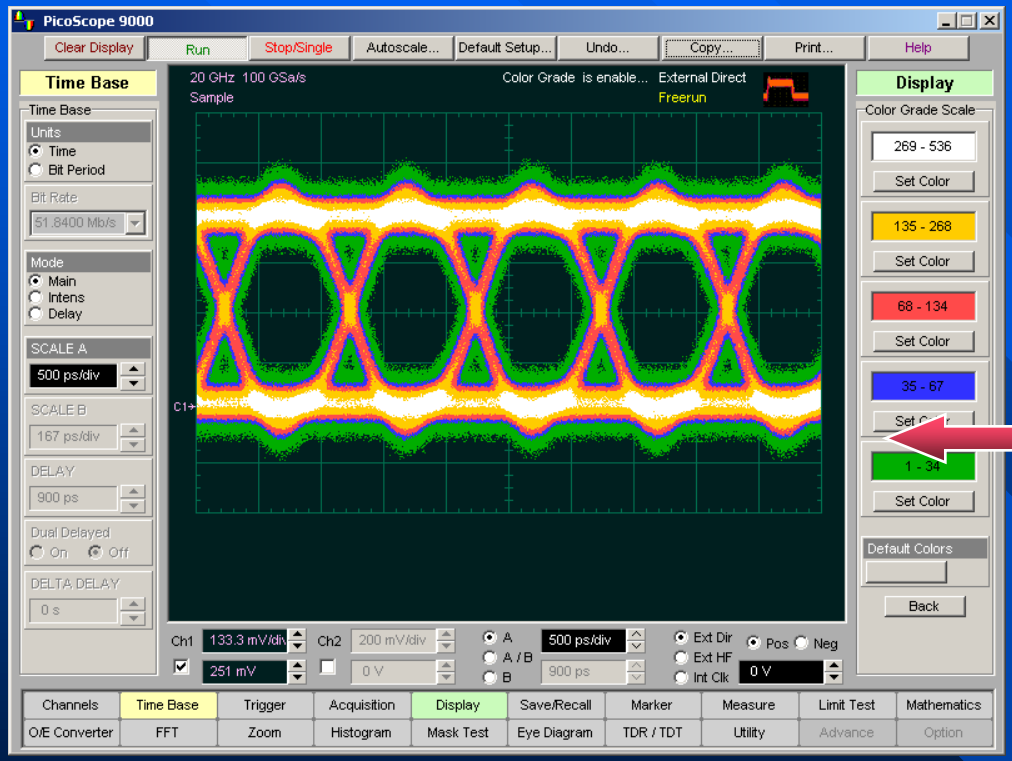


- The maximum population automatically gets the highest color intensity, the minimum population gets the lowest color intensity, and intermediate populations get intensities in between these extremes
- The information in the lower populations (for example, down at the noise level) could be of greater interest to you than the rest.
- The Grey Scaling persistence view highlights the distribution of data so that you can examine it in detail.

Get valuable insight into your device behavior with gray scaling display. View pattern dependencies and different rare versus common events

Градация цветом

В режиме градации цветом отображение формируется накопленными точками, имеющими различные цвета. Цвет индицирует плотность попадания точек сигнала в данный пиксел осциллограммы. Режим градации цветом полезно использовать при работе с гистограммами, глаз-диаграммами, масками, то есть при статистических измерениях. Используйте режим градации цветом также при необходимо получить как можно больше визуальной информации о сигнале.



Режим градации цветом позволяет оператору подробно исследовать все детали осциллограммы *2.5-GHz* глаз-диаграммы

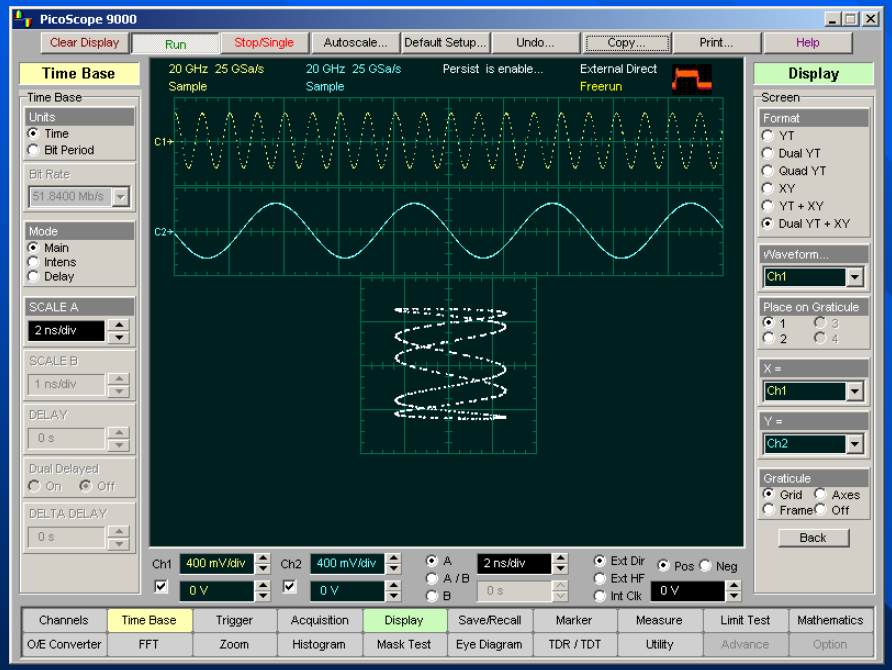
Режим градации цветом использует накопленную базу данных о сигналах, составляющую *257 точек* по вертикали и *501 точка* по горизонтали. За каждой точкой находится свой *16-разрядный счетчик*. Любое попадание сигнала в точку экрана увеличивает значение кода, записанного в счетчик. Каждый цвет, используемый в режиме градации цветом представляет собой диапазон значений, записываемых в счетчик каждой точки в данный момент. В процессе сбора, когда общее число попаданий растет, растет и значение диапазона, соответствующего каждому цвету. Максимальное значение, записываемое в счетчик равно *65 535.*

Осциллограф использует пять цветов для формирования режима градации цветом. Каждый цвет может быть выбран из стандартного меню Windows.

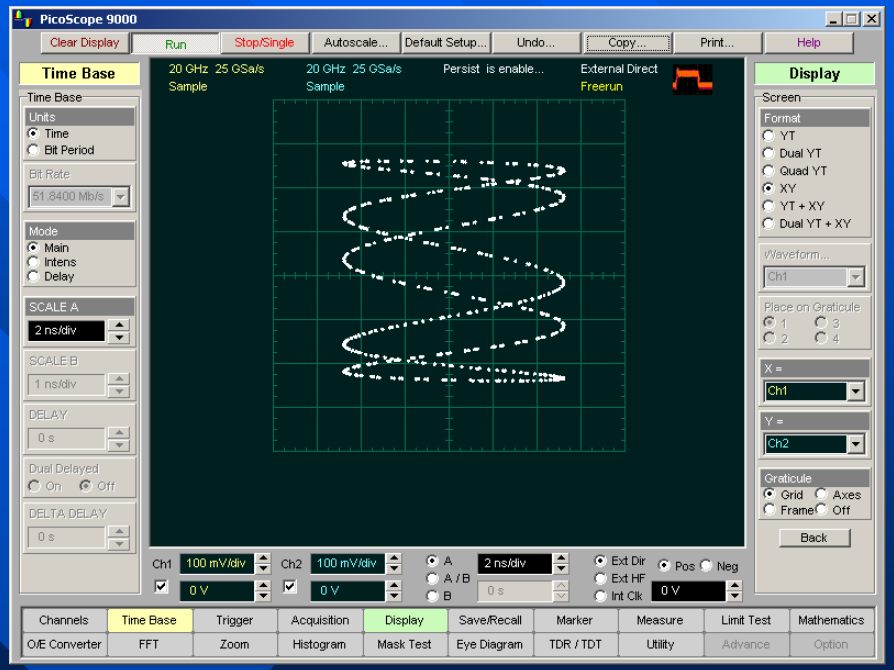
X-Y Display Format

Three Format menus determines how the instrument draws the waveforms:

- **The YT format is the normal time (on the horizontal axis) versus voltage (on the vertical axis).**
- **The XY format displays voltages of two waveforms against each other, and draws as the Source 1 versus Source 2 display of the two selected sources. Source 1's amplitude is plotted on the horizontal X axis and the Source 2's amplitude is plotted on the vertical Y axis**
- **The XY & YT format displays both YT and XY pictures. The YT format places on upper part of the screen, and XY format places on lower part of the screen.**



YT & XY Display Format



XY Display Format

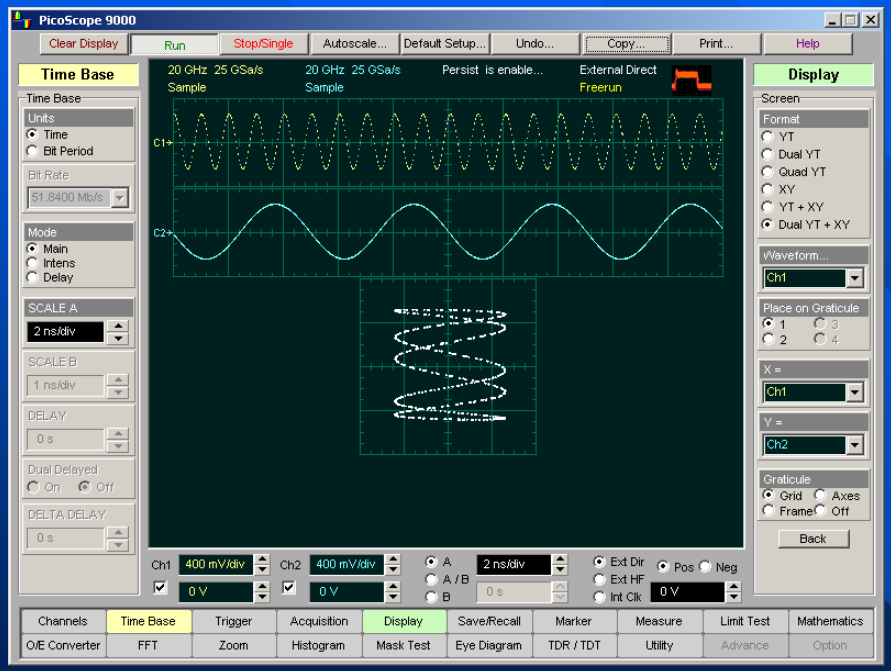
You can use the XY format to:

- **Compare frequency and phase relationships between two signals.**
- **Display strain vs. displacement, flow versus pressure, volts versus current, or voltage versus frequency.**

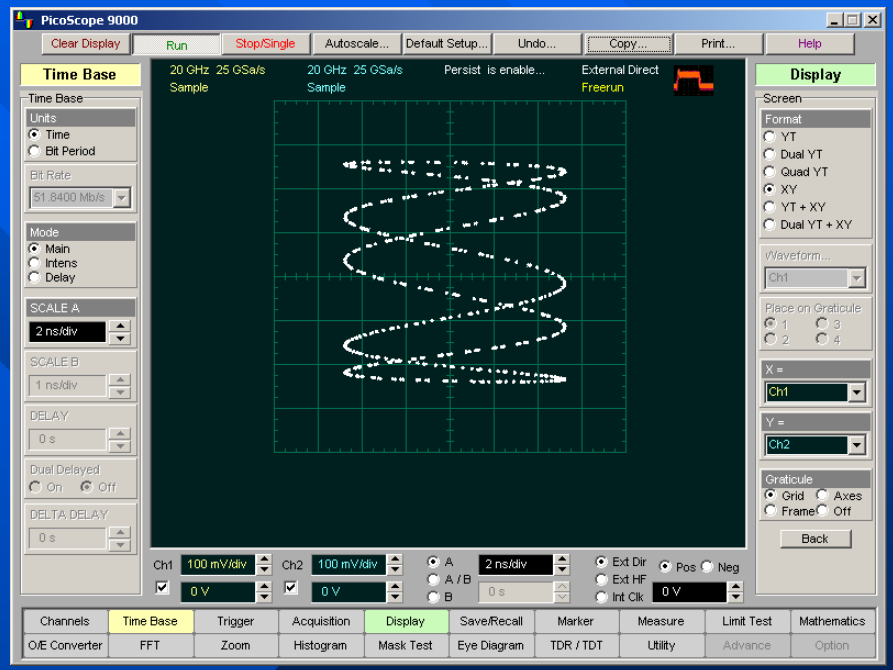
Отображение в формате X-Y

Три формата определяют, каким образом осциллограф отображает сигналы:

- **В формате YT горизонтальная ось является осью времени, в то время как вертикальная - является осью напряжения.**
- **В формате XY горизонтальная ось является осью напряжения одного из источников сигнала, в то время как вертикальная - является осью напряжения другого источника сигнала.**
- **В формате XY & YT отображаются осциллограммы обоих форматов - YT и XY. При этом формат YT расположен в верхней части экрана, а формат XY – в нижней части.**



Пример осциллограммы в формате YT & XY



Пример осциллограммы в формате XY

- **Формат XY используется для:**
  - **Сравнения частот и или разности фаз между двумя сигналами.**
  - **Отображения взаимной зависимости двух величин, например, тока от напряжения или напряжения от частоты.**

Waveform Manipulation

Two features are available that can simplify your work with waveforms:

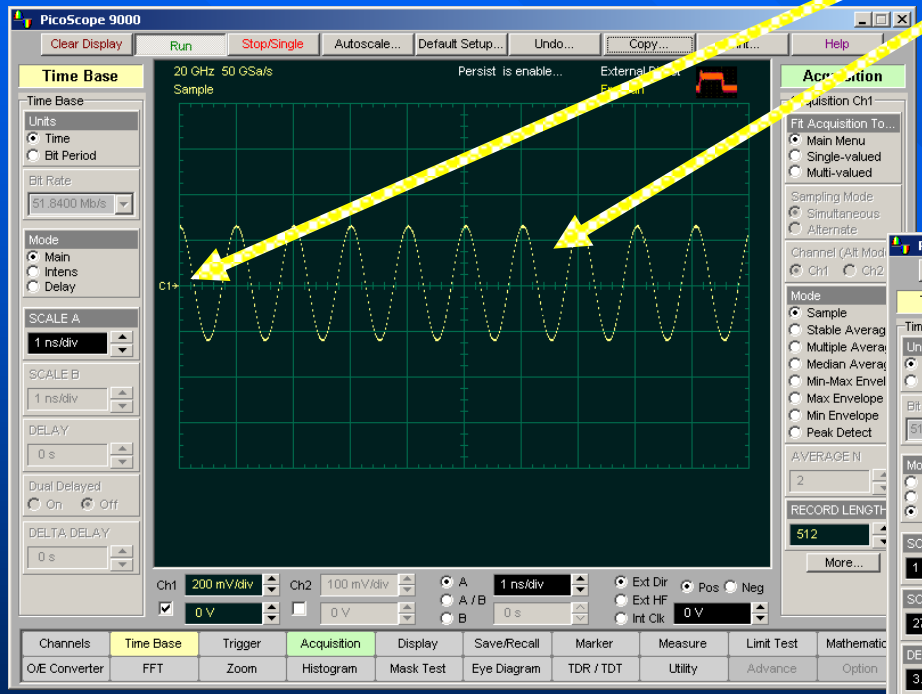
- **Direct Manipulation**
- **Zoom**

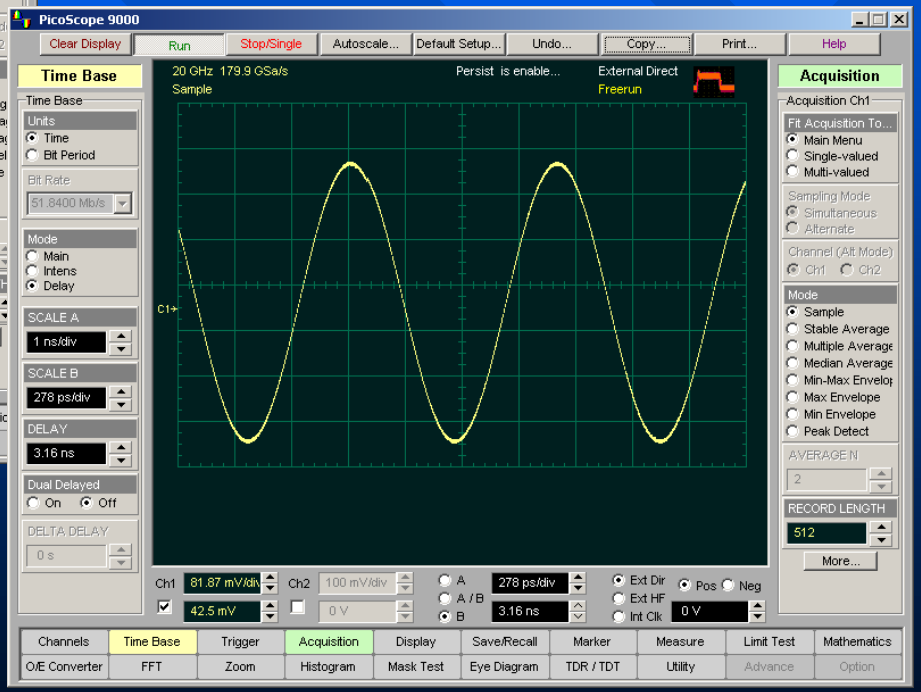
Direct Manipulation

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.





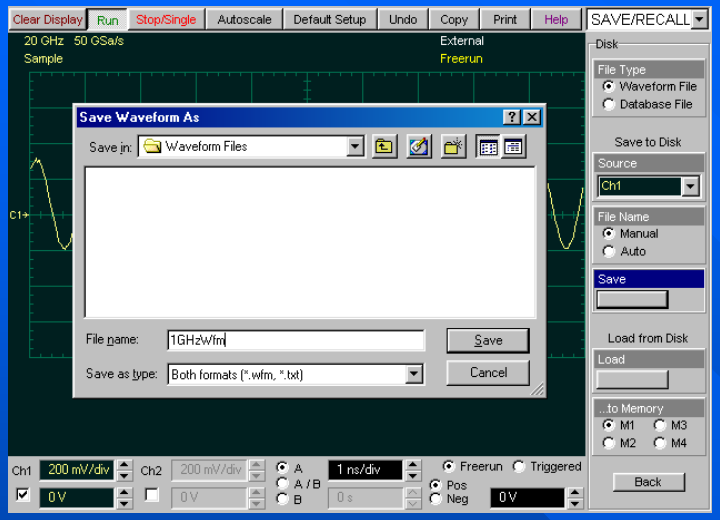
Zoom

- **Draw a box around the section of the waveform you want to expand**
- **Then click inside the box**

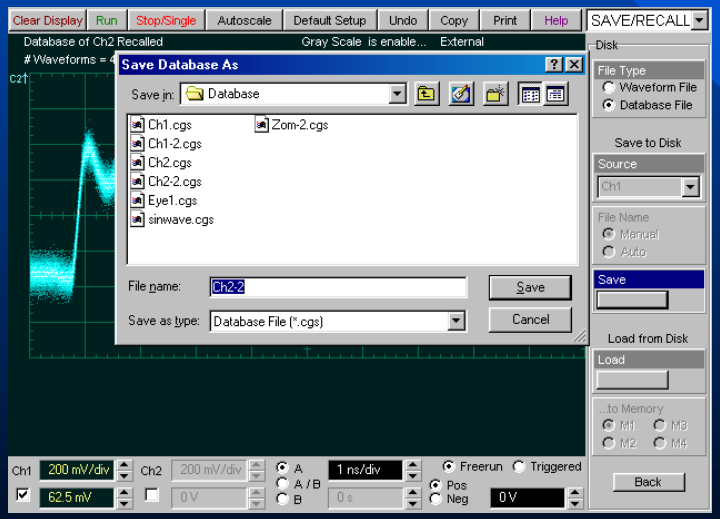
Familiar File Management

Standard Windows user interface allows you save and recall on PCs hard disks:

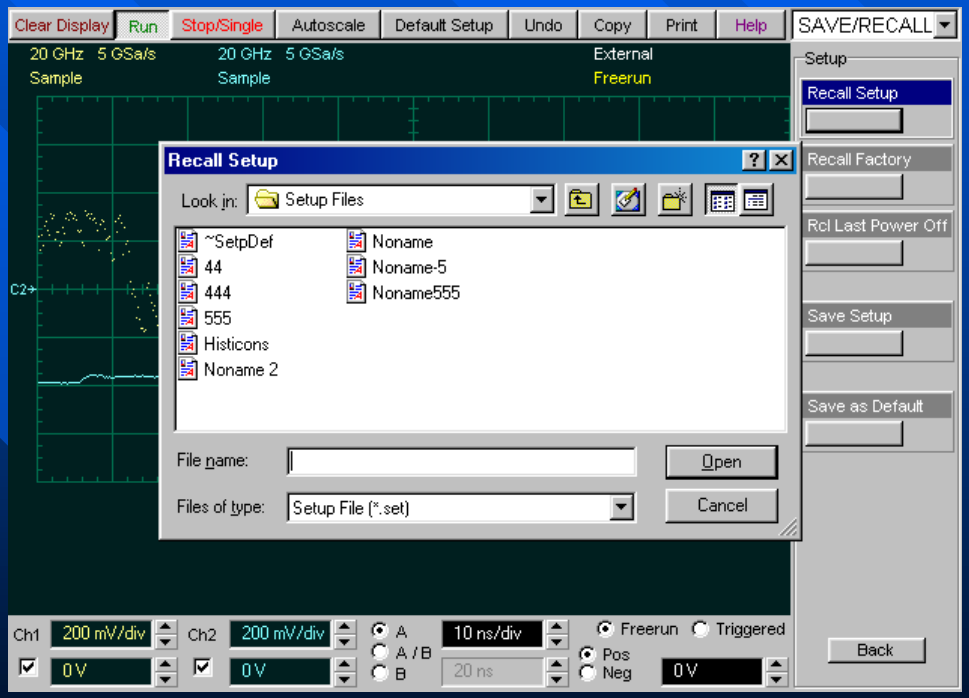
- Waveforms in various formats
- Waveform Database
- Scope setups
- Screen images



Saving into Waveform File



Recalling Waveform Database



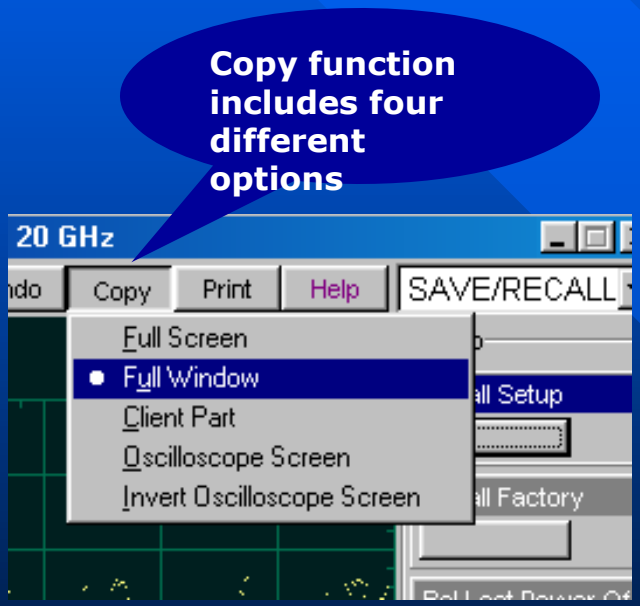
Recalling Setups

www.eltesta.com

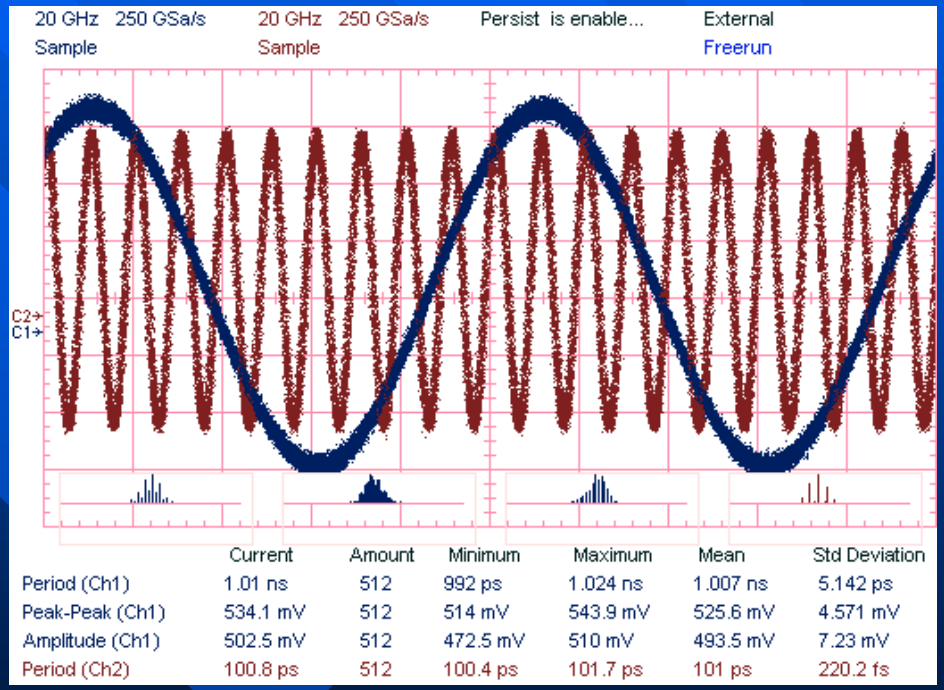
Copying a Waveform

Clicking the Copy button copies the programming window into the Window Clipboard. You can paste copied information in such Windows programs as Word, Corel Draw, Paint Brash, and etc.

- **Use Copy function when preparing documentation based on usage of the PicoScope 9201.**



PicoScope 9201 Copy function

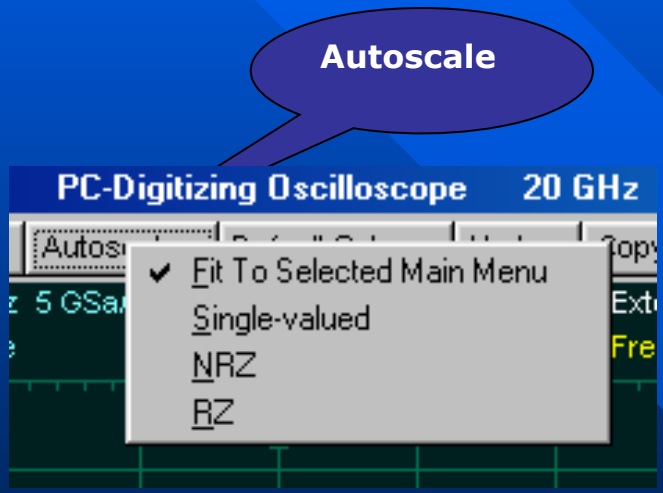


Screen image copied with Invert Oscilloscope Screen option

Autoscale

Get waveform on screen quickly with Autoscale button.

Autoscale function adjusts an 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 Austoscale button location

The Autoscale function can find repetitive signal 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*.**

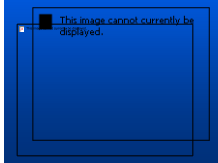
When you click the Autocale button, you tell the PicoScope 9201 to examine the signal and adjust the following controls for optimum display:

- **Vertical scale and offset.**
- **Time base scale and delay.**
- **Trigger level, if appropriate to that trigger source.**

Измерения и испытания

Виды измерений, используемых в осциллографе PicoScope 9201

Измерения по шкале

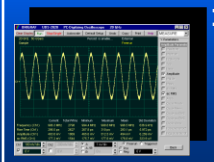


Электронная шкала размером 10 x 8 делений и содержащая сетку, оси, рамку

Маркерные измерения

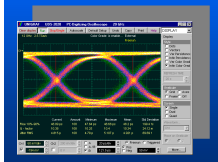
Два X-, Y-, или XY-маркера. Абсолютные, разностные, относительные измерения

Автоматические измерения



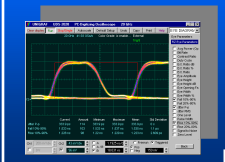
19 амплитудных, 15 *временных* и 5 *спектральных* измерний

Измерения NRZ глаз-диаграмм



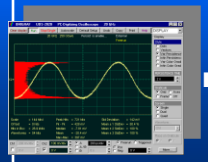
Список из 38 измеряемых параметров NRZ глаз-диаграммы

Измерения RZ глаз-диаграмм



Список из 40 измеряемых параметров RZ глаз-диаграммы

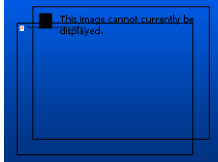
Гистограммные измерения



До 11 статистических измерений вертикальной или горизонтальной гистограммы

Виды испытаний, используемых в осциллографе PicoScope 9201

Допусковый контроль



Автоматически сравнивает до 4 измеряемых параметров с заданными допусками

Тест масок

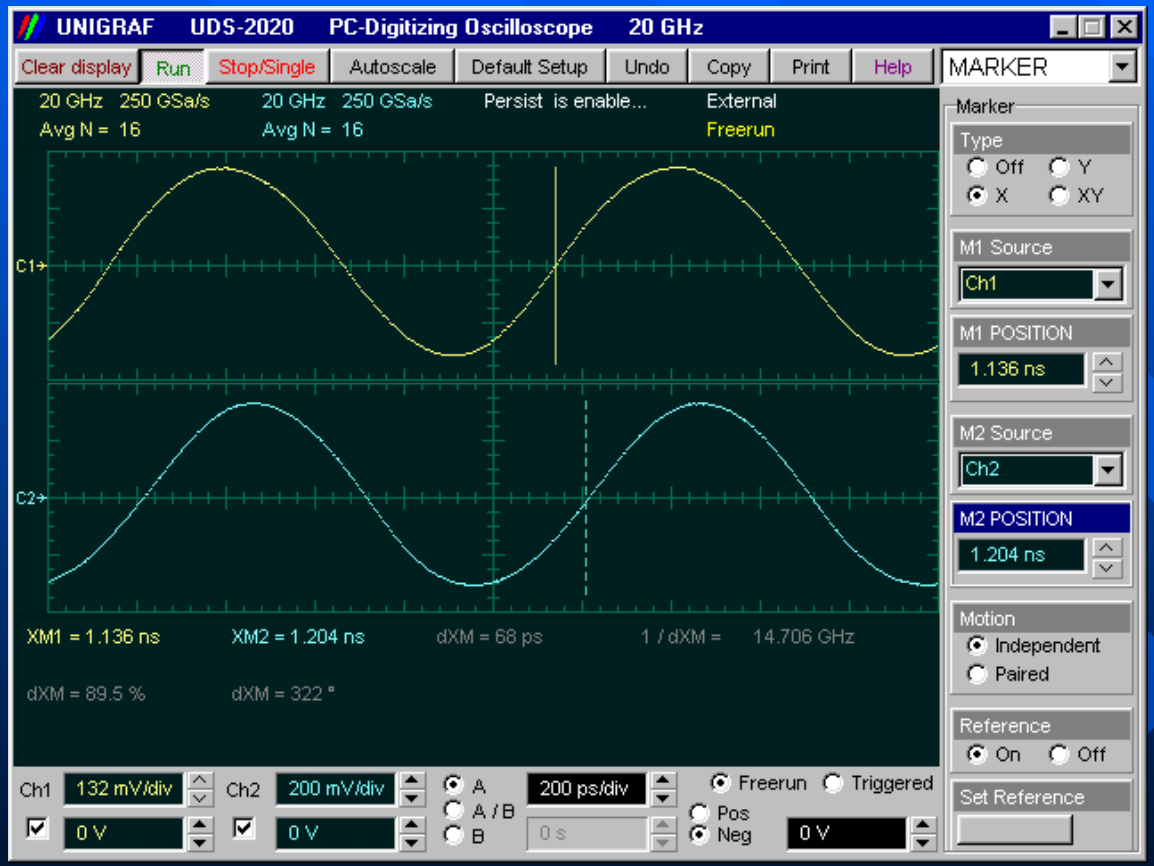
Стандартные или произвольные маски могут использоваться для проведения теста

Тест расширенных границ маски

Расширенные границы масок используют для ужесточения испытаний

Marker Customize Measurements

Markers are movable lines on the display that provide Customize Measurements. You set marker's value by positioning them on the display. Their actual value, however, comes from internal data. This makes marker measurements more precise than graticules.



Markers measure timing shift of ***1-GHz*** sine-wave signal with ***1-ps*** resolution

Marker Measurements:

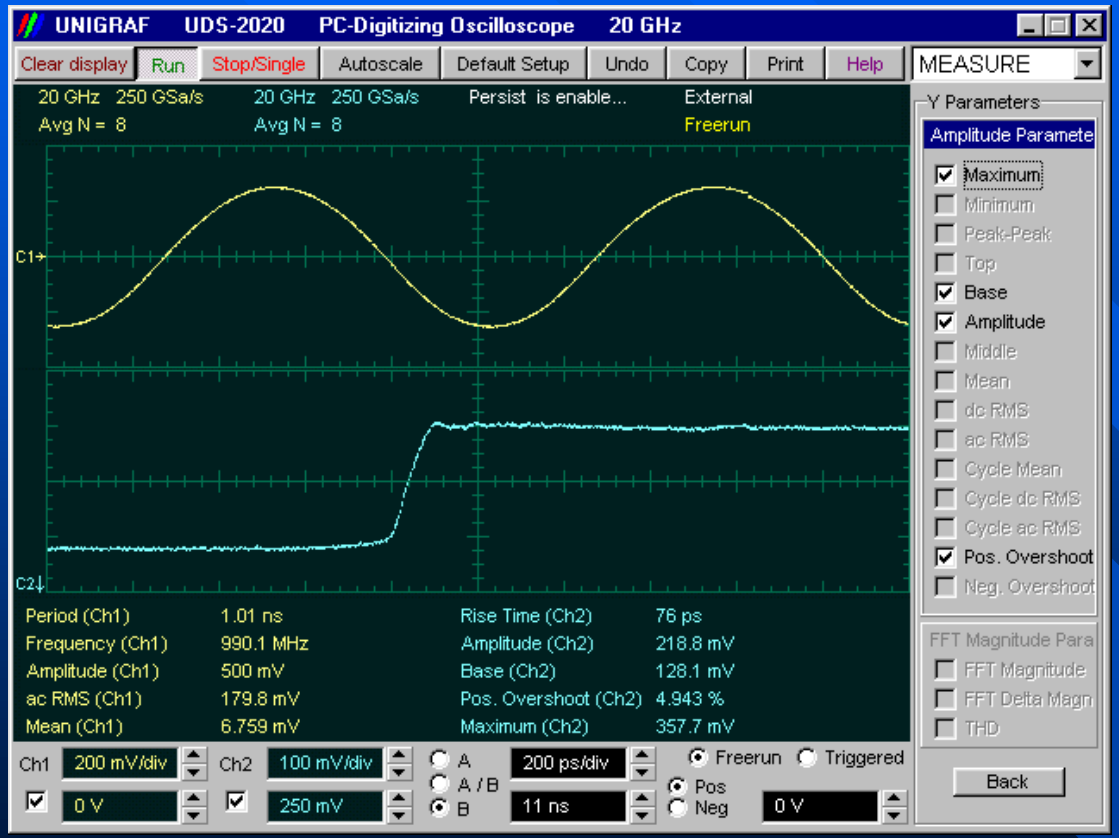
- Absolute vertical (voltage)
- Ratiometric vertical (voltage)
- Absolute horizontal (timing)
- Ratiometric horizontal (timing)

Best Marker Resolution:

- Voltage: ***31.25 uV***
- Time Interval: ***0.2 ps***

Automatic Measurements

The PicoScope 9201 provides accurate Automatic Measurements. They make the measurement process fast and easy, while reducing human errors, particularly essential for repetitive test. All measurements conform to the *IEEE standards*. Measurements cover *Voltage*, *Timing* and *FFT*.



The PicoScope 9201 measures up to 10 parameters simultaneously on 8 sources with maximum time resolution of *0.1 ps* and *1.6%* vertical accuracy

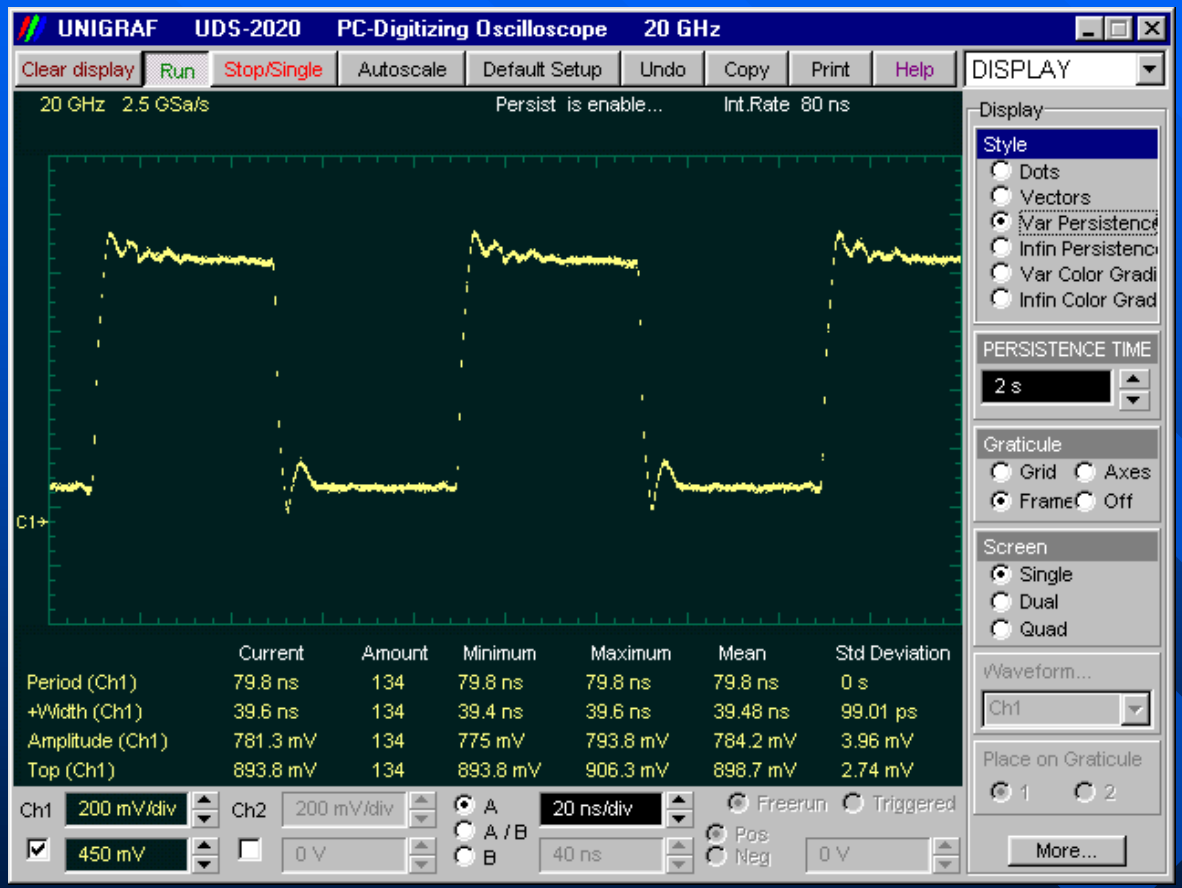
19 *Amplitude Measurements* are made on vertical parameters. They typically mean voltage. They are: ● *Maximum*, ● *Minimum*, ● *Peak-Peak*, ● *Top*, ● *Base*, ● *Amplitude*, ● *Middle*, ● *Mean*, ● *dc RMS*, ● *ac RMS*, ● *Area*, ● *Cycle Middle*, ● *Cycle Mean*, ● *Cycle dc RMS*, ● *Cycle ac RMS*,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

15 *Timing Measurements* are made on horizontal parameters. They typically mean seconds or hertz. They are: ● *Period*, ● *Frequency*, ● *Pos. Width*, ● *Neg.Width*, ● *Rise Time*, ● *Fall Time*, ● *Pos.Duty Cycle*, ● *Neg. Duty Cycle*, ● *Pos Crossing*, ● *Neg Crossing*, ● *Burst Width*, ● *Cycles*, ● *Time@Maximum*, ● *Time@Minimum*, ● *Delay*.

5 *FFT Measurements* are made on both vertical and horizontal parameters. They typically mean volts and hertz. They are: ● *FFT Magnitude*, ● *FFT Delta Magnitude*, ● *THD*, ● *FFT Frequency*, ● *FFT Delta Frequency*.

Statistics Measurements

The PicoScope 9201 measures up to 4 statistics parameters simultaneously



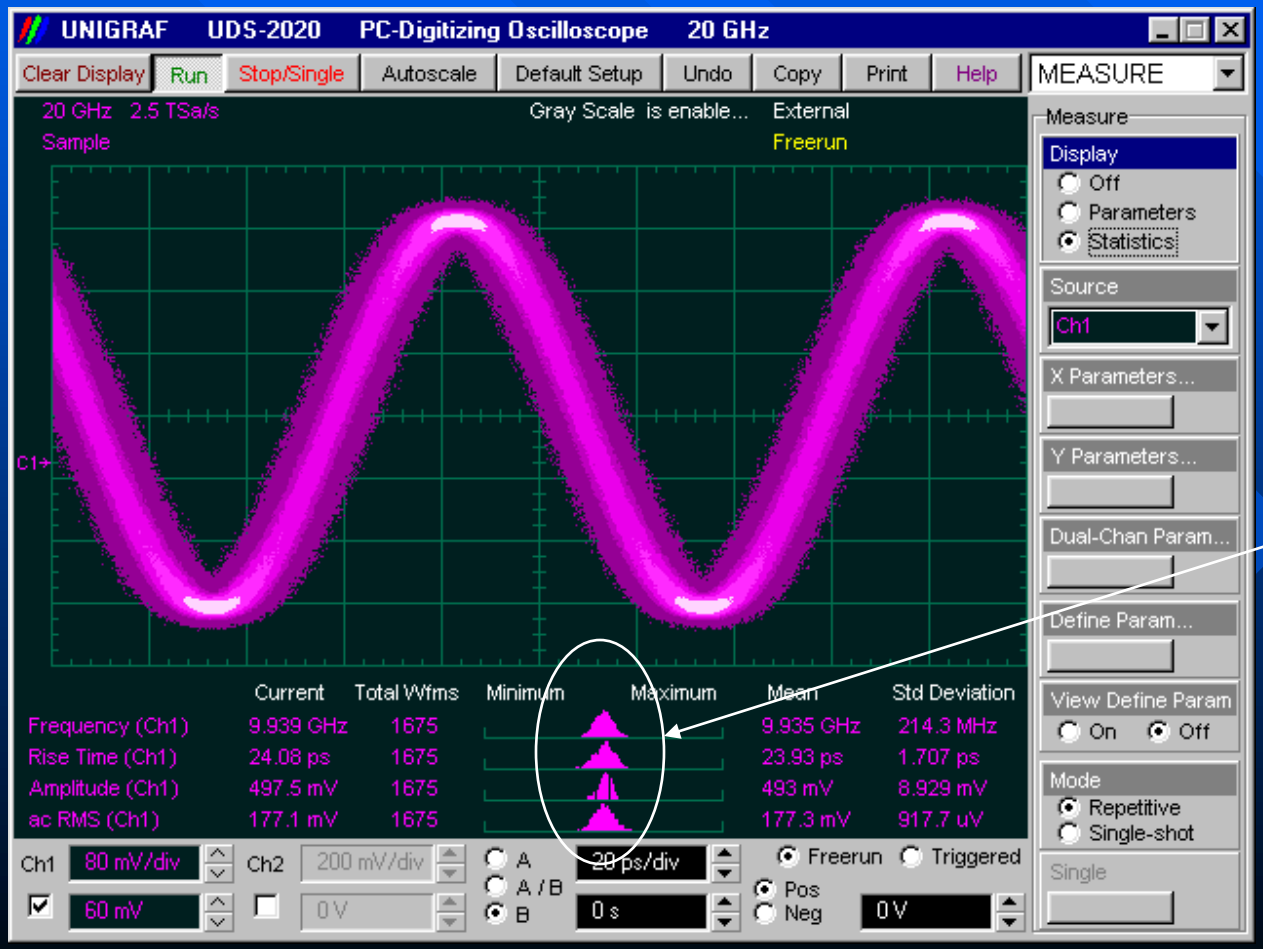
Simultaneous statistics measurements of Period, +Width, Amplitude and Top parameters of *12-MHz* Pulse

- **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 calculates 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.**

Histicons

Histicons are miniature histograms of parameter measurements that appear in Measurement Area. These thumbnail histograms let you see at a glance the statistical distribution of each parameter.

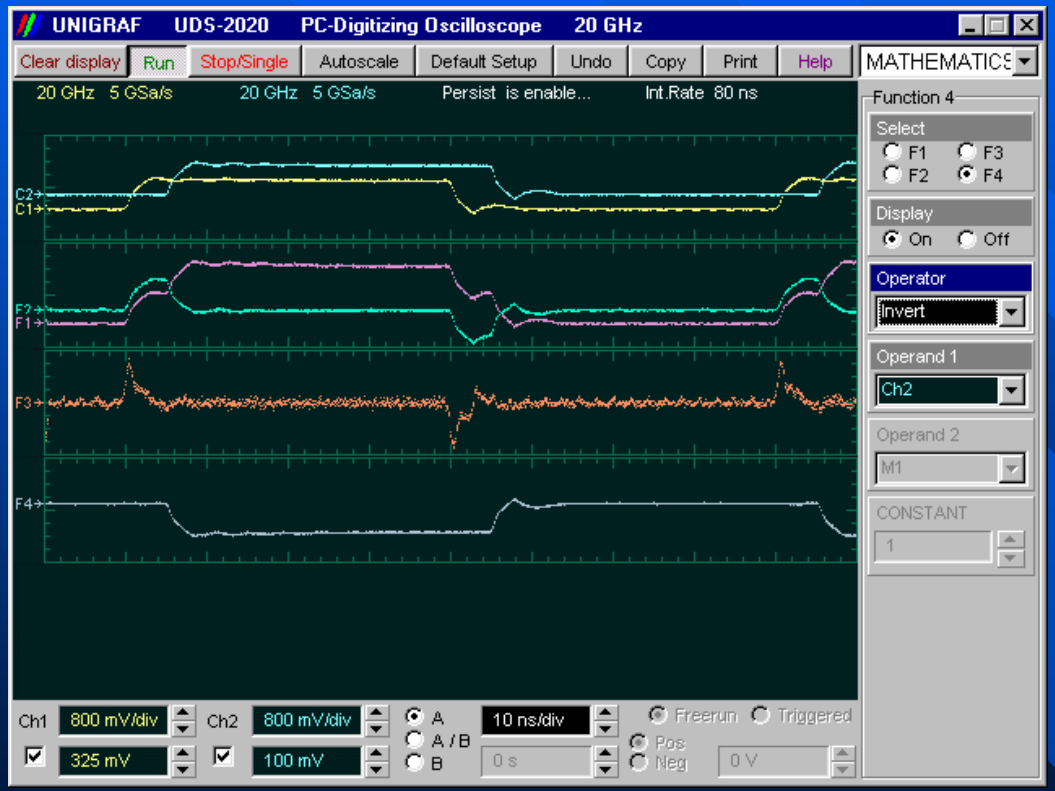
- **Histicons** provide a fast, dynamic view of parameters and wave shape characteristics.



Four **Histicons** correspond to each of statistics measurement

Mathematics

The PicoScope 9201 supports up to four simultaneous mathematical combination and functional transformation of waveforms that is acquires.



An examples of PicoScope 9201 Math Functions.
F1=Ch1+Ch2 F2=Ch1-Ch2
F3=Diff(Ch1) F4=Inv(Ch2)

Source (operand) waveform (Ch1) **Math function (operator, Divide)** **Math function (waveform F1)**

Functional transformation of an acquired waveform

You can select any of the math functions as a math operator to act on the operand or operands. A waveform math operator is a math function that requires either one or two sources.

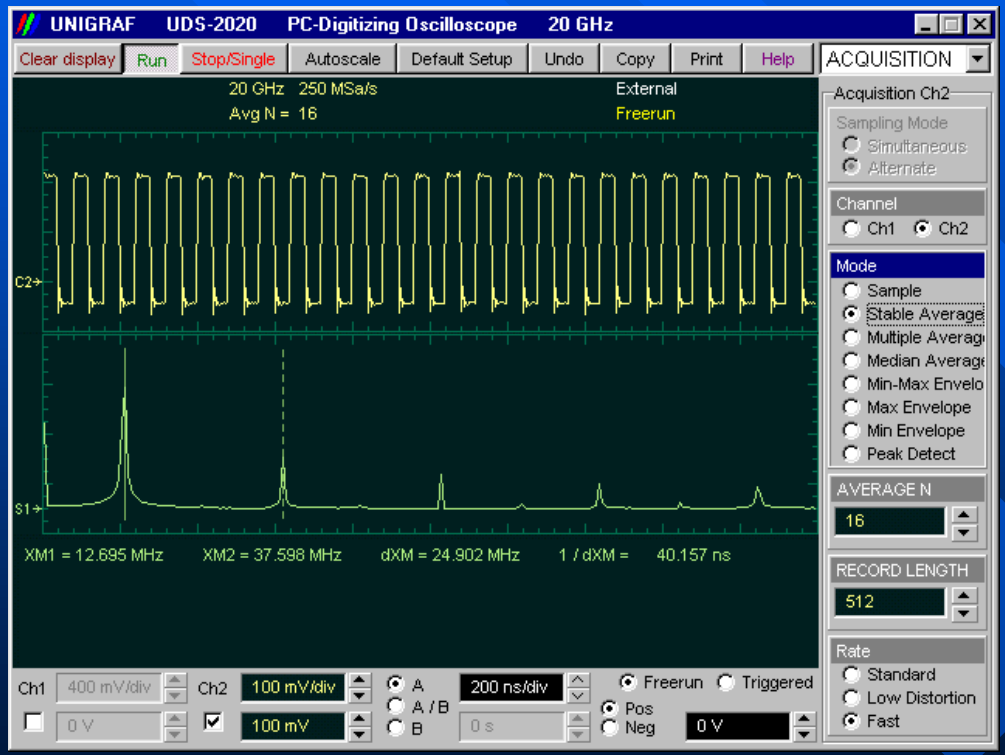
The operators that involve two waveform sources are: ● *Add*, ● *Subtract*, ● *Multiply*, and ● *Divide*.

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*, ● *Trend* and ● *Sin(x)/x Interpolation*.

Fast Fourier Transform

The math option of the PicoScope 9201 includes FFT capabilities for examine the harmonic content of high-frequency signals. You can perform FFT on any waveform. The record length of the waveform can be up to maximum *4096 points*.

- **Use the FFT function to:**
  - **Find cross-talk problems.**
  - **Find distortion problems in analogue waveforms caused by non-linear amplifiers.**
  - **Adjust filter circuits designed to filter out certain harmonics in a waveform.**



To compensates 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.

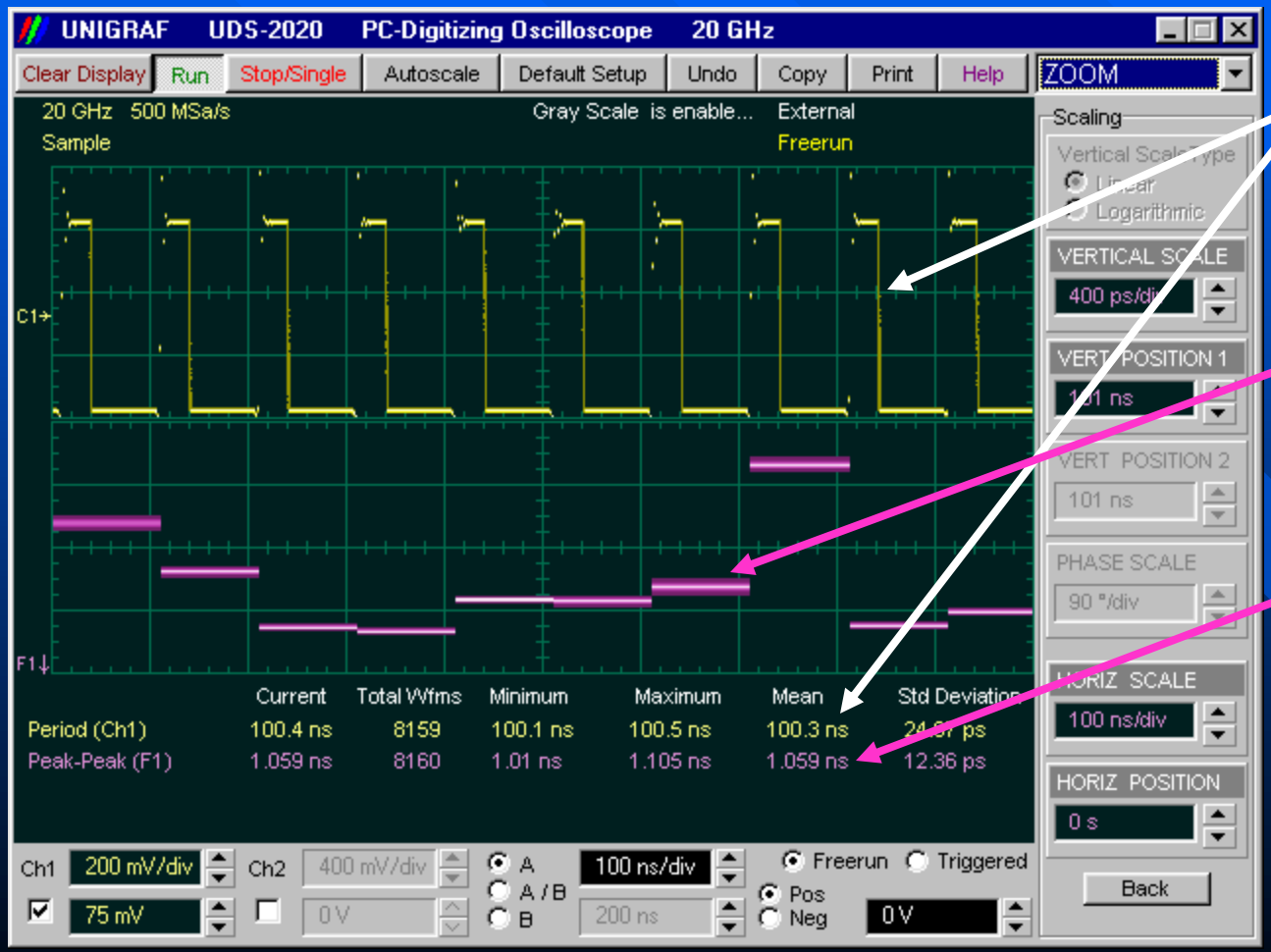
The PicoScope 9201 supports six types of windows:

- **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. Picture shows an example of FFT made with *38-MHz* pulse with near *50 %* duty cycle.

Trend Function

Trend is a math function that represents the evolution of timing parameters in line graphs whose vertical axes are the value of the parameter, and horizontal axes the order in which the values were acquired.



- The **PicoScope 9201** makes period measurement of pulses
- Trend of period measurement is displayed as a math function
- Amplitude measurement of trend function gives evolution of period value

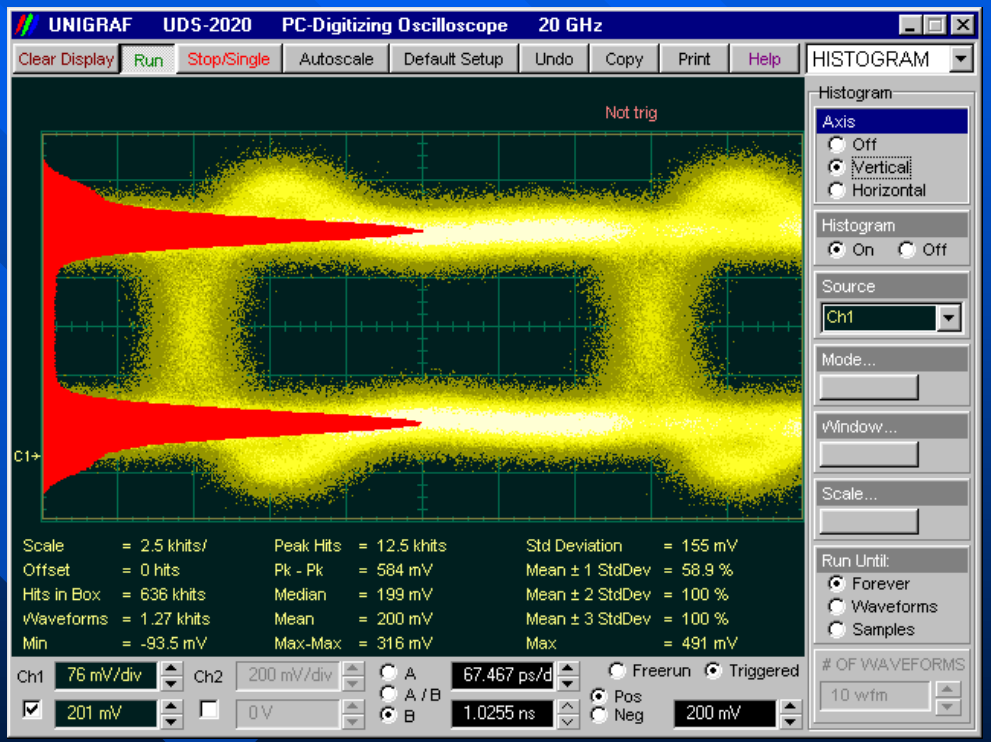
Vertical Histogram

A histogram is a probability distribution that shows the distribution of acquired data from a source within a user-definable histogram window.

The information gathered by the histogram is used to perform statistical analysis on the source. The most common use for vertical histogram is measuring and characterizing noise on displayed waveforms.

The list of histogram statistics:

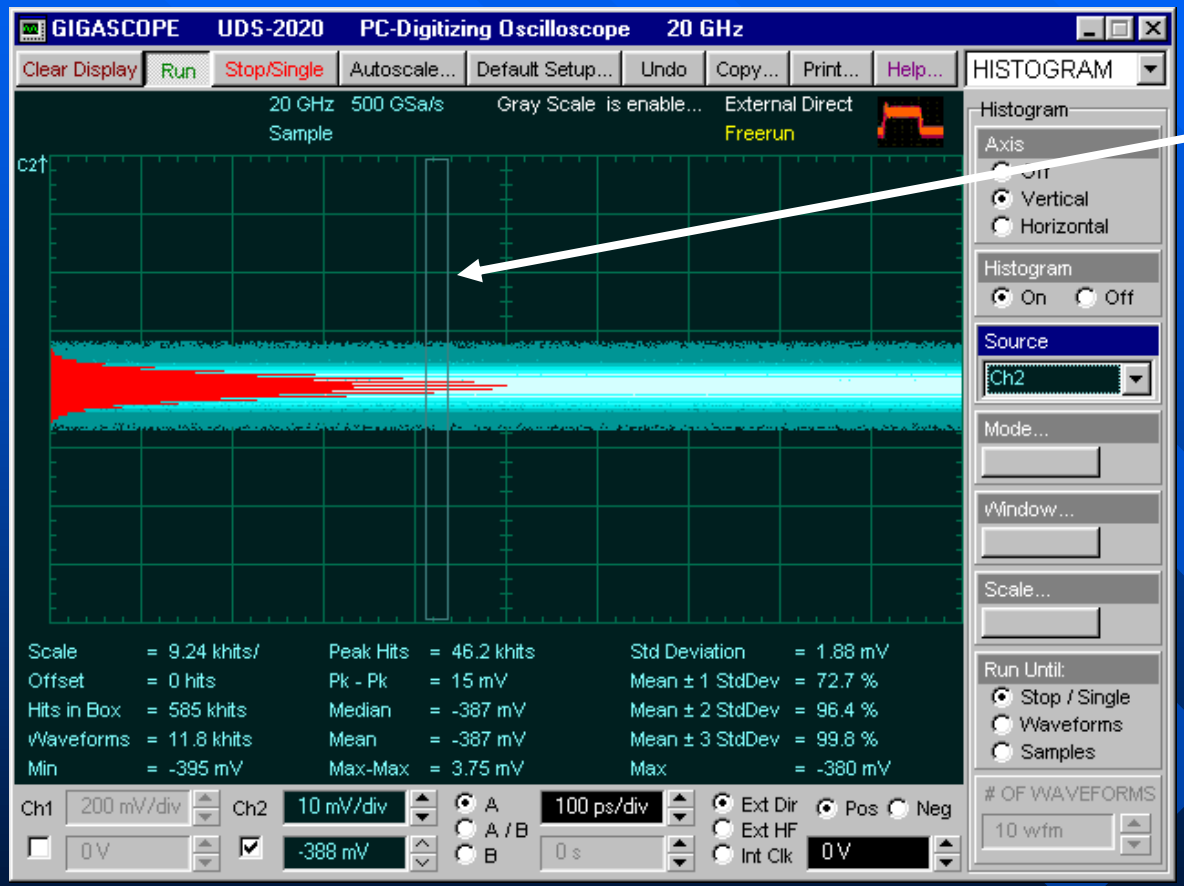
- **Scale-Scale lists the display scale in hits per division or dB per division.**
- **Offset lists the offset in hits or dB. Offset is the number of hits or dB at the bottom of the display, as opposed to the center of the display.**
- **Hits in Box-The total number of samples included in the histogram 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 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 (σ) value 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 Vertical Histogram Measurement

Statistical Analysis of Noise

Vertical Histogram is the most common use for measuring and characterizing noise on displayed waveforms.



- **Sizing the histogram window to a narrow portion of time and observing a vertical histogram that measures the noise on an edge measure noise**

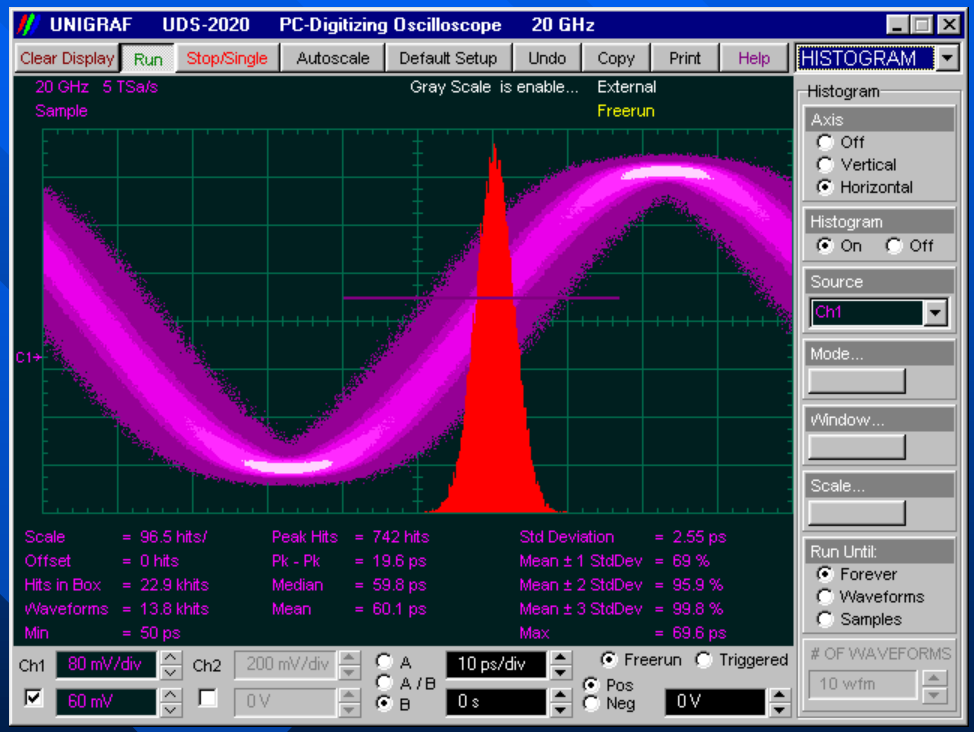
- **The PicoScope 9201 has a very low "noise floor" (*<2 mV* of internal noise RMS), making noise measurements very accurate.**

Picture shows noise measurement with Vertical Histogram of ECL high voltage level.

Horizontal Histogram

A **histogram** is a probability distribution that shows the distribution of acquired data from a source within a user-definable histogram window. 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

- **The list of histogram statistics:**
  - **Scale-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 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 (σ) value 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**

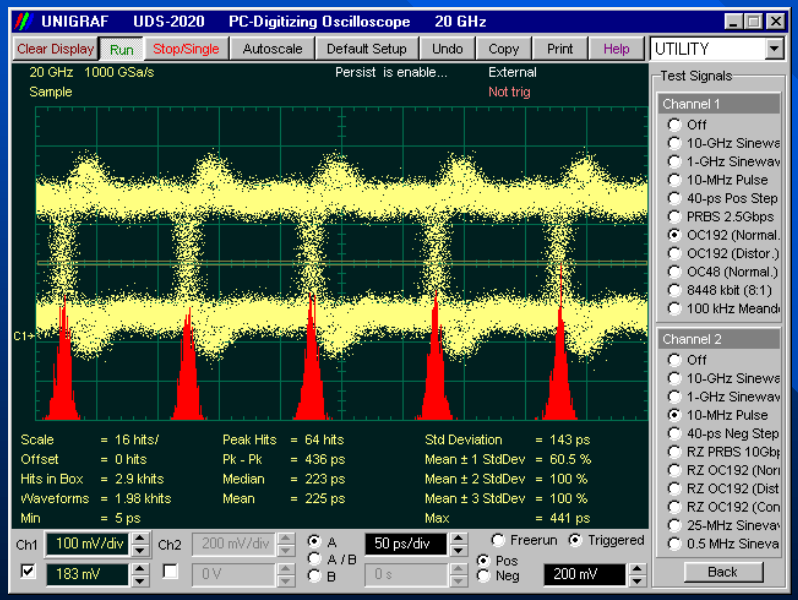
Jitter Mesurements

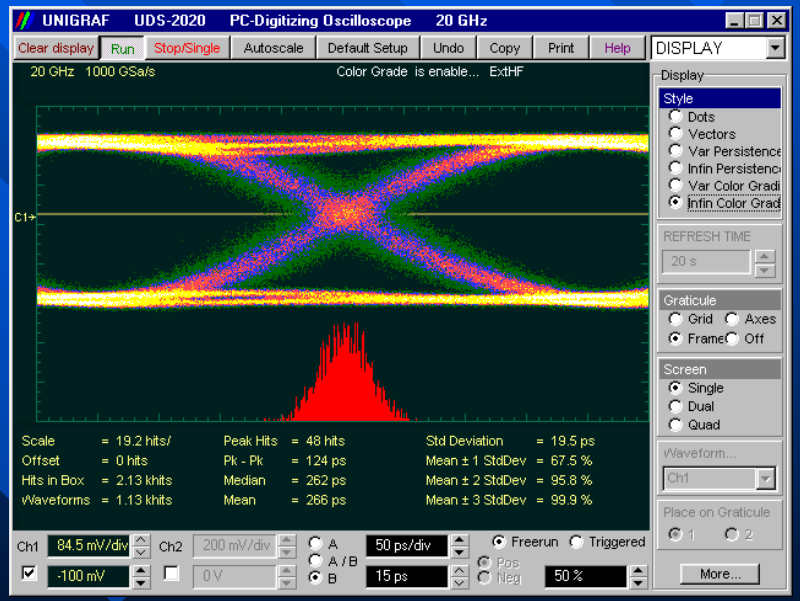
Among other things Jitter is caused by:

Thermal noise	▶ **Random and ever changing, always Gaussian**
Upstream reference clocks	▶ **From power supplies and oscillators, with harmonic content**
Injected noise (EMI/RFI)	▶ **Cabling or wiring, from distance sources**
Circuit instabilities	▶ **Loop bandwidth, dead-band oscillations**

Types of Jitter:

- Period Jitter
- Cycle-to-Cycle Jitter
- Delay Jitter
- Time Interval Error
- Clock Jitter
- Data Jitter

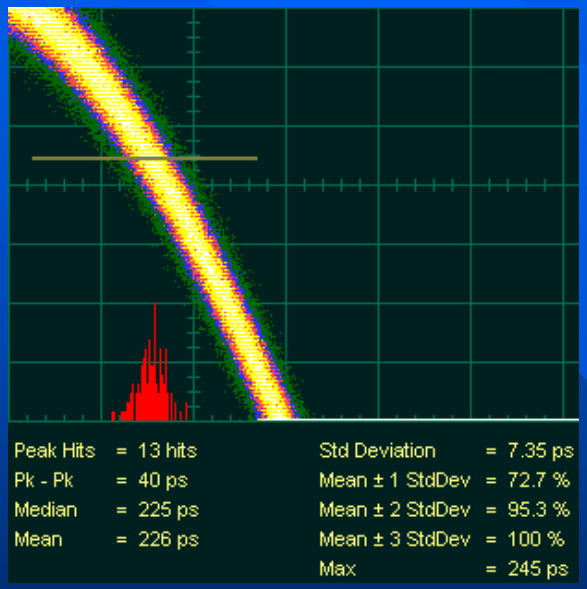




Eye-Crossing Jitter can be quantified with horizontal histogram.
Two examples of **NRZ Eye Pattern** with jitter histogram

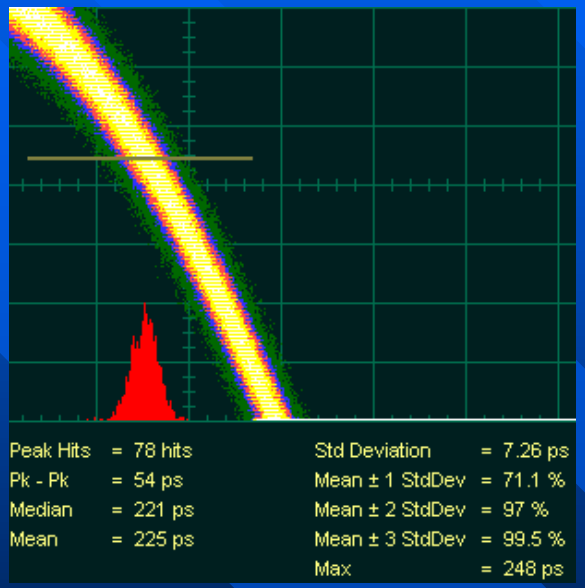
Histogram Measurements: acquiring statistically significant amount of data

- Larger sample of data



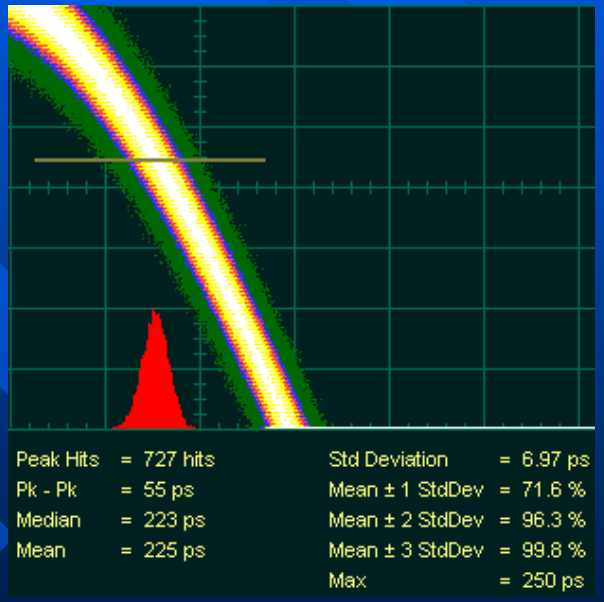
100 wfms, 1 s

- Three-dimensional accumulation



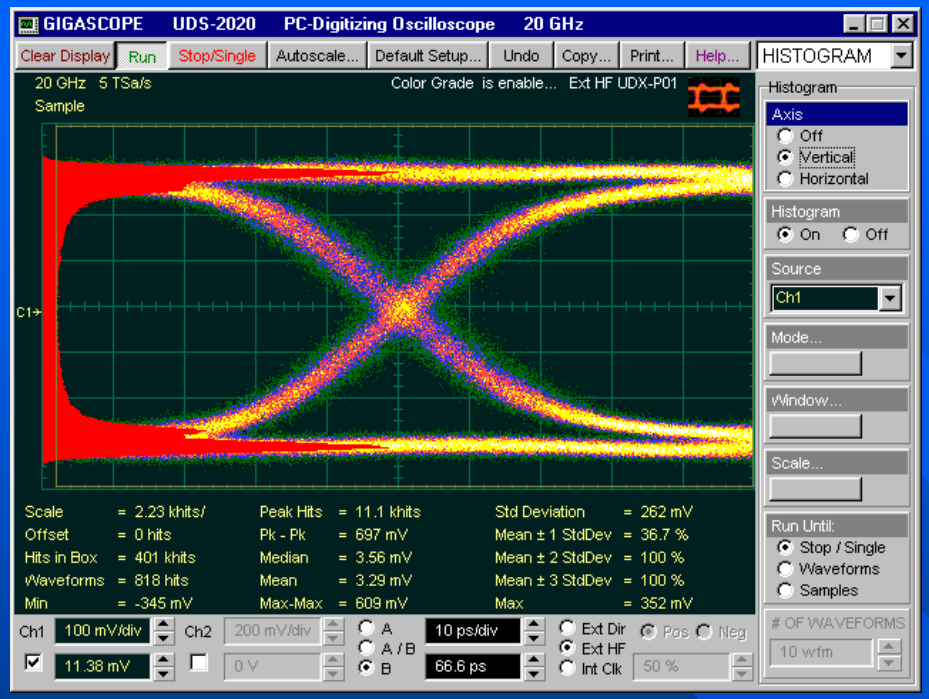
1 000 wfms, 10 s

- Parametric measurements derived from the database use statistical technique to produce more stable, accurate results

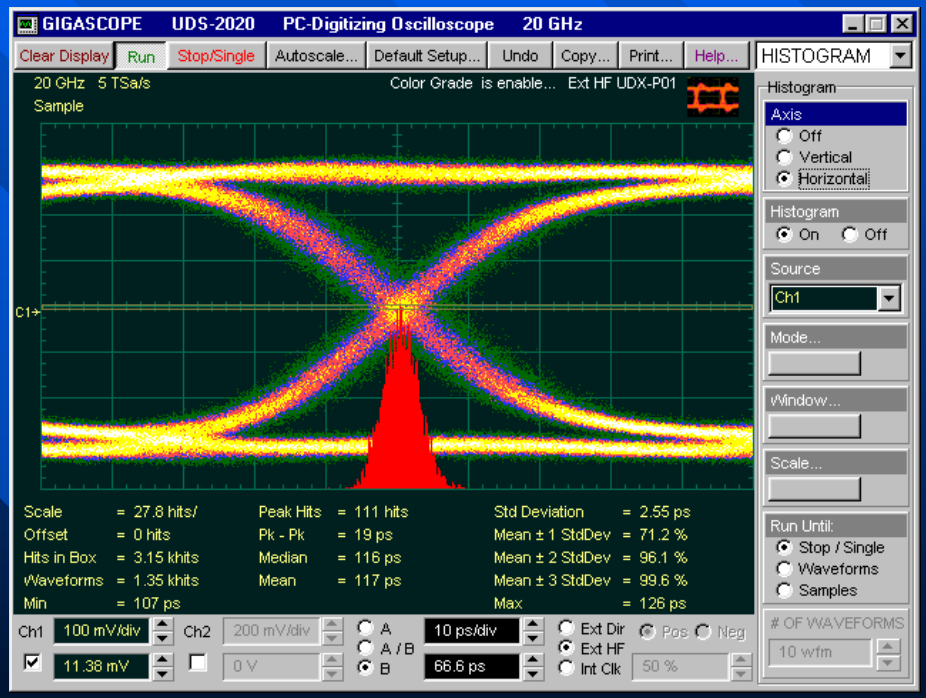


10 000 wfms, 100 s

Histogram Measurements of Eye Diagrams



The left picture demonstrates how the **PicoScope 9201** quickly measures all parameters of vertical histogram for ***12-Gbit*** Eye Diagram

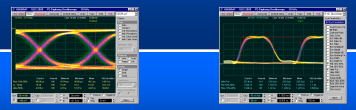
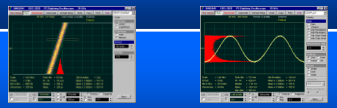


The right picture demonstrates how the **PicoScope 9201** quickly measures all parameters of horizontal histogram for ***12-Gbit*** Eye Diagram

PicoScope 9201 Solutions up to 10 Gbit

The PicoScope 9201 provides wide range solutions for testing of *10 Gbit* signals

Key PicoScope 9201 Specifications for Telecom/Datacom Measurements	
Bandwidth	▶ *20 GHz*
Sampling Rate	▶ *10 Tsa/s*, equivalent
Acquisition Speed	▶ *100 Wfms/s*
Trigger Jitter, RMS	▶ *<2.5 ps, <2.0 ps typ*

PicoScope 9201 Telecom/Datacom Measurements	
Eye Diagram	
Mask Test	
Mask Margins	
Histogram	

Telecom/Datacom Industry Standards

PicoScope 9201 supports measurements of signal integrity for the following Telecom/Datacom Industry Standards

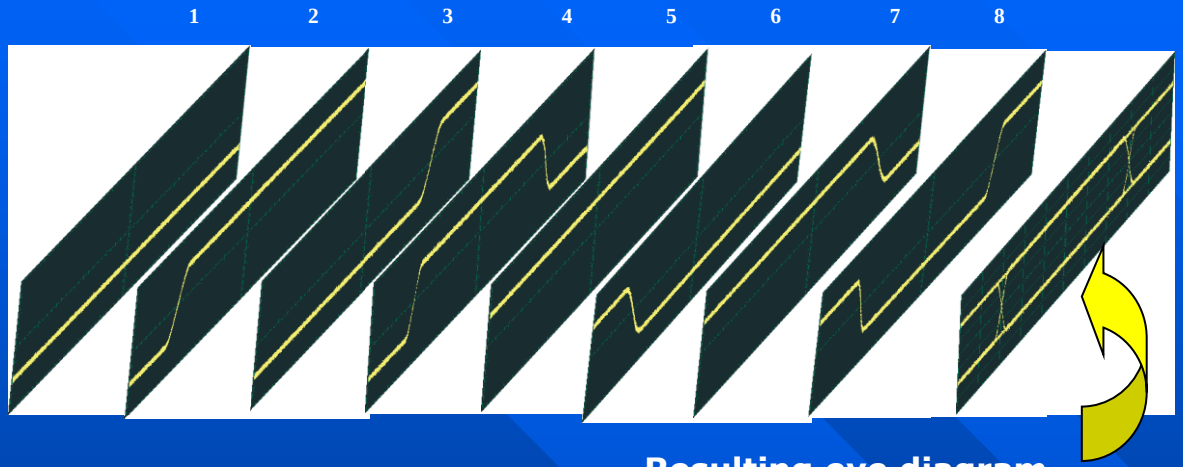
TELECOM/OPTICAL ❖ Bellcore GR-253-CORE and ANSI T1.106 (SONET OC-n signals) ❖ ITU-T G.957 (SDH STM-n signals)		DATACOMM/ ELECTRICAL/OPTICAL ❖ ANSI X3.230 (Fiber Channel)		DATACOMM/ ELECTRICAL/OPTICAL ❖ IEEE 802.3ae (Gigabit Ethernet)	
STM0/OC1	*51.8 Mb/s*	FC133	*133 Mb/s*	GB Ethernet	*1250 Mb/s*
STM1/OC3	*155.5 Mb/s*	FC266	*266 Mb/s*	2XGB Ethernet	*2.500 Gb/s*
STM4/OC12	*621.8 Mb/s*	FC531	*531 Mb/s*	10XGB Ethernet	*9.953 Gb/s* *10.3125 Gb/s* *12.5 Gb/s*
STM16/OC48	*2.48832 Gb/s*	FC1063	*1063 Mb/s*	DATACOMM/ ELECTRICAL/OPTICAL	
STM64/OC192	*9.953 Gb/s* *10.664 Gb/s* *10.709 Gb/s* *12.24945 Gb/s*	FC2125	*2125 Mb/s*	XAUI	*3.125 Gb/s*
STM256/OC768	*39.812 Gb/s* *42.65691 Gb/s* *43.01841 Gb/s*	FC3187	*3.187 Gb/s*	DATACOMM/ ELECTRICAL/OPTICAL	
		10X FC	*10.51875 Gb/s*	Infiniband	*2.500 Gb/s*

Промышленные стандарты в области коммуникационных и компьютерных линий связи

Осциллограф PicoScope 9201 поддерживает измерения парметров целостности сигналов для следующих промышленных стандартов

TELECOM/OPTICAL ❖ Bellcore GR-253-CORE and ANSI T1.106 (SONET OC-n signals) ❖ ITU-T G.957 (SDH STM-n signals)		DATACOMM/ ELECTRICAL/OPTICAL ❖ ANSI X3.230 (Fiber Channel)		DATACOMM/ ELECTRICAL/OPTICAL ❖ IEEE 802.3ae (Gigabit Ethernet)	
STM0/OC1	*51.8 Mb/s*	FC133	*133 Mb/s*	GB Ethernet	*1250 Mb/s*
STM1/OC3	*155.5 Mb/s*	FC266	*266 Mb/s*	2XGB Ethernet	*2.500 Gb/s*
STM4/OC12	*621.8 Mb/s*	FC531	*531 Mb/s*	10XGB Ethernet	*9.953 Gb/s* *10.3125 Gb/s* *12.5 Gb/s*
STM16/OC48	*2.48832 Gb/s*	FC1063	*1063 Mb/s*	DATACOMM/ ELECTRICAL/OPTICAL	
STM64/OC192	*9.953 Gb/s* *10.664 Gb/s* *10.709 Gb/s* *12.24945 Gb/s*	FC2125	*2125 Mb/s*	XAUI	*3.125 Gb/s*
STM256/OC768	*39.812 Gb/s* *42.65691 Gb/s* *43.01841 Gb/s*	FC3187	*3.187 Gb/s*	DATACOMM/ ELECTRICAL/OPTICAL	
		10X FC	*10.51875 Gb/s*	Infiniband	*2.500 Gb/s*

Building Eye Diagram



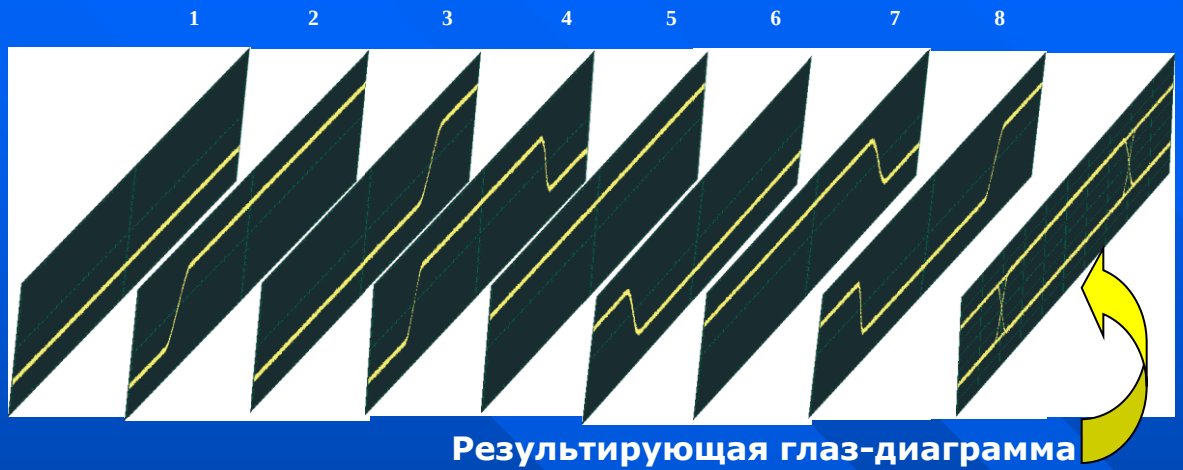
Resulting eye diagram

Process of building Eye Diagram includes serial acquisitions of waveform data base

- **Eye Diagram** is valuable because of 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 ±350 mV
  - Random Noise and pattern dependent, deterministic errors mask each other

Построение глаз-диаграммы

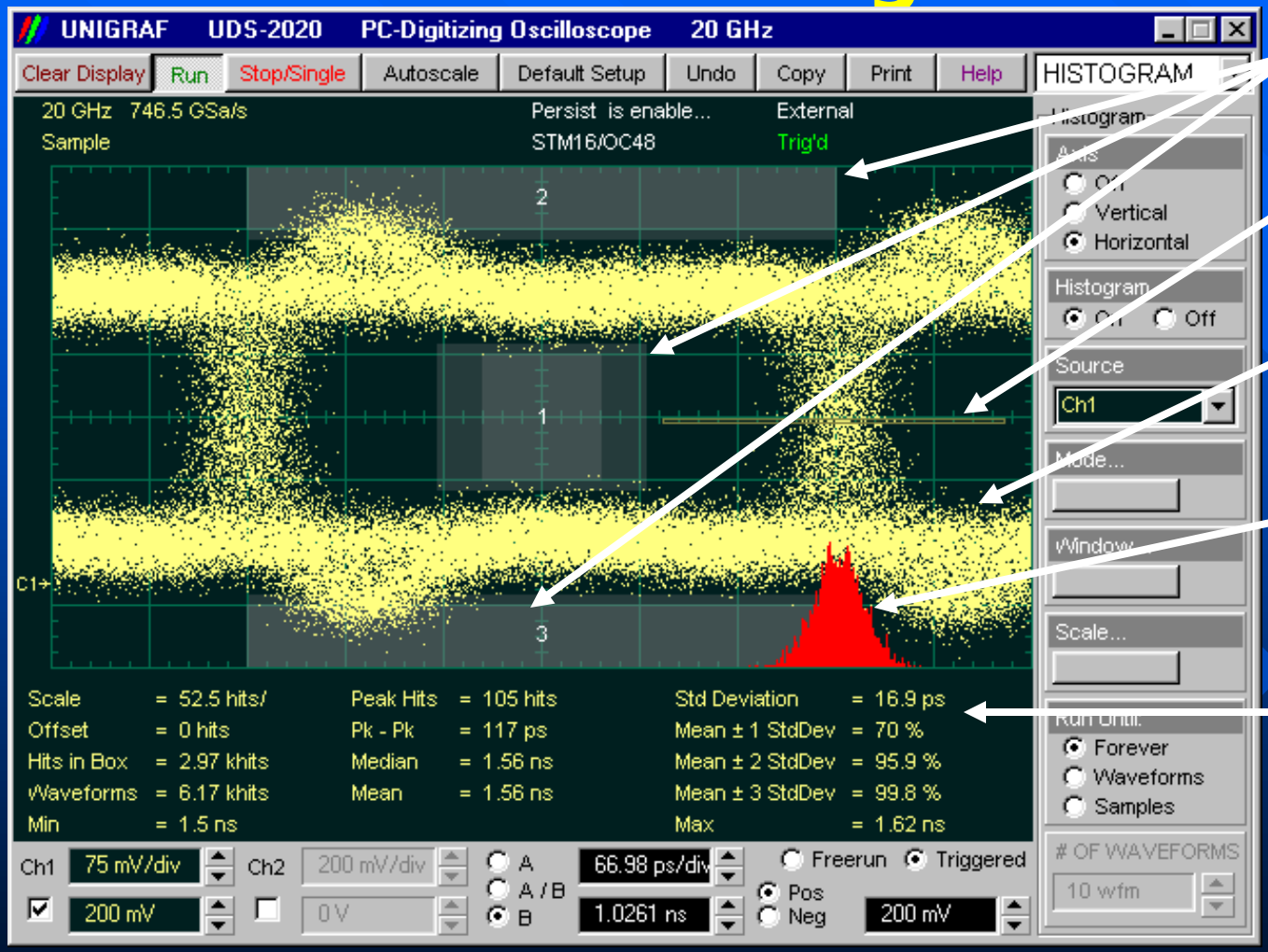


Процесс построения глаз-диаграммы состоит из ряда последовательных сборов и запоминании данных о сигнале (построение базы данных)

- **Измерение параметров глаз-диаграммы чрезвычайно информативно, поскольку оно дает всестороннее представление о целостности сигнала, то есть о таких его параметрах, как:**
  - **Шум**
  - **Временная нестабильность**
  - **Отражения**
  - **Выбросы на сигнале**
  - **Взаимное влияние сигнала одного канала на другой**
  - **Паразитные связи через источник питания и землю**

- **Проблемы, возникающие при измерении глаз-диаграммы осциллографами, использующими последовательное стробирование во временной области:**
  - **Невозможно отделить одну от другой последовательности, из которых формируется глаз-диаграмма.**
  - **Невомножно использовать усреднение**
  - **Динамический диапазон входных сигналов ограничен ±350 mV**
  - **Шумы и взаимное влияние одной последовательности на другую взаимно маскируют искажения и ошибки.**

A typical PicoScope 9201 Eye Diagram with Mask, Margins and Histogram



Customizeable Mask with Margins

Histogram window

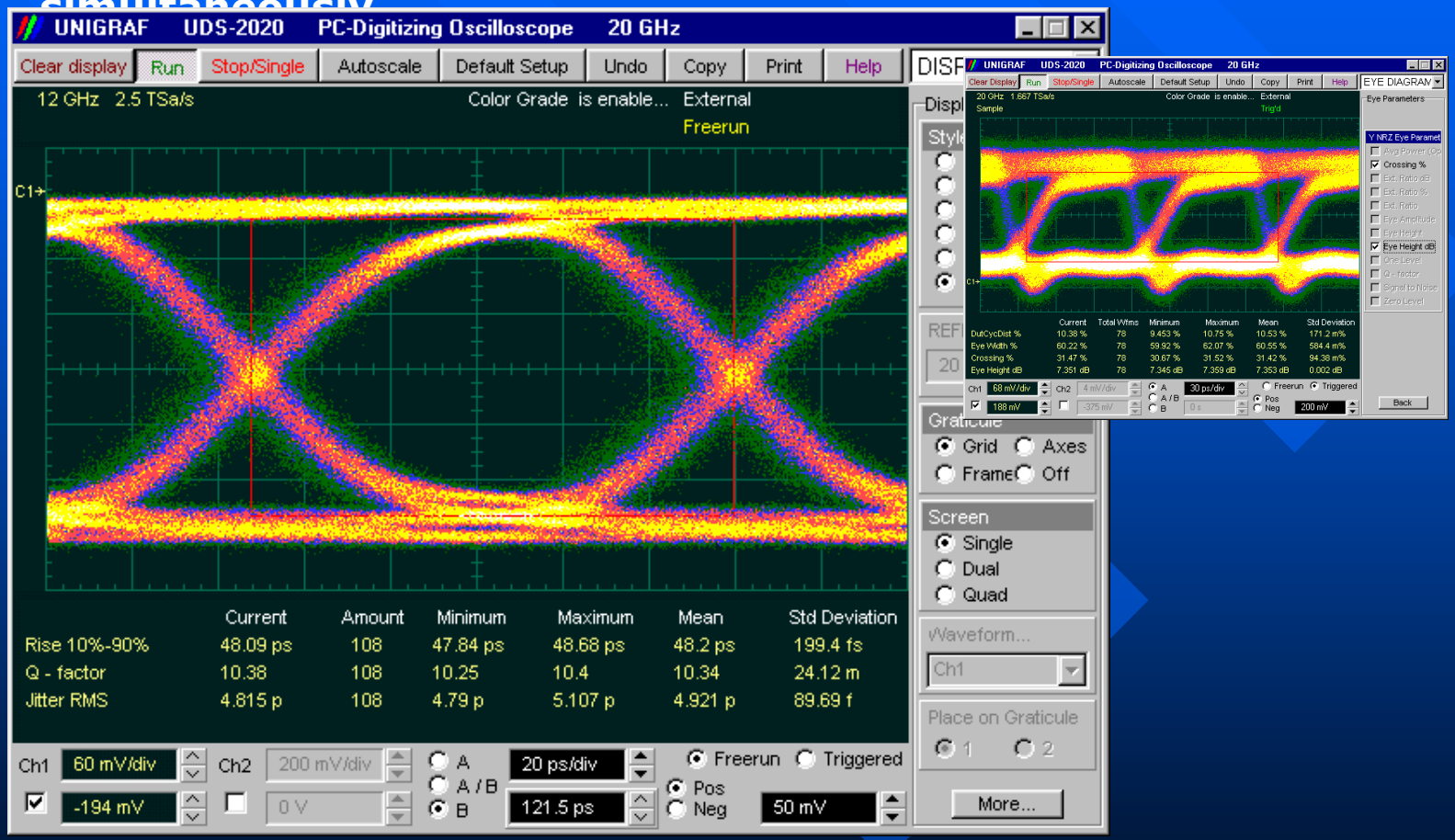
***2.5-Gb/s* Eye Diagram**

Using Histogram on the eye crossing to characterize jitter

Histogram measurement results

NRZ Eye Diagram Measurements

The PicoScope 9201 quickly measures 38 fundamental parameters used to characterize non-return-to-zero (NRZ) signals. Up to four parameters can be measured simultaneously.



Main picture demonstrates of how PicoScope 9201 measures good quality *10-Gbit* NRZ eye-diagram. Top picture demonstrates the same measurements made in case when eye parameters are used to detect bad termination effect.

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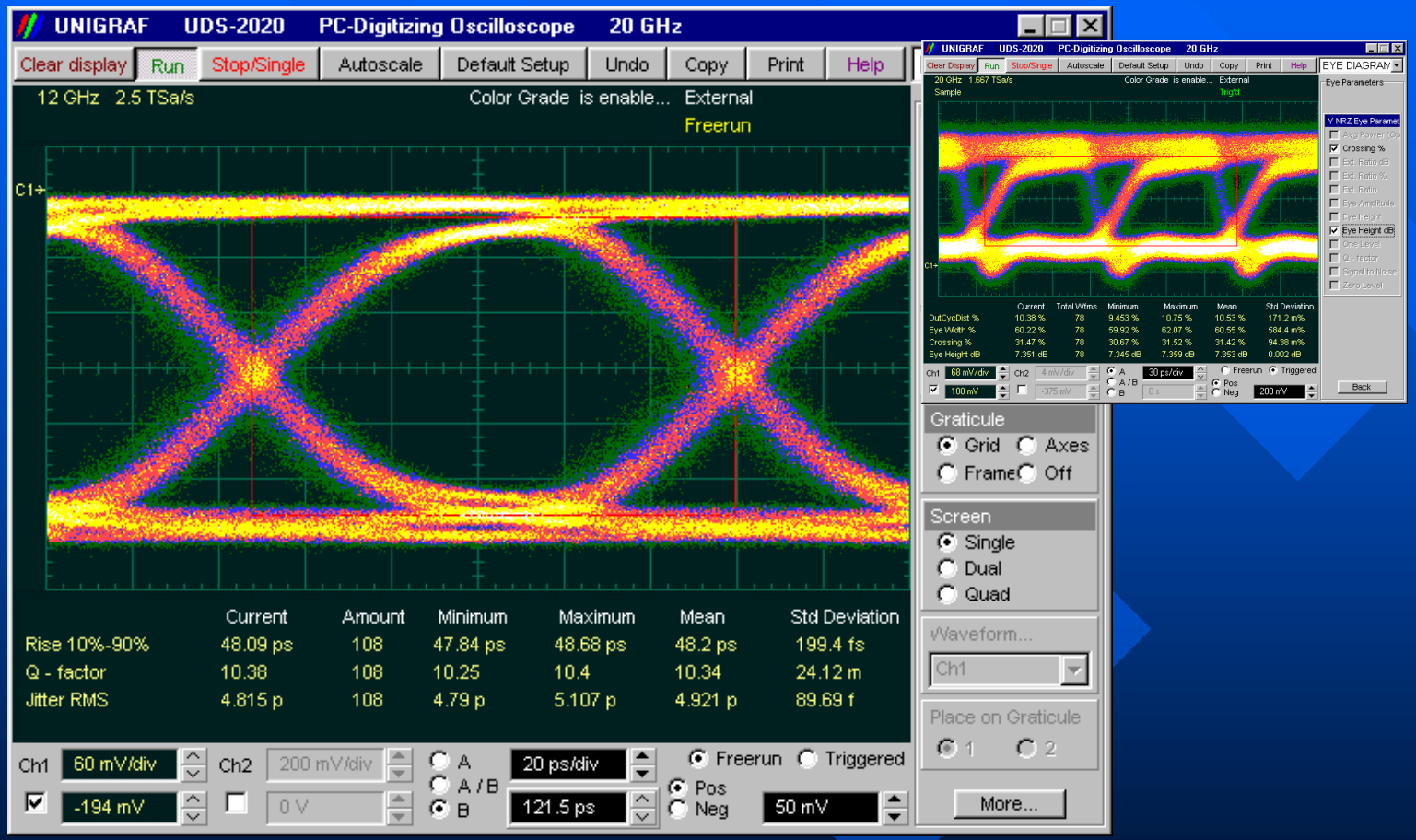
Анализ NRZ глаз-диаграмм

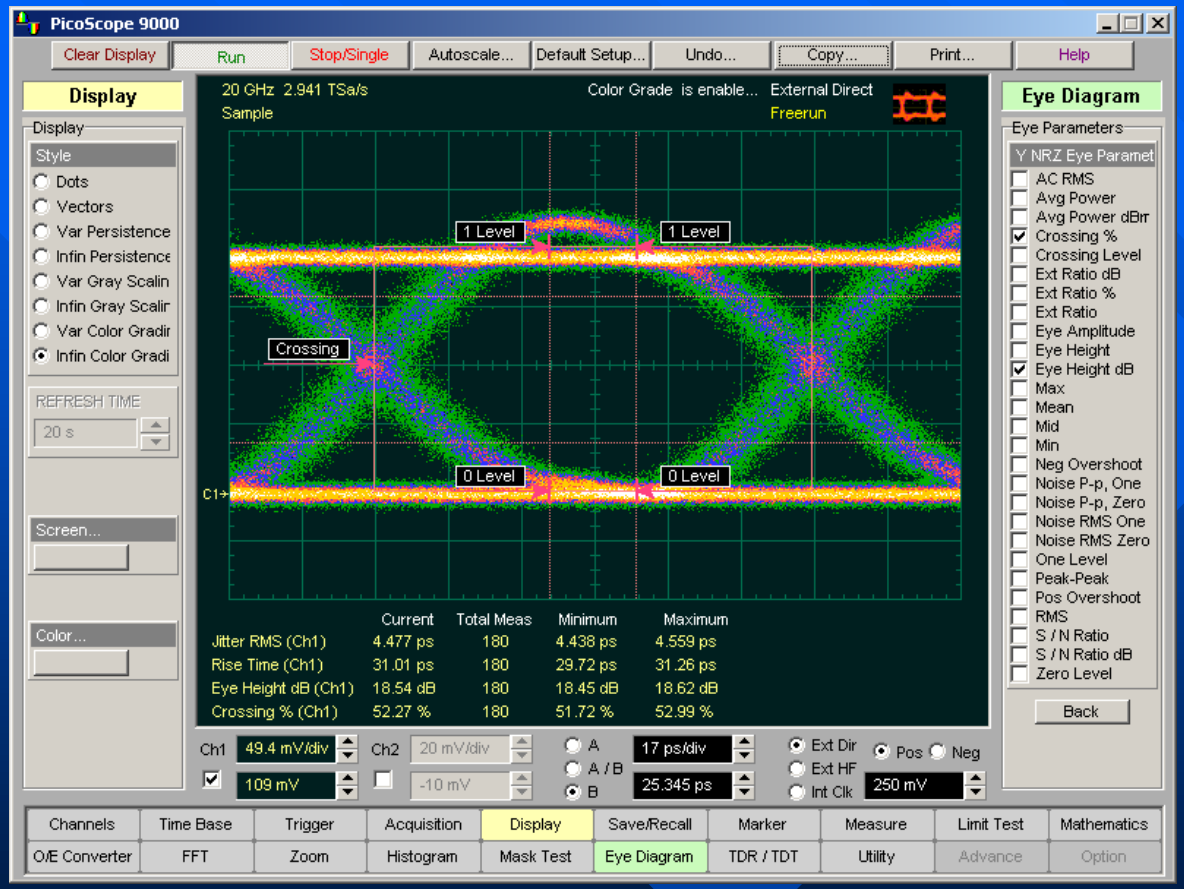
Осциллограф C7-24 оперативно измеряет 38 фундаментальных параметров, используемых для описания NRZ-сигналов. До четырех параметров могут быть измерены одновременно.



Основная осциллограмма показывает, каким образом осциллограф C7-24 измеряет параметры неискаженной *10-Gbit* NRZ глаз-диаграммы. Верхняя осциллограмма показывает те же измерения, проведенные в условиях плохого согласования линии передачи сигнала.

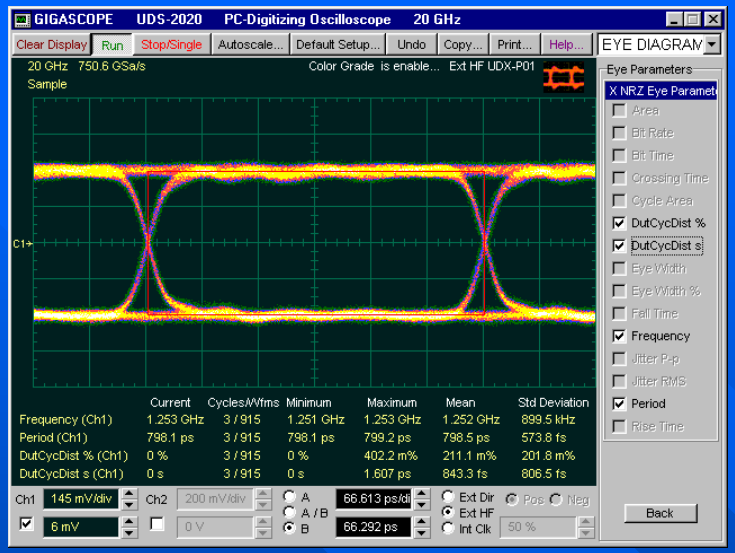
Анализ NRZ глаз-диаграмм

Осциллограф PicoScope 9201 оперативно измеряет 38 фундаментальных параметров, используемых для описания NRZ-сигналов. До четырех параметров могут быть измерены одновременно.

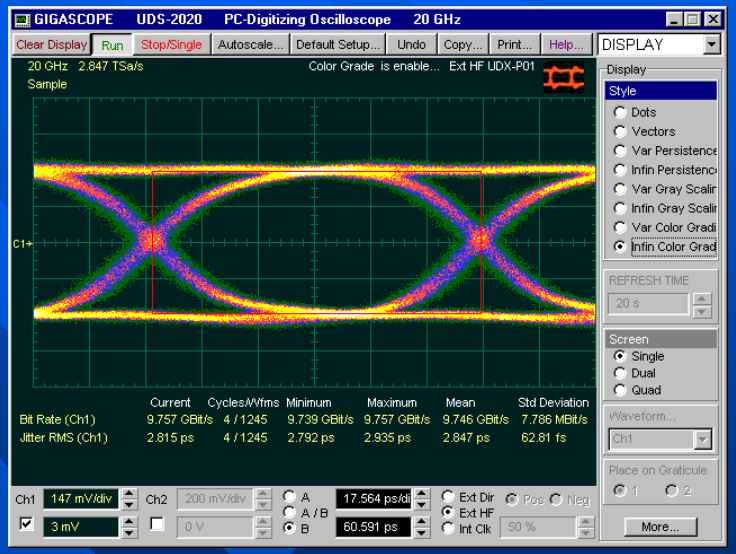


Осциллограмма показывает, каким образом осциллограф PiocScope 92101 измеряет параметры *10-Gbit* NRZ глаз-диаграммы.

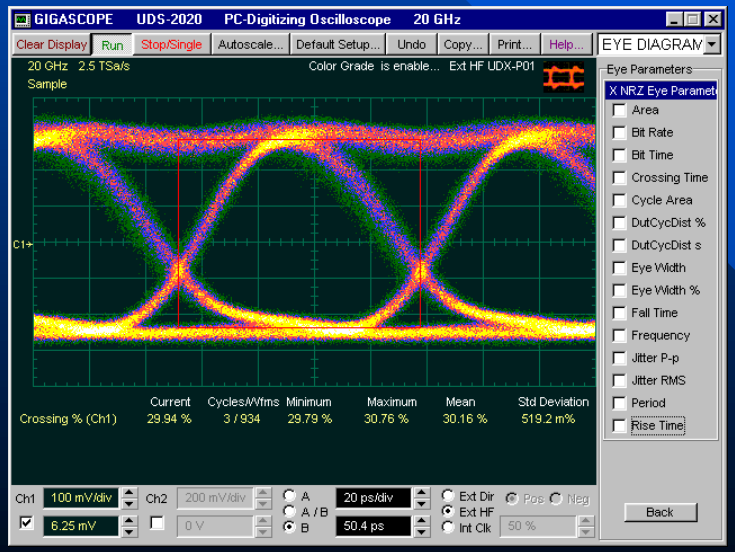
Examples of NRZ Measurements



Timing measurements of *2.5-Gbit* Eye Diagram



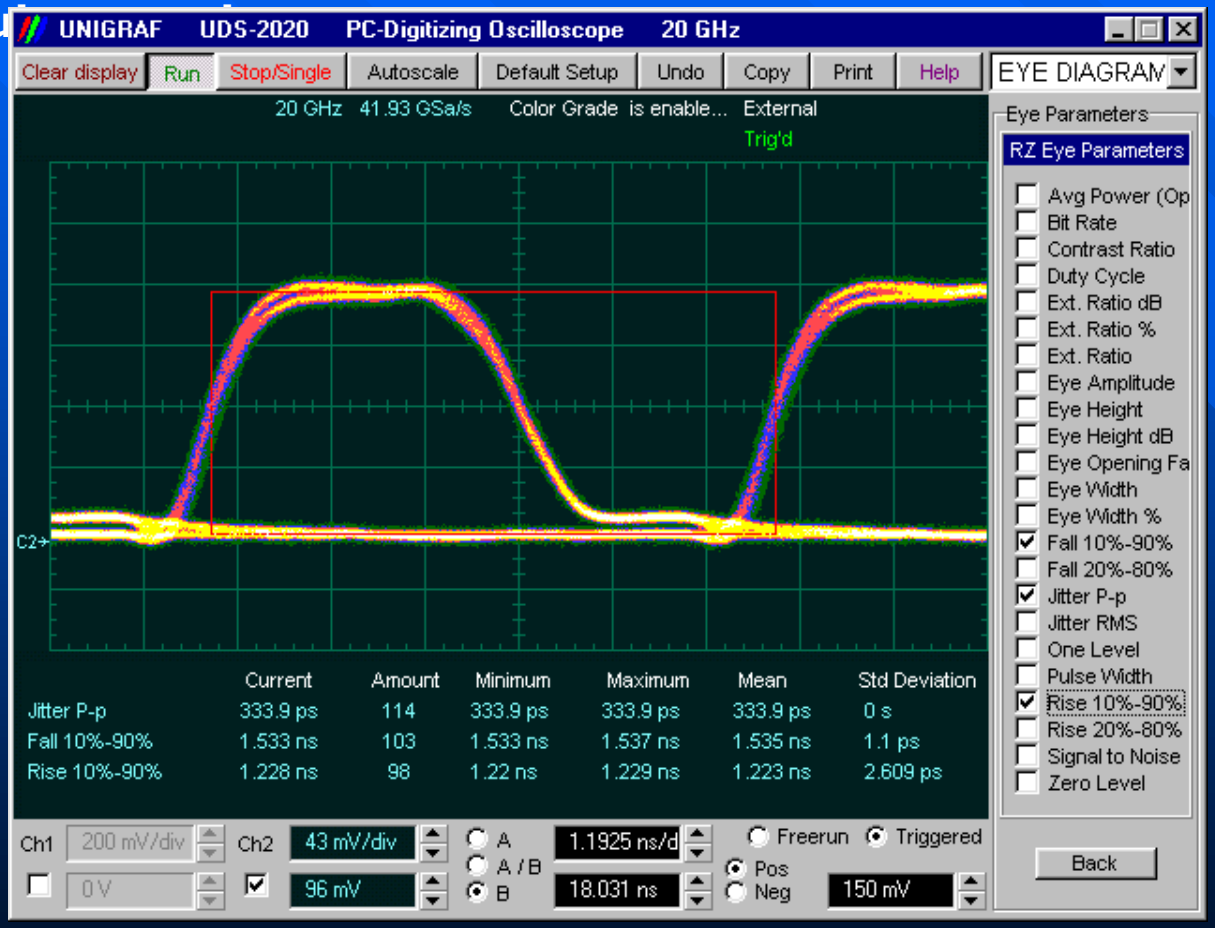
Timing measurements of *9.5-Gbit* Eye Diagram



Crossing measurement of high-distorted *12-Gbit* Eye Diagram

RZ Eye-Diagram Analysis

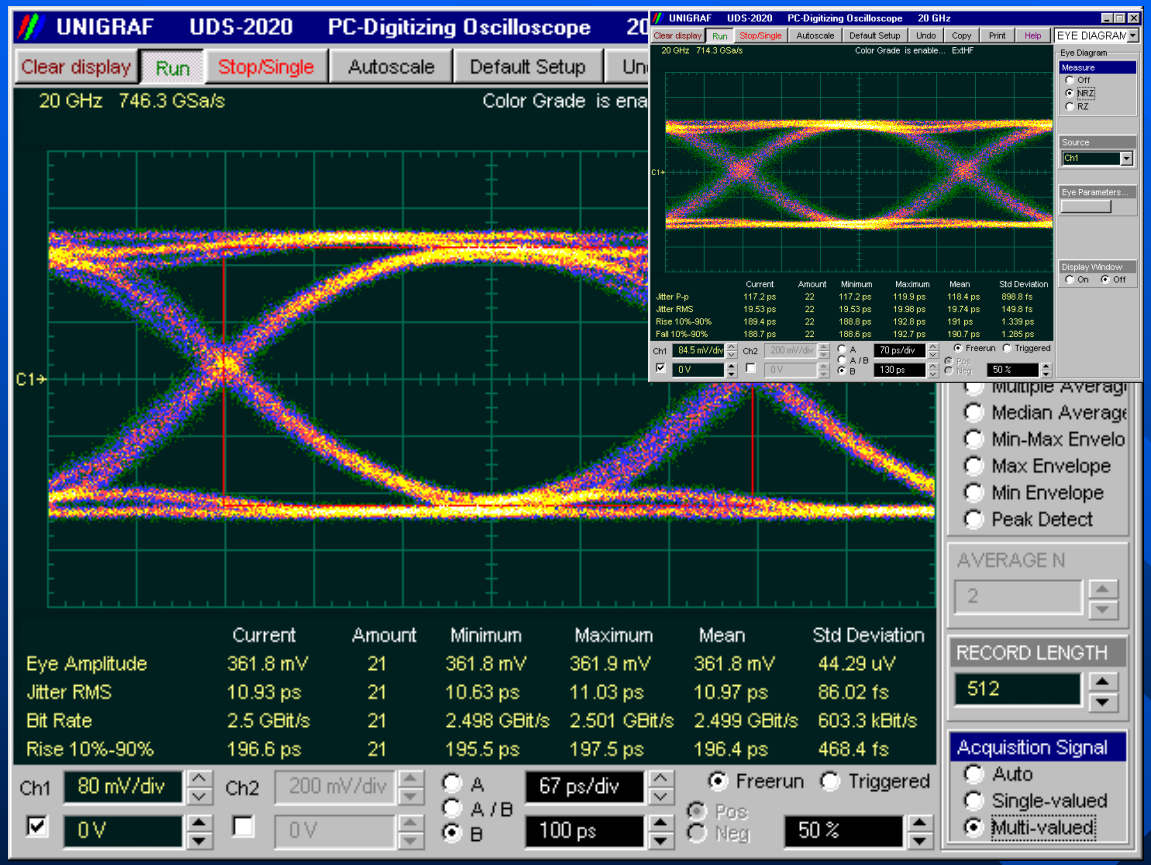
The PicoScope 9201 quickly measures 40 fundamental parameters used to characterize an return-to-zero (RZ) signals. Up to four parameters can be measured simu



The PicoScope 9201 measures *139-Mbit* RZ eye-diagram

Clock Recovery Triggering

Very high-speed oscilloscopes are not capable of triggering directly on the signal under test. Typically an external timing reference is used to synchronize the oscilloscope to the test signal. In cases where a trigger signal is not available, clock recovery modules are available to derive a timing reference directly from the waveform to be measured.



The same *2.5 Gb/s* (OC-48/STM-16) real signal from Teleste Rooter communication equipment triggered on a data signal with UDX-P01 Head (top picture) gives *20 ps* RMS jitter, and the more accurate recovered with UDX-R02 Head clock signal with less then *11 ps* RMS Jitter (main picture).

Clock Recovery Trigger provides:

- No external clock signal trigger is required
- Low frequency jitter rejection expose pattern dependent anomalies or dropouts that edge detection would miss

The UDX-R0X series of clock recovery modules cover the most popular electrical lines used today. Both two modules have excellent jitter performance to ensure accurate measurement.

- **The UDX-R01 covers *622 Mbps OC12/STM4* bit rate**
- **The UDX-R02 covers *2.488 Gbps OC48/STM16* bit rate**

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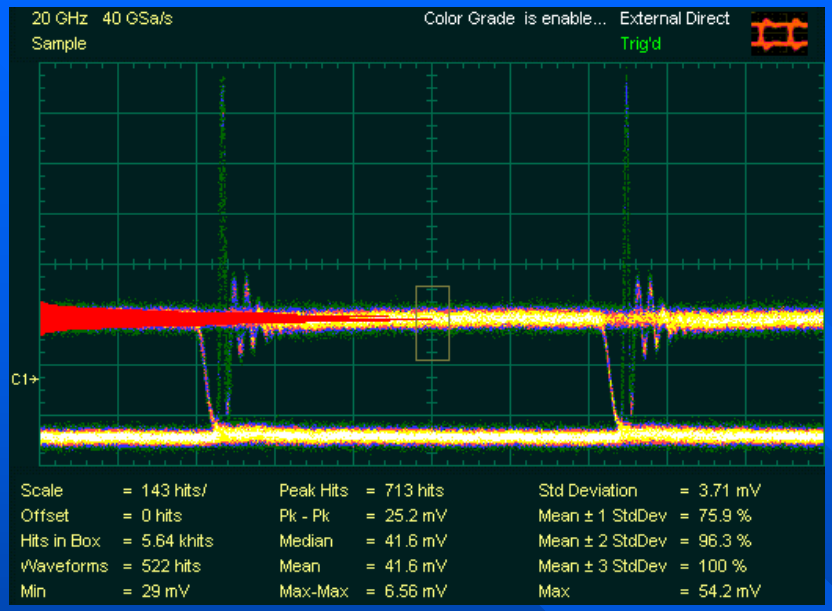
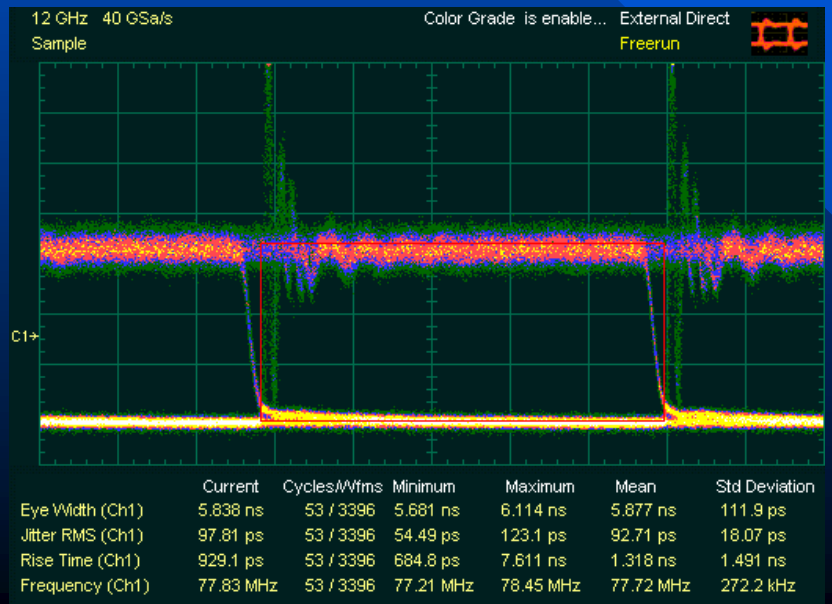
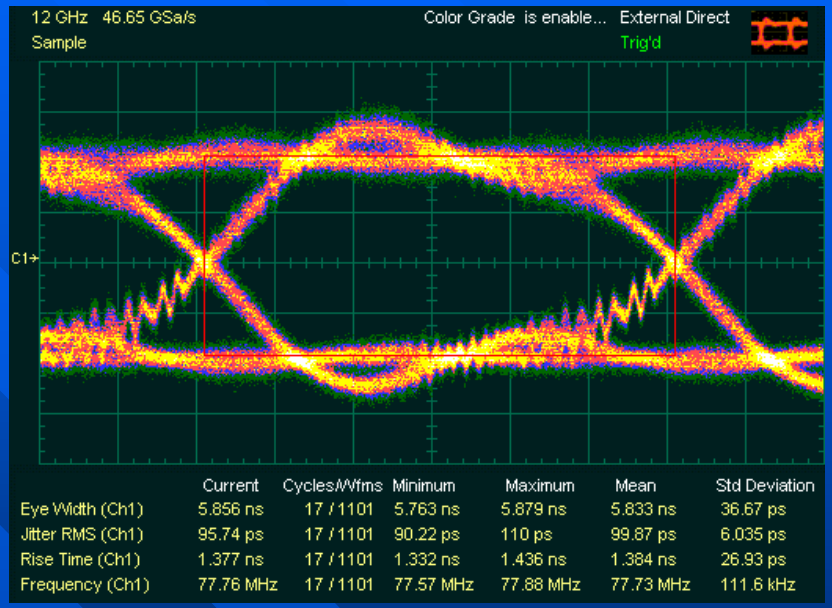
OC-3 Laser Measurements



Noise measurement with No LP-Filtering



Source: Anritsu 1570A Sonet/SDH Analyzer
Signal: Optical 1,31 um, -8 dBm, OC3
Trigger: Locked to signal
OE-Converter: IR 10 GHz, S/N IC-0001

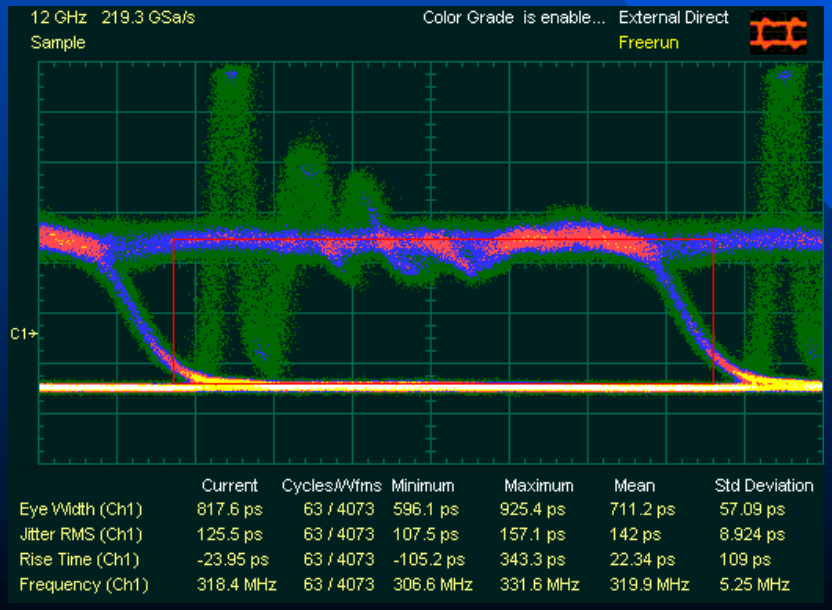


Eye-Diagram Measurements with LP-Filtering: Mini-Circuits Model NLP-200

Source: Anritsu 1570A Sonet/SDH, Analyzer, Signal: Optical 1,55 um, -3 dBm, OC3, Trigger: Locked to data, OE-converter S/N IC-0001, 11.09.2003

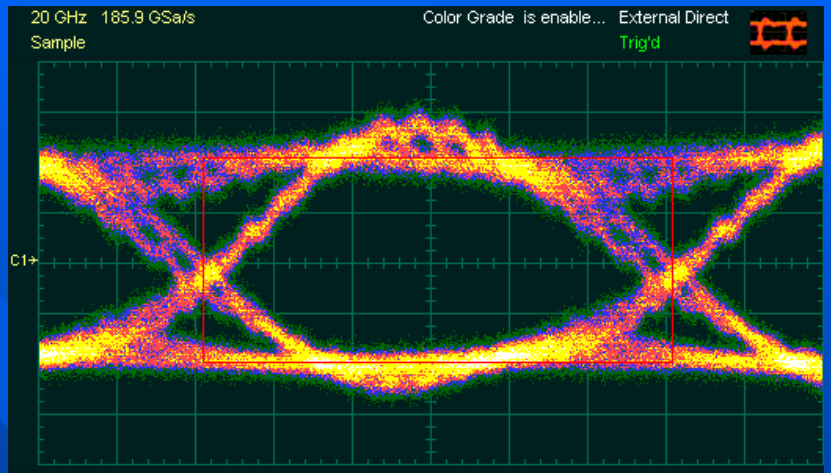
OC-12 Laser Measurements

Waveform with No LP-Filtering



	Current	Cycles/Wfms	Minimum	Maximum	Mean	Std Deviation
Eye Width (Ch1)	817.6 ps	63 / 4073	596.1 ps	925.4 ps	711.2 ps	57.09 ps
Jitter RMS (Ch1)	125.5 ps	63 / 4073	107.5 ps	157.1 ps	142 ps	8.924 ps
Rise Time (Ch1)	-23.95 ps	63 / 4073	-105.2 ps	343.3 ps	22.34 ps	109 ps
Frequency (Ch1)	318.4 MHz	63 / 4073	306.6 MHz	331.6 MHz	319.9 MHz	5.25 MHz

Source: Anritsu 1570A Sonet/SDH Analyzer
Signal: Optical 1,31 um, -8 dBm, OC12
Trigger: Locked to signal, Direct input

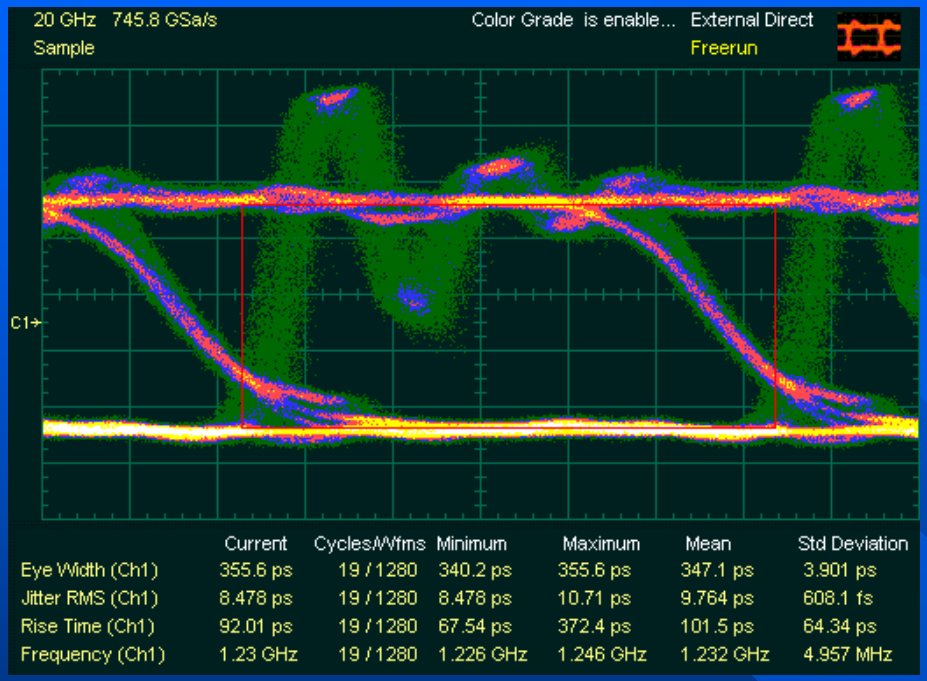


	Current	Cycles/Wfms	Minimum	Maximum	Mean	Std Deviation
Eye Width (Ch1)	1.323 ns	15 / 986	1.309 ns	1.36 ns	1.328 ns	13.15 ps
Jitter RMS (Ch1)	47.19 ps	15 / 986	41.87 ps	49.73 ps	46.29 ps	1.922 ps
Rise Time (Ch1)	298.1 ps	15 / 986	259.5 ps	315.8 ps	286 ps	16.91 ps
Frequency (Ch1)	311.4 MHz	15 / 986	309.9 MHz	314.2 MHz	311.5 MHz	1.049 MHz

Eye-Diagram Measurements with LP-Filtering:
OE-Converter: IR 10 GHz (Actually 9 GHz),
S/N IC-0001
LPF: Mini-Circuits Model NLP-750

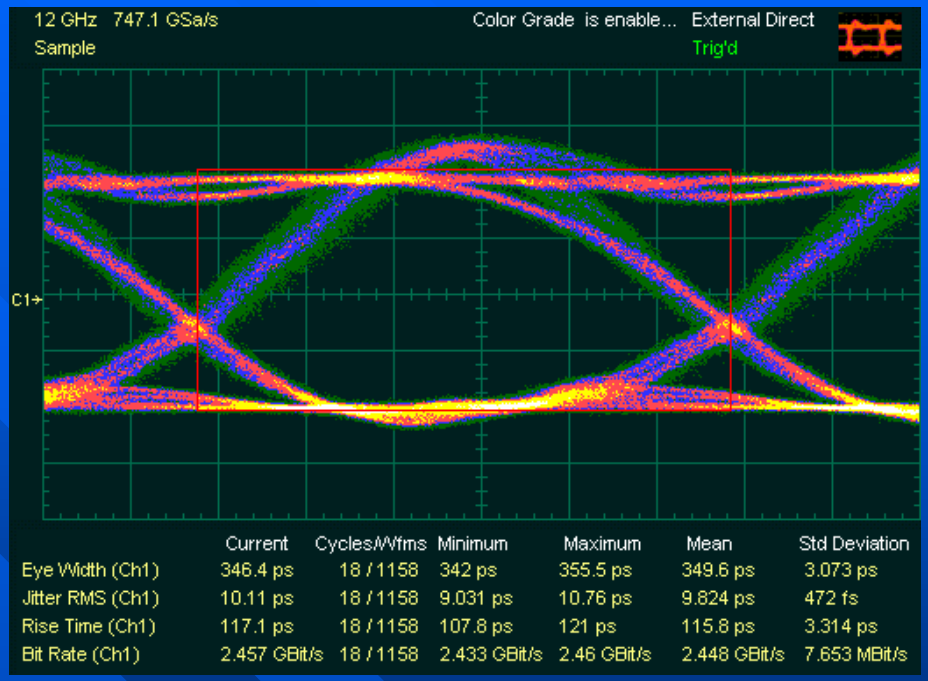
Source: Anritsu 1570A Sonet/SDH Analyzer
Signal: Optical 1,55 um, -3 dBm, OC12
Trigger: Locked to signal, Direct inpu

OC-48 Laser Measurements



	Current	Cycles/Wfms	Minimum	Maximum	Mean	Std Deviation
Eye Width (Ch1)	355.6 ps	19 / 1280	340.2 ps	355.6 ps	347.1 ps	3.901 ps
Jitter RMS (Ch1)	8.478 ps	19 / 1280	8.478 ps	10.71 ps	9.764 ps	608.1 fs
Rise Time (Ch1)	92.01 ps	19 / 1280	67.54 ps	372.4 ps	101.5 ps	64.34 ps
Frequency (Ch1)	1.23 GHz	19 / 1280	1.226 GHz	1.246 GHz	1.232 GHz	4.957 MHz

Eye-Diagram Measurements with No LP-Filtering



	Current	Cycles/Wfms	Minimum	Maximum	Mean	Std Deviation
Eye Width (Ch1)	346.4 ps	18 / 1158	342 ps	355.5 ps	349.6 ps	3.073 ps
Jitter RMS (Ch1)	10.11 ps	18 / 1158	9.031 ps	10.76 ps	9.824 ps	472 fs
Rise Time (Ch1)	117.1 ps	18 / 1158	107.8 ps	121 ps	115.8 ps	3.314 ps
Bit Rate (Ch1)	2.457 GBit/s	18 / 1158	2.433 GBit/s	2.46 GBit/s	2.448 GBit/s	7.653 MBit/s

Eye-Diagram Measurements with LP-Filtering

LP-Filtering: Mini-Circuits Model NLP-2950 (-3 dB BW about 3 GHz)

Source: Anritsu 1570A Sonet/SDH Analyzer
Signal: Optical 1,31 um, -4 dBm, OC48
Trigger: 156 MHz, Direct Input
OE-Converter: IR 10 GHz, S/N IC-0001

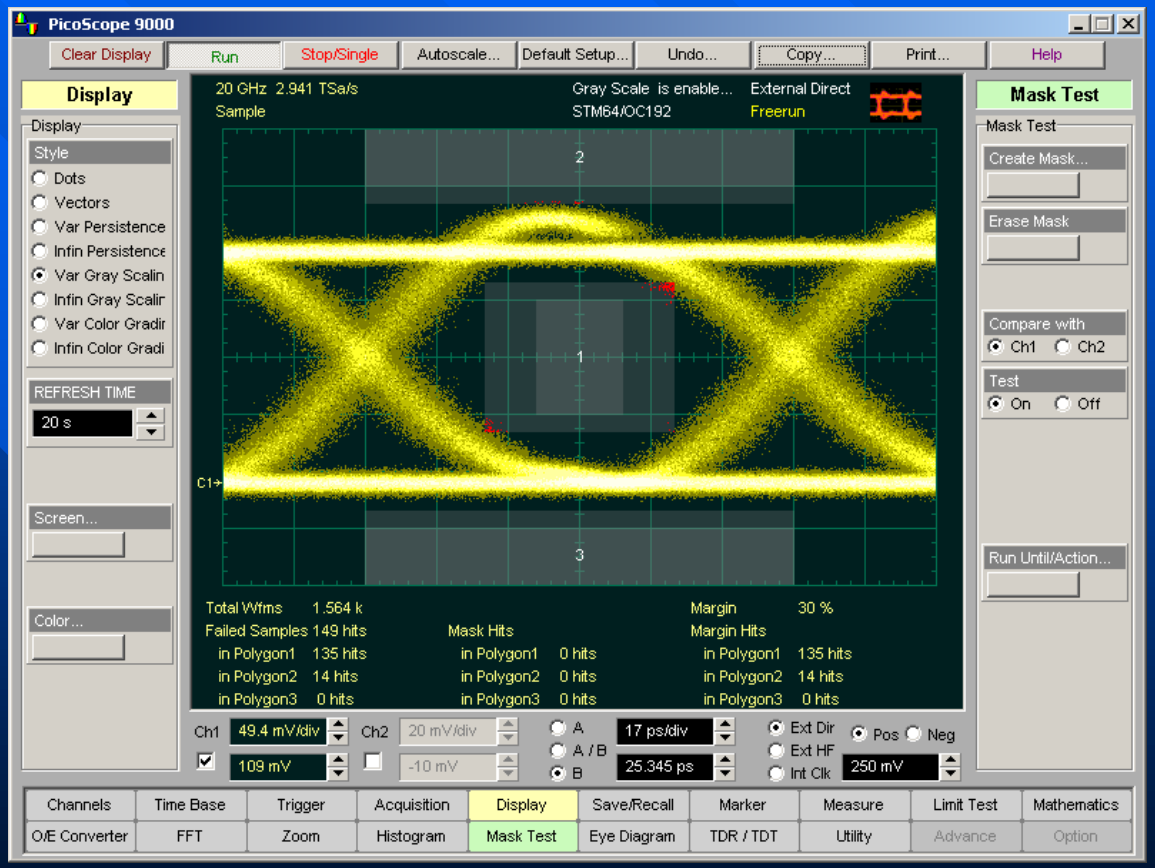
Mask Test

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 gray scaled or color-graded display to aid in analyzing noise and jitter in eye-diagrams.

Mask Test quickly characterizes:

- Noise
- Jitter
- Aberrations
- Rise Time
- Fall Time

On-board mask drawing capability allows simple, operator-independent visual comparison of signal to standard mask.
Picture demonstrates a SONET/SDH (OC48/STM16) signal compared with the standard mask, showing a compliant waveform.

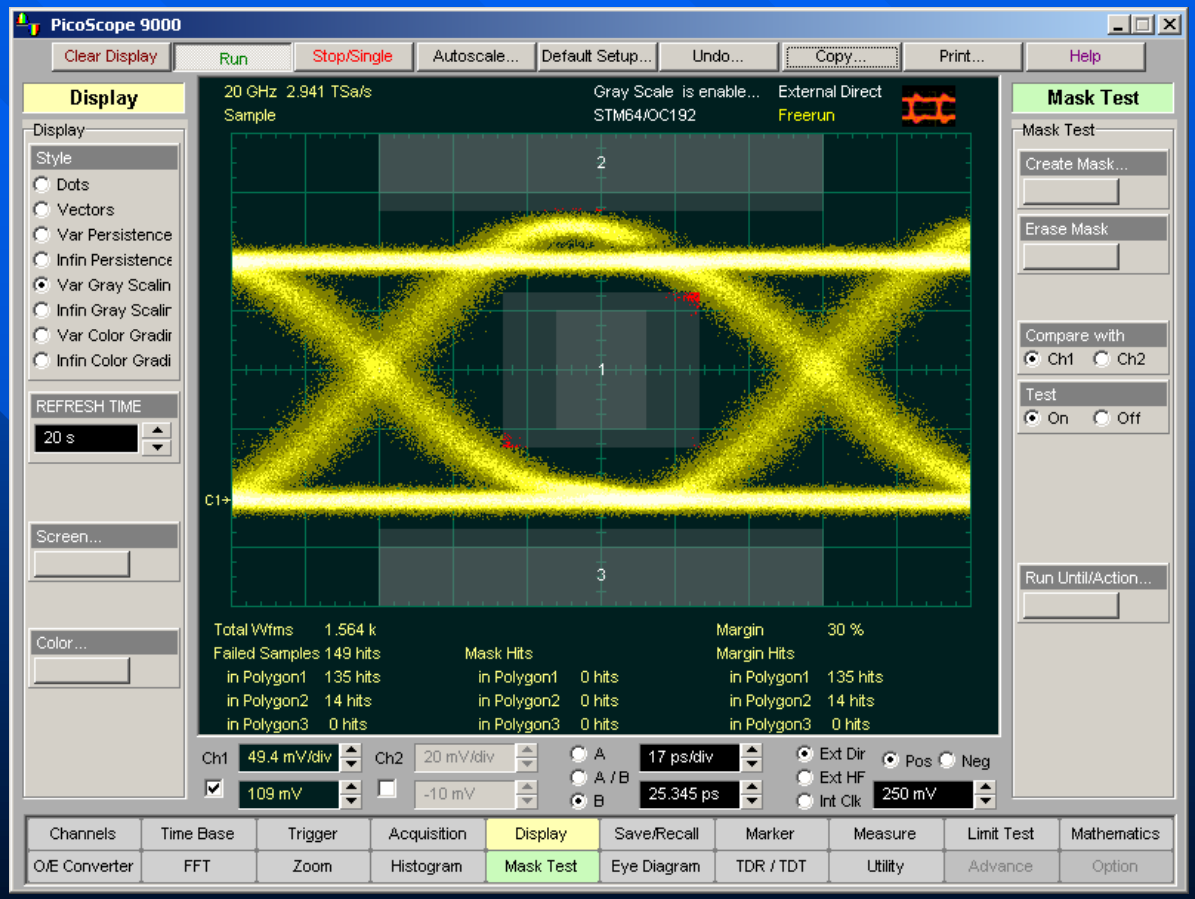


Тест с помощью масочных шаблонов

Осциллограф C7-24 позволяет отображать маски глаз-диаграмм, относящихся к таким стандартам, как SONET/SDH, Ethernet или Fiber Channel. В дальнейшем тест маски проводится путем сравнения сигнала глаз-диаграммы со стандартной маской. Для наглядного анализа шумов и временной нестабильности отображение устанавливают в режим градации серым или градации цветом.

- **Тест масок оперативно характеризует:**
  - **Шум**
  - **Временную нестабильность**
  - **Искажения формы сигнала**
  - **Длительность фронта**
  - **Длительность среза**

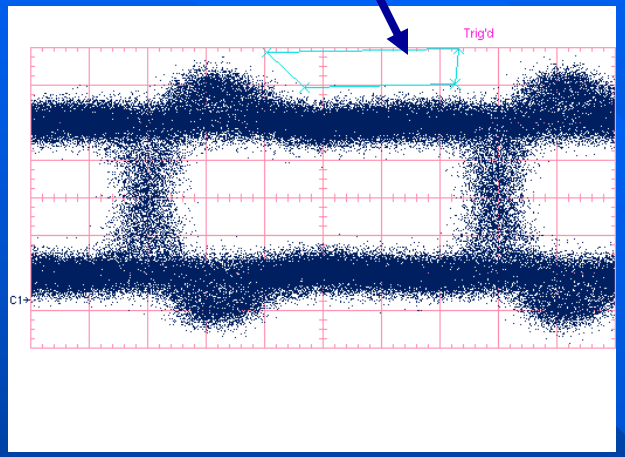
- **Осциллограмма демонстрирует тест стандартной маски для сигнала SONET/SDH (OC48/STM16) частотой *2.488 Gbps,***



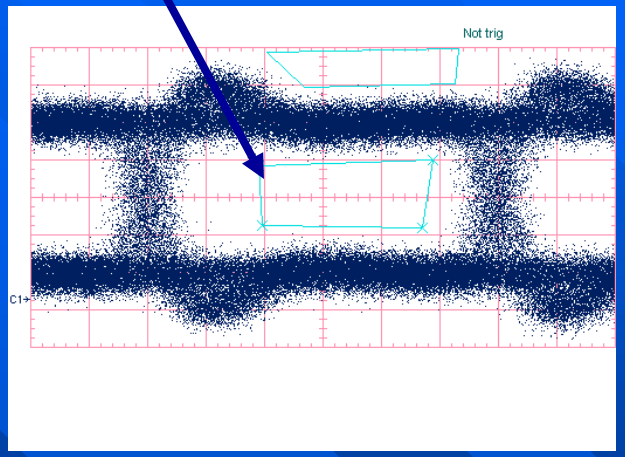
Creating Custom Mask

Five pictures below demonstrate how PicoScope 9201 builds Custom Mask for NRZ waveform

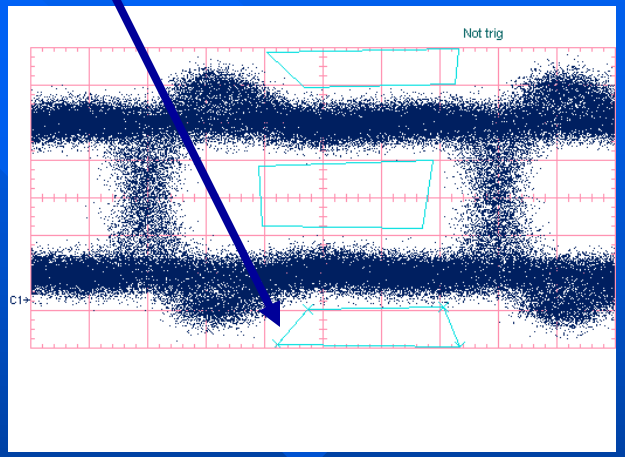
1. Create the top Polygon of the Mask

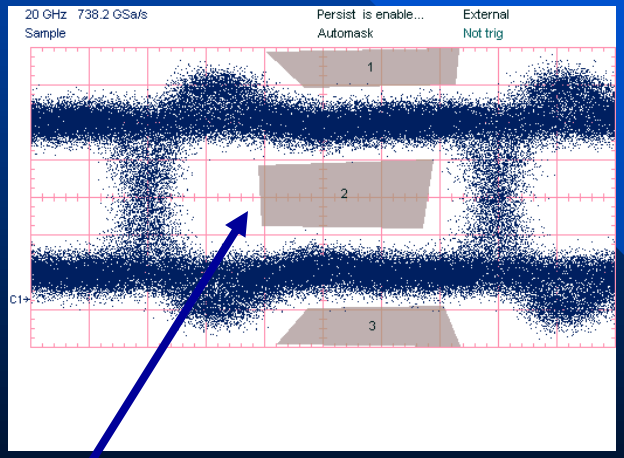


2. Create the center Polygon of the Mask

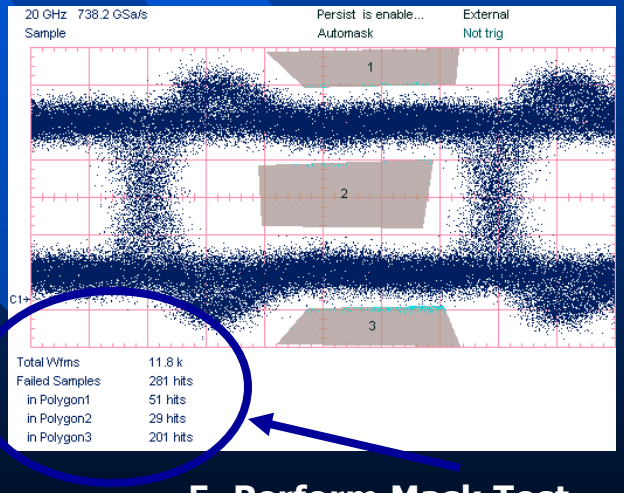


3. Create the bottom Polygon of the Mask





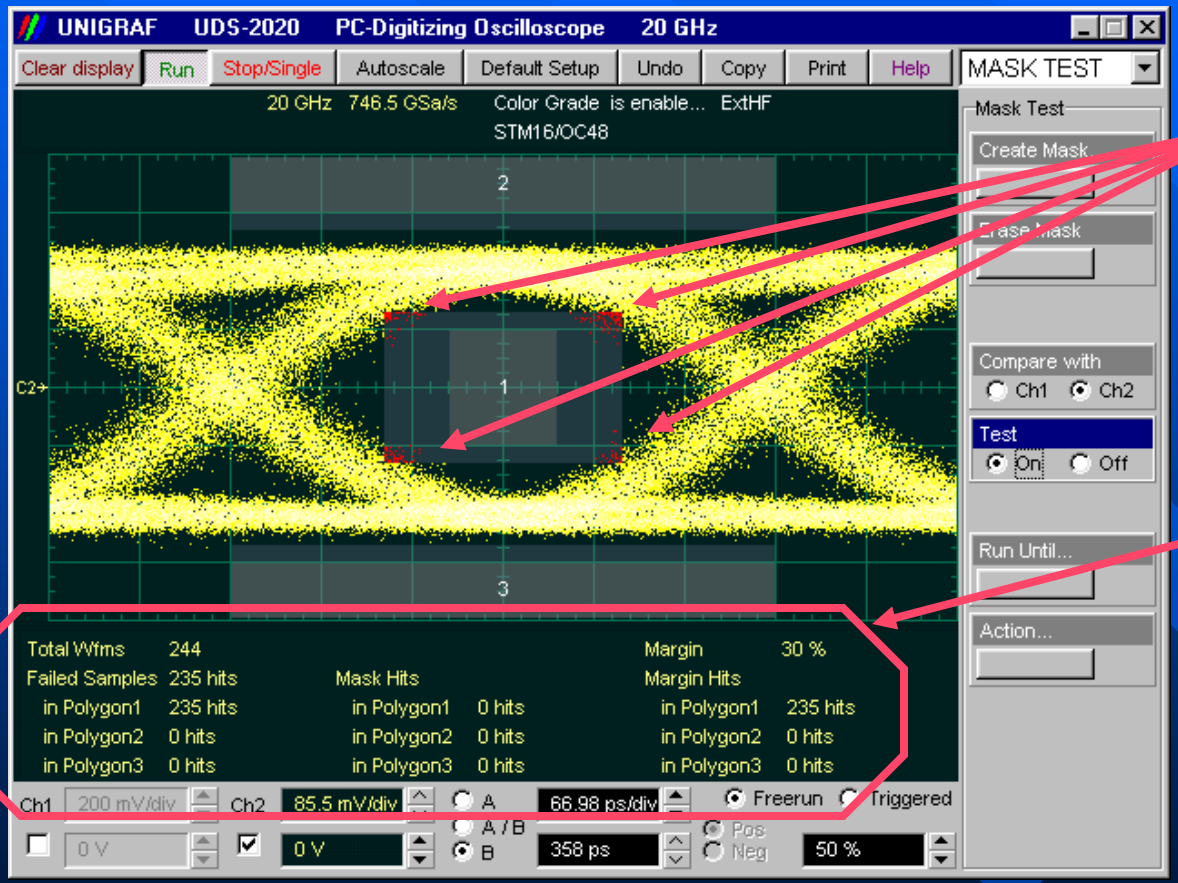
4. Create full Mask



5. Perform Mask Test

Mask Margins

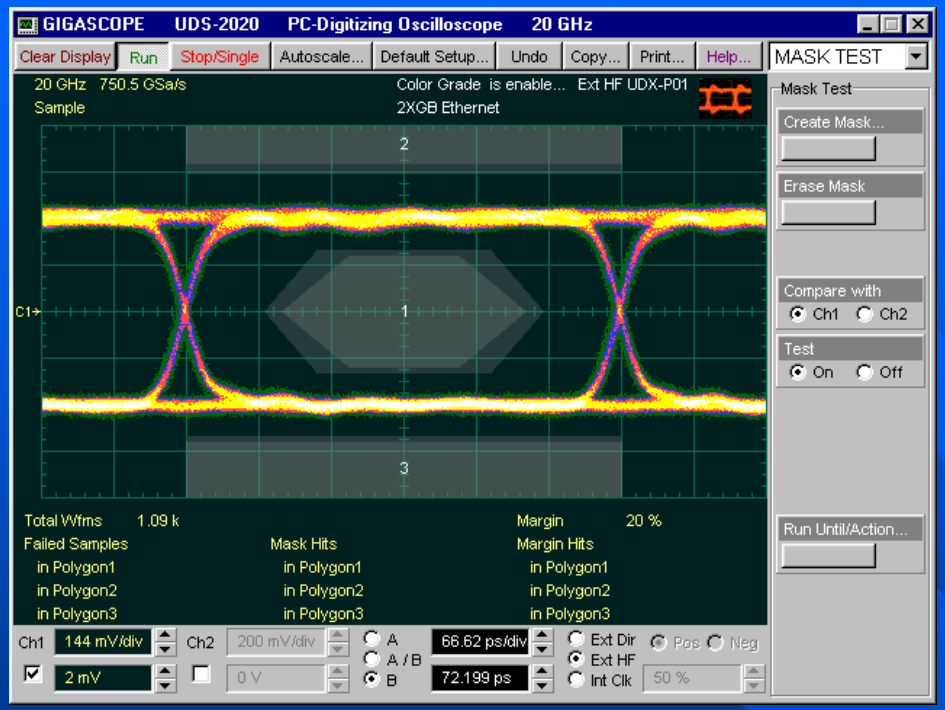
Mask Margins are used to determine the margin of compliance for a standard or scaled mask. The **PicoScope 9201** goes beyond basic testing with mask margin analysis for process monitoring.



- **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**

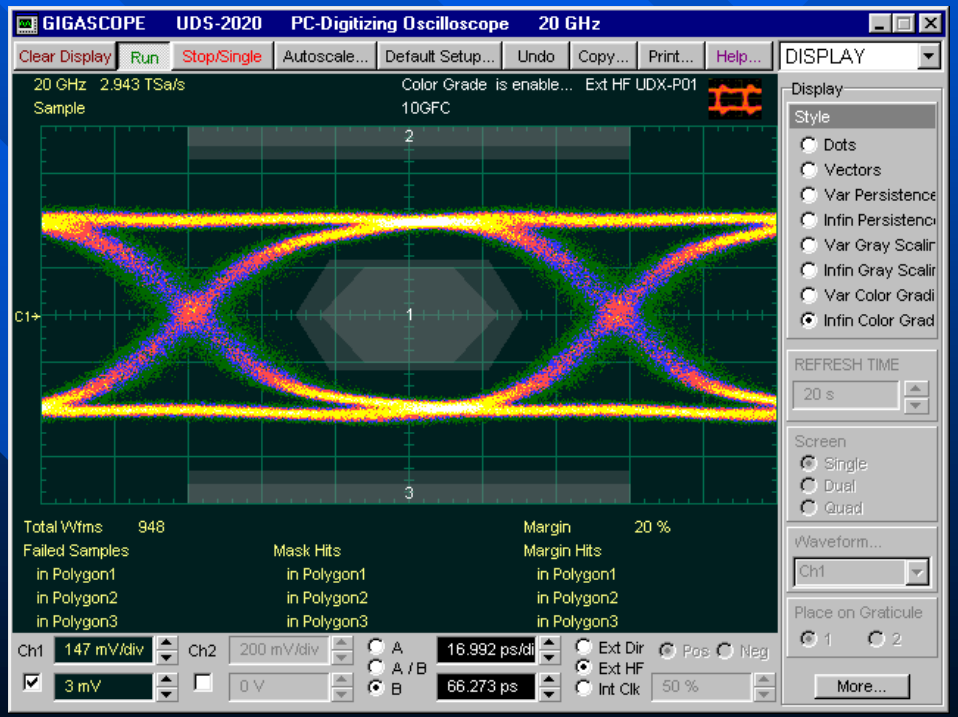
Mask margins are used to determine the margin of compliance for a standard *2.5 Gbps STM16/OC48* eye-diagram or scaled mask.

Examples of Mask Test



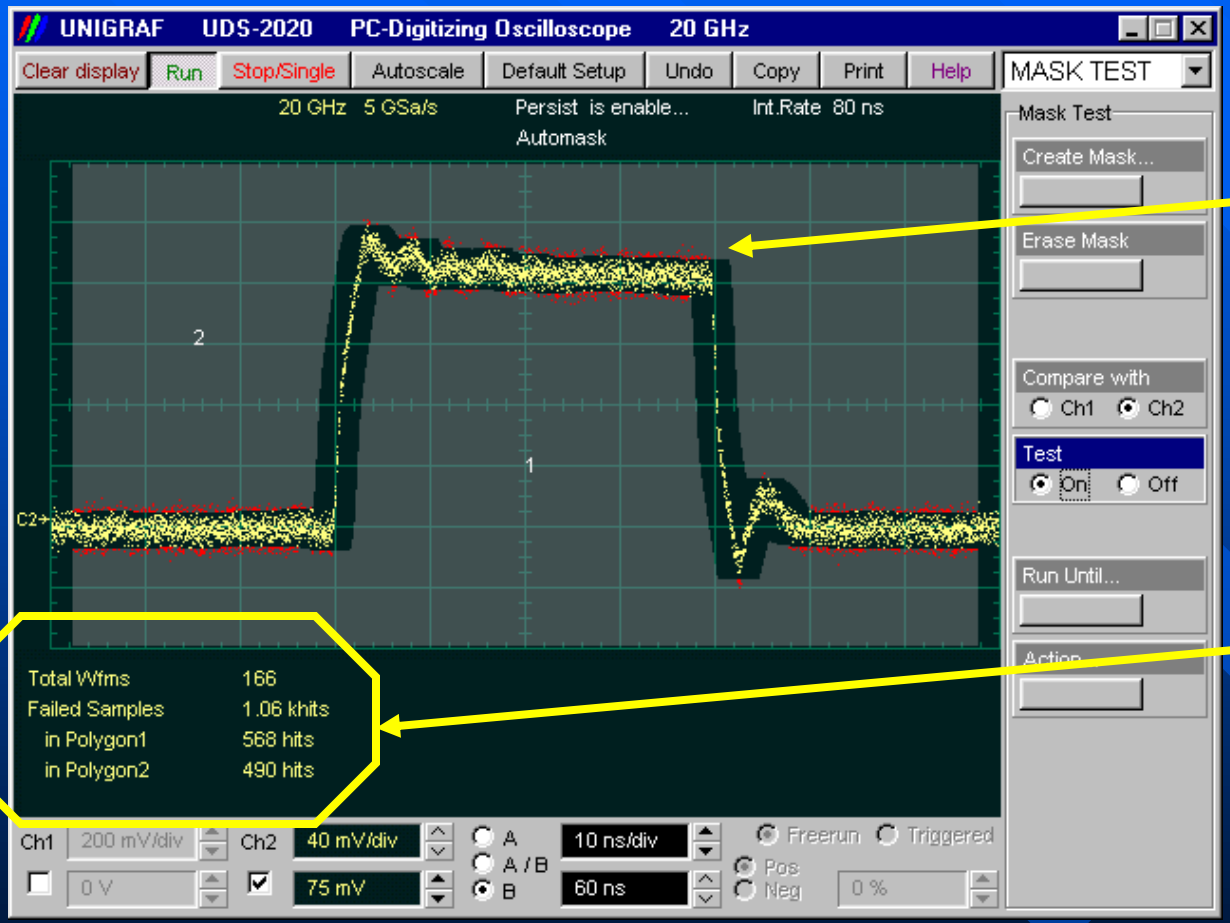
Mask Test and 20-% Margin Test performed for a standard *2.5 Gbps STM16/OC48* eye-diagram.

Mask Test and 20-% Margin Test performed for a standard *9.5 Gbps STM64/OC192* eye-diagram.



On-Fly Limit Test

The PicoScope 9201 offers fully automatic pass-fail limit testing. You can built 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.

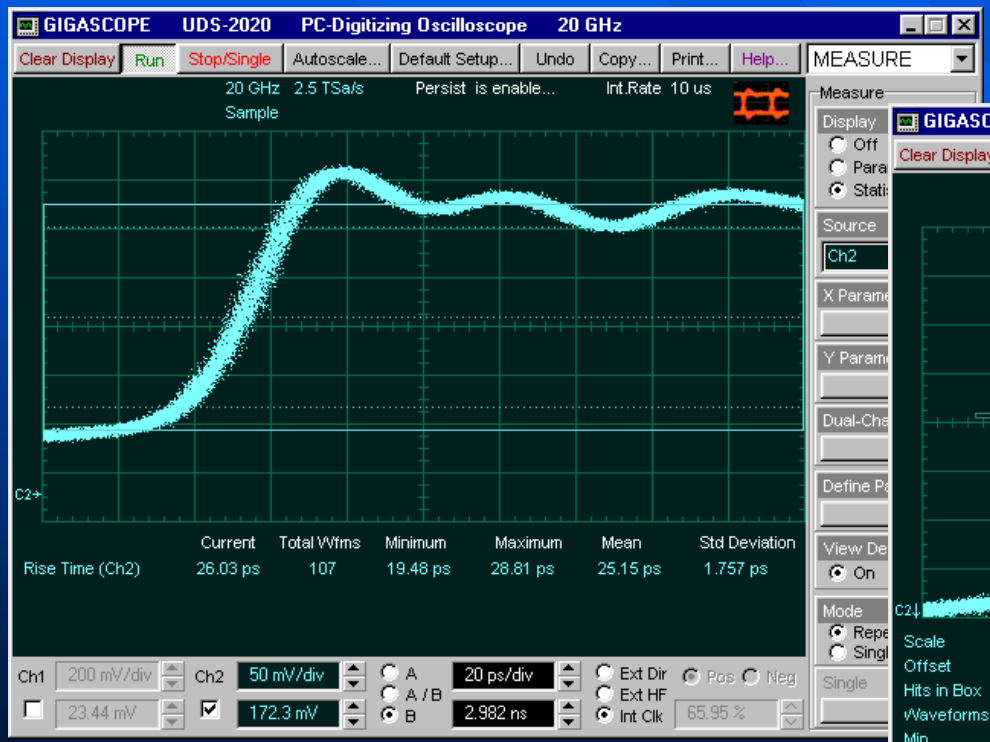
UDX-G01 Pulse Generator Head

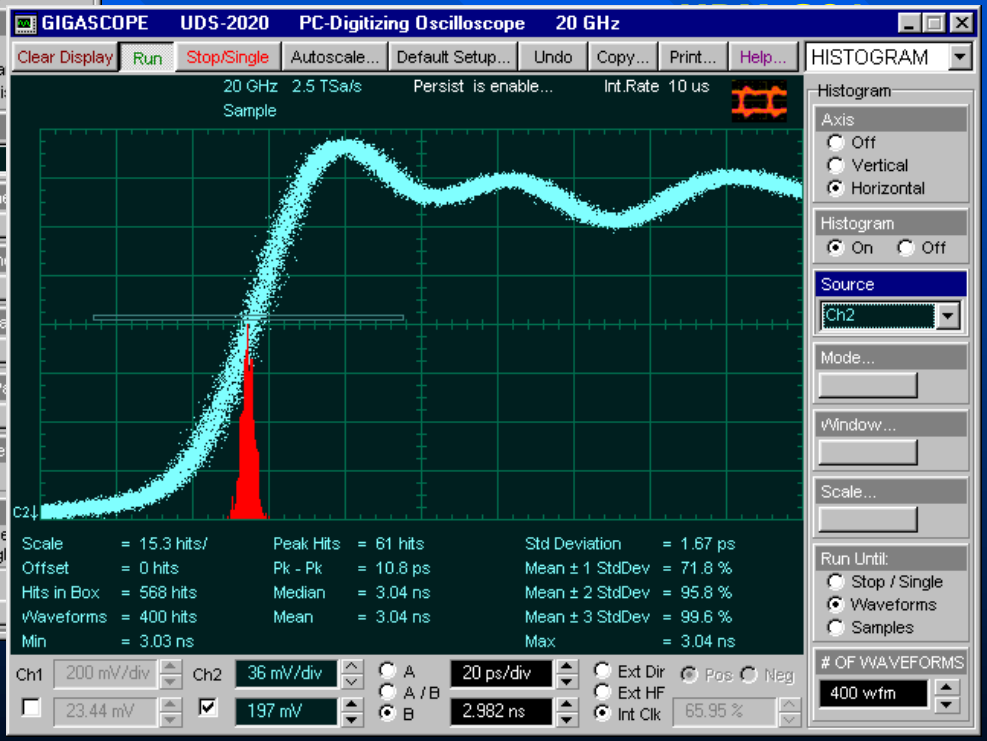
The PicoScope 9201 is equipped a *35-ps* rise time the UDX-G01 Pulse Head. It provides capability of performing single-ended TDT measurements as well as TDR measurements. Combined Oscilloscope and Pulse Head rise time not exceed *40 ps*. TDR/TDT menu provides you automatic and manual single-ended TDR and TDT measurement capability in 7 mm coaxial line.

PicoScope 9201/UDX-G01 Specified characteristics:

- **Rise Time: < *40 ps***
- **Aberrations:**
  - **Overshoot: *<10%***
  - **Before 150 ps: *<±6%***
  - **0.15 to 2 ns: *<±4%***
  - **2 to 100 ns: *< ± 2 %***

- **Displayed RMS Jitter:**
  - **Maximum: *2.5 ps***
  - **Typical: *2.0 ps***

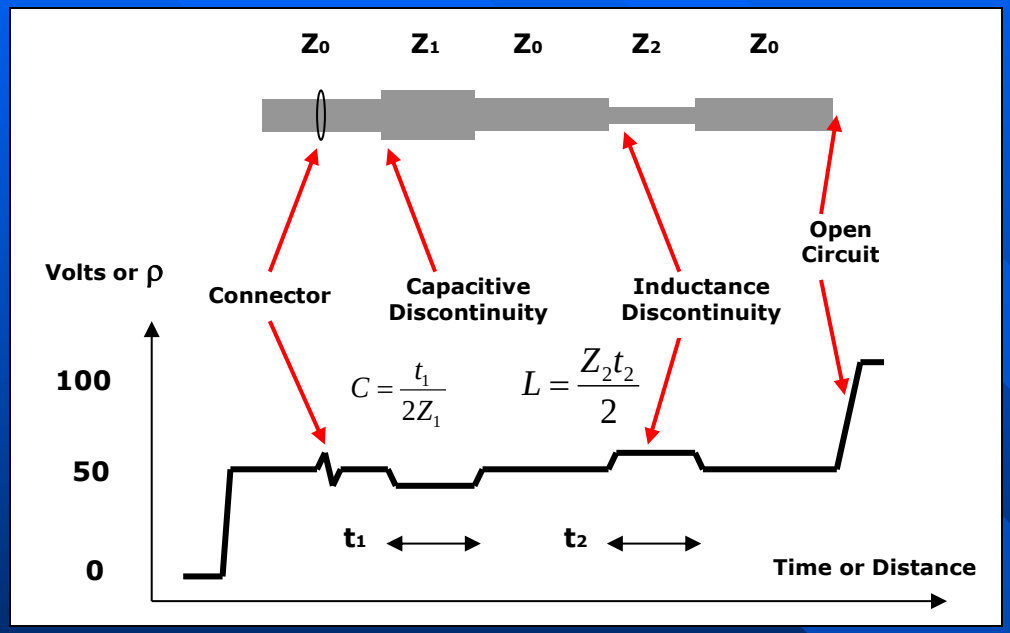




A typical <30 ps transient (left) and <2 ps RMS Jitter (right) characteristics of PicoScope 9201/UDX-G01 system

Distributed Discontinuities

TDR Measurement are used to characterize the signal transmission properties



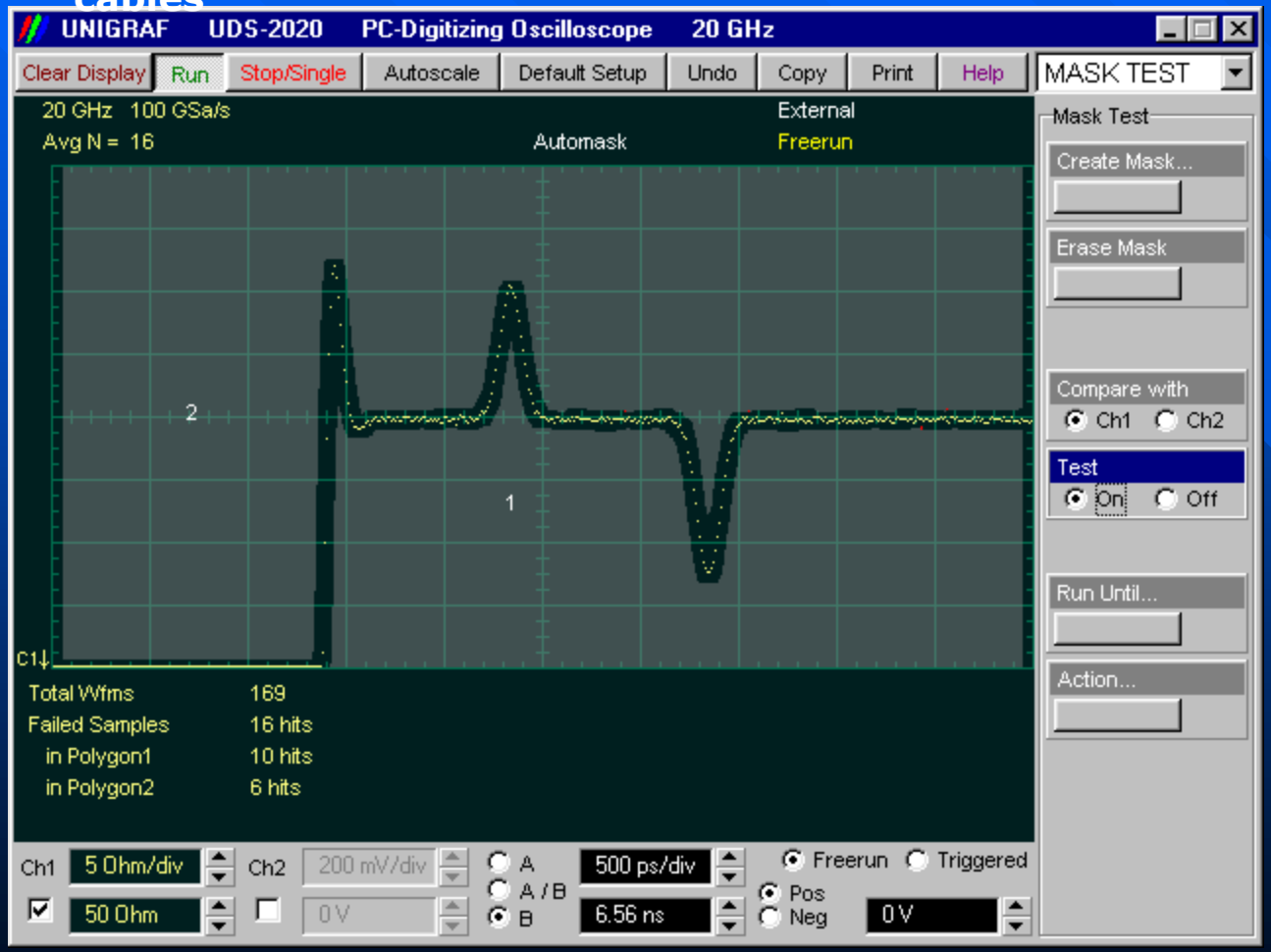
- **Typical TDR Applications:**

TDR Measurement are used to characterize the signal transmission properties of:

- Printed Circuit Boards
- Connectors
- IC Packages
- Cables and Interconnects

Mask Test for Impedance profile

Using the Automask testing cabality of the PicoScope 9201 you can perform TDR go/no-go testing in impedances in circuit board runs, IC packages and cables



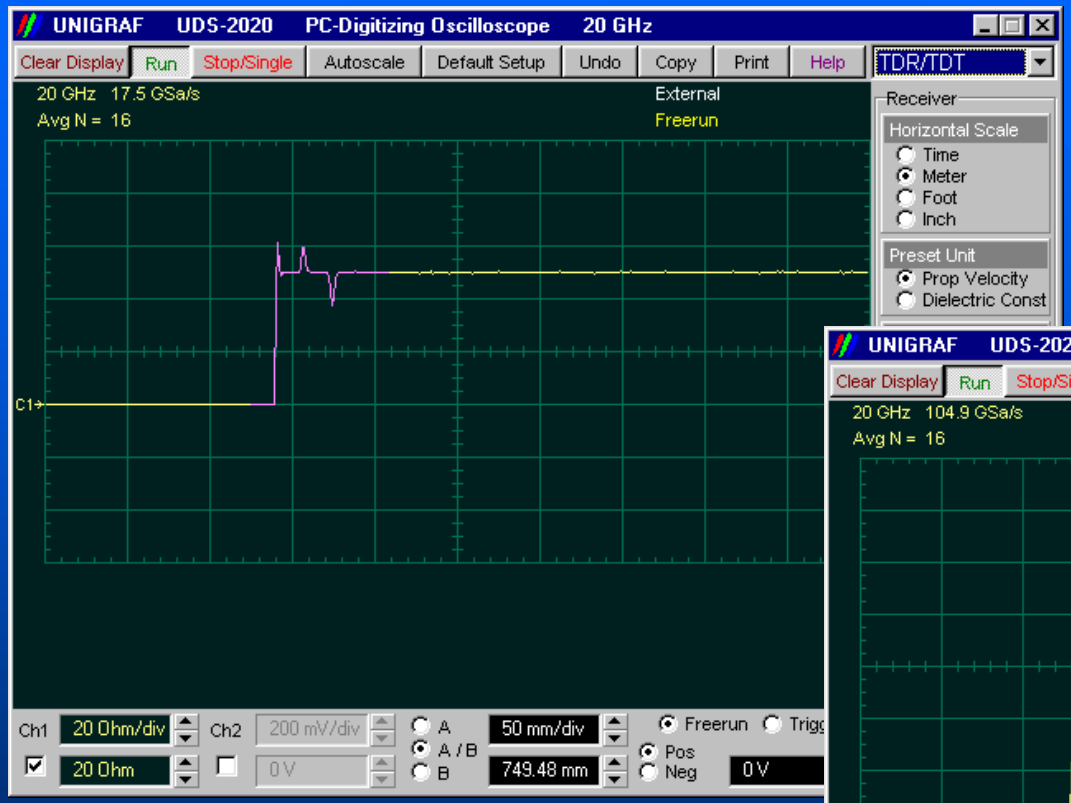
TDR/TDT Measurements

Time Domain Reflectometry (TDR) is a method of characterizing a transmission line or network by sending a signal into one end and monitoring the electrical reflections.

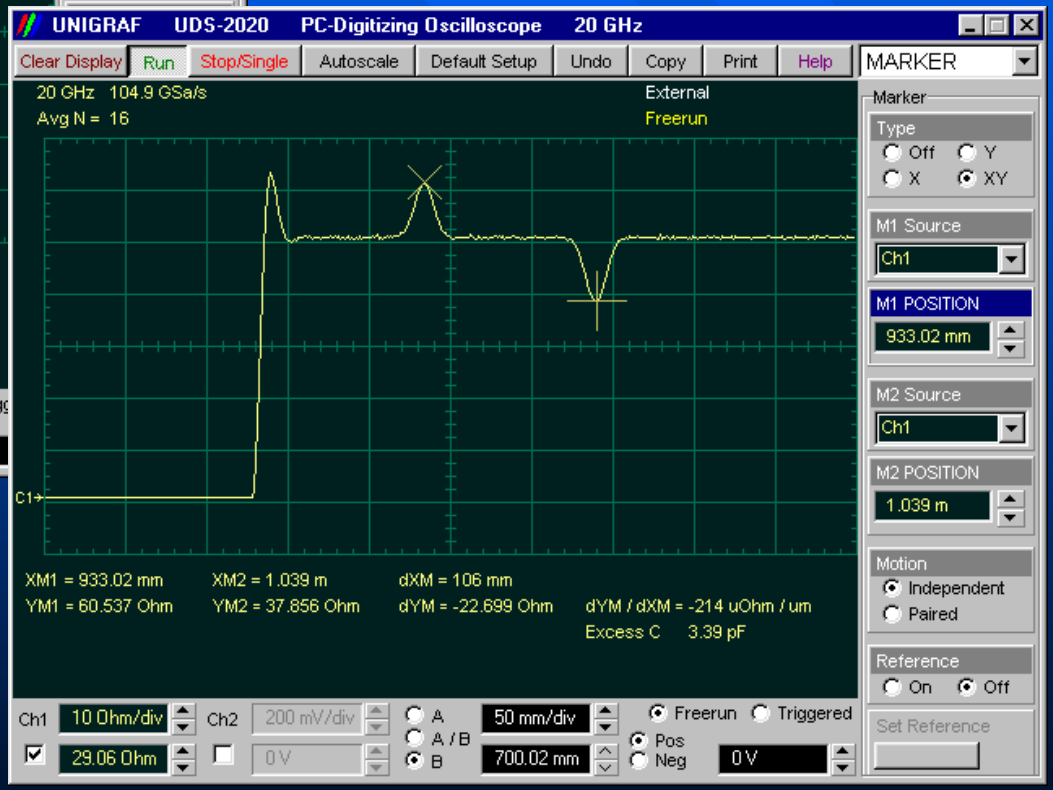
An example of **Z-profile** of ***169-Ohm*** transmission line.
Both markers provide distance and Ohm measurements

- A **TDR** step can also be used to make **Time Domain Transmission (TDT)** measurements. **TDT** is a technique that allows you to measure the response of a system by sending steps through a device and monitoring the output of the device.
- The measurements are made on signals transmitted through the device, rather that reflections from the device (as in **TDR**).

Transmission Line Characteristics

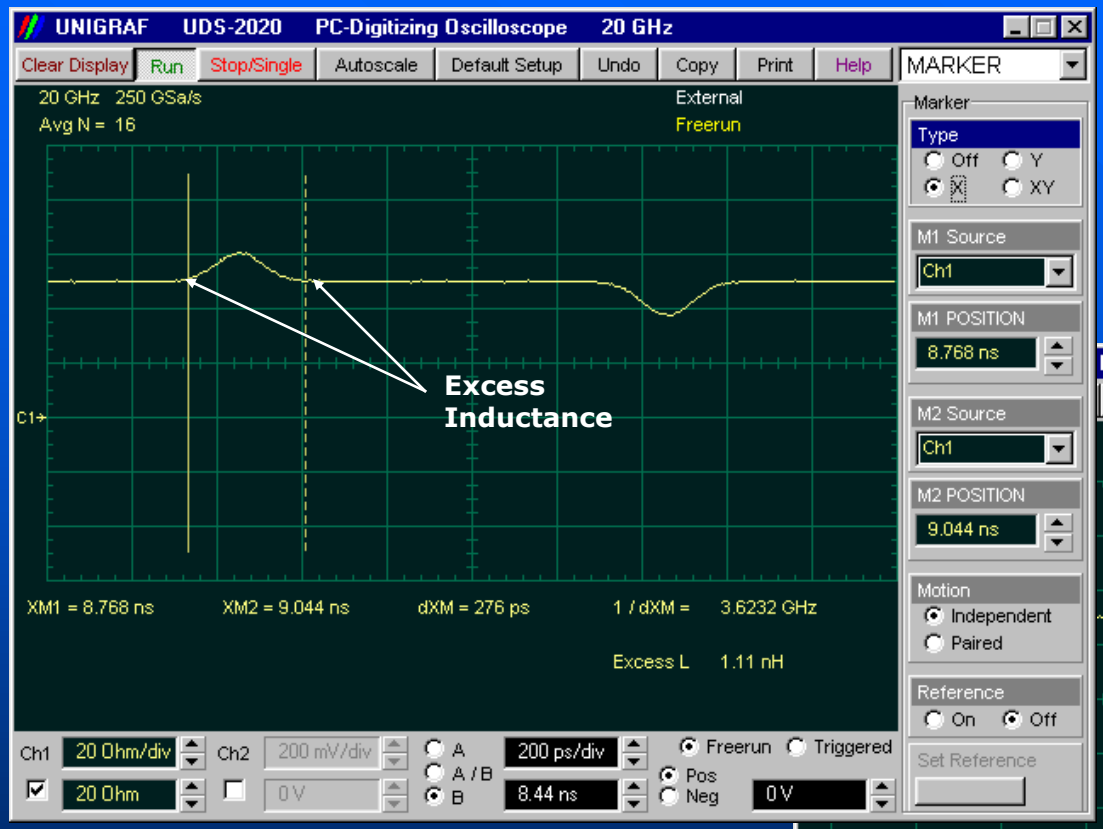


You can isolate a break in a transmission line, highlight it by using windowing, and expand it to examine the discontinuity in detail.

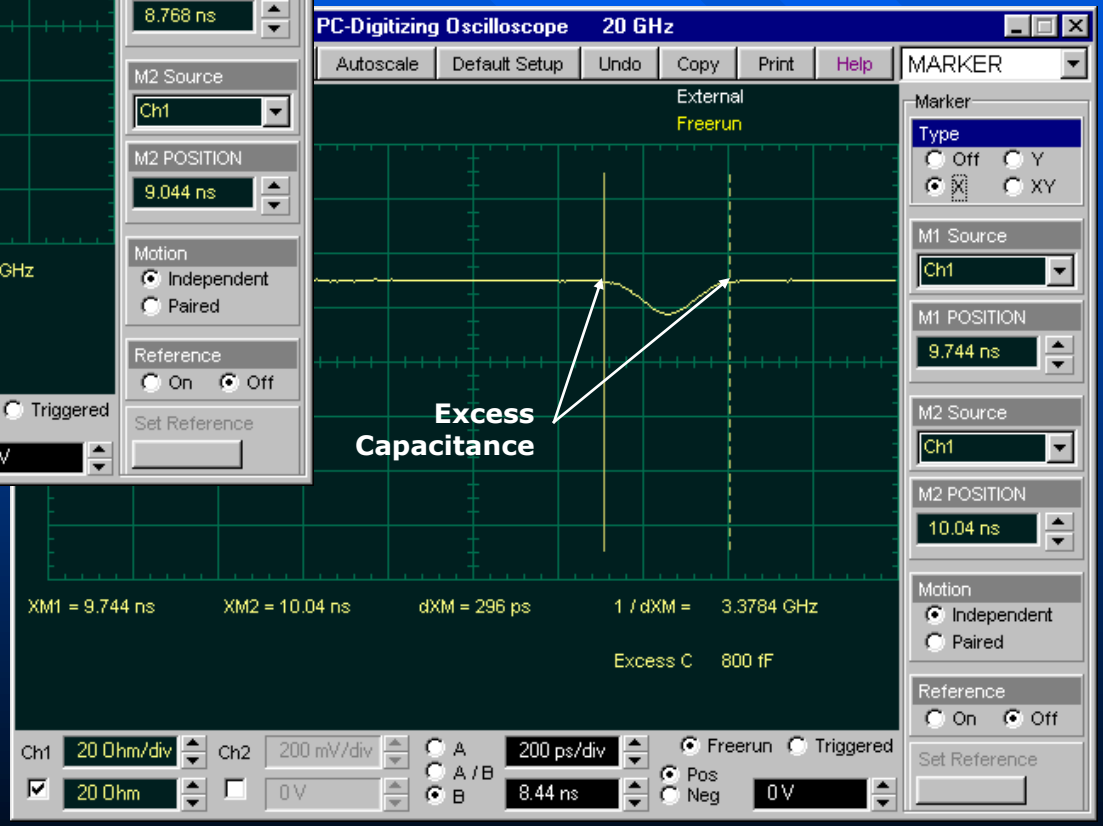


Position **XY marker** and You can make **TDR/TDT** measurements directly for **Rho** and **Delta Rho**, also for **Ohms** and **Delta Ohms**.

Precise Measurement of Discontinuities



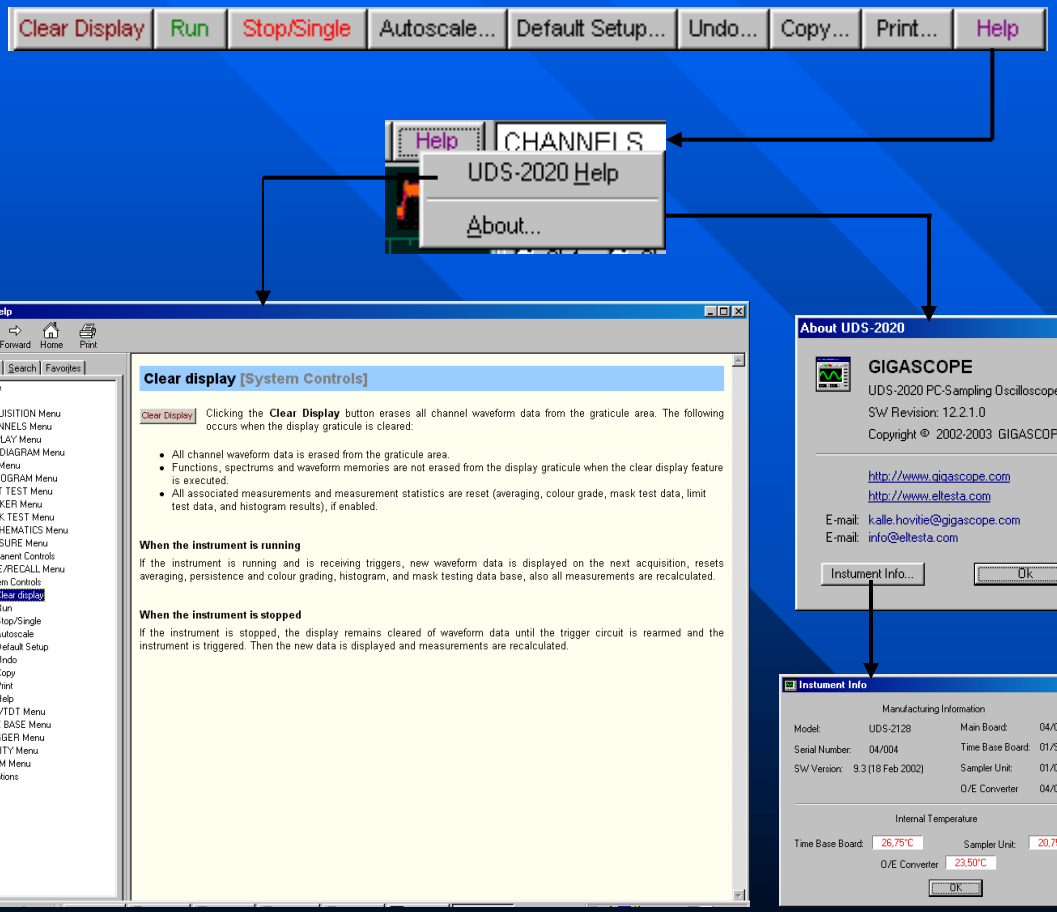
- Cursors can read out in units of **distance** in **meters**, **feet** or **inches** along the horizontal axis.
- Waveforms can be displayed in units of **volts**, **ohms**, or **reflection coefficient** along the vertical axis.
- Scaling in **ohms/division** and **ohms offset** is provided.



The waveform is integrated between both X markers to yield an excess inductance of *1.11 nH* (shown above) and capacitance of *0.8 pF* (shown right). Negative-going variations are capacitive and positive-going variations are inductive.

Built-In Information System (Help)

Built-in information system helps to find the information you need to use the oscilloscope effectively. After clicking the Help button the information system is displayed. The information system Window will always stay on top of the interface display, so you can refer to it while working with the oscilloscope. You can move the window around the screen or resize it to make it easier to use.



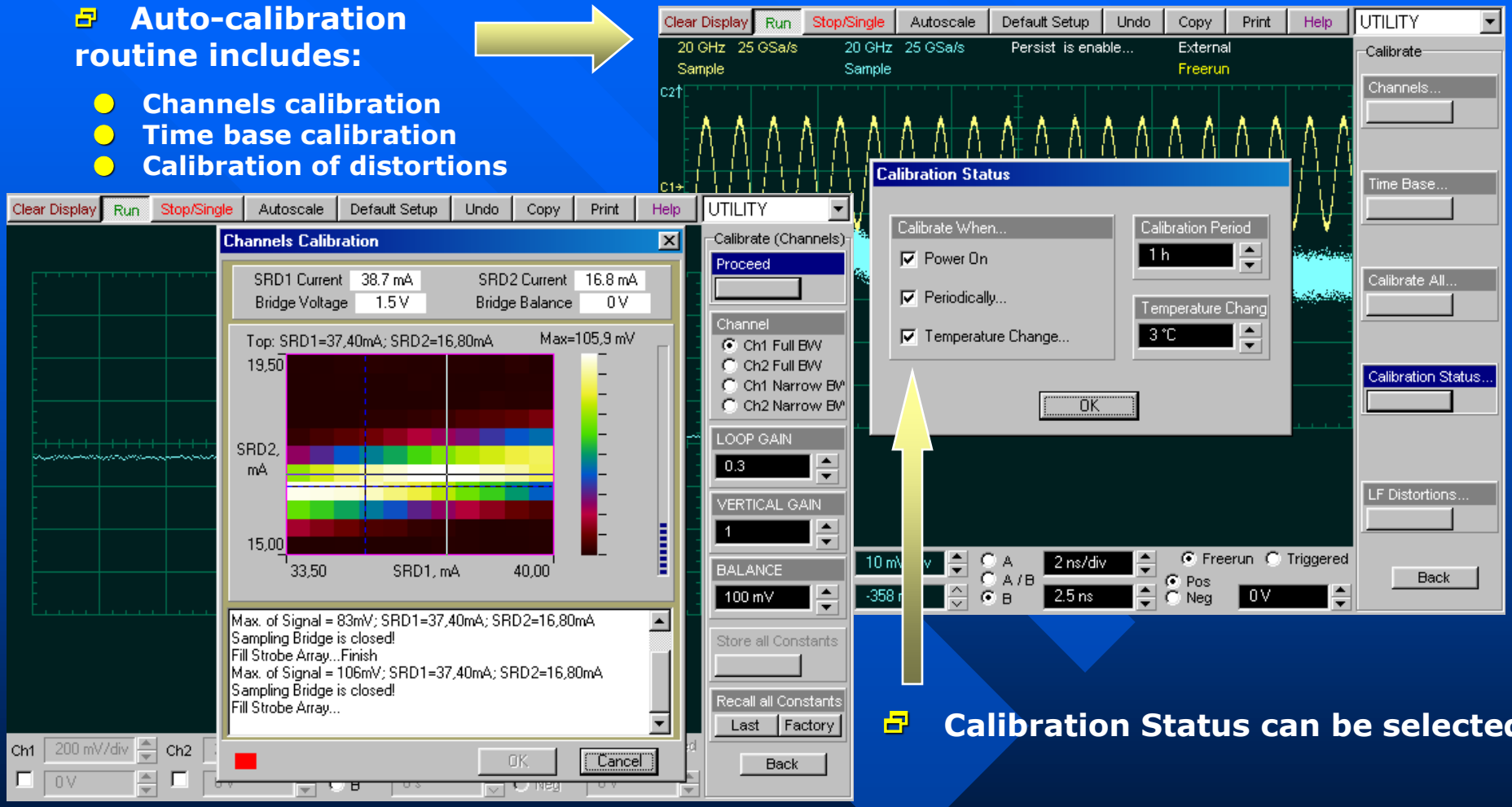
The on-line context-sensitive Help manual provides immediate answers to your questions about using the instrument. Links on the measurement screen take you directly to the information you need.

The PicoScope 9201 Built-in information system

www.eltesta.com

Calibration

- **Auto-calibration routine includes:**
  - **Channels calibration**
  - **Time base calibration**
  - **Calibration of distortions**

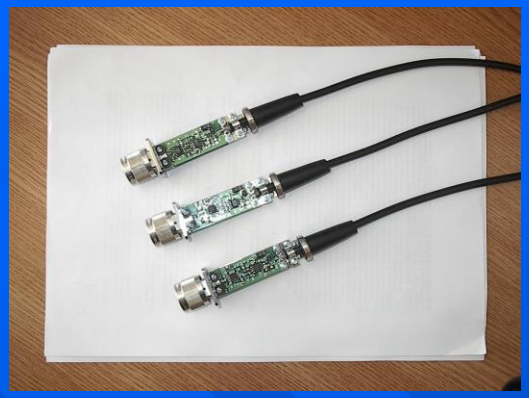


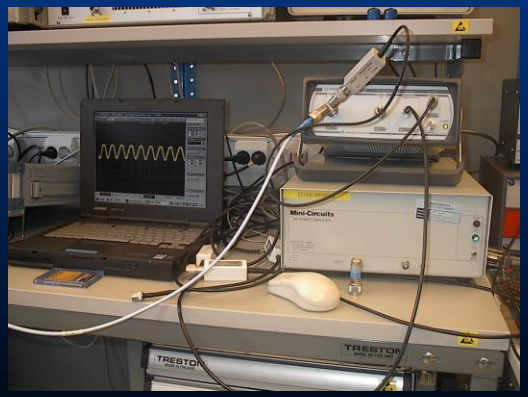
- **Calibration Status can be selected**

Calibration of the PicoScope 9201 has been simplified by using full auto-calibration procedure and placing all performance level menu, indicators and messages in one menu page.

Packaging

Manufacturing and Test





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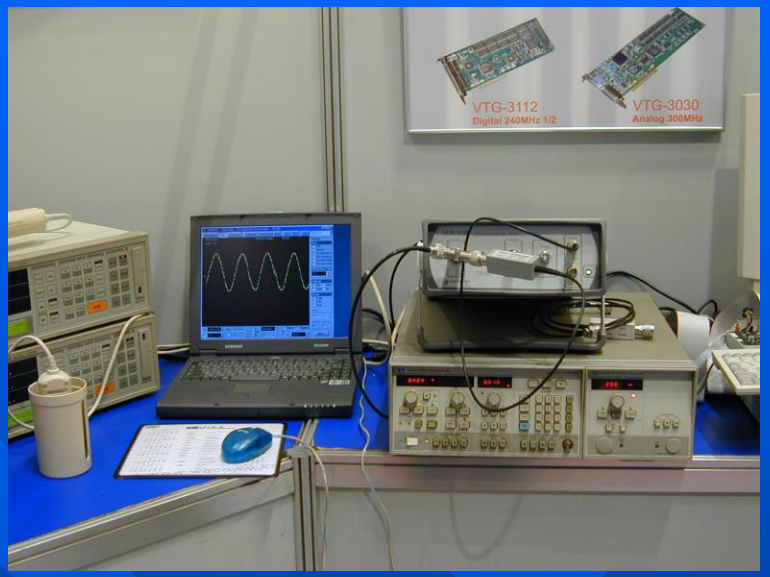
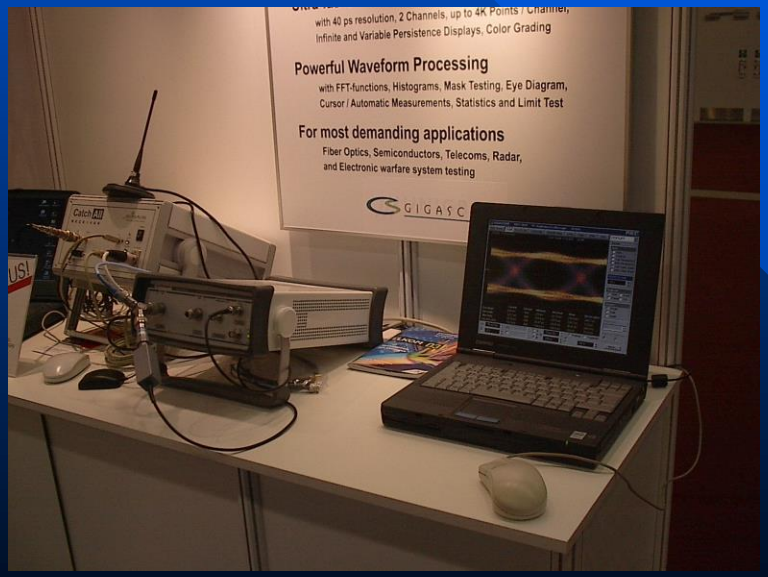
Marketing and Demonstration



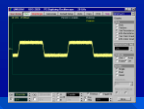


www.eltesta.com

Specifications

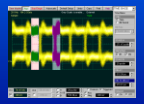
Channel (Vertical)

Number of Channels – 2.
Bandwidth - 20 or 12 GHz.
Rise Time (10-90%) - <17.5ps or <29.2ps.
RMS Noise -2mV@20GHz, 1.5mV@12GHz.
Scale Factors - 1 mV/div to 255 mV/div.
DC Difference Voltage Accuracy - ±1.6% of full vertical scale ±2mV
DC Offset Range - From -1 V to 1 V.
ADC - 14–Bits.
Vertical Resolution - 125 uV/LSB without averaging. Up to 16 bit with averaging.
Maximum input voltage - 1.0V p-p@±1V.
Maximum Safe Input Voltage - 16 dBm, or ± 2 V (dc + peak ac).
Nominal Input Impedance - (50±1)Ohm.
Input Connectors - N-type, 7x3,04 mm(f).
Deskew between channels - Up to 100ns.



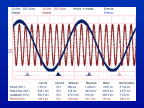
Time Base (Horizontal)

Time Bases - Main, Intensified, two Delayed, Dual Delayed.
Scale Factors - 10 ps/div to 2 ms/div.
Delta Time Interval Accuracy - ±0.4% of reading ± 15 ps ± 100 ppm of delay setting (maximum); ±0.4% of reading ± 10 ps ± 100 ppm of delay setting (typical).
Minimum Delay - 40 ns.
Time Interval Resolution - 100 fs min.
Variable Delay - 1000 screen diameters of Delayed TB or 19.98 ms.



Trigger

Trigger Sources - External Direct, External HF, Internal Clock.
Trigger Modes – Triggered, Freerun.
Slope – Positive, Negative.
External Direct Trigger - 100 mV p-p DC to 100 MHz, 400 mV p-p at 1 GHz.
Internal Clock Rate - 10 us to 2 ms.
RMS Jitter – 2.5 ps + 50 ppm of delay setting (maximum); 2.0 ps + 30 ppm of delay setting (typical).
Trigger Level Range - -1 V to 1 V.
Trigger Hysteresis – Normal, High Sensitive.
Trigger Holdoff - 10 us to 30.72 ms.



Maximum Safe Trigger Input Voltage - ± 2 V (dc+peak ac) or 16 dBm.
Input Impedance - (50 ± 1) OHm.
Coupling - DC coupled.
Trigger Input Connectors - BNC (f).

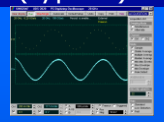
UHF Countdown Trigger with UDX-T01 Head

Coupling – AC.
Bandwidth and Sensitivity - 100 mV p-p 0.5 to 5 GHz, 200 mV p-p 5 to 10 GHz.

UHF Prescaled Trigger with UDX-P01 Head

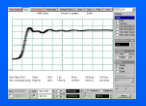
Coupling – AC.
Bandwidth and Sensitivity - 200 mV p-p 1 to 7 GHz, 400 mV p-p 7 to 10 GHz, 600 mV p-p 10 GHz to 12 GHz (typical).

Acquisition



Simultaneous Acquisition Channels - 2.
ADC Resolution - 14 –Bits.
Digitizing Rate - DC to 100 kHz. **Acquisition Modes -** Sample (normal), Average, Envelope, or Peak Detect.
Average - Stable, Multiple, or Median.
Number of averages - From 2 to 4096.
Envelope - Min, Max or both Min-Max.
Peak Detect Mode – Up to 20 ps High frequency and short repetitive glitches.
Data Record Length-32 to 4096 pnts/ch.

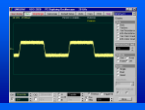
TDR/TDT System



Channels Single-ended with UDX-G01 Pulse Head.
Polarity Positive.
Displayed Rise Time< 40 ps.
Amplitude - 200 mV or more.
Pulse Width - 1 us or more.
Displayed RMS Jitter– 2.5 ps (maximum), 2.0 ps (typical).
Aberrations – Overshoot: 10%, Before 150 ps: <±6%, 150 ps to 2 ns: <±4%, 2 to 100 ns: < ± 2 %.

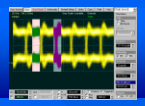
Characteristics

Channel (Vertical)



Attenuation – Range: 0.00001:1 to 1 mln :1. Units: Ratio or dB. Scale: Volt, Watt, Ampere, or Unknown.

Time Base (Horizontal)



Display Units - Time or Bit Period.

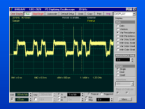
Display

Display Resolution - Full: 640H x 480V, Data**:** 501H x 257V.
Display Style - Dots, Vectors, Variable Persistence (100 ms to 20 s), Infinite Persistence, Variable Gray Scaling (1 to 200 s), Infinite Gray Scaling, Variable Color Grading (1 to 200 s), Infinite Color Grading.
Graticule - Full Grid, Axes, Frame, Off.
Screen - Single, Dual, Quad.
Display Format - YT, XY or both YT & XY.

Save/Recall

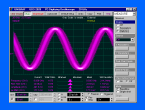
Management - Store and recall setups, waveforms, data base and screen images.
Operating System - MS Windows®95/98/ME/NT4/2000/XP..
Waveform Save/Recall - Up to 4 wfms may be stored into Wfm Mem (M1-M4).
Save/Recall to Disk
Save/Recall Setups
Autoscale

Marker



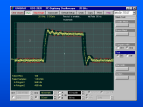
Marker Type - X-Marker (time). Y-Marker (volts). XY-Markers (waveform markers).
Marker Measurements - Absolute, Delta Volts, Time, Frequency, Slope (Volts/Time)
Marker Modes – Independent or Paired.
Ratiometric measurements-Between measured and reference values. Results in ratiometric units as: %, dB, and Degrees.

Measure



Automated Measure - Up to 10 measurements, or 4 statistics measurements simultaneously.
Parameters - 39 automatic measurements available.
Amplitude Measurements - Maximum, Minimum, Peak-Peak, Top, Base, Amplitude, Middle, Mean, dc RMS, ac RMS, Area, Cycle Middle, Cycle Mean, Cycle dc RMS, Cycle ac RMS, Cycle Area, Pos. Overshoot, Neg. Overshoot, Gain.
Timing Measurements - Period, Frequency, Pos Width, Neg Width, Rise Time, Fall Time, Pos Duty Cycle, Neg Duty Cycle, Pos Crossing, Neg Crossing, Burst Width, Cycles, Time@Maximum, Time@Minimum, Delay.
FFT Measurements - FFT Magnitude, FFT Delta Magnitude, THD, FFT Frequency, FFT Delta Frequency.
Statistics - Display minimum, maximum, mean and standard deviation on any waveform measurements.
Top-Base Definition - Histogram, Min/Max, or User Defined (in absolute voltage)
Thresholds - Settable in percentage, voltage or divisions. Standard thresholds are 10-50-90 % or 20-50-80 %.
Margins - Any region may be isolated for measurement using

Limit Test



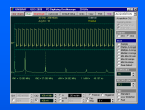
Test - Up to ten automatic measurements can be compared to user-defined test boundaries.
On failure actions - Beep, Save failed waveform to disk or Stop acquisition.

Mathematics

Waveform Math - Up to 4 math waveforms can be defined and displayed.
Math Operators - Add, Subtract, Multiply, Divide, Invert, Absolute, Exponentiation (e), Exponentiation (10), Logarithm (e), Logarithm (10), Differentiate, Integrate, Inverse FFT, Linear Interpolation, Sin(x)/x Interpolation, Smoothing, Trend.
Operands - Any channel, waveform memory, math function, spectrum, or constant can be selected as a source for one of two operands.

Characteristics (cont.)

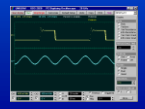
FFT



FFT - Up to two fast Fourier transforms can be run simultaneously.
FFT Windows - Rectangular, Hamming, Hanning, Flattop, Blackman-Harris and Kaiser-Bessel.
Marker FFT Measurements - Frequency, delta freq, magnitude, and delta magnit.
Automated FFT Measurements - FFT Magnitude, FFT Delta Magnitude, THD, FFT Frequency, and FFT Delta Frequency.

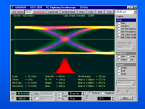
Zoom

Zoom feature - Memories, functions, and spectrums can be expanded and positioned in both vertical and horizontal axes.
Complex Scale - Magnitude, Phase, Magnitude + Phase, Real, Imaginary, and Real + Imaginary.
Vertical expanding and positioning - Up to 10 mln. divisions or 1 mln. screens.



Horizontal expanding and positioning – Up to 640 divisions or 64 screens.

Histogram

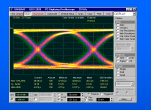


Histogram Axis - Vertical, or Horizontal over any region of the signal (Window).
Histogram Measurement Set - Scale, Hits in Box, Offset, Peak Hits, Pk-Pk, Median, Mean, Standard Deviation, Mean ±1 Std Dev, Mean ± 2 Std Dev, Mean ± 3 Std Dev.

Mask Test

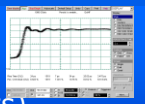
Mask Test - Up to eight polygons. Masks can be loaded from disk, created automatically or manually.
Mask Creation-Standard Mask, Automask, Mask saved on disk, Create new mask, Edit any mask.
Standard Mask – SONET, ITU G.703, ANSI T1/102
Automask Creation -Masks are created automatically for single-valued voltage signals. Automask specifies both delta X and delta Y tolerances.
Data collected during test - Total No of waveforms, No of failed samples, No of hits within each polygon boundary

Eye-Diagram



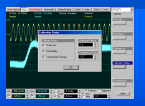
PicoScope 9201 automatically characterizes NRZ and RZ eye pattern.
Measurement Set - Crossing %, Duty Cycle Distortion (%, s), Extinction Ratio (dB, %, ratio), Eye High, Eye Width, Fall Time (10%-90%, 20%-80%), Jitter (P-p, RMS), One Level, Q-factor, Rise Time (10%-90%, 20%-80%), Zero Level.

TDR/TDT System



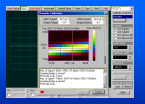
Vertical Scaling – Volts, Percent reflection or Ohms.
Horizontal Scaling - Time or Distance (meters or foots). Velocity or Dielectric Constant can be entered.
TDR/TDT Cursor Measurements - Reads out the percent reflection, impedance, time, and distance, Excess C/L.

Environmental Characteristics



Temperature - Operating:+5 °C to +40°C. Non-operating: -40 °C to + 50 °C.
Humidity – Operating: Up to 85% relative humidity (non-condensing) at +25 °C.

Power Requirements



Voltage - 110±15 VAC or 220±30 VAC.
Frequency - 48 to 66 Hz single phase.
Power - 60 VA maximum.

Physical Characteristics

Dimensions:
Width (with handle) - 270 mm
Width (without handle) - 255 mm
Height - 109 mm
Depth (with handle) - 427 mm
Depth (without handle) - 377 mm
Weight
Net - 5.5 kg,
Shipping - 12.0 kg.

The UDS-2000 Family of PC- Oscilloscopes

Eltesta offers a wide range of wide bandwidth PC-Sampling Oscilloscopes for electrical and optical signals to cover your measurement needs.

PicoScope 9201

- ***20 GHz*** Electrical Bandwidth
- ***12 GHz*** Trigger Bandwidth
- ***35 ps*** Step Generator

UDS-2128

- ***20 GHz*** Electrical Bandwidth
- ***8 GHz*** Optical Bandwidth
- ***2.7 Gb*** Clock-Data Recovery

UDS-2030

- ***30 GHz*** Electrical Bandwidth
- ***12 GHz*** Trigger Bandwidth
- ***2 ps*** RMS Jitter

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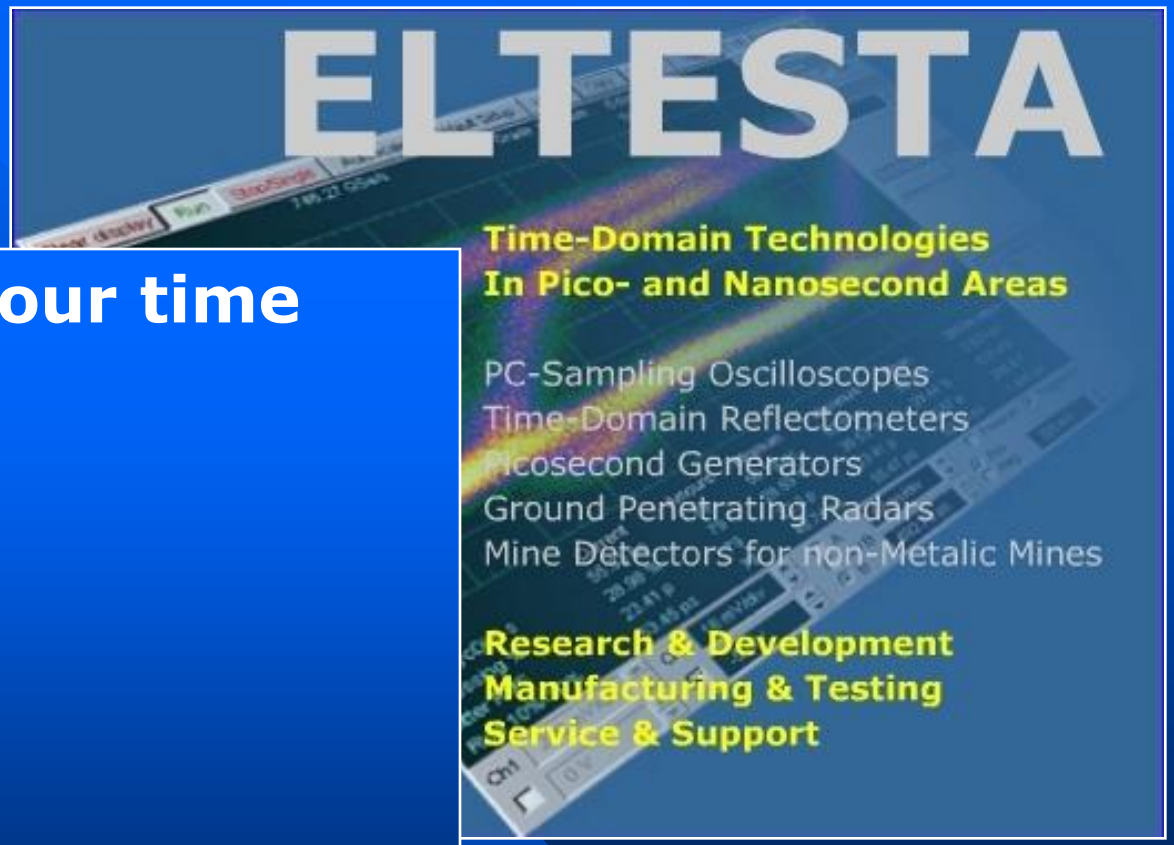
The End



Thank You for Your time

Questions?

info@eltesta.com

Application Notes available @ www.eltesta.com