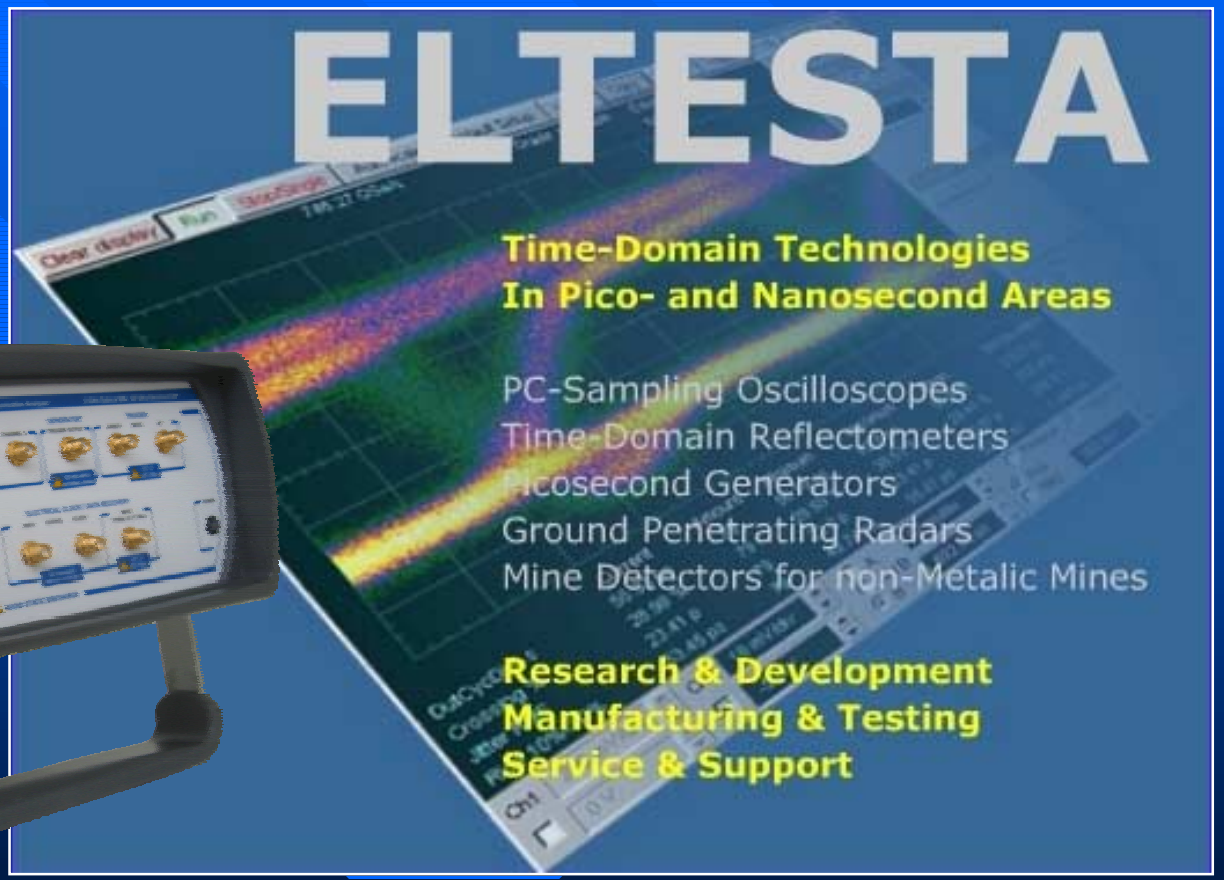
Welcome! UDS-2128
PC-Communication Analyzer



Product Presentation

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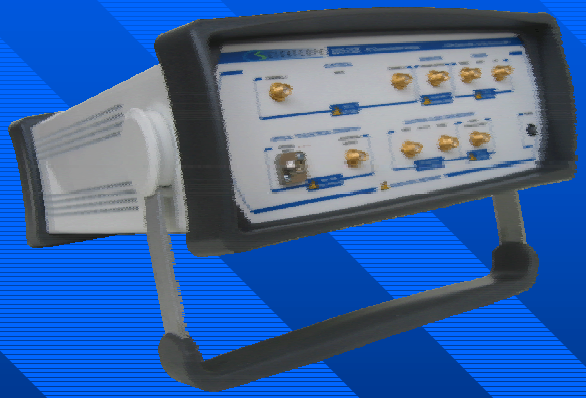
The UDS-2000 Family of PC- Oscilloscopes

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

UDS-2020

- **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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Introduction

The *UDS-2128* is the world Faster PC-Communication Analyzer

20 GHz Channel Bandwidth	***14-bit*** ADC	***1.6 %*** Vertical and ***0.4 %*** Horizontal Accuracy
8 GHz Unfiltered Optical Bandwidth	***100 fs*** Time Resolution	***<2 mV max*** RMS Noise ***<2.5 ps max*** RMS Jitter
12 GHz Trigger Bandwidth	***100 ks/s*** Acquisition Speed	***2.7 GHz*** Clock Recovered Trigger

- The **UDS-2128** is a powerful instrument designed specifically to give you the highest accuracy, measurement speed, and ease-of use for characterizing telecommunications and data communications waveforms.
- The **UDS-2128** is a three-channel (two electrical and one optical), wide-bandwidth Analyzer that uses a sequential equivalent-time sampling technology to achieve bandwidth of up to ***20 GHz***.
- The **UDS-2128** includes an integrated optical channels with ***20 GHz*** unfiltered bandwidth. It gives highest waveform fidelity and measurement accuracy.
- With the accurate optical power meter built into the module, optical signals are accurately measured and displayed in optical power units.
- The **UDS-2128** has a broad range of Bessel-Thomson filter combinations for standard data rates from ***155 Mbps*** to ***3.125 Gbps***.

- The **UDS-2128** provides fast acquisition, repeatable waveform performance analysis with:
  - ***Complete characterization of waveforms with automated measurement, and mask testing.***
  - ***Accurate and repeatable extinction-ratio measurements with automatic dark-level compensation.***
  - ***Fast measurement throughput resulting in lowest cost per test.***
  - ***Flexible platform with possibility to have two electrical channels or one electrical channel and one optical channel.***
  - ***High-resolution TDR/TDT.***
  - ***Histograms.***
  - ***Math or FFT analysis.***
  - ***Color-Graded Display.***

Units of the UDS-2128

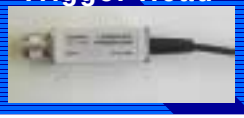
The **UDS-2128** is a PC-Communication Analyzer, or an analyzer for the Personal Computer.

It requires just USB 2.0 or LPT connector in your PC to give you the power of a stand-alone instrument within your PC.

The **UDS-2128** needs only simple USB 2.0 or LPT connection with PC.

Five Heads for UDS-2128

UDX-P01 Trigger Head



AC-coupled *12 GHz* typ prescaler for triggering on high-speed data without cumbersome manual adjustment.

UDX-T01 Trigger Head

Free-running tunnel diode oscillator with a control to synchronize the oscillator to a sub harmonic of the input trigger signal up to *10 GHz*.

***UDX-R01* Clock Recovery Head**

The *622 Mbps* Clock Recovery Head covers OC12 / STM4 bit rate.

UDX-R02 Clock Recovery Head

The *2.488 Gbps* Clock Recovery Head covers OC48 / STM16 bit rate.

UDX-G01 Pulse Head

A *35-ps* rise time Pulse Head provides capability of performing single-ended TDT as well as TDR measurements

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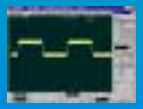
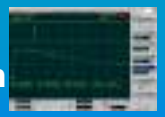
UDS-2128 Features

ELECTRICAL CHANNELS



- DC to *20* Electrical Bandwidth
- Two Electrical Channels
- *±1.6 %* Vertical Gain Accuracy
- *14-Bit* Vertical Resolution, *16-bit* with Avg
- *<2 mV* (20 GHz) and *<1.5 mV* (12 GHz) RMS Noise

OPTICAL CHANNEL



- *8 GHz* Unfiltered Optical Bandwidth
- Multi-mode or Dingle-mode Fiber
- *750 nm* to *1650 nm* Wavelength Range
- *1 uW/div* to *400 uW/div* Scale Factor
- *155 Mbps* to *3.125 Gbps* Bessel-Thomson Filter Option Data Rates

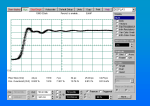
HORIZONTAL

- Dual Time Base *10 ps/div* to *2 ms/d*
- *0.4% +15 ps* Time Interval Accuracy
- *<100 fs* Sampling Interval (*<0.1 ps*)

TRIGGER

- DC to *1 GHz* Full Direct Trigger
- *10 GHz* Prescaled Trigger with UDX-P01 Head
- *10 GHz* Countdown Trigger with UDX-T01 Head
- *622 Mbps* and *2.488 Gbps* Clock Recovery Trigger with UDX-R01/UDX-R02 Heads
- *<2.5 ps* (*<2.0 ps* typical) RMS Jitter

TDR/TDT

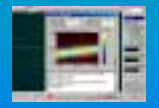


- *35-ps* UDX-G01 Pulse Generator
- *40-ps* System Rise Time

DISPLAY, MEASUREMENTS and ANALYSIS

- Infinitive and Variable Persistence, Grey Scaling and Color Grading
- Automatic Waveform Measurements with Statistics and Pass/Fail Limit Test
- Waveform Processing including FFT with five FFT windows
- Statistical Analysis with Time and Voltage Histograms
- Automated Mask Test with Standard and Custom Masks
- Eye Diagram Measurements
- TDR/TDT for Line Characterization

UTILITY



- Autoscale
- Automatic Calibration
- Win 95/98/ME/NT/XP/2000 Intuitive Graphical User Interface
- Built-in information system,Windows Help

OPERATIONAL

- Power Consumption: *70 VA max*
- Weight: *6.5 kg*
- Size: *W270 x H109 x D377mm*

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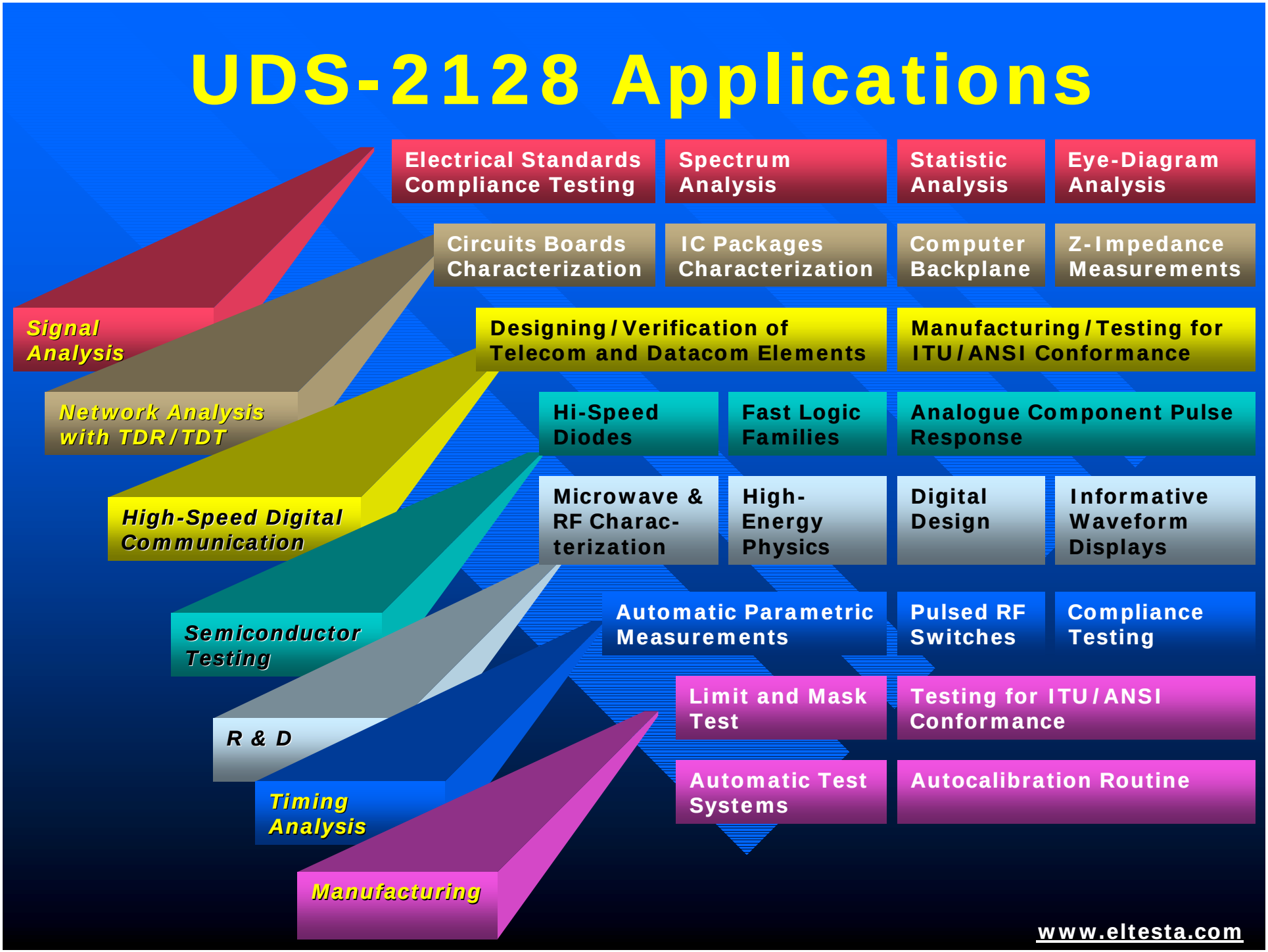
UDS-2128 Applications



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Sampling Oscilloscopes: Market Requirements

- Significant Increase in Sampling Oscilloscope Specifications

40 %	25 %	20 %	15 %
Bandwidth	Trigger Jitter	Price Level	Others

- Today's speeds are causing more signal integrity challenges than ever

Faster synchronous bus architecture	*Electrical and physical challenges*
➢ Faster clock and data rates ➢ Quicker rise and fall times ➢ Shorter setup and hold times	➢ Smaller logic swings ➢ Differential signal ➢ More signals to measure ➢ Signal impedance and termination issues

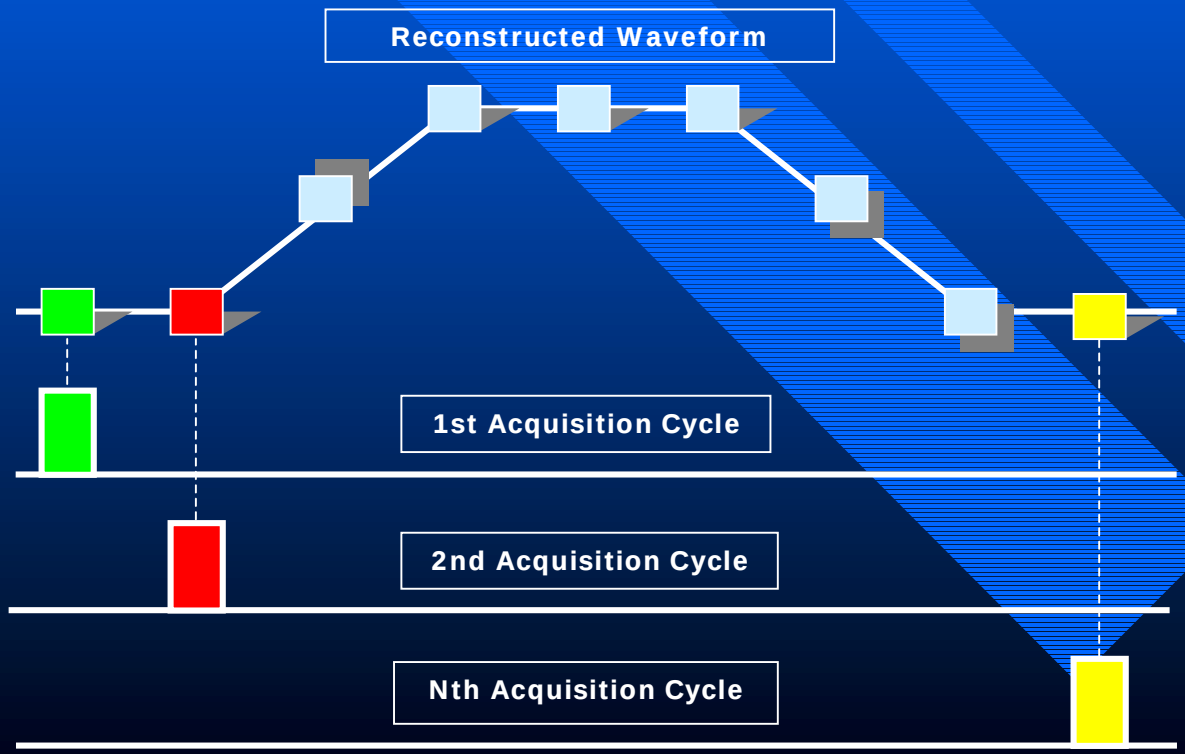
- What affects ease of use?

- ➢ Waveform Update Rate
- ➢ Display Quality
- ➢ User Input Control Response Time
- ➢ Measurement and Math Function Capability
- ➢ Intuitive GUI and Menu Structure
- ➢ PC Connectivity

Sequential Sampling

The **UDS-2128** uses digital sequential sampling technology to acquire and display high bandwidth waveforms.

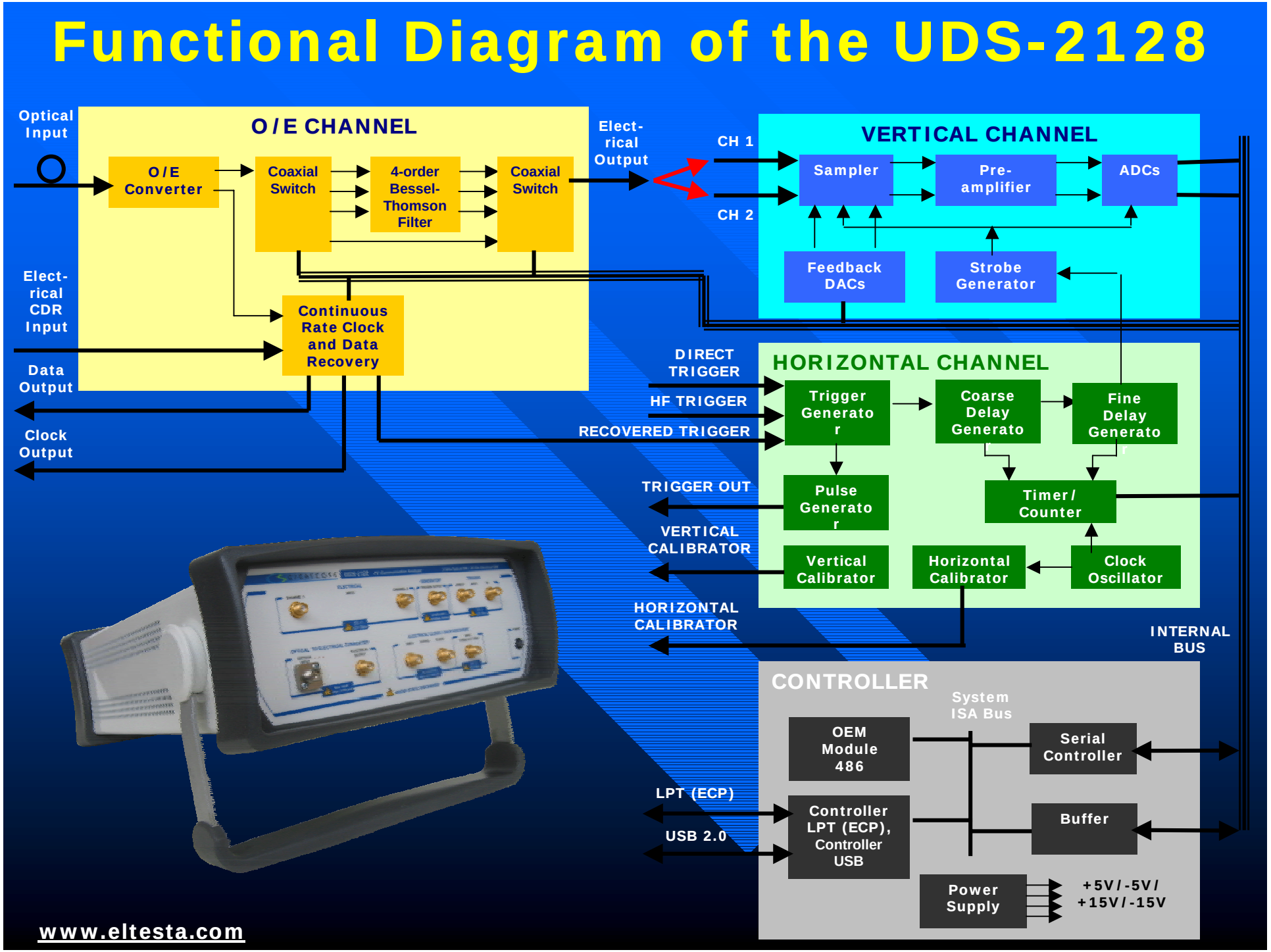
A **sampling oscilloscope** does not continuously monitor the input signal applied to the channel, but looks at it only at discrete points in time. At each discrete point, the oscilloscope samples the signal and stores a replica of the input voltage on an input sampling capacitor.



Sequential Sampling Technique means:

- Wide Bandwidth Applications *(> 1GHz)*
- Used *ONLY* with Repetitive Signals
- *One Sample* is taken for each Trigger
- *Multiple Trigger* Events Build Up Waveform
- *No Pre-Trigger* Information

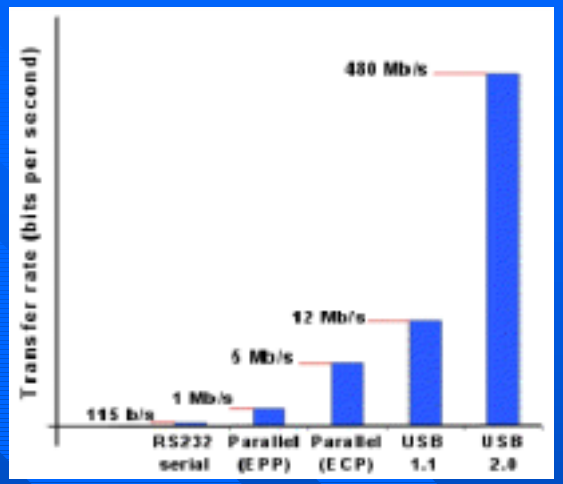
Functional Diagram of the UDS-2128



USB Interface

USB 2.0 for fast data transfer

The UDS-2128 PC-Communication Analyzer is connected to the USB port on any modern laptop or desktop PC. The USB 2.0 interface ensures a quick screen update rate, even when collecting large amounts of data, whilst still retaining backward compatibility with PC's using USB 1.1.



Easy to setup and use

Connecting and using a UDS-2128 USB oscilloscope could not be easier. Simply connect the oscilloscope to the PC using a standard USB cable (supplied). The host PC will automatically detect the UDS-2128 avoiding the need for any complex setup procedures, and without the need to reboot the PC.

Why USB ?

The Universal Serial Bus (USB) has become the standard method for interfacing peripherals to PCs. Today virtually all PCs, including laptops and notebooks, are fully USB-ready and include at least one USB port. The UDS-2128 uses now USB 2.0 Full-Speed USB. This allows UDS-2128 to take advantage of the fast data transfer rate that ensures a quick screen update rate, even when collecting large amounts of data.

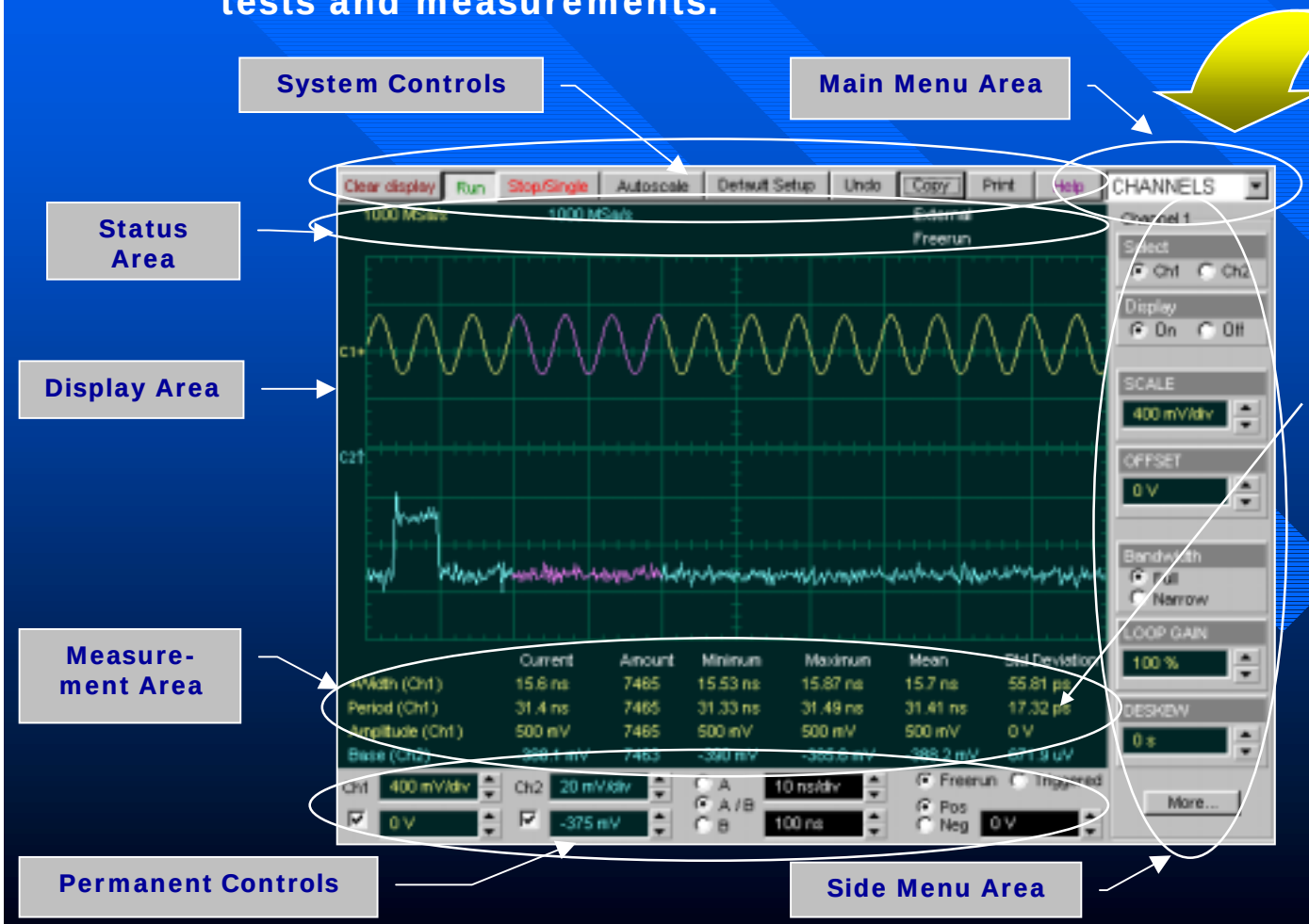
USB 2.0 is backward compatible with USB 1.1 allowing UDS-2128 to be used on older PCs with USB 1.1 ports. Although the data transfer rate will be slower when using USB 1.1, it is still faster than a parallel port connection.

The benefits of USB

- **Easy to use:** All USB peripherals are detected by the PC automatically and can be connected and reconnected without the need for rebooting the PC.
- **Fast:** Transfer rates many times faster than USB 1.1 or parallel port devices.
- **Expandable:** Up to 127 peripherals can be plugged into one host computer.
- **Compatibility:** USB 2.0 is backward compatible with USB 1.1.

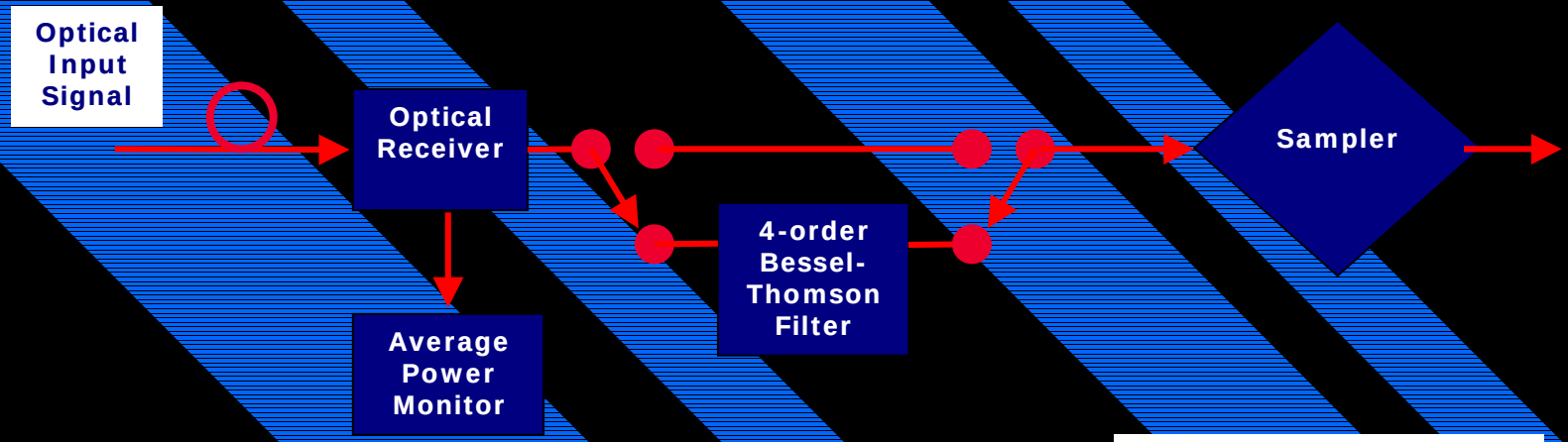
User Interface

The UDS-2128 has a Windows Intuitive Graphical User Interface, so you won't have to spend a lot of time learning or relearning 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.

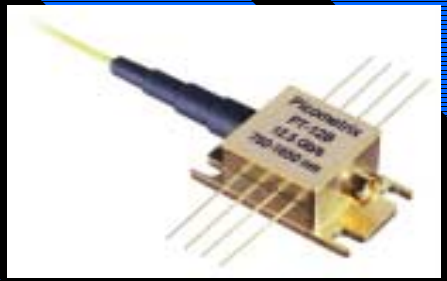


- Original Interface Delivers Intuitive Access to the UDS-2128
- Good organized test results
- View measurements, histogram, marker, mask and limit test results in individual places of Measurement Area

Integrated Optical Channel



- The integrated optical channel can be used as a fully calibrated SONET/SDH/Gigabit Ethernet or Fibre Channel reference receiver or as a wide-bandwidth receiver.



- 9 GHz PIN/TIA module for 12.5 Gb/s rates
- 62.5 μm MM fiber, SMA or GPO output
- 780 nm through 1550 nm applications
- Low frequency response to DC
- Adjustable DC output level
- 400 V/W / Conversion Gain (1310 nm)
- 450 V/A Transimpedance Gain

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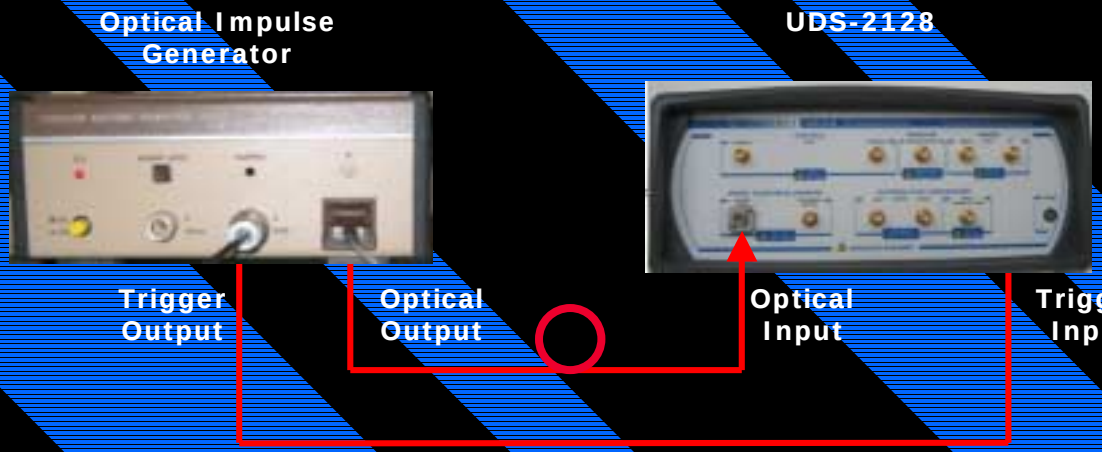
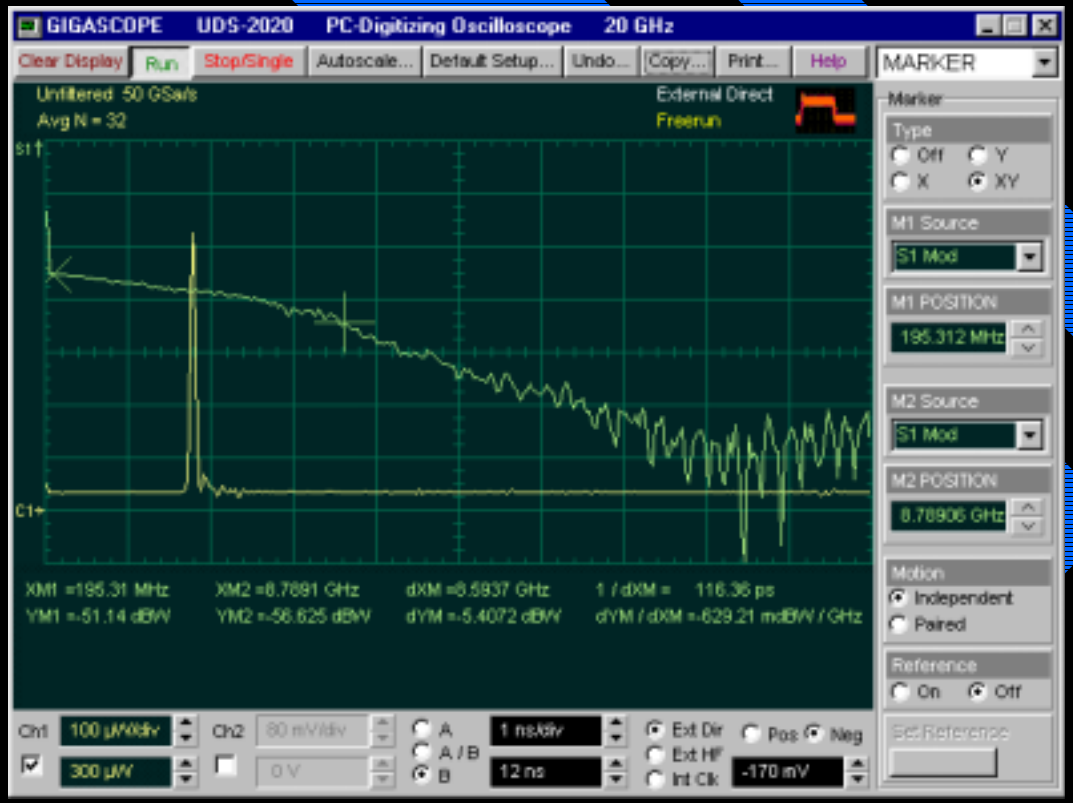
Optical Bandwidth Test





- **Optical Bandwidth Test**
  - **Input Optical Pulse Width: <30 ps**
  - **Unfiltered Optical Bandwidth: 8.6 GHz**

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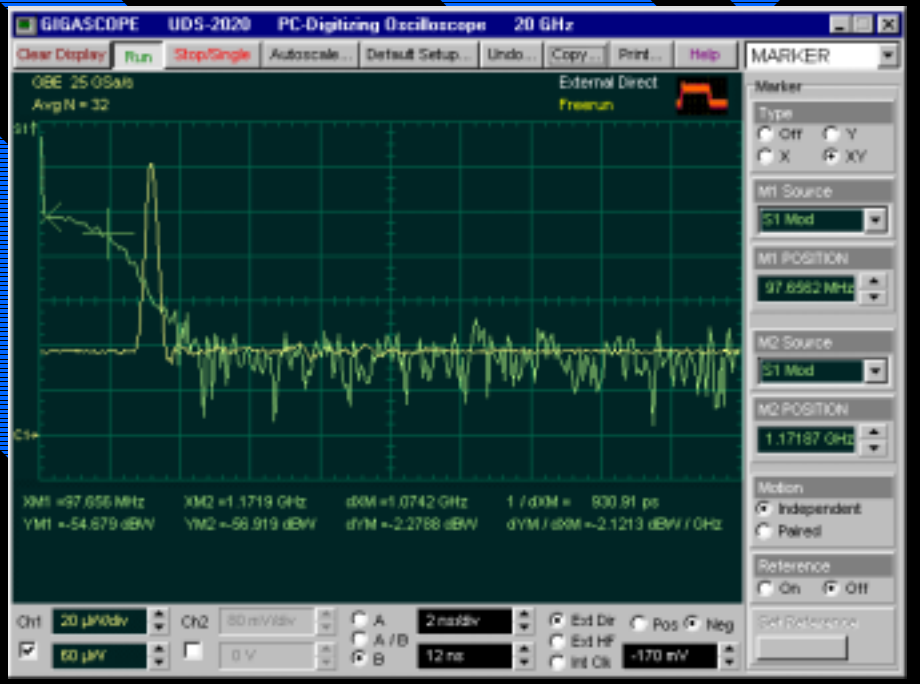
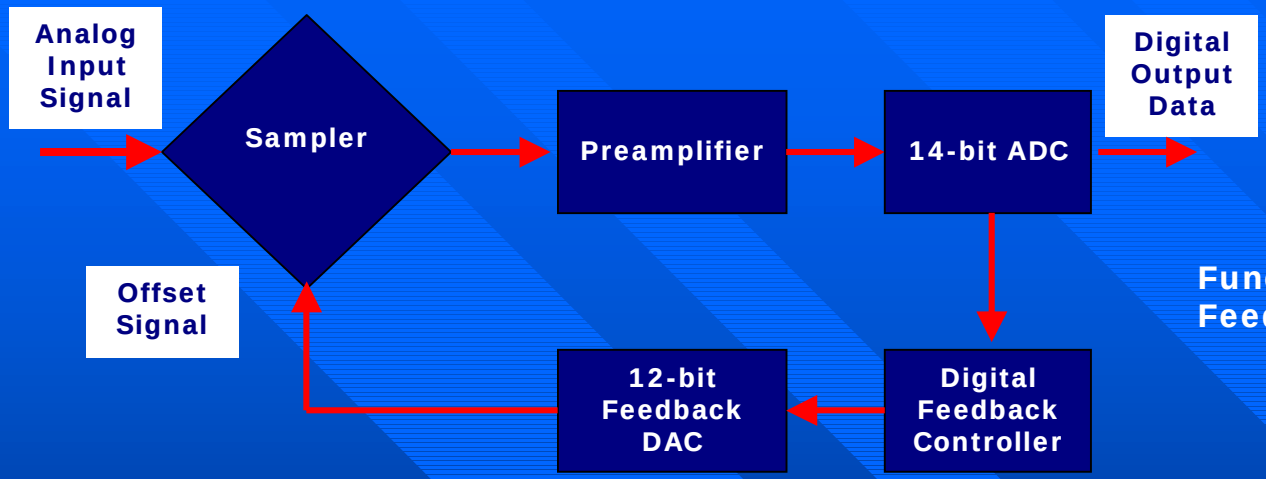
Optical Bandwidth Test (cont.)

Optical Bandwidth Test with OC-48 Bessel-Thomson Filter shows 2 GHz Optical Bandwidth.

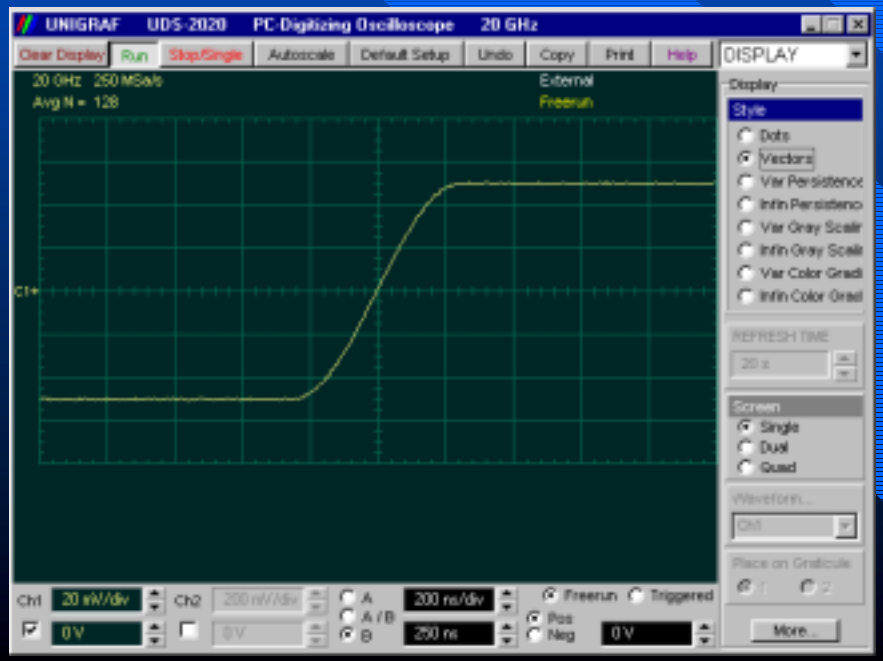
Optical Bandwidth Test with GBE Bessel-Thomson Filter shows 1 GHz Optical Bandwidth.



Digital Feedback Converter



Functional diagram of Digital Feedback Converter



- Digital feedback sampling allows software linearization of the sampling system to provide extremely linear response regardless of the sampling offset.
- Sampling offset can be removed completely, or can feedback previously stored information recorded at discrete instants in time.

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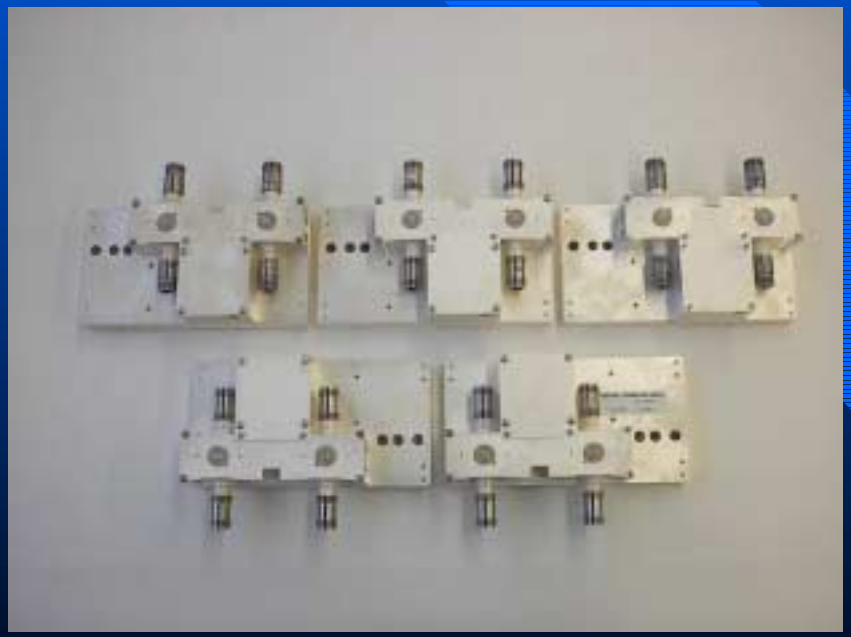
Dual-Channel 20-GHz Sampler

The **UDS-2128** includes a dual-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 ***17.5 ps***, with a typical ***20-GHz*** equivalent bandwidth, and maximum RMS noise ***2 mV*** to ensure clean, undistorted signals.
The electrical channel has both a ***20 GHz*** mode for better waveform fidelity, and a ***12 GHz*** mode for optimum noise performance. Changing the bias on the sampling bridge alters the bandwidth of both channels.



Dual-Channel ***20-GHz*** Sampler used in the **UDS-2128**

Key Specifications of the Sampler:

- Number of Channels - 2 (Simultaneous acquisition)
- Bandwidth (-3dB) – Full BW: DC to ***20 GHz***, Narrow BW: DC to ***12 GHz***
- Rise Time (10%-90%) - Full BW: ***≤17.5 ps***, Narrow BW: ***≤29.2 ps***
- RMS Noise (maximum) - Full BW: ***≤2 mV***, Narrow BW: ***≤1.5 mV***
- Maximum operating input voltage - ***1.0 V p-p*** at ***± 1 V*** range
- Maximum Safe Input Voltage - ***16 dBm***, or ***± 2 V (dc + peak ac)***
- Nominal Input Impedance - ***(50 ± 1) Ω***
- Reflection from Input - ***<±5 %*** for ***40-ps*** rise time
- Input connectors - ***N-type***, 7x3,04 mm (f)
- Channel-to-channel isolation - ***<1 % p-p*** for ***40-ps*** rise time

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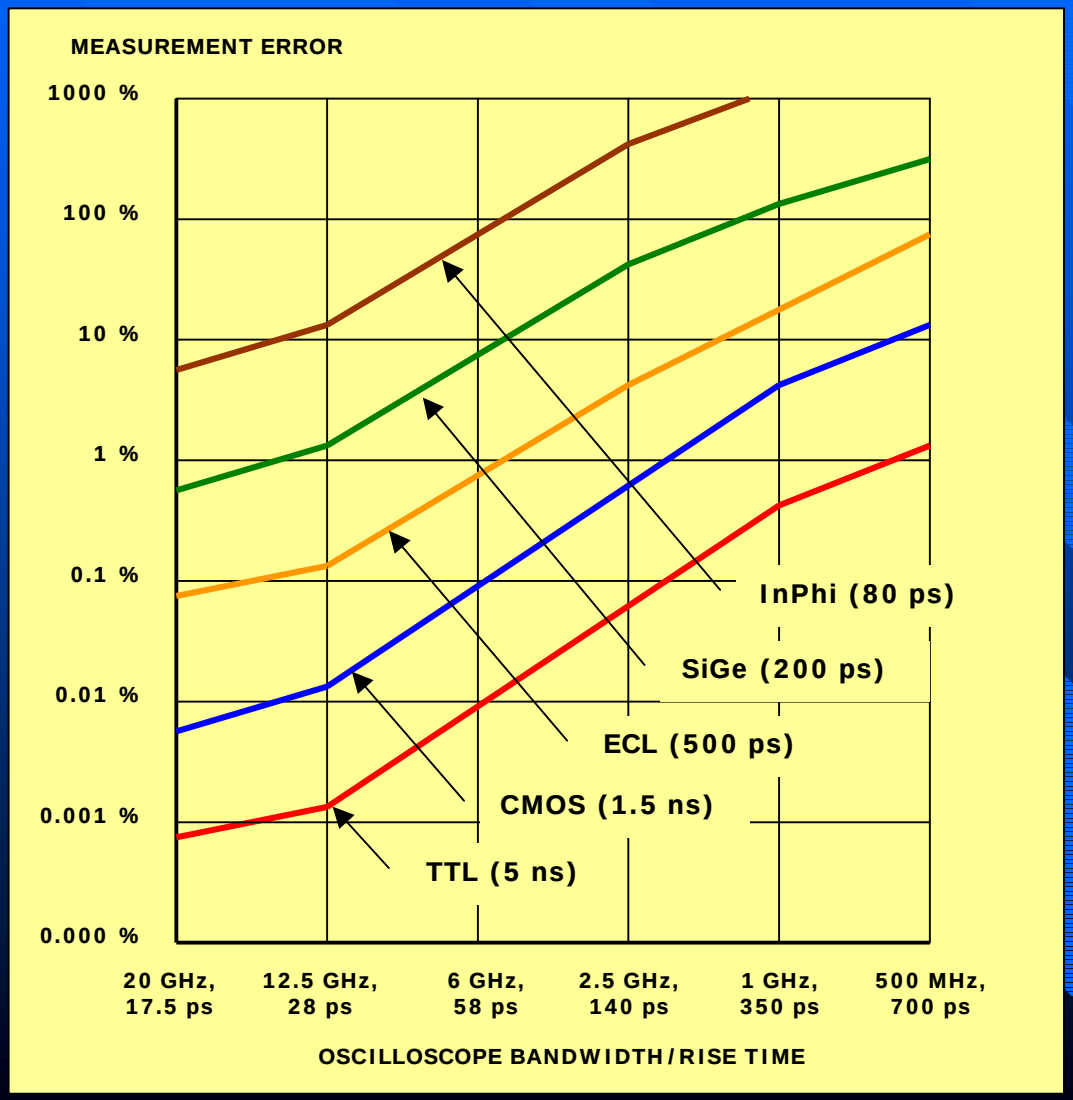
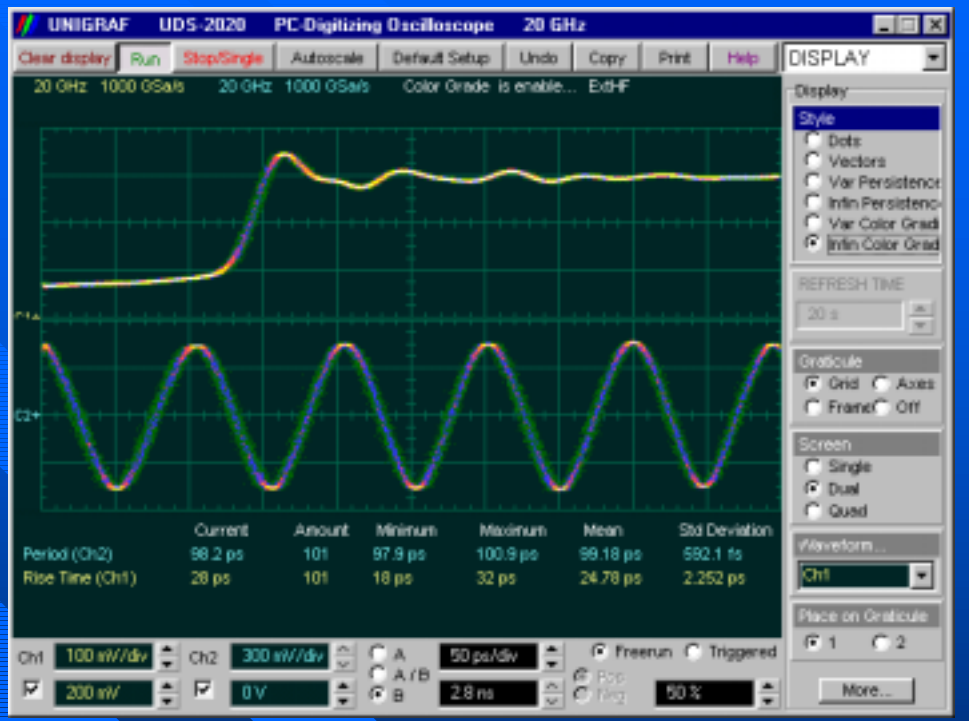
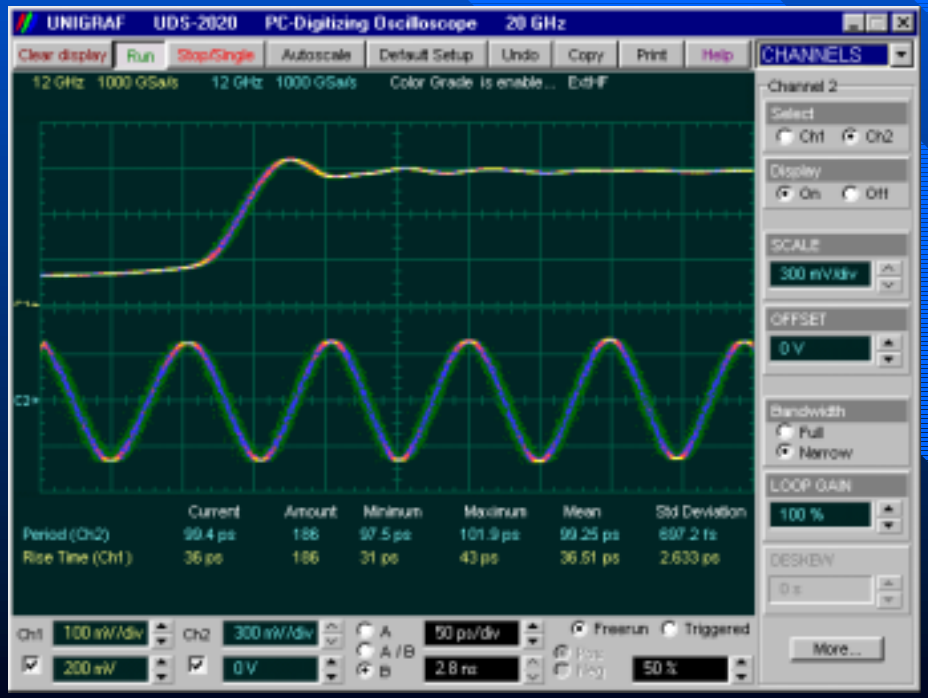
Electrical Rise Time Measurement Error vs. Oscilloscope Bandwidth



When the Scope Bandwidth (BW) is:	Rise Time Slowing Error is:
Equal to Signal Edge BW	▶ 41 %
Twice as fast as Signal Edge BW	▶ 12 %
Three times as fast as Signal Edge BW	▶ 5 %
Five times as fast as Signal Edge BW	▶ 2 %

Selected Sampler Bandwidth





The 20-GHz Full Bandwidth **mode delivers the power and precision to more accurately capture critical signal details**

The 12-GHz Narrow Bandwidth **mode offers the best sensitivity by reducing the noise on the input waveform while still maintaining good frequency response. A lower sampler bandwidth is especially useful for low-level signals that cannot be averaged, such as an eye diagram.**

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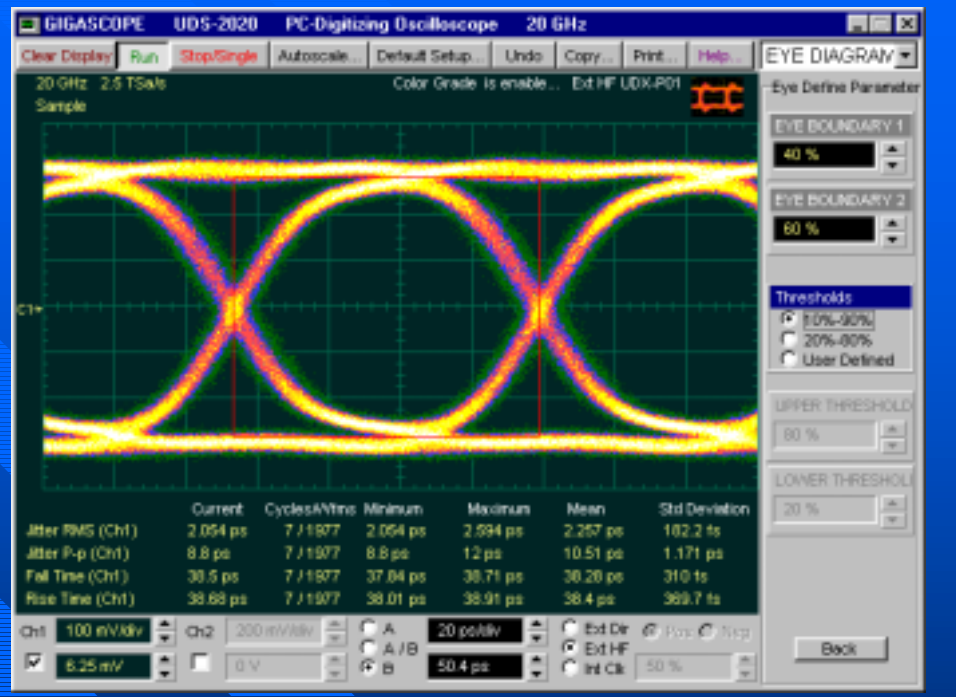
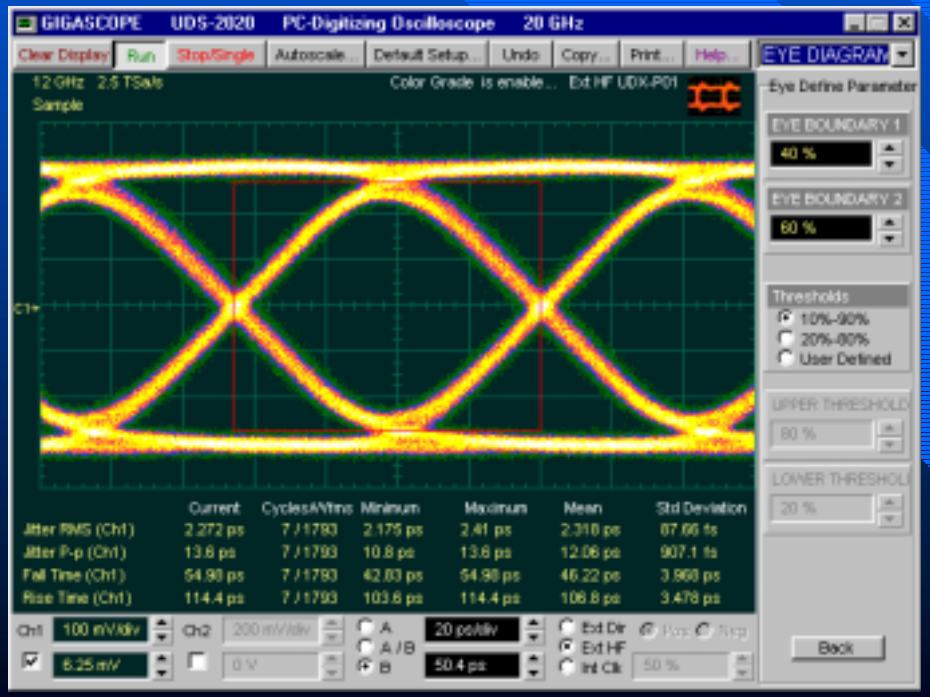
Selected Sampler Bandwidth (cont.)



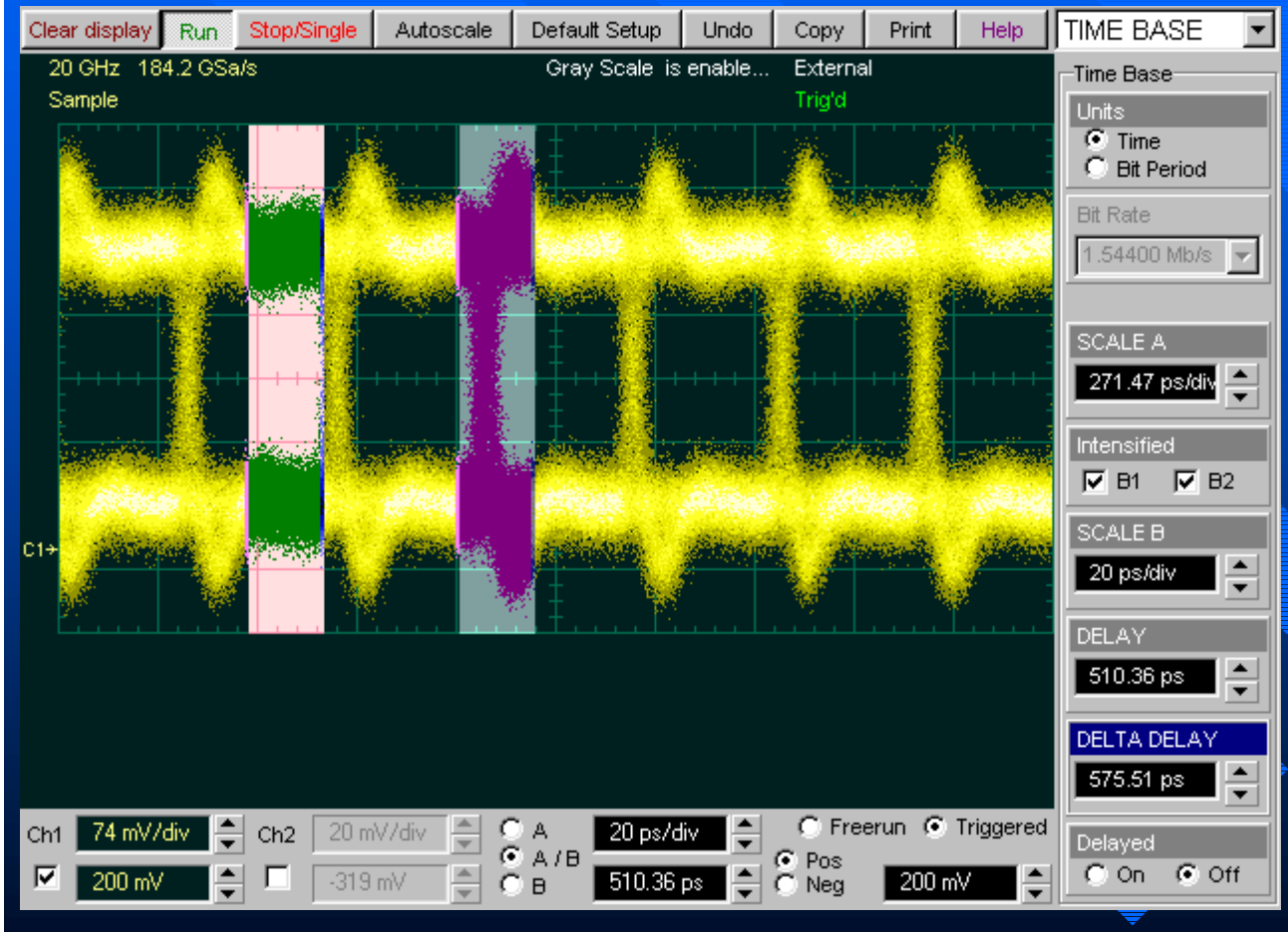
The 20-GHz Full Bandwidth **mode delivers the power and precision to more accurately capture critical signal details. Eye Fall Time=38.28 ps**



The 12-GHz Narrow Bandwidth **mode offers the best sensitivity by reducing the noise on the input waveform while still maintaining good frequency response. A lower sampler bandwidth is especially useful for low-level signals that cannot be averaged, such as an eye diagram. Fall Time=46.22 ps**

Time Base

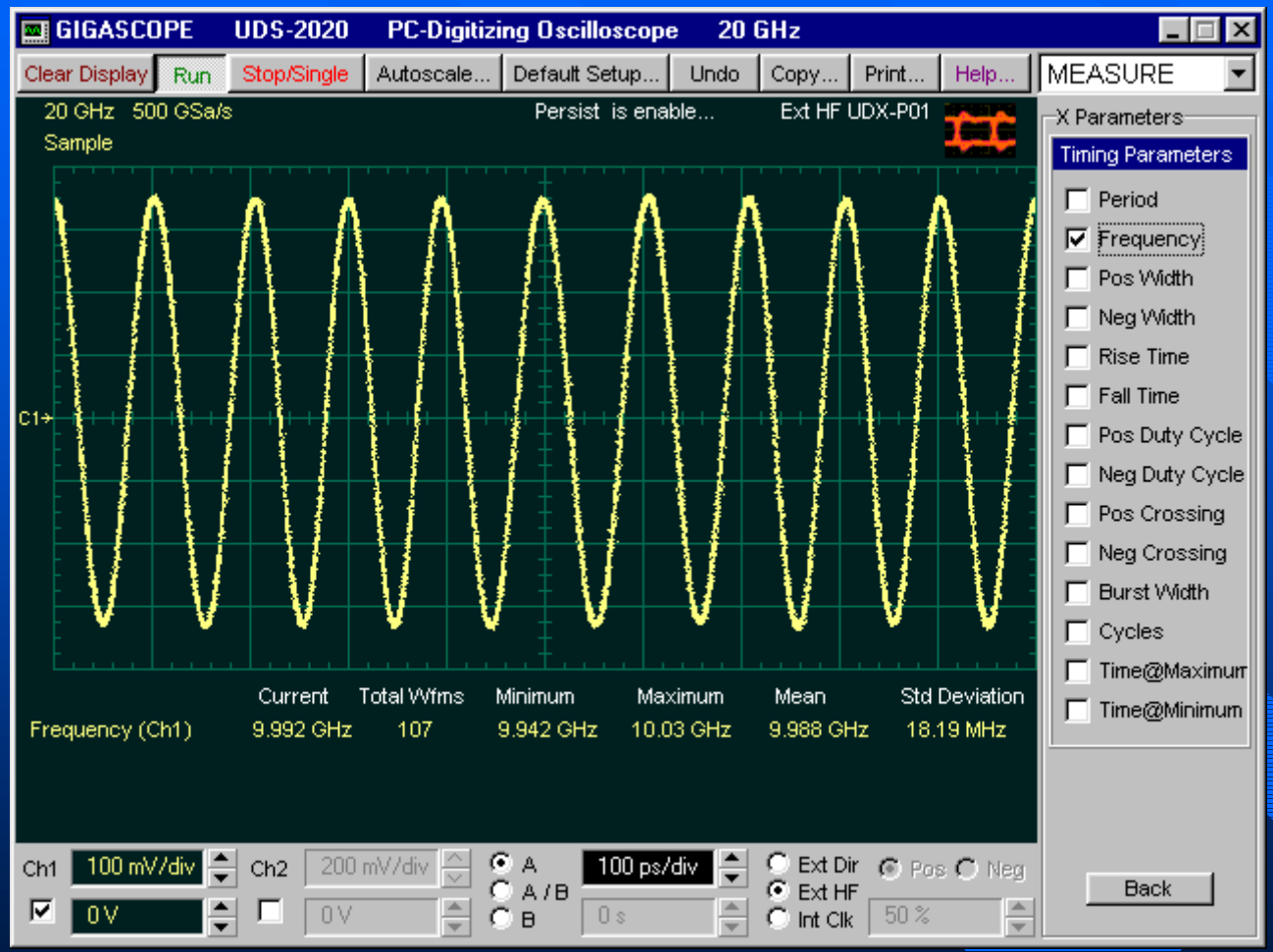
The Time Base allows you to control the horizontal display through the Main, Intensified, Delayed or Dual Delayed time bases also TIME/DIV and DELAY functions.



A *2.5-Gbps* Eye Diagram displayed with dual-intensified time base

- **The Units function of the UDS-2128 Time Base lets you set the instrument time base to:**
  - Basic time units (second)
  - Meter, foot, inch
  - Bit period (data rate)
- **Bit period units provide an easy and intuitive way to display digital communication signals.**
- **TIME BASE:**
  10 ps/div to 2 ms/div
- **Delta Time Interval Accuracy:**
  ± 0.4 % of reading ± 10 ps ± 100 ppm of delay setting (typical)

Time Base Preciseness

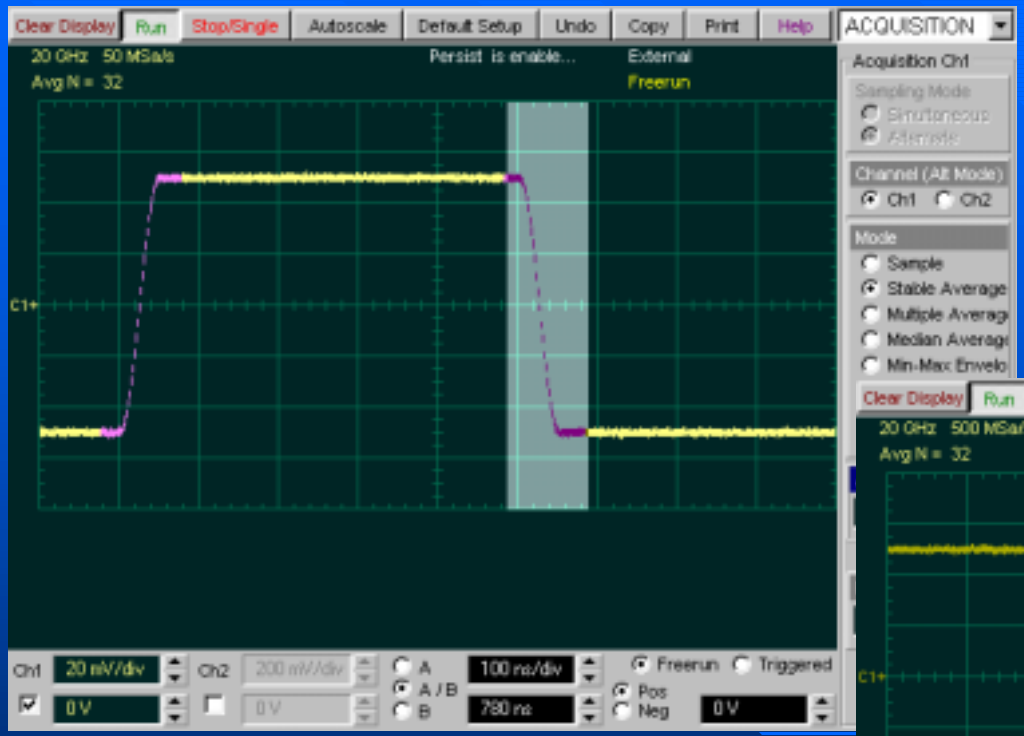


A *10-GHz* Sine-wave signal displayed with *100 ps/div* time base

The *UDS-2128* time base settings could be adjusted from *2 ms/div* to as low as *10 ps/div*. With a *10 ps/div* setting, the full span of the instrument is *100 ps*. Thus a *10 GHz* (or *10 Gb/s*) signal, with a *100 ps* bit period, would have one bit period displayed. When displaying eye diagrams, it is typically preferred to display a single bit period on a *60 %* of full horizontal screen. The ideal time span for a *10 Gb/s* eye diagram should be somewhere between *16 ps/div* and *12 ps/div*.

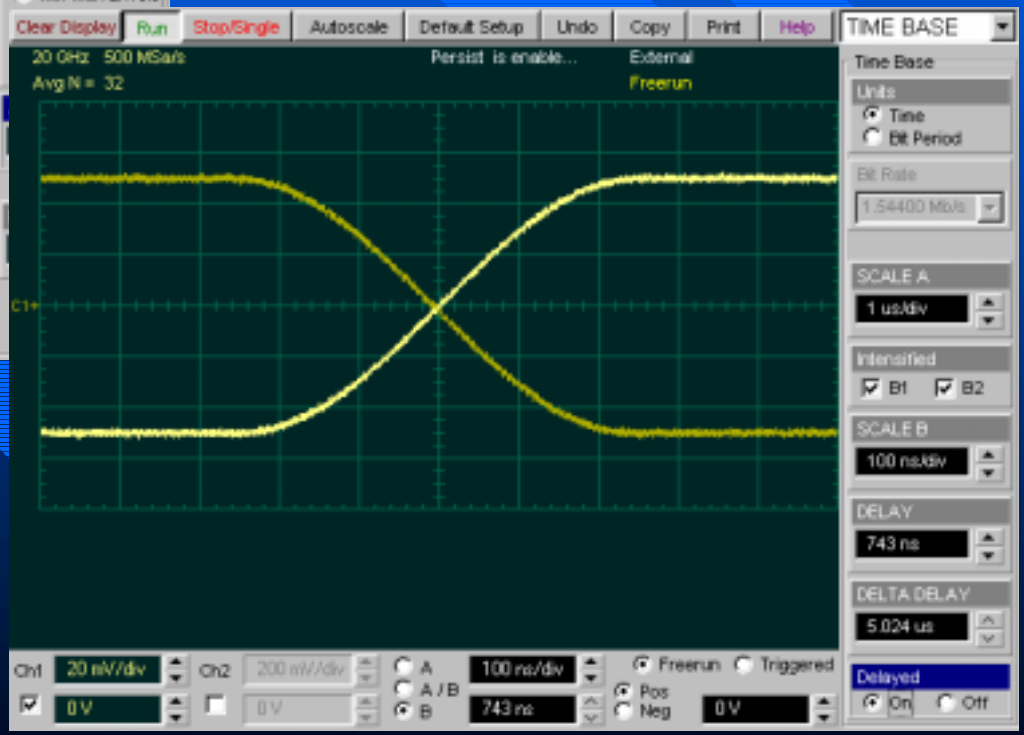
- **TIME BASE SCALE:** *10 ps/div to 2 ms/div*
- **Time Base Resolution:** *<100 fs*
- **Delta Time Interval Accuracy:** *± 0.4 % of reading ± 10 ps ± 100 ppm of delay setting (typical)*

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

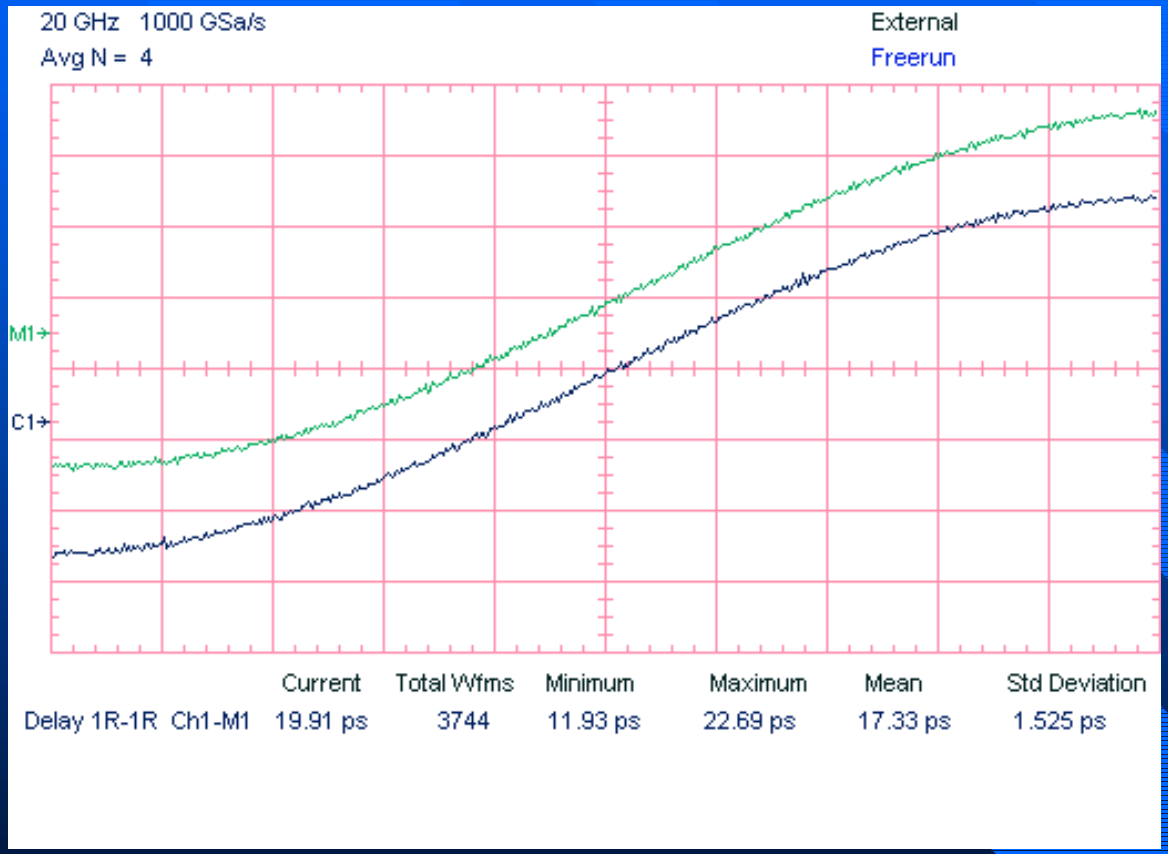
- Expanded time base allows you to pinpoint and to horizontally expand a portion (or two portions) of the signal for a more detailed or high-resolution analysis



- 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 = ***39.7 ns***

Precise Measurements by using Windowing

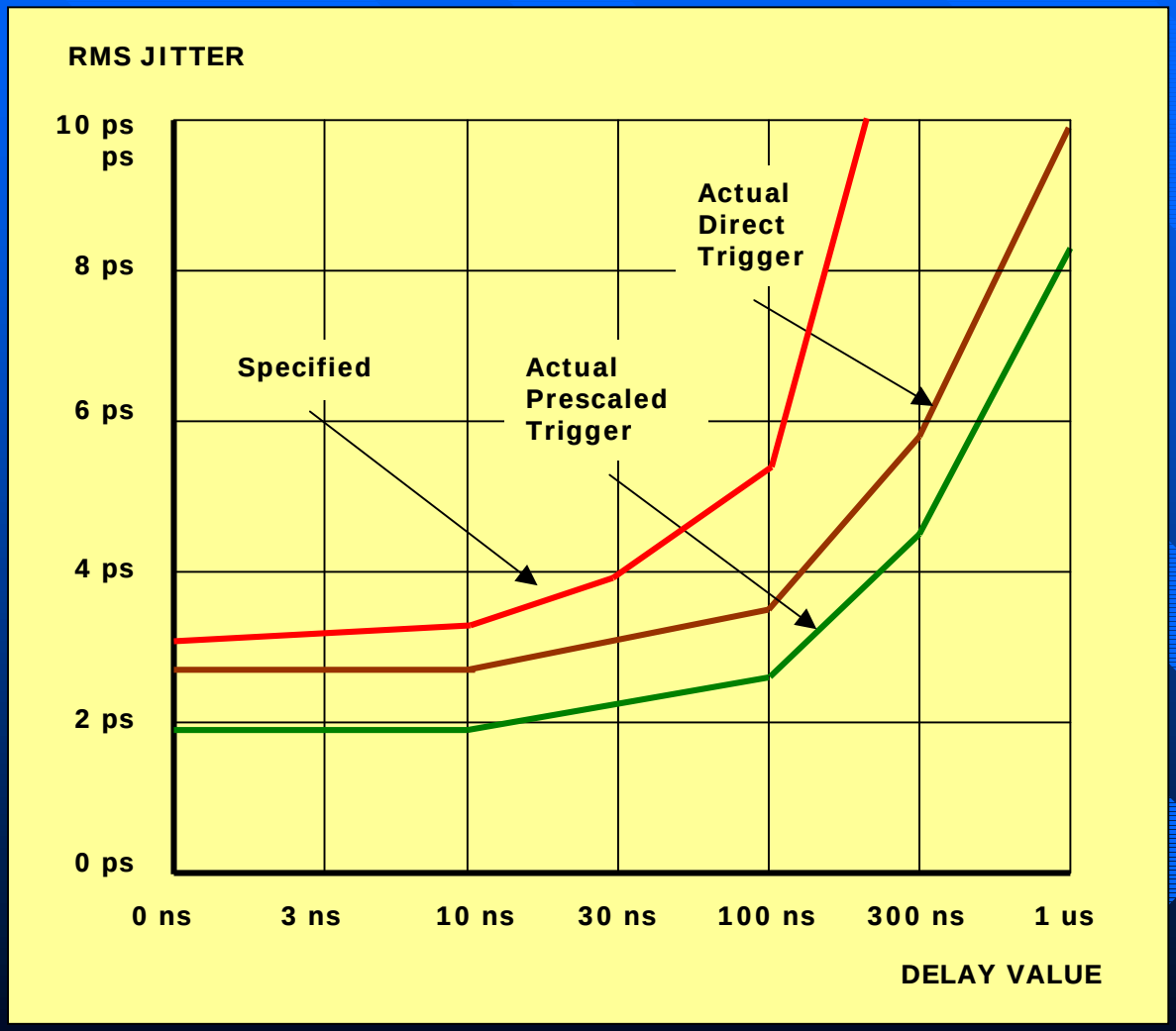


- **UDS-2128** windowing capability can be used to make precise measurements, including propagation delay measurements with ***0.1 ps*** timing resolution.

- Channel deskew capability provides accurately delay measurements in today's high-speed digital systems.

The **UDS-2128** measures ***17.33-ps*** delay between two sources

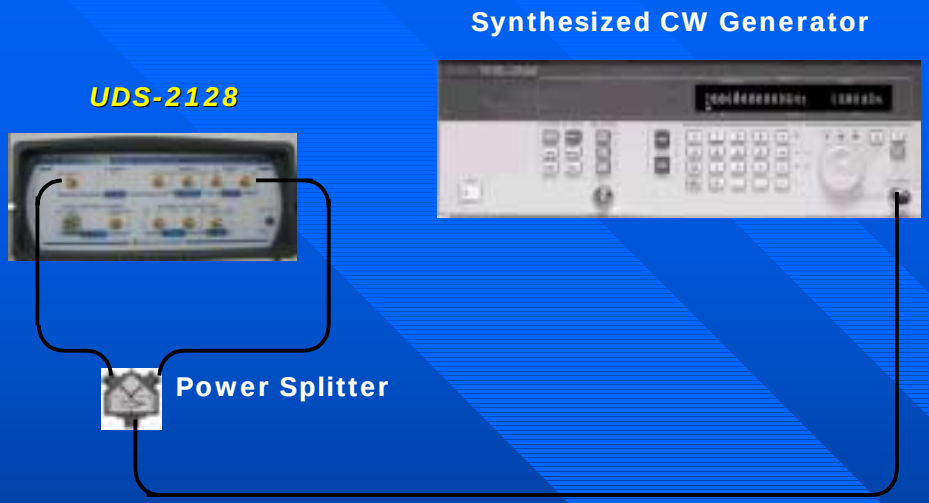
Long Delay Measurements



- **Timing accuracy leads to waveform jitter:**
  - How much uncertainty exists in determining the precise time when a sample is taken
  - A trigger event determines when the sampling process should begin
  - The time between a trigger event and the sampling event is often several tens of nanoseconds
  - Maintaining sub-pico-second timing precision over multiple nanosecond time span is extremely difficult
- **RMS Jitter**
  Max: ***2.5 ps + 50 ppm of Delay***
  Typ: ***2.0 ps + 30 ppm of Delay***

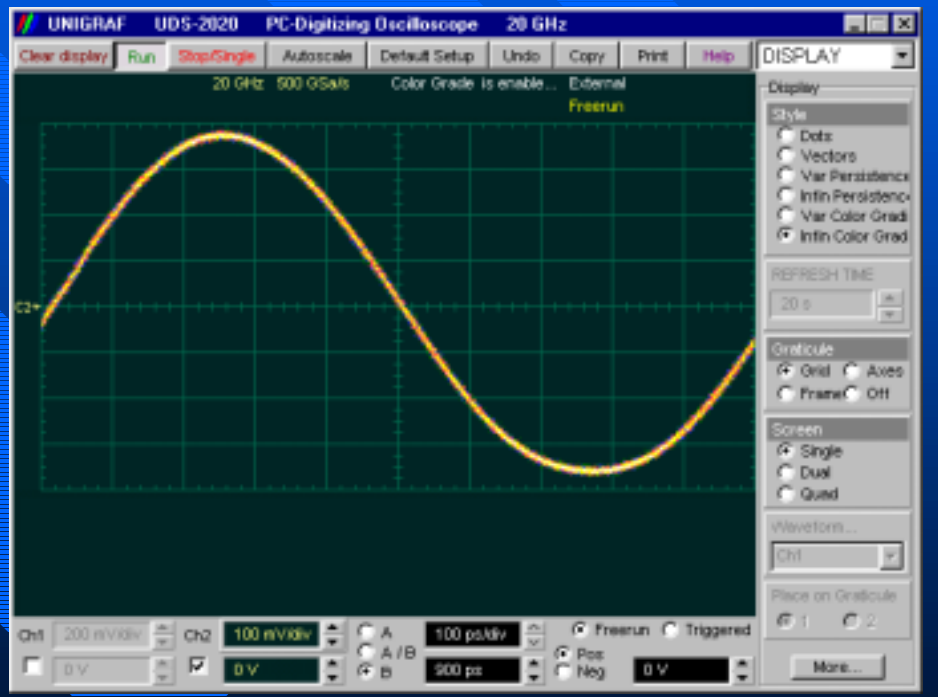
UDS-2128: RMS Jitter vs. variable Delay value

Direct Trigger



Equipment connections for Direct Trigger Test

The power of wide-bandwidth sampling oscilloscopes is largely useless without fast, low-jitter triggering. UDS-2128 is equipped with built-in direct trigger for signals up to *1 GHz* repetitive rates without using an external trigger unit.

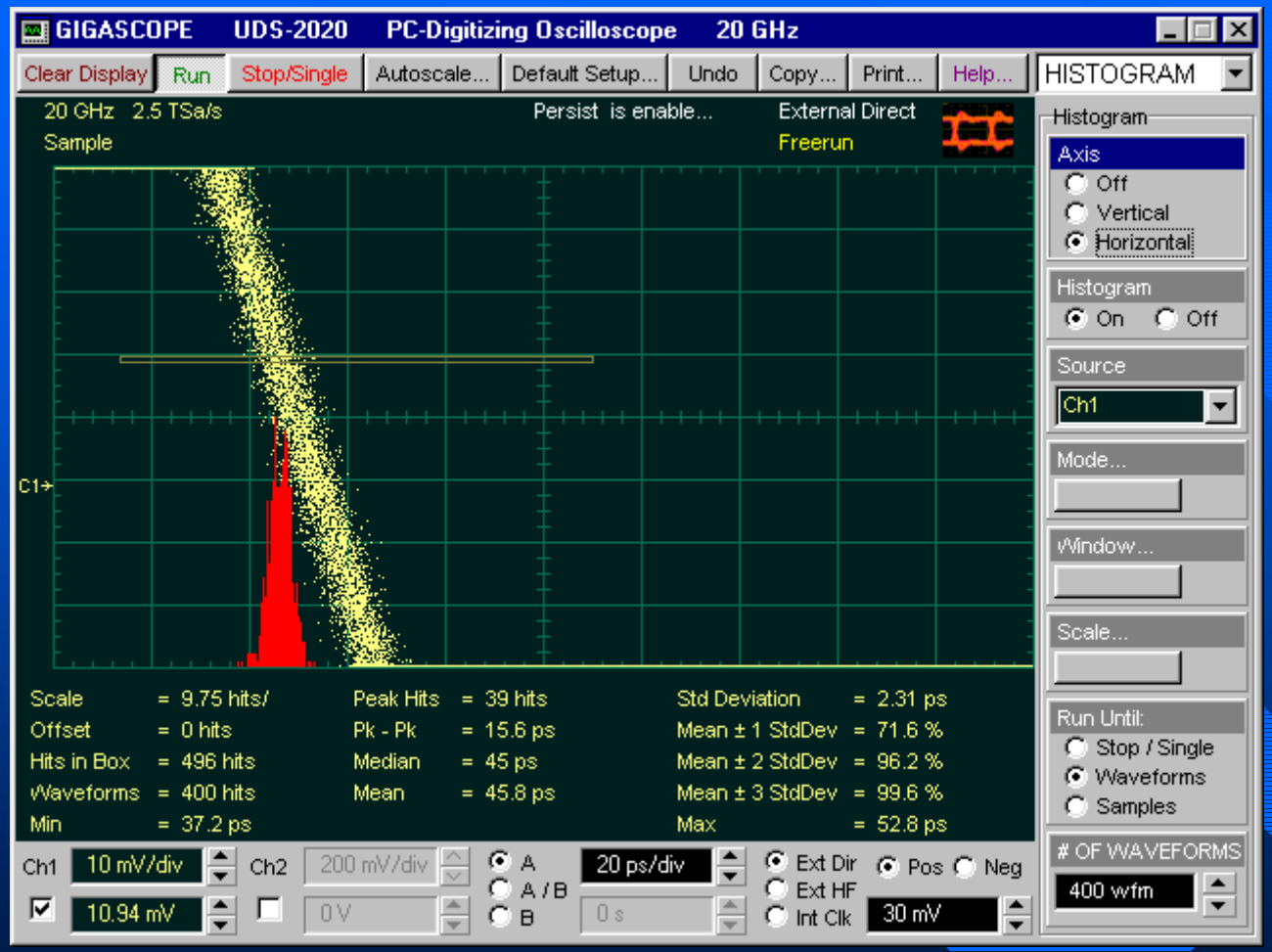


A typical picture of *1 GHz* signal by using Direct Trigger

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
- *<2.5 ps* max RMS jitter (*2 ps* typ)

Direct Trigger Jitter

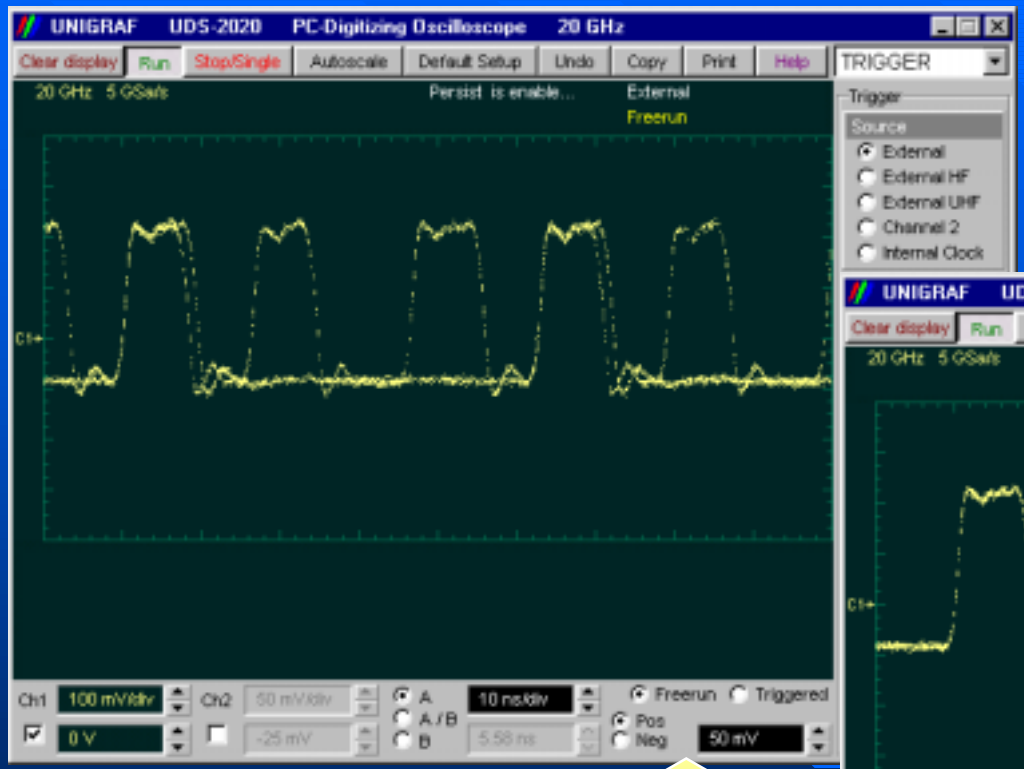


Timing accuracy leads to waveform jitter.

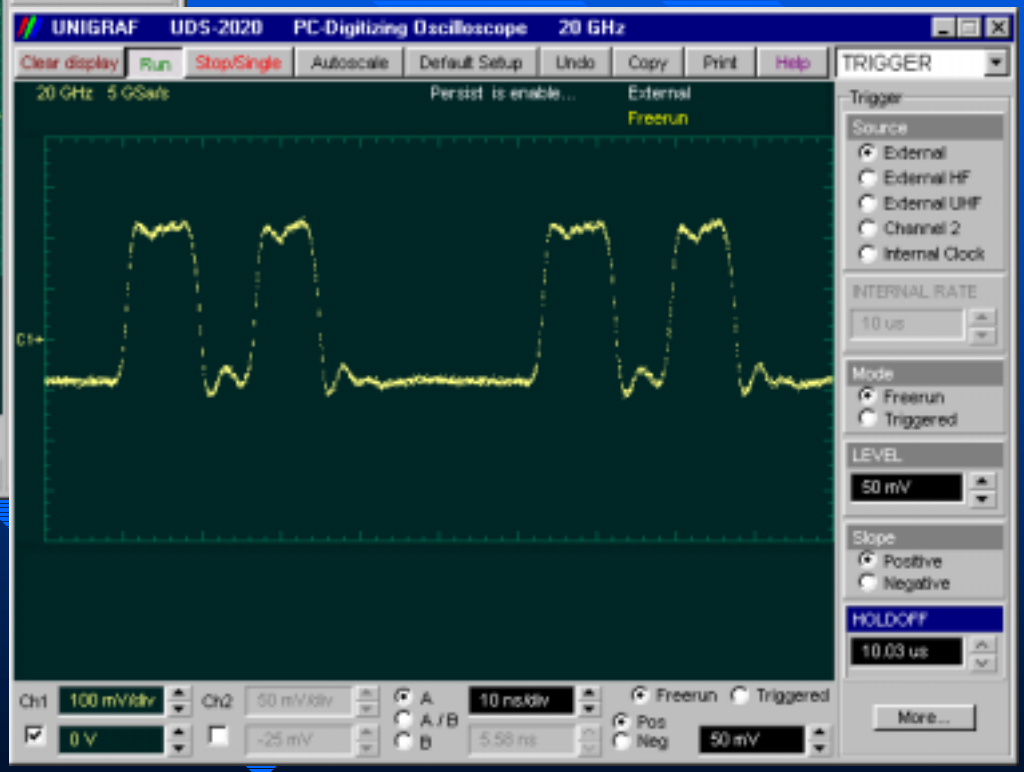
- **RMS Direct Trigger Jitter :**
  - **Max *2.5 ps + 50 ppm of Delay***
  - **Typ: *2.0 ps + 30 ppm of Delay***

A typical picture showing *2.31 ps* RMS Direct Trigger Jitter with *1-GHz* sine wave signal measured on *400 acquisitions*.

Adjustable Trigger Holdoff



Adjustable Trigger Holdoff allows locking on a particular point in a pulse train or in irregular repetitive signals, such as radar signals.



Left picture shows unstable trigger of signal from *20-MHz* Double Pulse Generator.

Right picture shows stable trigger of the same Double Pulse signal with a *30-ns* Trigger Holdoff adjusted with *2-ns* increment.

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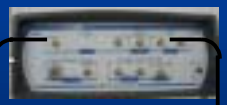
HF Prescaled Trigger

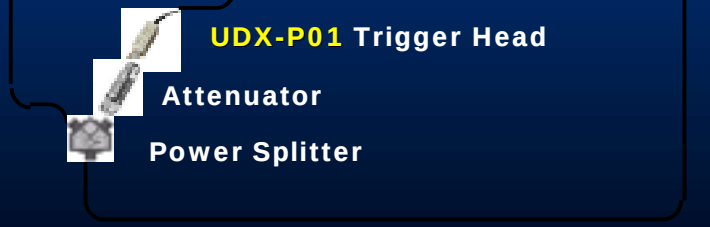
The UDX-P01 Trigger Head is an AC-coupled *12 GHz* prescaler for triggering on high-speed data without cumbersome manual adjustment, as bit rates *9.6 Gbits* and beyond. The heart of the Head is a low noise GaAs frequency Divide-by-8. Low RMS jitter *<2.0 ps typ* is available.

The UDX-P01 Trigger Head and its different options

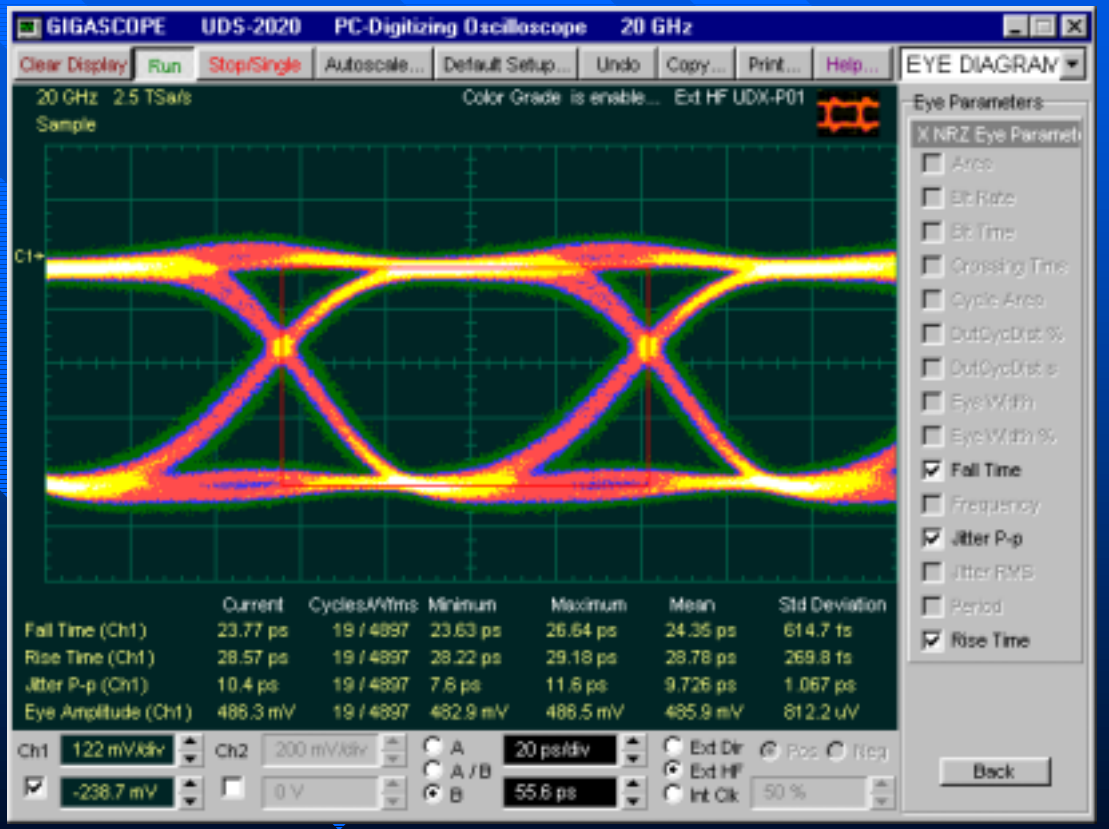
UDS-2128



Synthesized CW Generator



Equipment connections for Prescaled Trigger Test



12 Gbit eye-diagram made with *UDX-P01* Trigger Head. Output: CML. Low-level *9.7 ps* P-p Jitter is provided.

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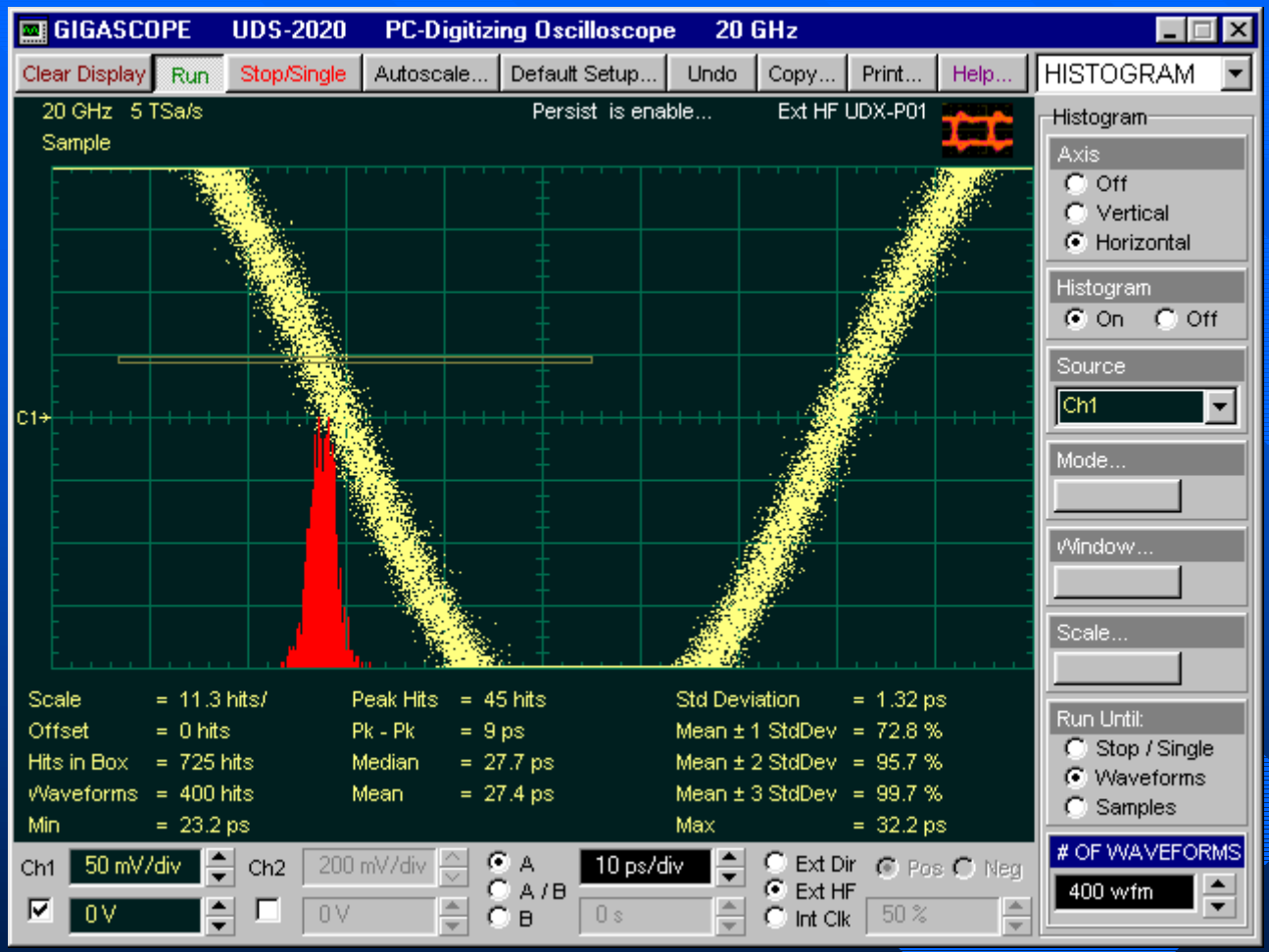
Trigger Jitter with HF Prescaler



Timing accuracy leads to waveform jitter.

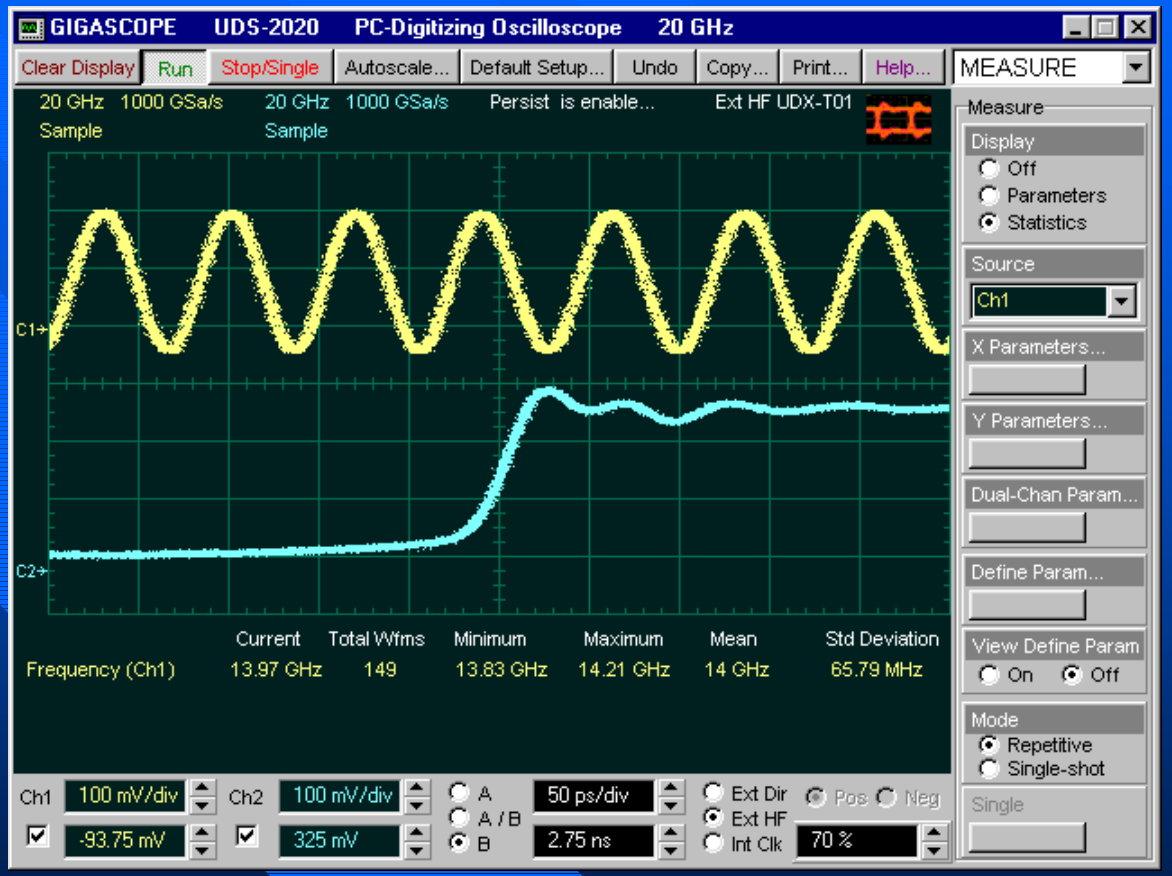
- **Max RMS HF Trigger Jitter: *2.5 ps***
- **Typical RMS HF Trigger Jitter: *2.0 ps***

A typical picture showing *1.32 ps* RMS HF Trigger Jitter with *10-GHz* sine wave signal measured on *400 acquisitions*.

HF Countdown Trigger

The UDX-T01 Trigger Head is a free-running tunnel diode oscillator with a control to synchronize the oscillator to a sub harmonic of the input trigger signal.
The head provides stable display of signals from *0.5 to 10 GHz* with less than *100 mV p-p* sensitivity and low RMS jitter *<2 ps max*.

UDX-T01 Trigger Head



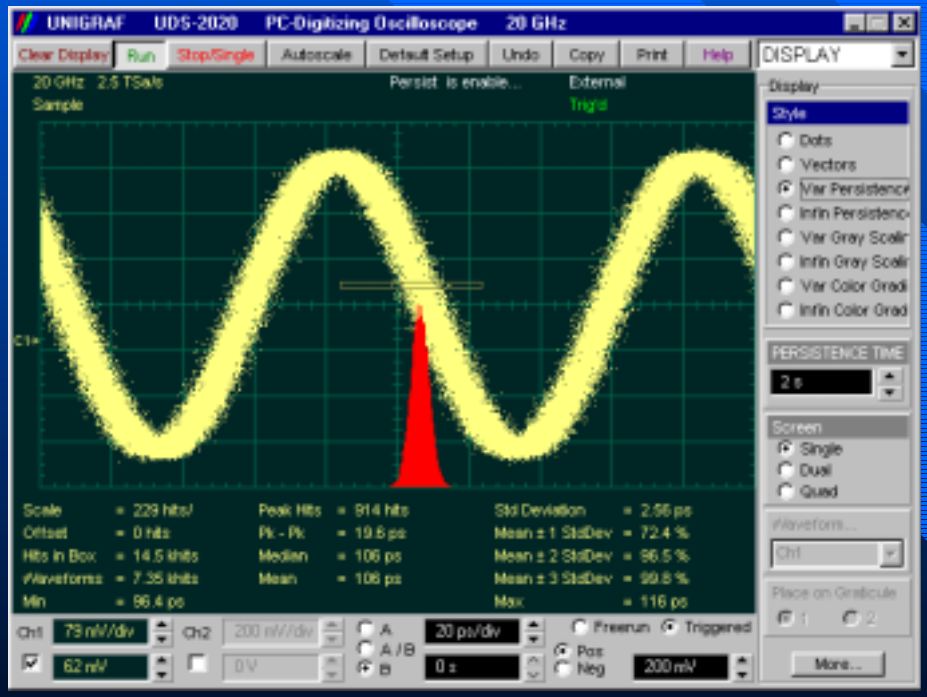
A waveform of *14-GHz* sine wave signal triggered with UDX-T01 Trigger Head together with fast step generated from UDX-G01 Pulse Head.

Averaging Reduces Noise

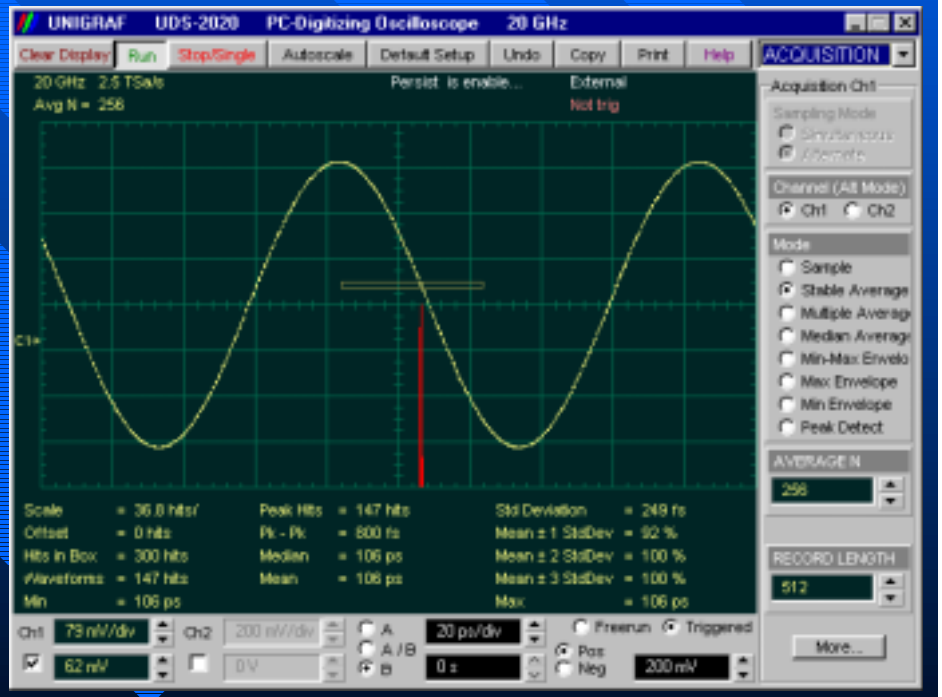
Averaging is often used eliminate random noise on the display and increase resolution and accuracy of measurements. If a waveform is "buried" in noise, averaging can be used to extract a signal from the noise as shown in this illustration.

- **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 UDS-2128 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.

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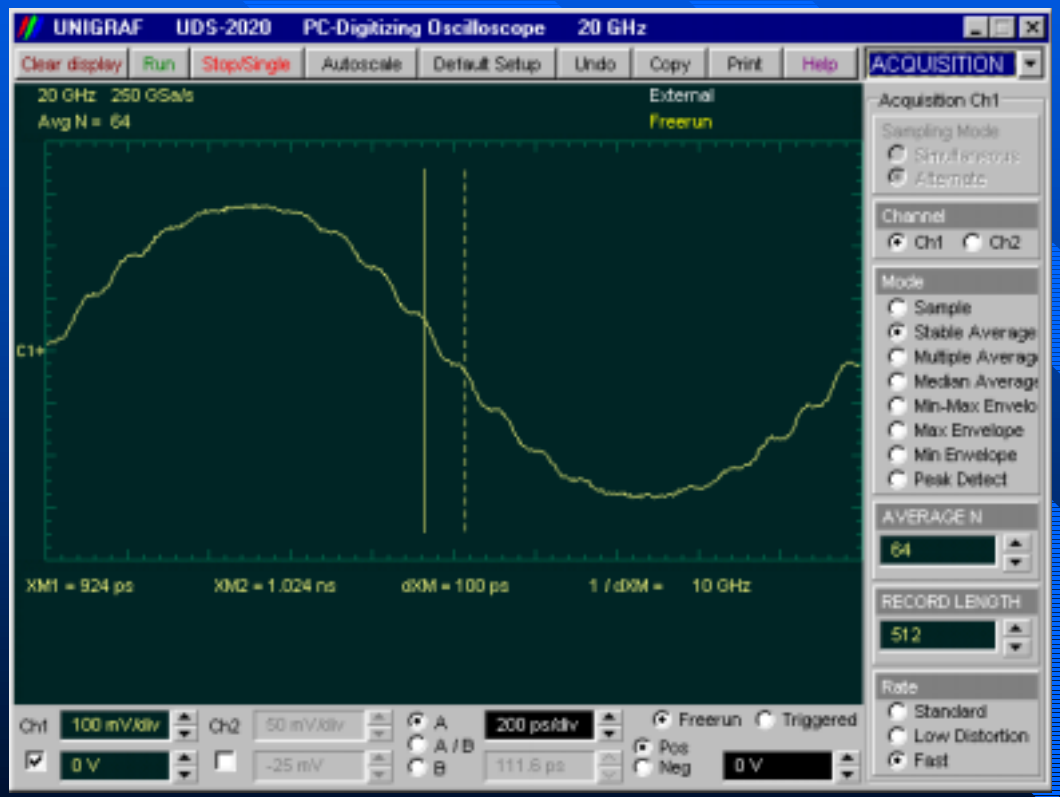
Averaging Extracts Synchronous Harmonic Components

Significant application of Averaging is to extract individual noise components from noisy signal. The output signal can be a composite of the input signal plus several noise components (synchronous and non-synchronous).

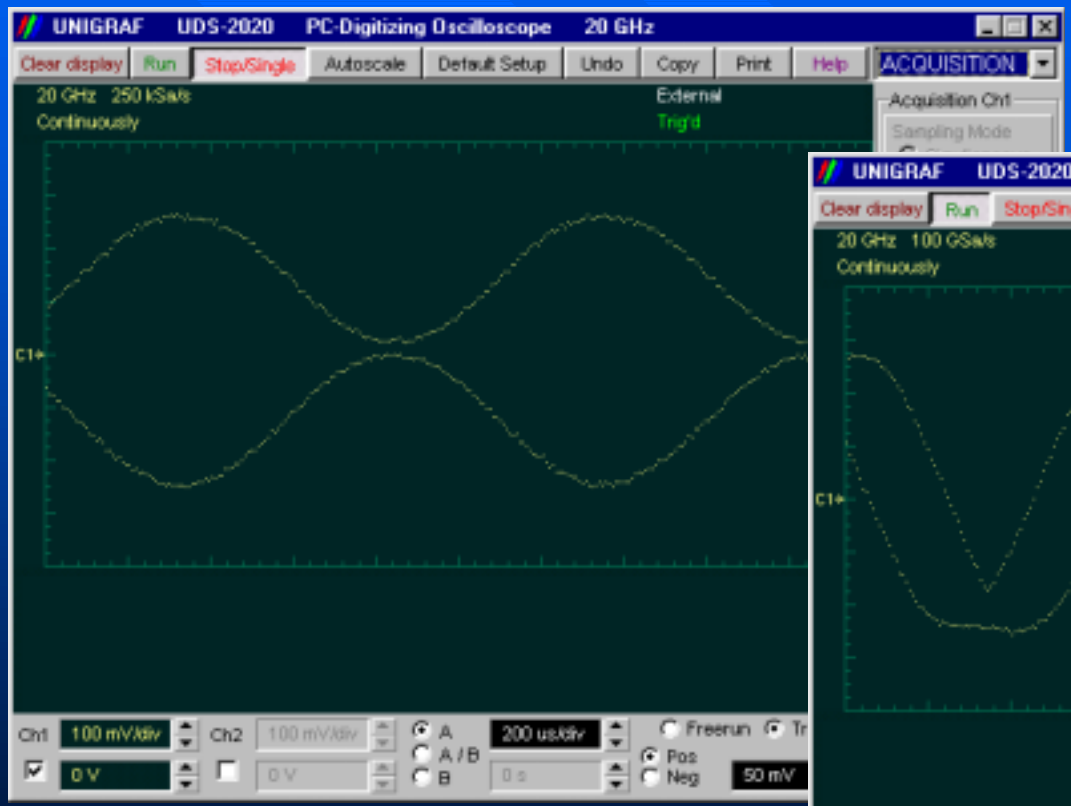


- All signal components (noise and signal) that are non-synchronous with the "suspect" will be "averaged out".
- Low-level synchronous components can be viewed without visual interference from the other noise components.

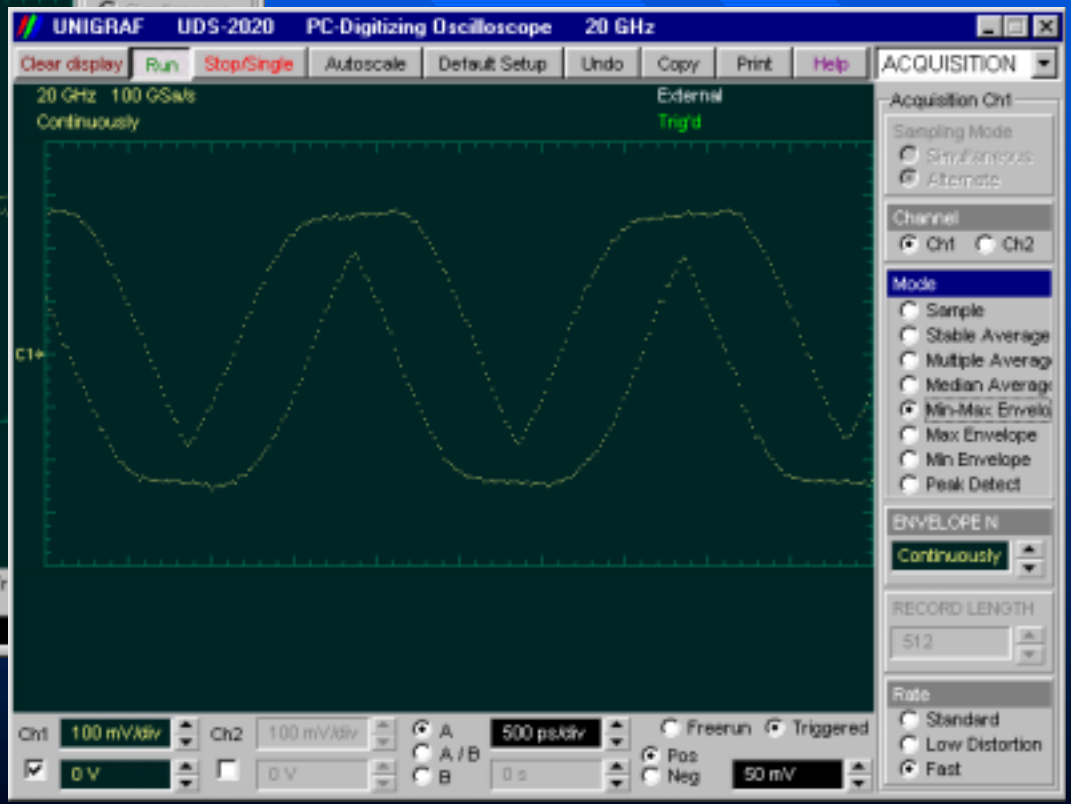
Averaging helps to extract synchronous low-level *10-GHz* harmonic components from *500-MHz* signal

Enveloping

When one of the envelope mode is selected the UDS-2128 lets you acquire and display a waveform that shows the variation extremes of several acquisitions over a period of time. The oscilloscope detects peaks.



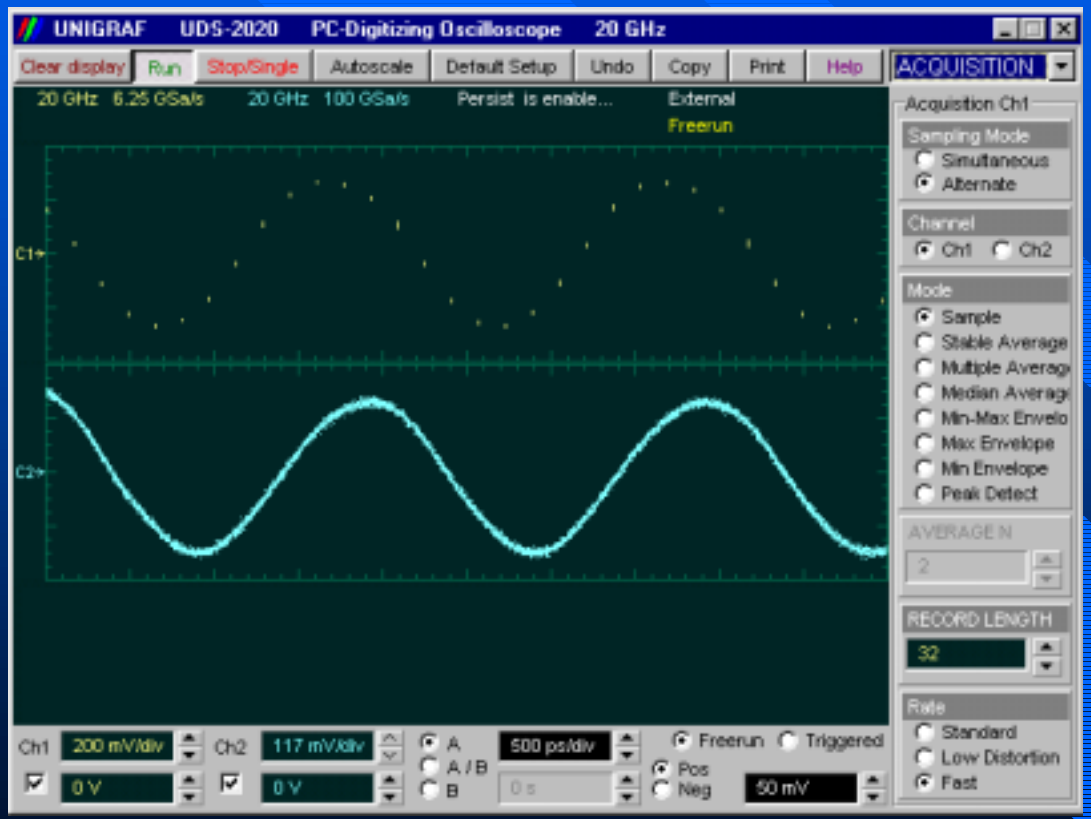
Min-Max Envelope detects *1-kHz* AM signal



Min-Max Envelope accumulates noise of *500-MHz* signal

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 UDS-2128 can be selected from *32* to *4096* samples by a multiple of two.

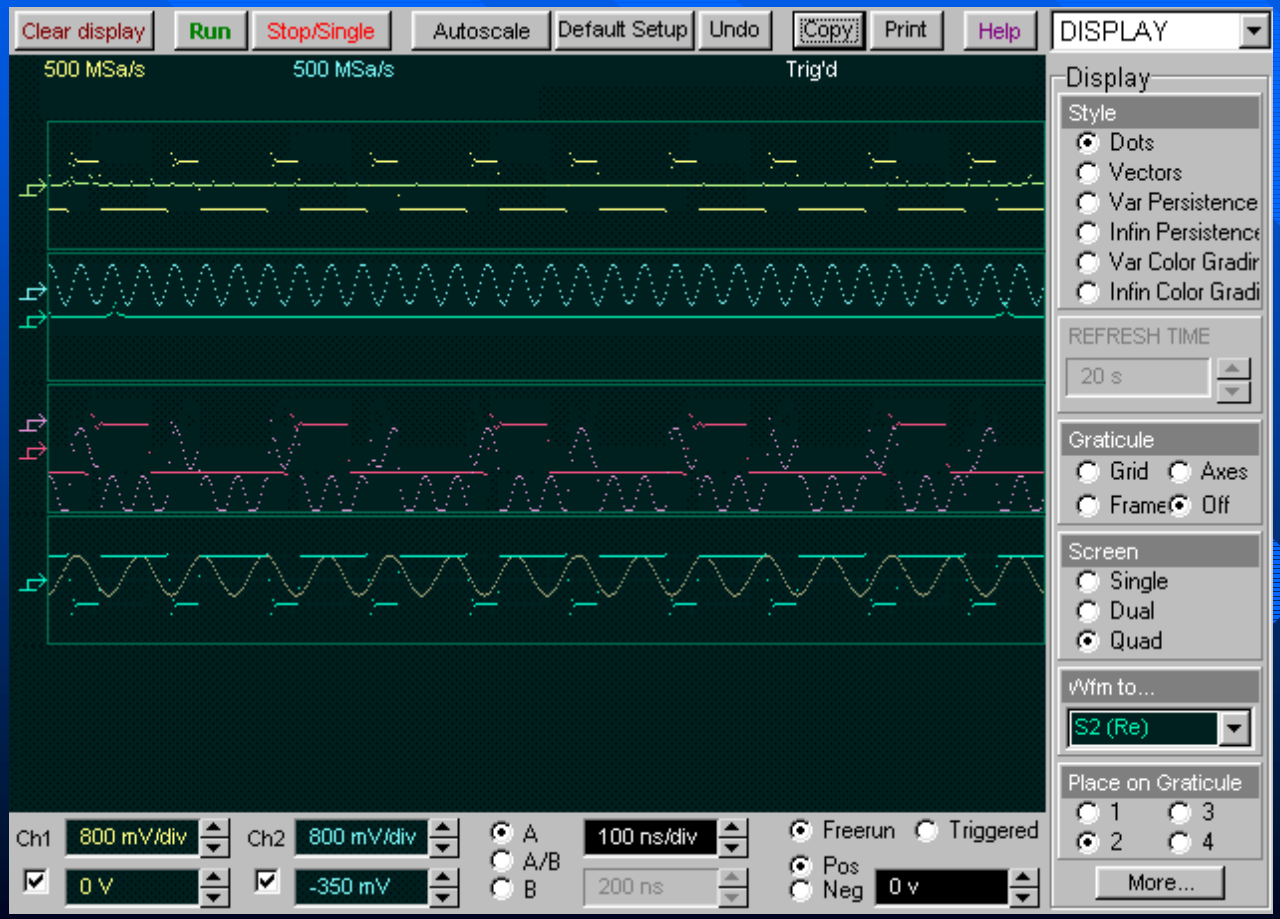


UDS-2128 traces with Record Length of *32* (top) and *512* (bottom) samples

- **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.**

Multi-Waveform Display

Up to eight traces can be displayed at the same time. The UDS-2128 can display two channels, four waveforms from waveform memories, four math waveforms (functions), and two FFTs (spectrums). Real and imaginary parts of memories, functions, and spectrums can be displayed separately.

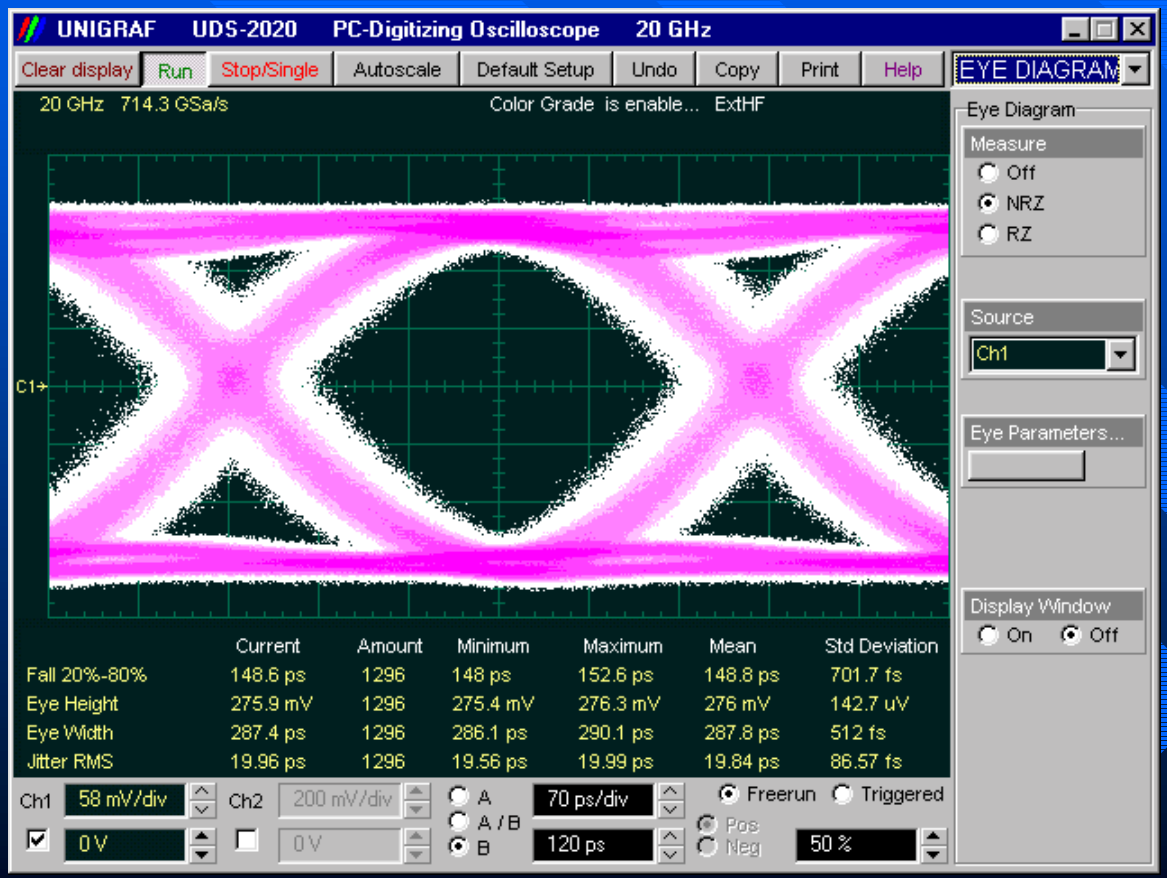


UDS-2128 eight-waveform display

The UDS-2128 color GUI dedicates a different color for 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, 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

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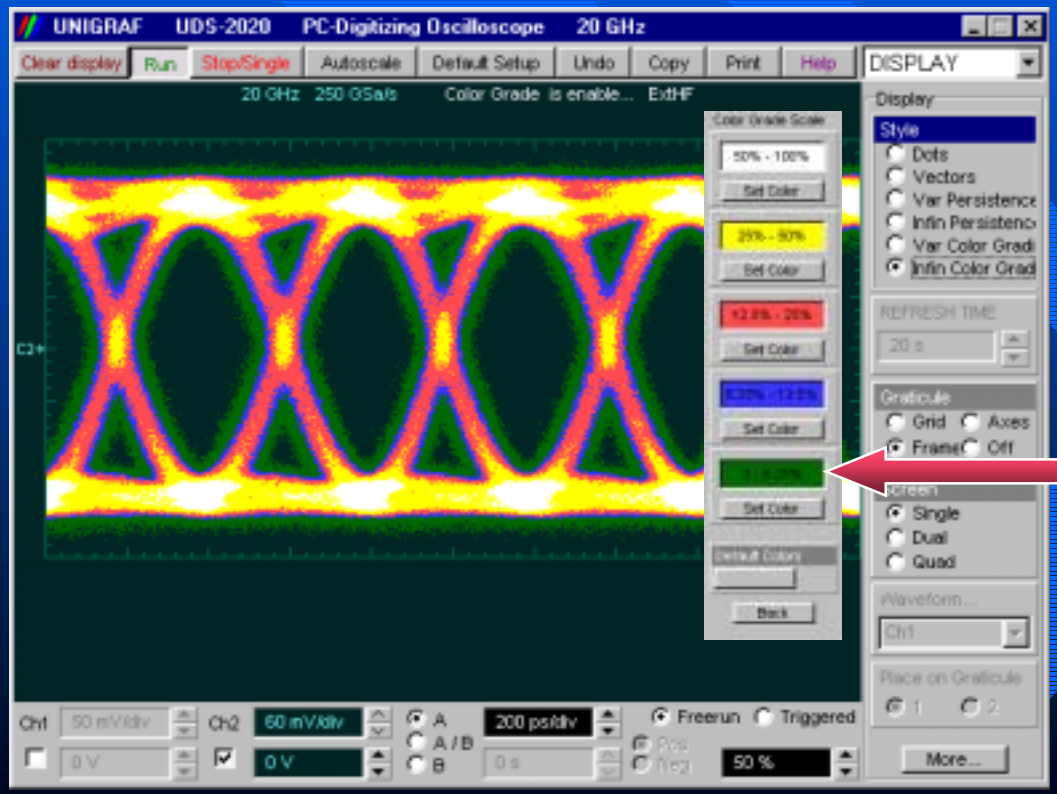
Informative Waveform Display: Color Grading

With Color Grading display style the accumulated points are color graded (shaded with different colors) to indicate the density of the points, and a color-graded database is built. You can use the color-graded database with histograms, mask testing, statistical measurements, and eye diagrams. You can also use color grading to provide more visual information about the waveforms.



The Color Graded display allows you clearly view any point of interest on the *2.5-GHz* eye-diagram

- The Color Grading function uses the database in the size of the graticule area, which are *257 pixels* high by *501 pixels* wide. Behind each pixel is a *16-bit counter*. Each time a pixel is hit by data, the counter for that pixel is incremented. Each color used for the color grade mode represents a range of data counts. As the total count increases, the range of hits represented by each color also increases. The maximum count for each counter is *65 535.*

- There are five colors used in the color-graded display. Each color shows the number of hits per pixel over the graticule area, and represents a range of counts, which depends on the total number of hits. As the total count increases, the range of hits represented by each color also increases. The colors can be changed form the Color Grade menu.

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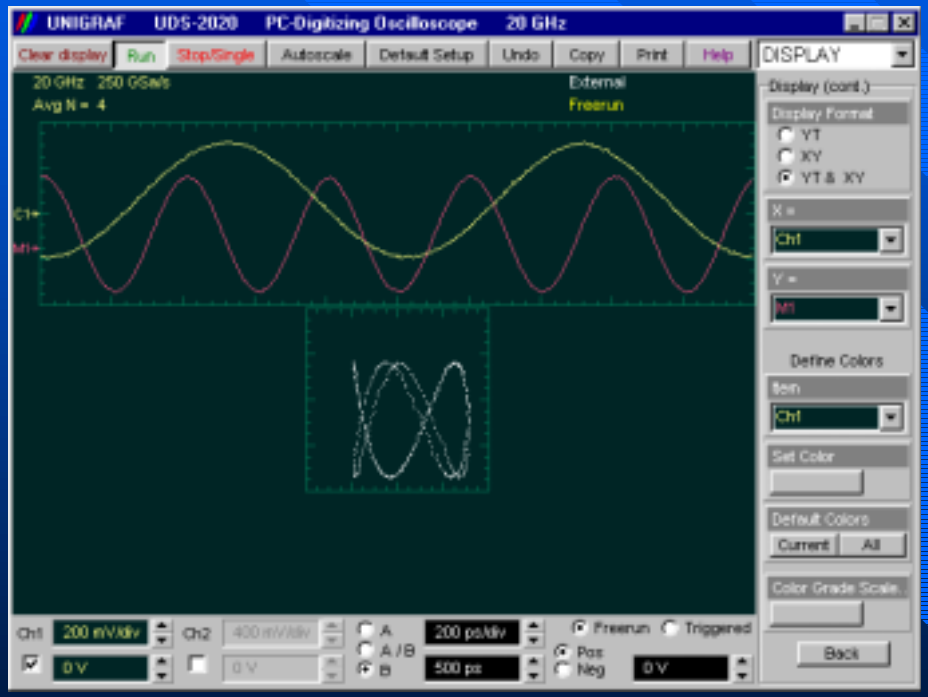
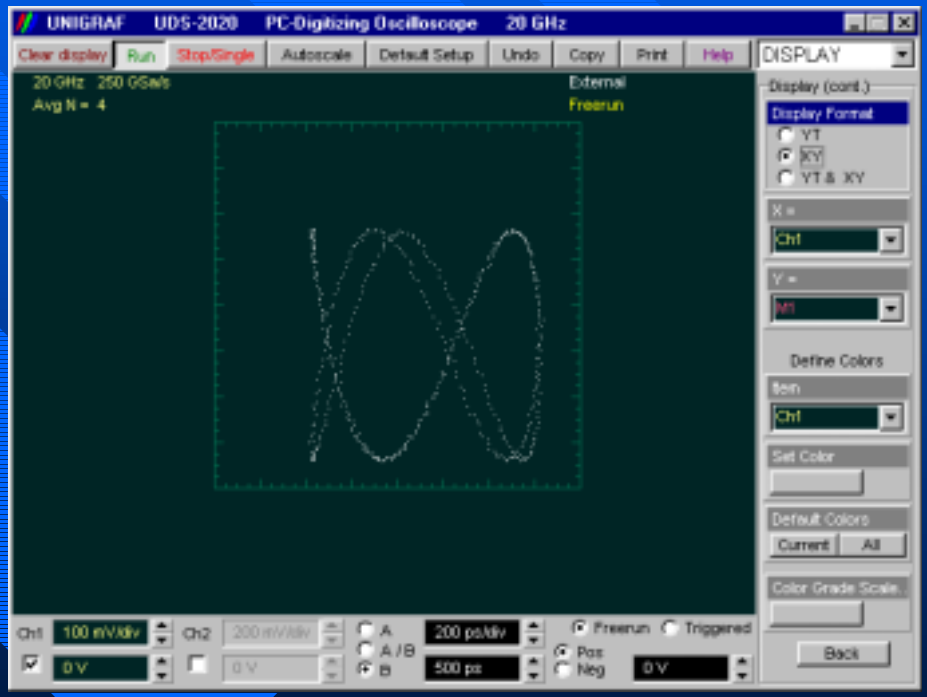
X-Y Display Format

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:

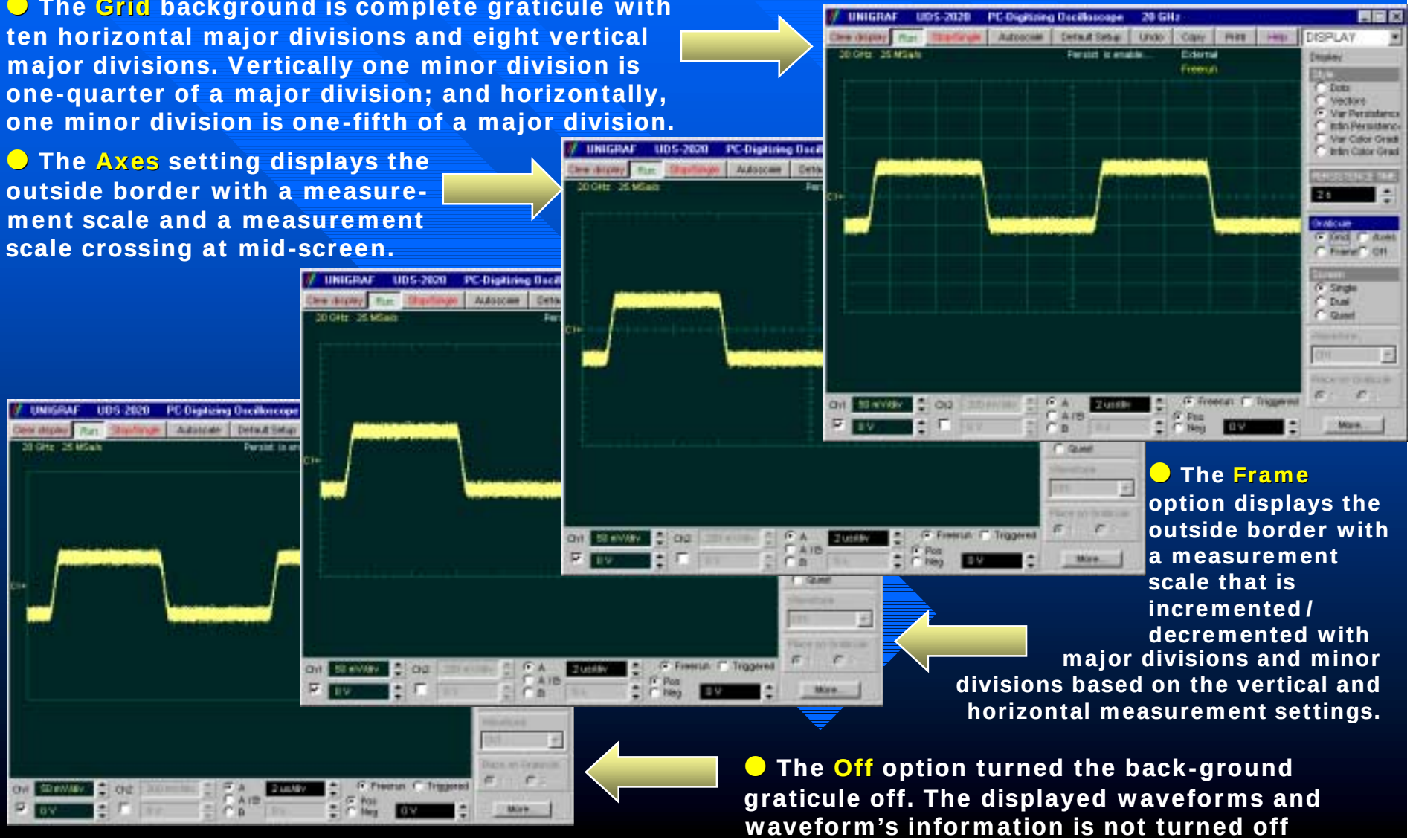
- Compare frequency and phase relationships between two signals.
- Display strain vs. displacement, flow versus pressure, volts versus current, or voltage versus frequency.

Graticule

The UDS-2128 has a 10 by 8 display graticule grid, which you can turn on, or off. The Graticule menu selection is: ● Grid, ● Axes, ● Frame, ● Off.

● The Grid background is complete graticule with ten horizontal major divisions and eight vertical major divisions. Vertically one minor division is one-quarter of a major division; and horizontally, one minor division is one-fifth of a major division.

● The Axes setting displays the outside border with a measure-ment scale and a measurement scale crossing at mid-screen.



● The Frame option displays the outside border with a measurement scale that is incremented / decremented with major divisions and minor divisions based on the vertical and horizontal measurement settings.

● The Off option turned the back-ground graticule off. The displayed waveforms and waveform's information is not turned off

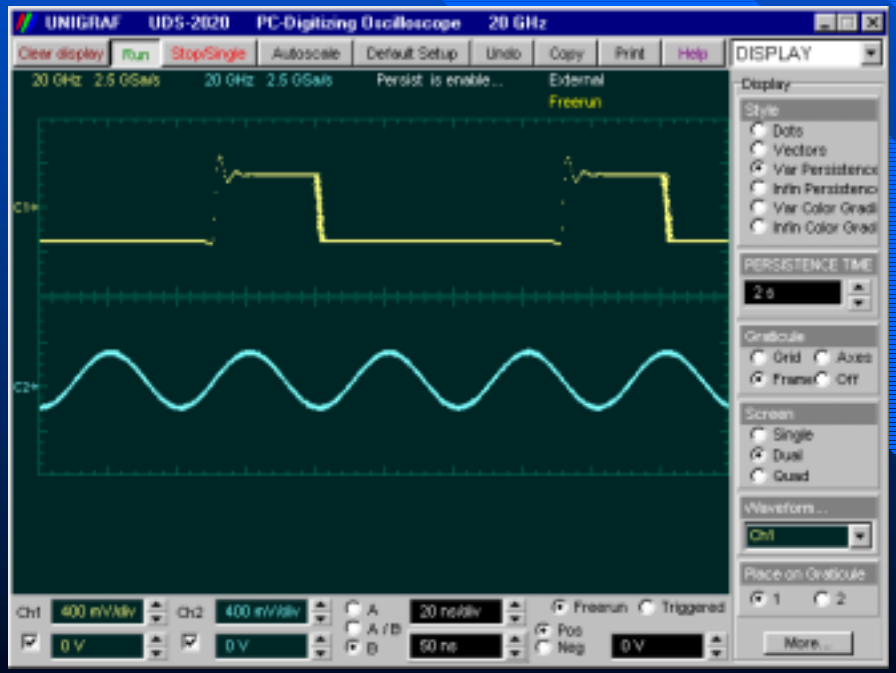
Screen

Screen function selects the number of screens to view:

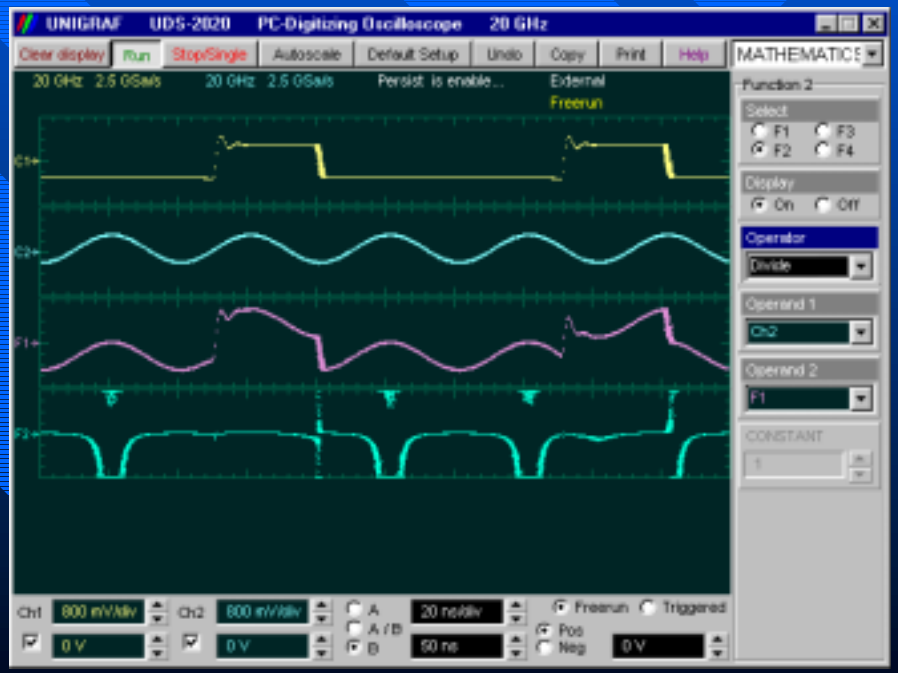
- **Single** - the entire display area is one screen and any displayed waveforms are superimposed on top of each other.
- **Dual** - the display area is divided into two equal screens.
- **Quad** - the display area is divided into four equal screens.

With the ***Wfm to...*** function you can set the waveform, that will be placed on the graticule, selected with the ***Place on Graticule*** menu.

With the ***Place on Graticule*** menu you can place a waveform, selected by the ***Wfm to...*** function to each from possible graticule.



Screen with frame in dual screen mode



Screen with frame in quad screen mode

Waveform Manipulation

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

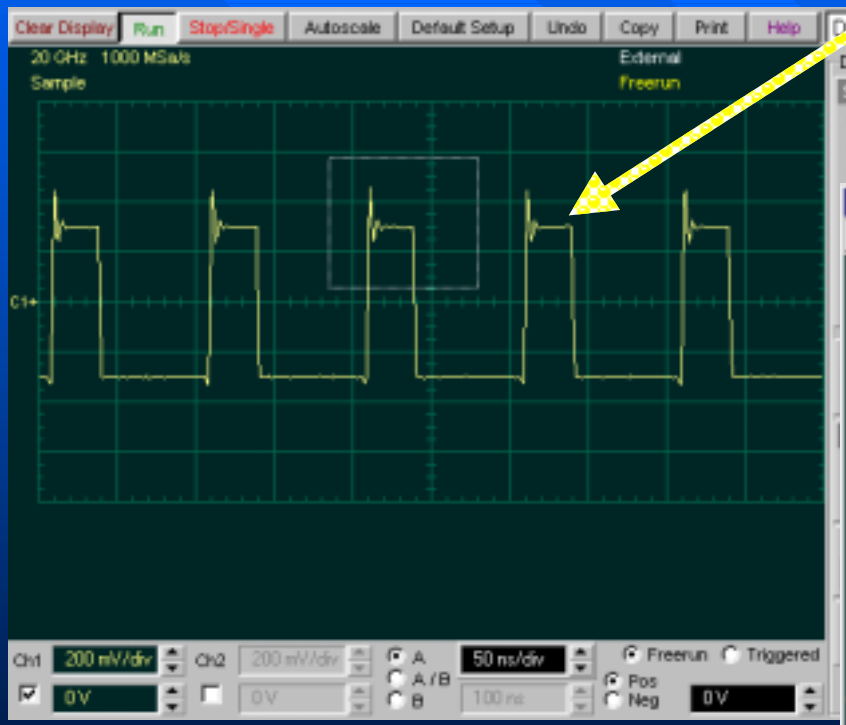
- **Direct Manipulation**
- **Zoom**

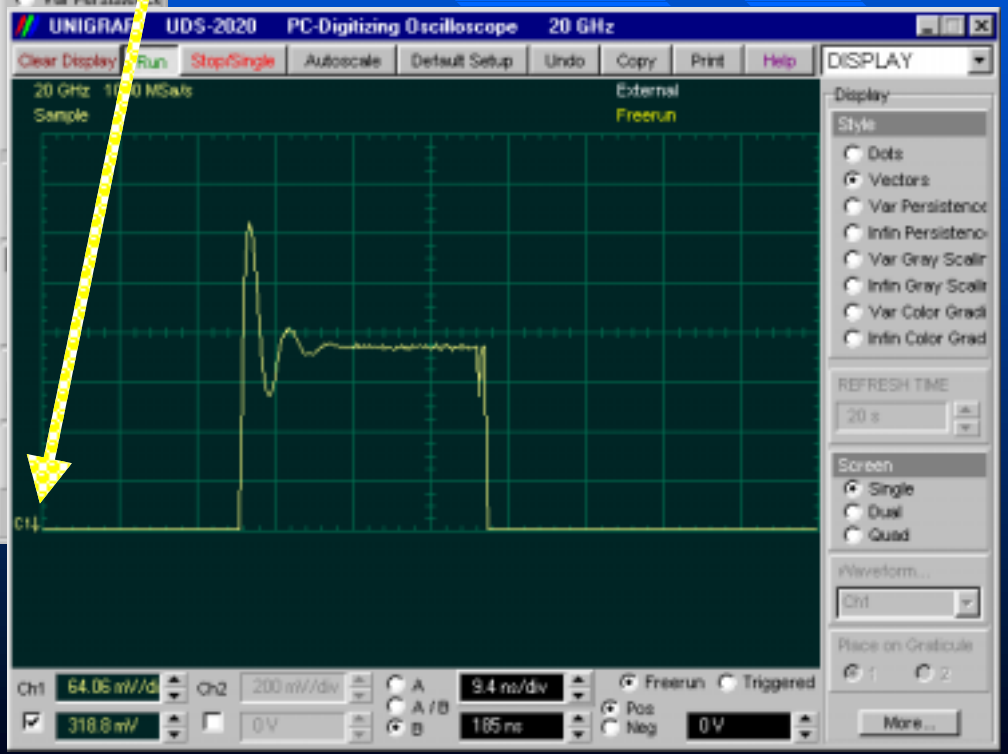
Direct Manipulation

Use the mouse to click and drag:

- **Waveforms**
- **Ground Reference Indicator**

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**

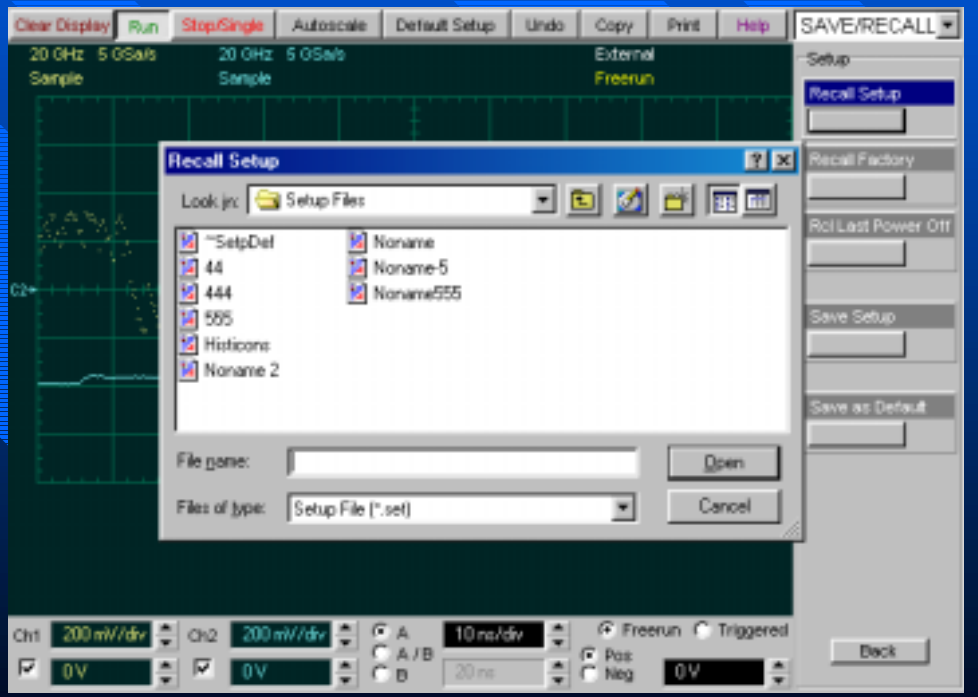
Familiar File Management

Saving into Waveform File

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

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

Recalling Waveform Database



Recalling Setups

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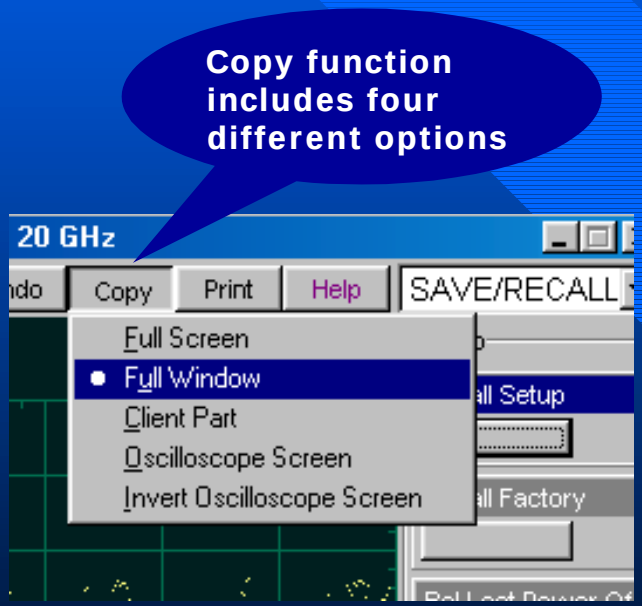
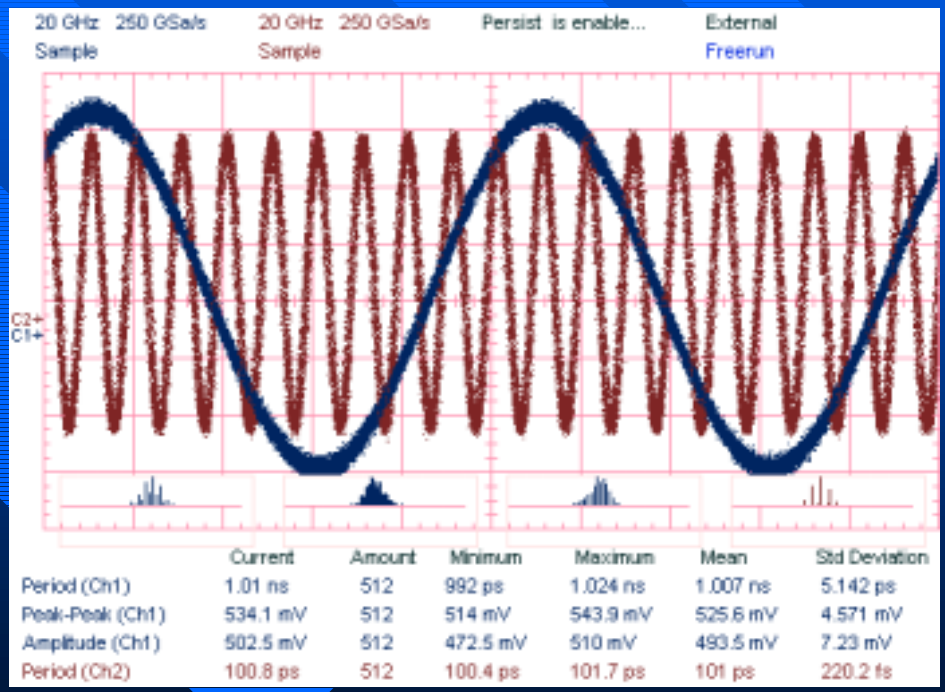
Copying a Waveform

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 UDS-2128.**



UDS-2128 Copy function

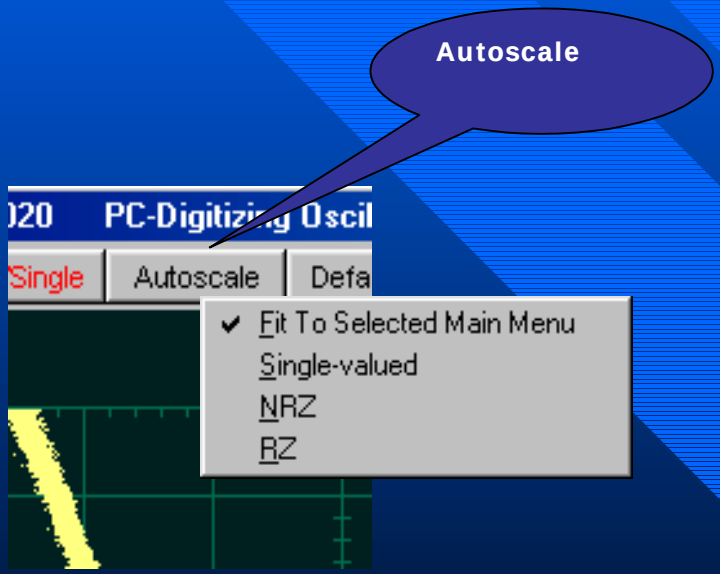


Screen image copied with Invert Oscilloscope Screen option

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 UDS-2128 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 UDS-2128 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.**

Measurements and Tests

Types of Measurements

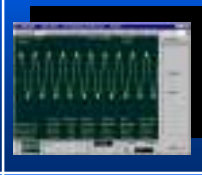
Graticule Measurements

10 by 8 display graticule with Grid, Axes, Frame and Off options

Marker Measurements

Two X, Y, or XY markers provide absolute, delta or ratiometric measurements

Pulse Measurements

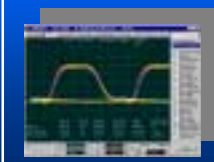


19 *Amplitude*, 15 *Timing* and 5 *FFT Measurements* can be performed automatically

NRZ Eye Measurements

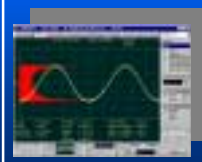
Measurement list includes 38 NRZ eye parameters

RZ Eye Measurements



40 automatic measurements are built for characterization of RZ signals

Histogram Measurements



Up to 11 statistic measurements of vertical and horizontal histogram

Types of Measurement Test

Limit Test

Allows you to automatically compare up to 4 measurement results with pass or fail limits

Mask Test

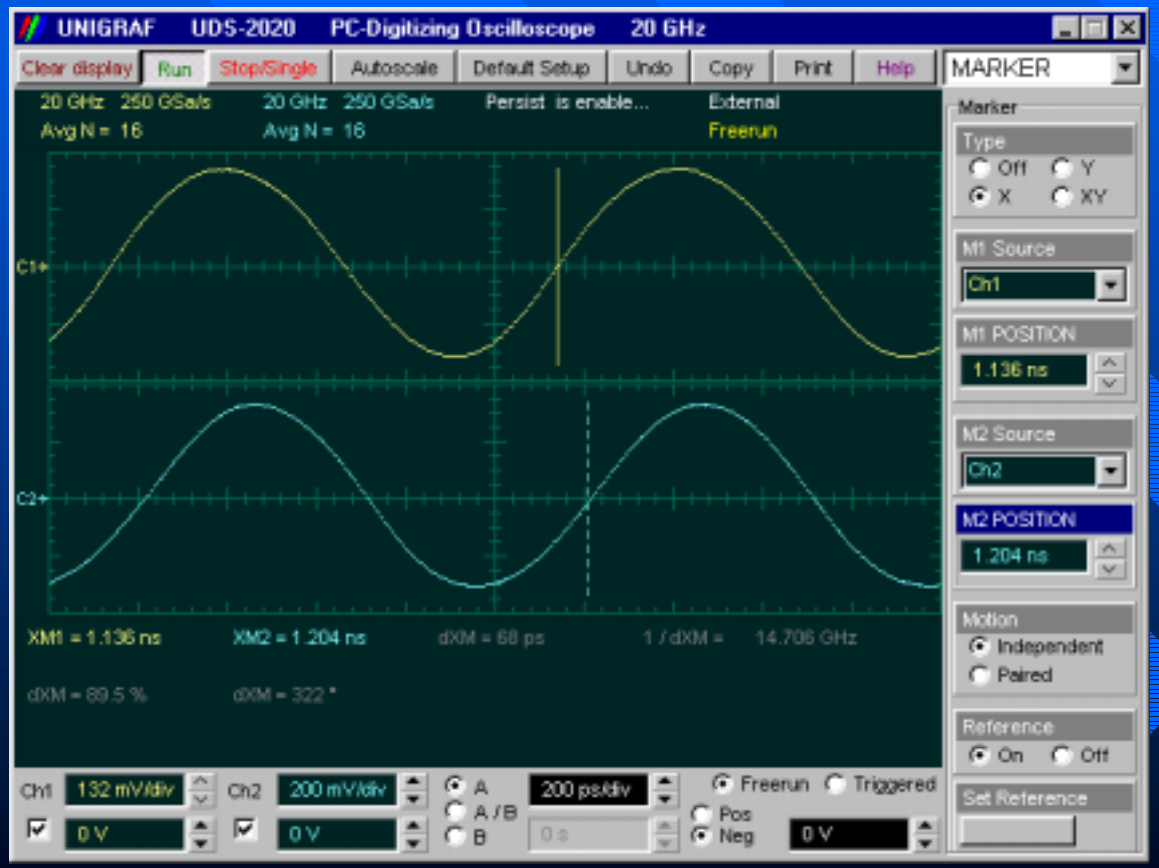
Standard, auto- or custom mask can be used for mask test

Mask Margin Test

Test is used to determine the margin of compliance for a standard or scaled mask

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:

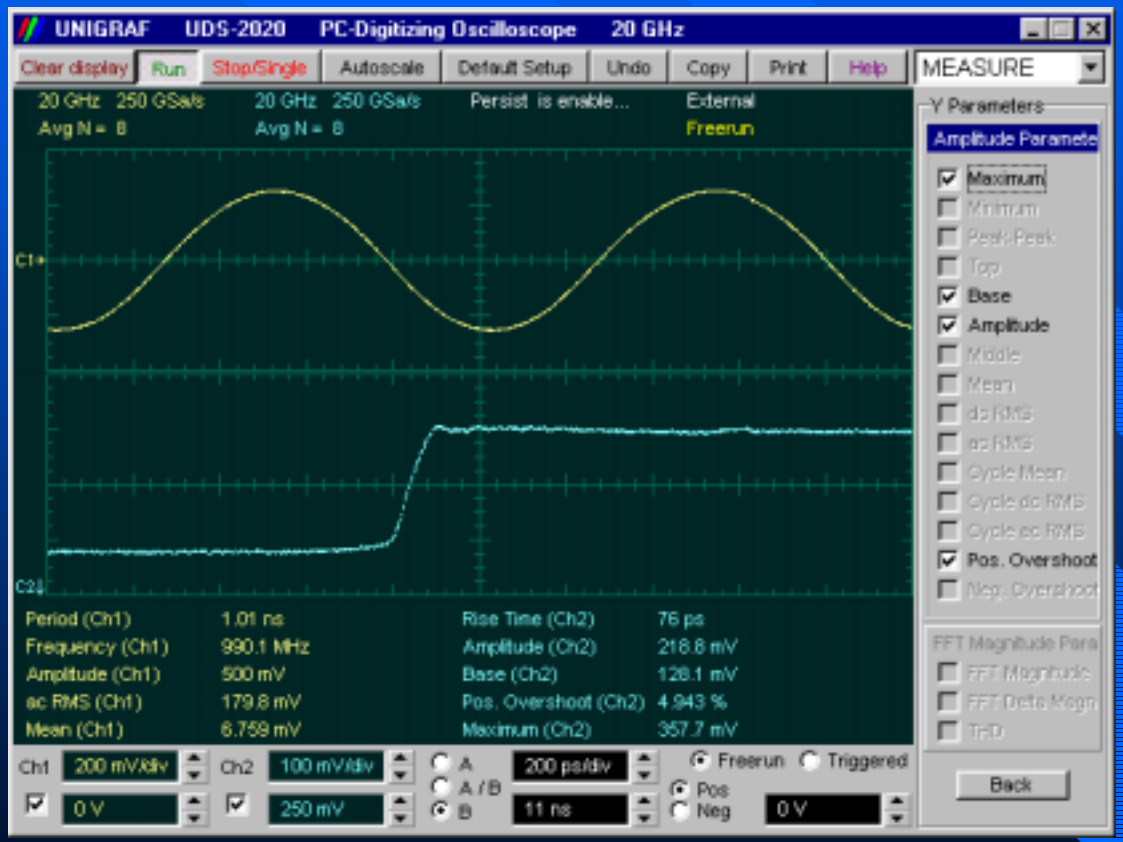
- Absolute vertical (voltage)
- Ratiometric vertical (voltage)
- Absolute horizontal (timing)
- Ratiometric horizontal (timing)

Best Marker Resolution:

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

Automatic Measurements

The UDS-2128 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 UDS-2128 measures up to 10 parameters simultaneously on 8 sources with maximum time resolution of *0.1 ps* and *1.6 %* vertical accuracy

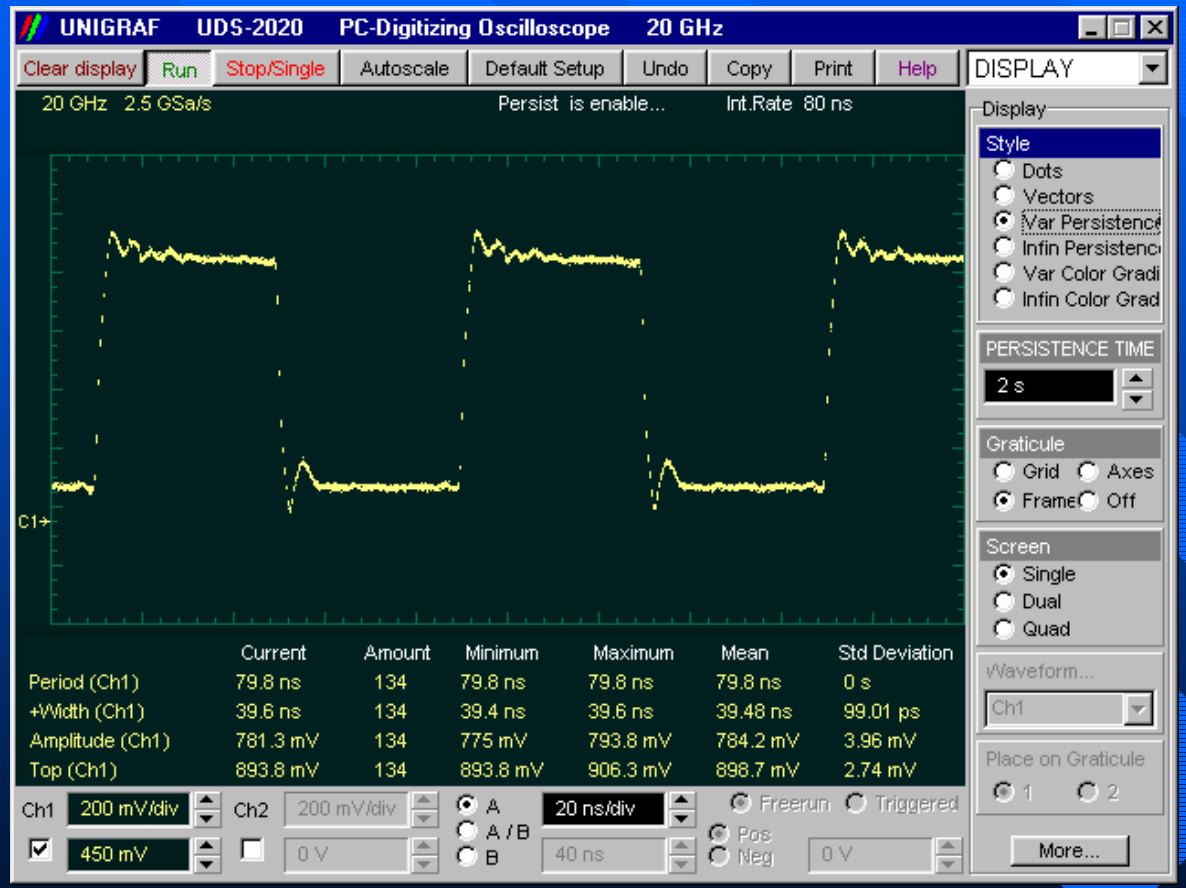
19 *Amplitude Measurements* are made on vertical parameters. They typically mean voltage. They are: ● *Maximum*, ● *Minimum*, ● *Peak-Peak*, ● *Top*, ● *Base*, ● *Amplitude*, ● *Middle*, ● *Mean*, ● *dc RMS*, ● *ac RMS*, ● *Area*, ● *Cycle Middle*, ● *Cycle Mean*, ● *Cycle dc RMS*, ● *Cycle ac RMS*, ● *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 UDS-2128 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.

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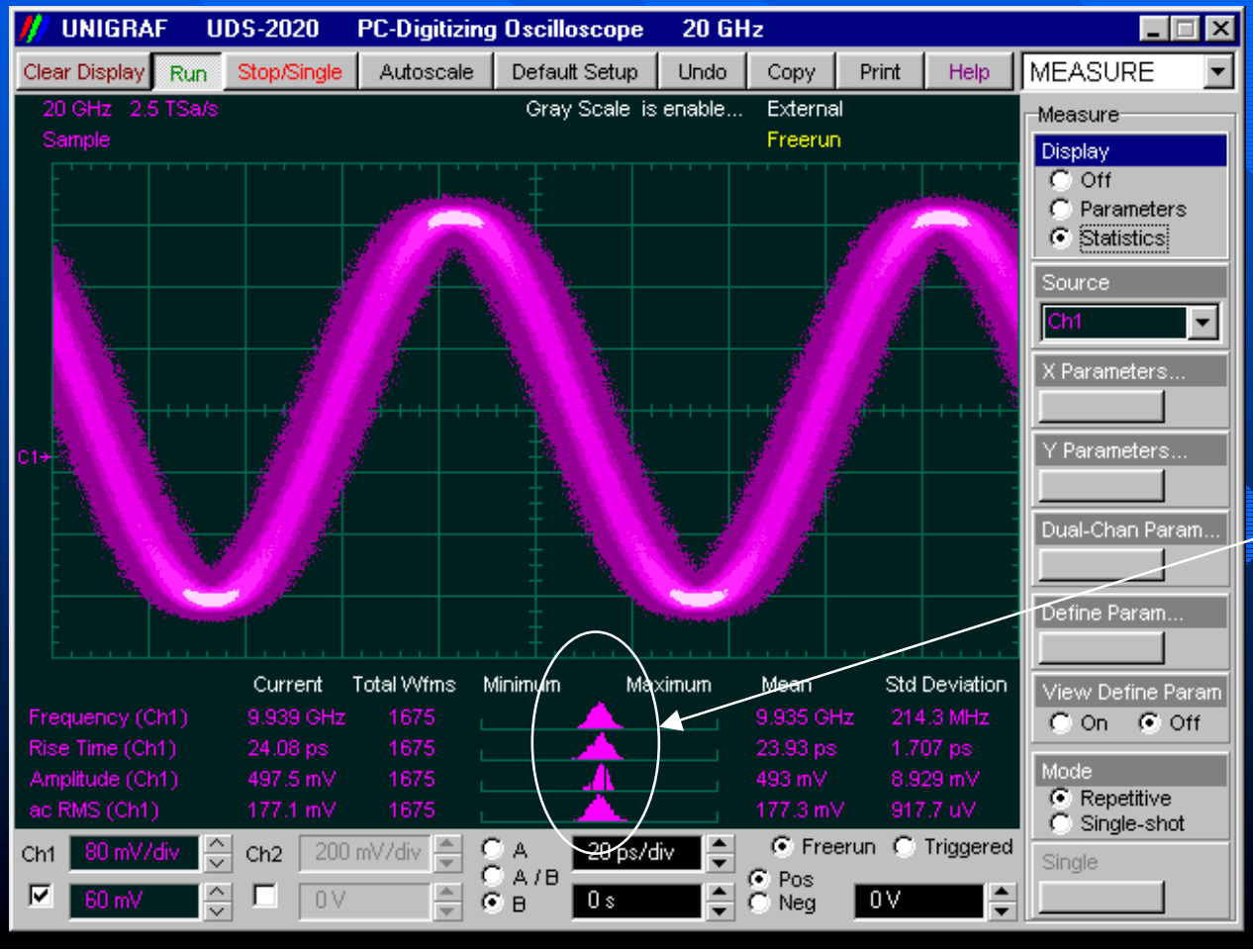
Histicons

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.

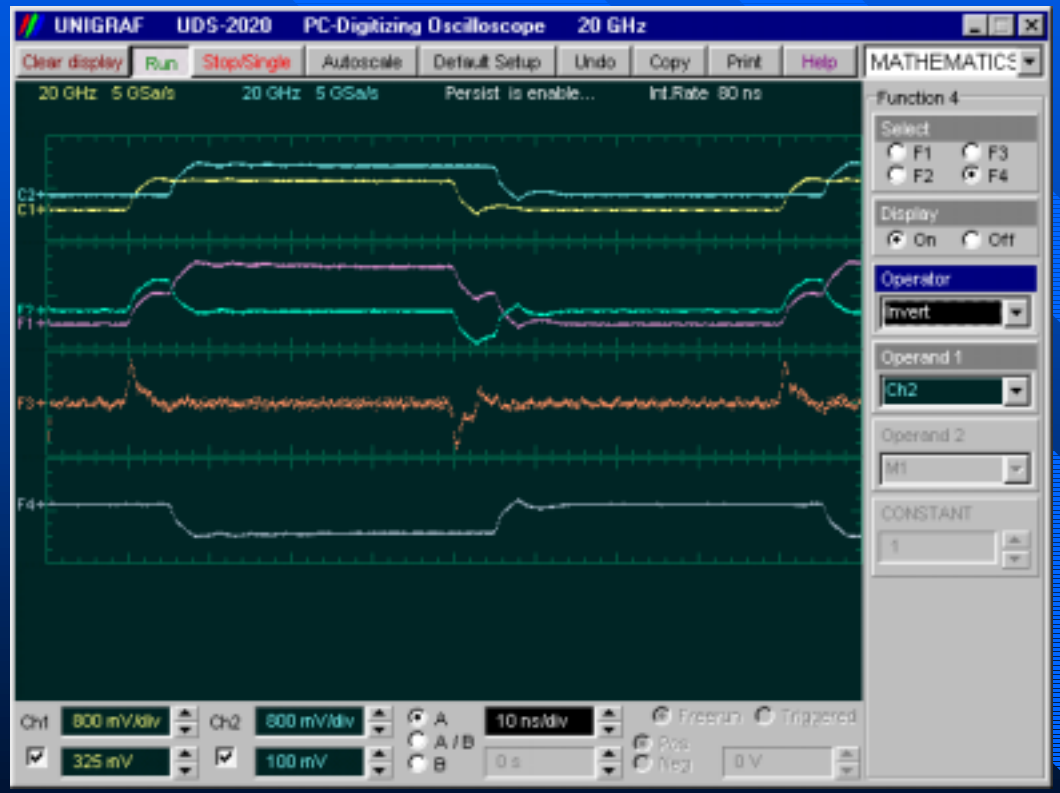
- **Histicons** provide a fast, dynamic view of parameters and wave shape characteristics.



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

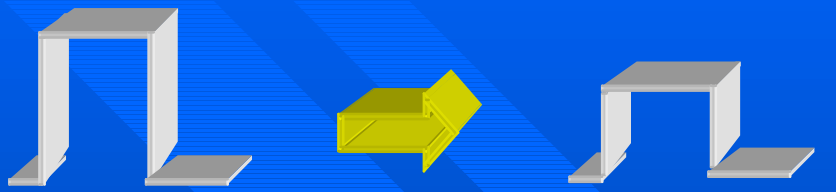
Mathematics

The UDS-2128 supports up to four simultaneous mathematical combination and functional transformation of waveforms that is acquires.



An examples of UDS-2128 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*.

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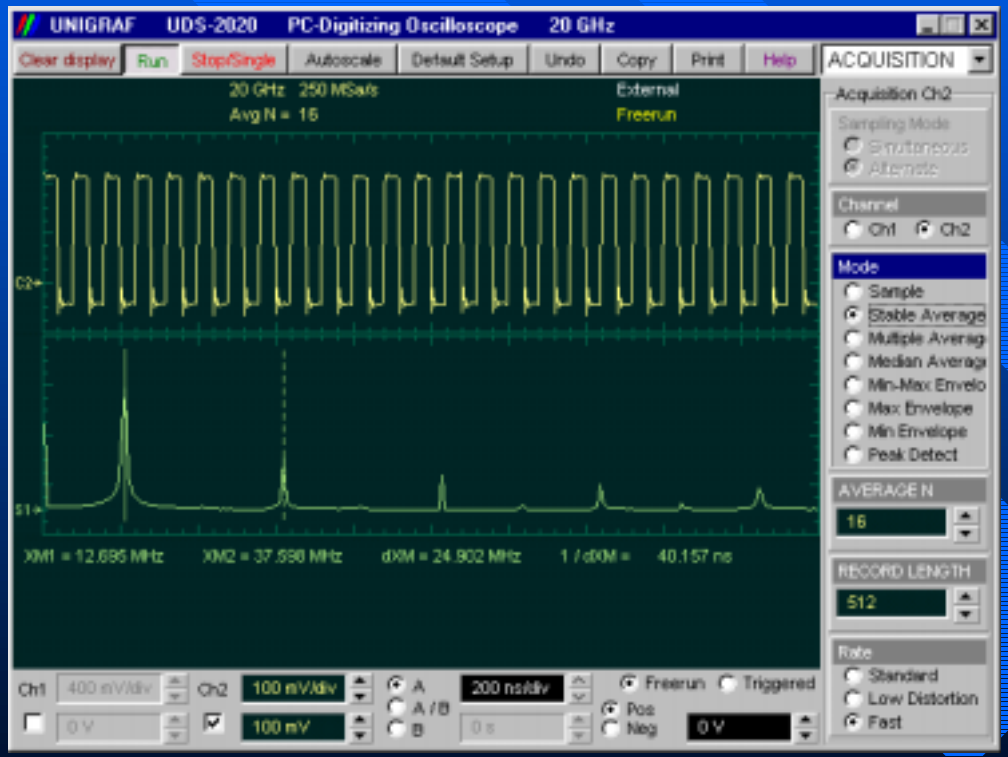
Fast Fourier Transform

The math option of the UDS-2128 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.

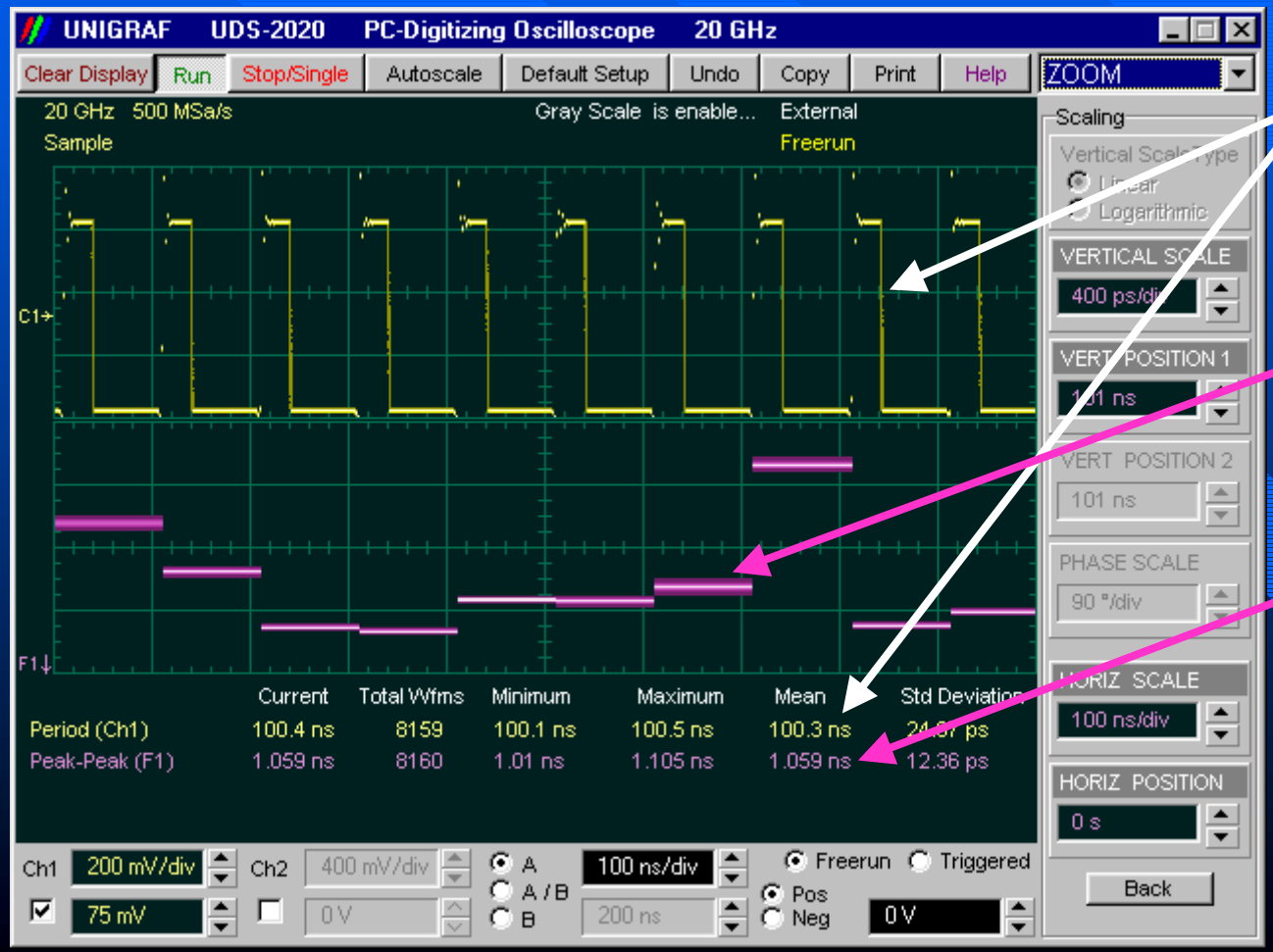
The UDS-2128 supports six types of windows:

- **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 **UDS-2128** 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

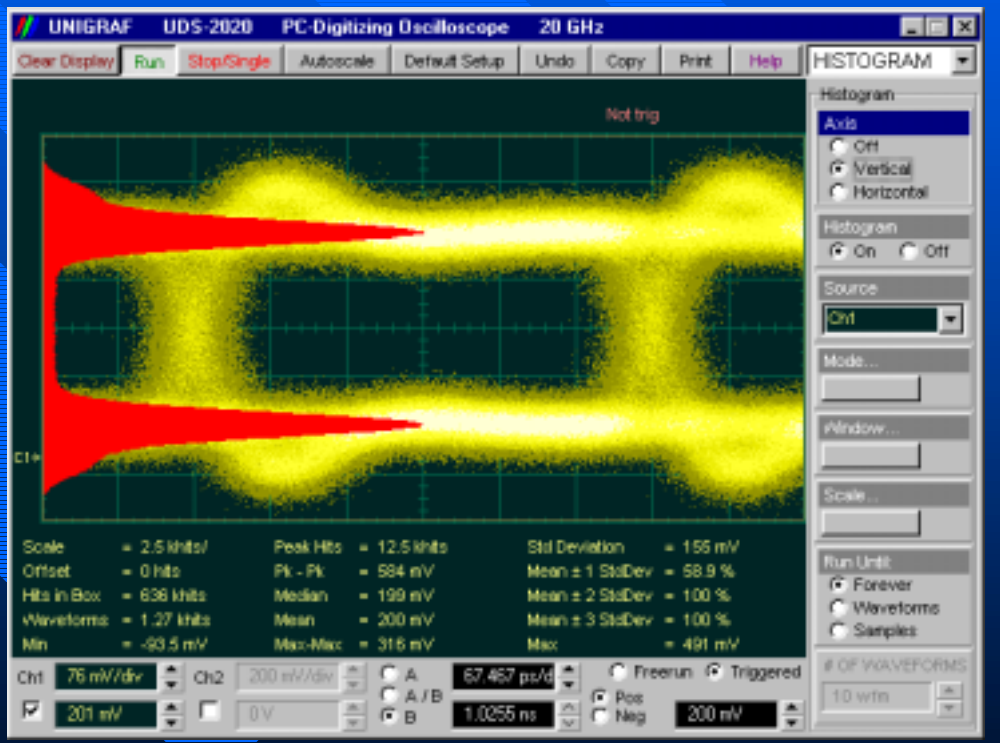
Vertical Histogram

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:

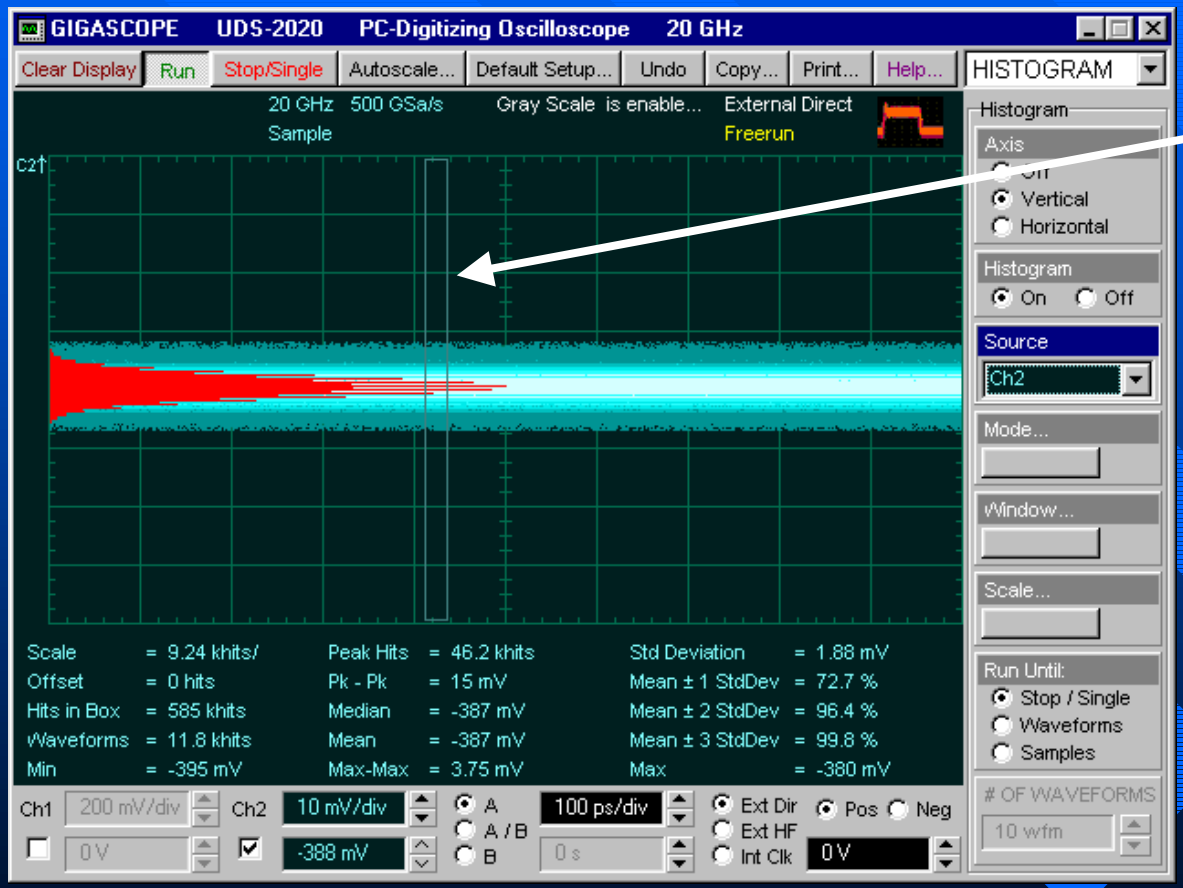
- **Scale-Scale** lists the display scale in hits per division or dB per division.
- **Offset** lists the offset in hits or dB. Offset is the number of hits or dB at the bottom of the display, as opposed to the center of the display.
- **Hits in Box**-The total number of samples included in the histogram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

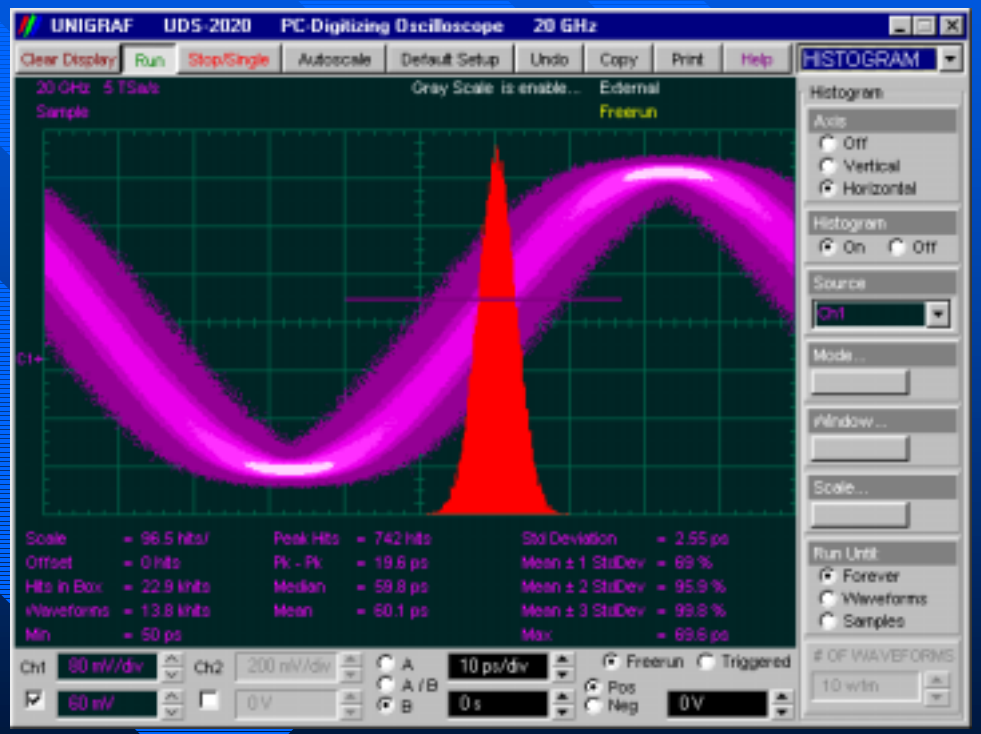
The **UDS-2128** has a very low "noise floor" (*<2 mV* of internal noise RMS), making noise measurements very accurate.

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**

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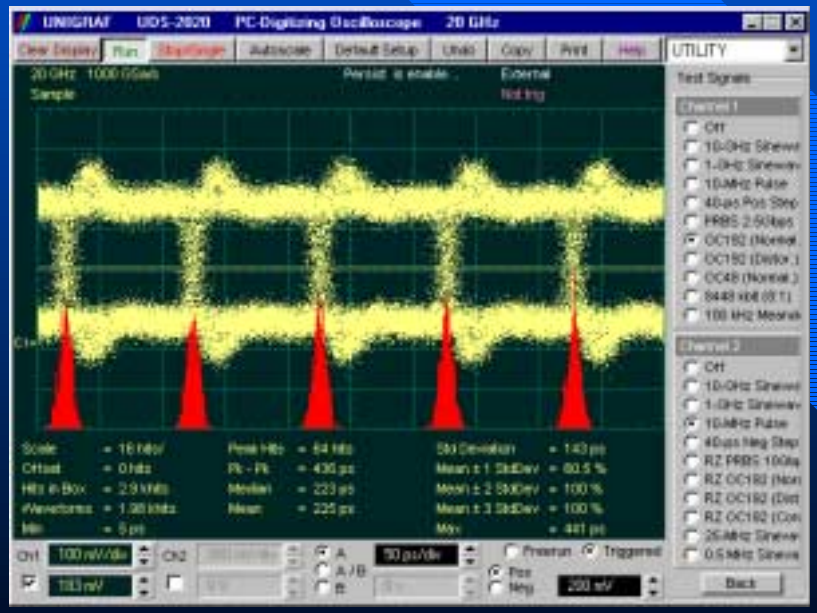
Jitter Mesurements

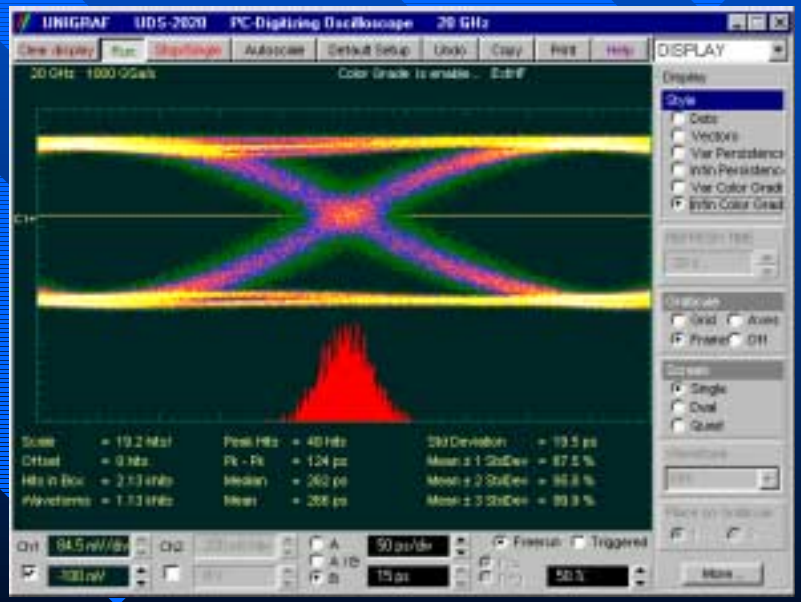
Among other things Jitter is caused by:

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

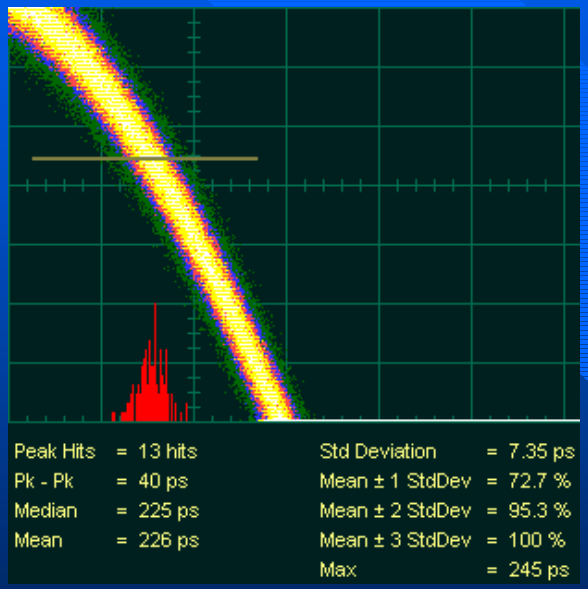




Eye-Crossing Jitter can be quantified with horizontal histogram.
Two examples of **NRZ Eye Pattern** with jitter histogram

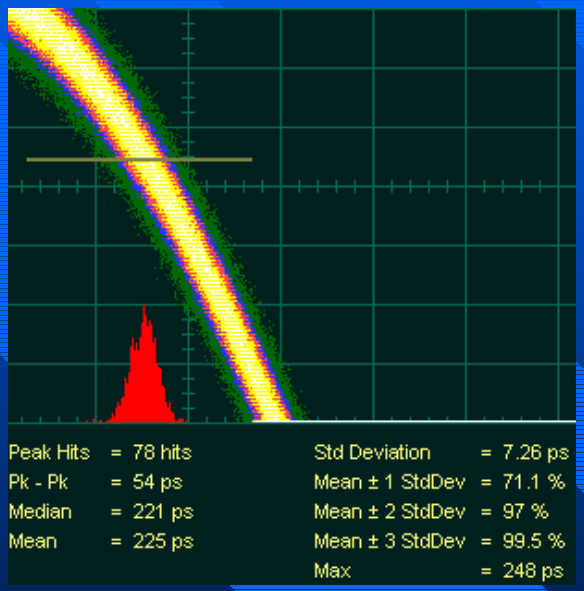
Histogram Measurements: acquiring statistically significant amount of data

- Larger sample of data



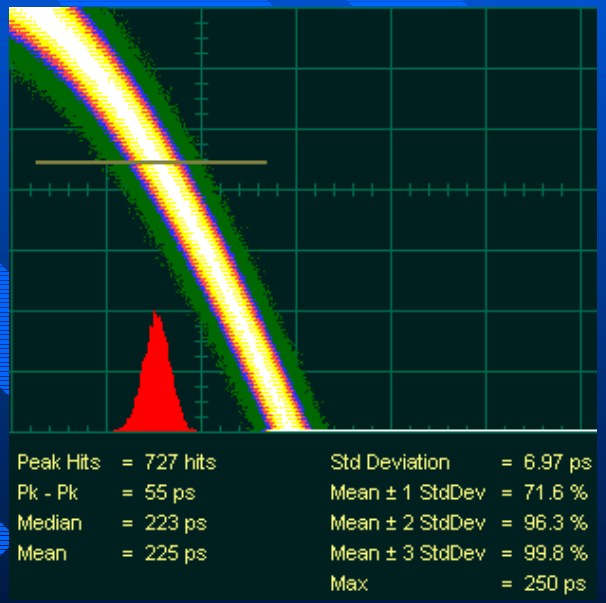
100 wfms, 1 s

- Three-dimensional accumulation



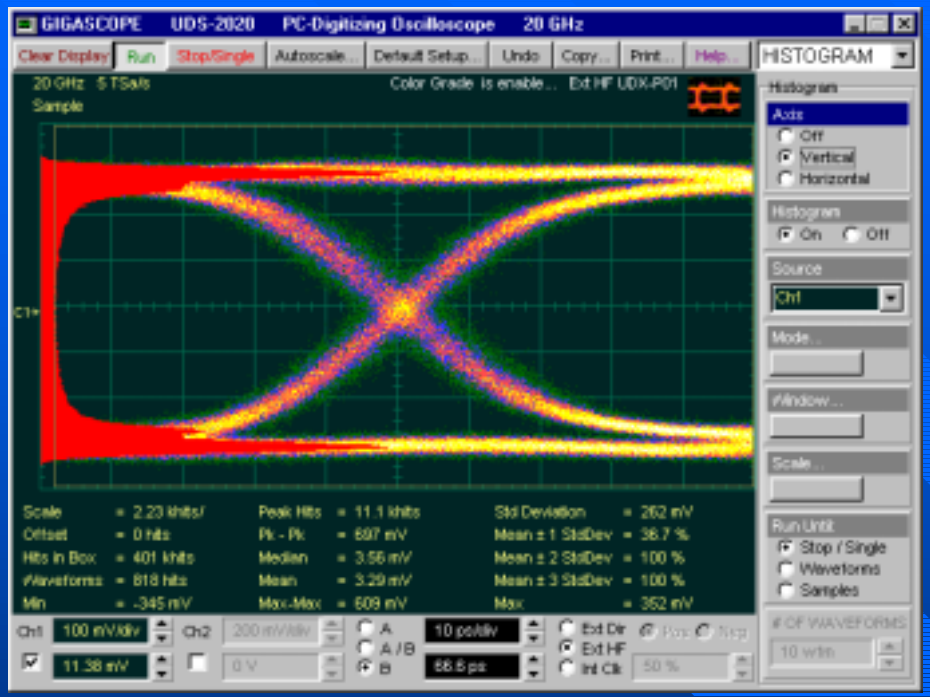
1 000 wfms, 10 s

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

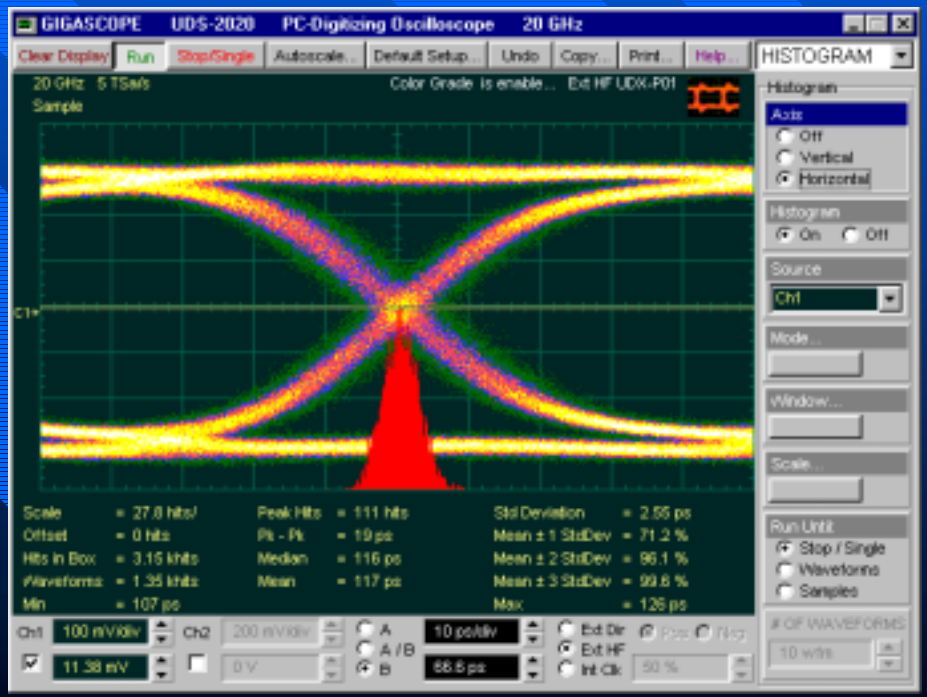


10 000 wfms, 100 s

Histogram Measurements of Eye Diagrams



The left picture demonstrates how the **UDS-2128** quickly measures all parameters of vertical histogram for ***12-Gbit*** Eye Diagram

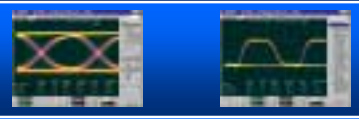


The right picture demonstrates how the **UDS-2128** quickly measures all parameters of horizontal histogram for ***12-Gbit*** Eye Diagram

UDS-2128 Solutions up to 10 Gbit

The **UDS-2128** provides wide range solutions for testing of ***10 Gbit*** signals

Key **UDS-2128** 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***

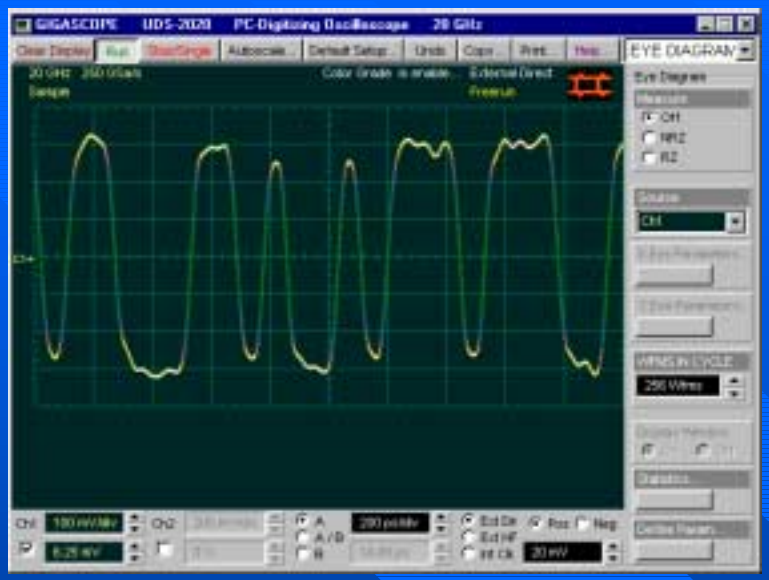
UDS-2128 Telecom / Datacom Measurements	
Eye Diagram	
Mask Test	
Mask Margins	
Histogram	

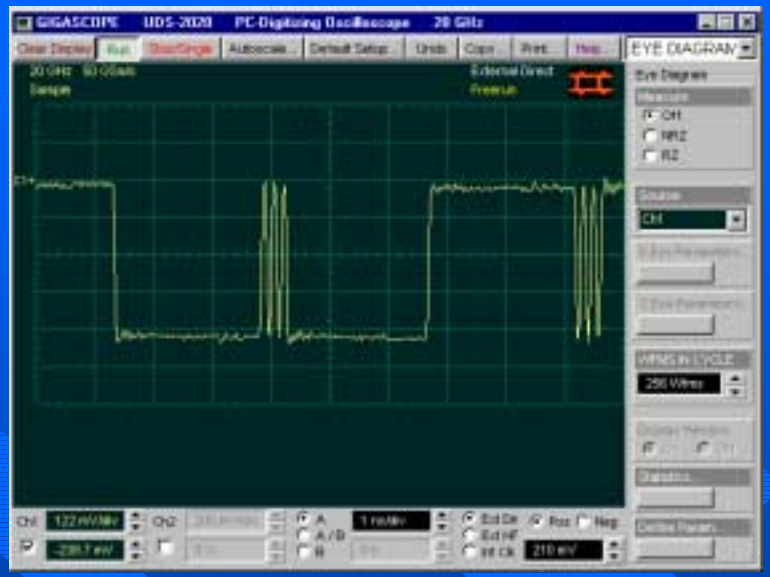
Telecom / Datacom Industry Standards

UDS-2128 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*

Digital Communication Measurements





Two examples of 12-Gbps Pattern

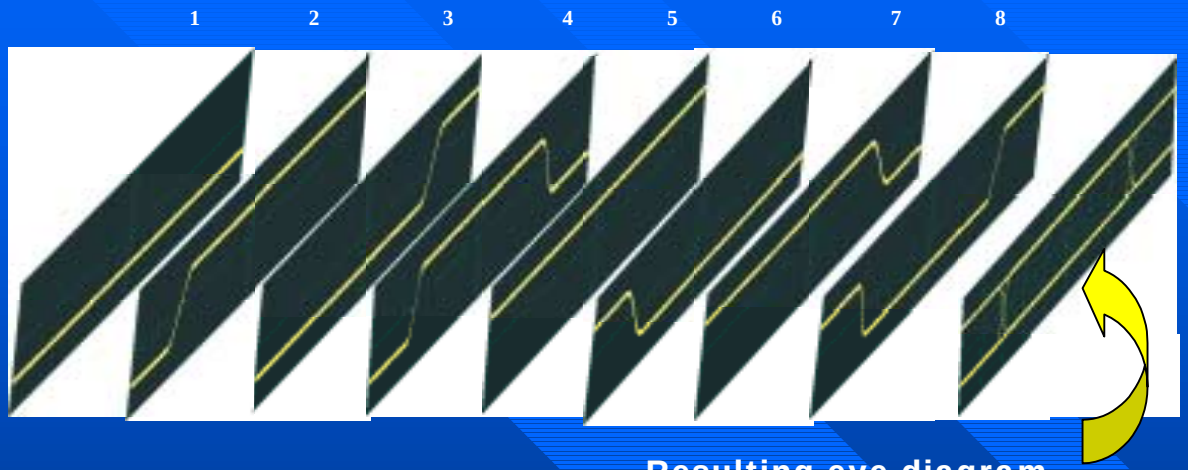
Device Testing

- Protocol Testing
- Serial Device
- MUX
- DMUX

Common Measurements

- Bit Error Ratio (BER)
- Eye Diagram Analysis
- Jitter Measurements

Building Eye Diagram



Resulting eye diagram

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

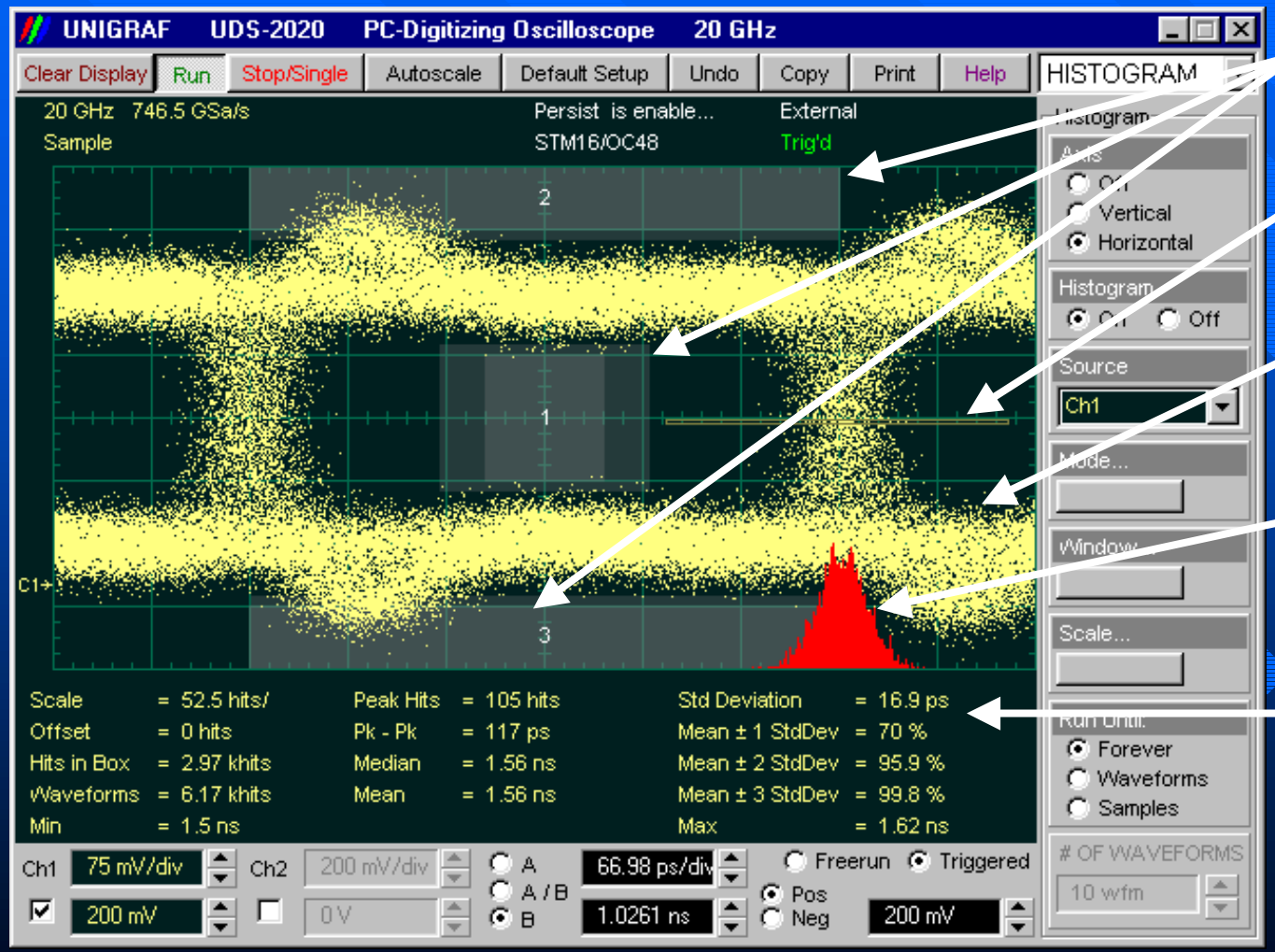
Eye Diagram is valuable because of comprehensive view of all signal integrity faults(except clock jitter):

- 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

A typical UDS-2128 Eye Diagram with Mask, Margins and Histogram



Customizeable Mask with Margins

Histogram window

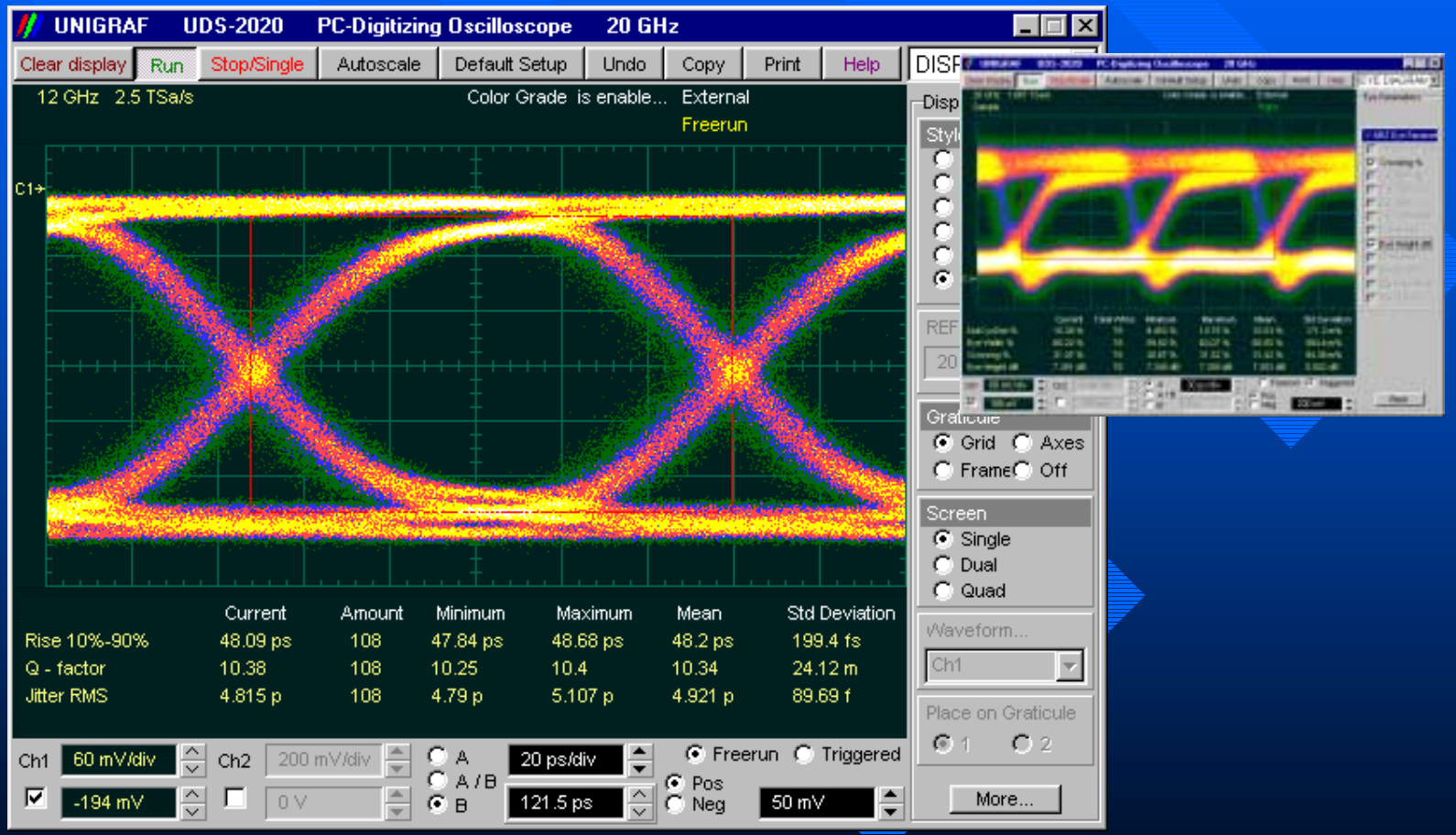
***2.5-Gb/s* Eye Diagram**

Using Histogram on the eye crossing to characterize jitter

Histogram measurement results

NRZ Eye Diagram Measurements

The UDS-2128 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 UDS-2128 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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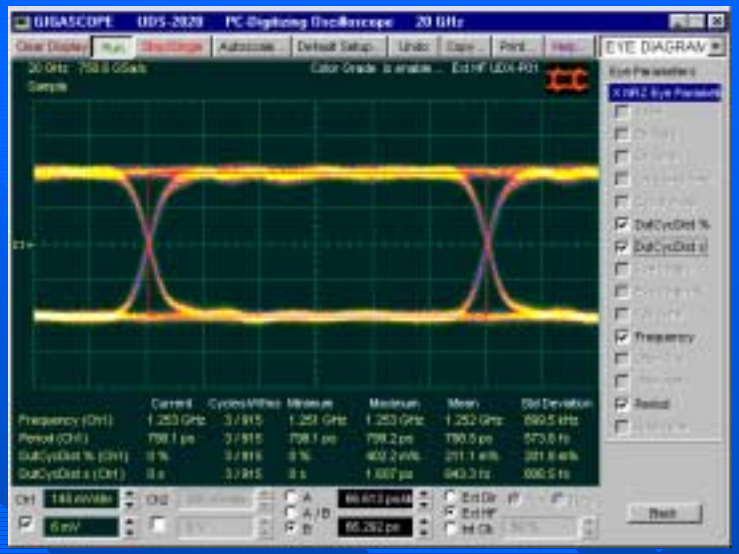
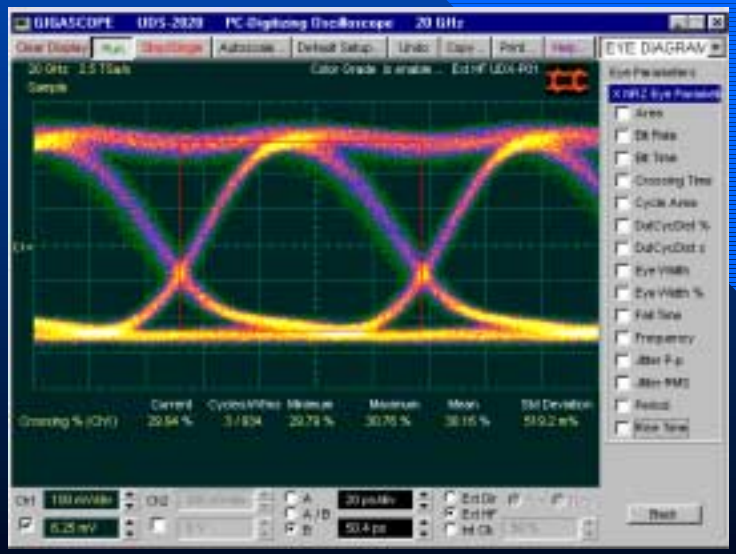
Examples of NRZ Measurements

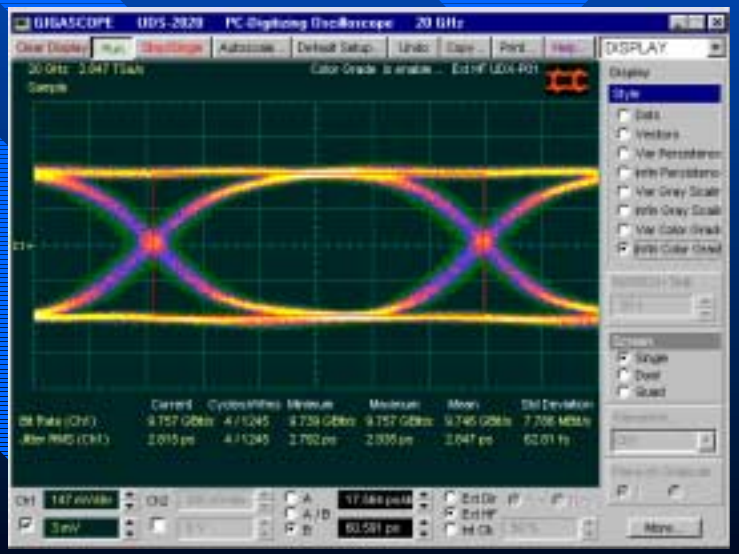
Timing measurements of ***155-Mbit*** Eye Diagram



Timing measurements of ***2.5-Gbit*** Eye Diagram



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



Timing measurements of ***9.5-Gbit*** Eye Diagram

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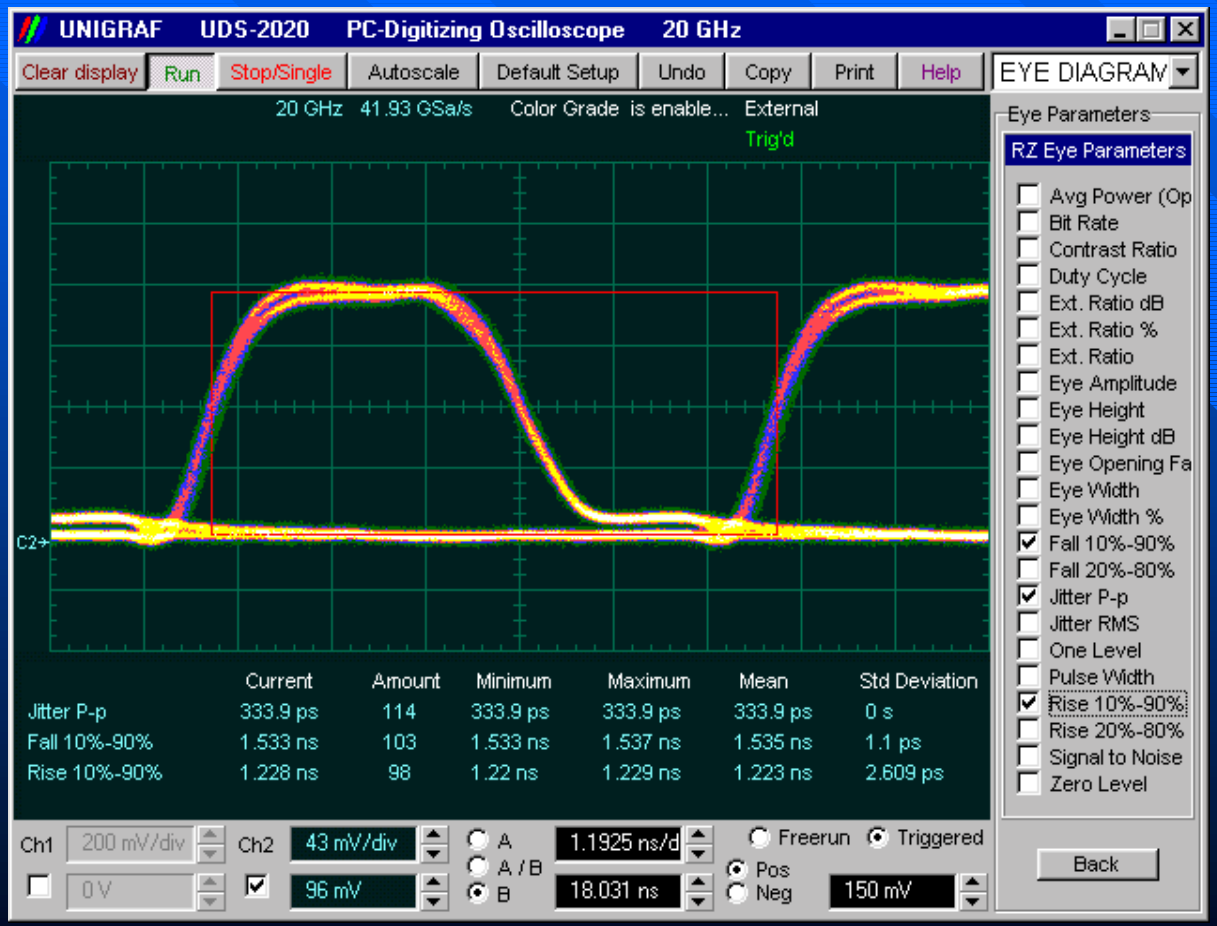
RZ Eye-Diagram Analysis

The UDS-2128 quickly measures 40 fundamental parameters used to characterize an return-to-zero (RZ) signals. Up to four parameters can be measured simultaneously.



The UDS-2128 measures *139-Mbit* RZ eye-diagram

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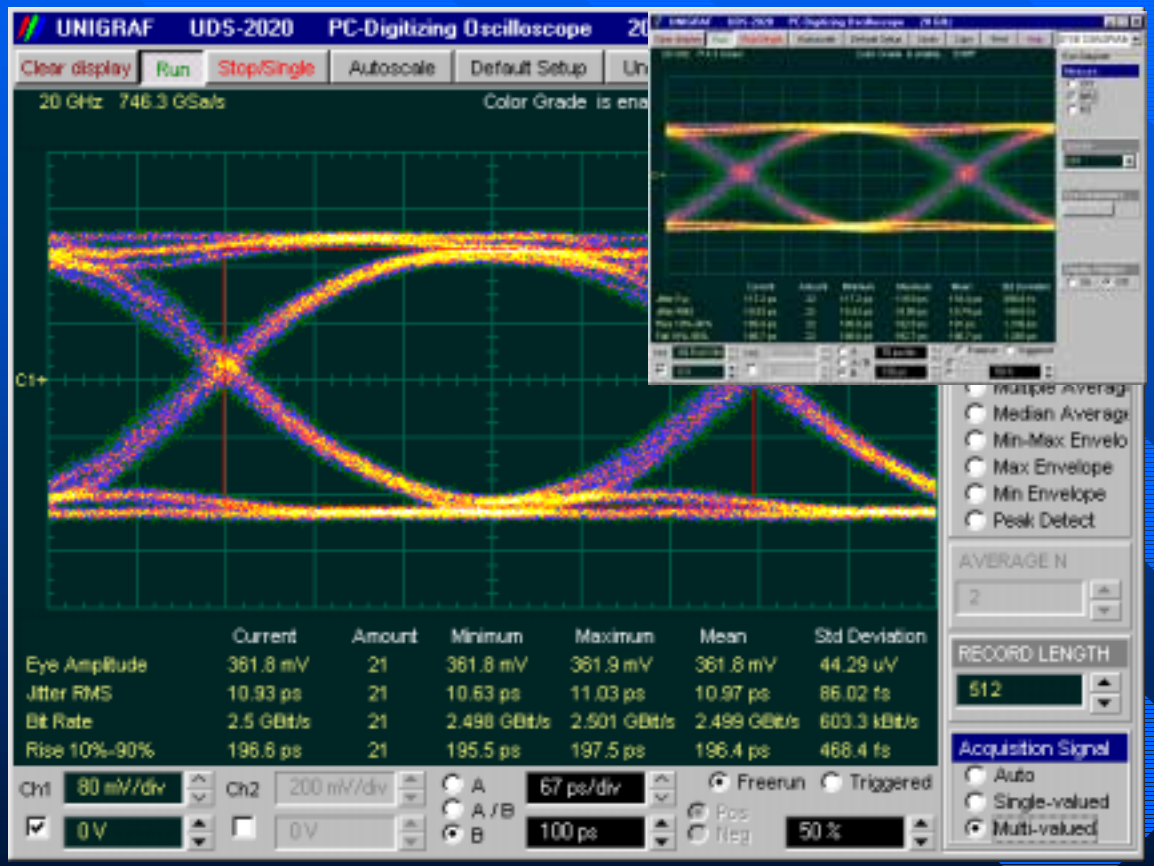
Clock Recovery Triggering

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.



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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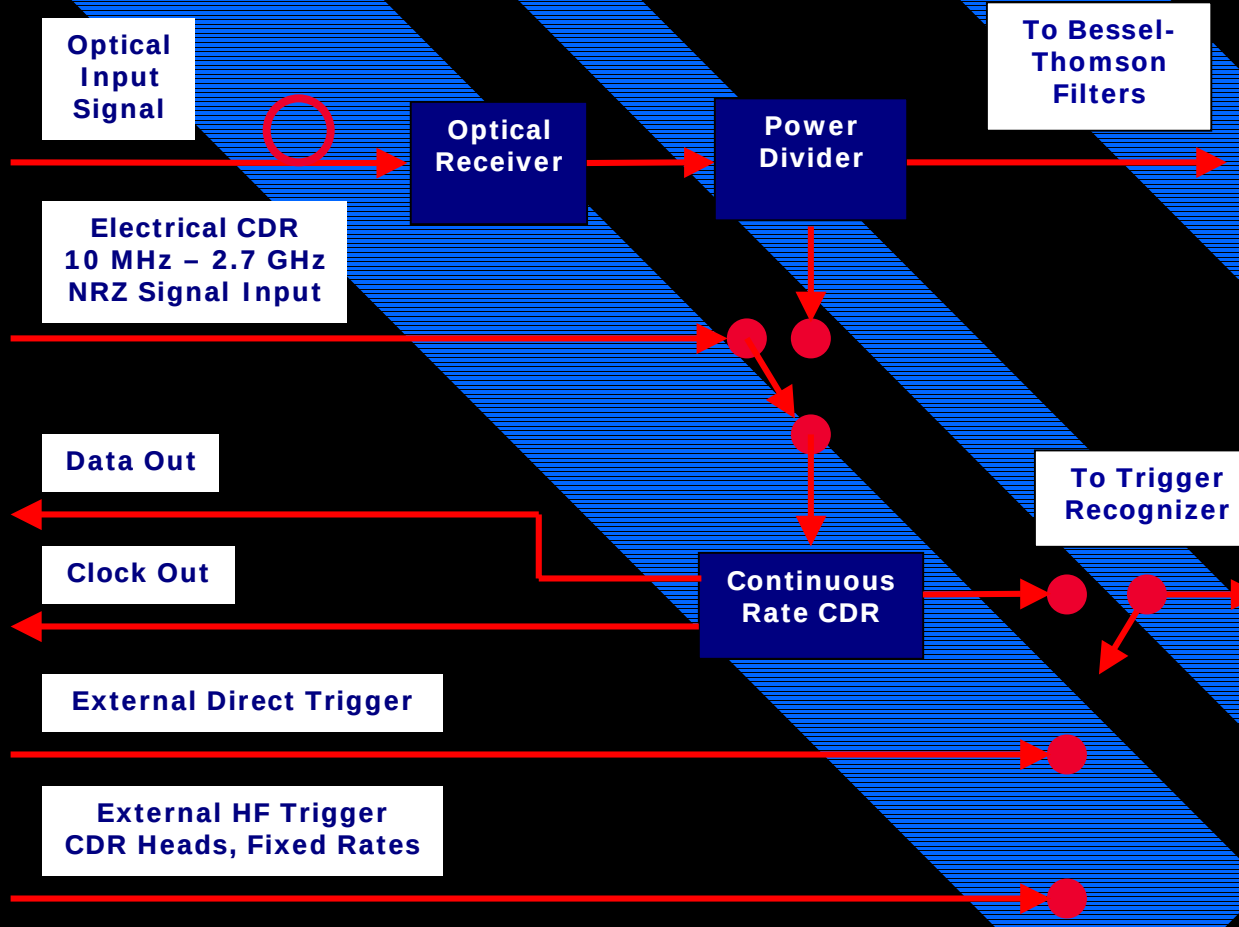
UDS-2128 Clock/Data Recovery Trigger System



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The UDS-2128 provides Continuous Rate CDR from 10 MHz to 2.7 GHz for both internal (Optical Receiver Output) and external signals. A built-in power divider reduces external hardware requirements. Optional clock recovery heads cover the two most popular transmission media used today—electrical lines 622 Mbps and 2.488 Gbps. All units have excellent jitter performance to ensure accurate measurements.

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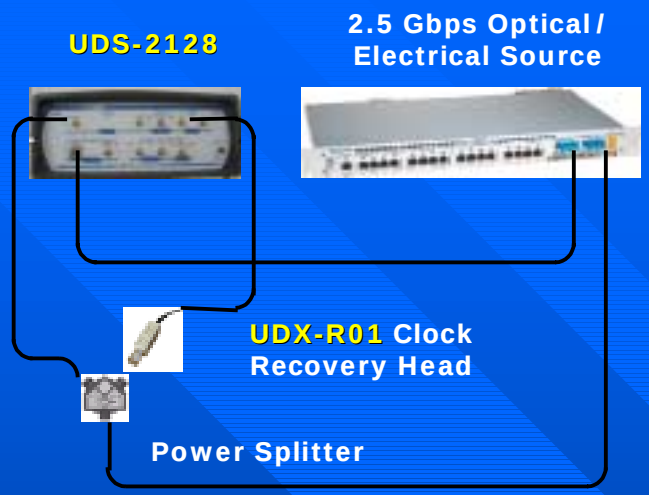
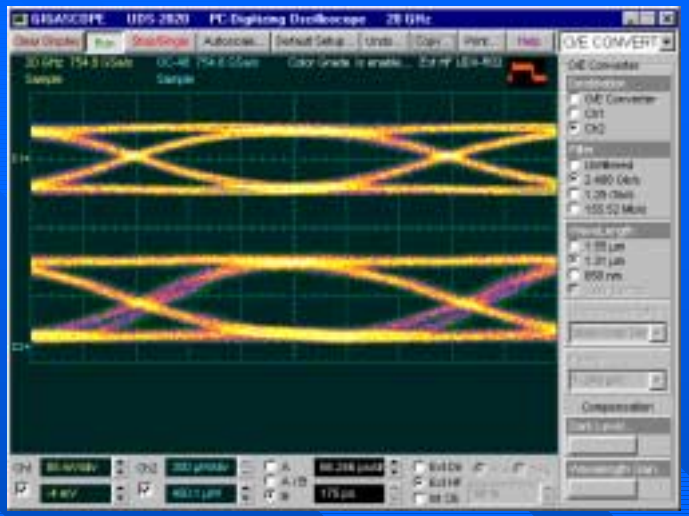
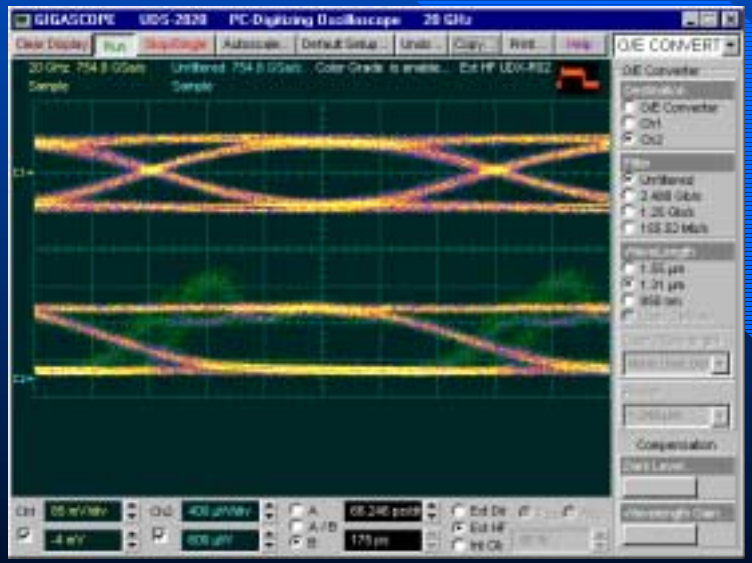
Optical and Electrical Measurements



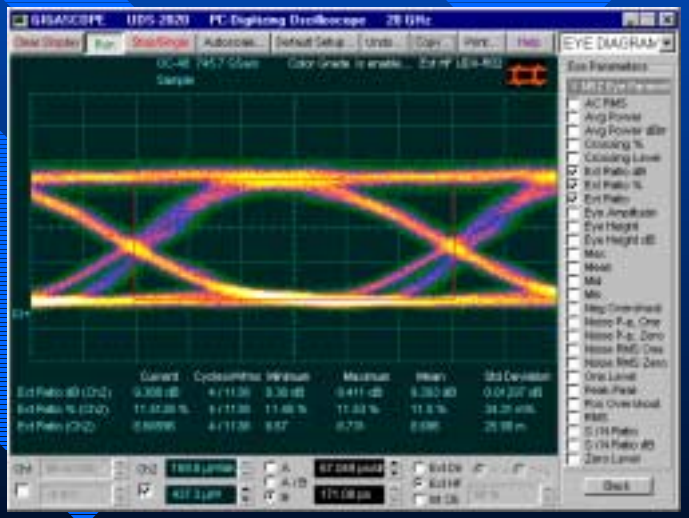
Equipment connections for parallel optical and electrical measurements



Top: 2.5-Gbps electrical eye-diagram.
Bottom: 2.5-Gbps optical eye-diagram with OC-48 Bessel-Thompson Filter .



Top: 2.5-Gbps electrical eye-diagram.
Bottom: 2.5-Gbps optical eye-diagram.



Extinction Ratio Measurements with filtered 2.5-Gbps optical eye-diagram.

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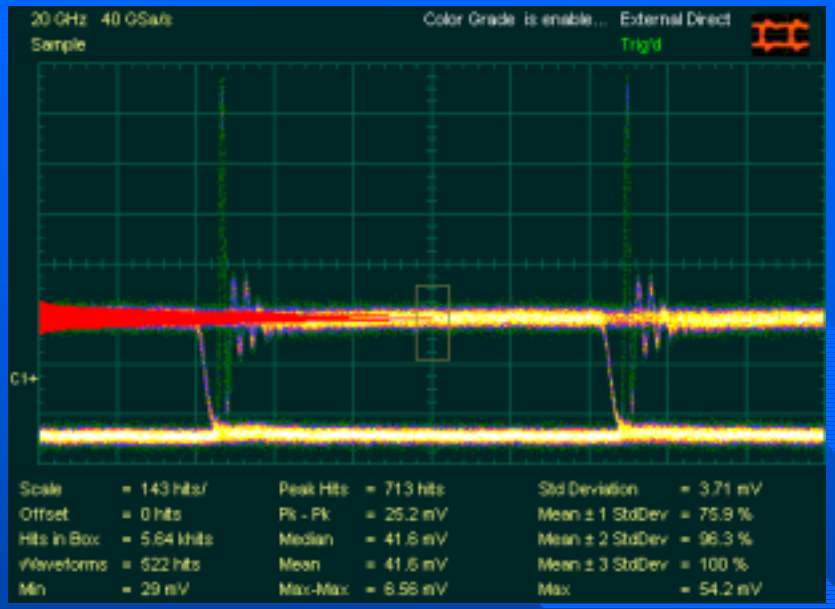
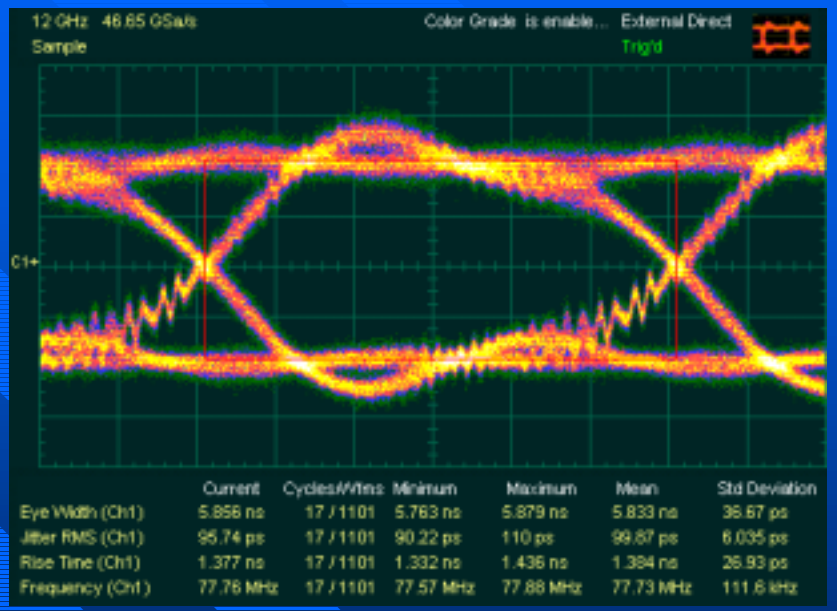
OC-3 Laser Measurements

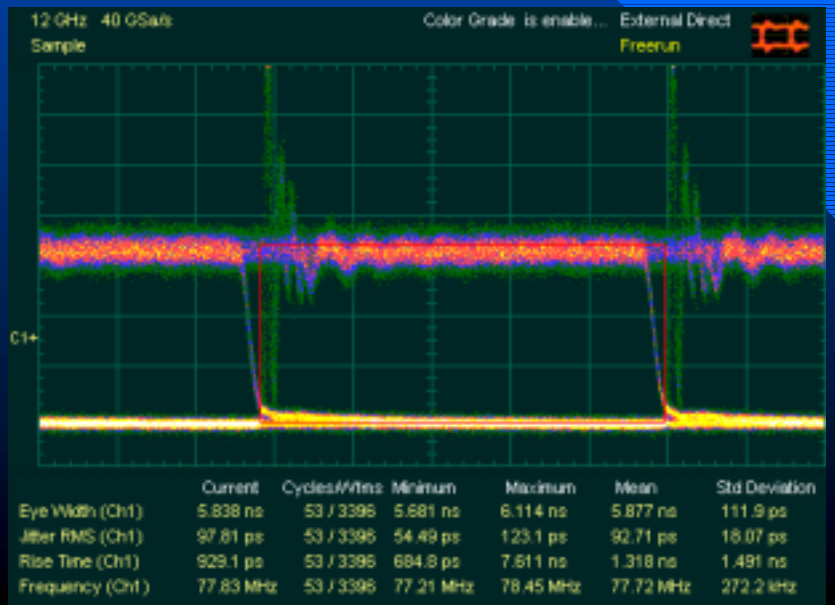


Noise measurement with No LP-Filtering

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

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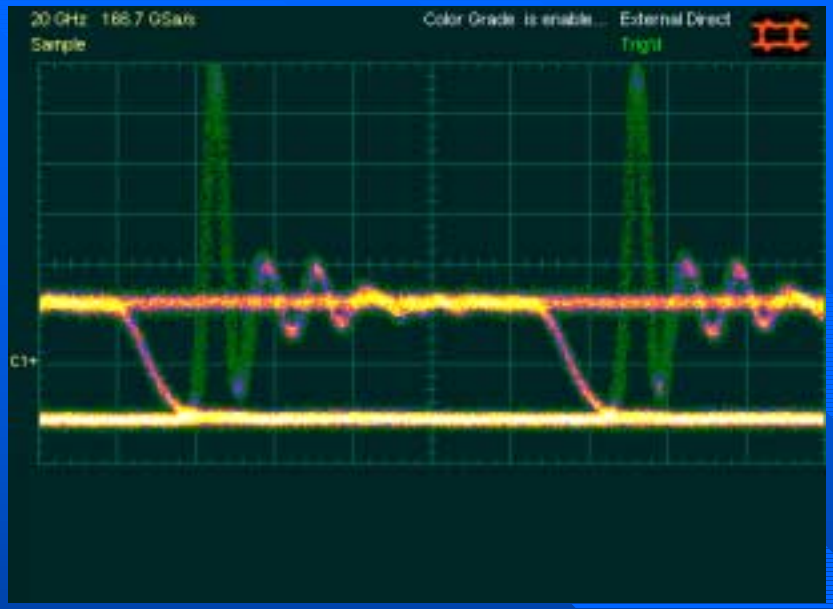
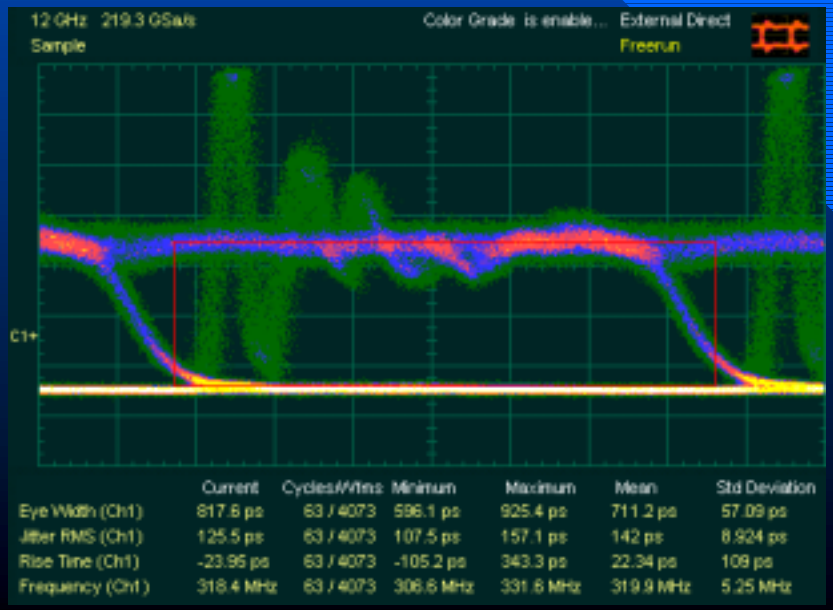
OC-12 Laser Measurements

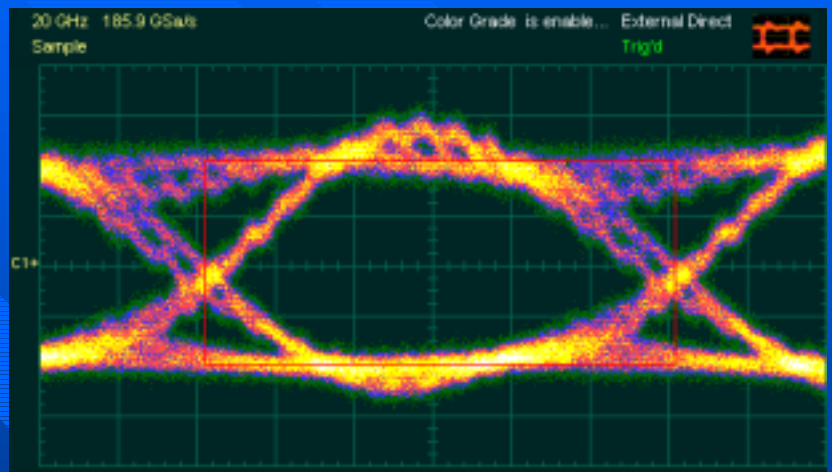


Waveform with No LP-Filtering



	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)	-23.96 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

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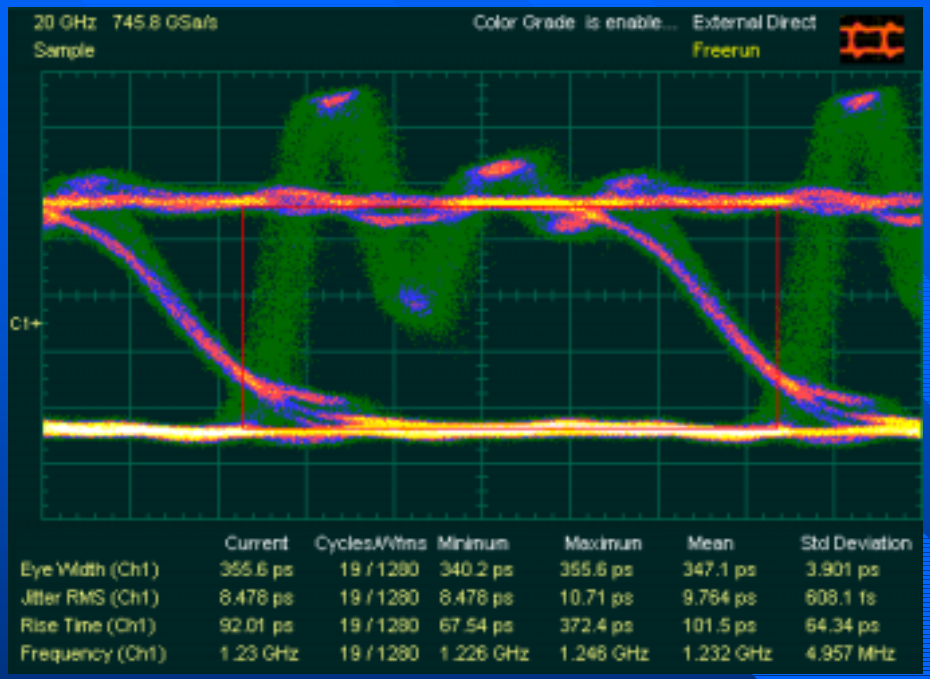
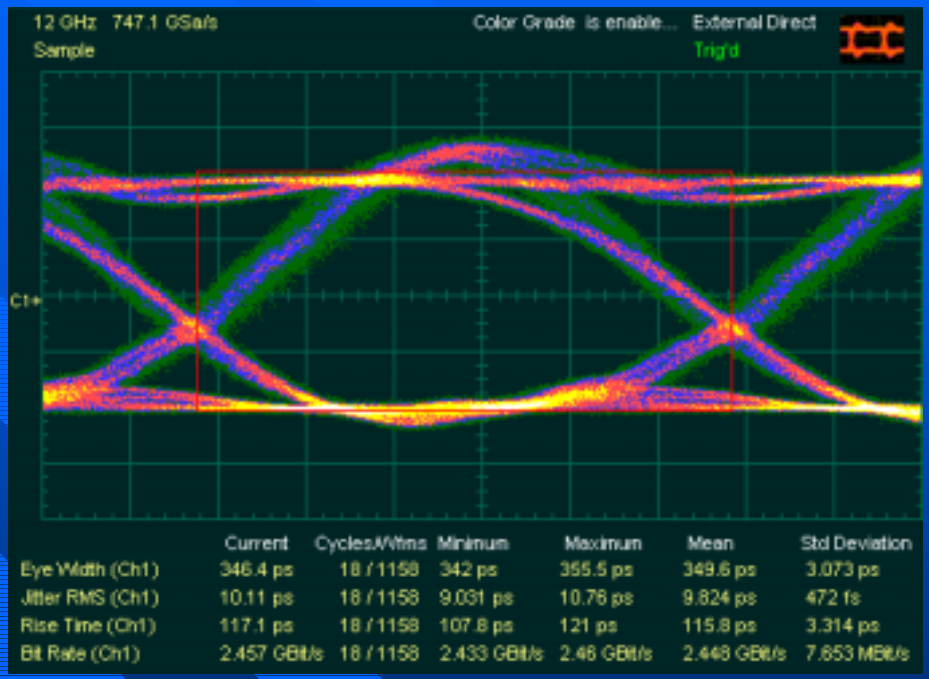
OC-48 Laser Measurements



	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



	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 No LP-Filtering

Eye-Diagram Measurements with LP-Filtering

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

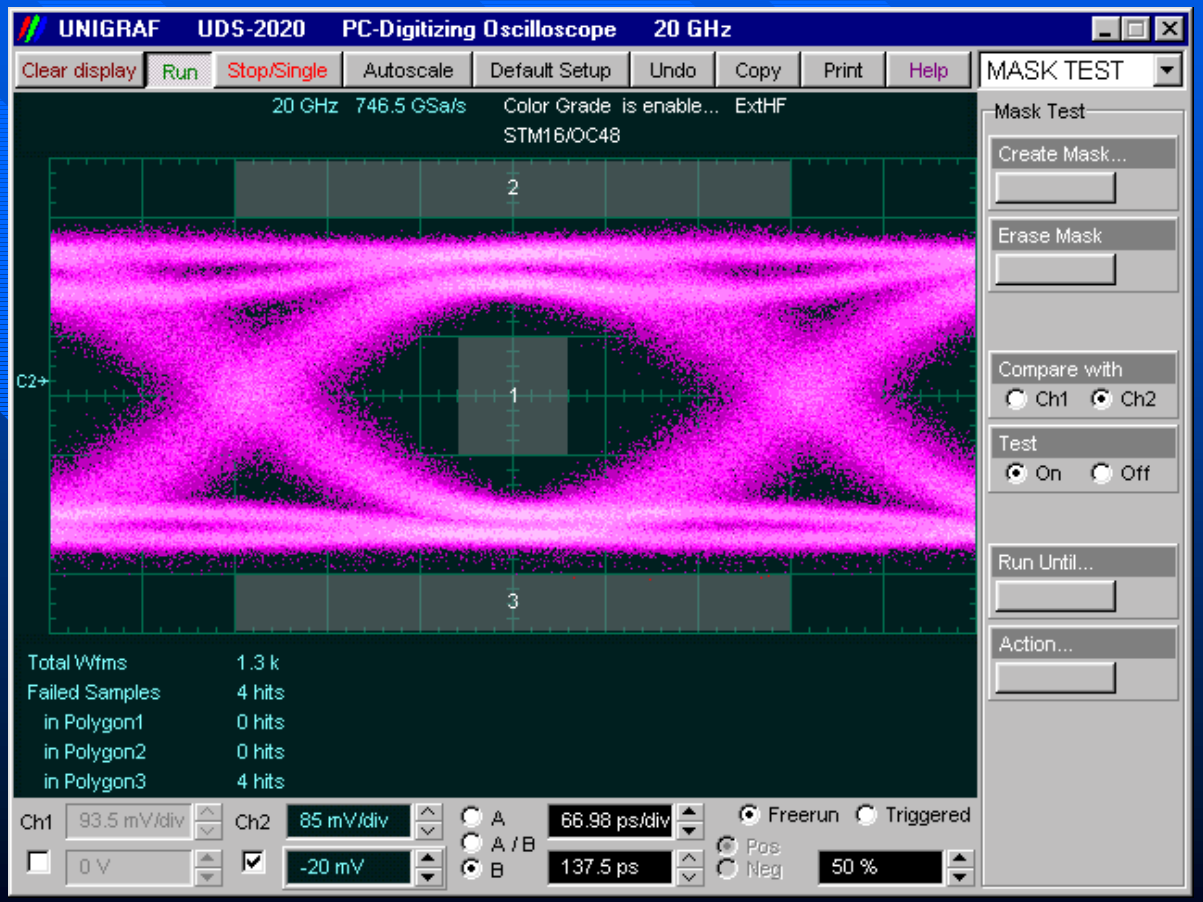
Source: Anritsu 1570A Sonet/SDH Analyzer
Signal: Optical 1,31 um, -4 dBm, OC48
Trigger: 156 MHz, Direct Input
OE-Converter: IR 10 GHz, S/N IC-0001

Mask Test

For **eye-diagram masks**, such as those specified by the SONET and SDH standards, the **UDS-2128** 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

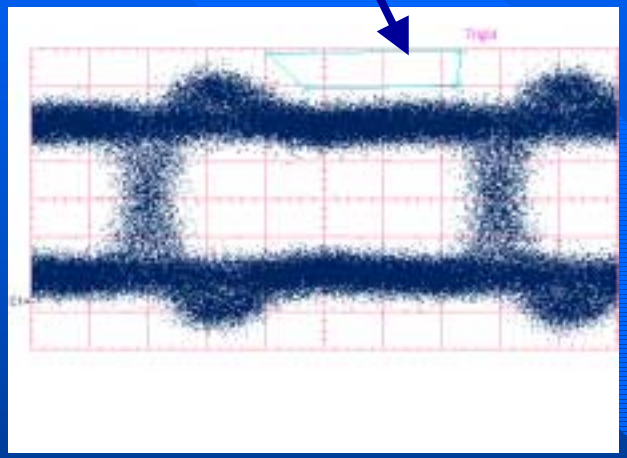
- **On-board mask drawing capability allows simple, operator-independent visual comparison of signal to standard mask.**
  Picture demonstrates a SONET/SDH (OC48/STM16) signal compared with the standard mask, showing a compliant waveform.



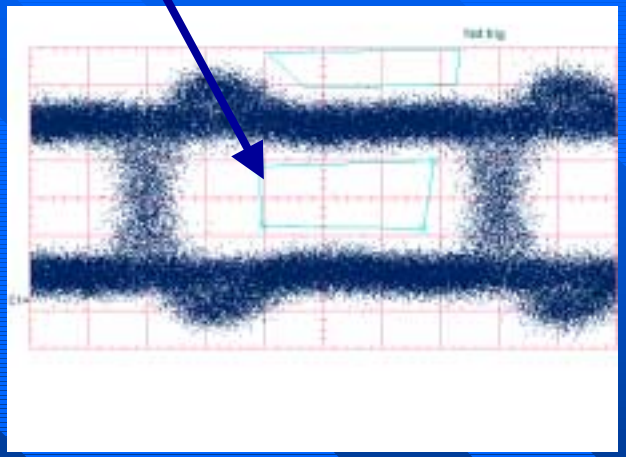
Creating Custom Mask

Five pictures below demonstrate how UDS-2128 builds Custom Mask for NRZ waveform

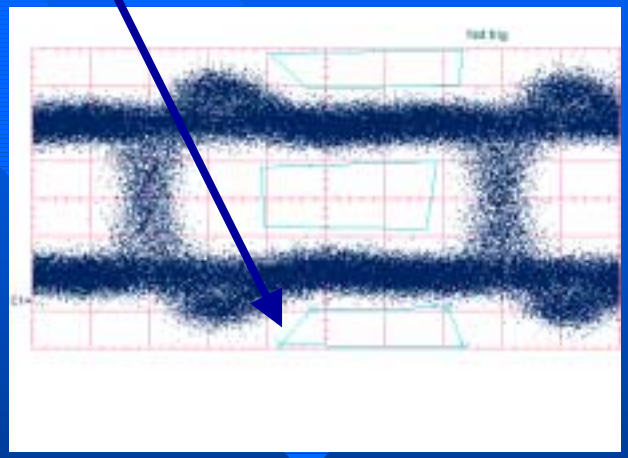
1. Create the top Polygon of the Mask

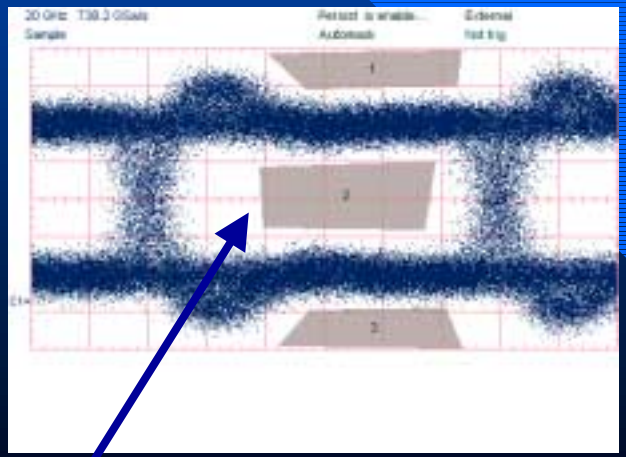


2. Create the center Polygon of the Mask

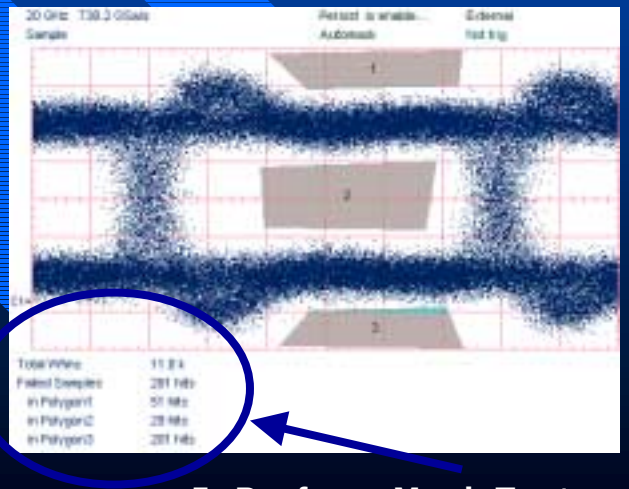


3. Create the bottom Polygon of the Mask





4. Create full Mask



5. Perform Mask Test

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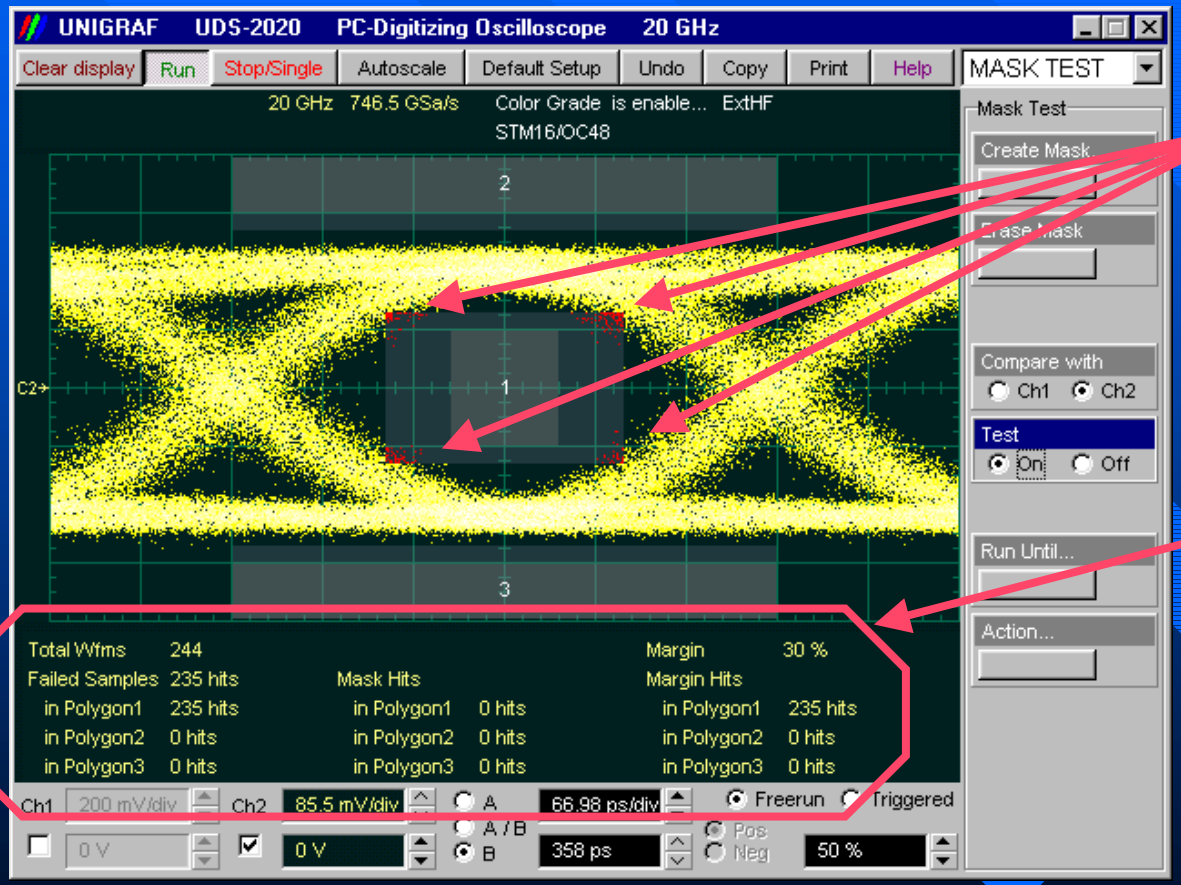
Mask Margins

Mask Margins are used to determine the margin of compliance for a standard or scaled mask. The **UDS-2128** 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.

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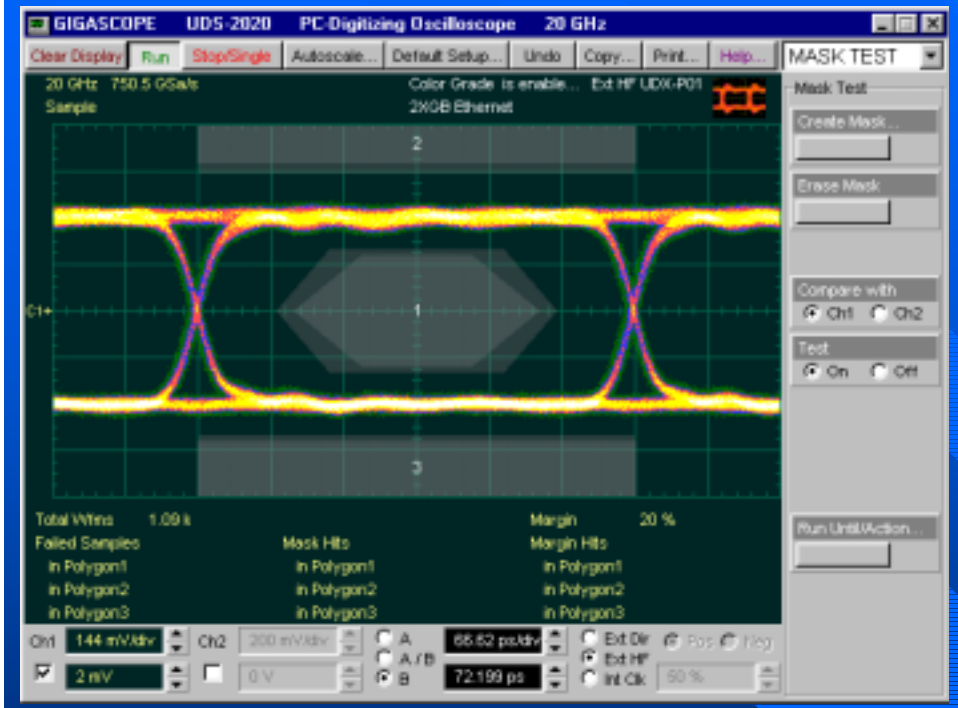
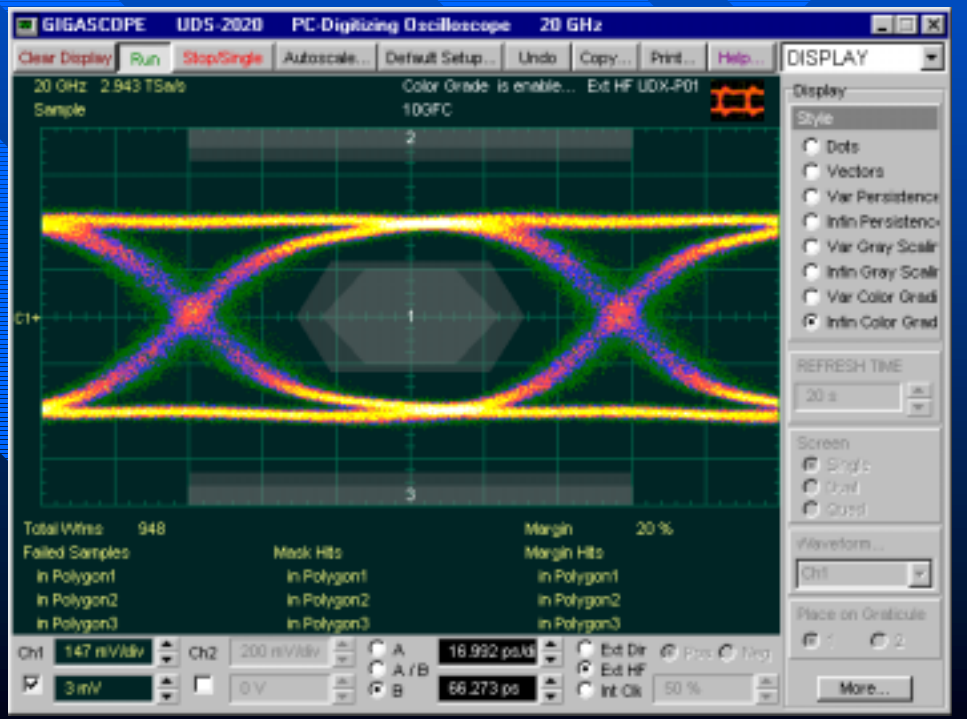
Examples of Mask Test



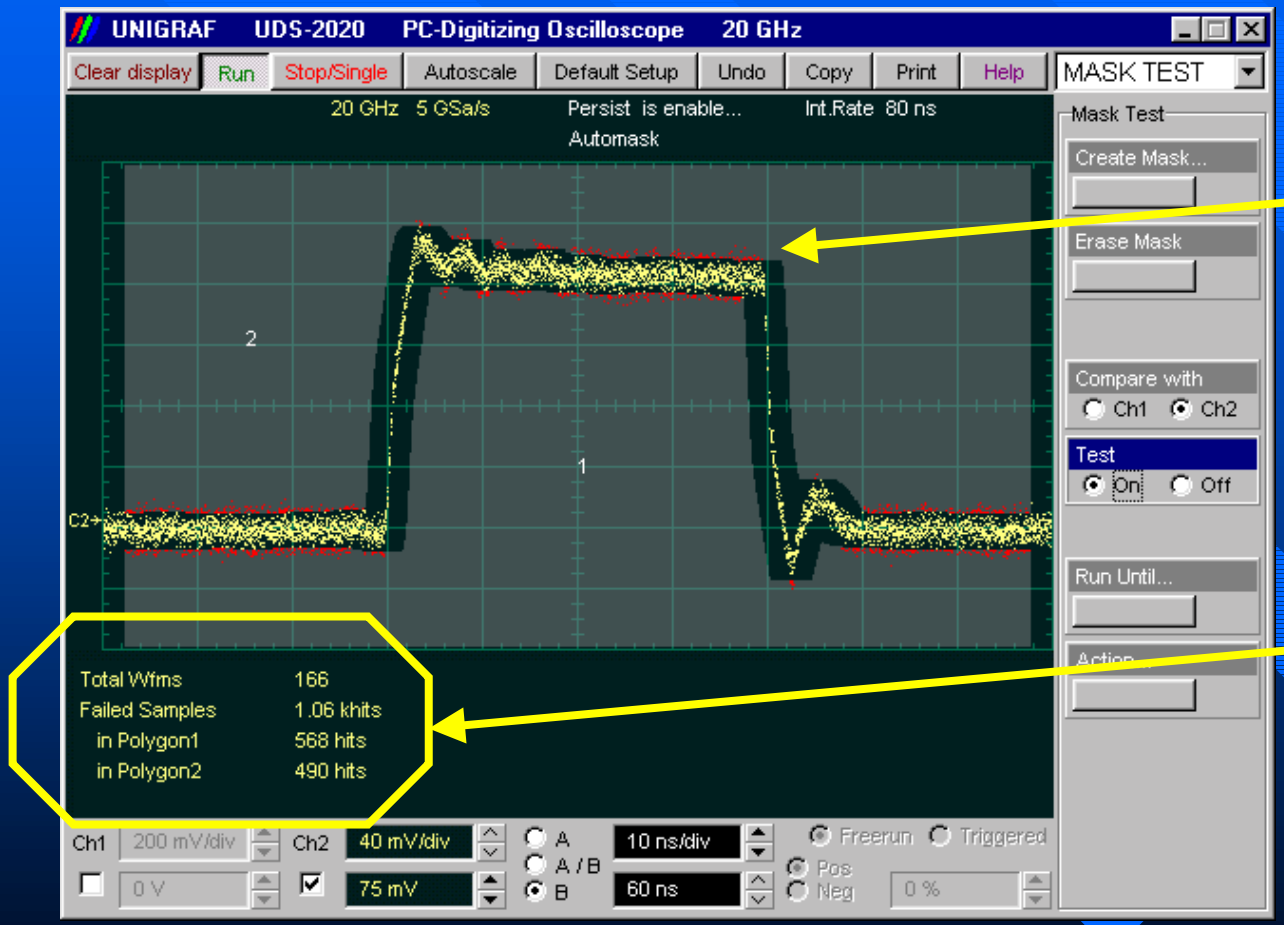
Mask Test and 20-% Margin Test performed for a standard *2.5 Gbps STM16/OC48* eye-diagram.



Mask Test and 20-% Margin Test performed for a standard *9.95 Gbps STM64/OC192* eye-diagram.

On-Fly Limit Test

The UDS-2128 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 UDS-2128's automatic, on-the-fly limit testing makes manufacturing pass-fail testing simple.

UDX-G01 Pulse Generator Head

The **UDS-2128** 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.

UDS-2128/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 **UDS-2128/UDX-G01** system

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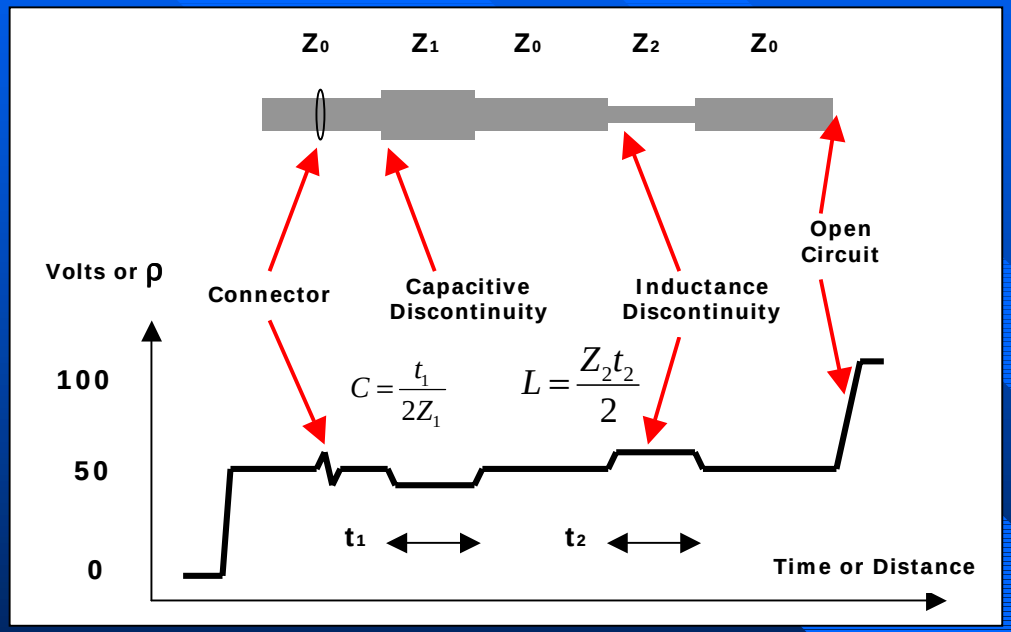
Distributed Discontinuities

TDR Measurement are used to characterize the signal transmission properties



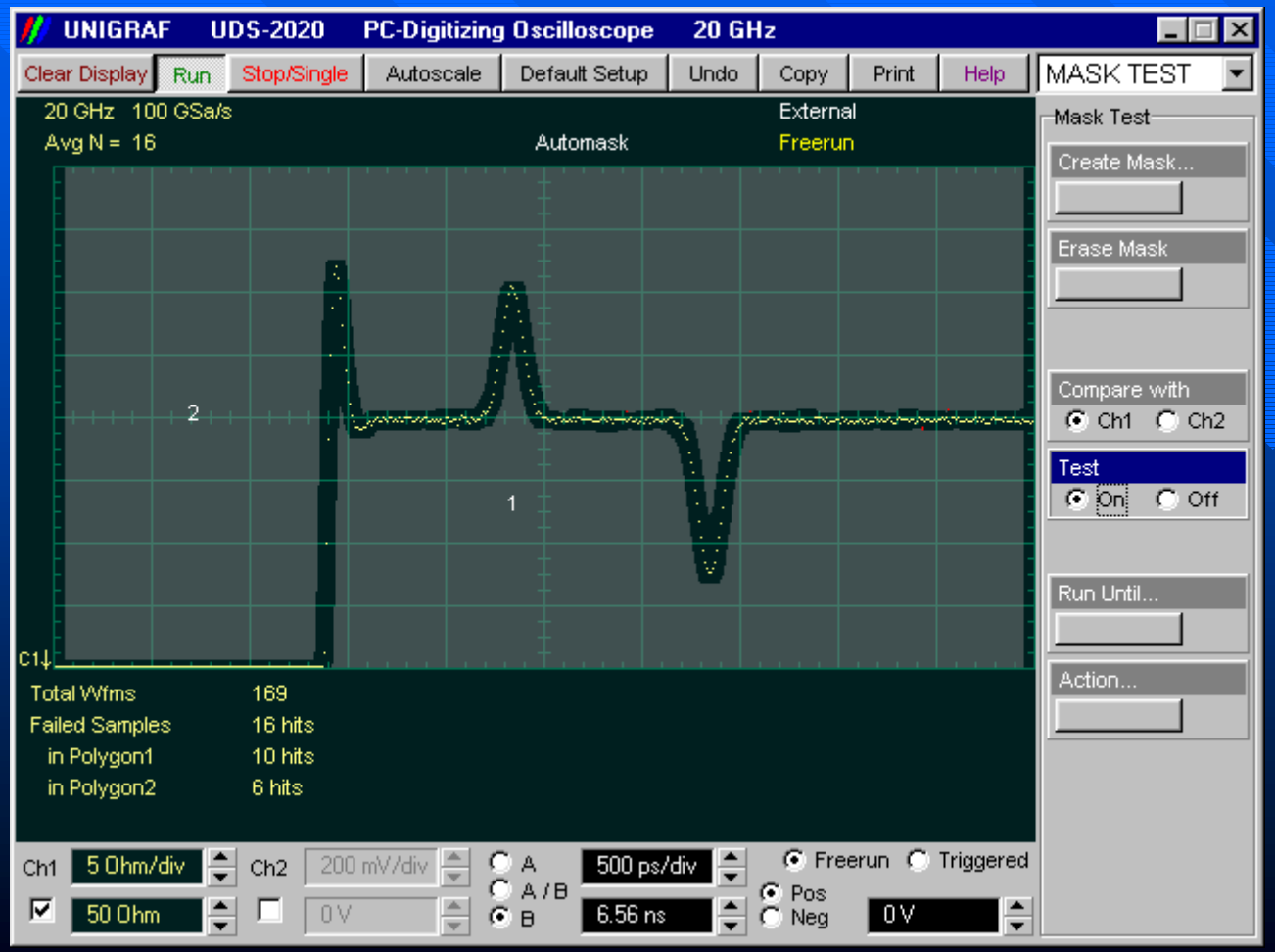
- **Typical TDR Applications:**

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 UDS-2128 you can perform TDR go/no-go testing in impedances in circuit board runs, IC packages and cables



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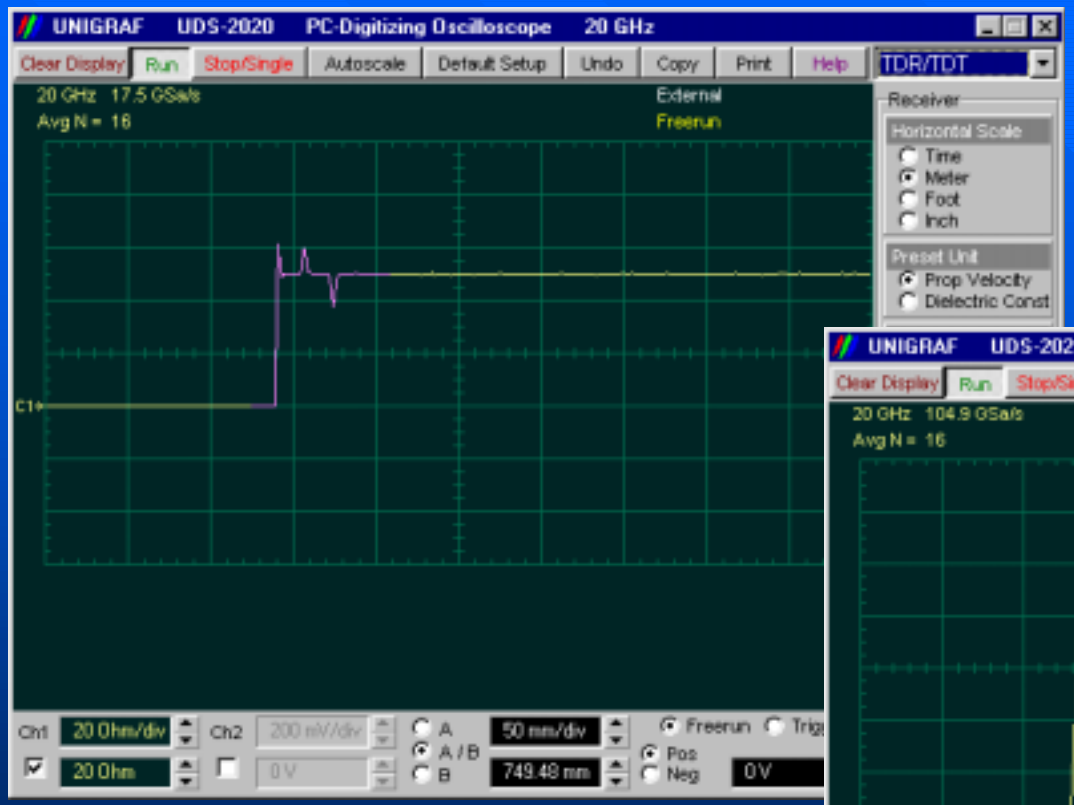
TDR/TDT Measurements

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.

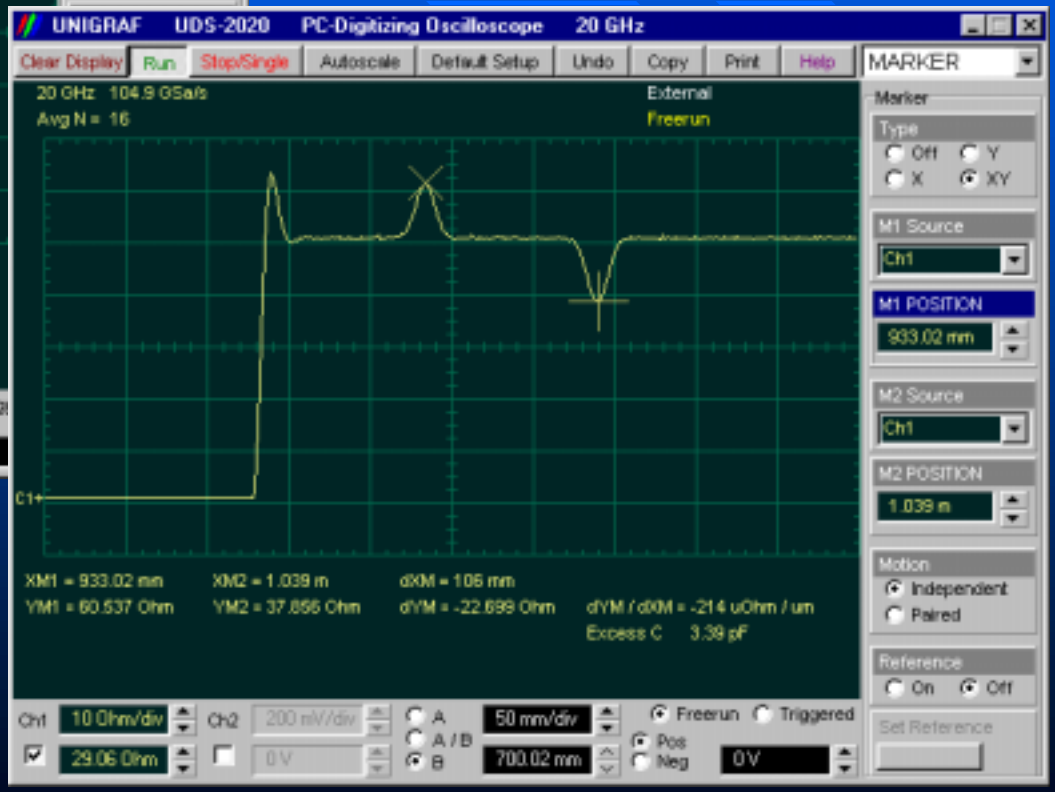
An example of **Z-profile** of ***169-Ohm*** transmission line.
Both markers provide distance and Ohm measurements

- 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

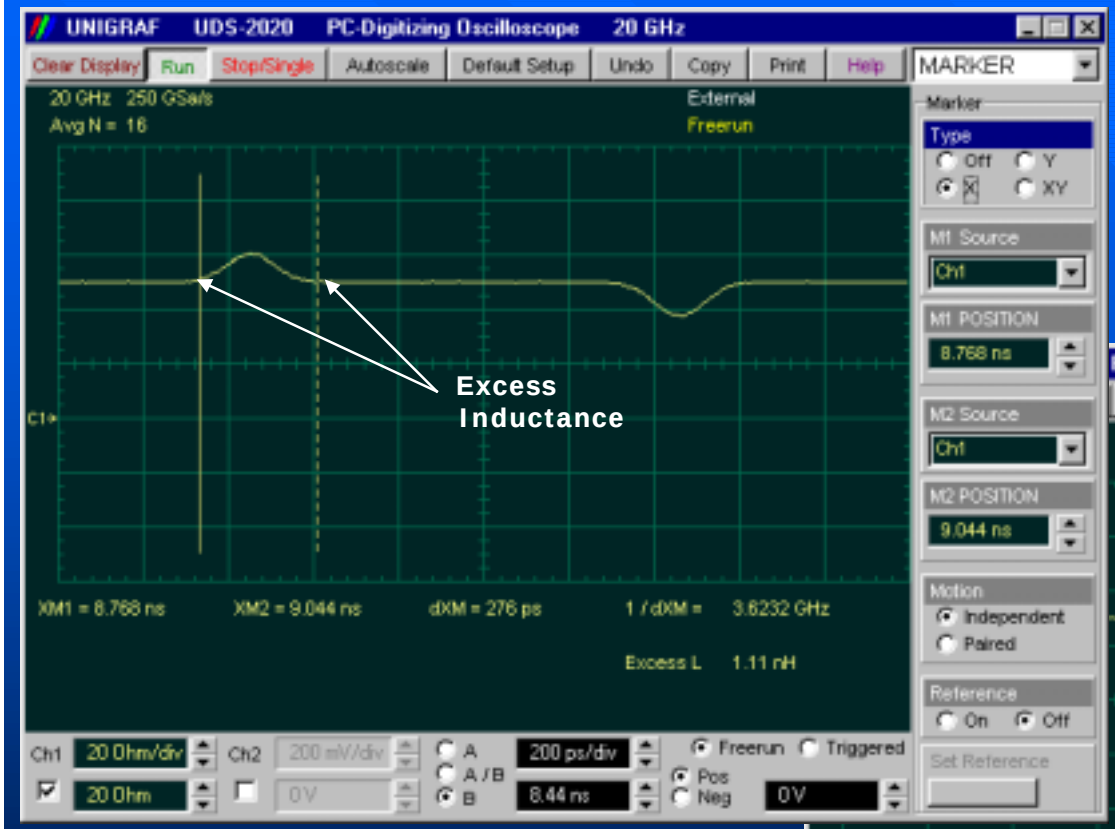


You can isolate a break in a transmission line, highlight it by using windowing, and expand it to examine the discontinuity in detail.

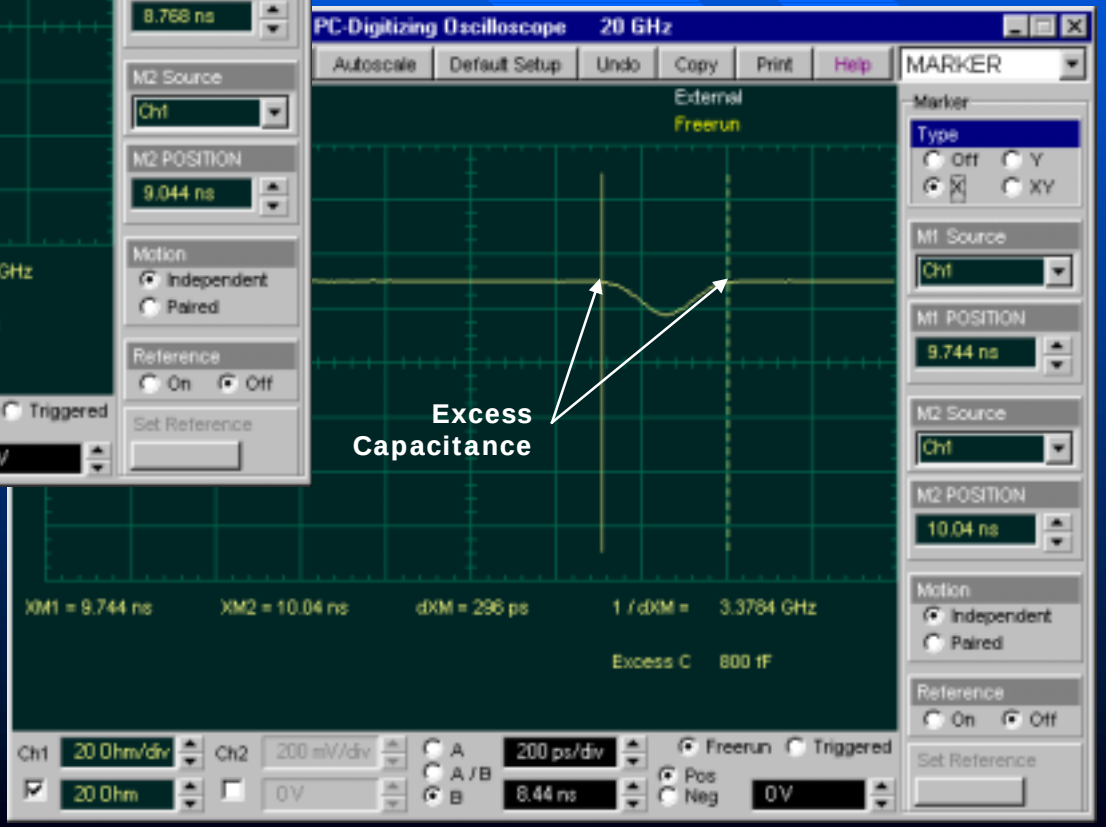


Position **XY marker** and You can make **TDR/TDT** measurements directly for **Rho** and **Delta Rho**, also for **Ohms** and **Delta Ohms**.

Precise Measurement of Discontinuities



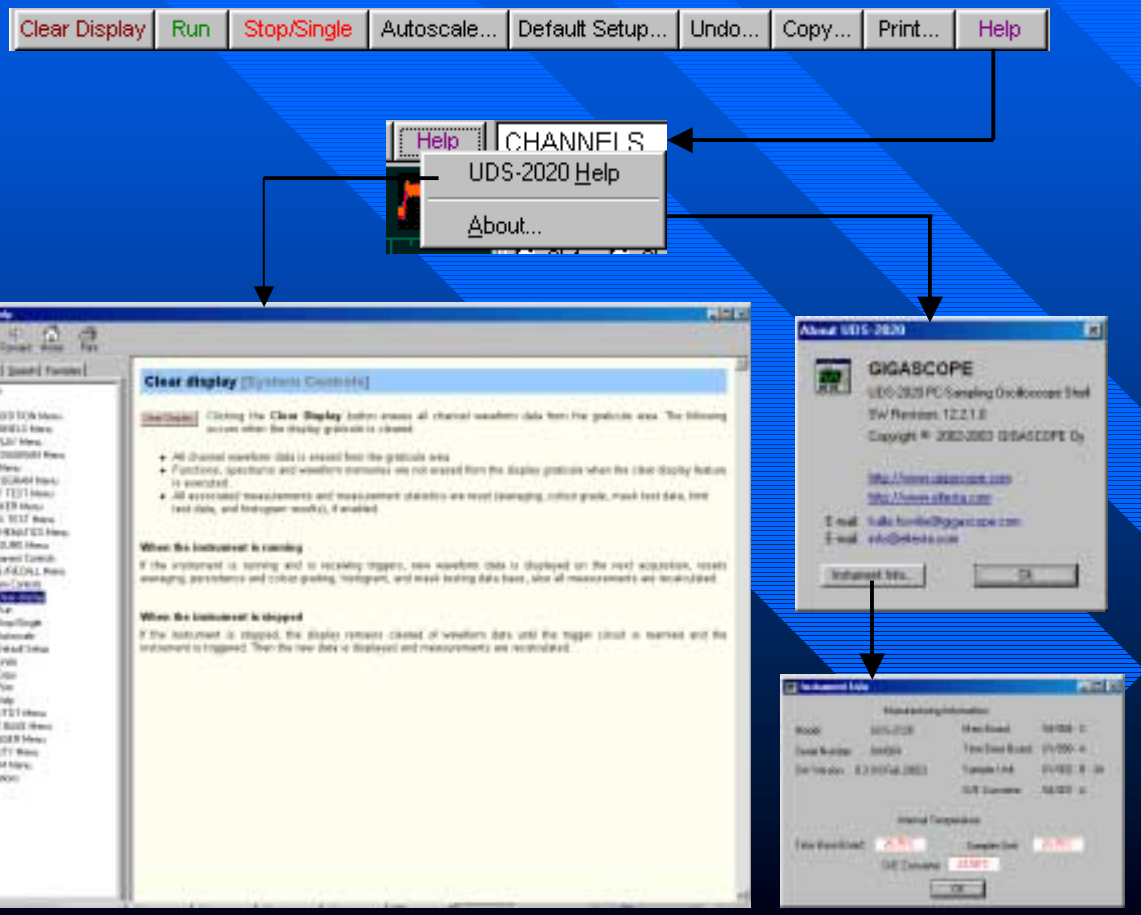
- Cursors can read out in units of **distance** in **meters**, **feet** or **inches** along the horizontal axis.
- Waveforms can be displayed in units of **volts**, **ohms**, or **reflection coefficient** along the vertical axis.
- Scaling in **ohms/division** and **ohms offset** is provided.



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.

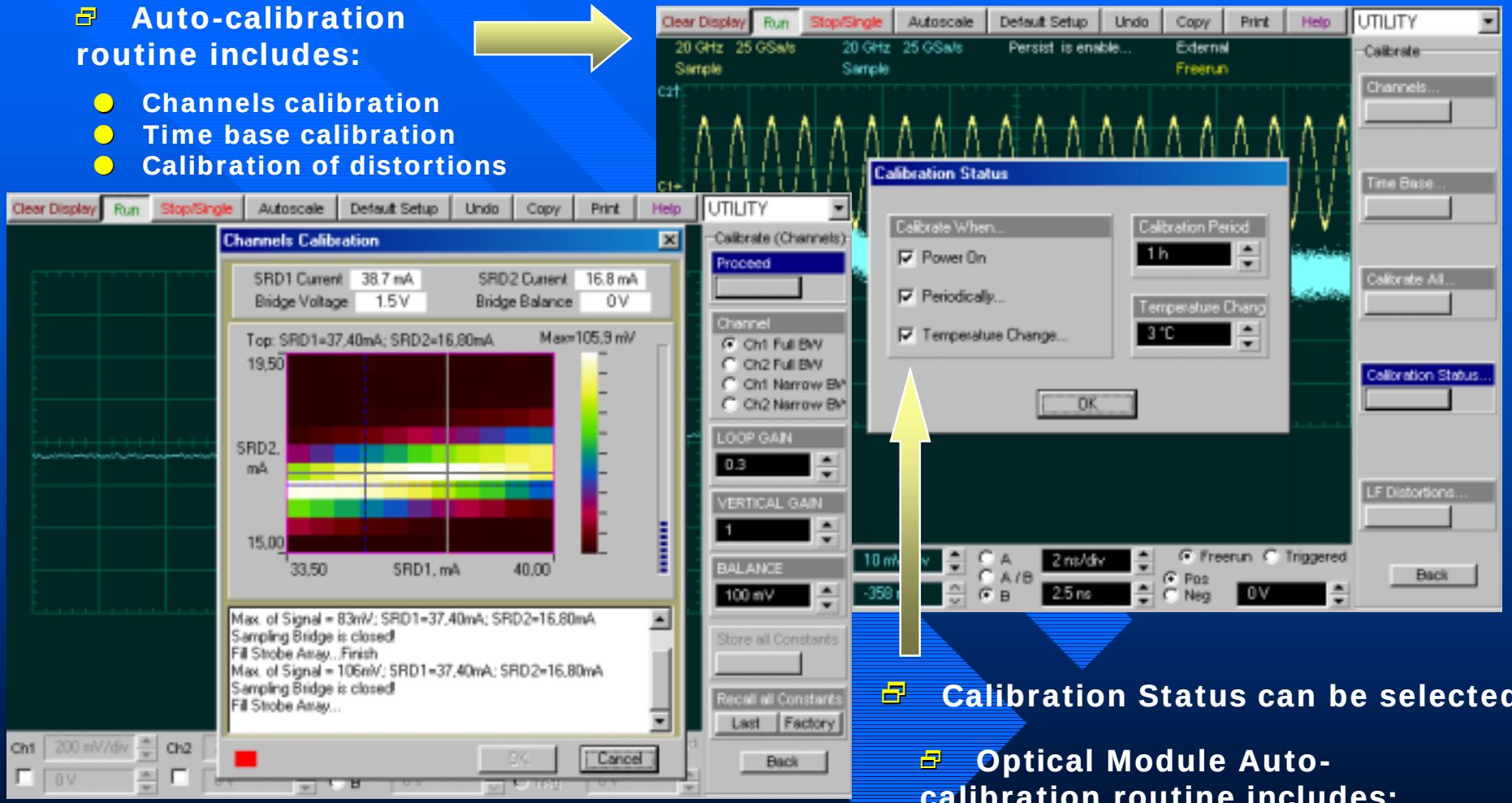


The on-line context-sensitive Help manual provides immediate answers to your questions about using the instrument. Links on the measurement screen take you directly to the information you need.

The UDS-2020 Built-in information system

Calibration

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



- **Calibration Status can be selected**

- **Optical Module Auto-calibration routine includes:**
  - Dark Level Compensation
  - Wavelength Gain Calibration

Calibration of the UDS-2128 has been simplified by using full auto-calibration procedure and placing all performance level menu, indicators and messages in one menu page.

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Packaging

Manufacturing and Test









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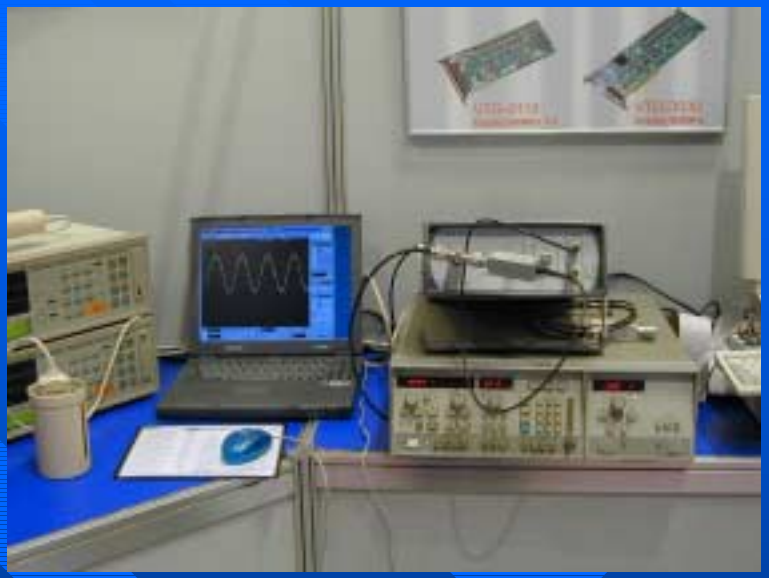
Marketing and Demonstration



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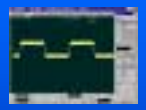
Specifications

Electrical Channels



Number of Channels – 2.
Bandwidth - 20 or 12 GHz.
Rise Time (10-90%) - <17.5ps or <29.2ps.
Maximum MS 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.
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 – SMA (f).

Optical Channel

Channel Configuration – O/E Converter +Two Electrical Channels, or One Optical Channel+ One Electrical Channel.
Fiber – MM or SM.
Unfiltered Optical Bandwidth – 8 GHz.
Calibrated WL - 850nm (MM), 1310nm (MM/SM), 1550nm (SM).
Maximum RMS Noise - 4 uW@1310 nm/1550 nm, 5 uW@850 nm.
Scale Factors - 1 uW/div to 400 uW/div.
Standard Data Rates - 155.52 Mbps (OC-3/STM-1), 1.25 Gbps (GBE), 2.488 Gbps (OC-48/STM-16).
Optional Data Rates - 622.08 Mbps (OC-12/STM-4), 1063 Mbps (FC1603), 2.125 Gbps (FC2125), 2.500 Gbps (Infiniband 2.5G), 3.125 Gbps (XAUI).
Input Connectors – FC/PC.

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 ± 10 ps ± 100 ppm of delay setting (typical).
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, Recovered Clock (optional).
Direct Trigger - 100 mV p-p DC to 100 MHz, 400 mV p-p @ 1 GHz.
Internal Clock Rate - 10 us to 2 ms.
RMS Jitter – 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.
Clock / Data Recovery- Continuous Rate 10 Mb/s to 2.7 Gb/s
Direct Trigger Input Connectors - SMA (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.

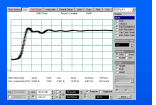
UHF Prescaled Trigger with UDX-P01 Head

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 %.

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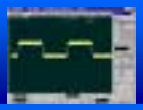
Characteristics

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

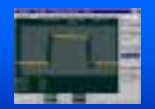
Marker

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



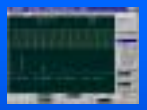
Test - Up to ten automatic measurements can be compared to user-defined test boundaries.
On failure actions - Beep, Save failed waveform to disk or Stop acquisition.

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.

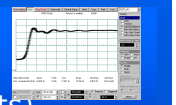
Mask Test

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

UDS-2128 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 - 70 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 - 6.5 kg,
Shipping - 12.0 kg.

UDS-2000 Family of Wide-Bandwidth PC-Sampling Oscilloscopes

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

The UDS-2020 oscilloscope

The UDS-2030 oscilloscope and a 30-GHz sampler

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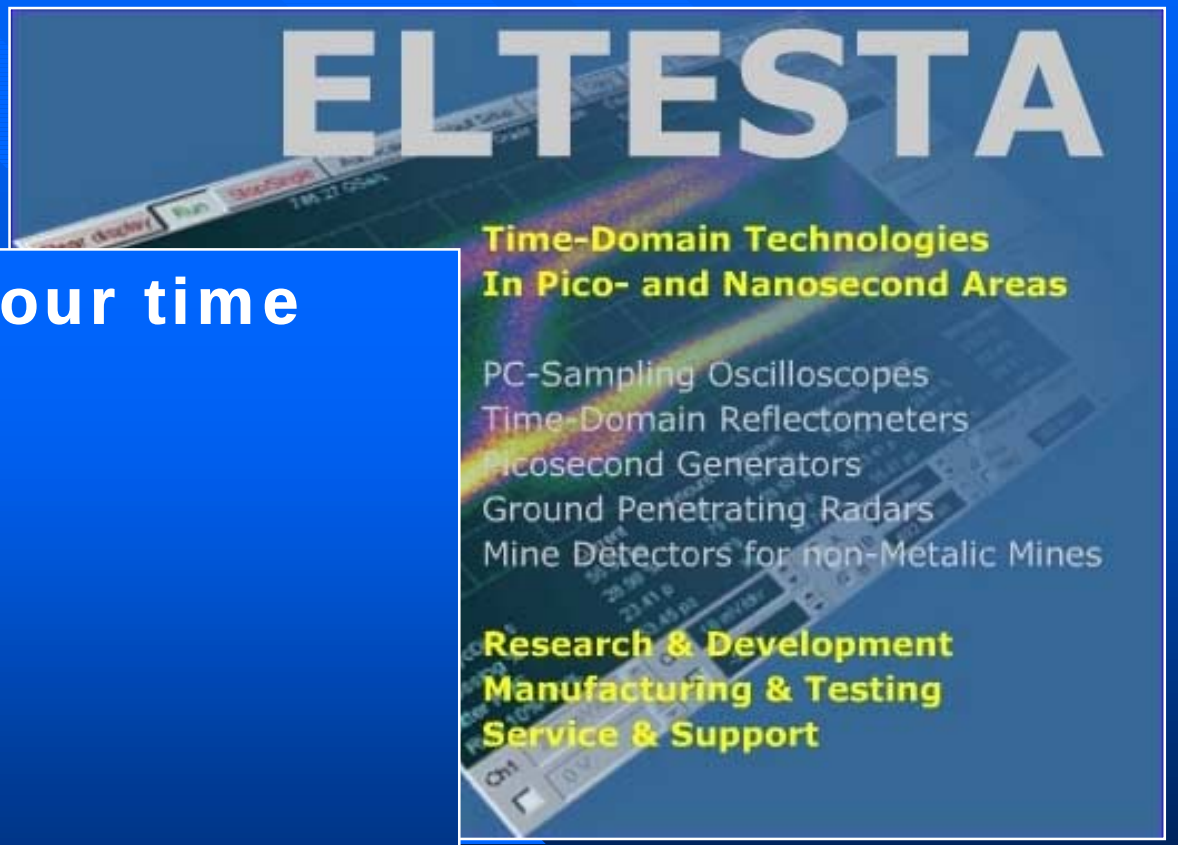
The End



Thank You for Your time

Questions?

info@eltesta.com

Application Notes available @ www.eltesta.com