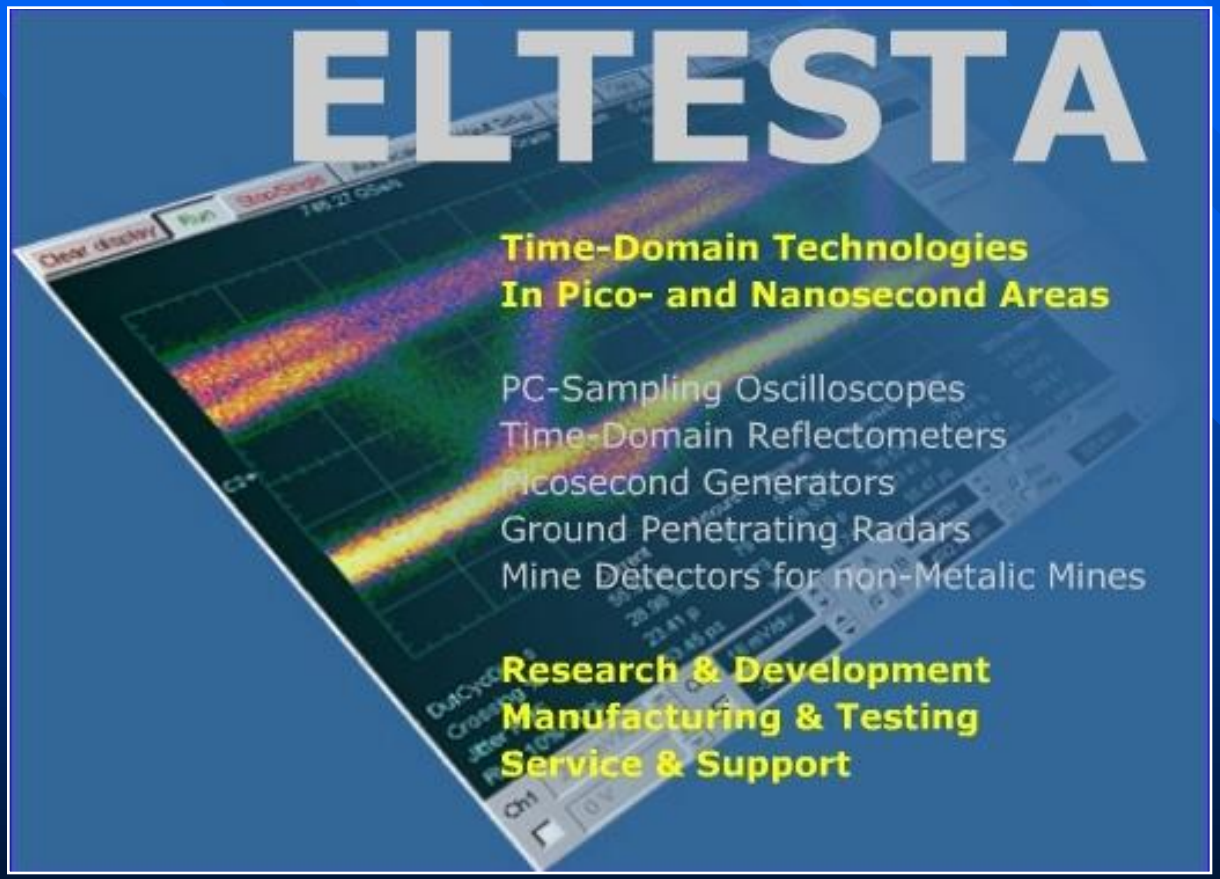
Modern Communication Measurements with the PicoScope9000 Sampling Oscilloscope



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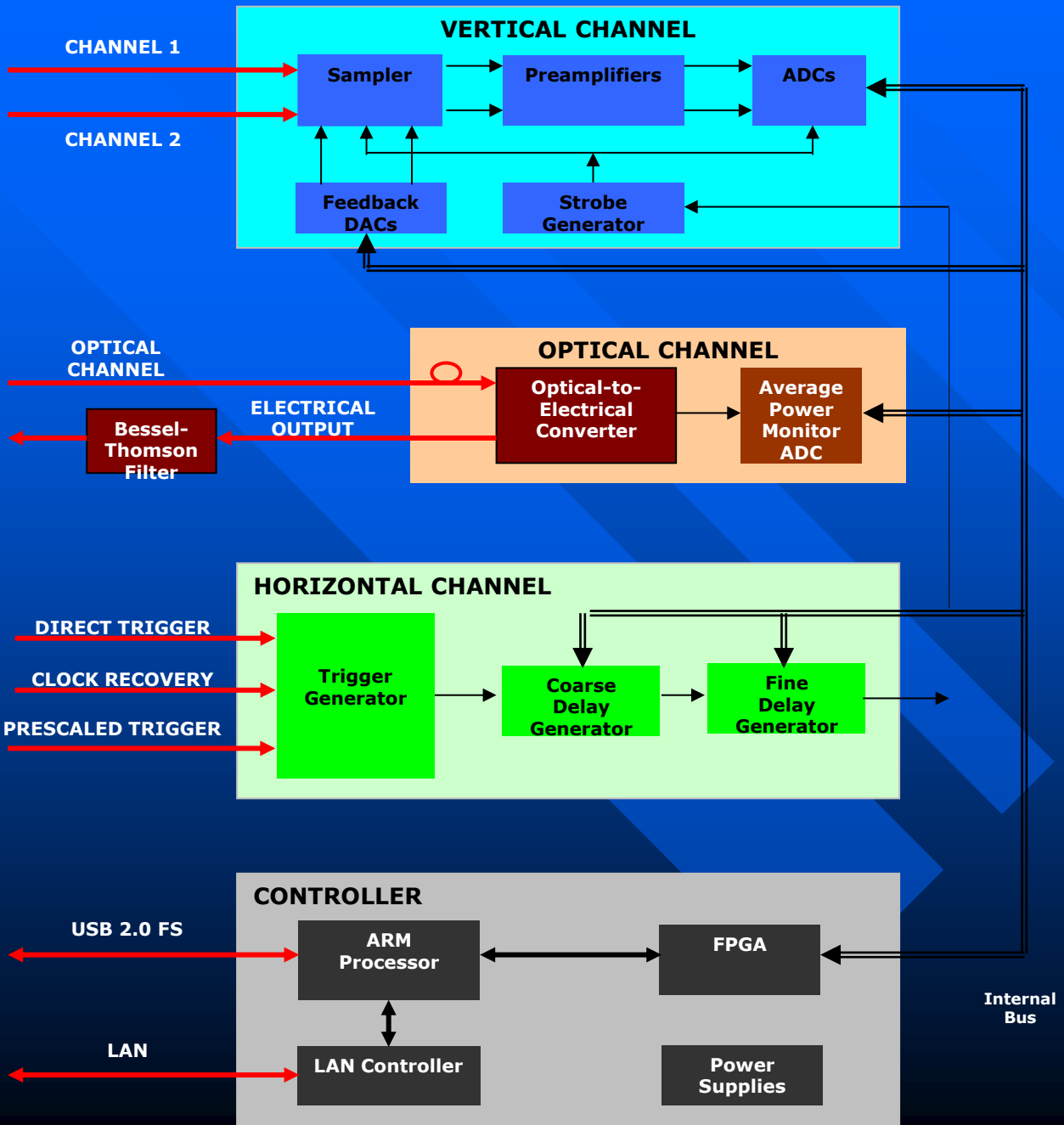
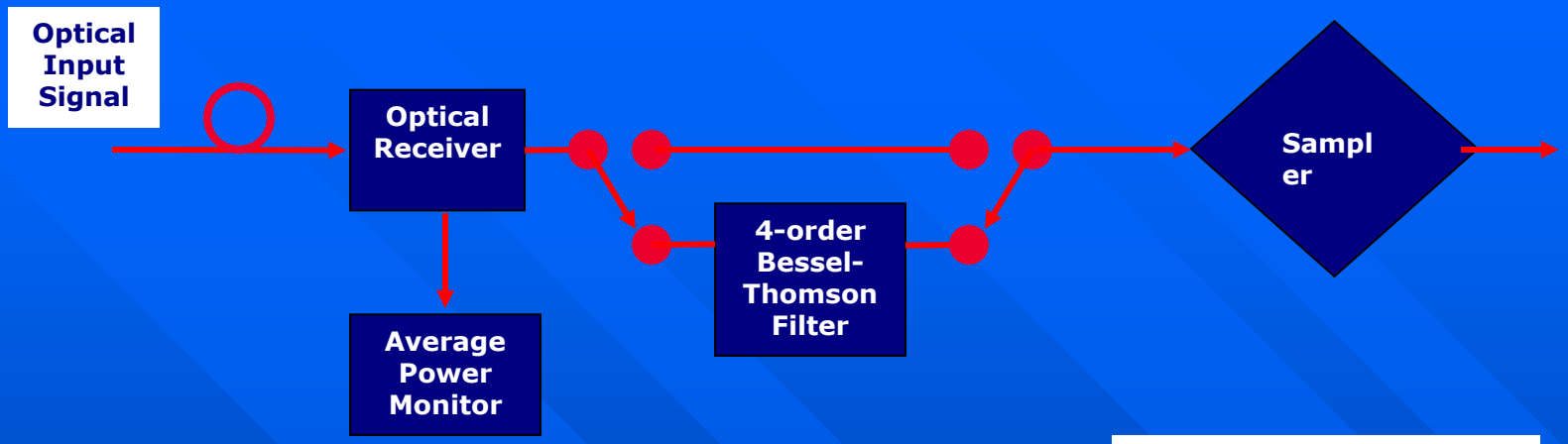
The PicoScope 9200 family of Wide-bandwidth PC-Sampling Oscilloscopes

PicoScope 9201: Sampling Oscilloscope	PicoScope 9211: Digital Signals Analyser	PicoScope 9221: Communication Signals Analyser
Two Electrical Channels	Two Electrical Channels	Two Electrical + One Optical Channels
12 GHz Electrical Bandwidth	12 GHz Electrical Bandwidth	12 GHz Electrical Bandwidth, and 8 GHz Unfiltered Optical Bandwidth
Up ot 1 GHz direct trigger, and up to 10 GHz, typ prescaled trigger.	Up ot 1 GHz direct trigger, up to 2.7 GBps clock recovery trigger, and up to 10 GHz, typical prescaled trigger.	Up ot 1 GHz direct trigger, up to 2.7 GBps clock recovery trigger, and up to 10 GHz, typical prescaled trigger.
10 ps/div to 50 ms/div time base	10 ps/div to 50 ms/div time base	10 ps/div to 50 ms/div time base
5 TS/s equivalent sampling rate	5 TS/s equivalent sampling rate	5 TS/s equivalent sampling rate
-	Pulse generators with 110 ps r/f time	-
USB 2.0 (FS) interface	USB 2.0 (FS) and LAN interfaces	USB 2.0 (FS) interface
Cursors and automatic Pulse, NRZ- and RZ-eye pattern measurements with statistics, histograms, automated mask test with predefine standard and custom masks, waveform processing including FFT.	Cursors and automatic Pulse, NRZ- and RZ-eye pattern measurements with statistics, histograms, automated mask test with predefine standard and custom masks, waveform processing including FFT.	Cursors and automatic Pulse, NRZ- and RZ-eye pattern measurements with statistics, histograms, automated mask test with predefine standard and custom masks, waveform processing including FFT.

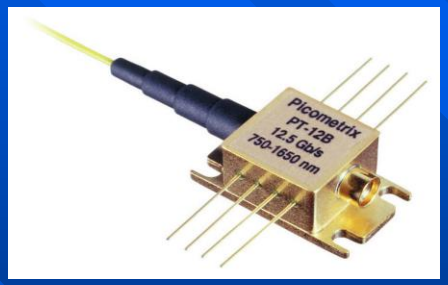
Functional Diagram



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.

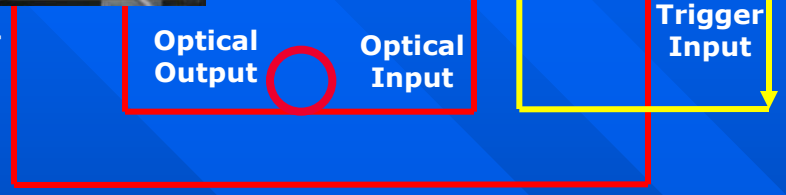


- 8 GHz PIN/TIA module
- 62.5 μm MM fiber, SMA or GPO output
- 780 nm through 1550 nm applications
- Low frequency response to DC
- Adjustable DC output level
- 400 V/W / Conversion Gain (1310 nm)
- 450 V/A Transimpedance Gain

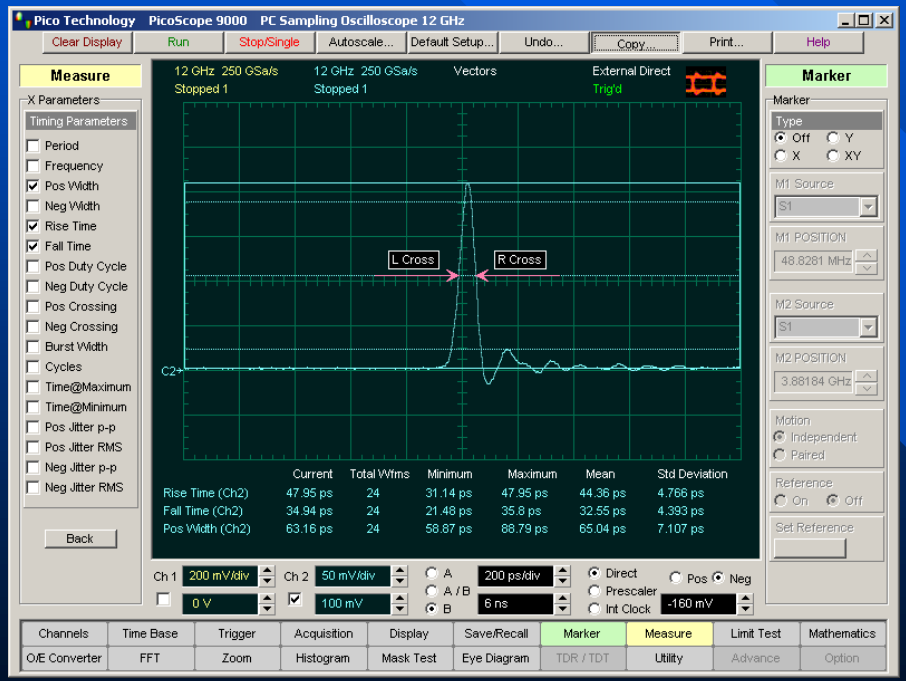
Optical Bandwidth Test

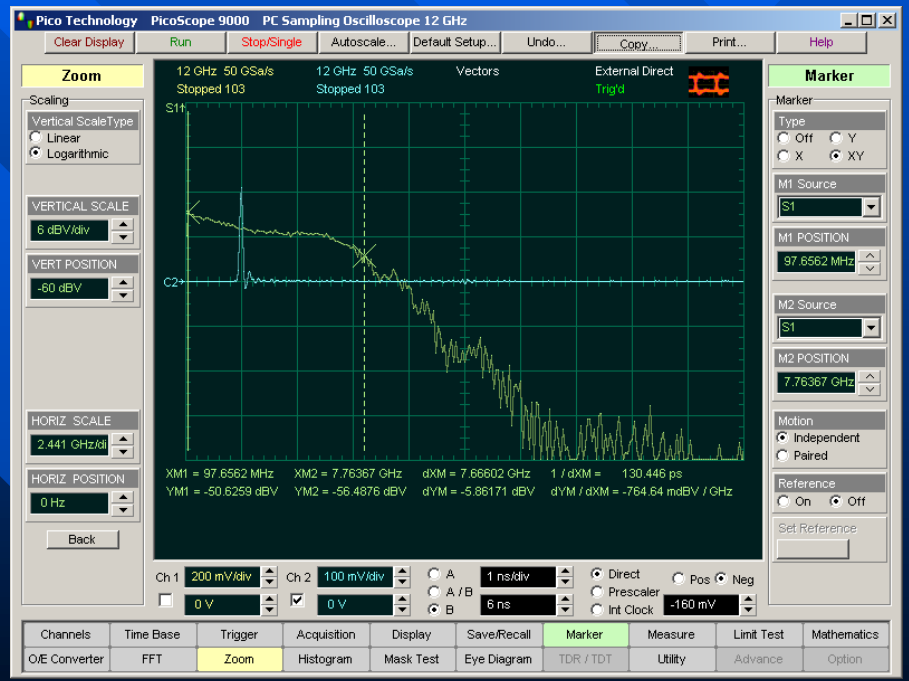
Optical Impulse Generator

PS 9221



- **Optical Bandwidth Test**
  - **Input Optical Pulse Width: <30 ps**
  - **Unfiltered Optical Bandwidth: 8 GHz**





Bessel-Thomson Filters

The main specification for Bessel-Thomson filters is usually that of a constant delay (or linear phase response) over as large a band of frequencies as possible. The result is that aberrations at much higher frequencies are suppressed from being displayed on the oscilloscope because they would not be a concern in an actual network.

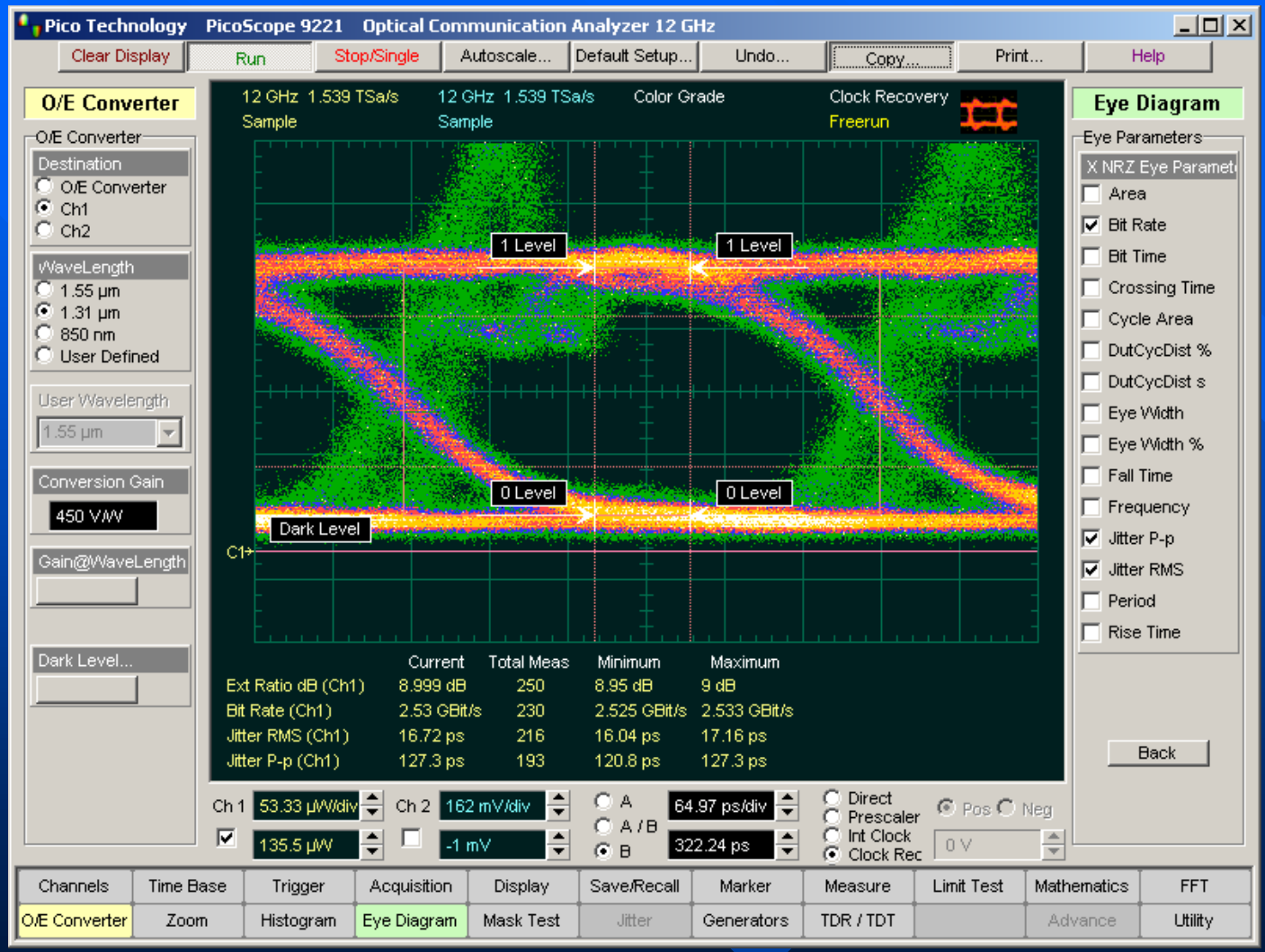
In general, an amplitude response *G(jw)* and a phase lag *φ* for fourth-order B-T filter:

$$G(jw) = \frac{1}{1 + jw + a_2(jw)^2 + a_3(jw)^3 + a_4(jw)^4}$$

$$\frac{d\phi}{dw} = t[1 - a_4^2(jwt)^8]$$

The coefficients are: a2=3/7 , a3=2/21 and a4=1/105.

OC-48 Laser Measurements



Eye-Diagram Measurements with No-Filtering

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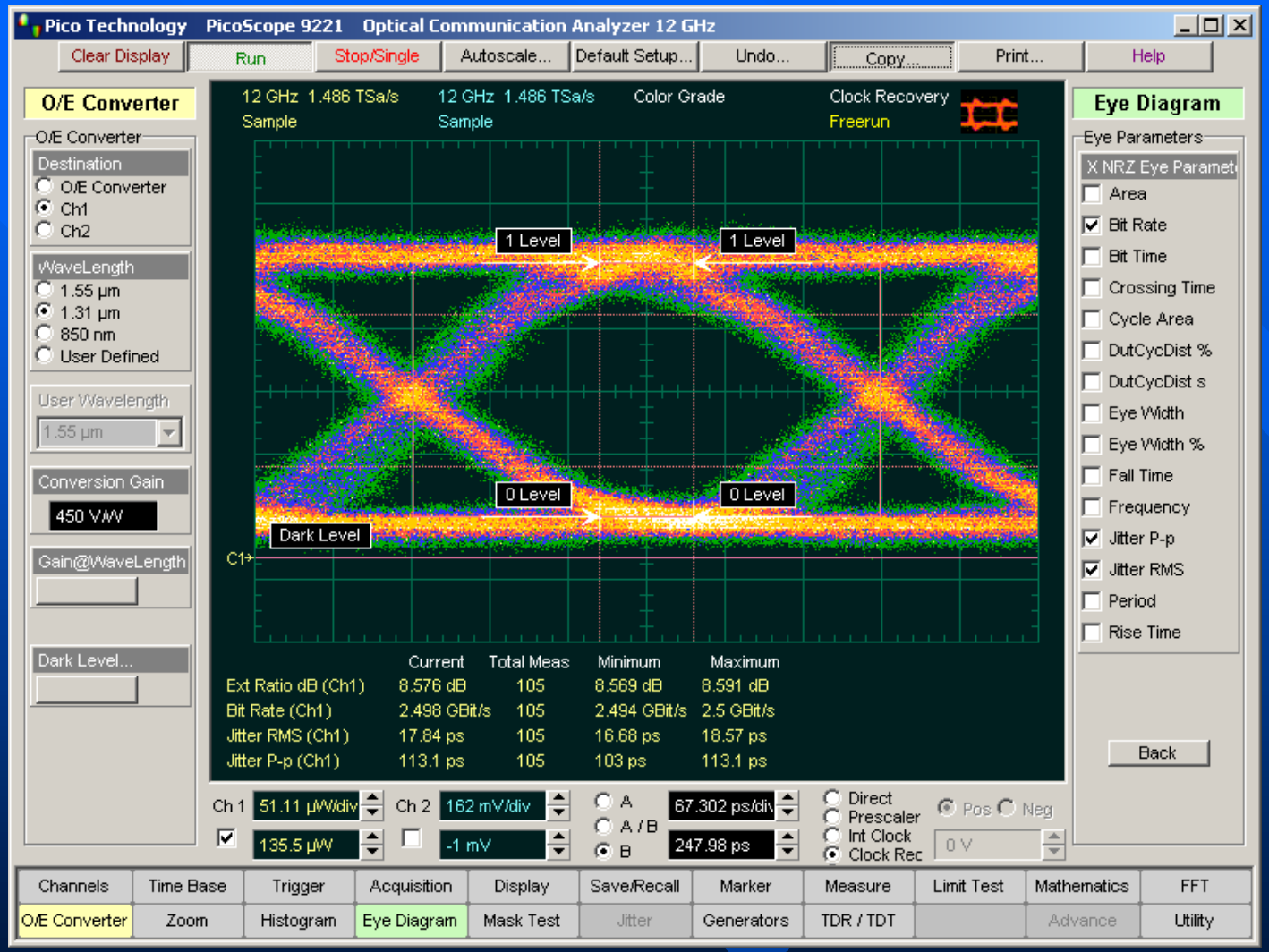
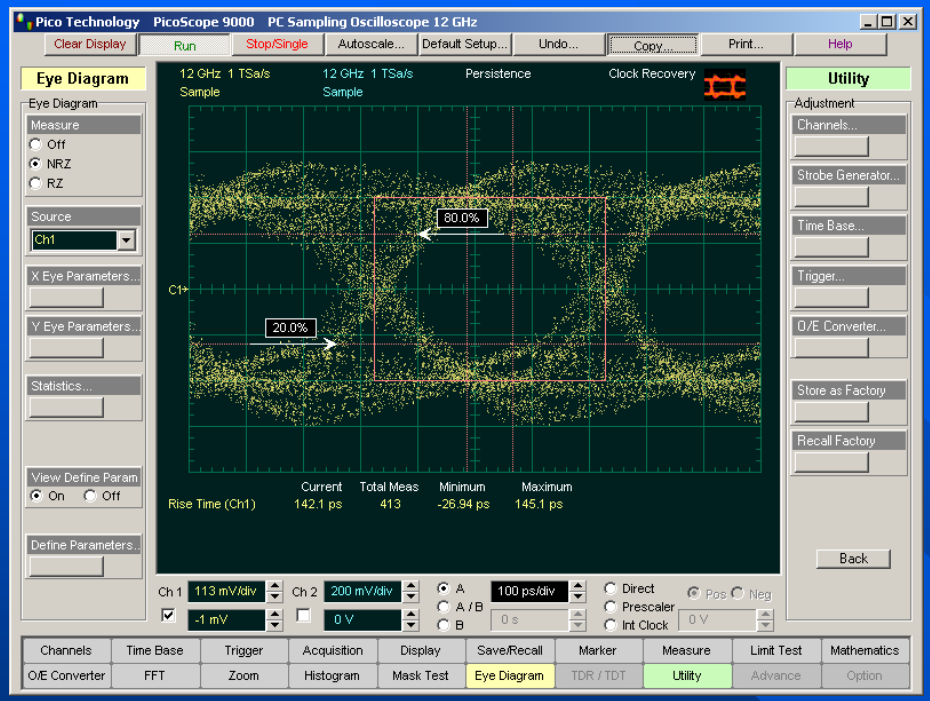
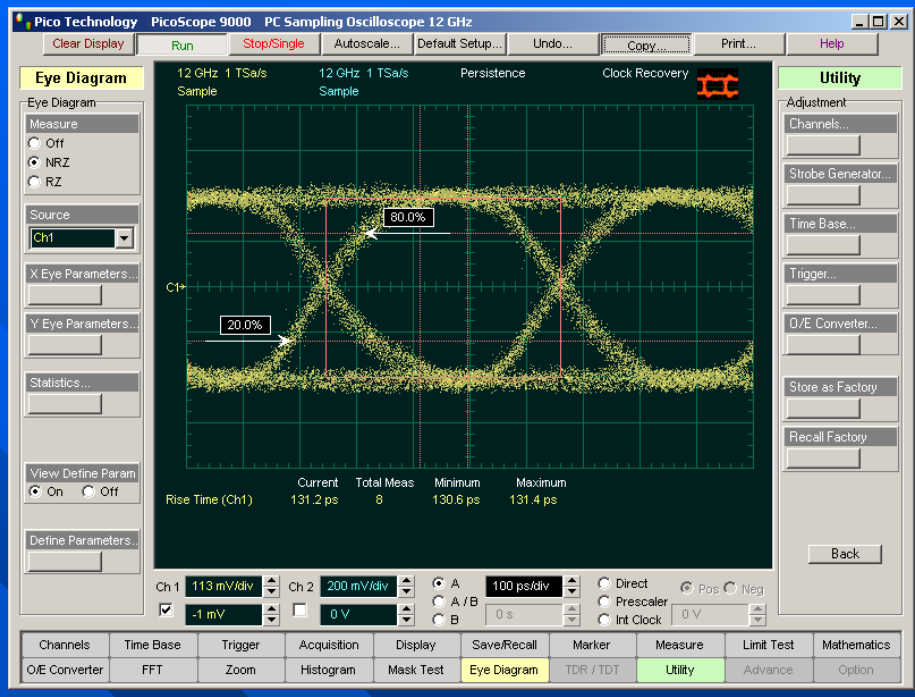
OC-48 Laser Measurements (cont.)



Eye-Diagram Measurements with filtering

Using Bessel-Thomson Filter

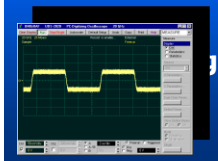




Communication Measurements and Tests

Types of Measurements

Graticule Measurements

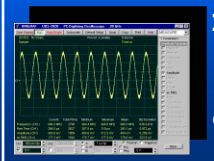


10 by 8 display graticule with **Grid, Axes, Frame and Off** options

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

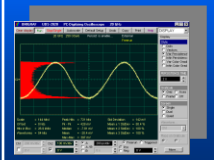
NRZ Eye Measurements

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

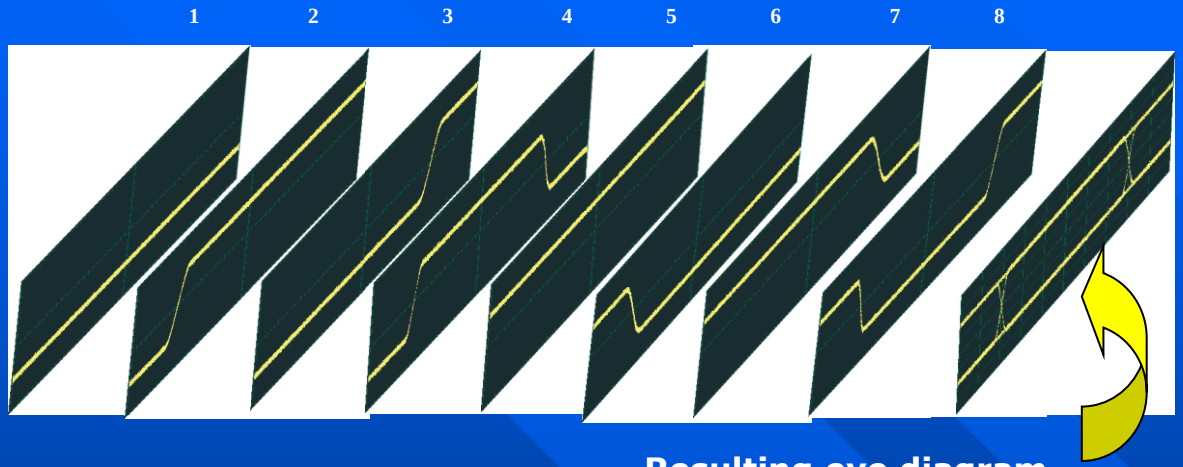
Mask Test

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

Building Eye Diagram



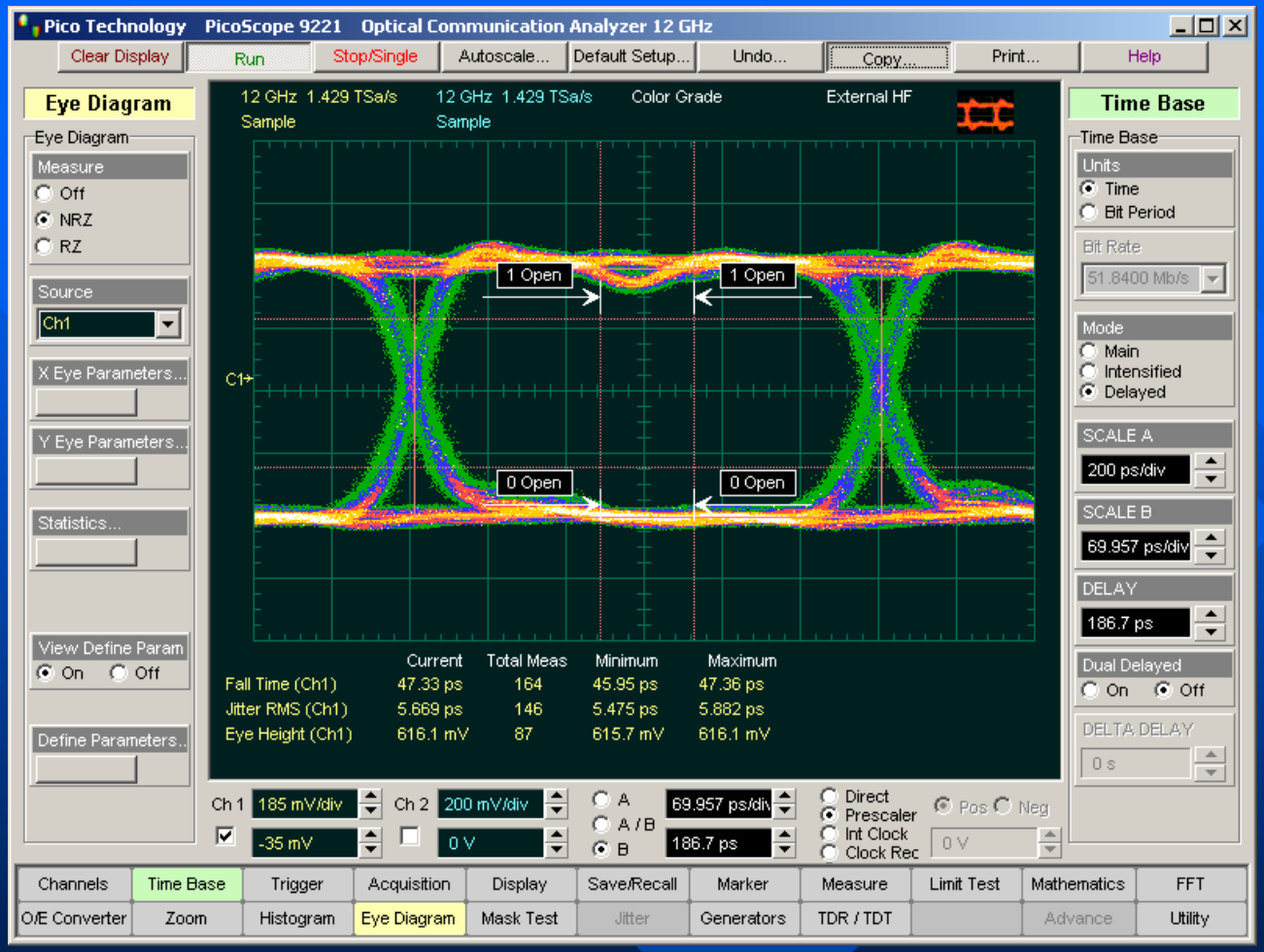
Resulting eye diagram

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

Eye-Diagram Measurements



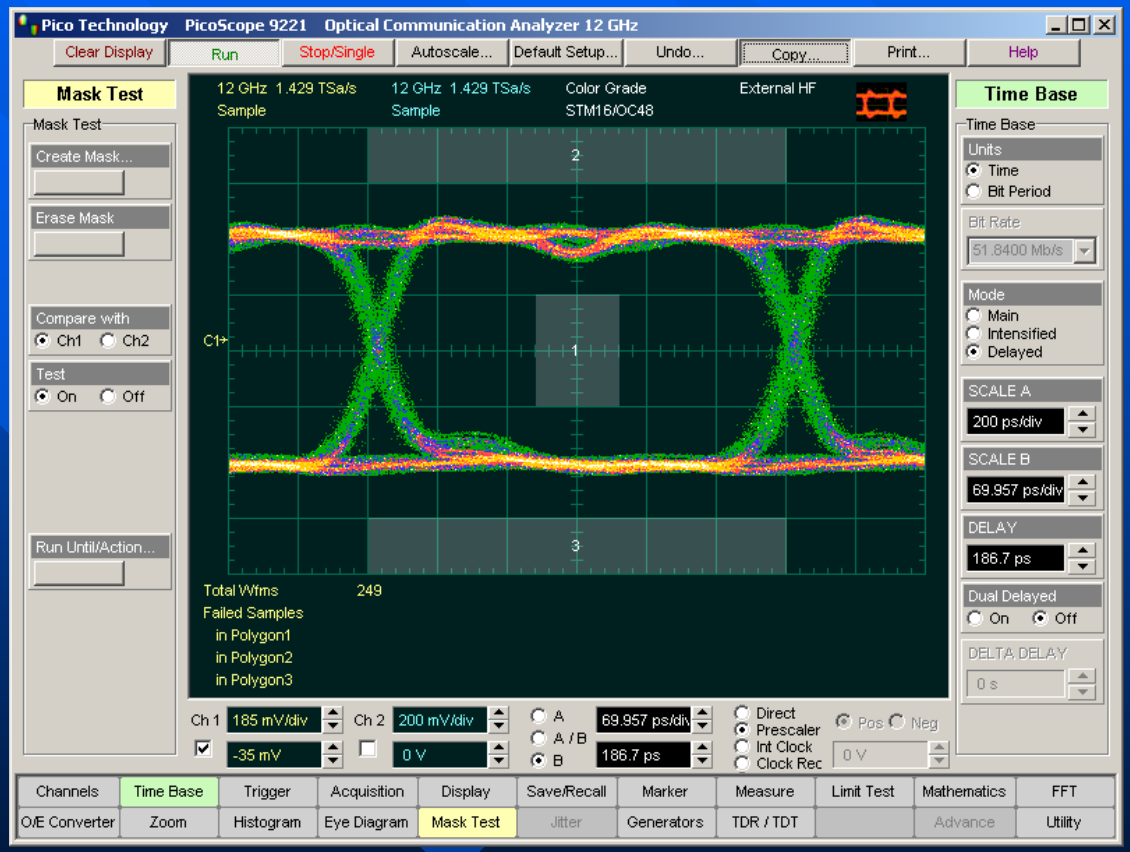
The picture demonstrates of how the PS9200 measures a good quality *2.5-Gbit* NRZ eye-diagram.

Communication Mask Test

For eye-diagram masks, such as those specified by the SONET and SDH standards, the PS9200 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

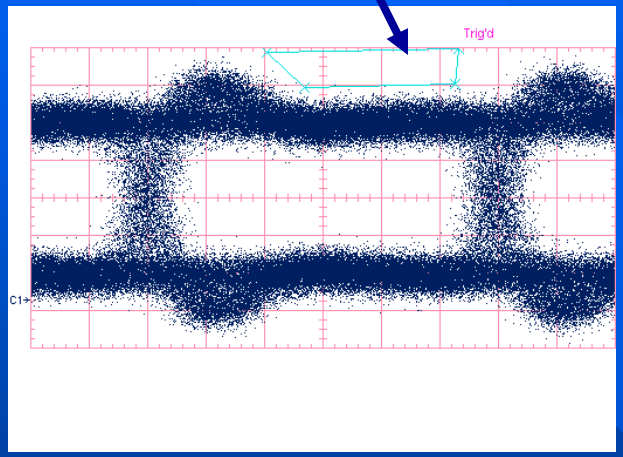
- **On-board mask drawing capability allows simple, operator-independent visual comparison of signal to standard mask.**
  Picture demonstrates a SONET/SDH (OC48/STM16) signal compared with the standard mask, showing a compliant waveform.



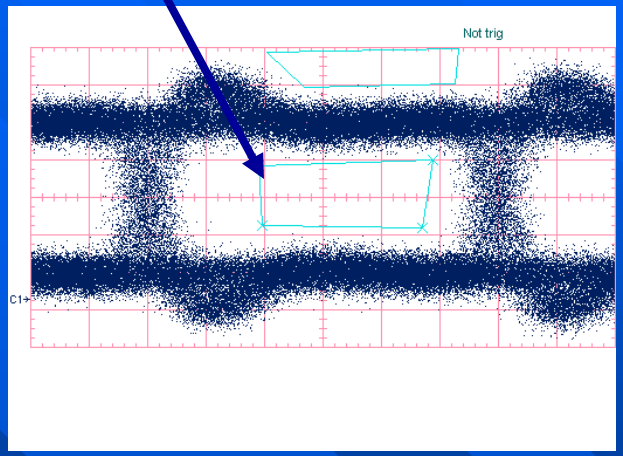
Creating Custom Mask

Five pictures below demonstrate how the PS9200 builds Custom Mask for NRZ waveform

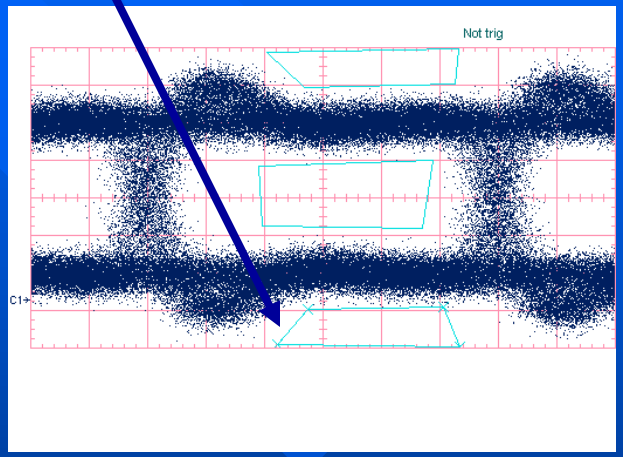
1. Create the top Polygon of the Mask

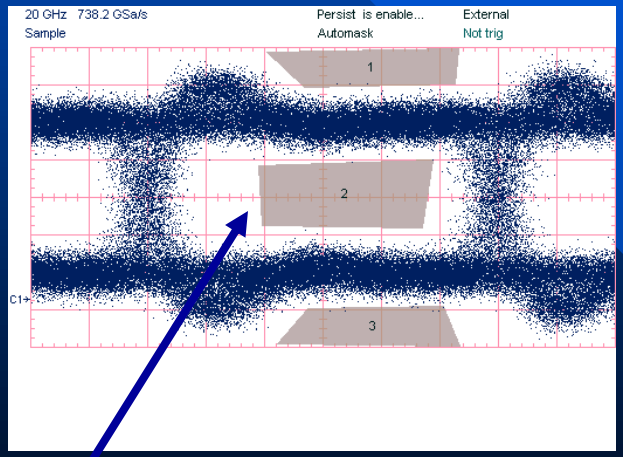


2. Create the center Polygon of the Mask

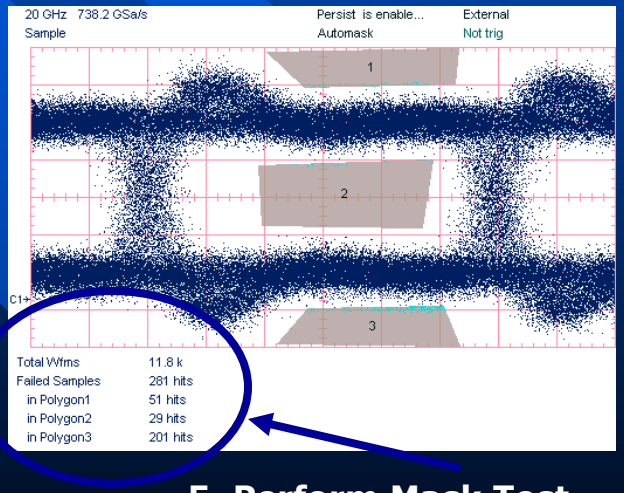


3. Create the bottom Polygon of the Mask





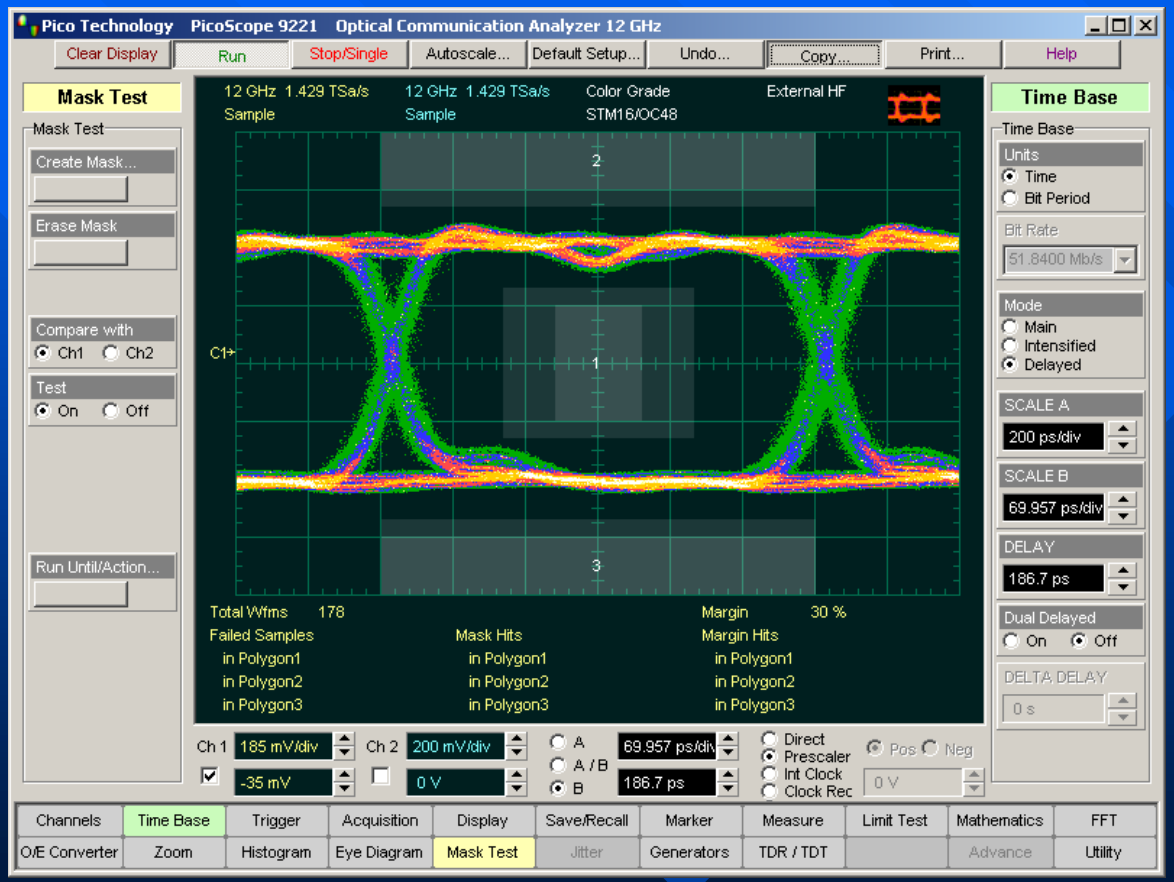
4. Create full Mask



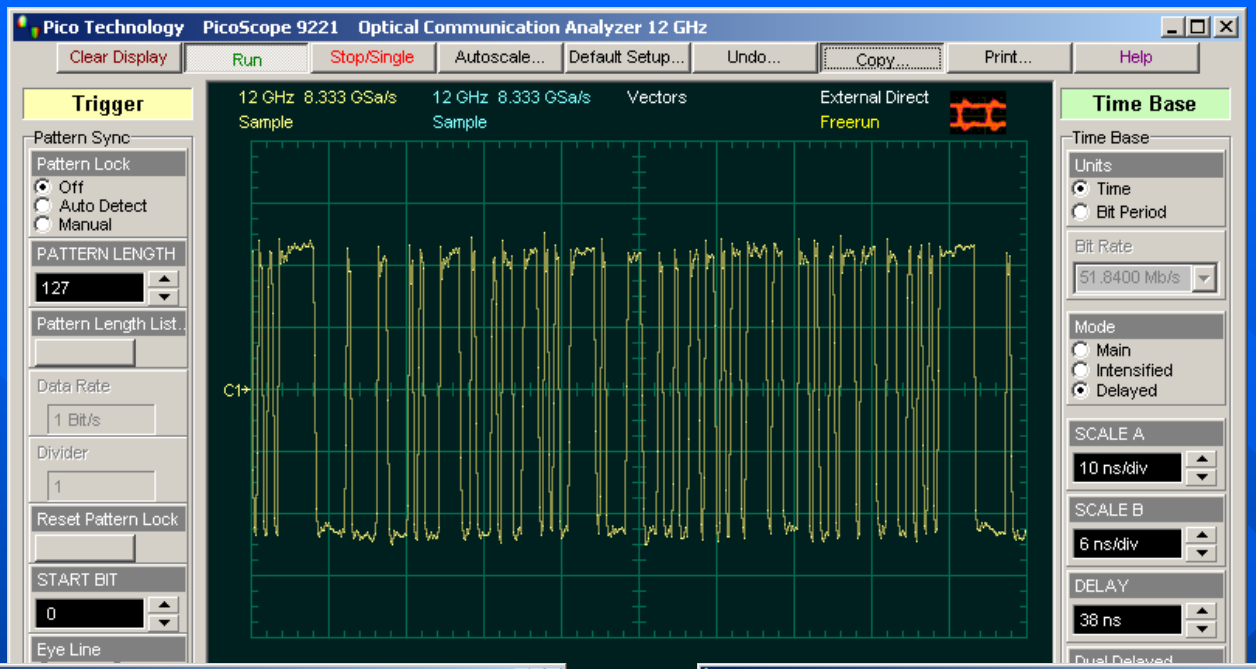
5. Perform Mask Test

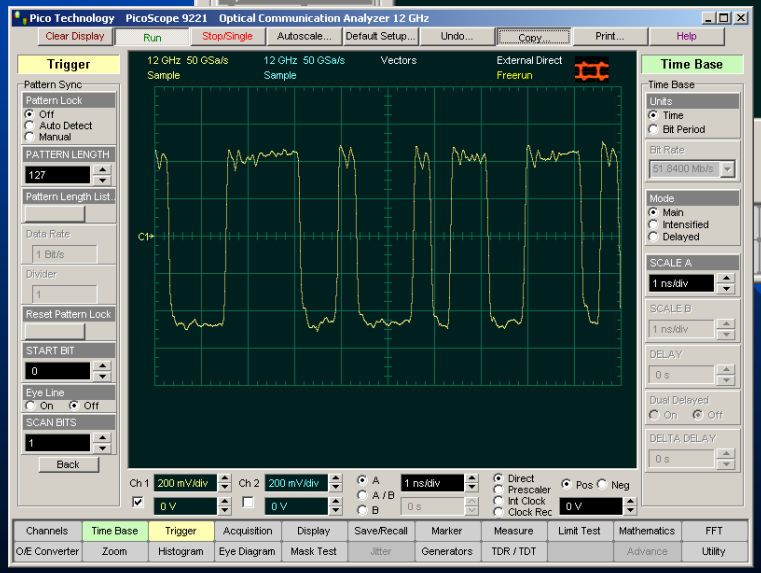
Mask Margin Test

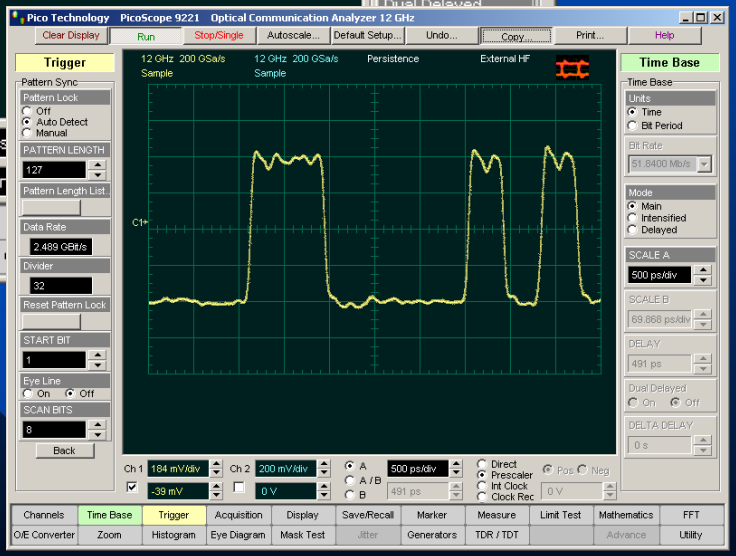
Mask Margins are used to determine the margin of compliance for a standard or scaled mask. The PS9200 goes beyond basic testing with mask margin analysis for process monitoring.



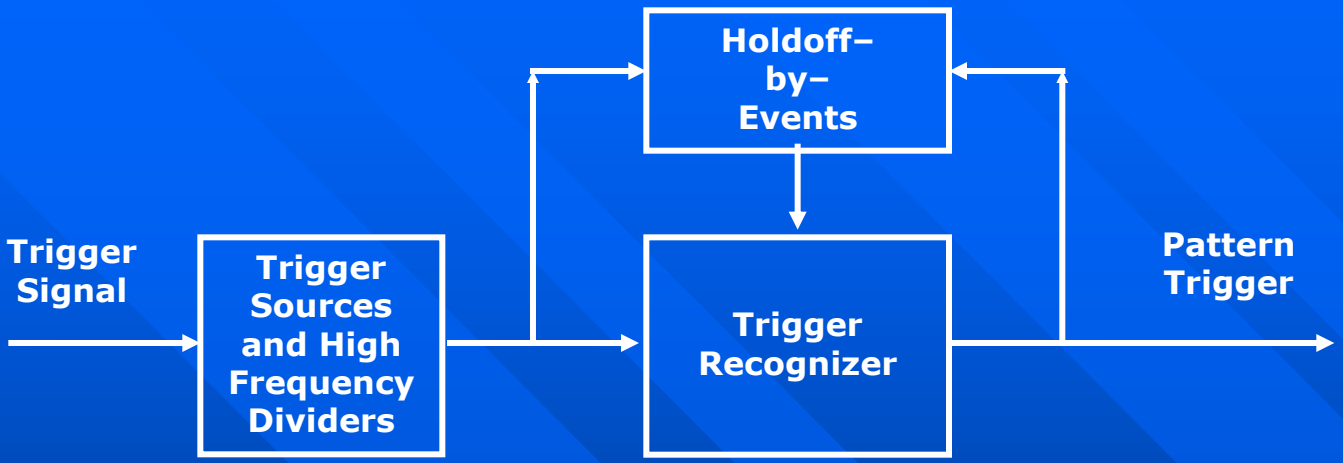
Examples of Pattern Signal

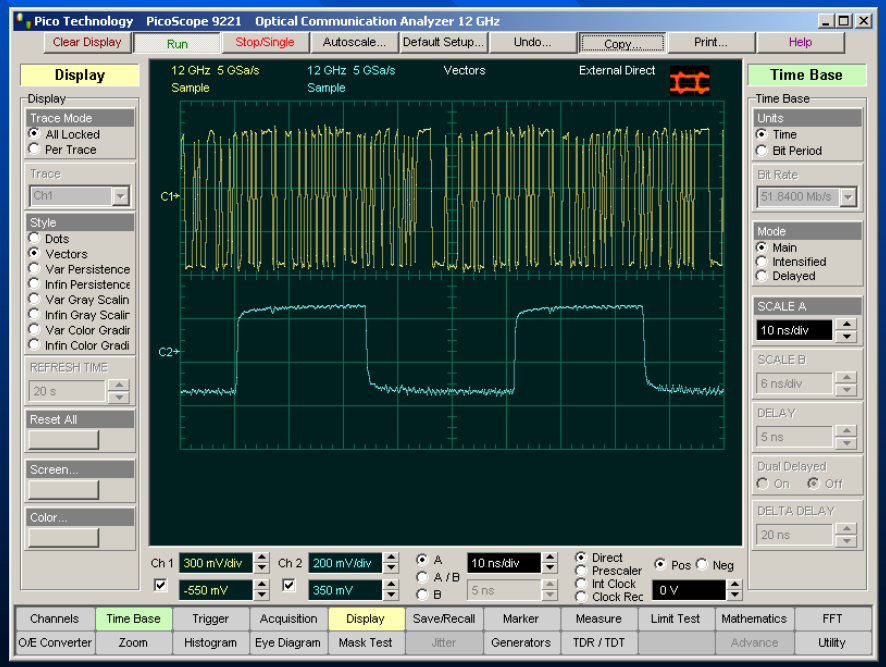




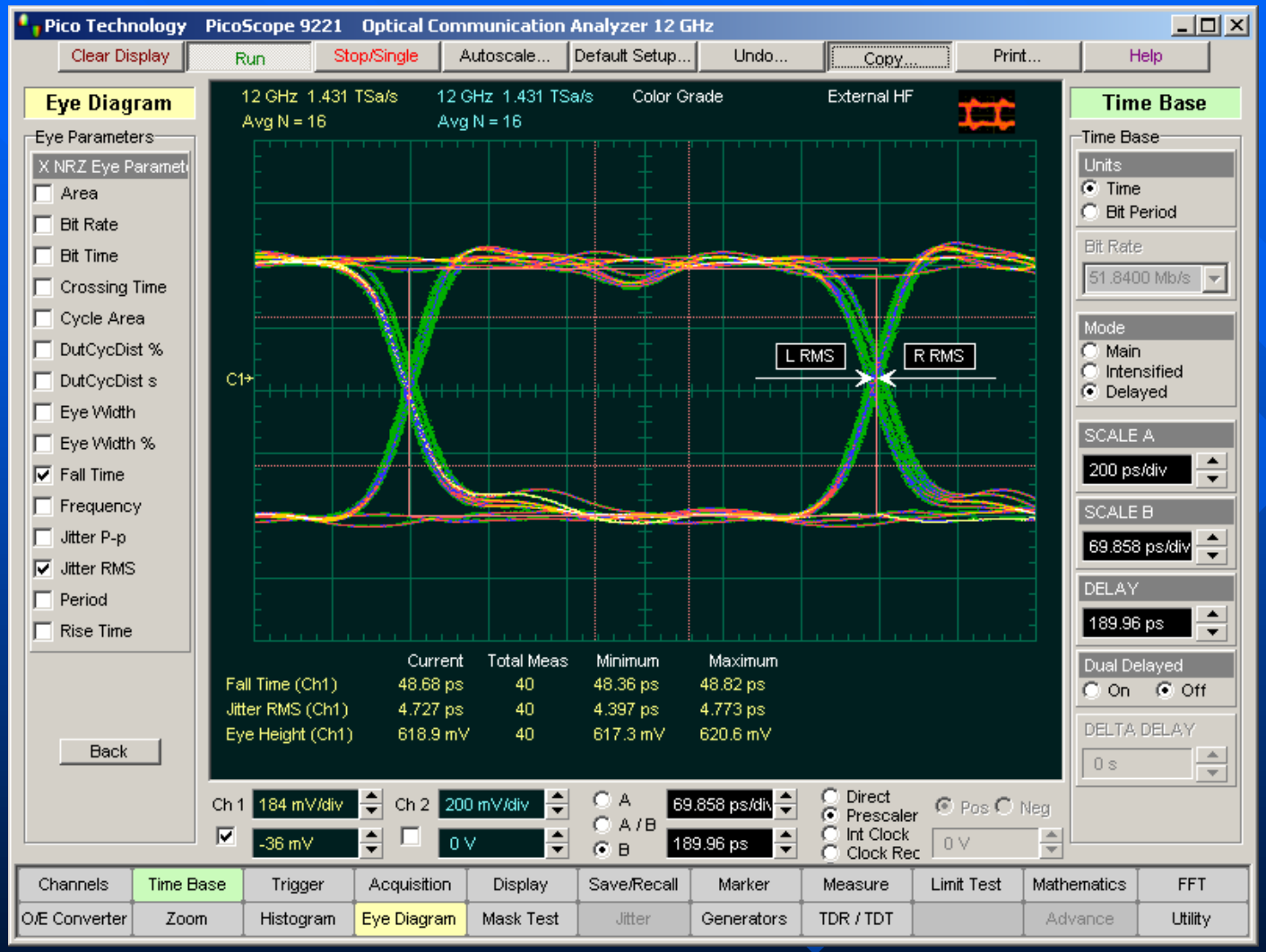


Functional Diagram for Internally Deriving a Pattern Trigger

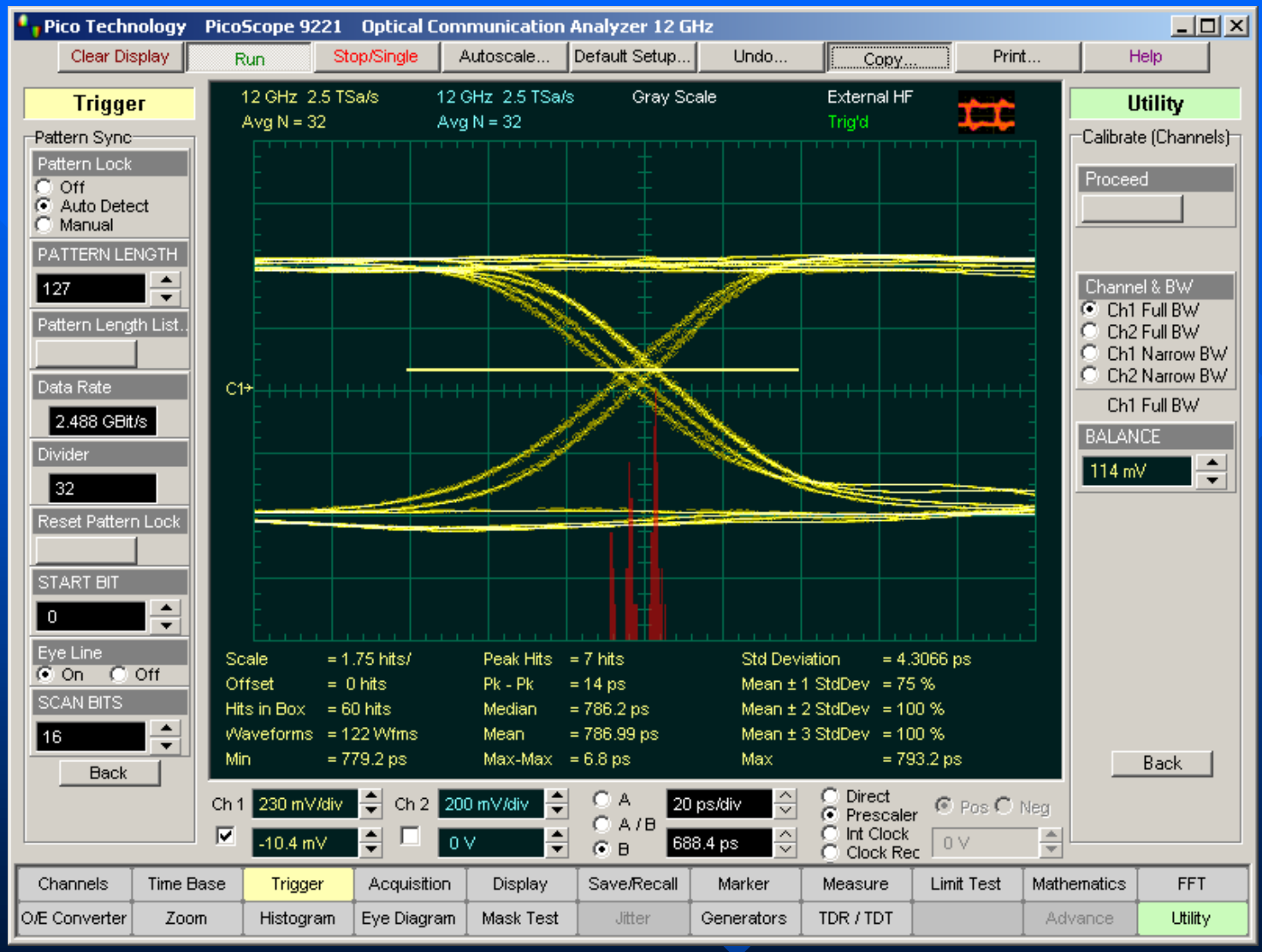




Averaging of Eye-Diagram



Determination of Jitter



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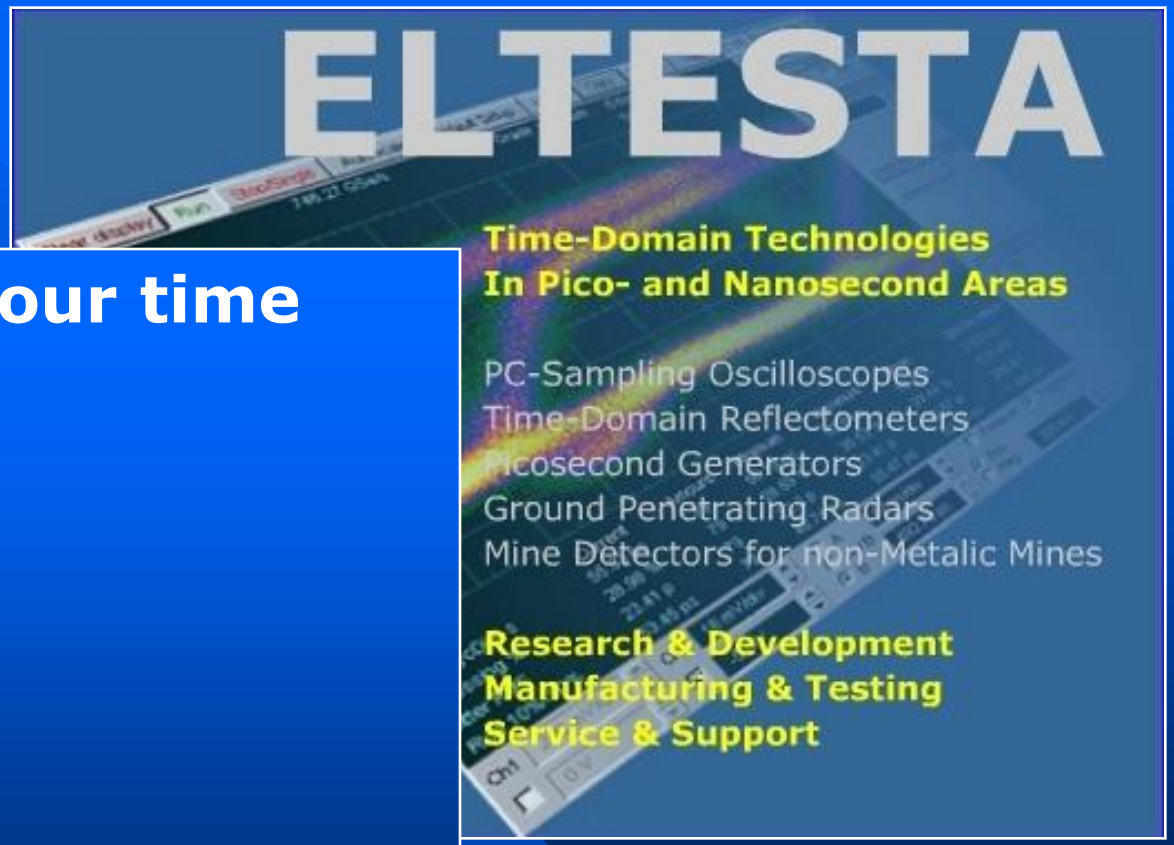
The End



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Questions?

info@eltesta.com

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