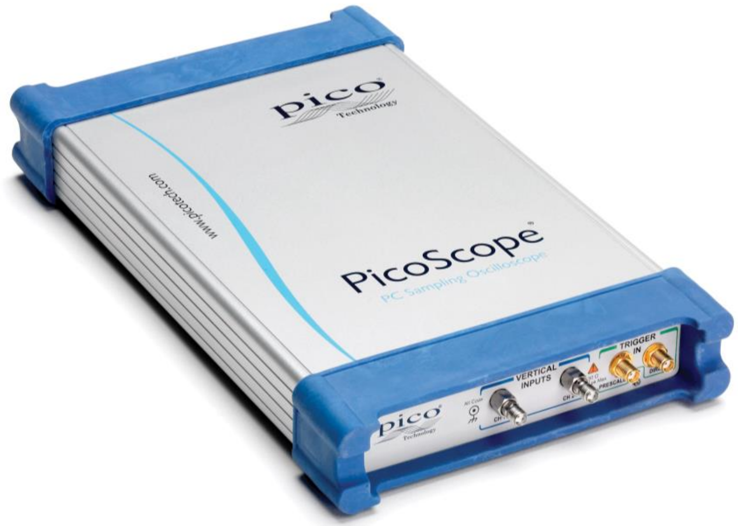
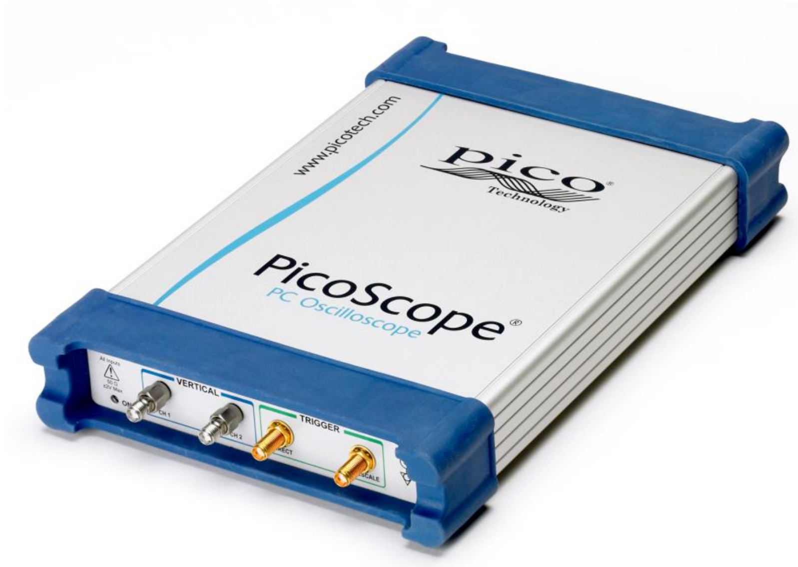


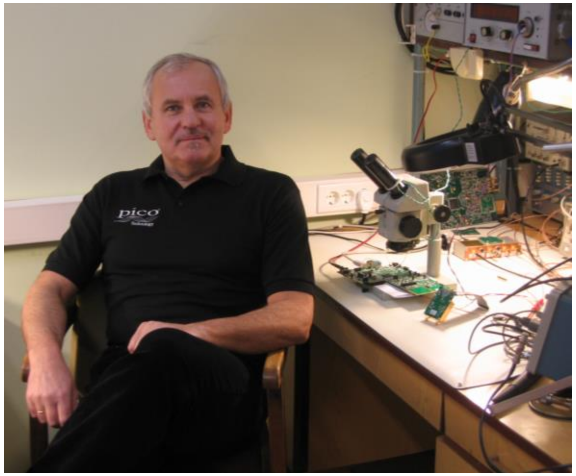


PicoScope 9000 Series and the NEW 9300 20 GHz Sampling Oscilloscopes

Pete Darby Sampling Consultant

Here Sits Much of the World's Sampling Scope Expertise ….

Eltesta have over 60 years leading edge experience in Oscilloscope design …. a goodly proportion of global Sampling Oscilloscope expertise.

This is the core development team at Eltesta, in Vilnius, Lithuania.

These guys wrote the book on the history of Oscilloscope design on the other side of the Iron Curtain.

Eltesta once owned 20% of the global Oscilloscope market!

Eltesta Product History …..
(nee: Vilnius Measurement Institute)

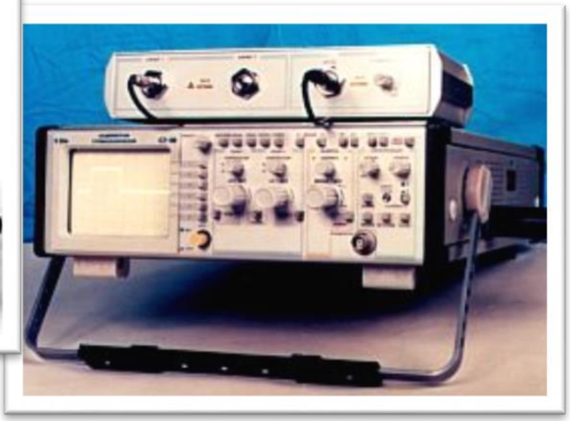
1981 18 GHz

1985 18GHz + measurements

1982 5MHz 1kSa DSO

1987 50MHz DSO

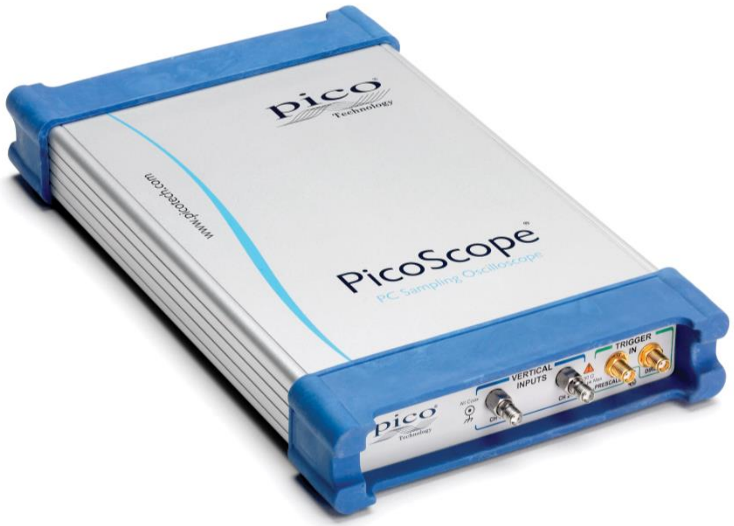
1990 30GHz

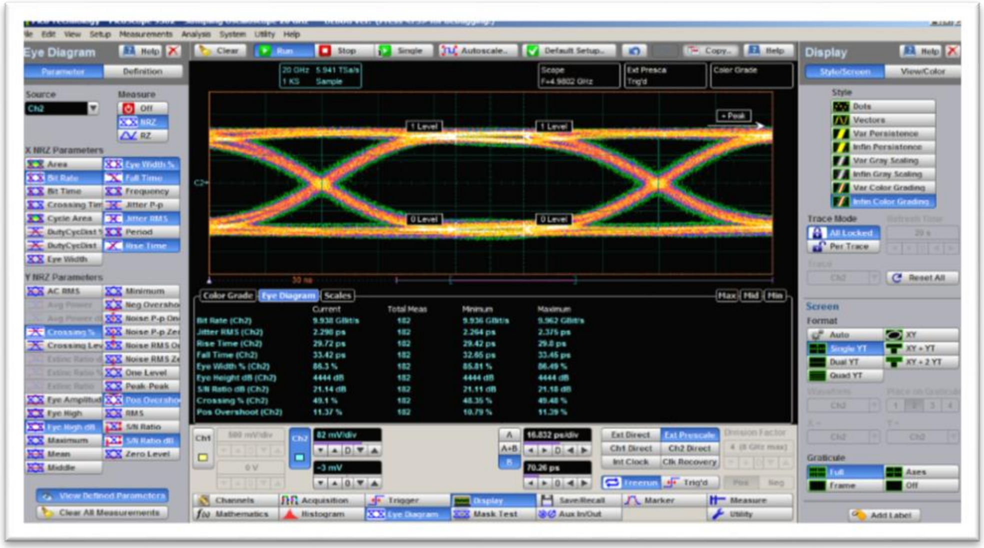


1994 30GHz

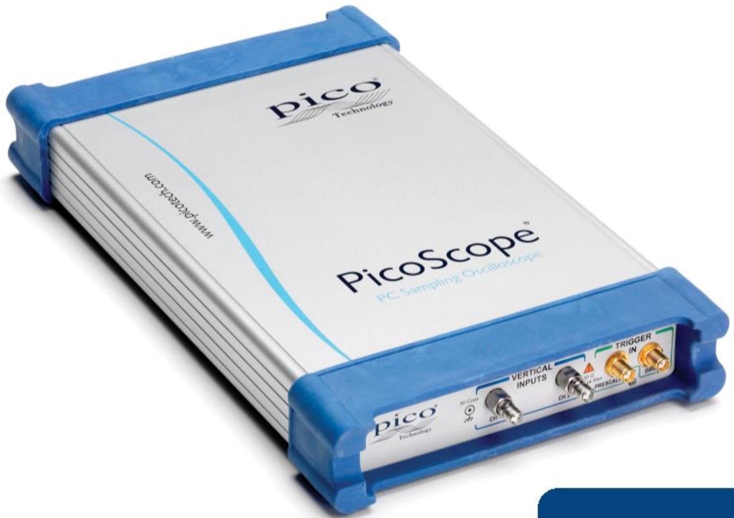
1994 1GHz DSO

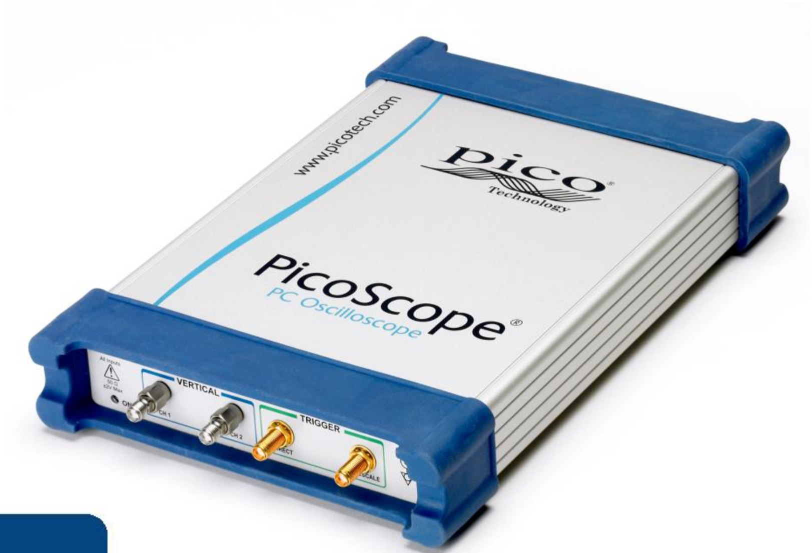
But these days, Eltesta design these …

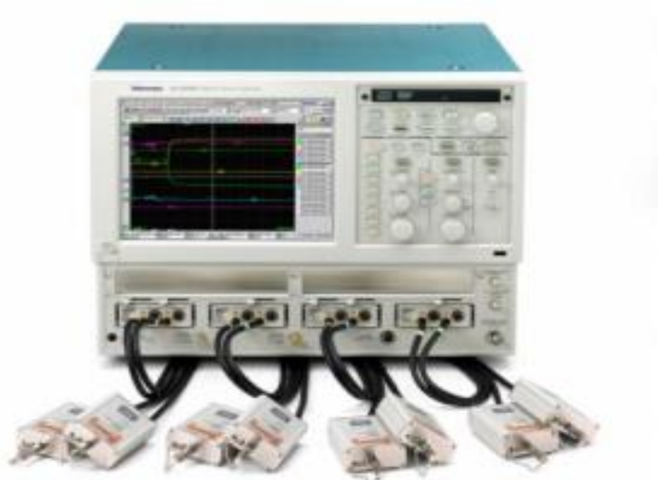


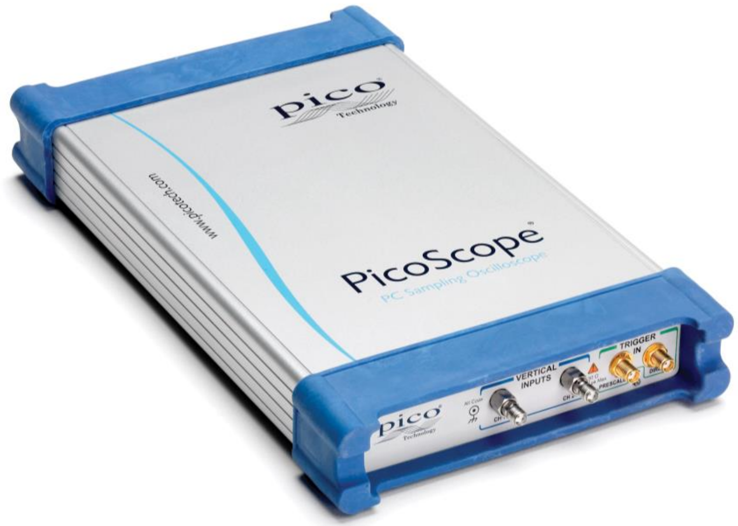


Who made the bigger step forward ?









PicoScope 9000 Series and the NEW 9300 20 GHz Sampling Oscilloscopes

Pete Darby Sampling Consultant

Agenda

- Sampling theory
- The new 9300 20 GHz Sampling Oscilloscopes
- Refreshed but familiar Software
- 9200 v 9300 series comparison

Presentation Format

'First Touch' – The Distributor Role

'High Touch' - Pico Technical Support


STANDARDS COMPLIANCE & 2 YEARS WARRANTY • SOFTWARE • HIGH END CUSTOMER SUPPORT •
High Bandwidth
Portable
Multi instrument
Deep memory
High Resolution
Flexible Resolution
9000 Series

Real-time Scope vs Sampling Scope

Real-time Oscilloscopes

- Can capture single instantaneous or repetitive events
- Lower ADC resolution, but high sample rate increases error
- Long record length
- Advanced triggers to capture intermittent events
- Serial bus decoding
- Ideal for general use and fault diagnosis
- Real-time GS/s sampling is EXPENSIVE

Sampling Oscilloscopes

- Can capture cyclic signals
  repeating patterns
  steady data rate
- Have lower sample rate
  (expanded in next slide)
- Wider bandwidth for lower budget
- Lower intrinsic jitter and noise
- Eye diagrams and mask testing
- Best choice for TDR/TDT
- Lower cost of ownership

Real-time Scope vs Sampling Scope

Real-time Oscilloscopes

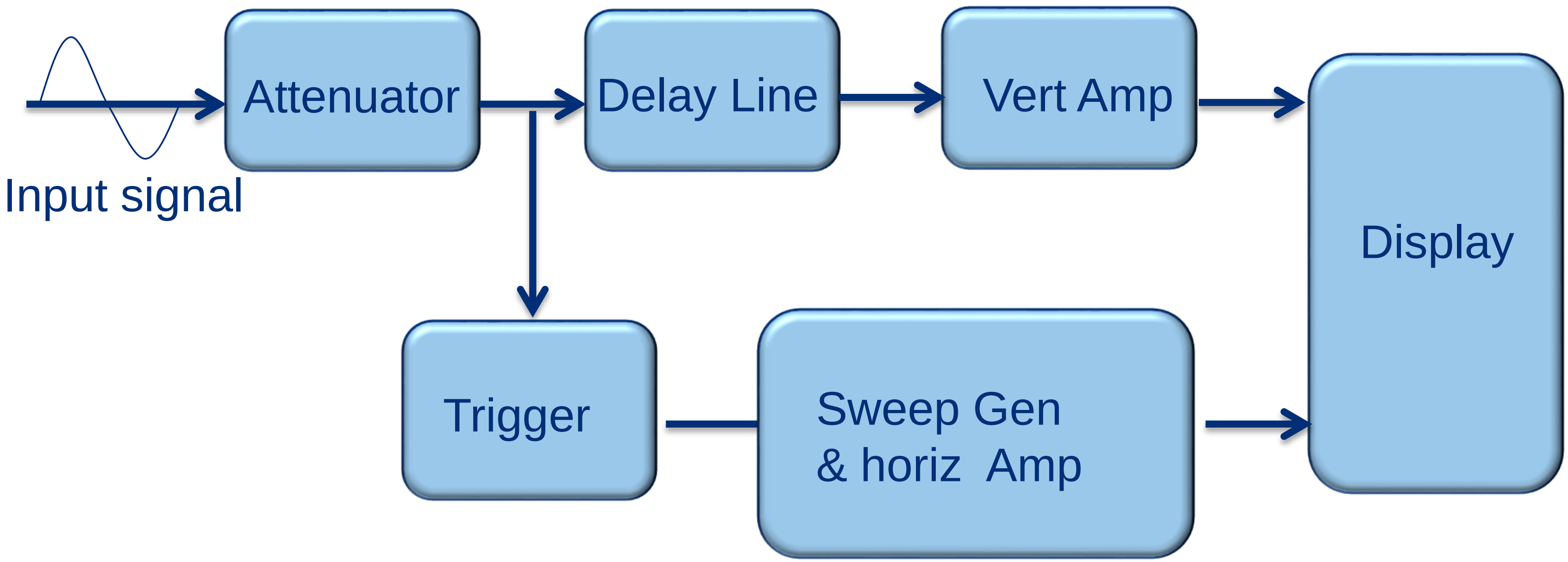
- Can capture single instantaneous or repetitive events
- Lower ADC resolution, but high sample rate increases error
- Long record length
- Advanced triggers to capture intermittent events
- Serial bus decoding
- Ideal for general use and fault diagnosis
- Real-time GS/s sampling is EXPENSIVE

Sampling Oscilloscopes

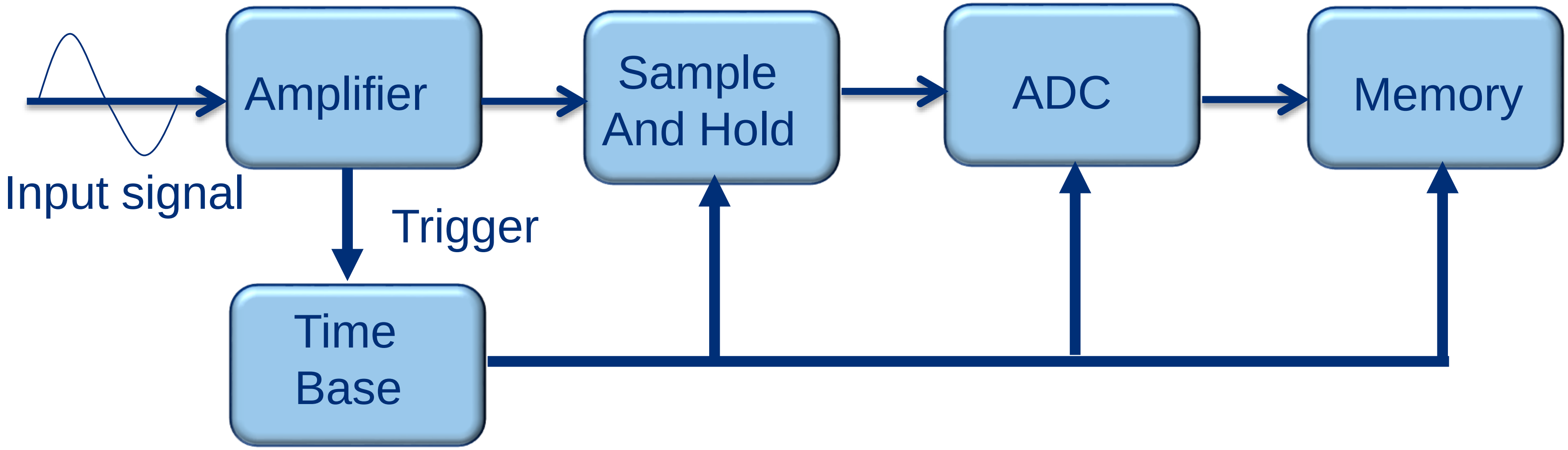
- Sampling scopes could have longer record length but this delays next trigger and slows the acquisition
- Have lower sample rate

It is really the dynamics of the Sample timing ramp/DAC and the track and hold that defines sampling rate
(our sampling rate is faster than most competition, Lecroy 10MS/s)

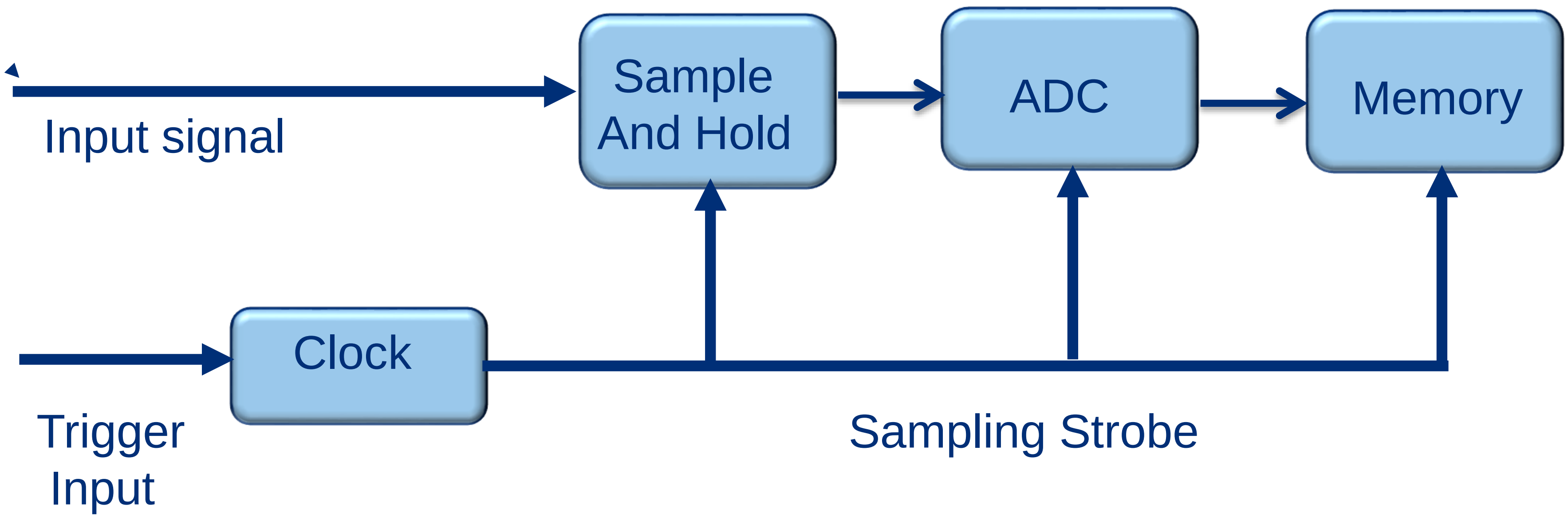
Analog Oscilloscope



Analog Oscilloscope (screen storage)



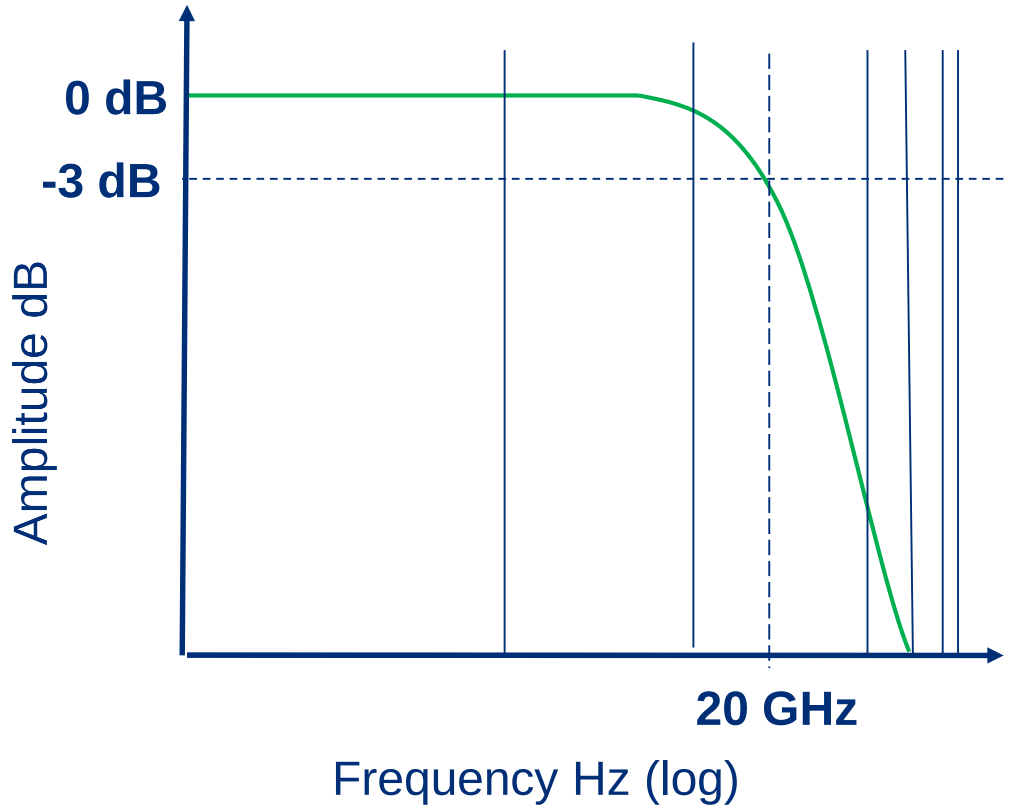
Real-time Digital Oscilloscope



Sampling Oscilloscope

Analog Bandwidth

‘Analog bandwidth’ is the maximum frequency that can pass through the front end of an Oscilloscope



Choose a Scope with enough bandwidth for the application:

- Signal transition time
- Signal clock or data rate
- Signal rise and fall time
- Signal narrowest pulse

Effects of too little bandwidth:

- Amplitude and timing errors
- Loss of high frequency aberrations and detail

Measured Rise Time Error vs 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%

Bandwidth and Data Rate

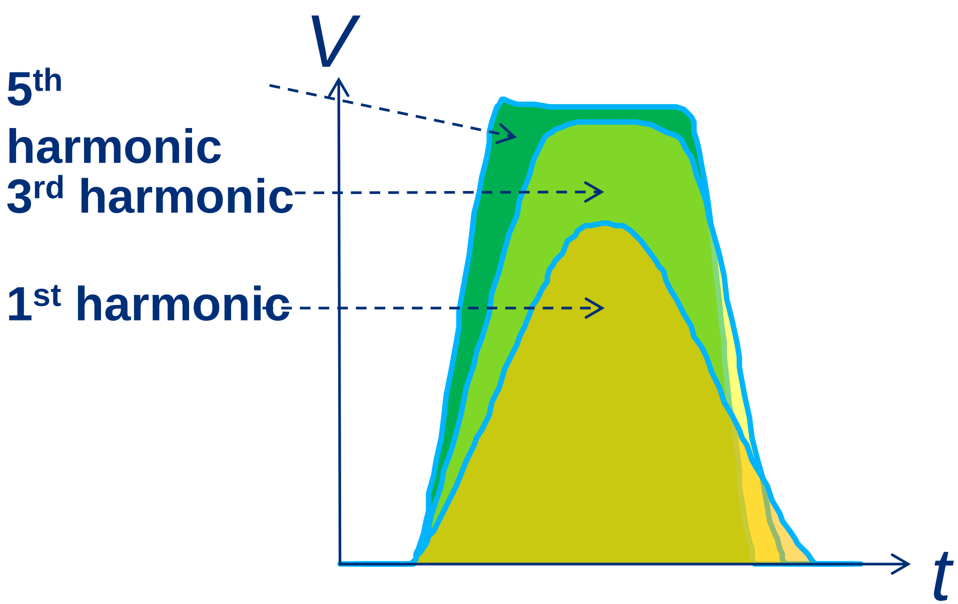
Calculating bandwidth from Data rate:

3^{rd} Harmonic = $3 \times \frac{\text{Bit rate}}{2}$

5^{th} Harmonic = $5 \times \frac{\text{Bit rate}}{2}$

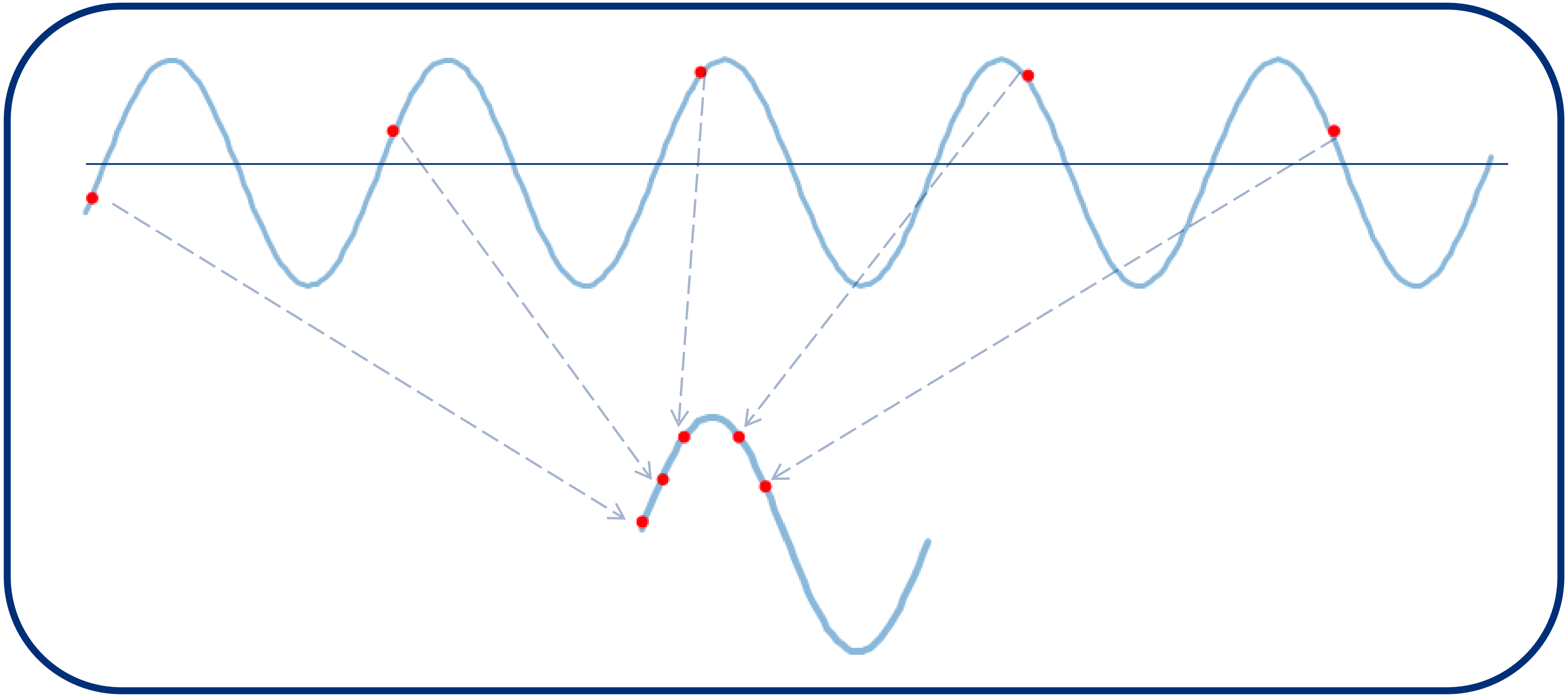
Application example

PCIe R1.0a has a data rate of 2.5 Gbps (1.25 GHz frequency)
Bandwidth required to see 5 harmonics is 1.25 GHz x 5 = **6.25 GHz**



Sampling Methods – Equivalent Time 1

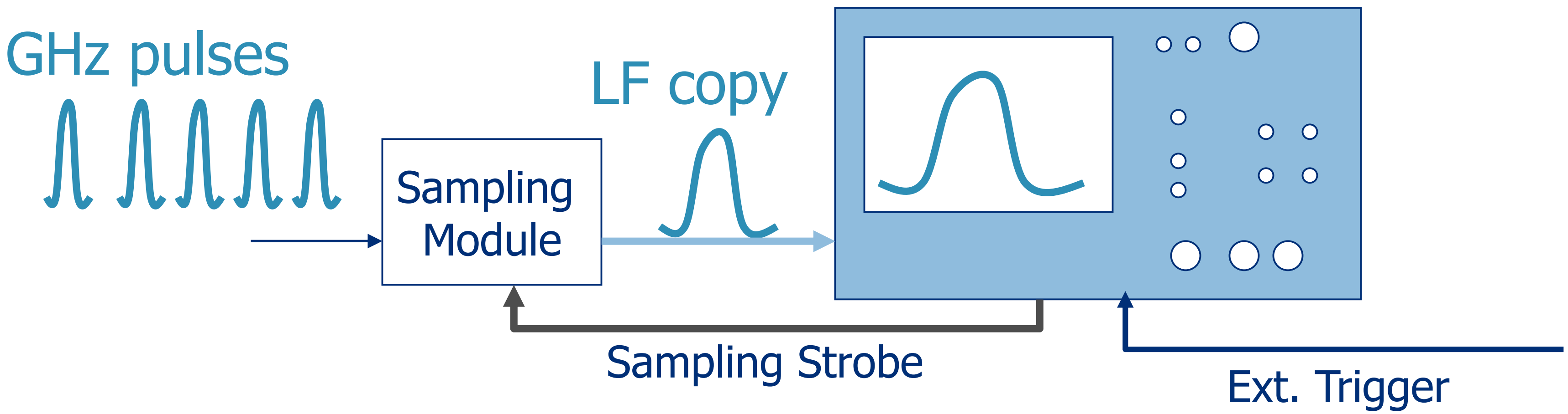
Sequential Sampling – as used with PicoScope 9300



- Data points are acquired sequentially from many cycles to build one screen image
    - PicoScope 9300 sample rate is 1MS/s, bandwidth is 20 GHz

Sampling Oscilloscope?

- Sampling?
- Convert High Speed signal (GHz) in a low frequency copy (kHz)



Sequential Equivalent Time Sampling

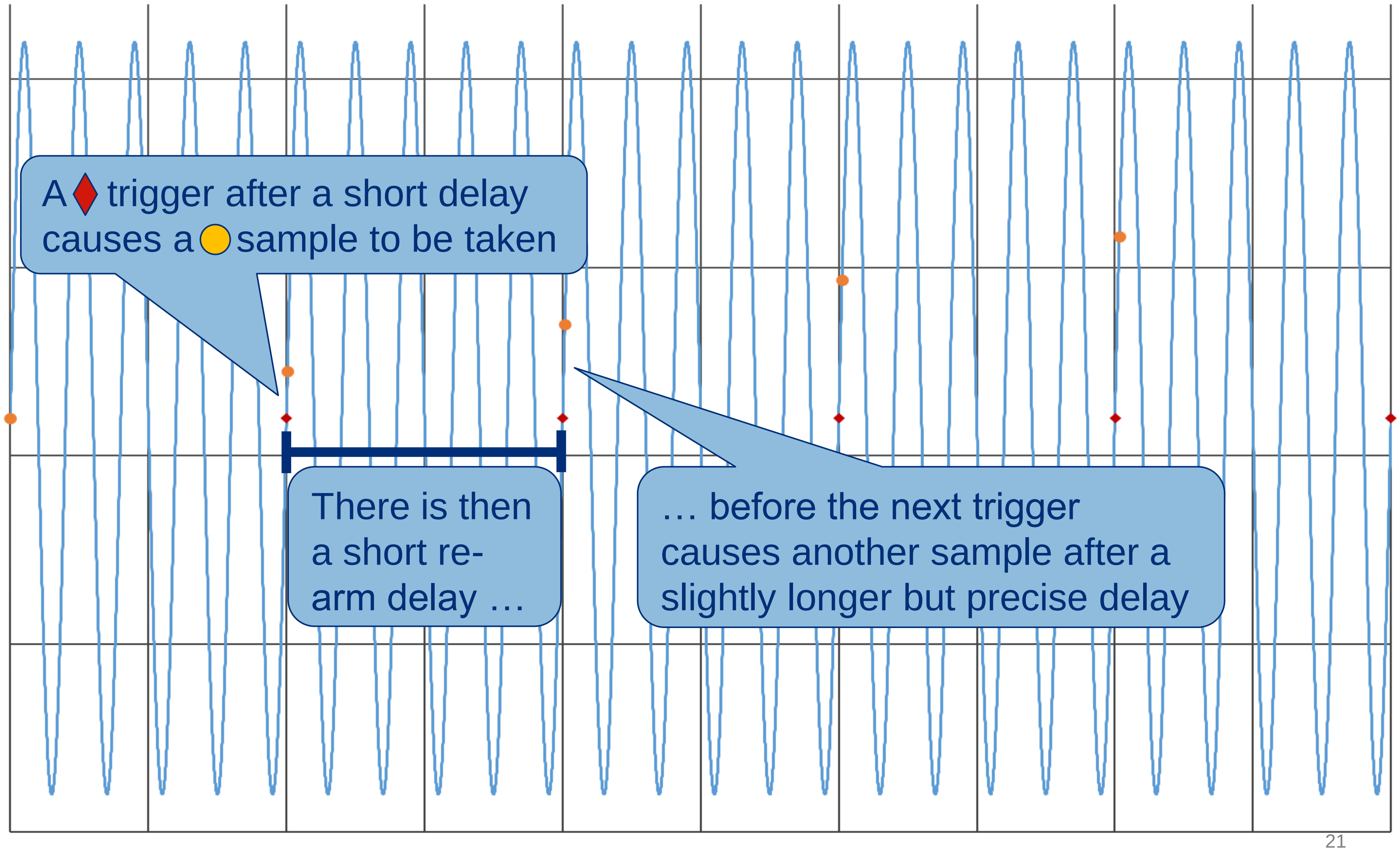
In Sequential Equivalent Time mode the Oscilloscope acquires one sample per external trigger independent of timebase settings.

When a trigger is detected, a sample is taken after very short but well-defined and gradually increased delay.

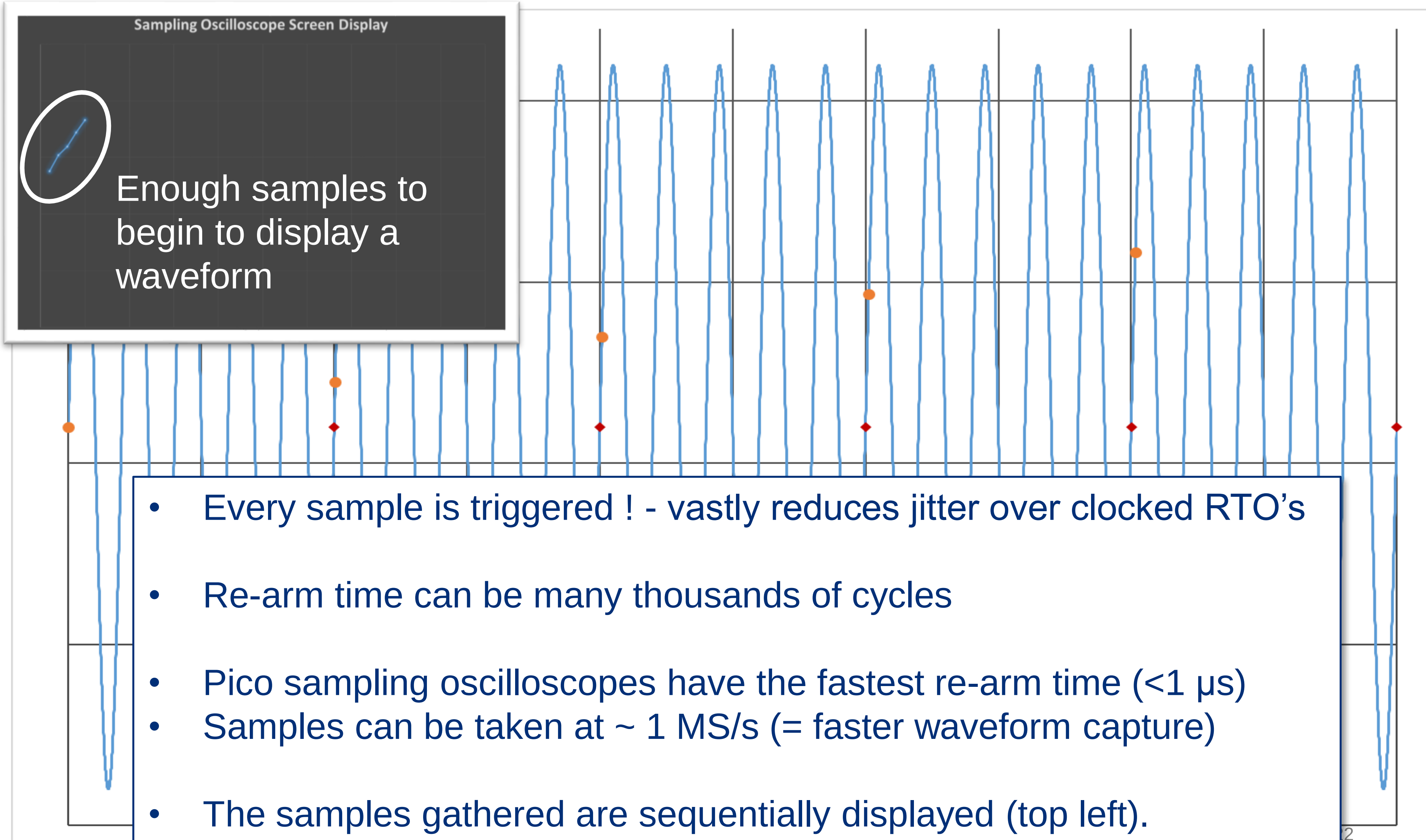
When the next external trigger occurs, a small time increment is added to delay and the next sample is acquired.

The sampling Oscilloscope generates the programmable delay using an internal triggerable oscillator.

Trigger derived sampling of HF Sinewave

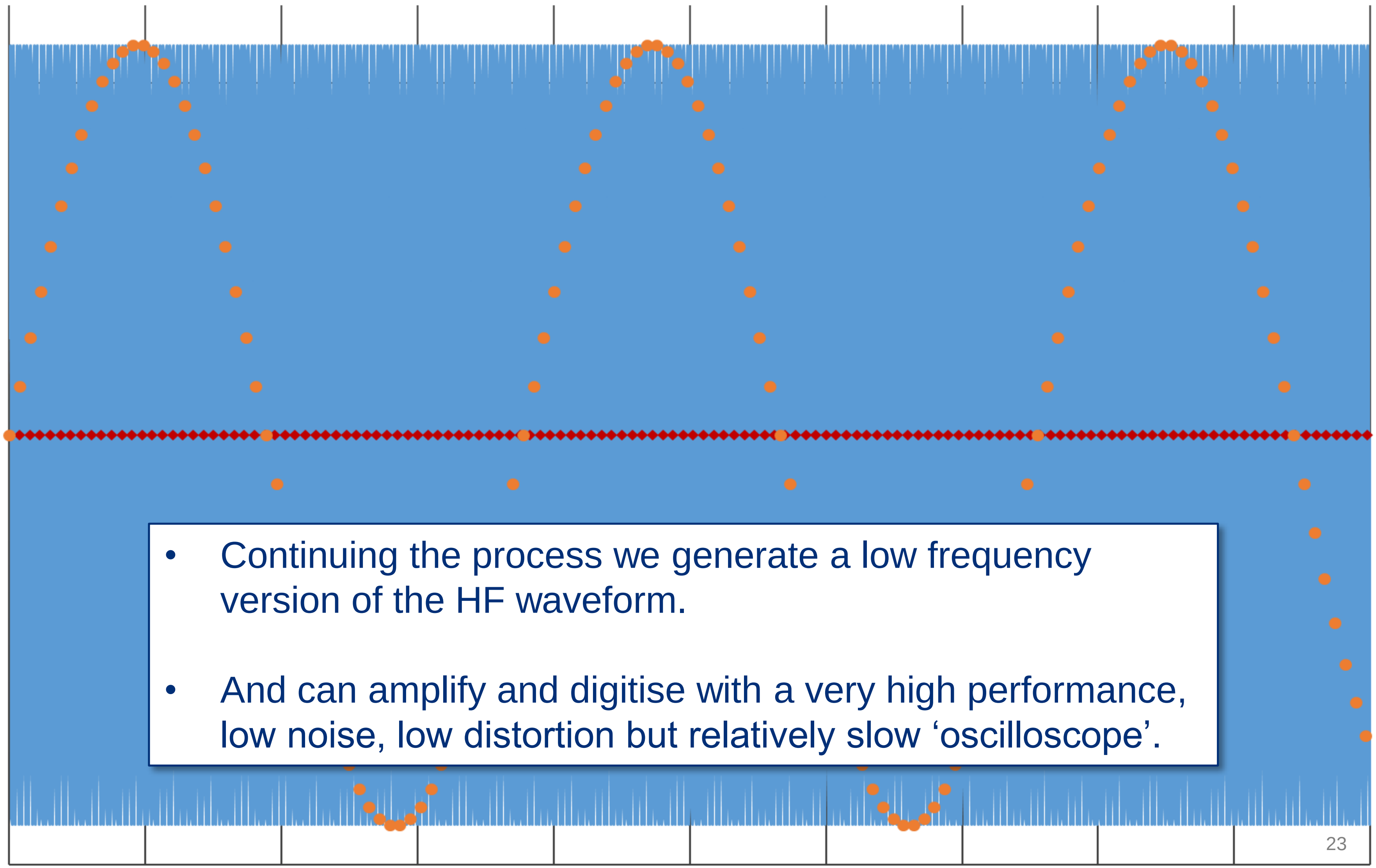


Trigger derived sampling of HF Sinewave



- Every sample is triggered ! - vastly reduces jitter over clocked RTO’s
- Re-arm time can be many thousands of cycles
- Pico sampling oscilloscopes have the fastest re-arm time (<1 µs)
- Samples can be taken at ~ 1 MS/s (= faster waveform capture)
- The samples gathered are sequentially displayed (top left).

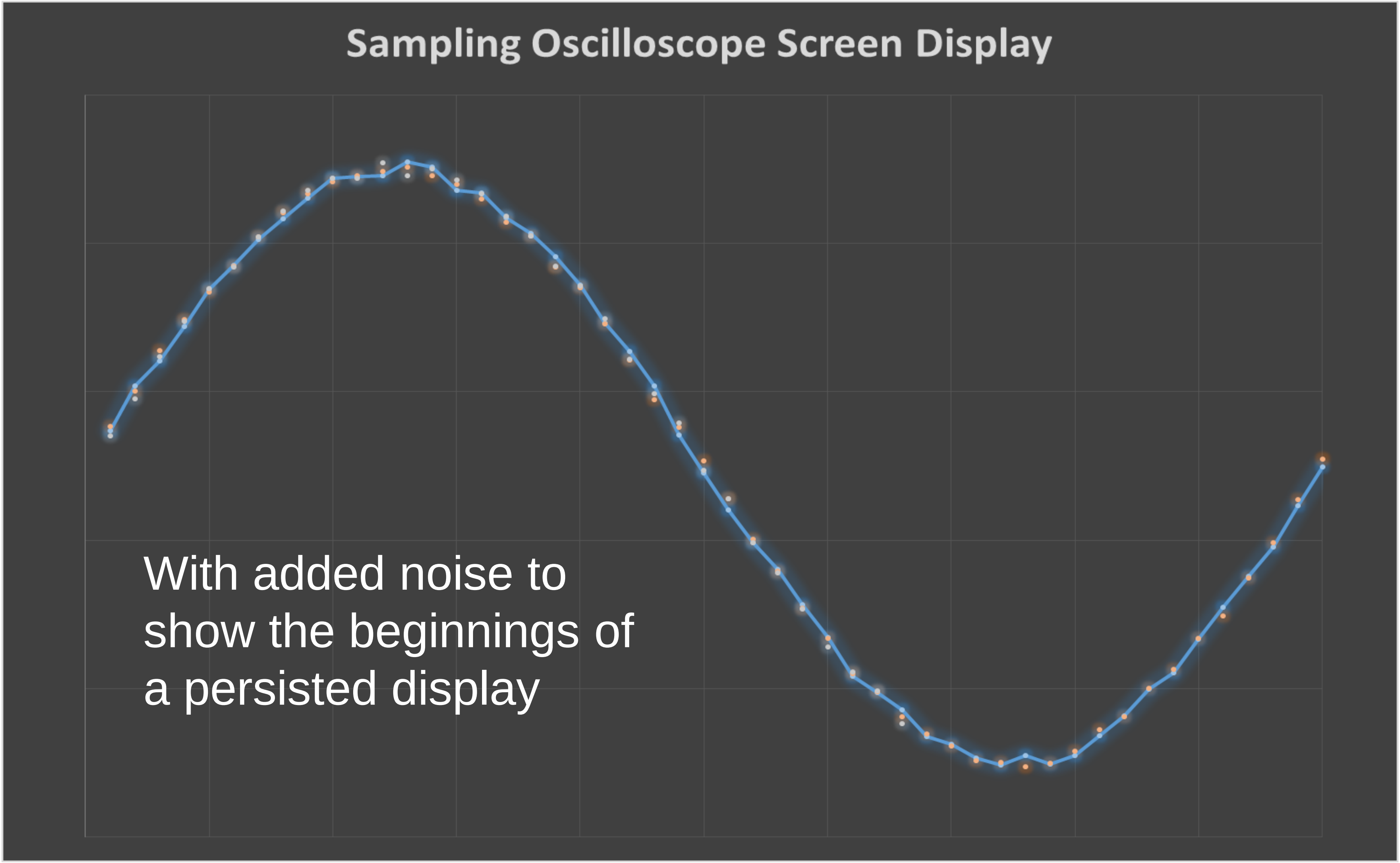
Trigger derived sampling of HF Sinewave



- Continuing the process we generate a low frequency version of the HF waveform.

- And can amplify and digitise with a very high performance, low noise, low distortion but relatively slow ‘oscilloscope’.

Sampling Oscilloscope Sine Display

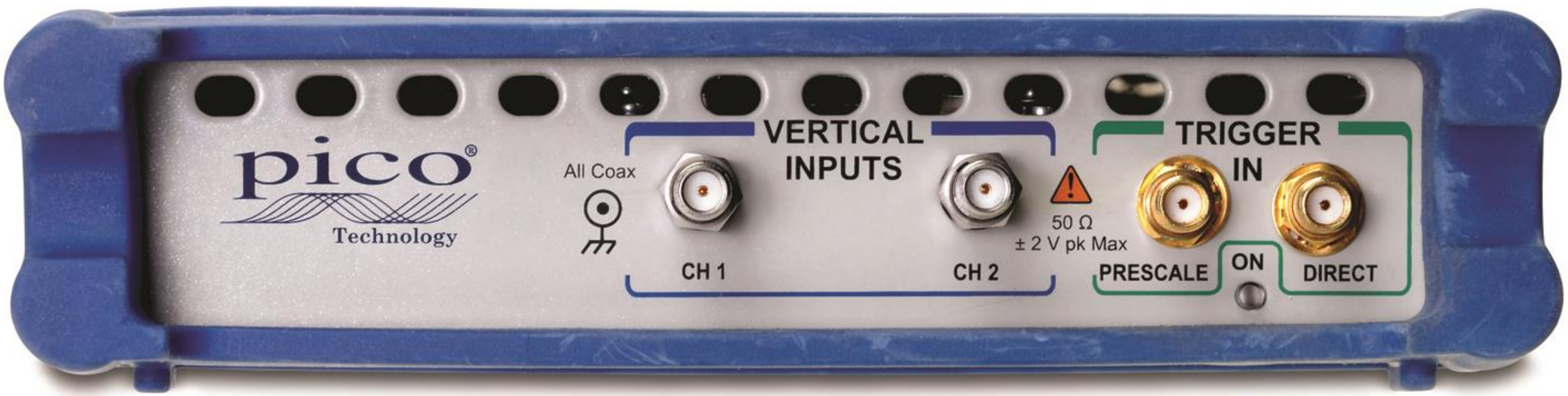


Comparing the 9200 & 9300 Series

Specification	9200 12 GHz Series	9300 20 GHz Series
Input Channels (Connector and Impedance)	2 Channels (SMA 50 Ω)	2 Channels (2.92 50 Ω)
Bandwidth and (Risetime)	12 GHz (30 ps)	20 GHz (17.5 ps)
Input Range, Noise, (Resolution)	± 1 V, 2 mV rms, (16 bit)	± 1 V, 1.5 mV rms (16 bit)
Timebase Range	10 ps/div to 50 ms/div	5 ps/div to 3.2 ms/div
Best Time Resolution (ETS Rate)	0.2 ps (5 000 GS/s)	0.06 ps (20 000 GS/s)
Maximum Sample Rate (Store Length)	200 kS/s (4 kS)	1 MS/s (32 Ks)
Channel Timing De-skew (Resolution)	10 ns (1 ps)	10 ns (1 ps)
Trigger Bandwidth Direct (Pre-scaled)	1 GHz (8 GHz)	2.5 GHz (14 GHz)
Trigger Jitter and Stability	3.5 ps rms + 20 ppm of delay setting	2.5 ps rms+ 20 ppm of delay setting
Clock Recovery Input	12.3 Mb/s to 2.7 Gb/s	12.3 Mb/s to 11.3 Gb/s [Model 9302A]
Pseudo Random Bit Sequence Pattern Length	7 to $2x10^{16} – 1$ (approx. 65 thousand)	7 to $2x10^{23} – 1$ (approx. 8.3 million)
Integrated Signal Sources	Step, PRBS NRZ, PRBS RZ, Timebase Clk [All Models] 100 ps fast edge [Models 9211A & 9331A]	Pulse, PRBS NRZ, PRBS RZ, 500 MHz Clk, Meander, Trig Out [All Models]
Time Domain Reflectometry and Transmission	100 ps 20-80% transition at ?? V pk-pk Display volts, ohms or rho by time or distance.	Available Shortly
Typical Distance Resolution	42 mm (1.65 inches)	
Optical to Electrical Conversion Bandwidth (Fibre modes & wavelength)	8 GHz [Model 9221A] Single and Multi-mode, λ = 750 - 1650 nm	Available Shortly

- Better bandwidth, sampling interval, noise & jitter, store length and clock recovery
- Fastest available sampling rate and waveform build in any sampling oscilloscope!

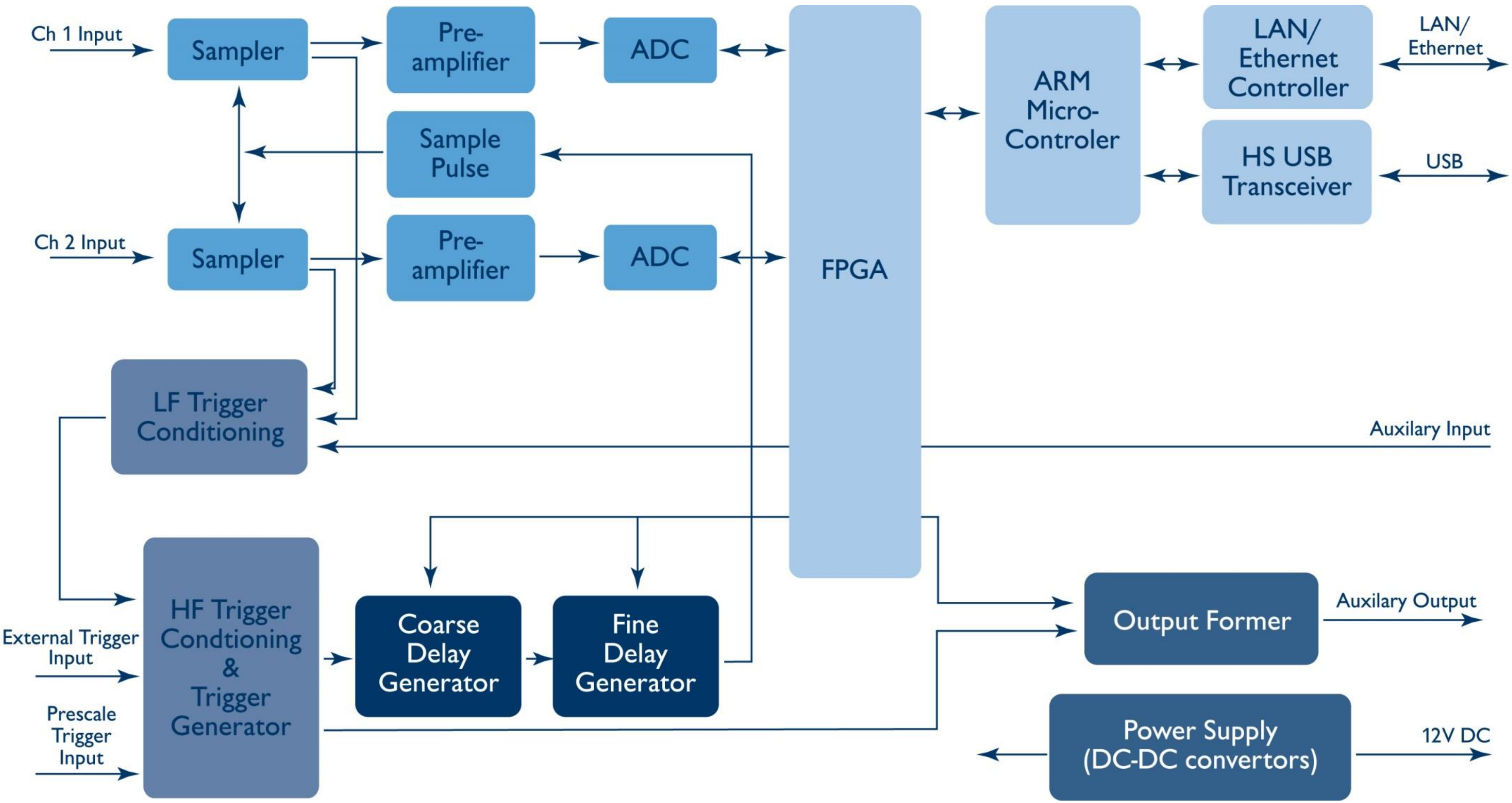
PS9301 Front Panel



Notice:
2.92 connectors for 20 GHz inputs
and SMA connectors for trigger.

These are compatible types, but the better
2.92 connector should be used at 20 GHz

PS9301 Block Diagram



PicoScope 9301 Applications

SIGNAL ANALYSIS

- Electrical standards compliance testing
- Eye-diagram analysis

HIGH-SPEED DIGITAL COMMUNICATIONS

- Design and verification of telecom and datacoms elements
- Manufacturing and testing for ITU / ANSI conformance
- Mask testing

RF COMPONENT TESTING

- RF components
- Cables and connectors
- Pulsed RF switches

SEMICONDUCTOR TESTING

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

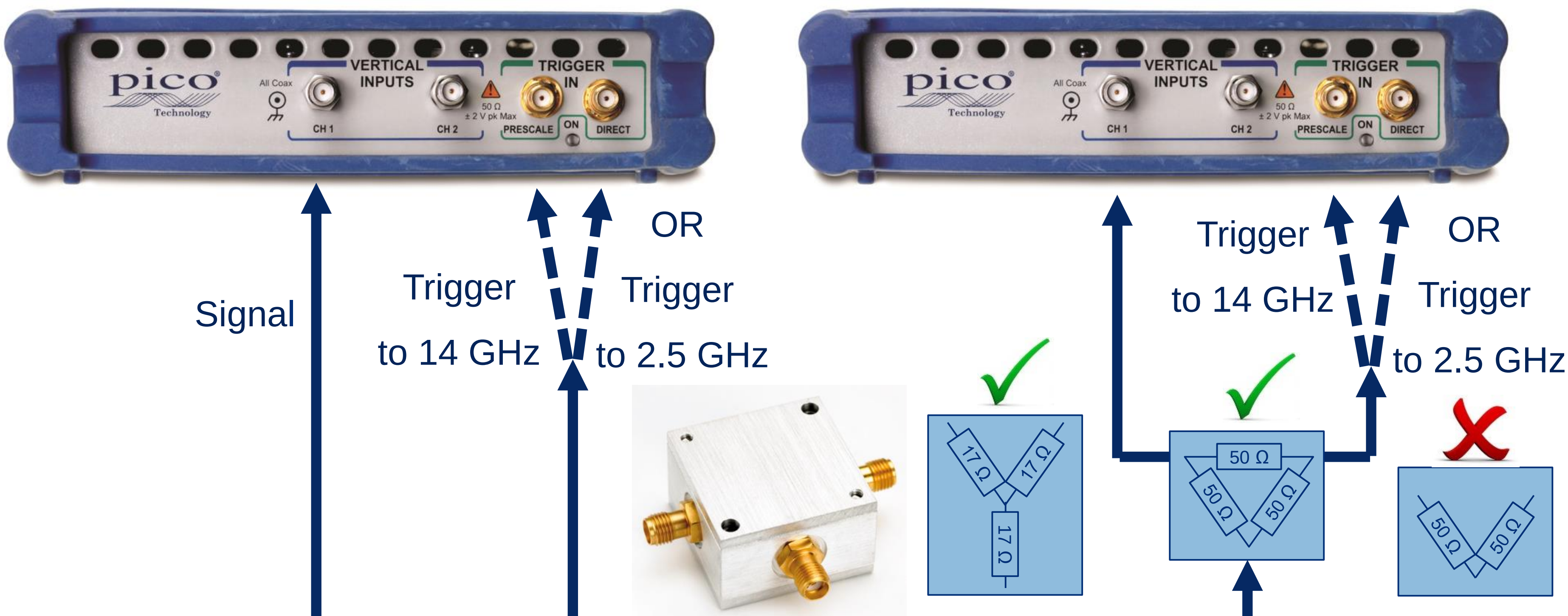
R & D

- Microwave & RF characterisation
- High-energy physics
- Digital design

MANUFACTURING

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

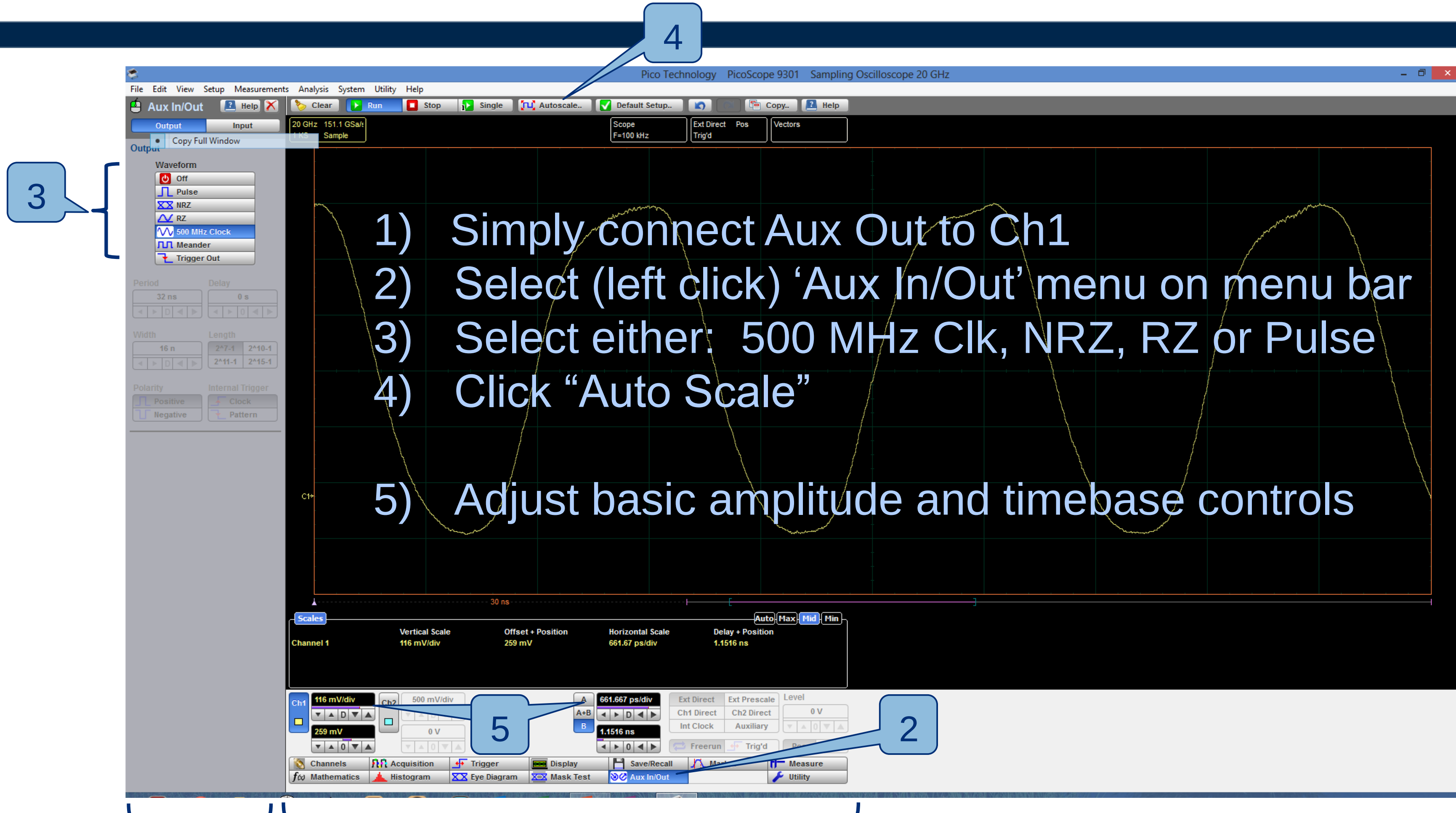
Connecting to a PS9301 Sampling 'Scope



Signal and Trigger
available from
device under test at 50 Ω

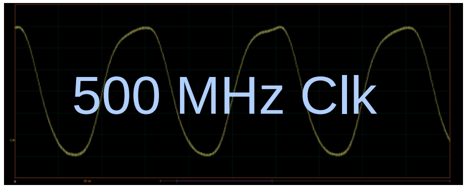
Only Signal available from
device under test at 50 Ω

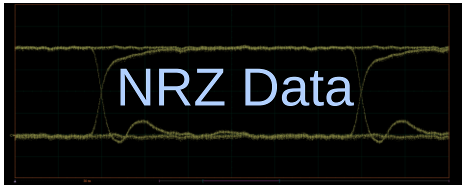
To Demonstrate a PS9301 …..

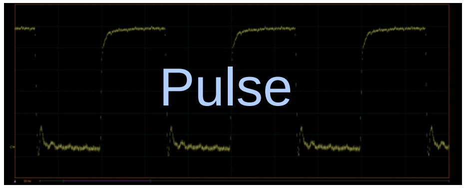


Revealed Menu

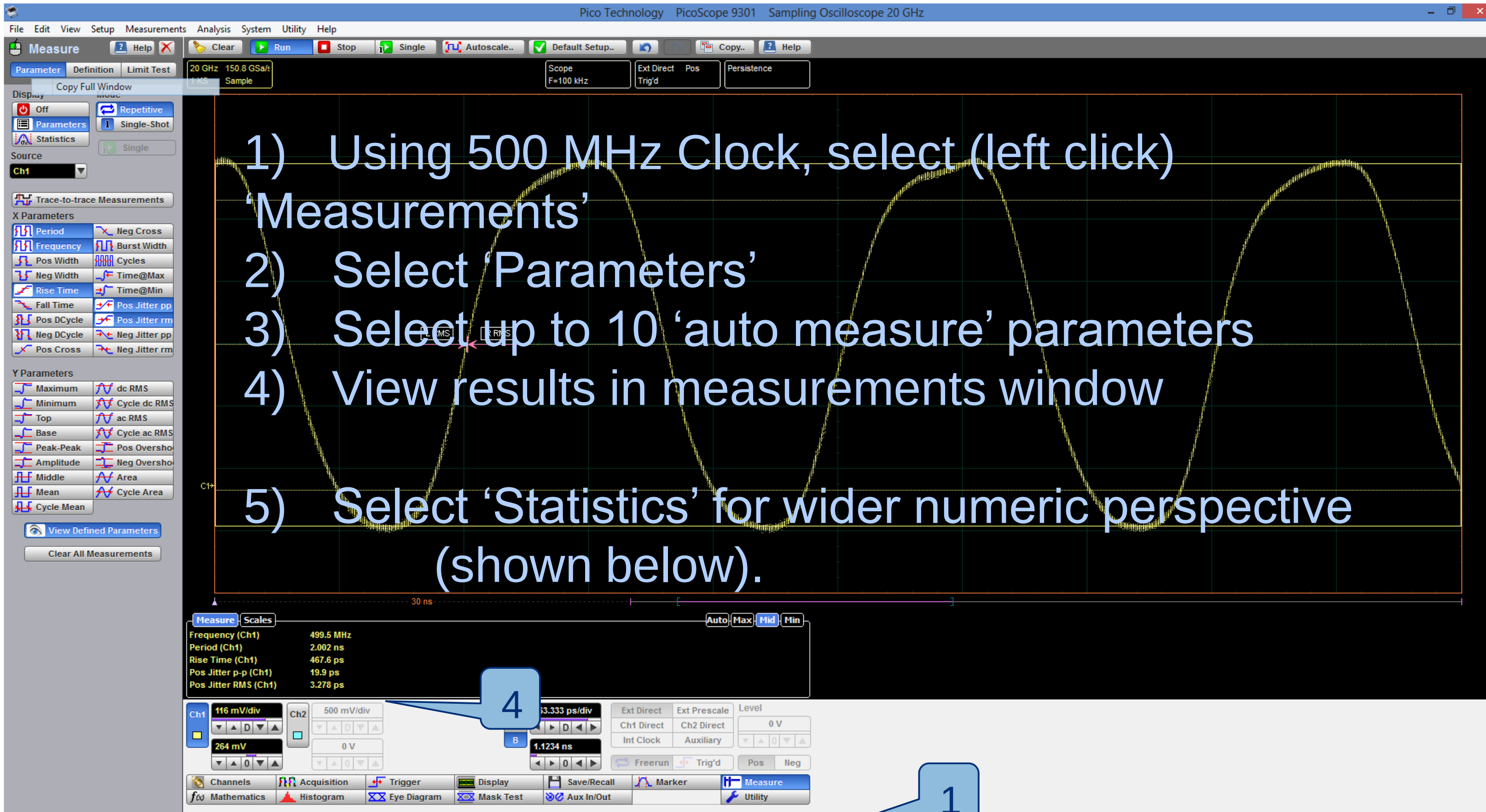
Menu bar and basic controls above







Comprehensive Measurements



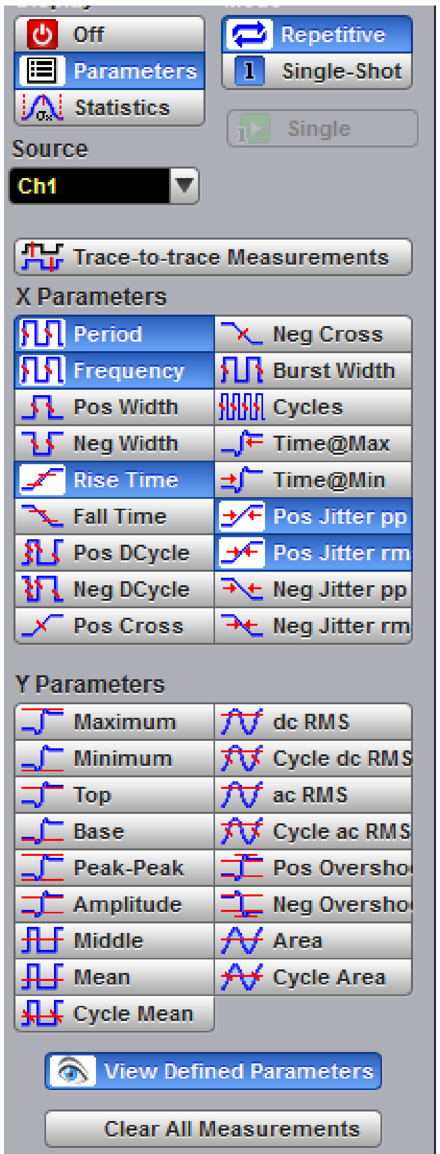
1) Using 500 MHz Clock, select (left click) 'Measurements'
2) Select 'Parameters'
3) Select up to 10 'auto measure' parameters
4) View results in measurements window

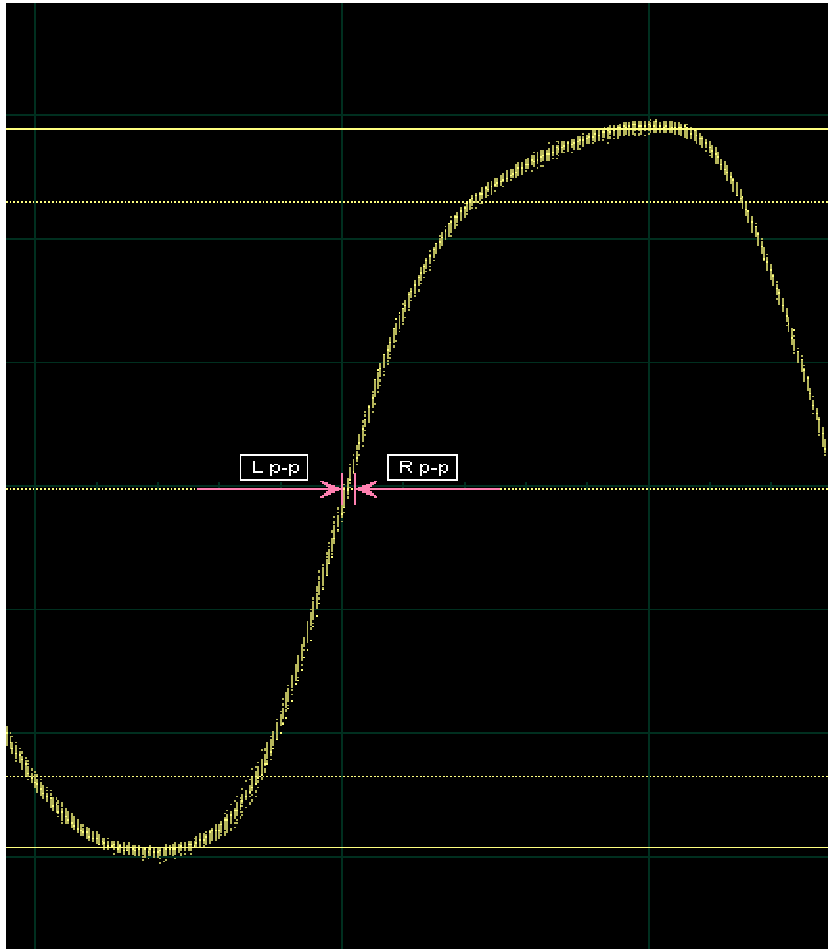
5) Select 'Statistics' for wider numeric perspective (shown below).

Measure | Scales | Auto | Max | Mid | Min

	Current	Total Wfms	Minimum	Maximum	Mean	Std Deviation
Frequency (Ch1)	500 MHz	36905	498.3 MHz	501.3 MHz	499.9 MHz	367.6 kHz
Period (Ch1)	2 ns	36905	1.995 ns	2.007 ns	2 ns	1.471 ps
Rise Time (Ch1)	477.2 ps	36905	453.6 ps	484.7 ps	469.5 ps	4.347 ps
Pos Jitter p-p (Ch1)	26.53 ps	36856	6.633 ps	26.53 ps	21.27 ps	2.888 ps

Comprehensive Measurements ….





Measure | Scales | Auto | Max | Mid | Min

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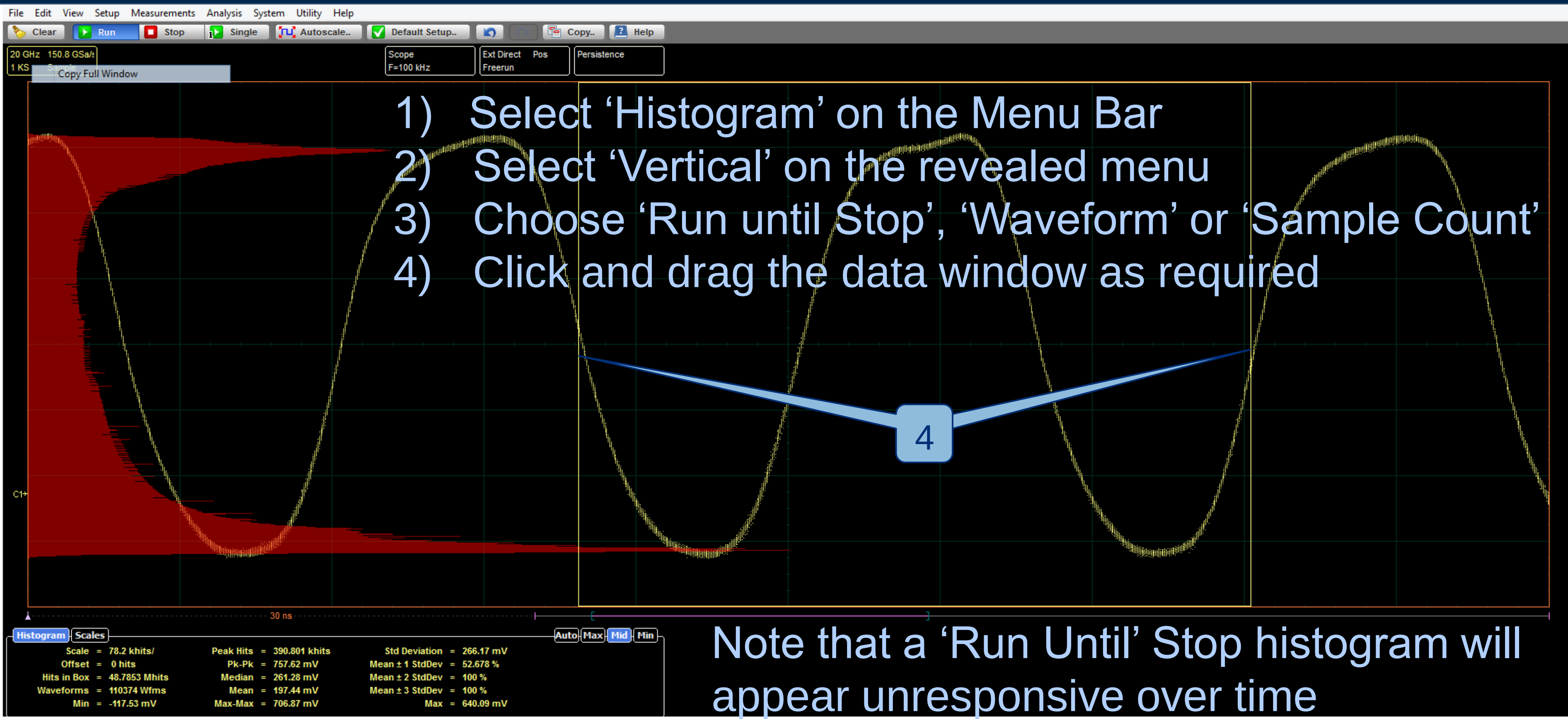
Pos Jitter p-p (Ch1)	26.53 ps	36856	6.633 ps	26.53 ps	21.27 ps	2.888 ps

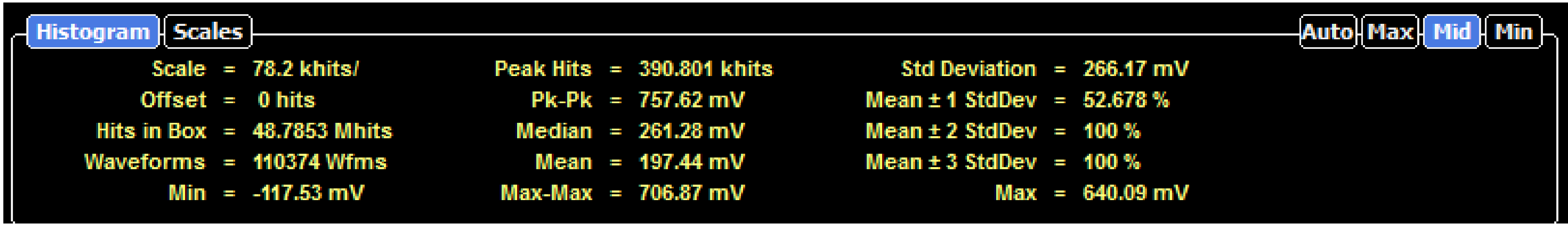
Auto Measurements
18 X (time) parameters
17 Y parameters
13 Channel to Channel
with or without statistics
15 NRZ Time
27 NRZ Y Params
with or without statistics
17 RZ Time
26 RZ Y Params
with or without statistics
5 FFT Parameters
138 Total Measurements

Vertical Histogramming

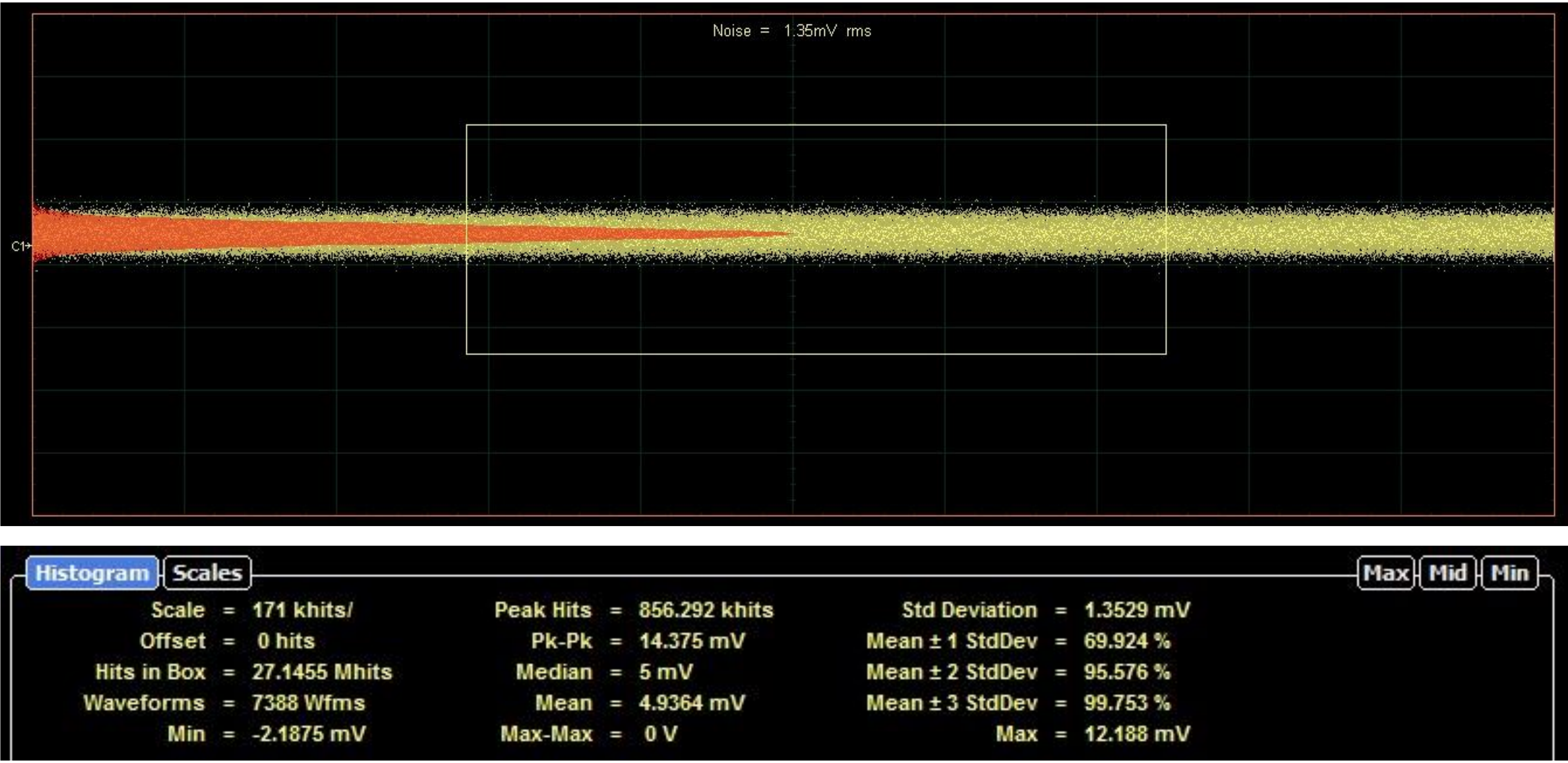


1) Select ‘Histogram’ on the Menu Bar
2) Select ‘Vertical’ on the revealed menu
3) Choose ‘Run until Stop’, ‘Waveform’ or ‘Sample Count’
4) Click and drag the data window as required

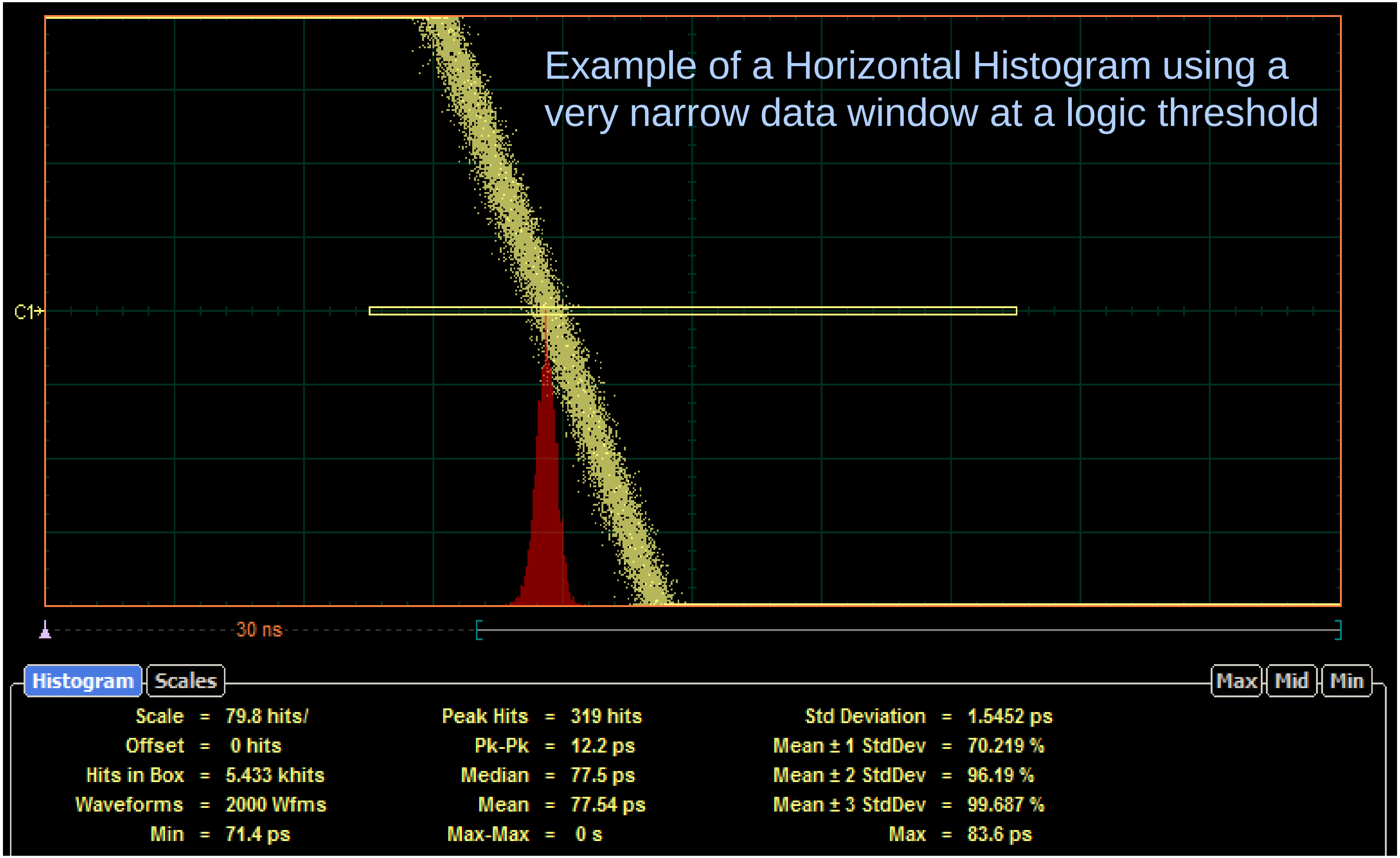
Note that a ‘Run Until’ Stop histogram will appear unresponsive over time



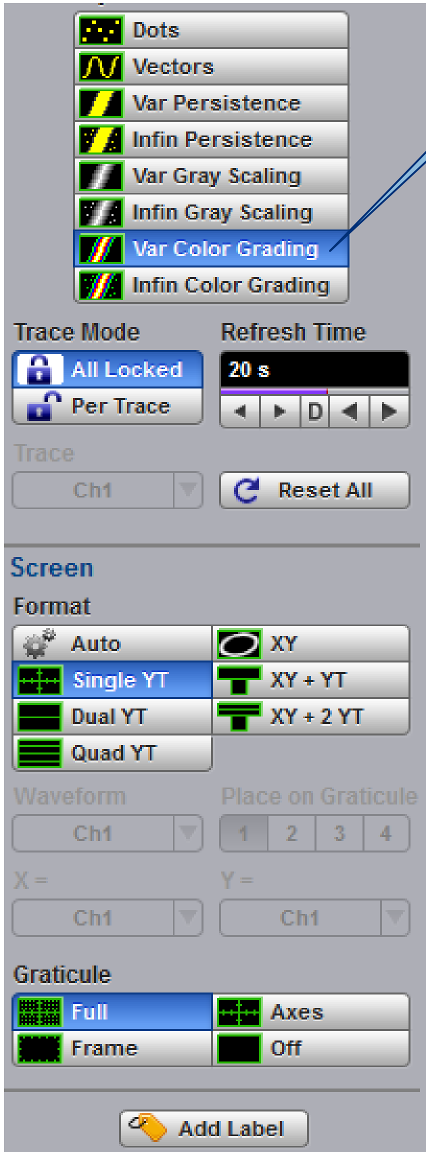
Histogram used to determine Noise Floor and Offset

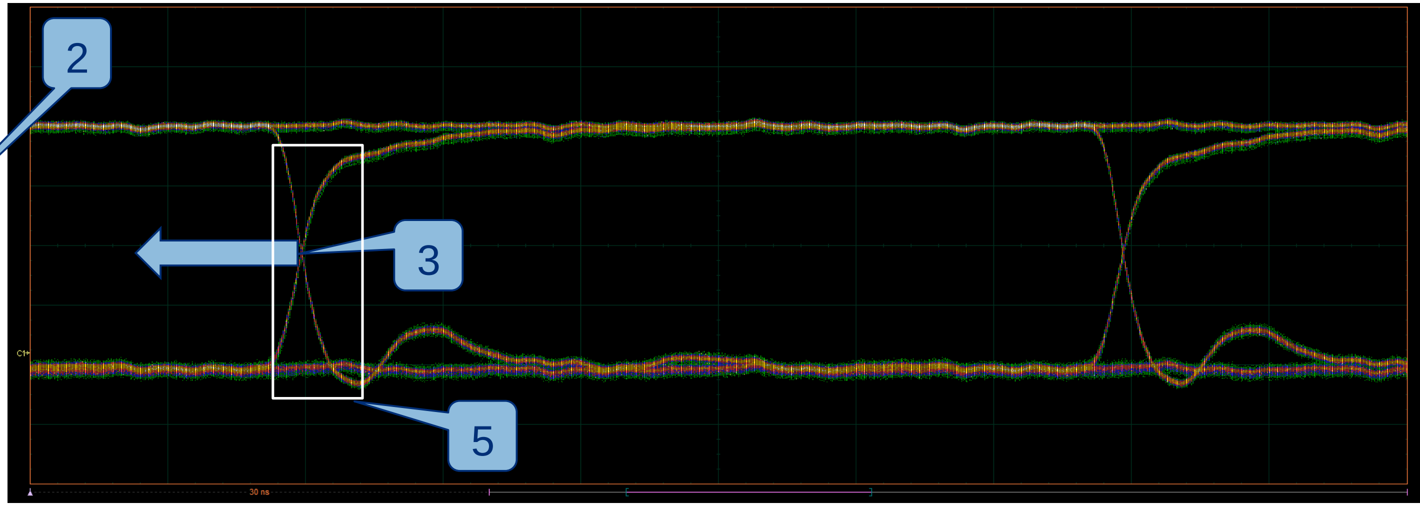


Horizontal Histogram



Display Features

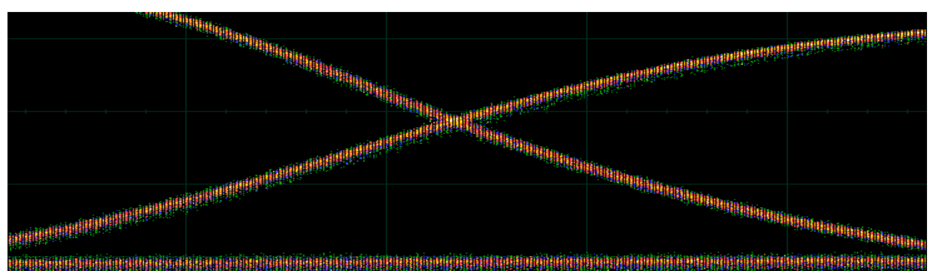




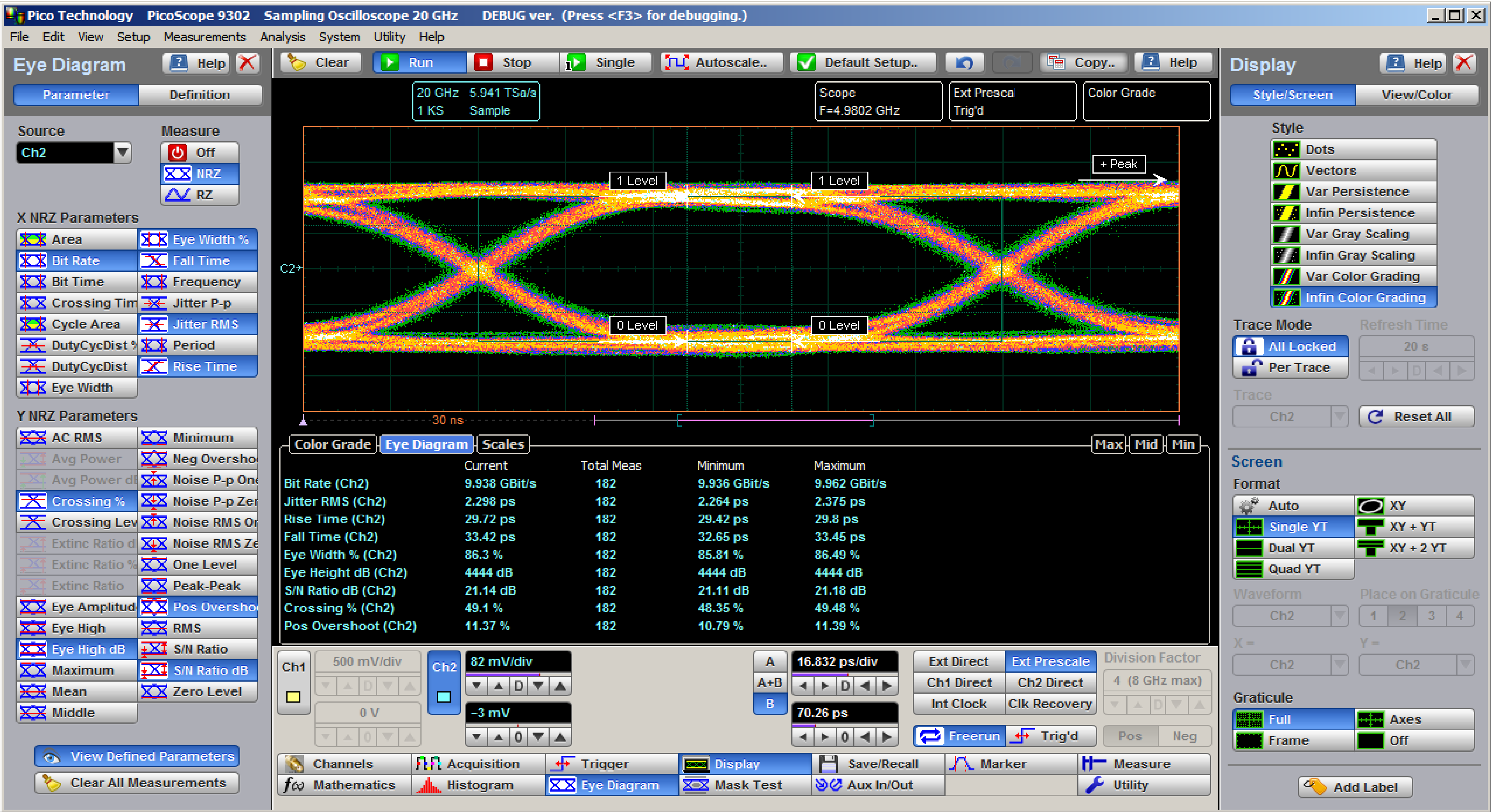
1) Using NRZ waveform, select the 'Display' Menu in the menu bar
2) Select 'Var Colour Grading' (above display)
3) Click on the waveform and drag to left
4) Set faster timebase using the basic controls (display below)

OR

5) Click outside the waveform to drag out a zoom window
6) Click to Zoom (actually starts and delays a second 'B' timebase)



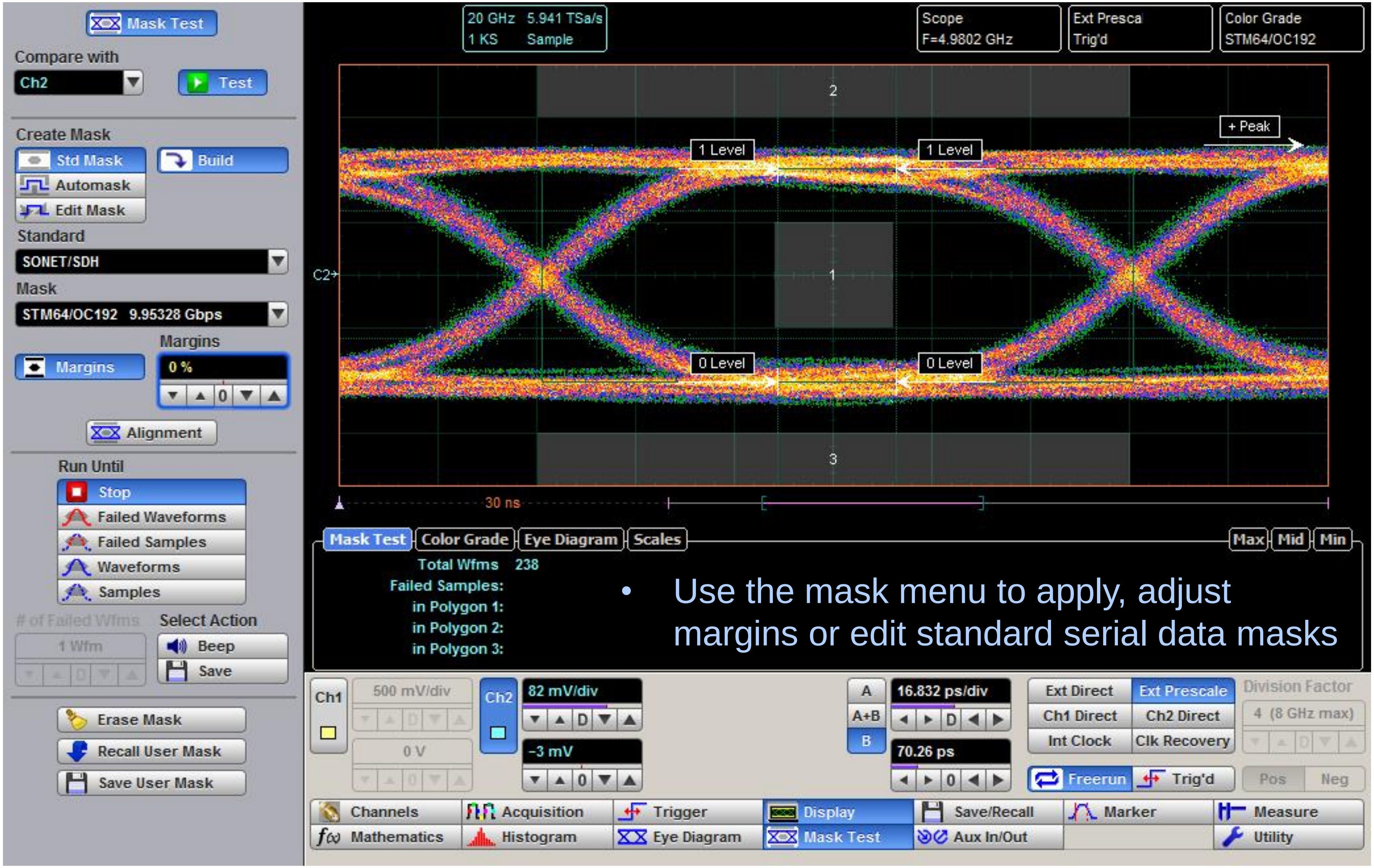
9.95 GB/s Clean Eye



Vast array of automatic eye measurements and data

Note: Right click in the Menu bar, places the menu here

9.95Gb/s with 10 GB/s Mask



- Use the mask menu to apply, adjust margins or edit standard serial data masks

PS9200 / PS9300 applied to Serial Data Standards - 1.54Mb/s to 12.5Gb/s

pico Technology

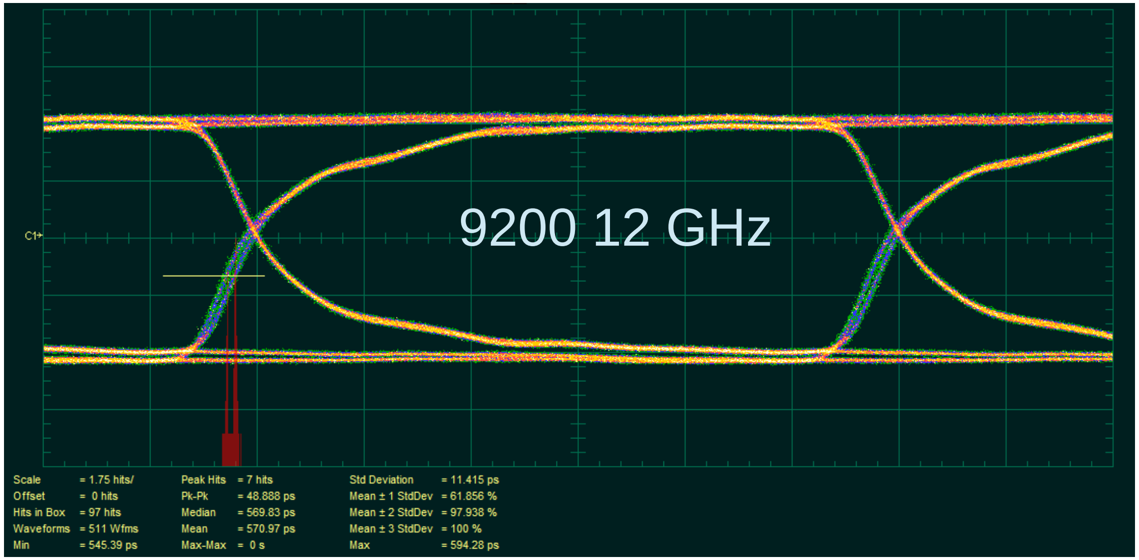
<table>
<tr><th>Serial Data Masks</th><th># Masks</th><th>To Bit Rate</th><th>PS9000 Series Samplers</th></tr>
<tr><td>SONET</td><td>11</td><td>10.709 Gb/s</td><td rowspan="11"><u>PS9200 12 GHz Series</u>
Capture & Display up to 24 Gb/s
3rd Harm Capture to 8 Gb/s
5th Harm Characterise to 4.8 Gb/s

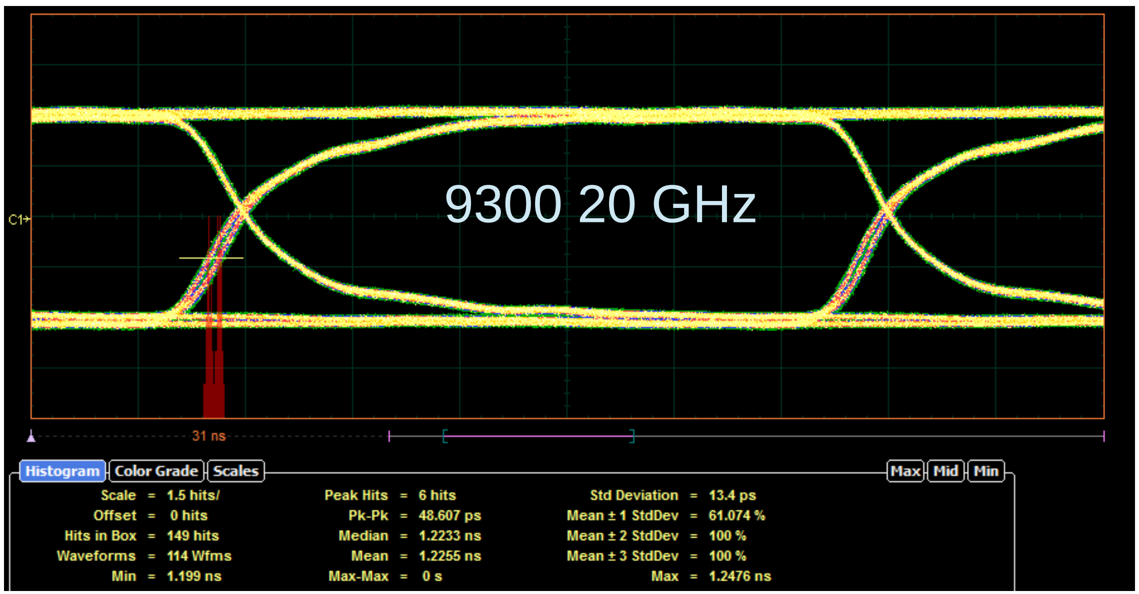
<u>PS9300 20 GHz Series</u>
Capture & Display up to 40 Gb/s
3rd Harm Capture to 13 Gb/s
5th Harm Characterise to 8 Gb/s</td></tr>
<tr><td>ETHERNET</td><td>10</td><td>12.5 Gb/s</td></tr>
<tr><td>Fibre Channel</td><td>31</td><td>10.5188 Gb/s</td></tr>
<tr><td>PCI express</td><td>41</td><td>5 Gb/s</td></tr>
<tr><td>Infiniband</td><td>16</td><td>5 Gb/s</td></tr>
<tr><td>XAUI</td><td>4</td><td>3.125 Gb/s</td></tr>
<tr><td>Rapid I/O</td><td>9</td><td>3.125 Gb/s</td></tr>
<tr><td>SATA</td><td>24</td><td>3 Gb/s</td></tr>
<tr><td>ITYU G.703</td><td>14</td><td>155.52 Mb/s</td></tr>
<tr><td>ANSI T1.102</td><td>7</td><td>155.52 Mb/s</td></tr>
<tr><td>Total Masks</td><td>167</td><td></td></tr>
</table>

Compliance Acceptance Bandwidth

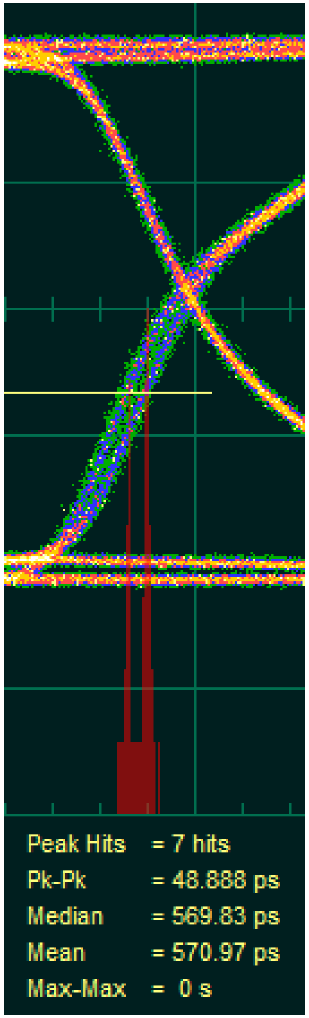
Standard	Data Rate	Measurement Bandwidth Range
SATA gen. III	6 Gb/s	50 MHz to 9 GHz
PCI E gen. 2.0	5 Gb/s	100 MHz to 7.5 GHz
HDMI 1.3	5 7Gb/s to 2.25 Gb/s	300 KHz to 4.125 GHz
Display Port	2.7 Gb/s	100 MHz to 5 GHz
FibreChannel	4.25 Gb/s to 8.5 Gb/s	100 MHz to 16 GHz
Infiniband	5-10 Gb/s	Up to 5 GHz
XAUI	3.125 Gb/s	100 MHz to 2 GHz
10 GigE	10.3125 Gb/s	100 MHz to 15 GHz

Comparing PS9200 with PS9300
622MHz Eye Histogram

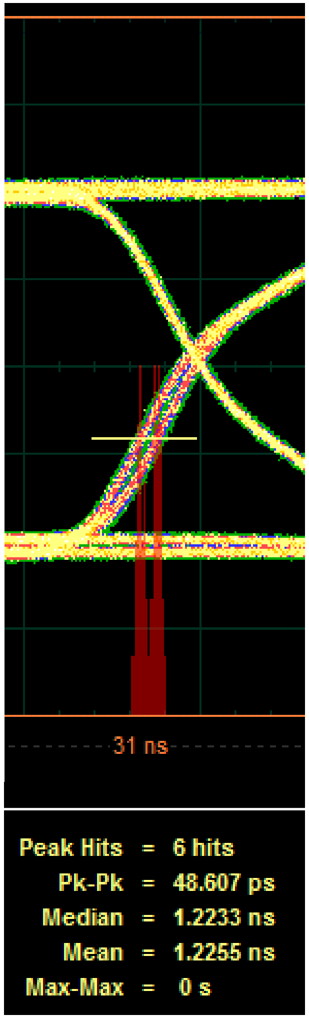




9200
12 GHz

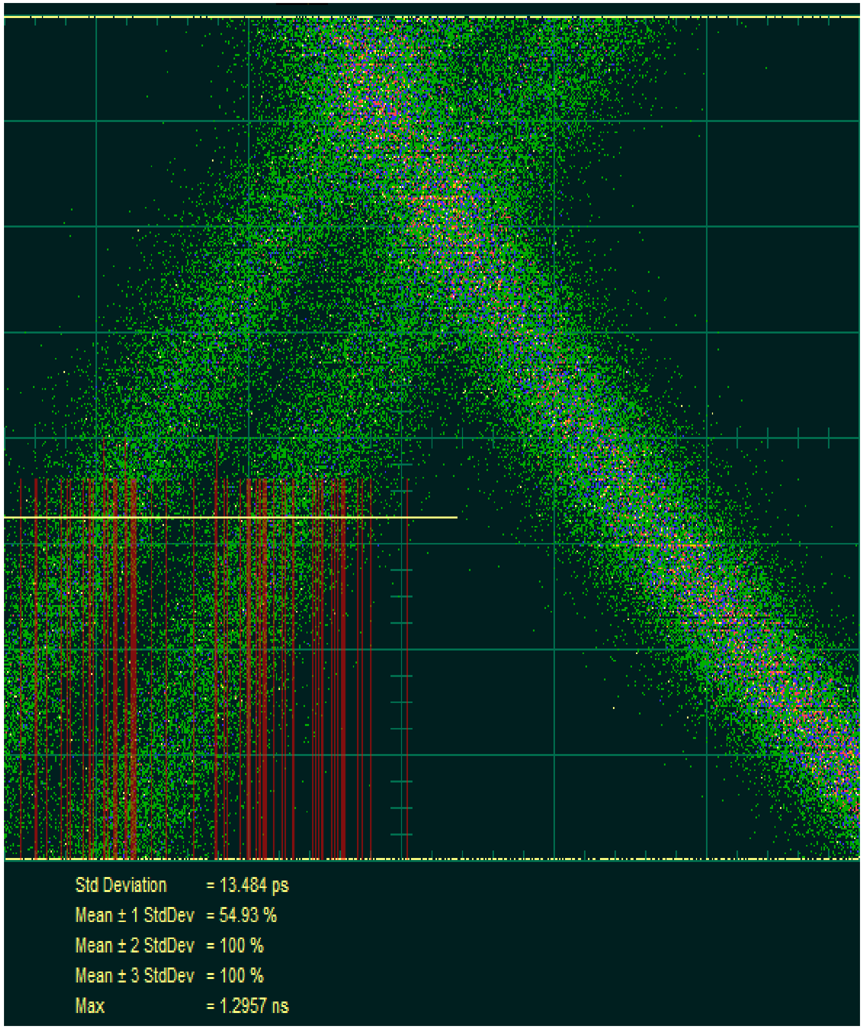


9300
20 GHz

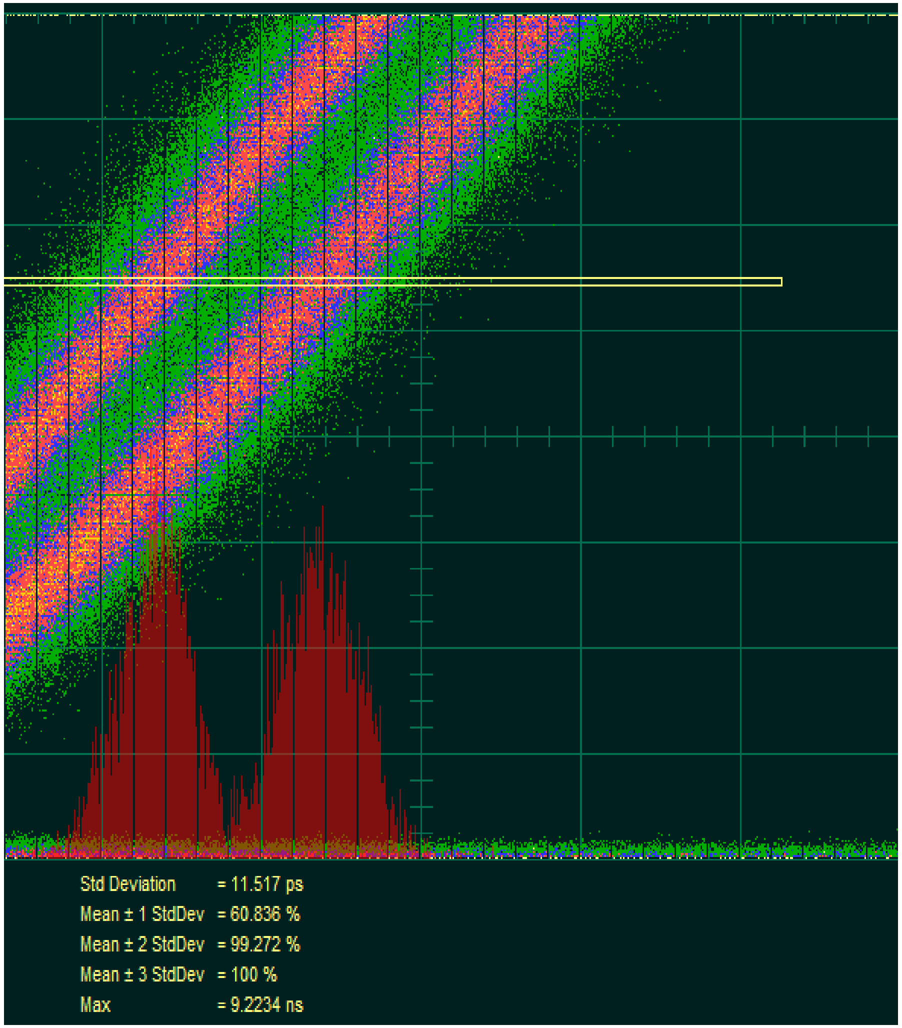


Comparing PS9200 with PS9300 622MHz Eye Histogram

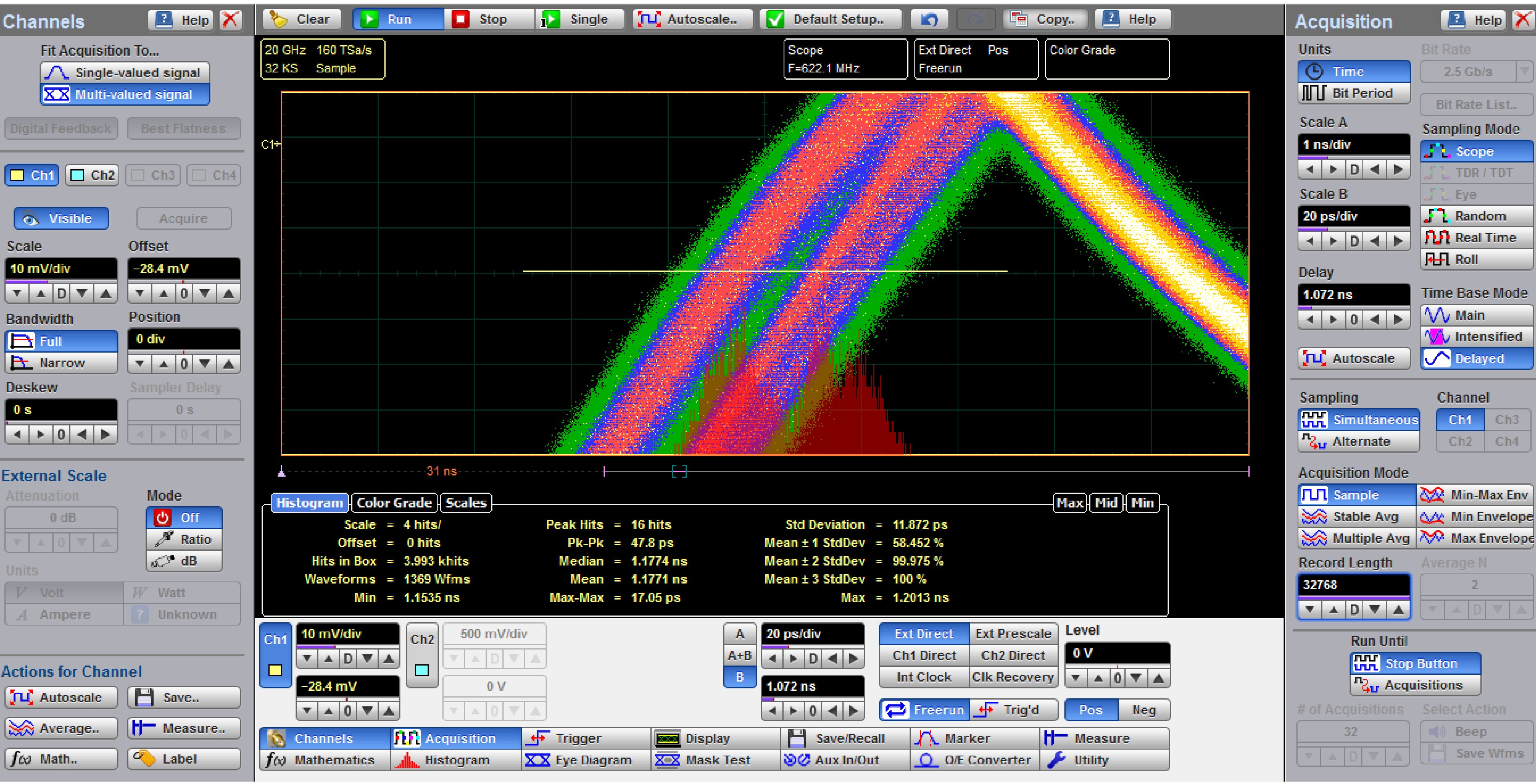
9200 12 GHz



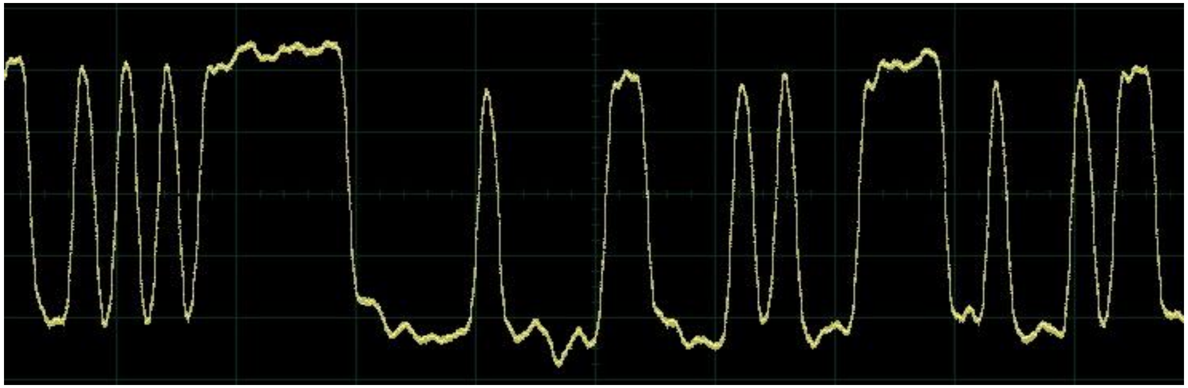
9300 20 GHz

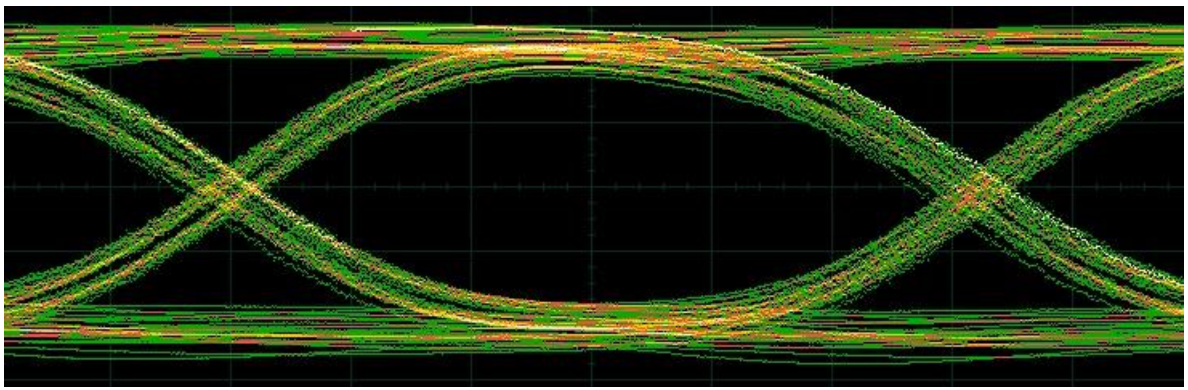


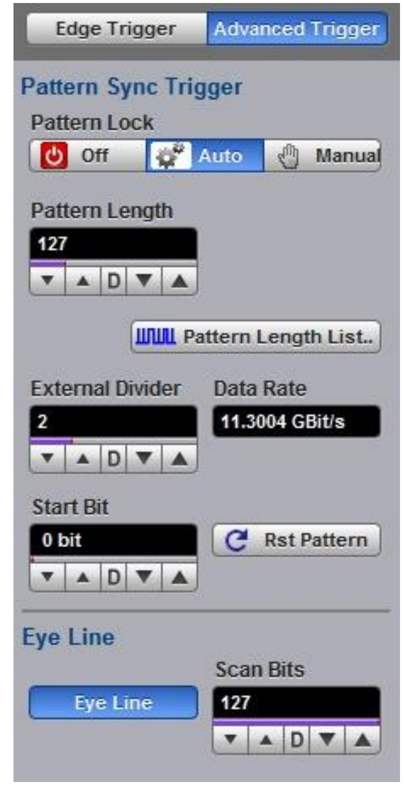
PS9300 622MHz Delay Eye



Typical High Speed Serial Data
11.3 Gb/s Pseudo Random Sequence







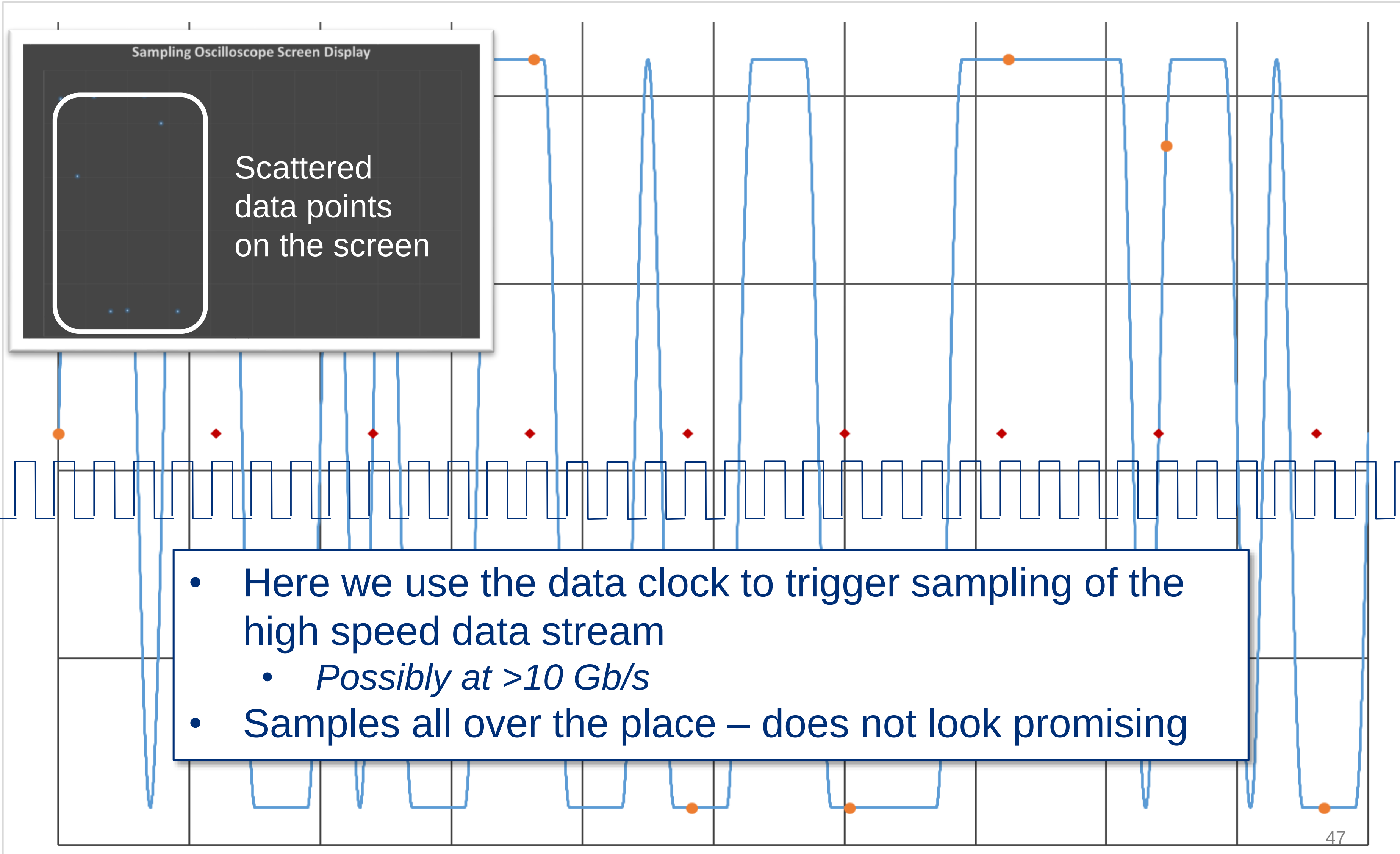
Clearly not a repeating signal, and yet is captured on a PS9300 sampling ‘scope ?

What we need to enable use of a sampling Oscilloscope is:

- A data clock – this alone will trigger an eye diagram capture
- If the pattern repeats at some point we can capture and step thru the waveform

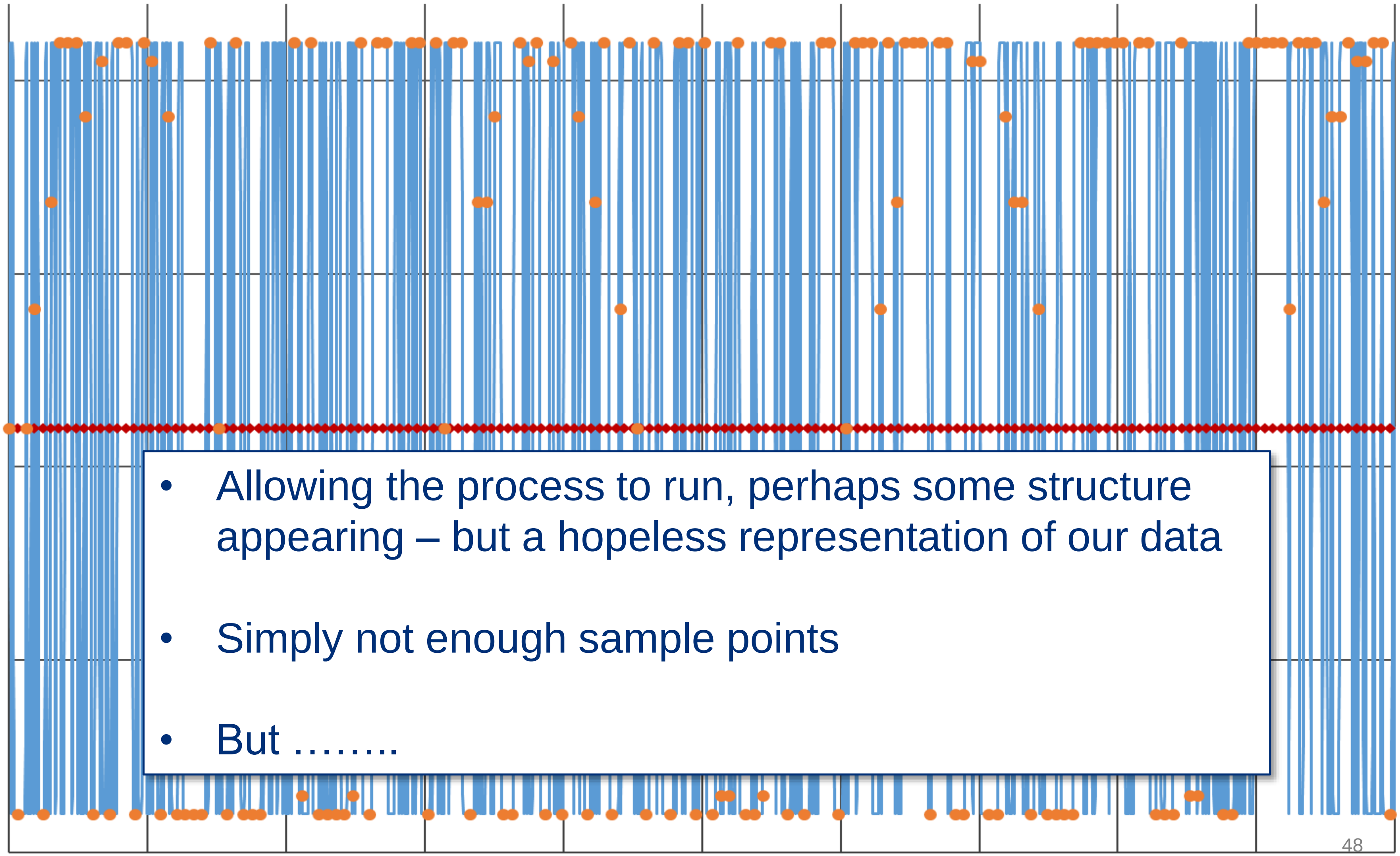
“Eyeline” for patterns of up to $2^{23} – 1$ (over 8 million bits)

Sampling a serial data bit stream



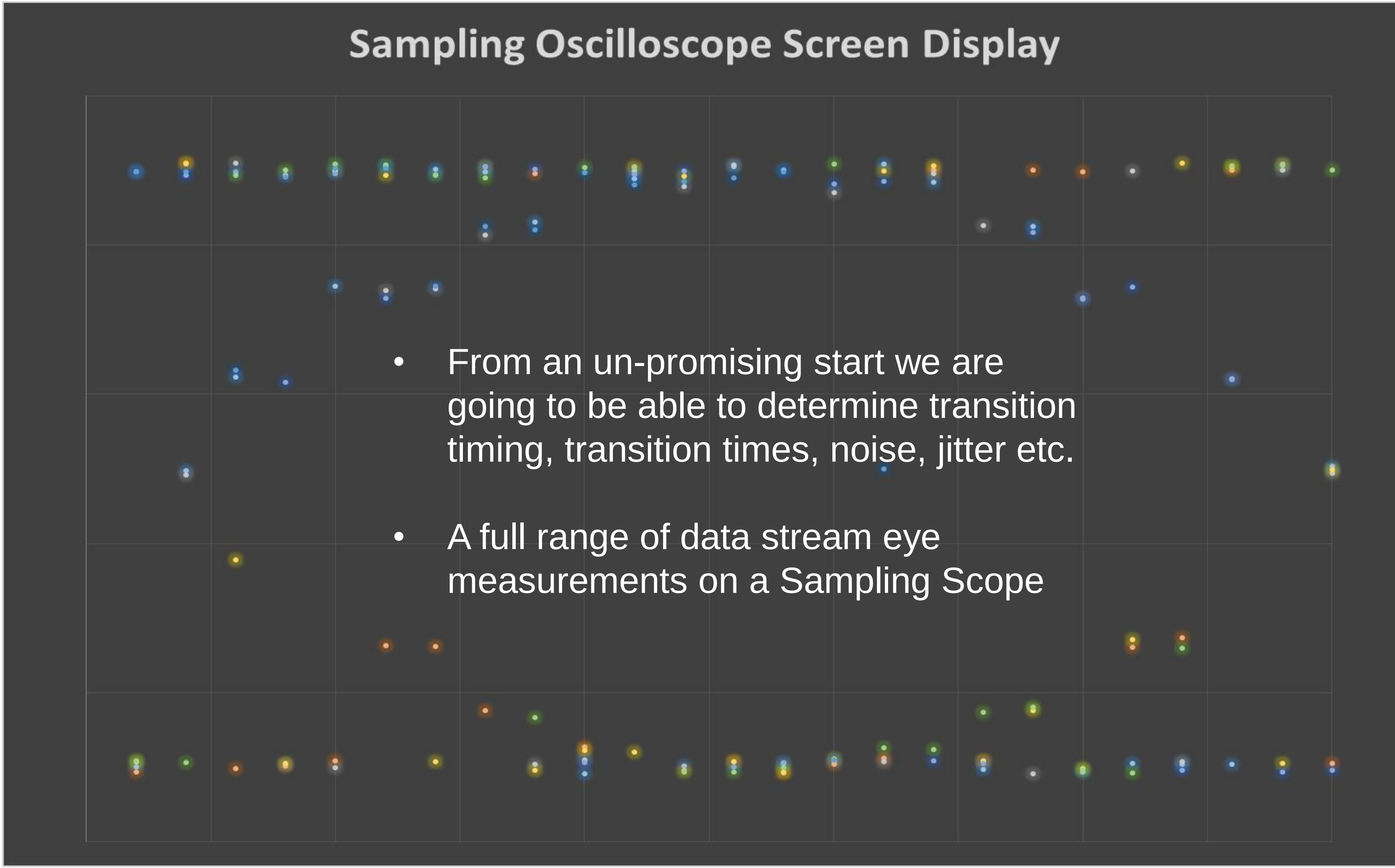
- Here we use the data clock to trigger sampling of the high speed data stream
  - *Possibly at >10 Gb/s*
- Samples all over the place – does not look promising

Sampling Serial Data over the longer term – still not promising



- Allowing the process to run, perhaps some structure appearing – but a hopeless representation of our data
- Simply not enough sample points
- But ……..

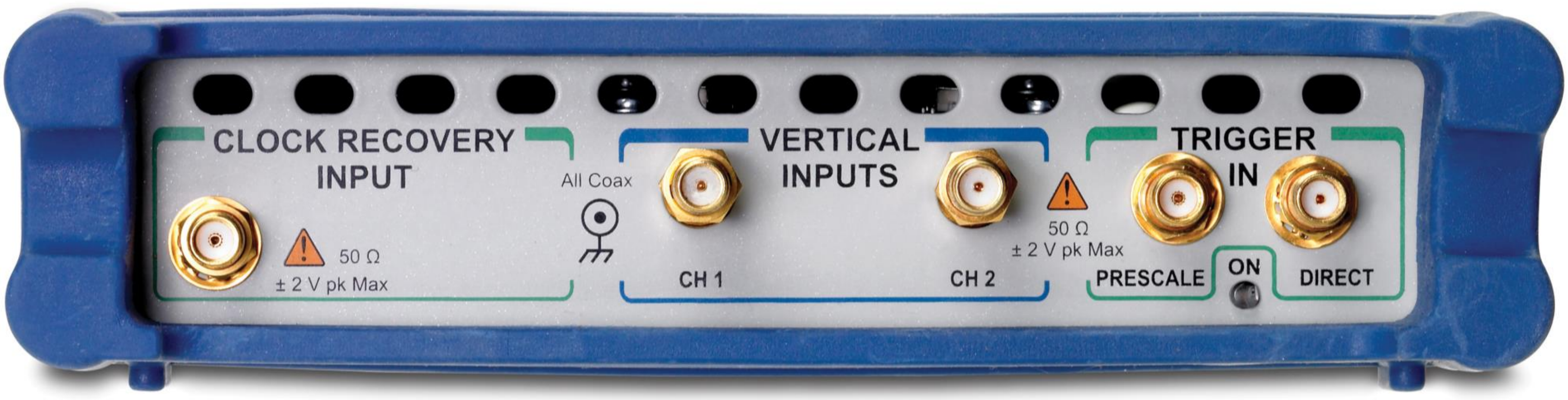
On the display, an ‘Eye’ Begins to Form



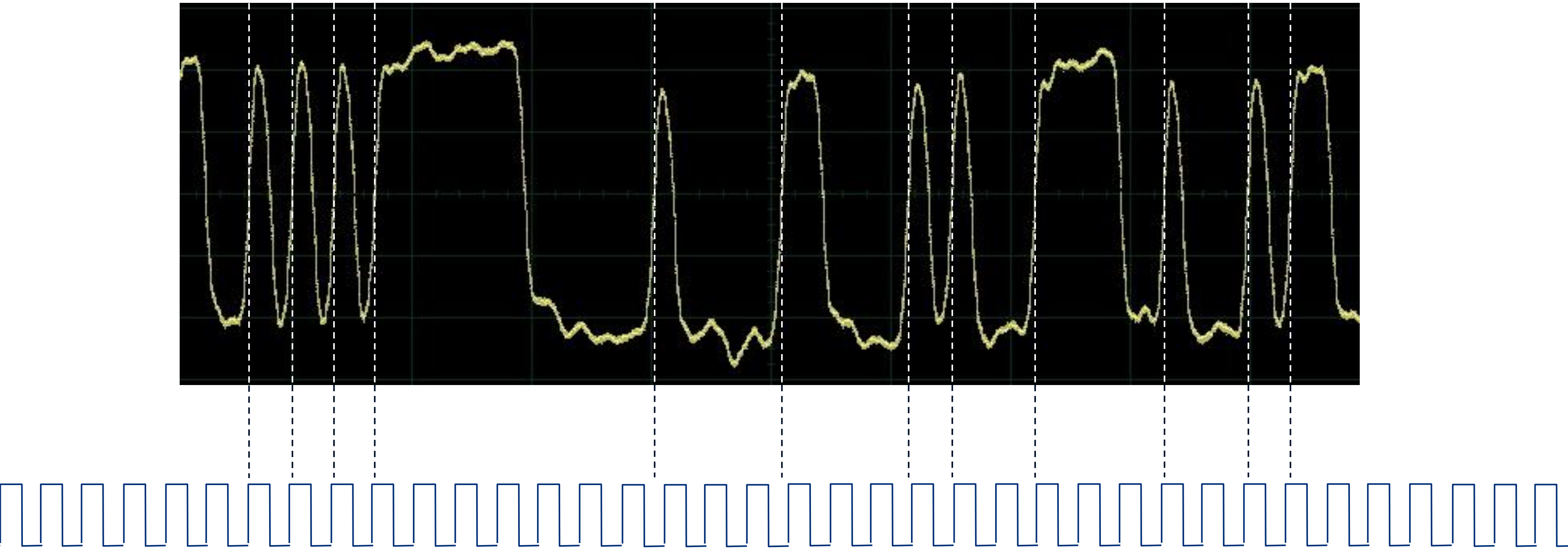
- From an un-promising start we are going to be able to determine transition timing, transition times, noise, jitter etc.
- A full range of data stream eye measurements on a Sampling Scope

But if we don't have the data clock ….

Enter the PS9302, and Clock Recovery !!!



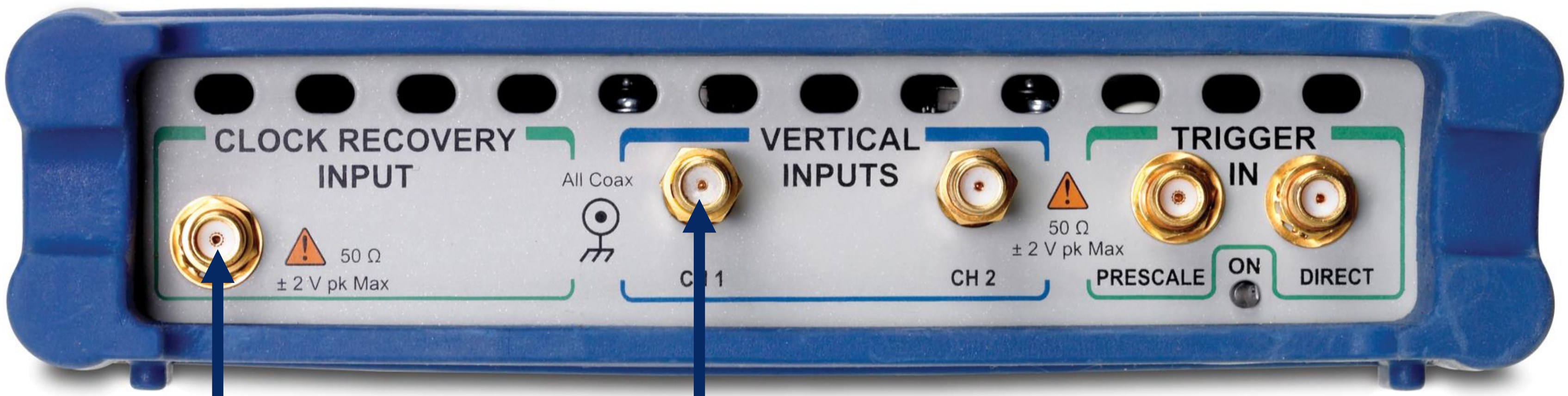
Regenerate a clock from a data sequence

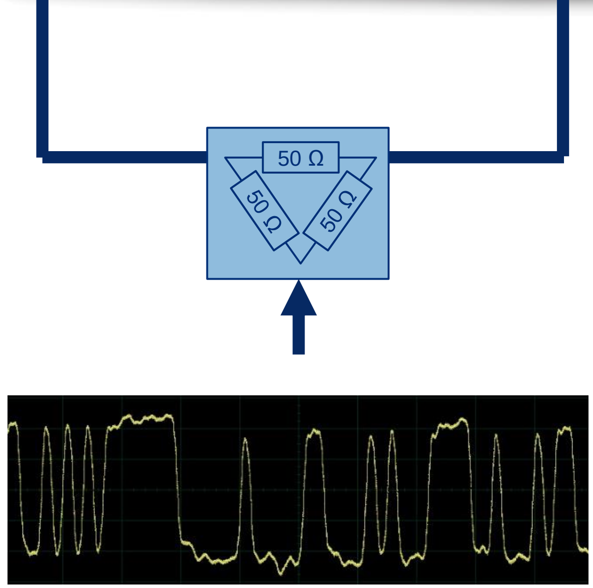


- Clock recovery locks a synthesised clock to the data stream, averaging out any jitter to define equi-spaced ‘expected’ data transition points

- The recovered clock is used as the oscilloscope trigger

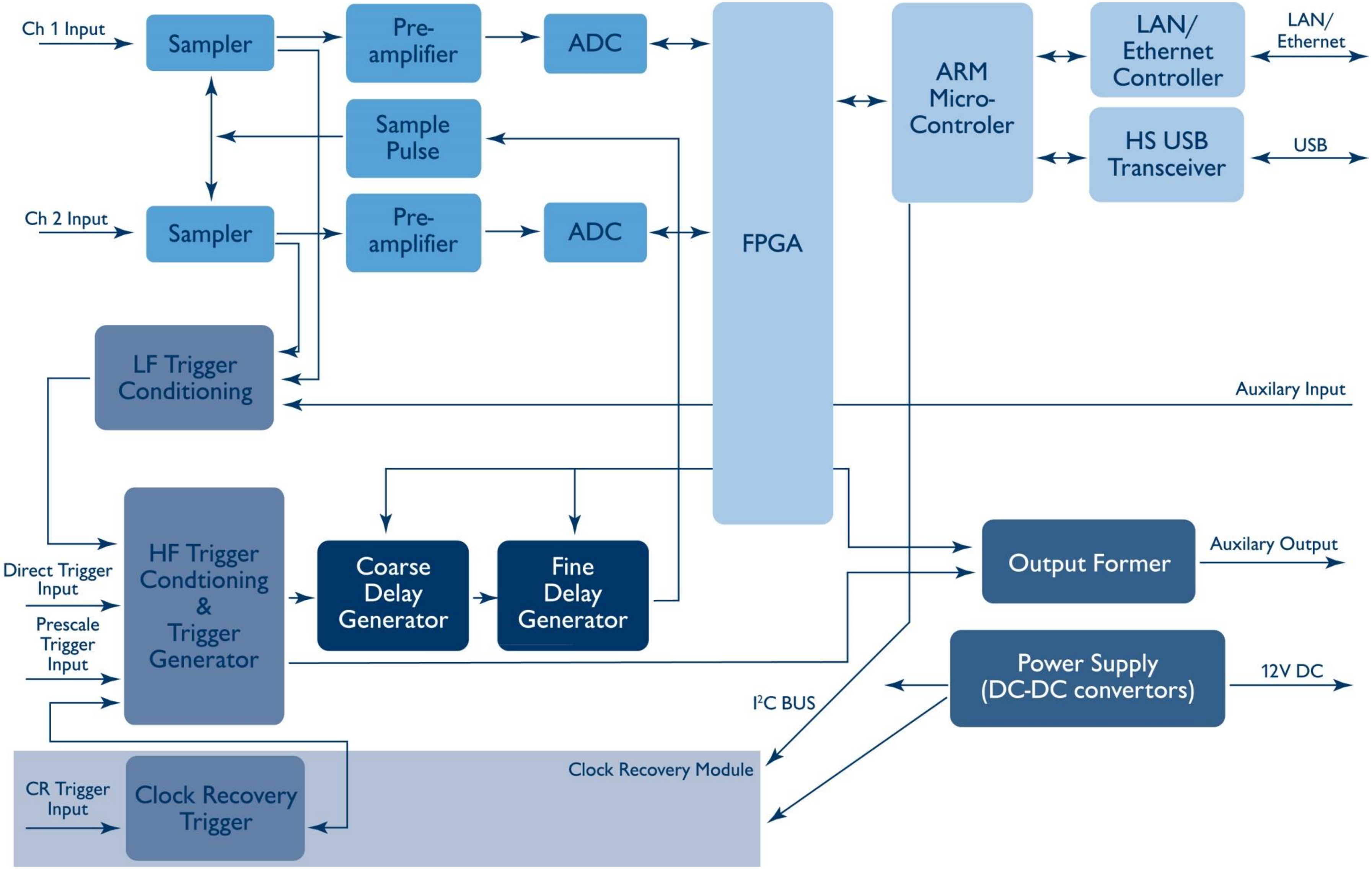
Connecting to a PS9302 for Clock Recovery





- Serial data is fed to clock recovery and an input simultaneously
- Use a 3-resistor power divider
  - *Supplied with the PS9302*
- Recovered Clock RMS Jitter, *1.5 ps + 1.0% of Unit Interval maximum*

PS9302 Specification



PicoScope 9302 Applications

SIGNAL ANALYSIS

- Electrical standards compliance testing
- Eye-diagram analysis

RF COMPONENT TESTING

- RF components
- Cables and connectors
- Pulsed RF switches

R & D

- Microwave & RF characterisation
- High-energy physics
- Digital design

HIGH-SPEED DIGITAL COMMUNICATIONS

- Design and verification of telecom and datacoms elements
- Manufacturing and testing for ITU / ANSI conformance
- Mask testing

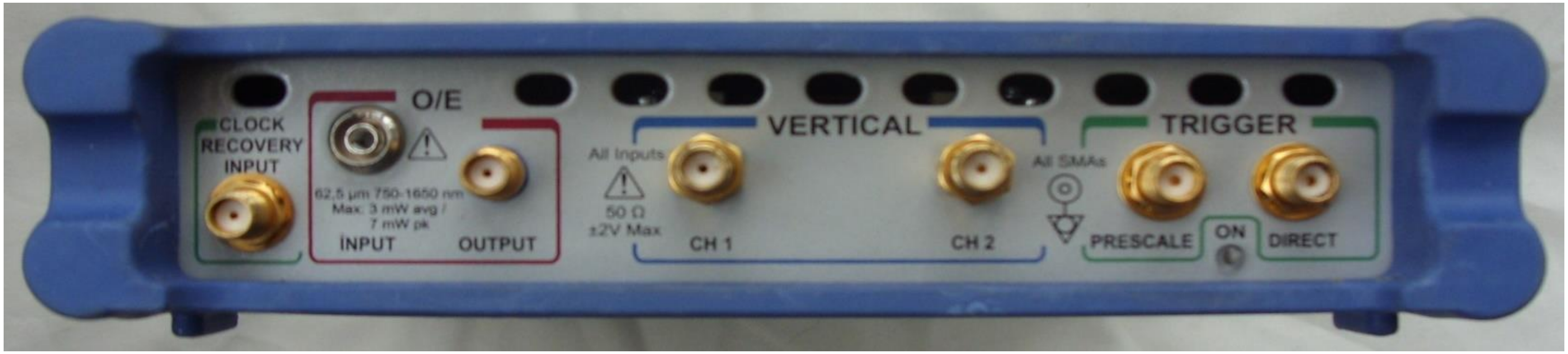
SEMICONDUCTOR TESTING

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

MANUFACTURING

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

PS9321 Front Panel



PS9321 Specification

• Optical Bandwidth	DC to 9GHz
• Effective Wavelength range	750nm to 1650 nm
• Calibrated Wavelength	850 nm
	1310 nm
	1550 nm

PicoScope PS9322 Applications

SIGNAL ANALYSIS

- Electrical standards compliance testing
- Eye-diagram analysis

OPTICAL COMPONENT TESTING

- Optical components
- Optical Cables and connectors
- Laser testing

R & D

- Microwave & RF characterisation
- High-energy physics
- Digital design

HIGH-SPEED DIGITAL COMMUNICATIONS

- Design and verification of telecom and datacoms elements
- Manufacturing and testing for ITU / ANSI conformance
- Mask testing

SEMICONDUCTOR TESTING

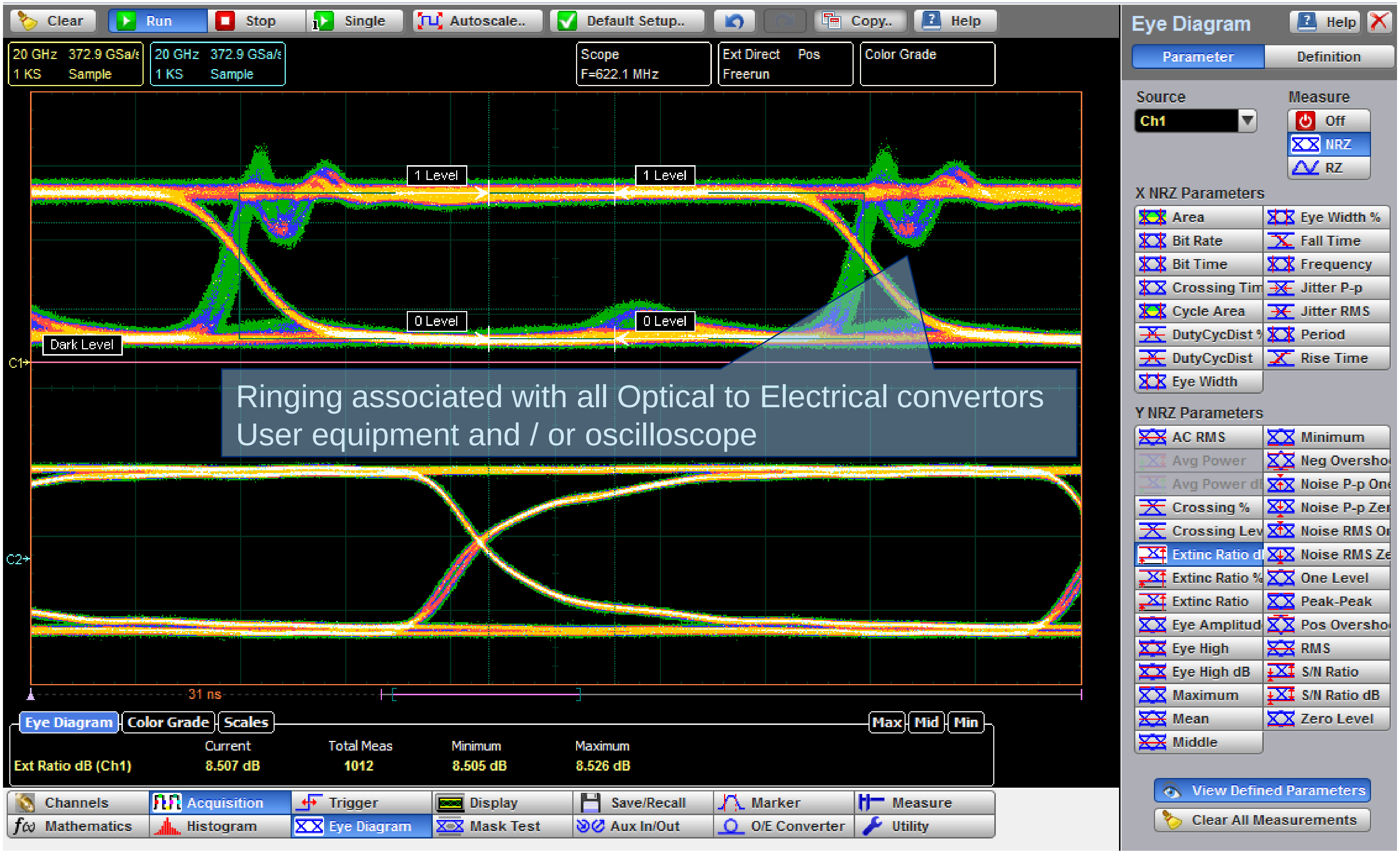
- Microwave & RF characterisation
- High-energy physics
- Digital design
- Informative waveform displays

MANUFACTURING

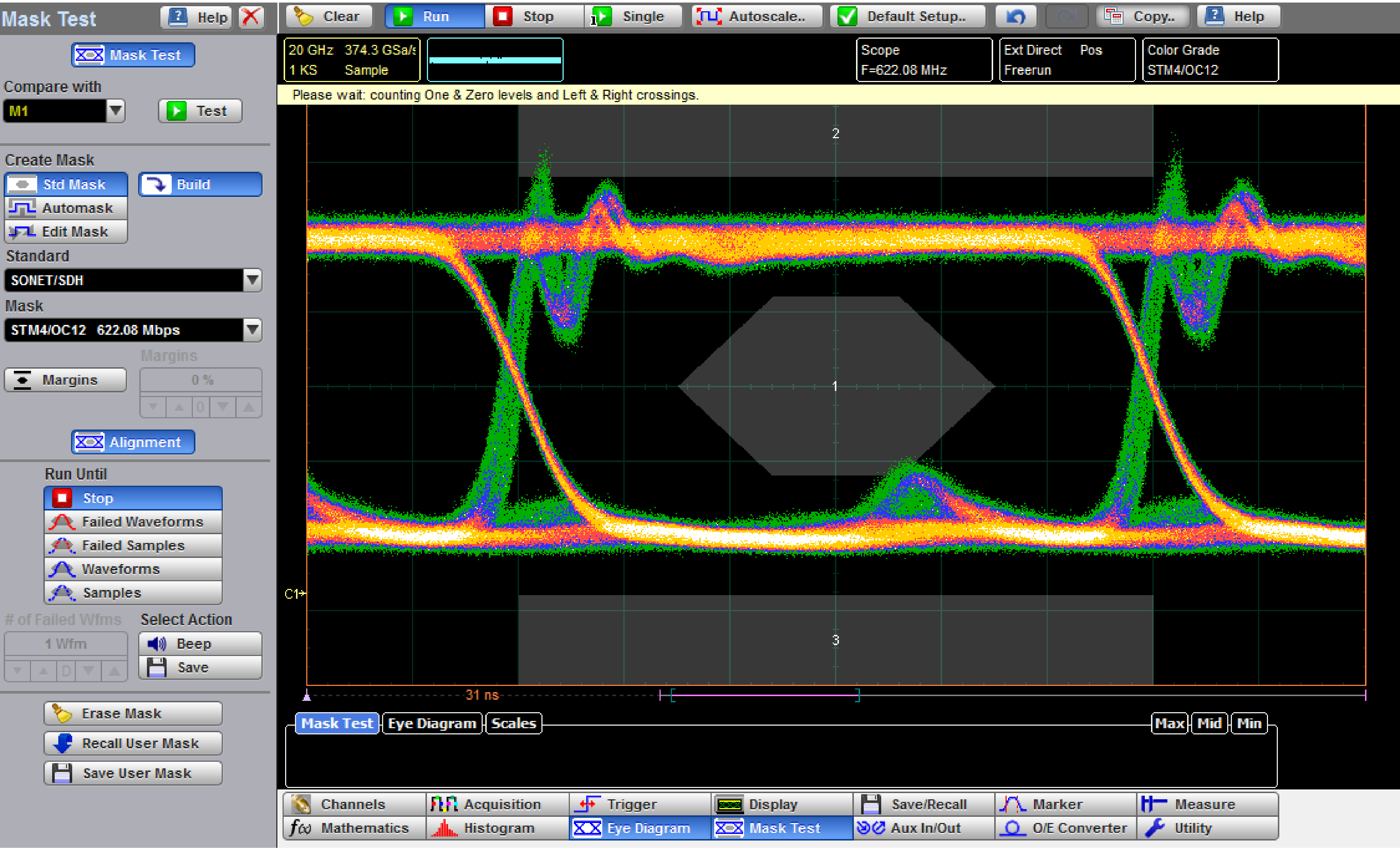
- Limit and mask testing
- Testing for ITU / ANSI conformance
- Automatic test systems
- Auto-calibration routine

PS9321 Front Panel

Determination of Extinction Ratio

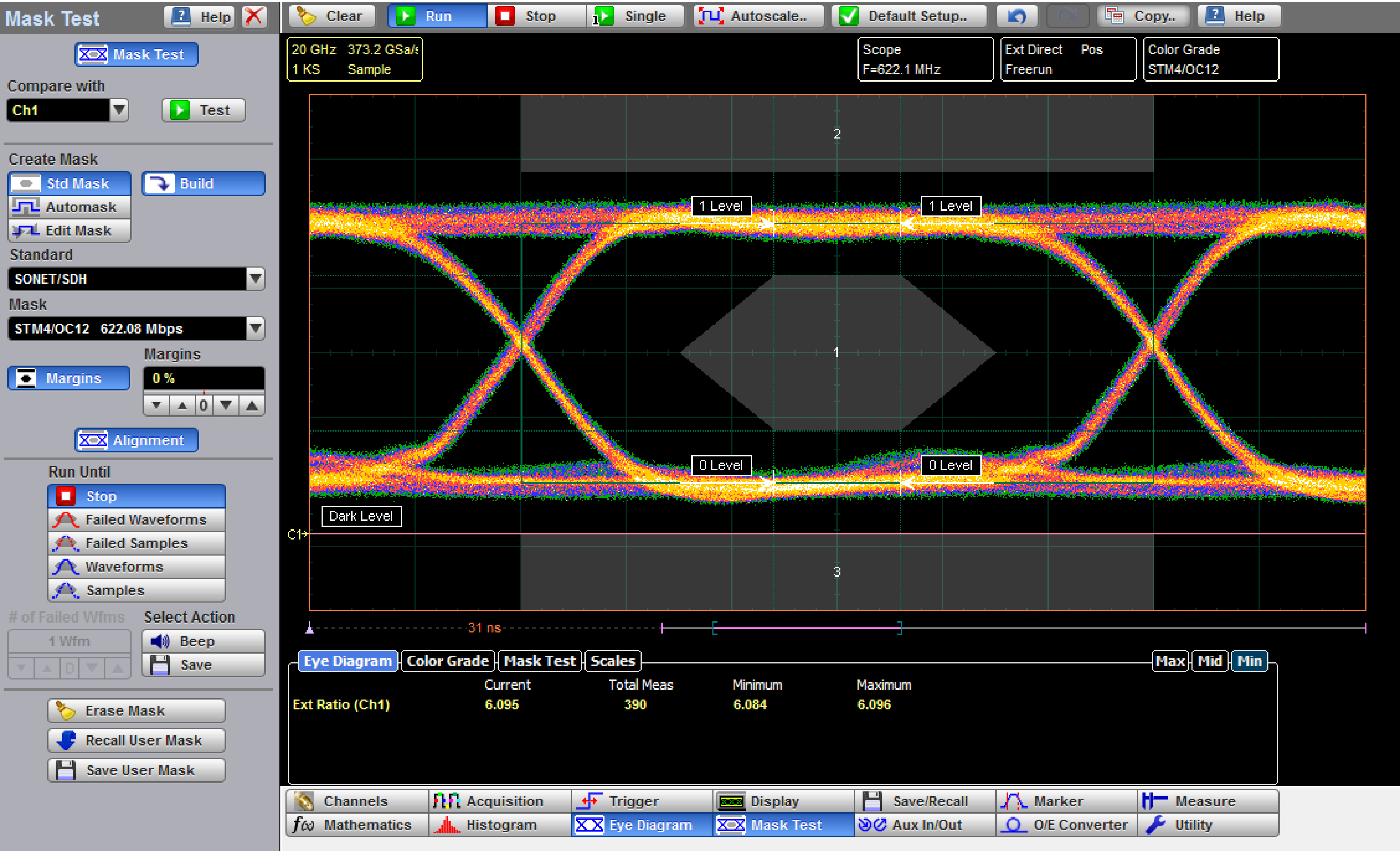


OC12 Mask – ringing impacts

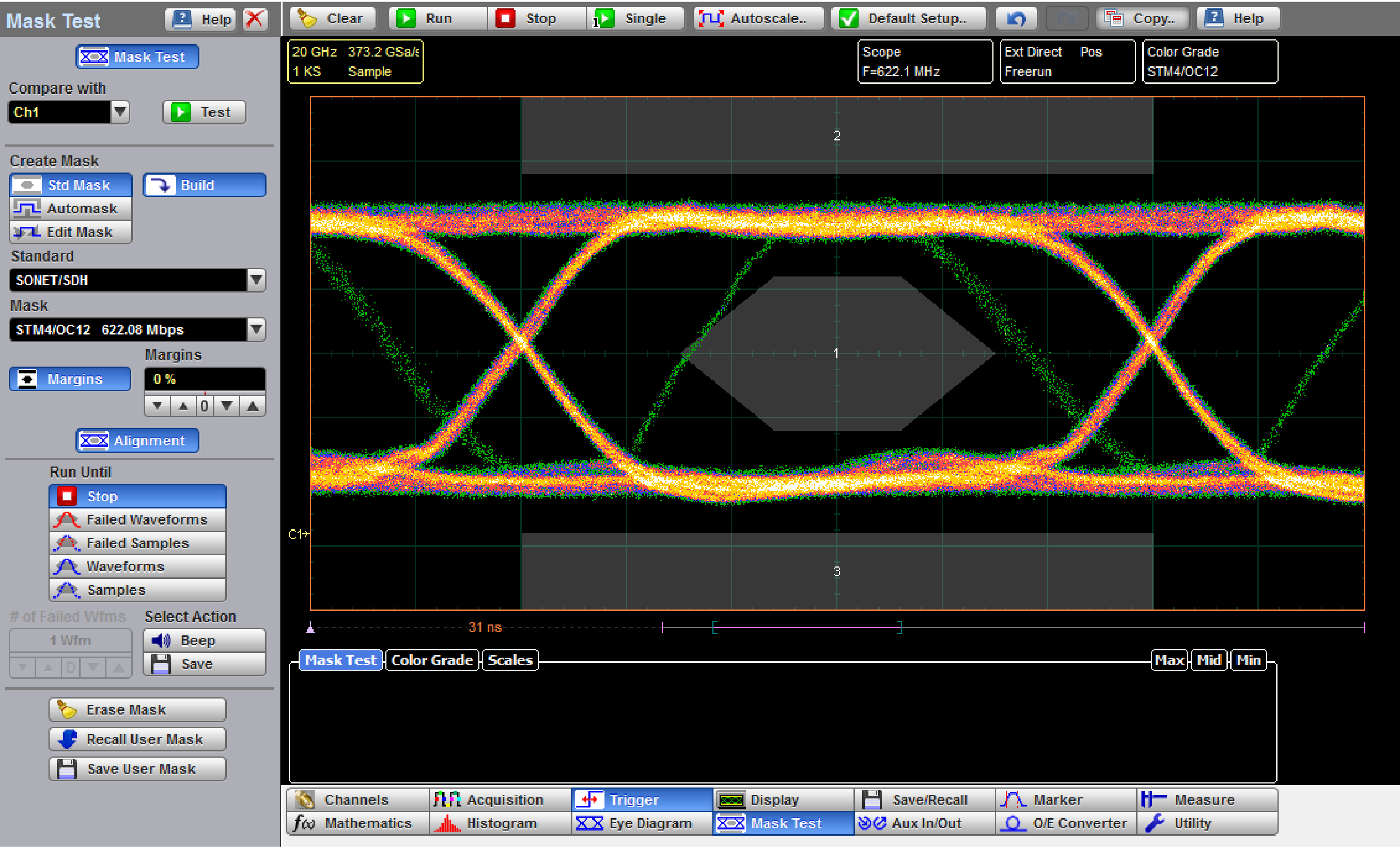


Standard filters address waveshape corruption
(within user equipment or a measurement)

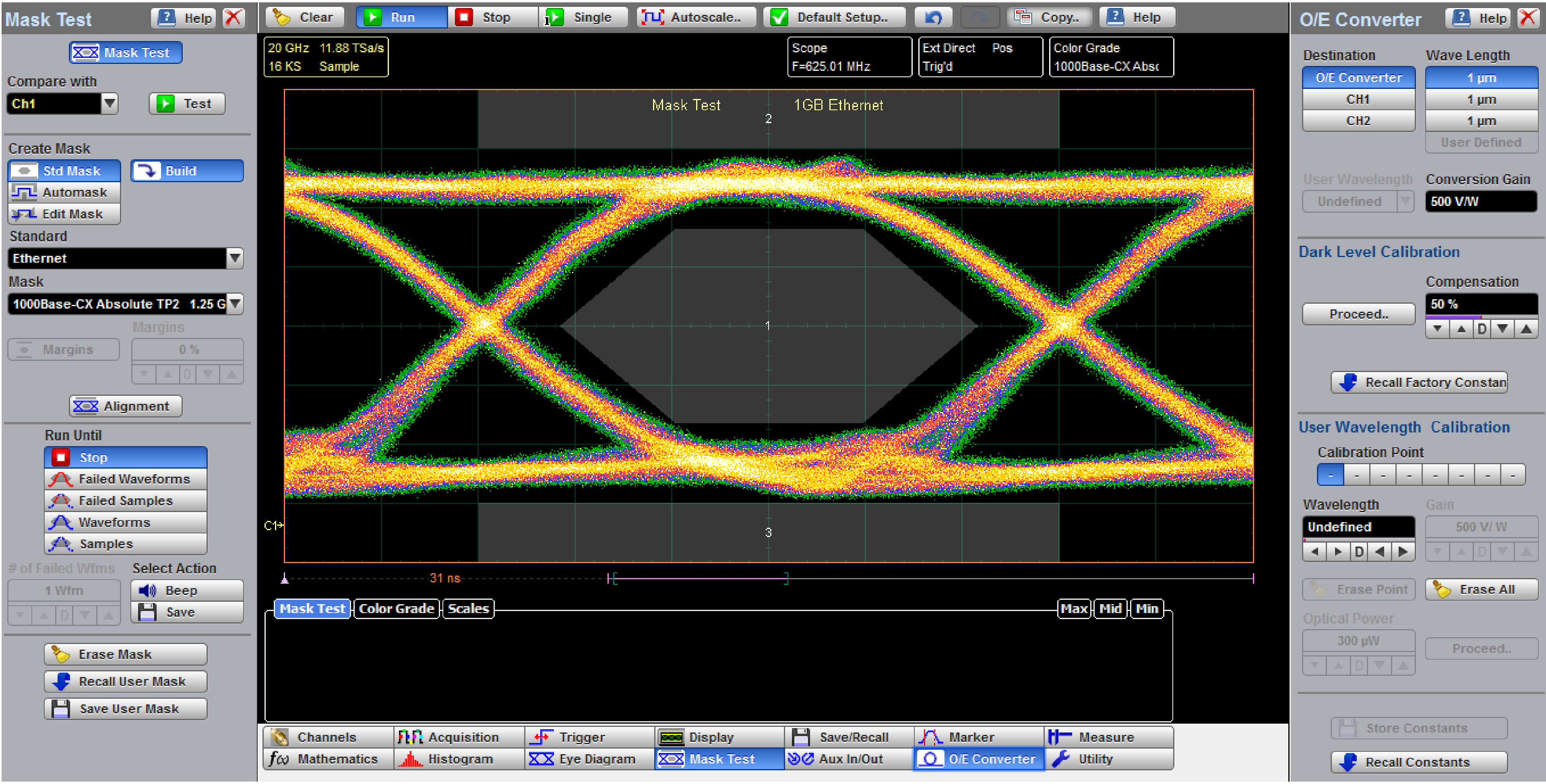
OC12 Mask Test with filter



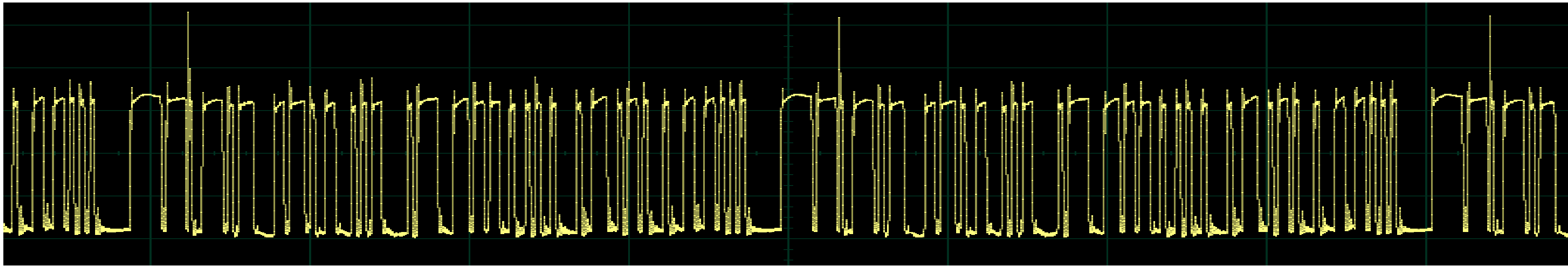
OC12 with error bit

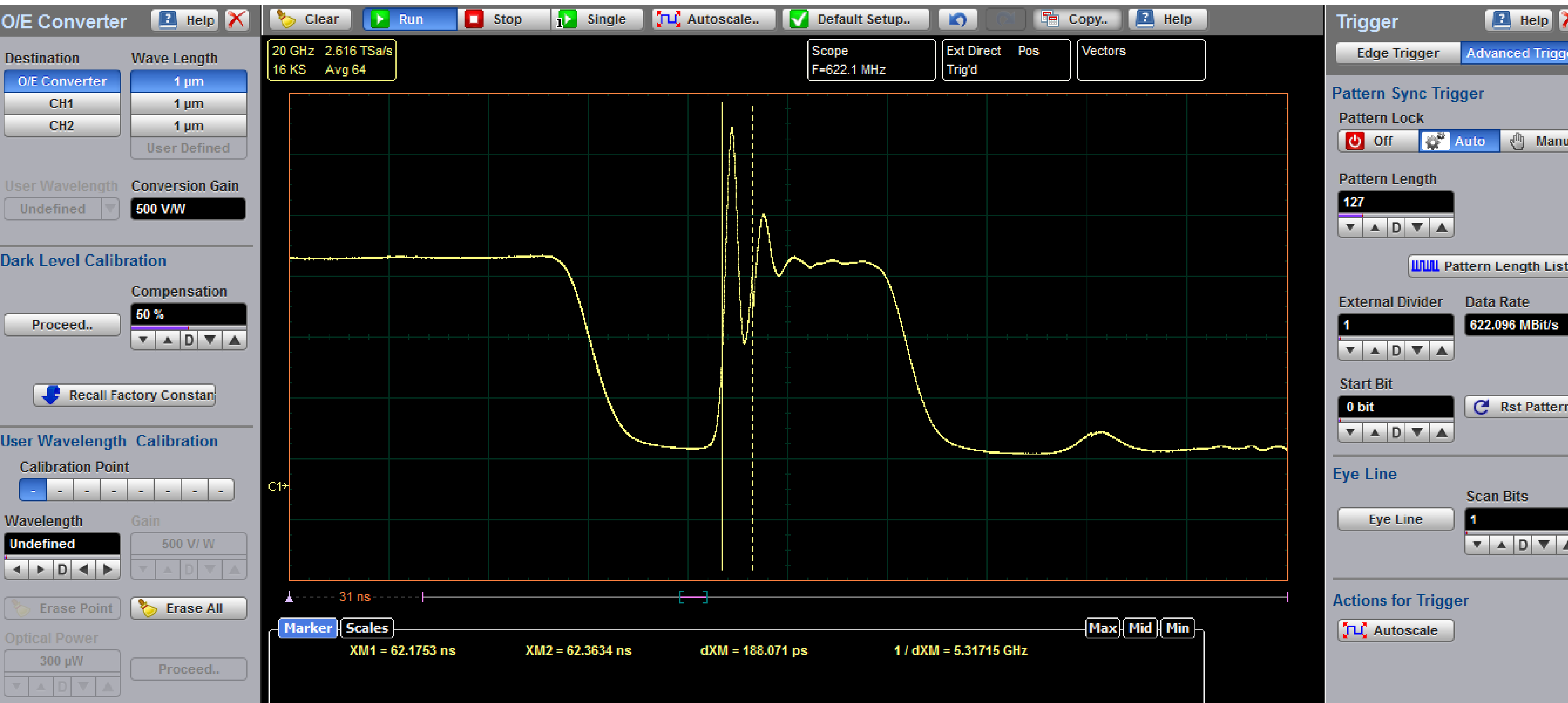


Example tight limits of 1GB Ethernet

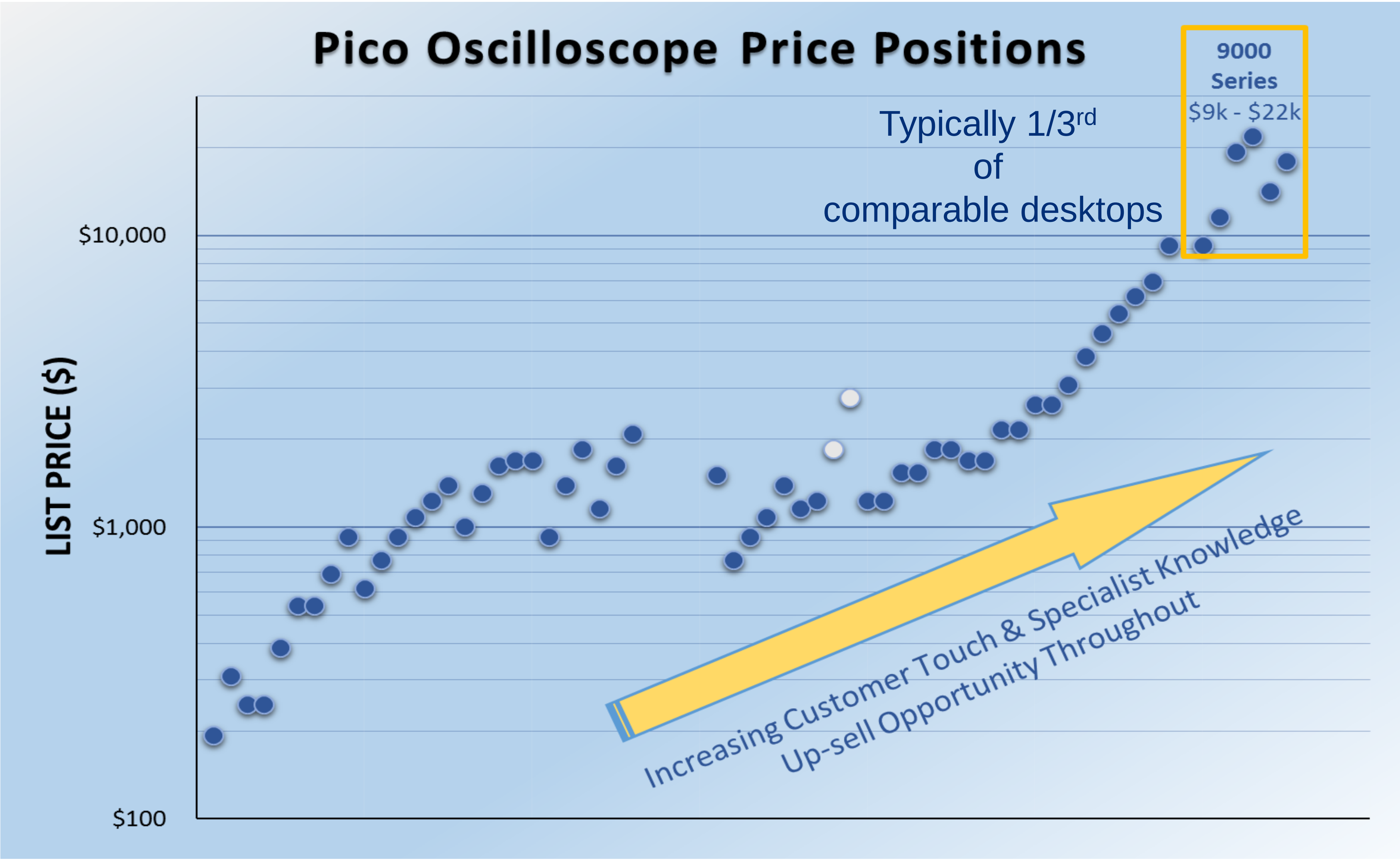


5GHz Pattern Trigger Ringing





PS9000 Series Price Positions



PS9000 Series Target Market Segments

Applications to look for …	
Toolbox	None
Hobbies & Home Automation	None
Classroom	Potential
Scientific Research	Target
Design & Debug Activity	Target
Monitoring (Qty / Performance)	Potential
Service Centre or Maintenance	Target
Field Service / Maint. Activity	Potential
Production Line & Test Bench	Target
ATE System	Target
Calibration / Compliance Test	Target

Electrical discipline	
Digital Compute/Control or Comm's	Target
Analog Interface or Control	Potential
RF, Microwave or Serial Data	Target

Customer scale or type	
Private	None
Self Employed	Potential
Small < $10 M	Target
Medium < $500	Target
Large Corporation > $500 M	Target
OEM	Target
Public Service	Potential
Military	Target

Technical / Application / Selling Expertise

- Catalogue, technical website / datasheet
- High speed digital, RF, μW expertise
- App. Awareness. Foot in door for Pico.

Where to find PS9300 Customers

Signal Analysis	Electrical standards compliance testing • Spectrum analysis • Statistic analysis • Eye-Diagram analysis
Network Analysis with TDR/TDT	• Circuits boards characterization • IC Packages characterization • Computer backplane • Z-Impedance measurements
High-Speed Digital Communication	• Designing/Verification of telecom and data elements Manufacturing/Testing for ITU/ANSI conformance
Semiconductor Testing	• Hi-Speed diodes • Fast logic families • Analogue component pulse response
R & D	• Microwave & RF characterization • High energy physics • Digital design • Informative waveform displays
Timing Analysis	• Automatic parametric measurements • Pulsed RF switches • Compliance testing
Manufacturing	• Limit and Mask testing • Testing for ITU/ANSI conformance • Automatic test systems • Auto-calibration routine

Roles in a Sampling Oscilloscope Sale

Distributor Role

- Find customers with a sampling scope requirement
- Introduce and demonstrate the product

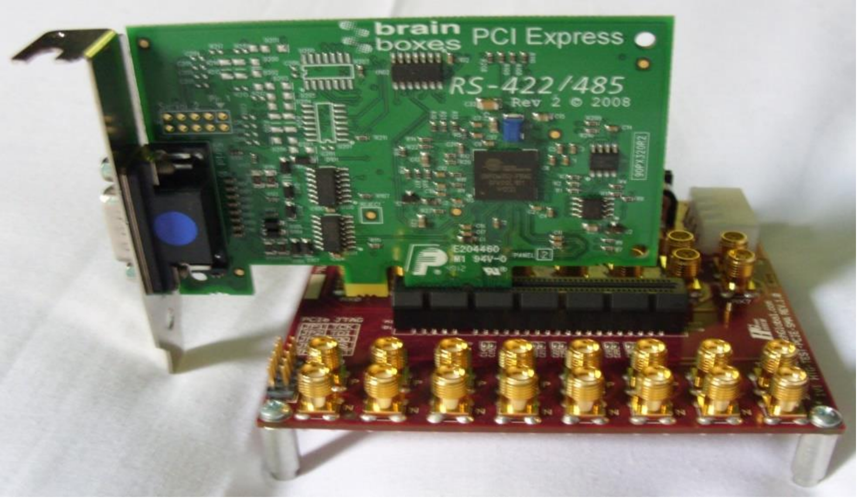
Pico Technical Support

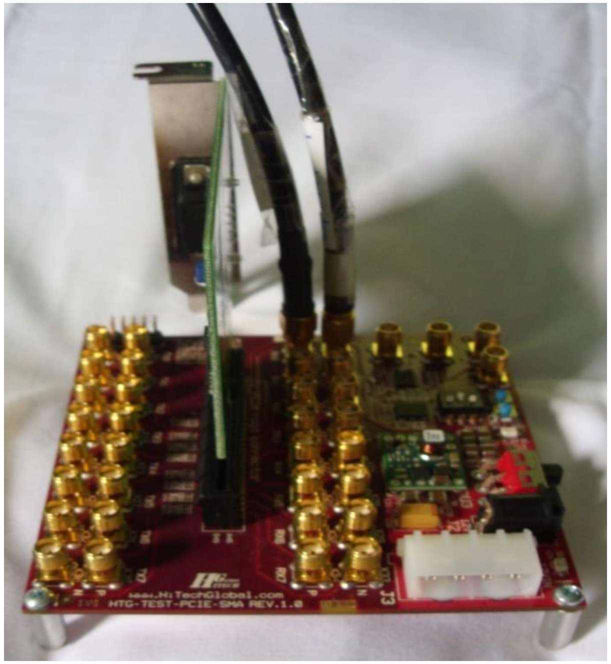
- Demonstrate and sell to specific customer application
- Address more complex aspects such as Acquisition modes, triggering functionality and needs.
- TDR / TDT and Optical demonstrations

Demonstration applied to PCI Express

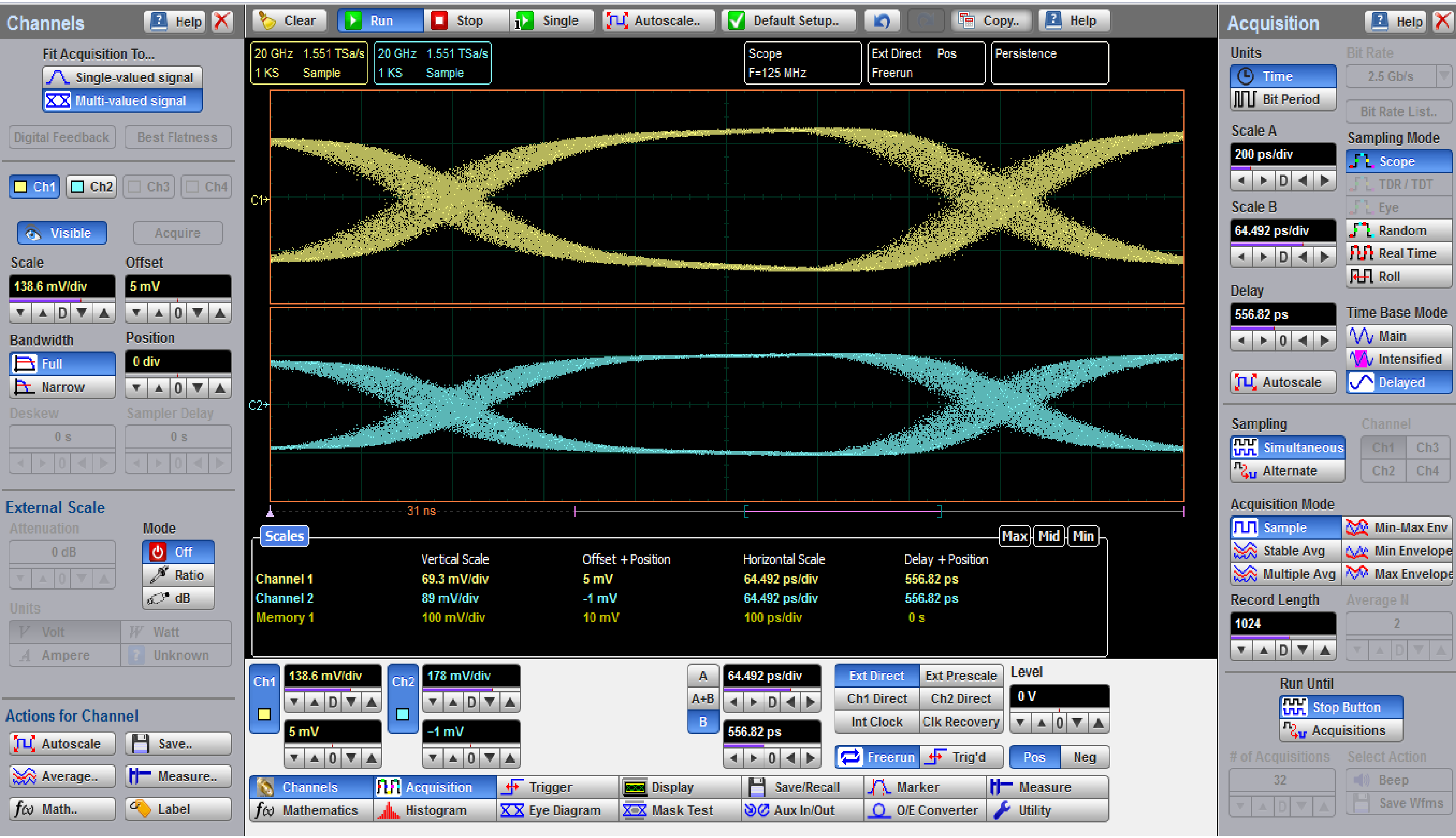
- PCI Express
- 2.5GB/s Data Rate
- Differential Signal
- Trigger Clock Recovery
- Measure Eye Opening and Jitter
- Pattern Sync Pulse Analysis

PCI Express Card
Plugged to a Break Out Board

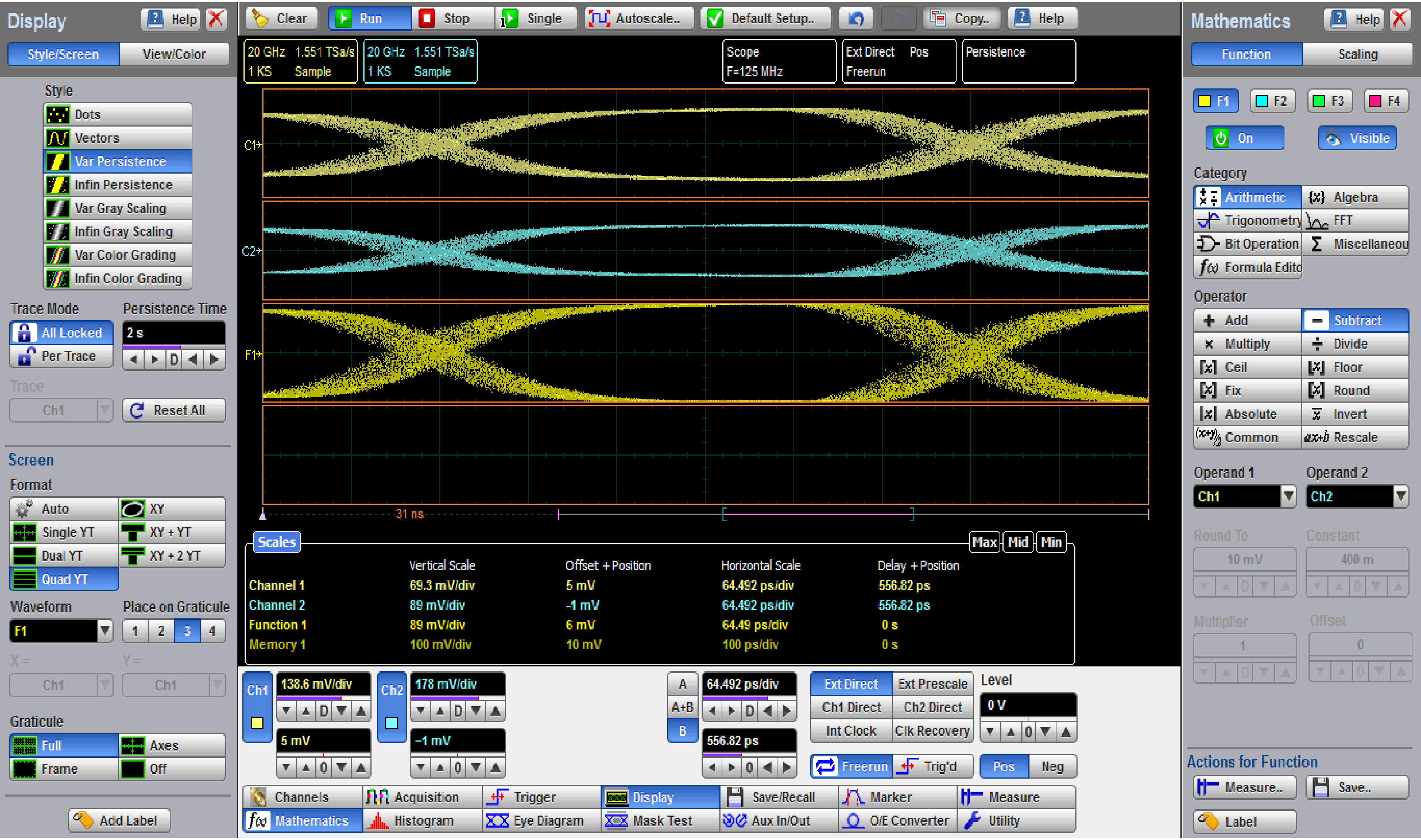




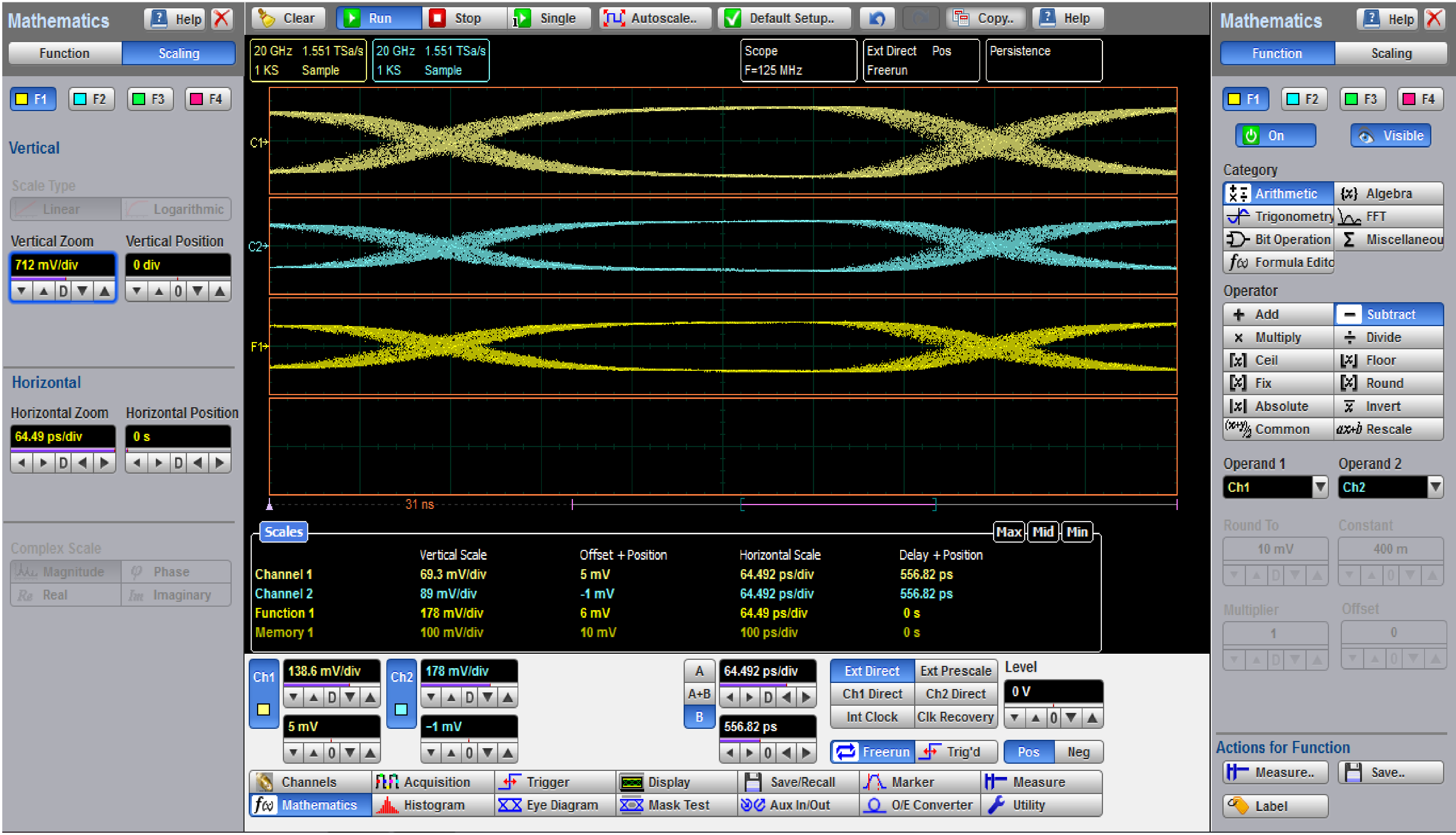
Autoscale one eye



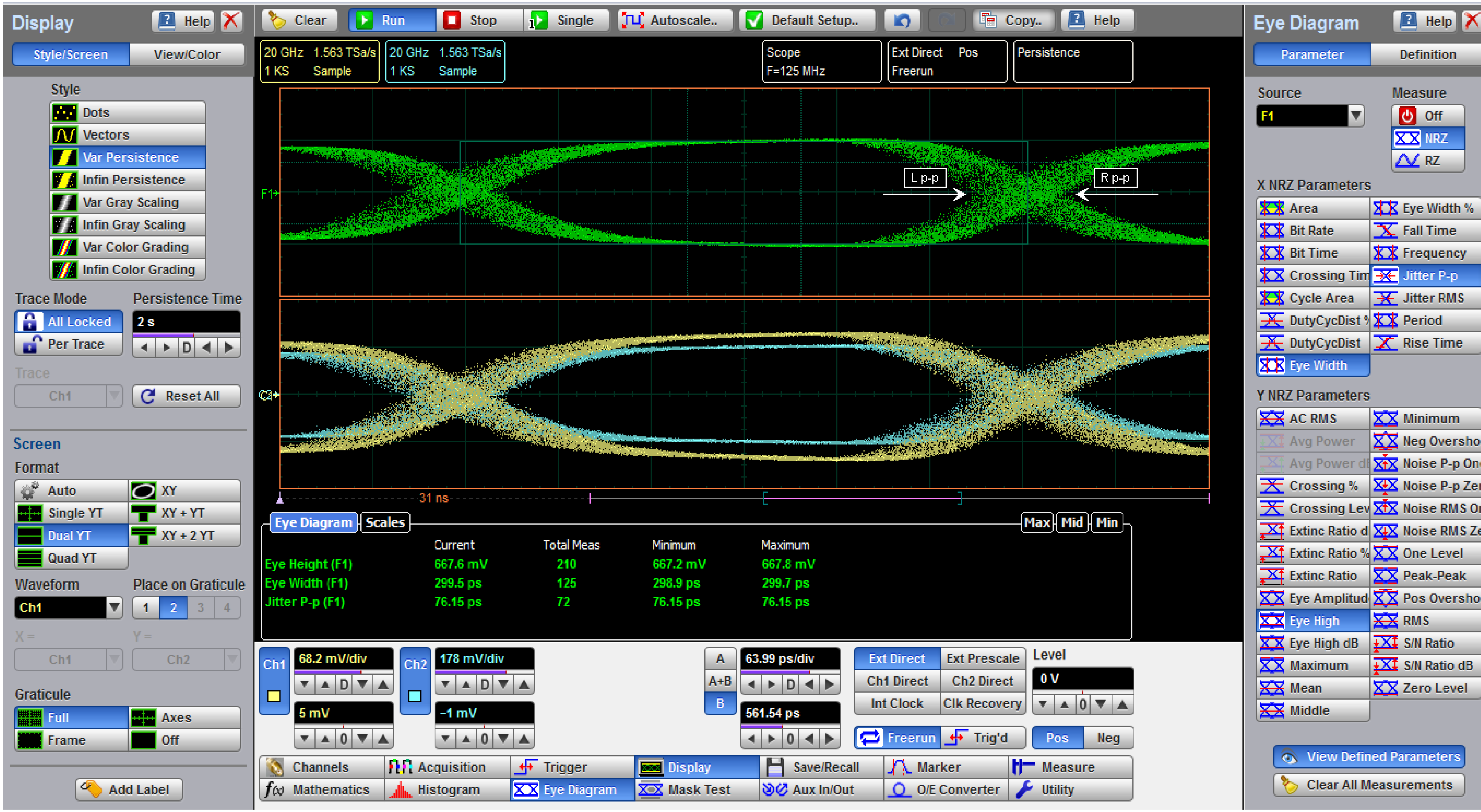
Use Differential Quad Display



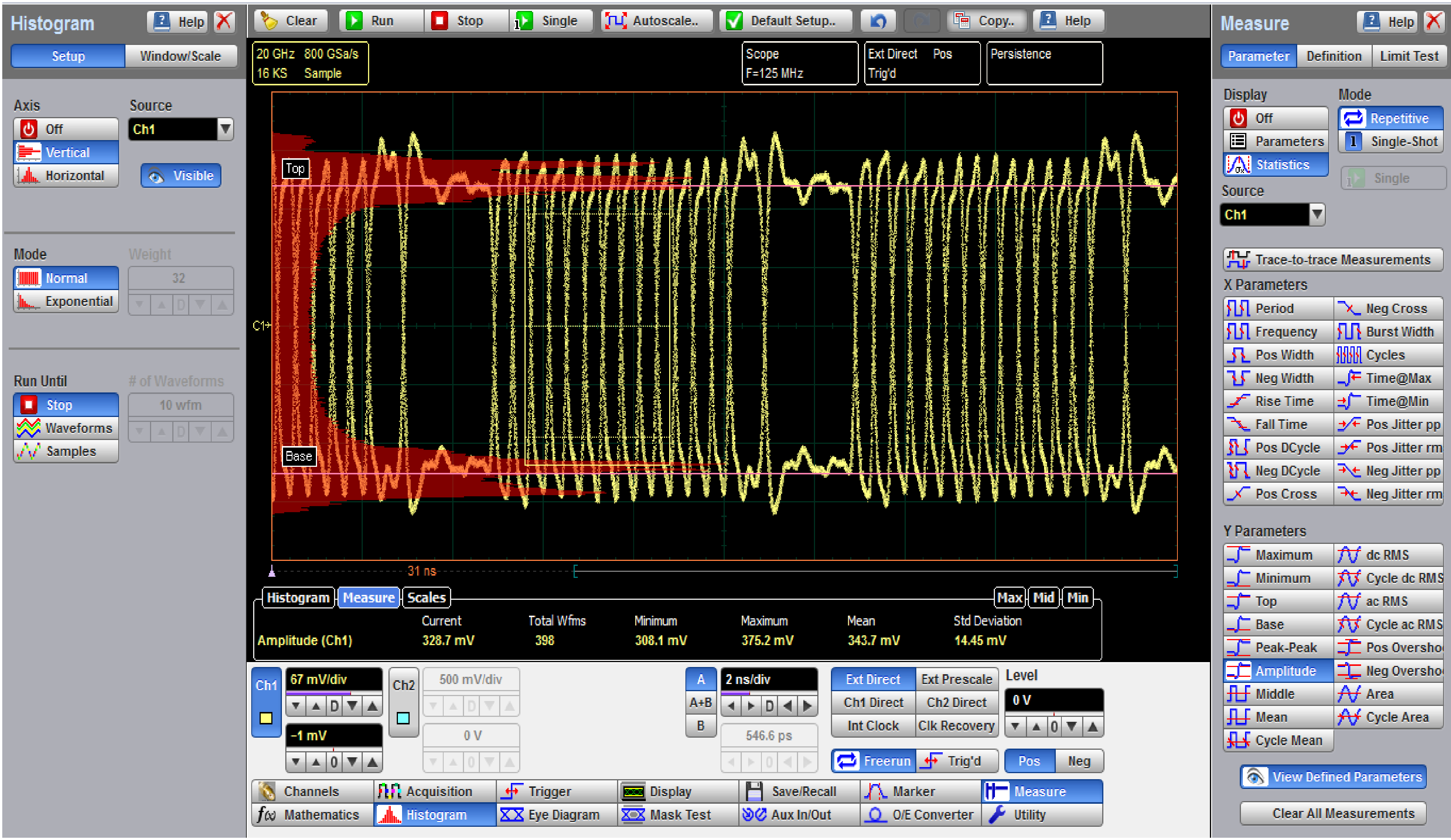
Apply Mathematics Scaling



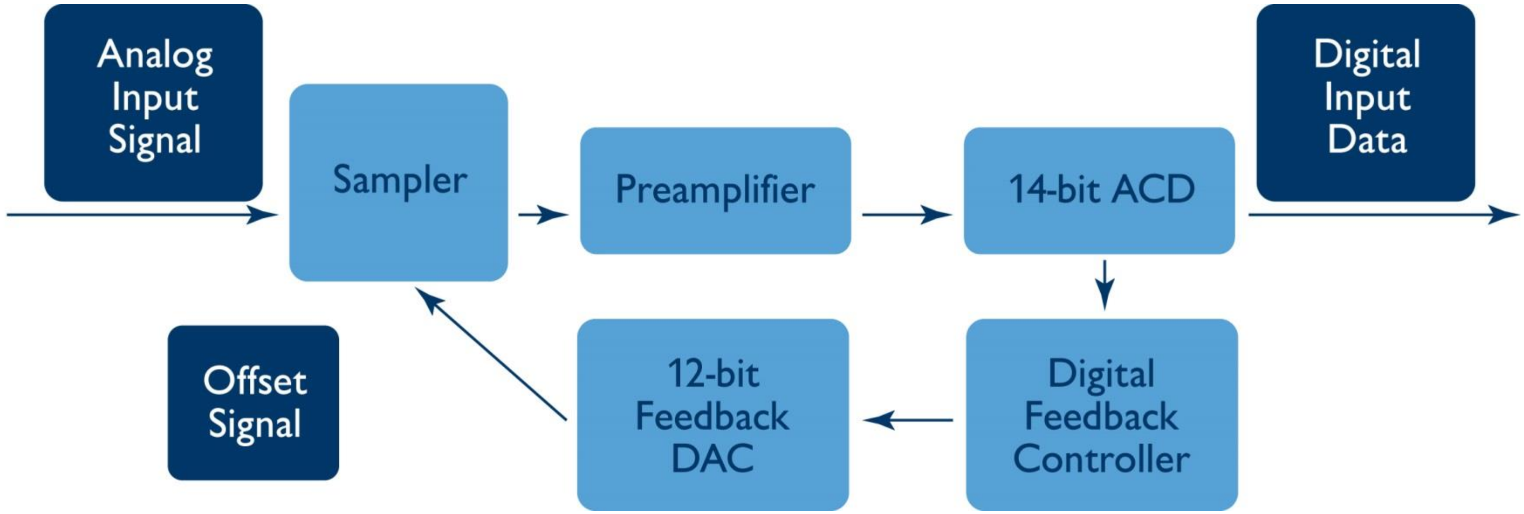
Make Differential Measurement



Amplitude Histogram 350mV



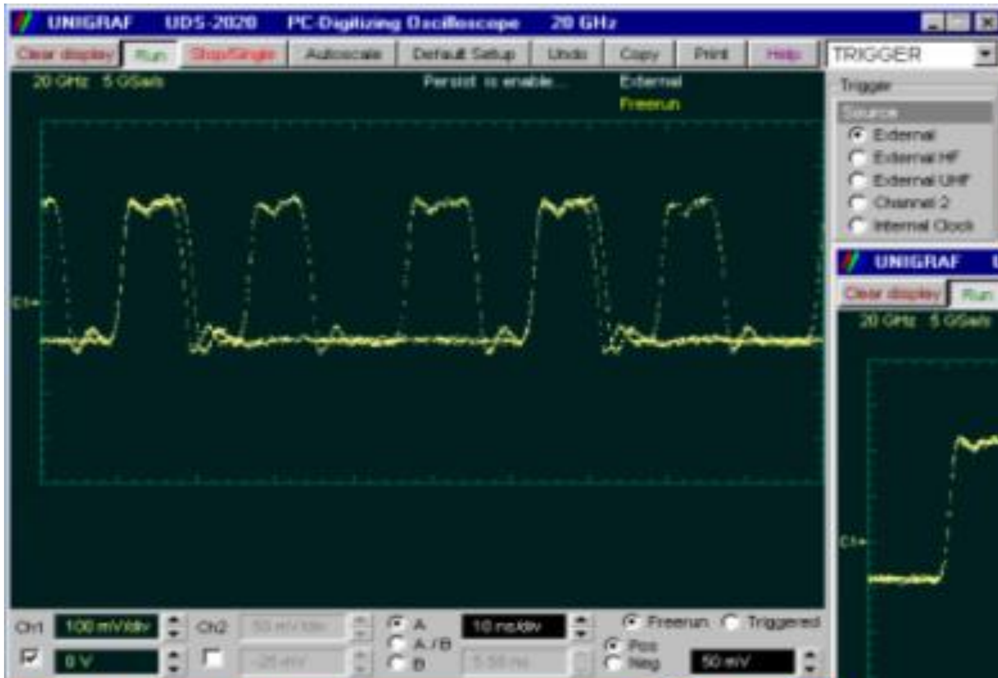
Automated Digital Offset for Sampler Optimisation



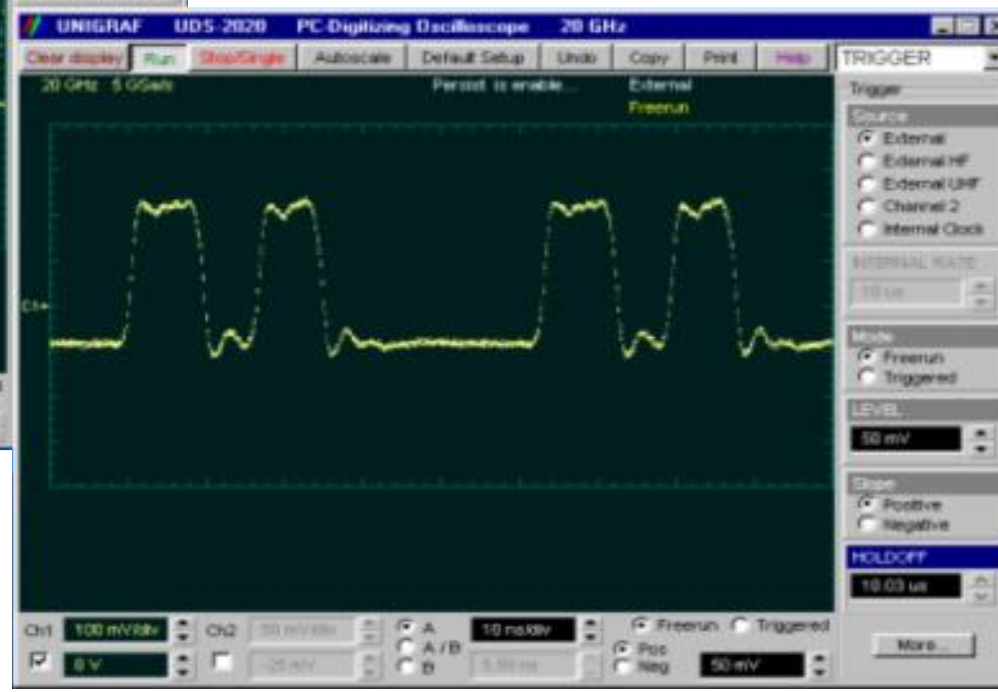
Digital feedback sampling allows software linearization of the sampling system to provide extremely linear response regardless of the sampling offset

Sampling offset can be removed completely, or can feedback previously stored information recorded at discrete instants in time

Unique Trigger Holdoff Features



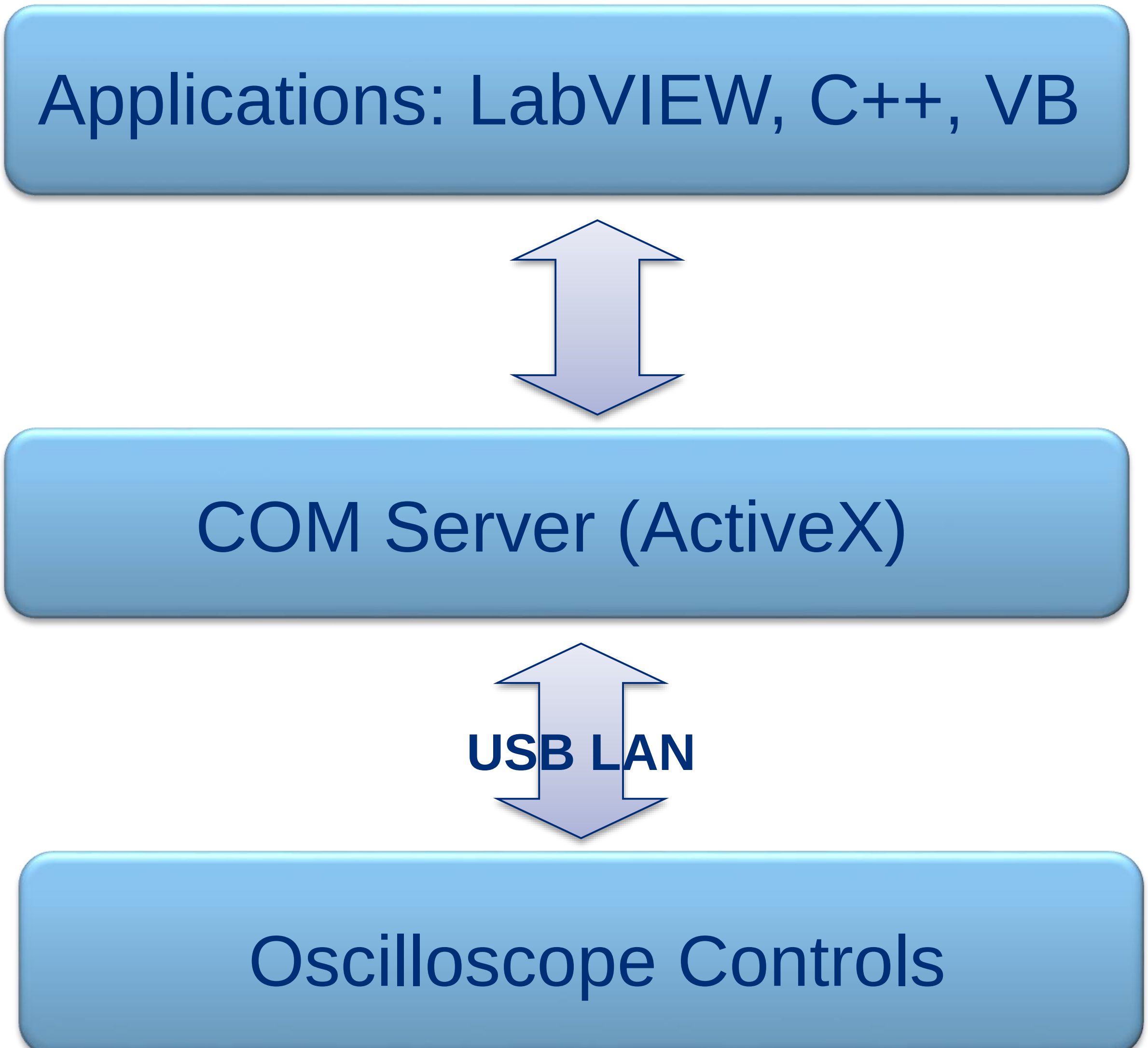
Adjustable Trigger Holdoff allows locking on a particular point in a pulse train or in irregular repetitive signals, such as radar signals.



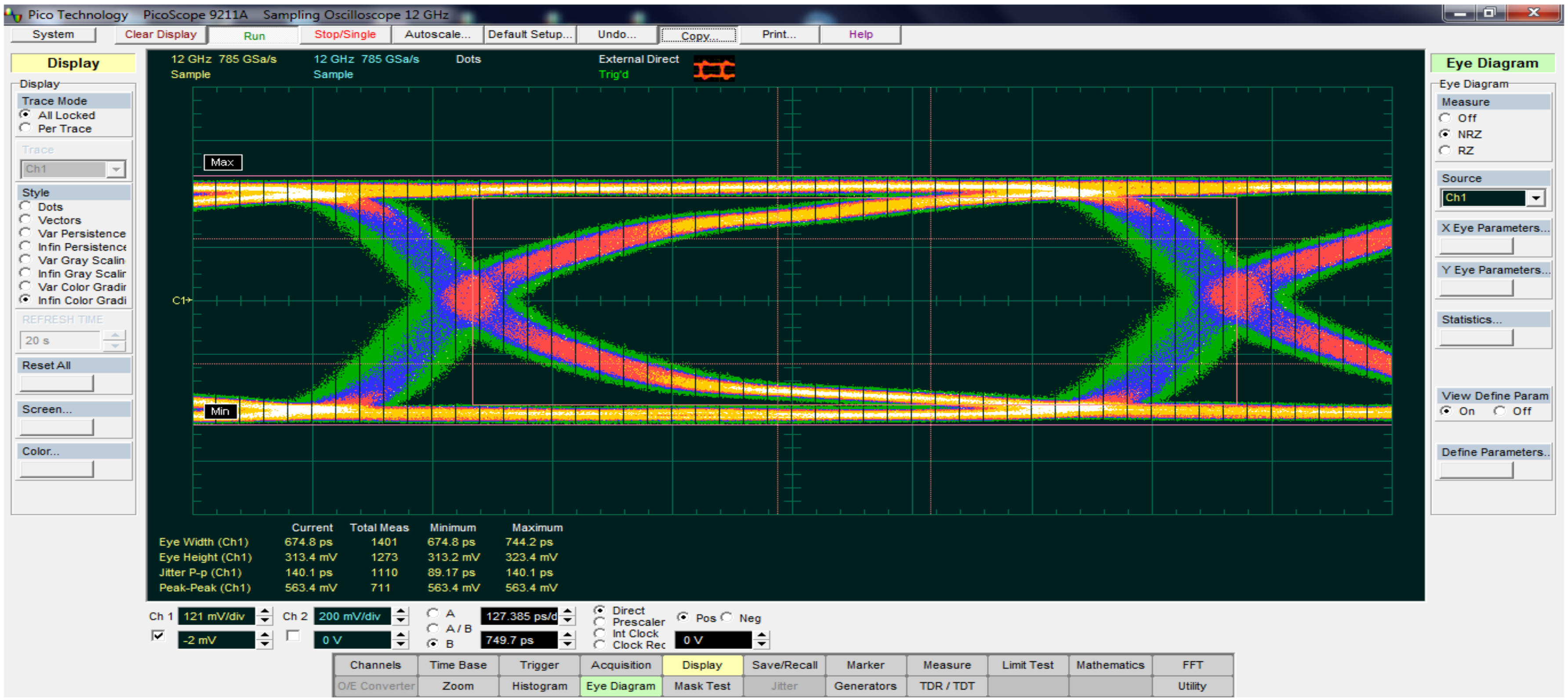
Unstable trigger or signal from 20-MHz Double Pulse Generator.

Stable trigger of the same Double Pulse signal with a 30-ns Trigger Holdoff adjusted with 2-ns increment.

Programming with the PS9200 / PS9300 Series

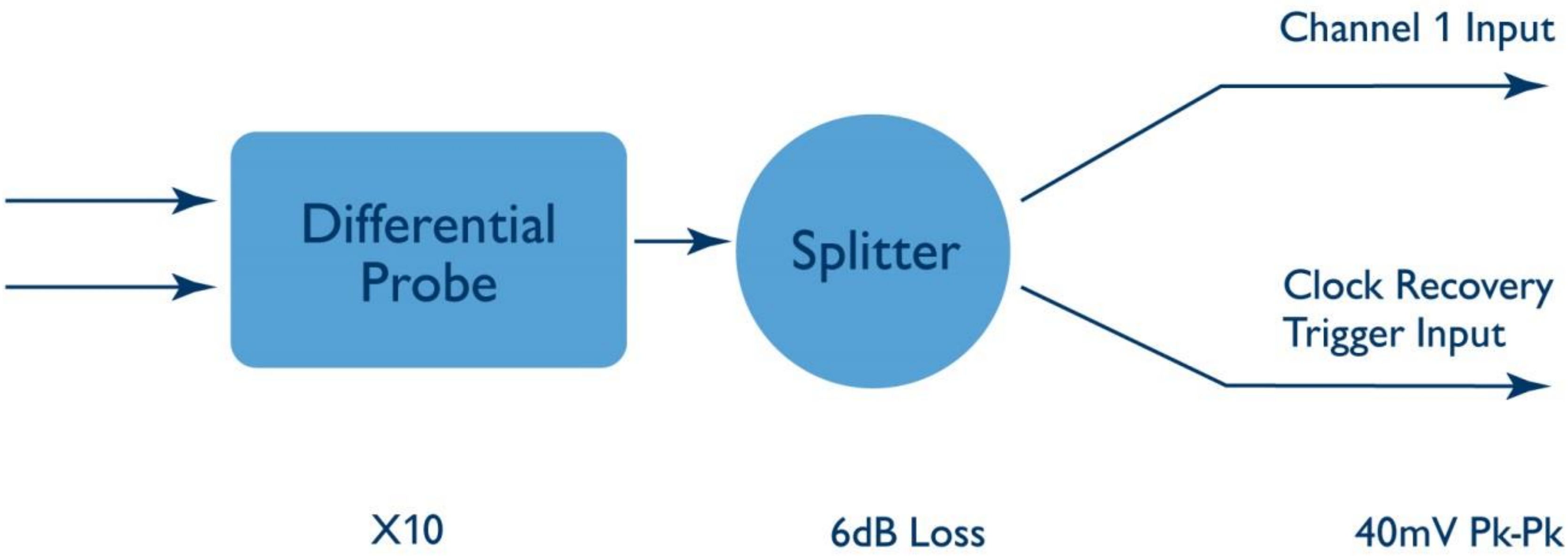


Successful Application 1



- Manufacturing Test
- To monitor a differential signal for a defined test period
- To make measurements on the acquired eye
- Record screen image for each unit under test

Successful Application 1

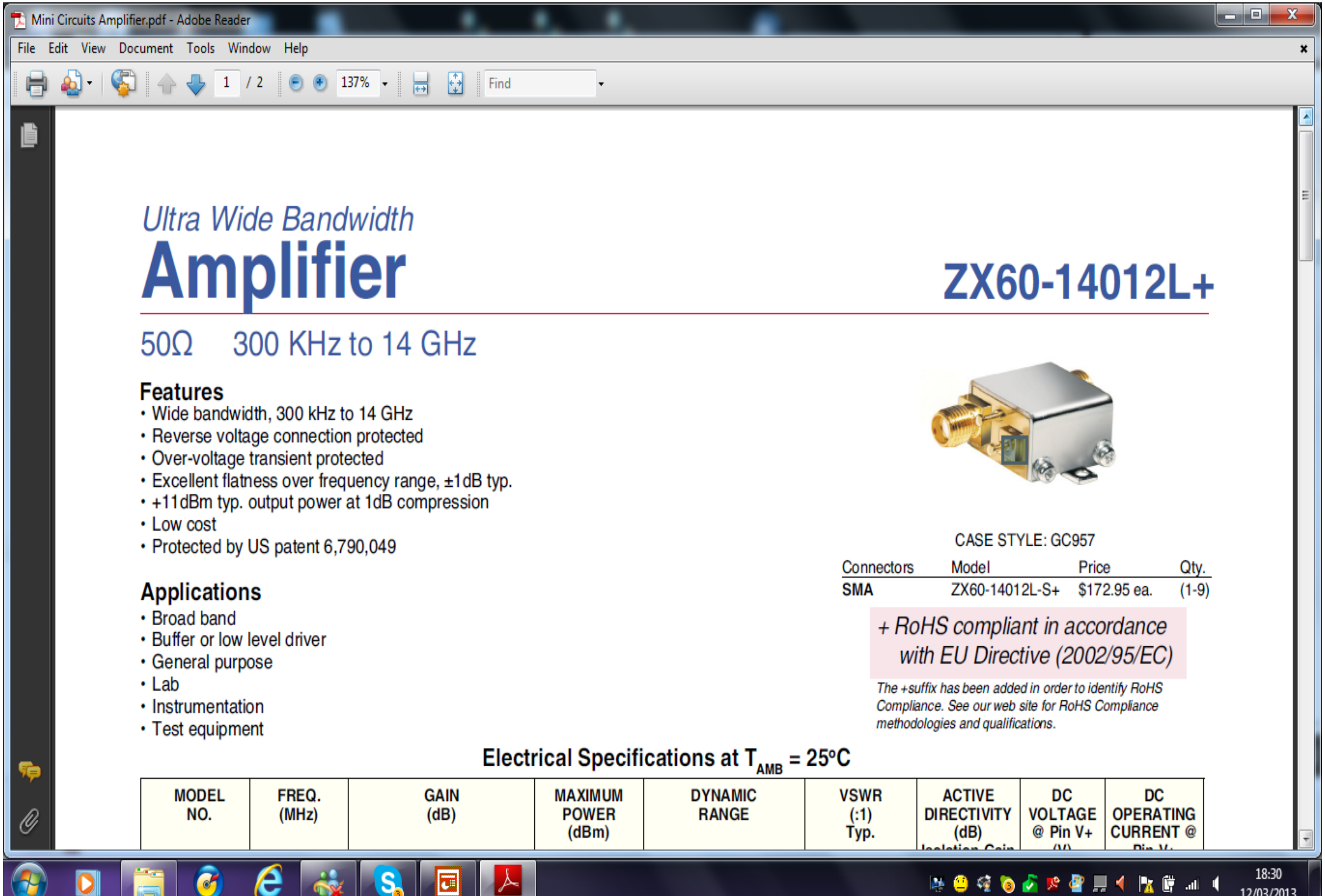


Successful Application 1

- Clock Recovery Trigger Sensitivity

- 50mV p-p 12Mb/s to 1Gb/s
- 100mV p-p 1Gb/s to 2.7Gb/s

Successful Application 1



Mini Circuits Amplifier.pdf - Adobe Reader

File Edit View Document Tools Window Help

Ultra Wide Bandwidth

Amplifier

ZX60-14012L+

50Ω 300 KHz to 14 GHz

Features

- Wide bandwidth, 300 kHz to 14 GHz
- Reverse voltage connection protected
- Over-voltage transient protected
- Excellent flatness over frequency range, ±1dB typ.
- +11dBm typ. output power at 1dB compression
- Low cost
- Protected by US patent 6,790,049

Applications

- Broad band
- Buffer or low level driver
- General purpose
- Lab
- Instrumentation
- Test equipment

CASE STYLE: GC957

Connectors	Model	Price	Qty.
SMA	ZX60-14012L-S+	$172.95 ea.	(1-9)

+ RoHS compliant in accordance with EU Directive (2002/95/EC)

The +suffix has been added in order to identify RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications.

Electrical Specifications at T_{AMB} = 25°C

MODEL NO.	FREQ. (MHz)	GAIN (dB)	MAXIMUM POWER (dBm)	DYNAMIC RANGE	VSWR (:1) Typ.	ACTIVE DIRECTIVITY (dB)	DC VOLTAGE @ Pin V+	DC OPERATING CURRENT @

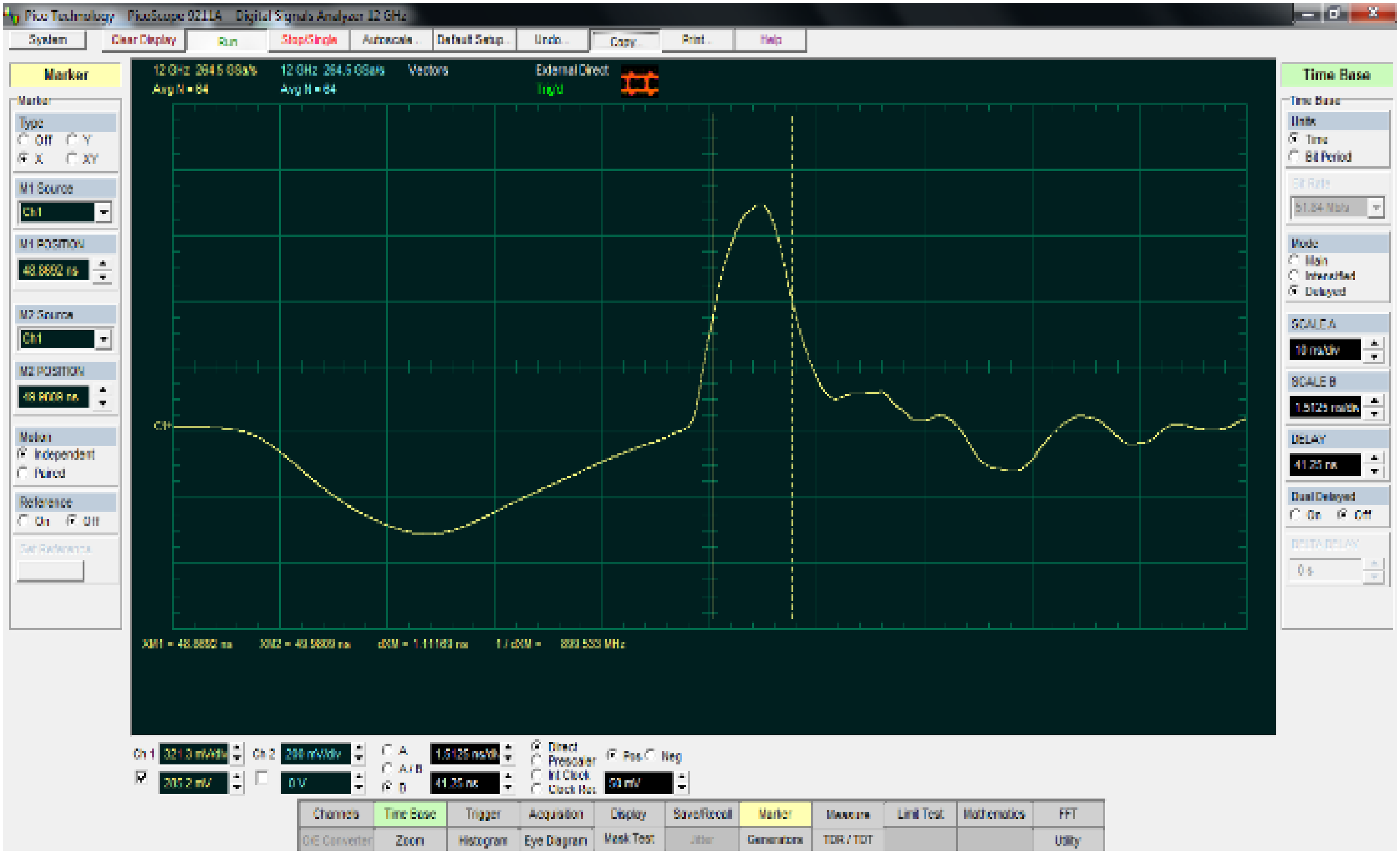
18:30
12/03/2013

Successful Application 2

- Laser testing
- Analog Bandwidth
- Test the electrical signal to drive the laser

Successful Application 2

Successful Application 2



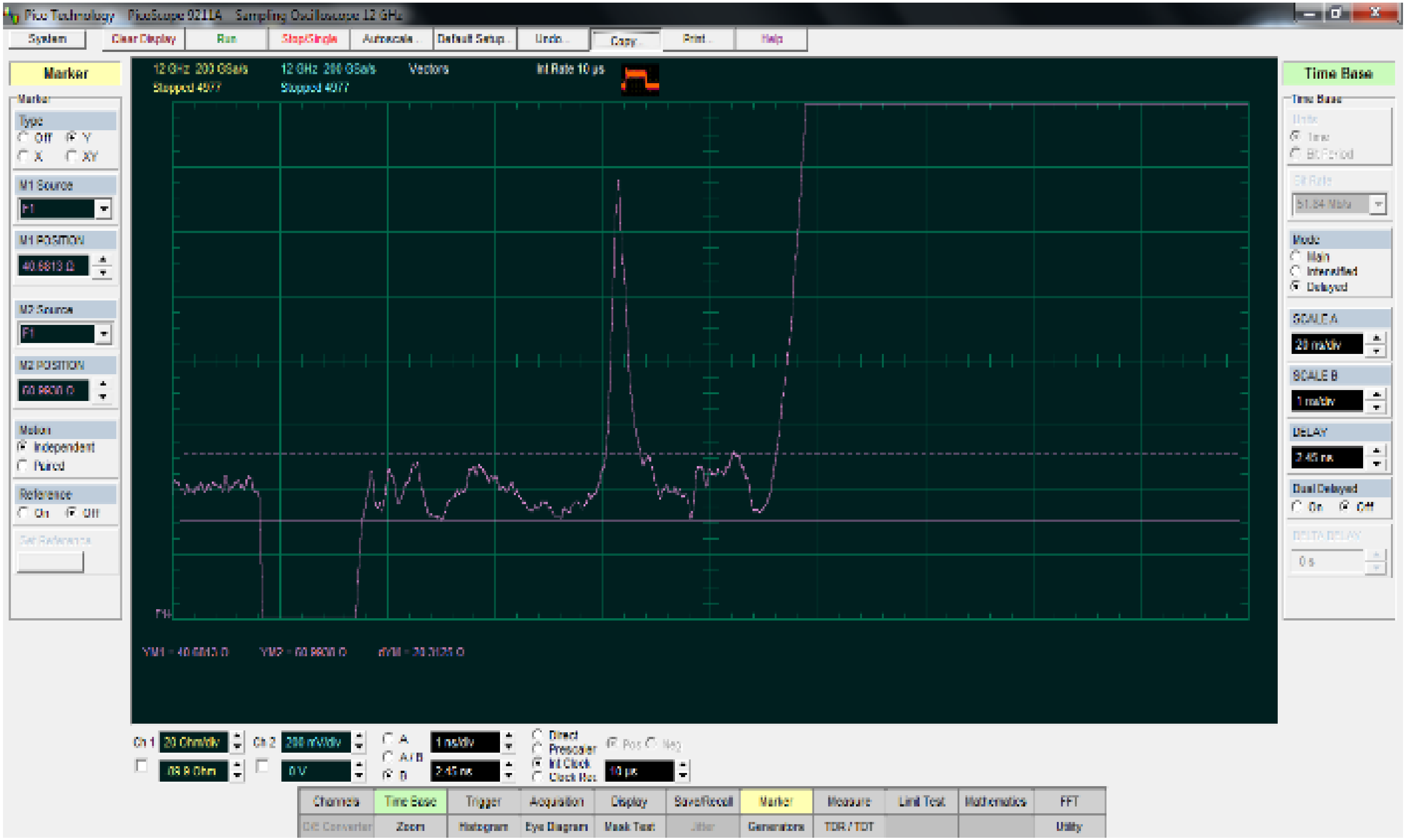
Application 3 HDMI Testing

- **HDMI APPLICATION**
  - To separate the audio signal, which is embedded in the data packets
  - Mount an HDMI connector on the PCB
  - Lay out tracks to link the differential signal to IC devices to process the HDMI signal

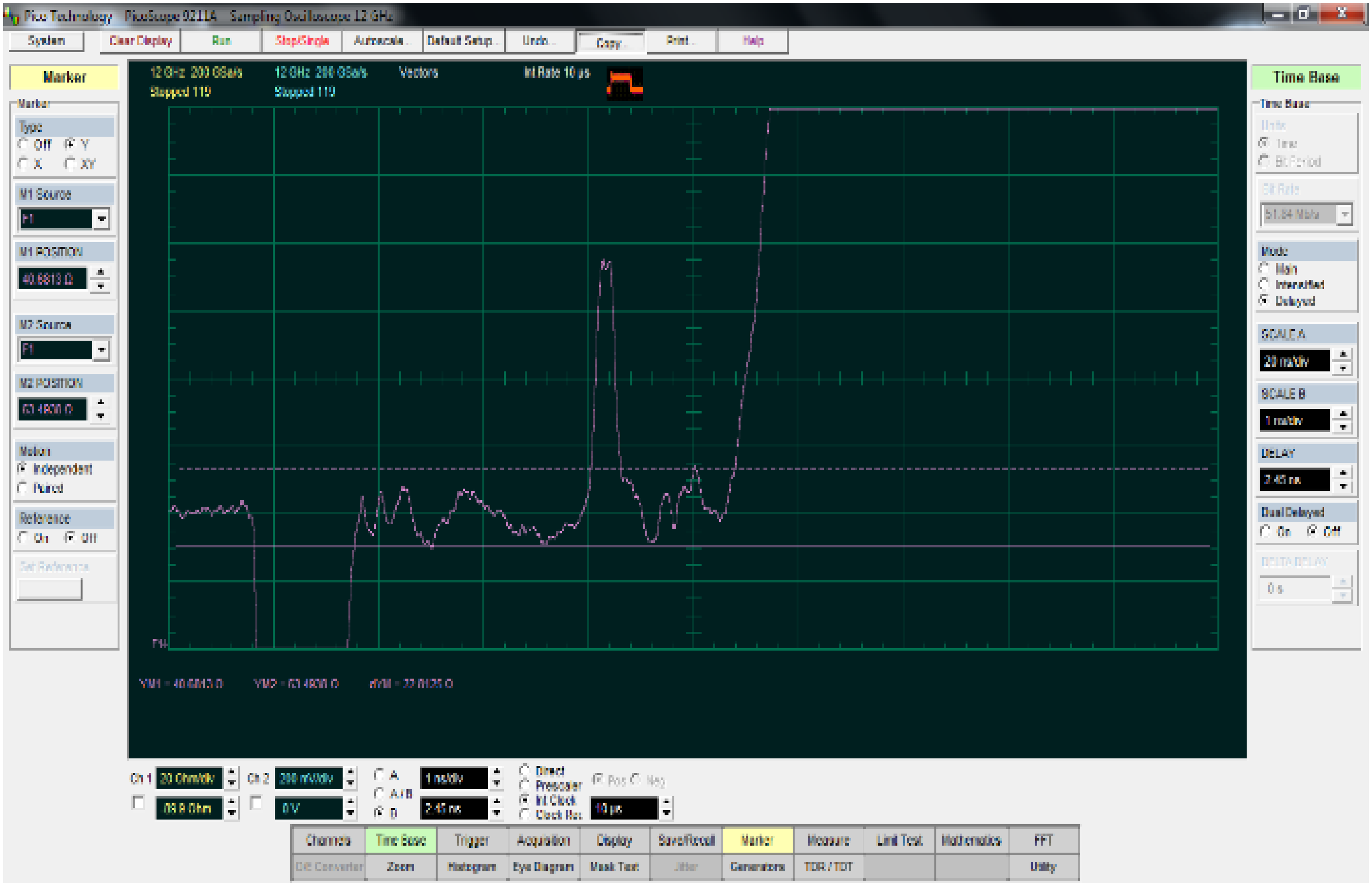
- **HDMI TESTING**
  - Eye diagram to measure signal quality
  - Jitter
  - Amplitude noise and rise time
  - High Bandwidth instrument required

- **PCB TDR**
  - HDMI PCB Track Layout
  - Test the interface conector

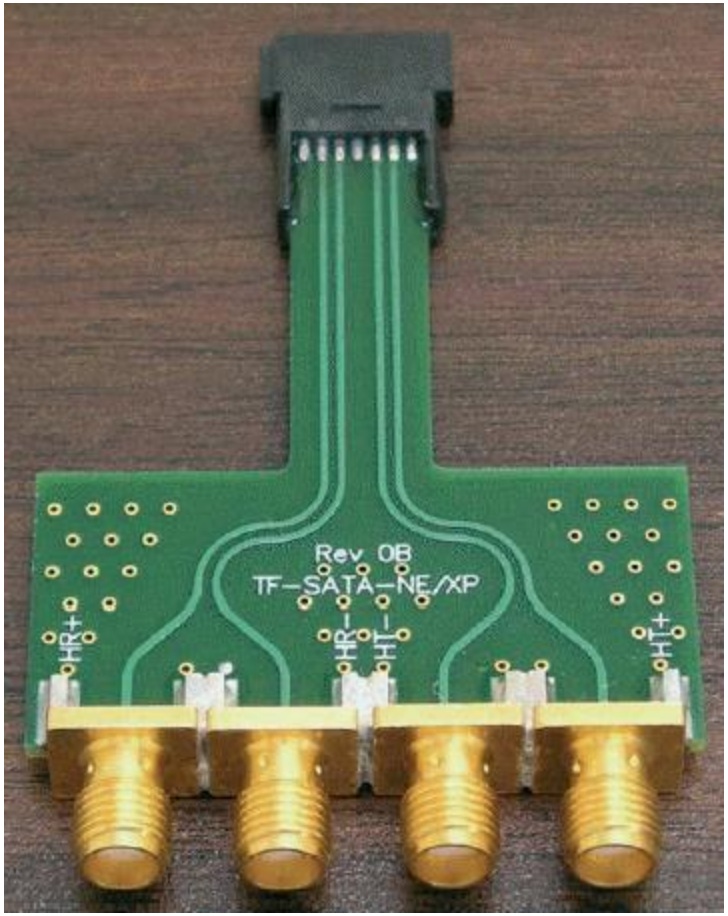
HDMI Clock Input



HDMI Data Input



Application 4 Inter Face Adapters

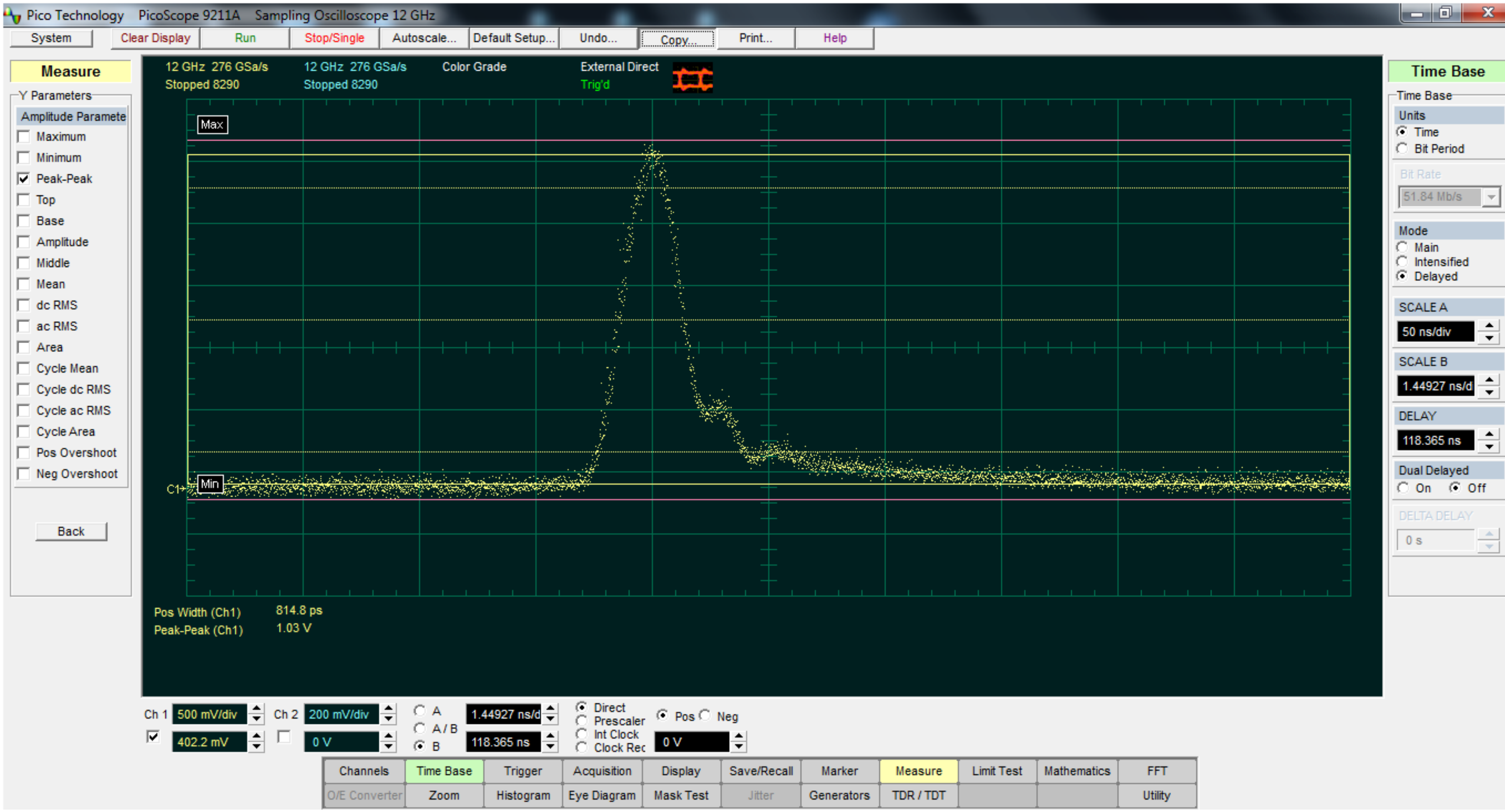


Application 4

- **TESTING HIGH SPEED INTERFACE BOARDS**
  - Test interface boards for
  - PCI Express
  - HDMI
  - Display Port
  - GEthernet
  - Sata

- **COMPLIANCE TESTING**
  - Eye diagram measurements
  - TDR track impedance

Application 5 Laser testing



Application 5 laser testing

Product Objections

- Product is so small it cannot make accurate measurements

Response - The other manufactures have removable sample heads to get close to device under tests, We have it in one box

- No history in sampling technology

Response – Pico / Eltesta has 60 years history in sampling oscilloscope design

- It is not a stand alone instrument requires a PC

Response - Most engineers like to have a PC to store results and store screen shots

Three Questions to ask customers

- Are you testing high speed serial data links over long (communication) distances or short (PCB / backplane) distances?
- Are you testing RF or microwave systems through to components?
- Are you testing optical links or components?

“Yes” to any of these identifies a potential sampling oscilloscope application

PS9000 Series In Summary

- Pico / Eltesta have long established leading edge expertise in Sampling Oscilloscope design

- Pico Sampling Oscilloscopes, now at 12 & 20 GHz, typically sell at less than 1/3rd comparable benchtop products

- And yet provide all the measurement, analysis, math, mask and programmability that you would expect of these very high performance and uniquely capable products

- Any Questions On This Session