Anritsu Advancing beyond

BERTWave MP2110A

BERTWave

Contents

- Anritsu products for optical transmission market
- BERTWave MP2110A Features
  - Sampling Oscilloscope Functions and Performance
  - BERT Functions and Performance
- Optimum MP2110A Cost-Performance Results

Contents

- Anritsu products for optical transmission market
- BERTWave MP2110A Features
  - Sampling Oscilloscope Functions and Performance
  - BERT Functions and Performance
- Optimum MP2110A Cost-Performance Results

Anritsu Products for Optical Transmission Market

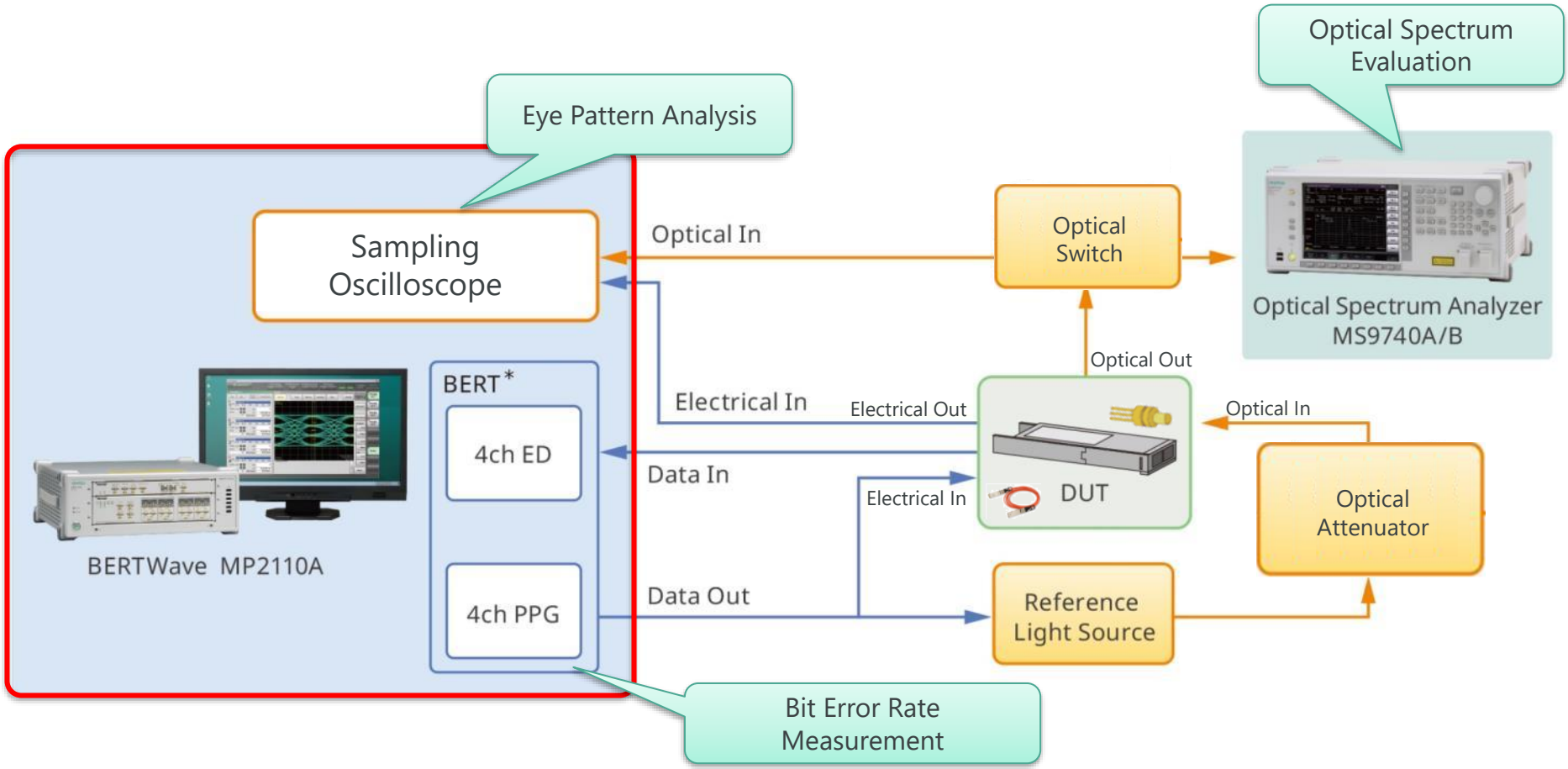
Anritsu
Advancing beyond

		R&D	Design Verification	Mass Production
Optical Components 	10G-800G	MS4640B VNA	MS9740B OSA, MP1900A BERT	MS9740B OSA, MP2110A BERTWave BERT + Scope
Optical Transceivers  AOC 	10G-800G	MS9740B OSA, MP1900A BERT	MS9740B OSA, MP2110A BERTWave BERT + Scope	
Network Equipment	Up to 400G	MT1040A Transport Tester 		
	Up to 100G	MT1000A Transport Tester 		

Anritsu supports all stages from optical module R&D to mass production

Optical Module/Device Manufacturing Application Example (Optical Transceiver Evaluation)

Anritsu
Advancing beyond



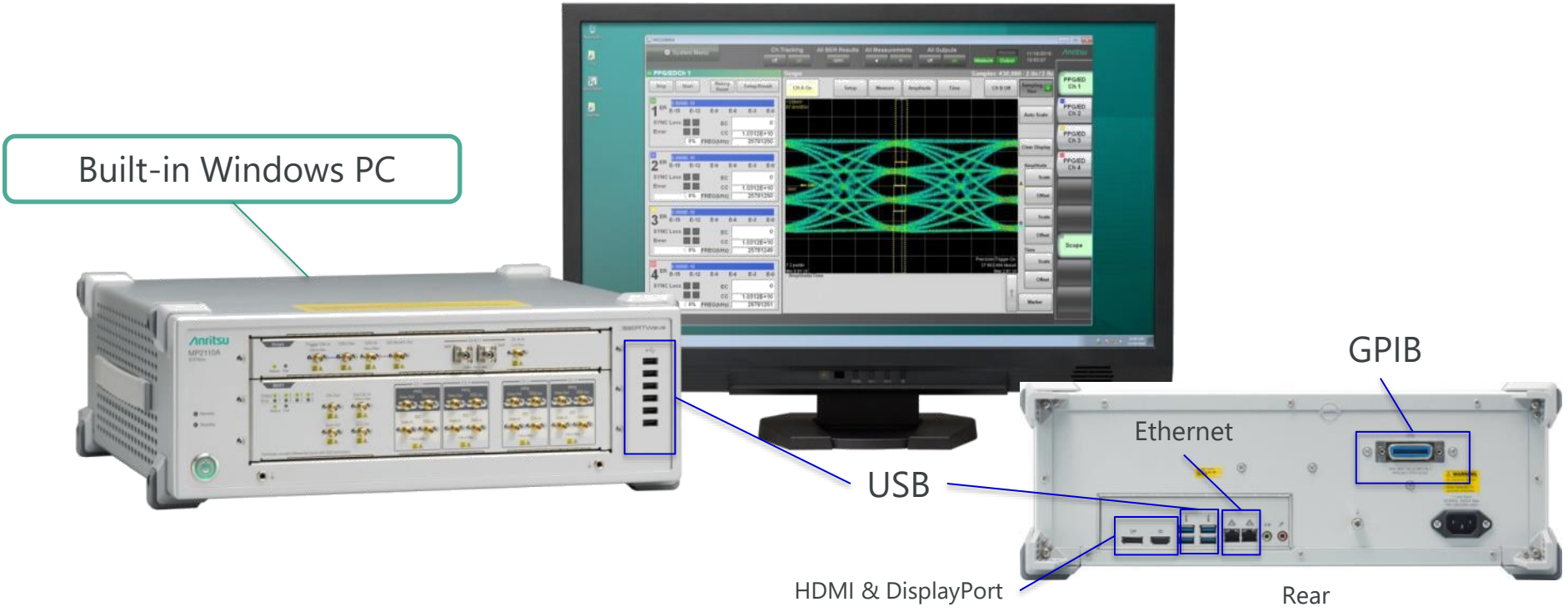
Anritsu offers total measurement solutions for manufacturing optical modules

Contents

- Anritsu products for optical transmission market
- BERTWave MP2110A Features
  - BERT Functions and Performance
  - Sampling Oscilloscope Functions and Performance
- Optimum MP2110A Cost-Performance Results

About BERTWave MP2110A

- Multichannel BERTS and sampling oscilloscope in one cabinet—
  422 (W) x 142.5 (H) x 389.4 (D) mm
- No unnecessary built-in screen, helping cut infrastructure cost-of-entry and facilitating centralized remote inspection on production lines; supports connection of general-purpose PC display (with touch panel if required) and GUI-based operation
- Embedded Windows for stable performance



BERTWave MP2110A Features

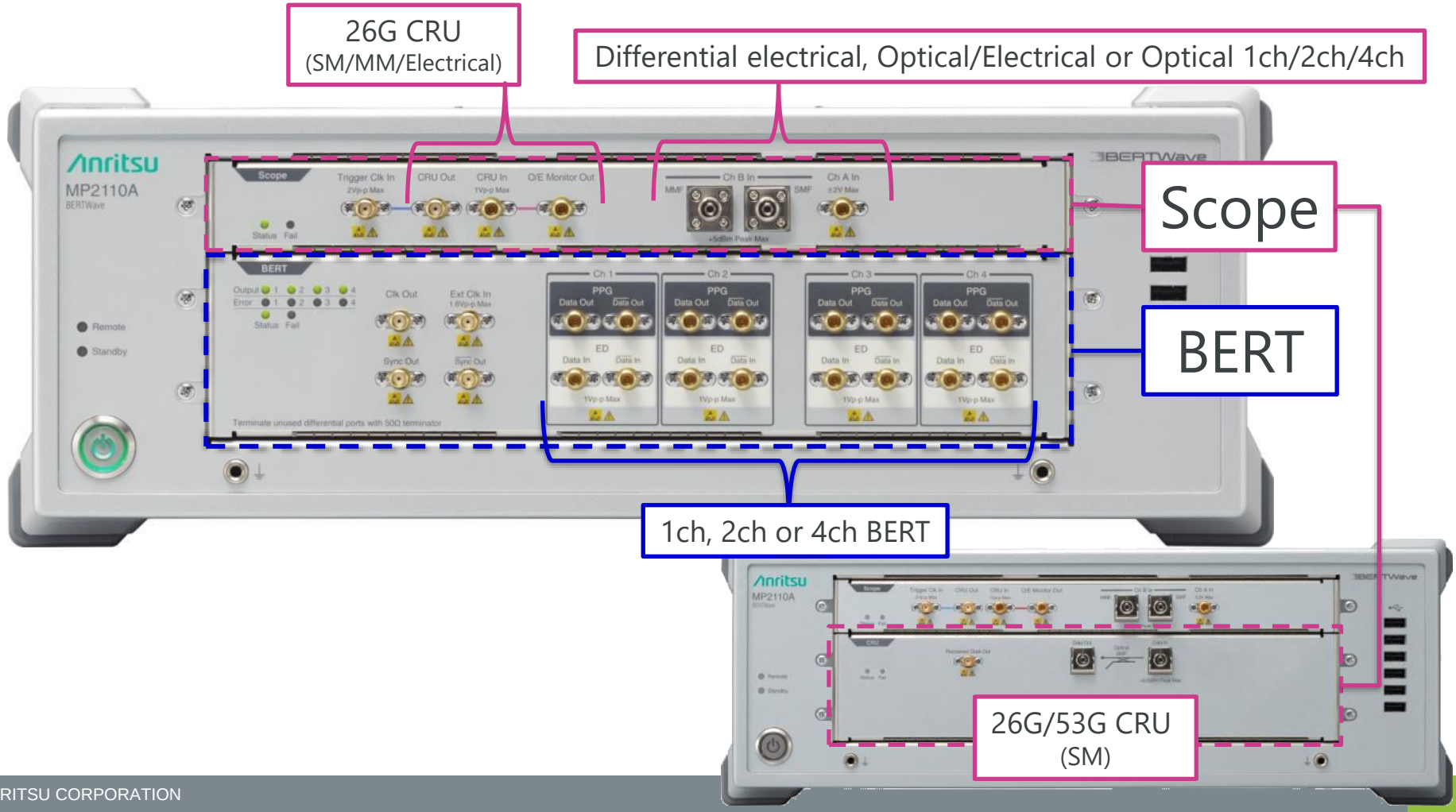
Anritsu
Advancing beyond

Four key features help the MP2110A improve productivity and yield on production lines and in development.

1. Customizable all-in-one configuration
2. Simple, compatible operability
3. Stable, high-speed performance
4. Comparable functions and correlated performance for R&D

Features – Customizable All-In-One Configuration –

- All-in-one BERTWave with BERT and oscilloscope (scope)
- Choice of BERT only or scope only
- Customized choice for number of channels and retrofit support
- Licensed retrofit options including PAM4 analysis and BERTS bit-rate expansion
- Oscilloscope with built-in clock recovery unit (CRU)

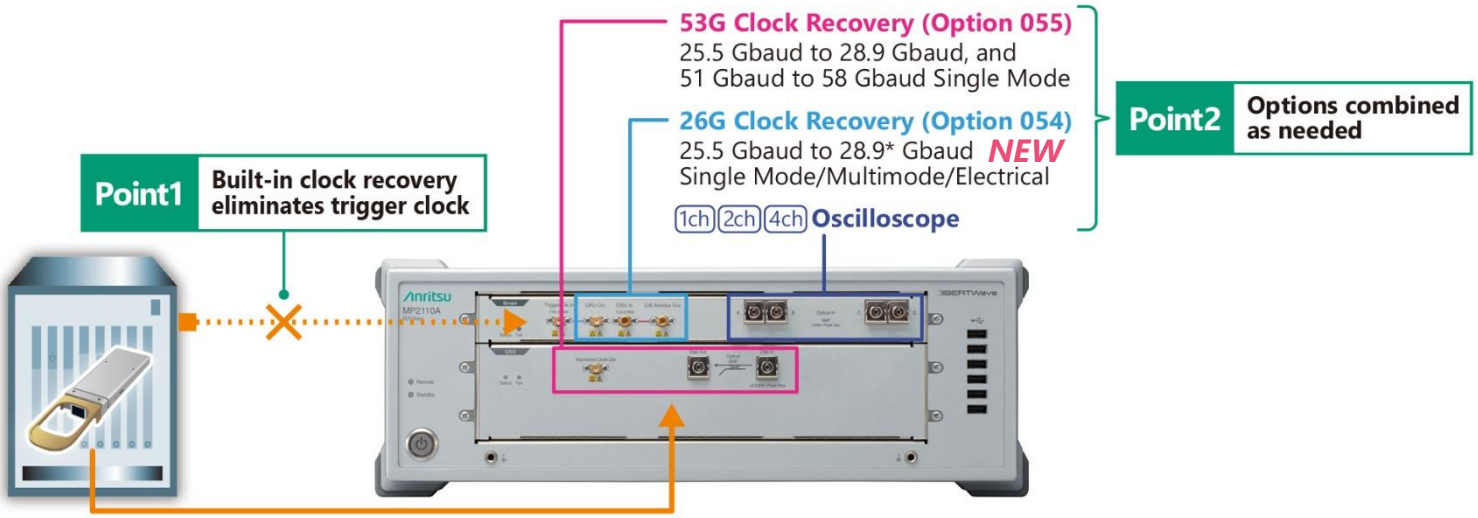


Oscilloscope – Clock Recovery (Opt-054 and 055) –

Anritsu
Advancing beyond

UPDATED

Two optional built-in clock recovery units are available according to the application. With both options installed, one unit can evaluate various types of optical modules without requiring a trigger signal. Moreover, multiple channels can be measured at once when used in combination with a 4ch oscilloscope.



Optical module and Optical transmission equipment

QSFP-DD/OSFP	:	800G DR8/FR8 (PAM4)
		400G DR4/FR4/LR4/SR8/FR8/LR8/ER8 (PAM4)
QSFP	:	200G SR4/DR4/FR4/LR4/ER4 (PAM4)
		100G SR4/SWDM4/PSM4/CWDM4/LR4 (NRZ)
QSFP/SFP	:	100G DR/FR/LR/ER/SR2 (PAM4)
SFP	:	50G SR/FR/LR/ER (PAM4)
		25G SR/LR (NRZ)
		32GFC (NRZ) 64GFC (PAM4)

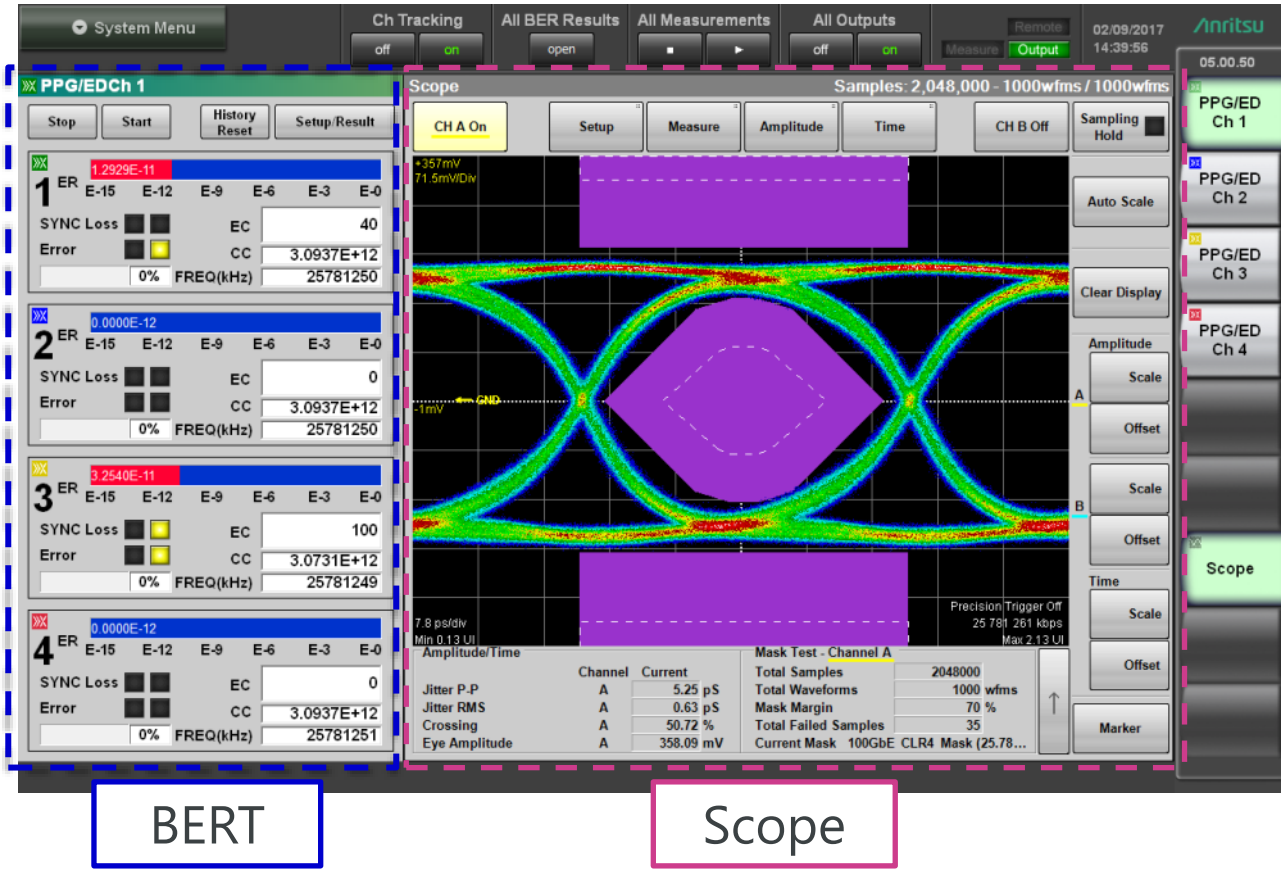
Point3 All optical modules measured with one unit

Point4 4ch multi-channel measurement also supported

*: Requires Option 059 with Option 054 when using 28.2 Gbaud to 28.9 Gbaud.

Features – Simple, Compatible Operability –

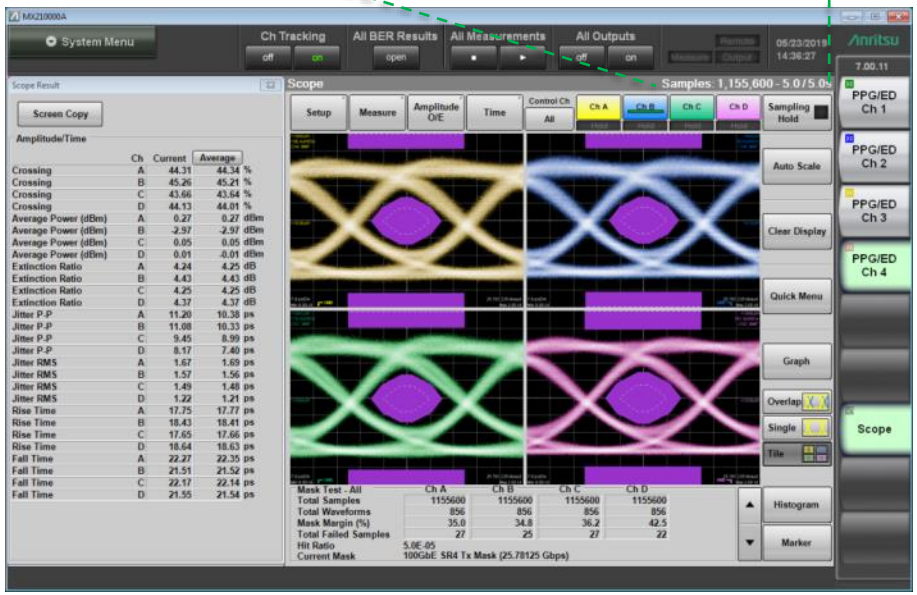
- Intuitive GUI operation with display of multichannel bit error rate measurement results and Eye Pattern analysis results on one screen
- Compatible remote commands with 10G BERTWave MP2100A/B support easy instrument upgrades



Features – Stable, High-Speed Performance –

- Scope with high sampling speed (250 ksamples/s) completes Eye Pattern analysis for 1 Msamples in less than 5 s; almost same sampling speed even at multichannel measurement
- BERT all-at-once multichannel measurements and BER measurements in 10 ms time slots cut adjustment inspection times

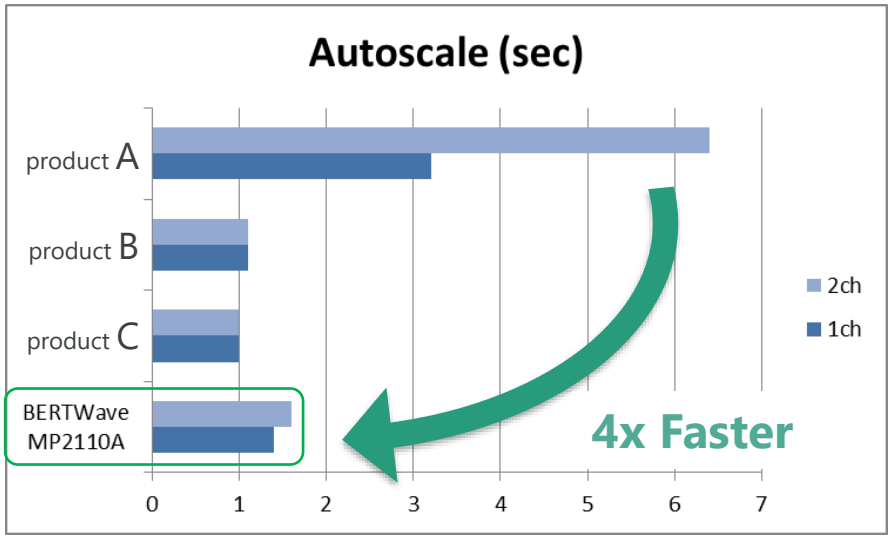
4ch Eye analysis for 1 Msamples in less than 5 s

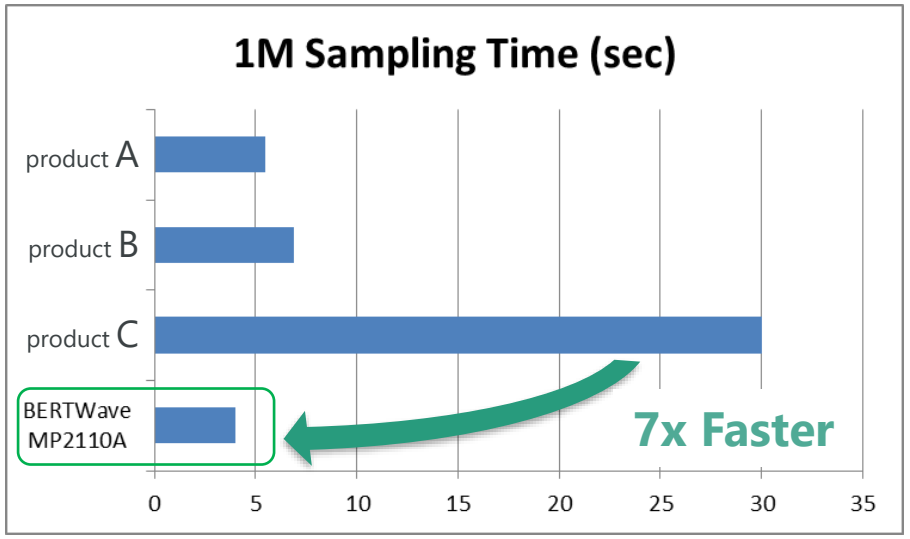


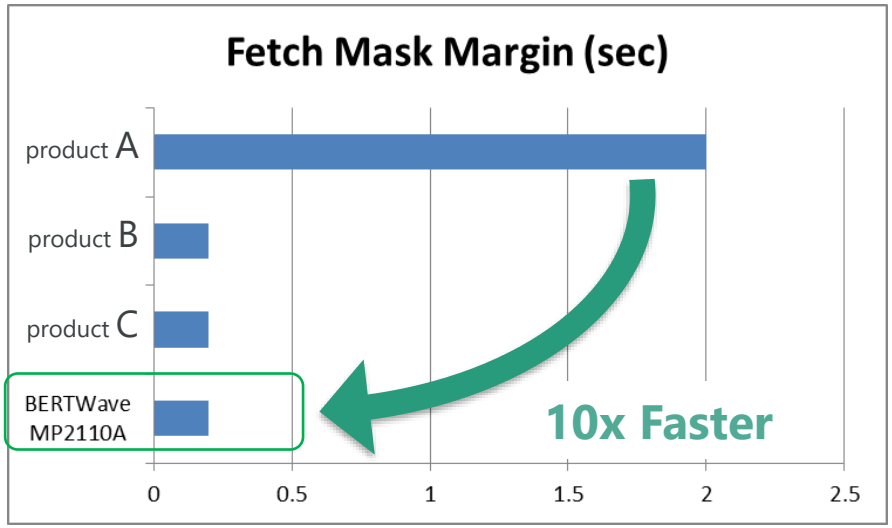
All-at-once 4ch BER measurements

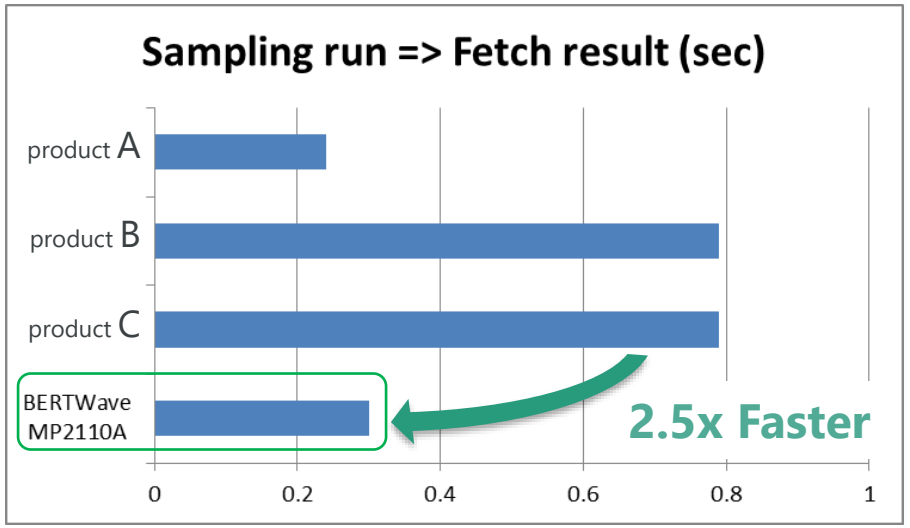
Features – Stable, High-Speed Performance –

Anritsu
Advancing beyond









High-speed operation for all main MP2110A sampling oscilloscope operations

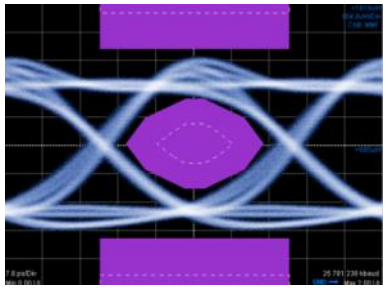
Contents

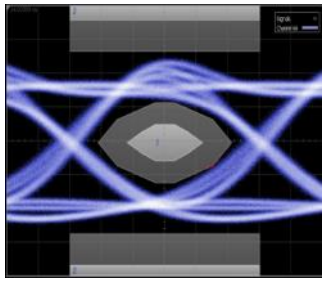
- Anritsu products for optical transmission market
- BERTWave MP2110A Features
  - Sampling Oscilloscope Functions and Performance
  - BERT Functions and Performance
- Optimum MP2110A Cost-Performance Results

Features – Assured Performance & Functions Correlated with Instruments for R&D

Anritsu Advancing beyond

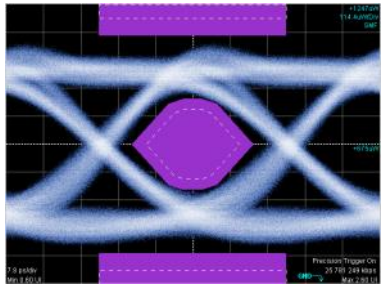
Sampling oscilloscopes have issues with waveform differences, which can have an impact on yields. A product line correlated with customers' standards helps eliminate poor line yields.

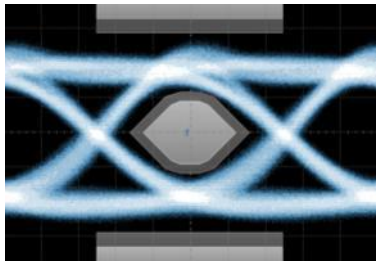




Measurement	MP2110A-04x	Product B
ExR [dB]	4.88	4.78
Jitter rms [ps]	1.26	1.33
Rise Time [ps]	14.87	14.56
Fall Time [ps]	18.85	17.92
Mask Margin [%]	55.4	51.2

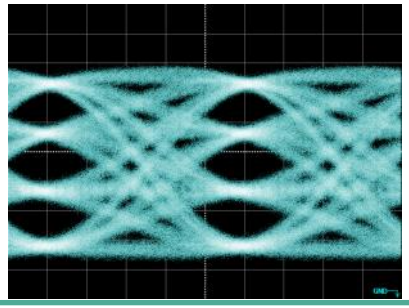
Opt-04x offers results equivalent to Product B





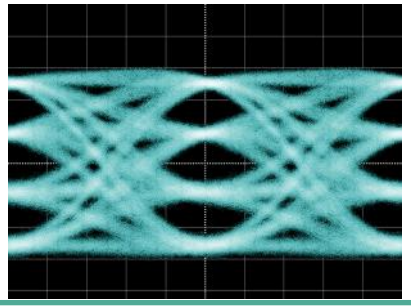
Measurement	MP2110A-03x	Product C
ExR [dB]	3.9	4.1
Jitter rms [ps]	1.5	1.5
Rise Time [ps]	16.8	16.1
Fall Time [ps]	20.5	19.8
Mask Margin [%]	30.7	28.0

Opt-03x offers results equivalent to Product C



TDECQ = 1.19 dB

MP2110A-03x
13.3 GHz filter



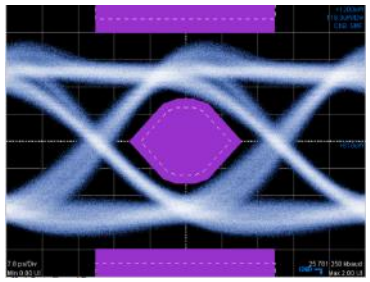
TDECQ = 1.24 dB

MP2110A-04x
13.3 GHz filter

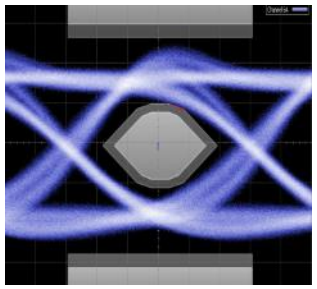
There are no differences between options at PAM4 measurement because a separately adjusted filter is used.

Oscilloscope – Opt-04x and Opt-03x –

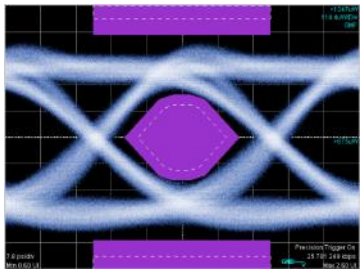
Anritsu
Advancing beyond



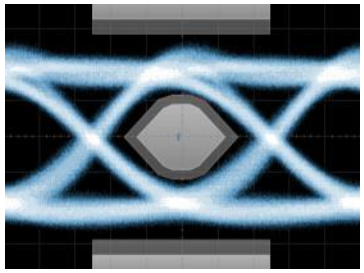
Anritsu
MP2110A-04x



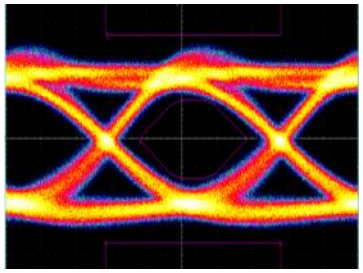
Product B



Anritsu
MP2110A-03x



Product C



Product A

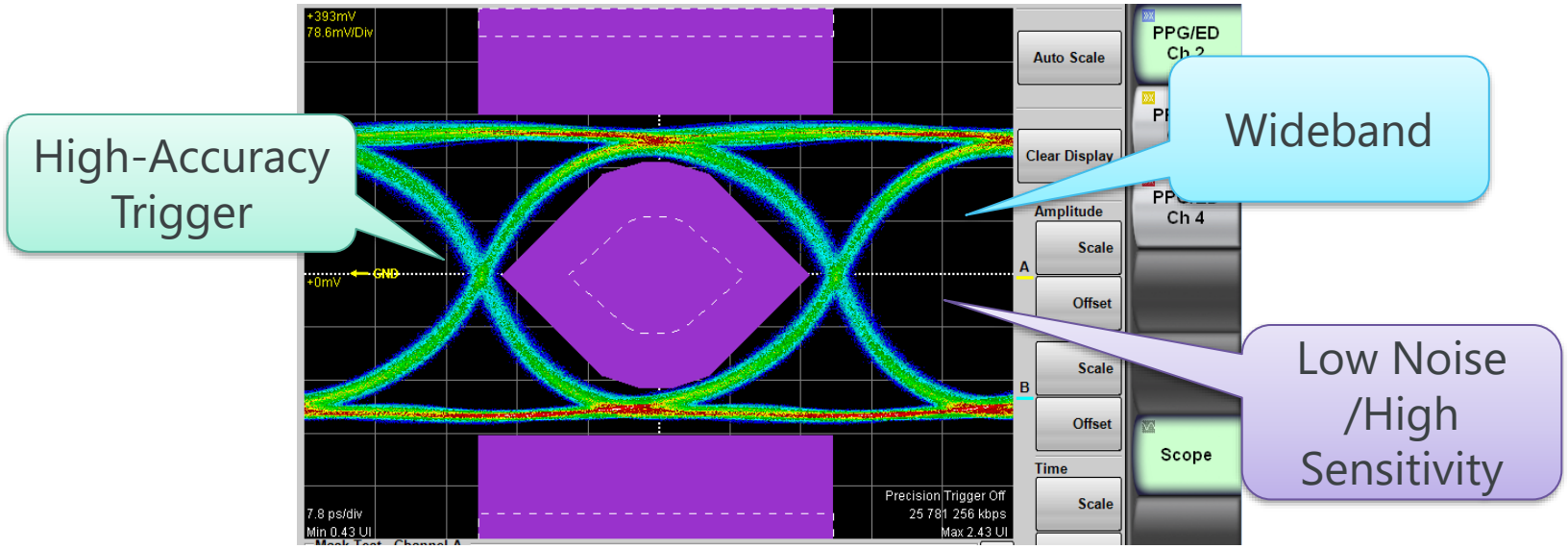
	MP2110A-04x	Product B	MP2110A-03x	Product C	Product A
ExR [dB]	4.8	4.9	3.9	4.1	4.3
Crossing [%]	48.3	48.0	48.2	48.2	48.9
Jitter RMS [ps]	1.6	1.5	1.5	1.5	1.5
Rise Time [ps]	15.9	15.9	16.8	16.1	15.8
Fall Time [ps]	20.2	20.2	20.5	19.8	19.4
Mask Margin [%] @5E-5	26.2	24.9	30.7	28.0	25.5

To obtain measurement results that correlate with other makers' sampling oscilloscopes, the MP2110A has two options types: Opt-04x and Opt-03x.

MP2110A Oscilloscope – Good Functions & Performance –

- Wideband
  - Optical 35 GHz (SMF)/25 GHz (MMF)/Electrical 40 GHz
- Low-Noise/High-Sensitivity O/E
  - Low Noise (3.4 μW), –15 dBm Mask Margin Sensitivity* (typ. SMF)
- High-Accuracy Trigger
  - 200 fs rms (typ.) Intrinsic Jitter
- Little Variability between Units

*Estimate from noise performance at 0% Mask Margin

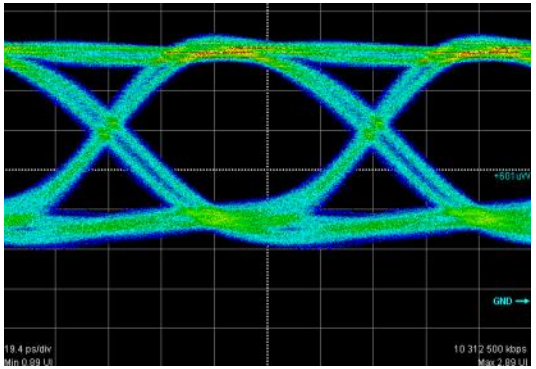


Oscilloscope

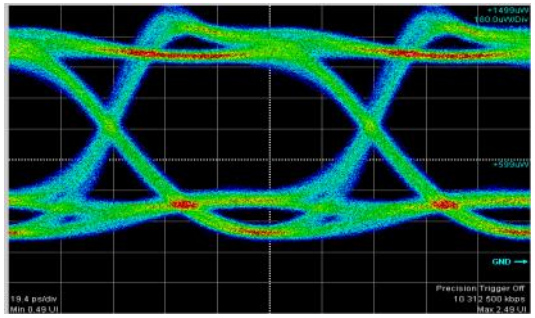
Anritsu
Advancing beyond

– Low Noise & Wideband Optical Interface –

Although a 9 GHz (typ.) bandwidth sampling oscilloscope cannot be used to observe transient responses of a Direct modulated DFB laser, the MP2110A can observe these properties.



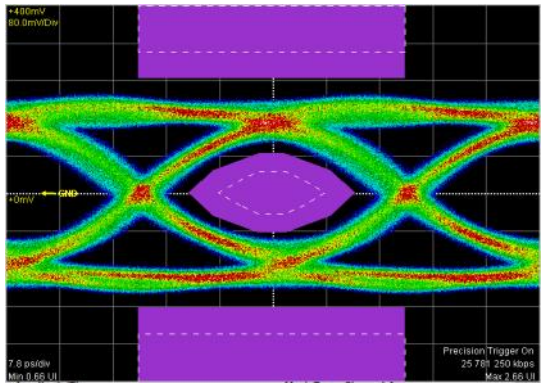
BW = 9 GHz Modulation Waveform (observed directly by MP2100B)



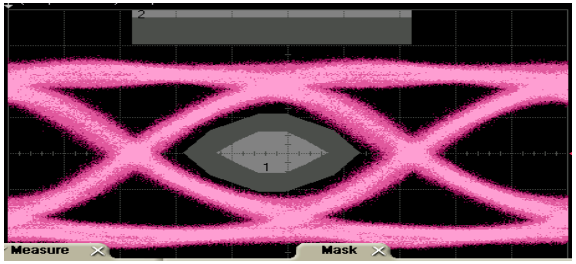
BW = 35 GHz Modulation Waveform (observed directly by (MP2110A)

– Good Flatness, Wide Band & Electrical Interface –

It is available that observing the waveform at the output electrical interface (CAUI-4) of 100 GbE Active Optical Cables (AOC). With a guaranteed flatness of ±1 dB, MP2110A measurements have almost no differences between units.



MP2110A

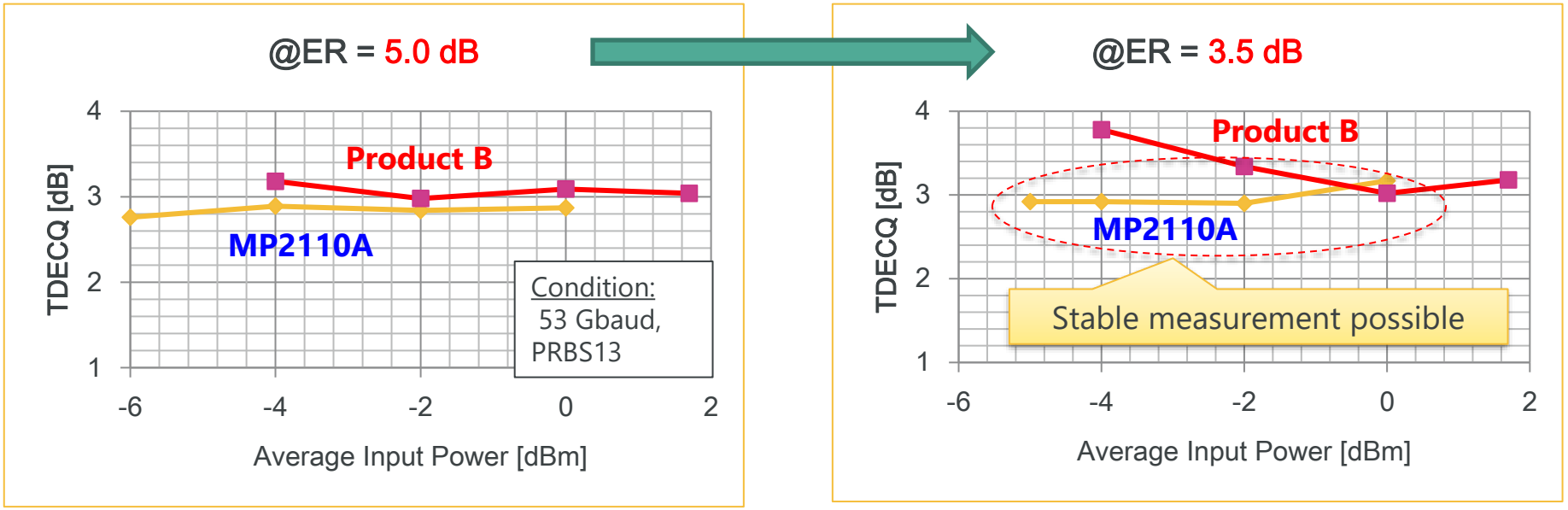


Product C (BW=50 GHz)

Very similar results are obtained to other company's products for the same band.

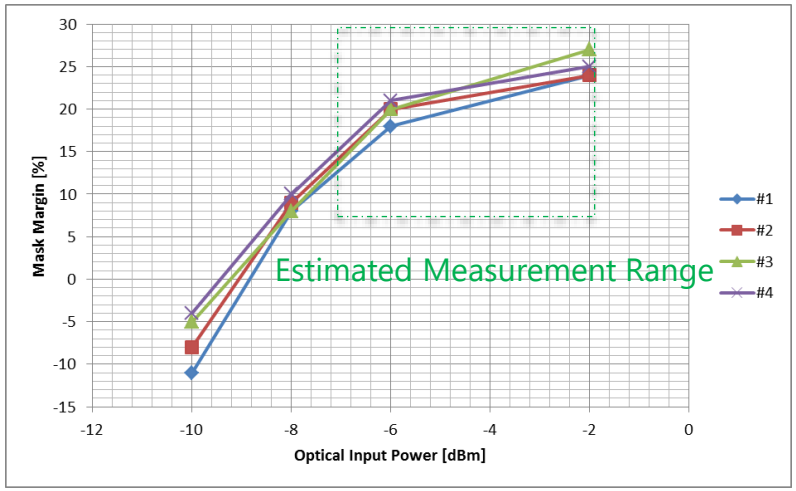
Oscilloscope – Low Noise and High-Sensitivity O/E –

With low noise and high sensitivity, line yields are improved by stable measurement results even at low input levels. The following graphs compare the PAM4 TDECQ input power dependency for the MP2110A and Product B.
At an Extinction Ratio (ER) of 5 dB, there are no apparent differences, but at 3.5 dB the MP2110A is stable at 0.3 dB while Product B has an input power dependency of 0.8 dB.
Since OMA becomes smaller at low ER, noise affects TDECQ results easily.

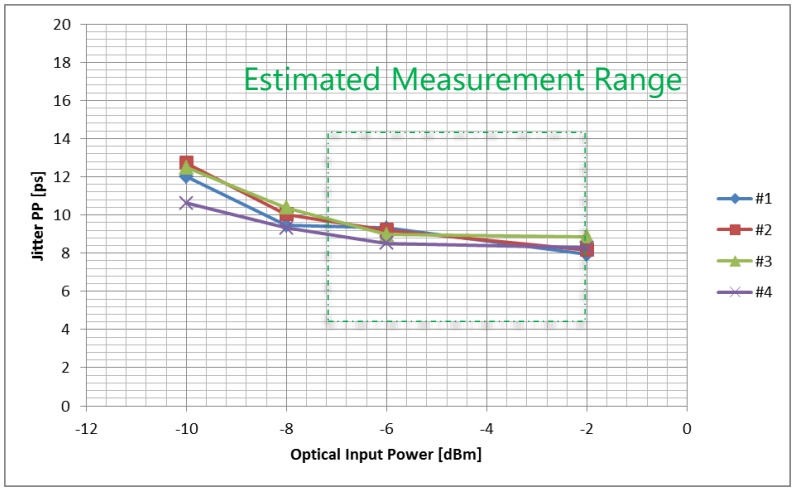


The MP2110A low noise and high-sensitivity performance characteristics support stable TDECQ measurements even under low power and extinction ratio conditions.

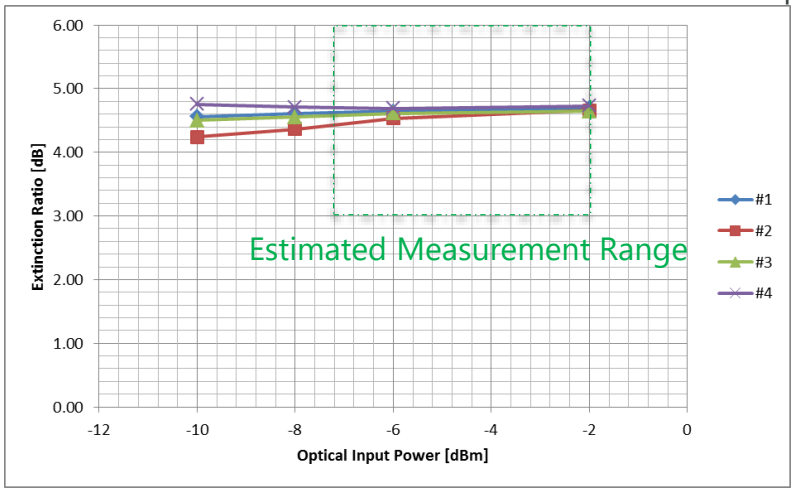
Oscilloscope – Small Instrument Variability –



Mask Margin: **≤3%**



Jitter p-p: **≤600 fs**

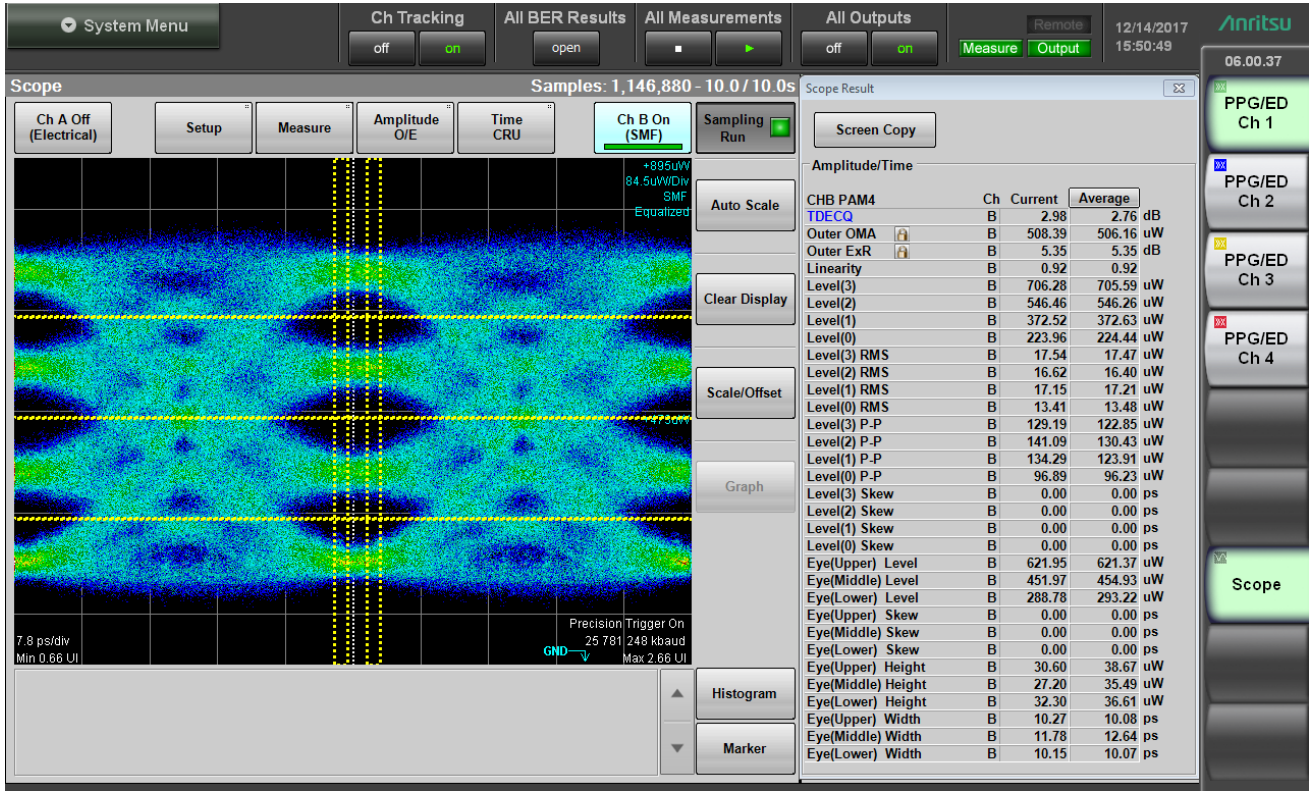


Extinction Ratio: **≤0.3 dB**

Small instrument variability assures stable measurement results when configuring multiple multichannel production lines.

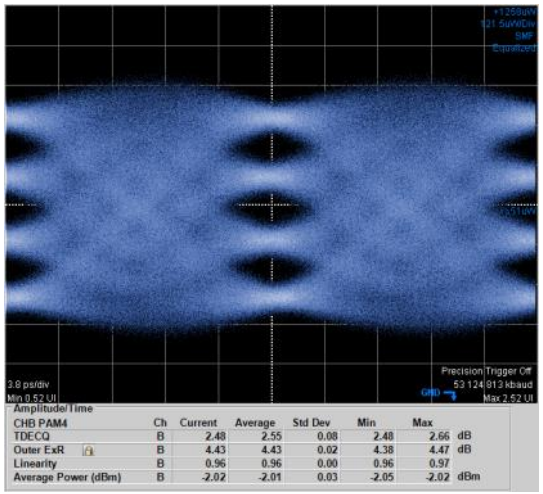
Oscilloscope – PAM4 Analysis Software (Opt-095) –

- **Easy:** TDECQ measurement using a reference filter and equalizer is supported. Measurement results are obtained with good reproducibility and correlation with other makers' oscilloscopes.
- **Fast:** The fast sampling speed of 250 ksample/s cuts measurement times to help improve productivity.
- **Low Noise:** This O/E module with world-beating sensitivity and a low noise of 3.4 µW improves line yields by supporting accurate measurement of PAM4 signals with narrow Eye openings.



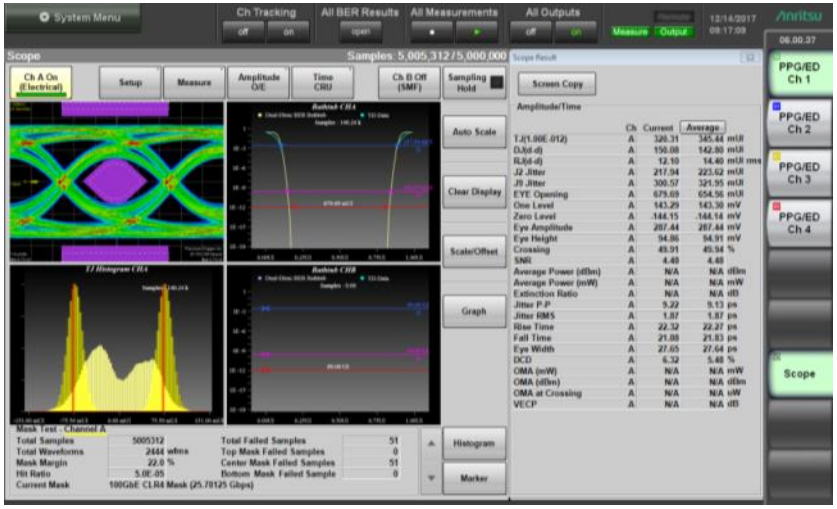
With display of up to 32 selectable measurement items, the large number of PAM4 measurement results can be confirmed at one screen.

Not only 26 Gbaud, but also 53 Gbaud measurements are supported.

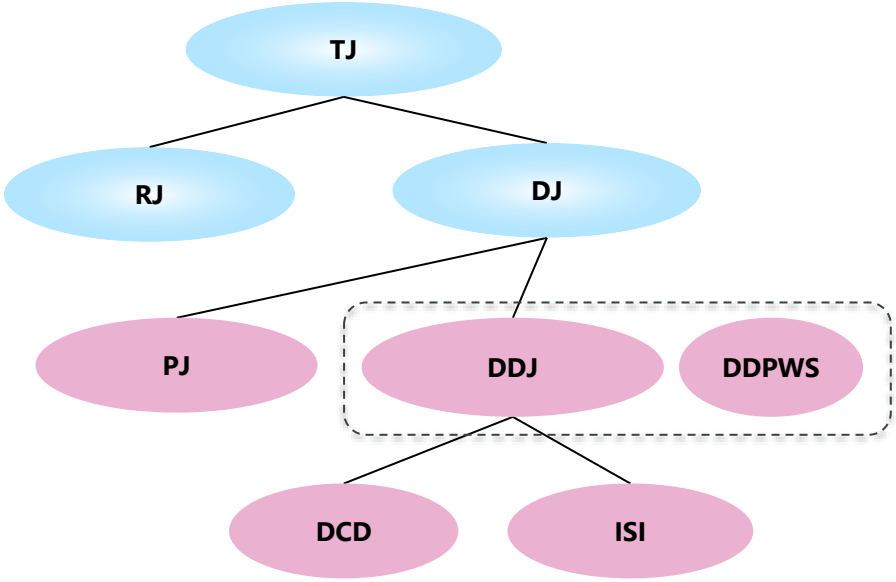


53 Gbaud PAM4 TDECQ Measurement

Oscilloscope – Jitter Analysis Software (Opt-096) –



- Jitter analysis using multiple graph displays
- Two modes matching analysis needs



Eye Mode (Histogram)
Simultaneous, fast and easy Jitter analysis, such as J2, J9, etc., and Eye Mask tests required for production line inspections; supports any periodic signal, including PRBS31

- TJ (J2, J9, User Defined)
  : Total Jitter at 2.5E-3, 2.5E-10 and specified BER)
- EYE Opening: Horizontal EYE opening at specified BER
- DJdd : Deterministic Jitter (Dual Dirac model)
- RJdd : Random Jitter (Dual Dirac model)

Advanced Jitter Mode (Pattern Lock)
For DJ separation analysis to troubleshoot separated Jitter components *Data lengths up to PRBS15 equivalent

- DDJ : Data Dependent Jitter vs. Bit
- DDPWS : Data Dependent Pulse Width Shrinking
- PJ : Periodic Jitter
  (supports PJ frequency estimation)
- DCD : Duty Cycle Distortion
- ISI : Inter Symbol Interference

Contents

- Anritsu products for optical transmission market
- BERTWave MP2110A Features
  - Sampling Oscilloscope Functions and Performance
  - BERT Functions and Performance
- Optimum MP2110A Cost-Performance Results

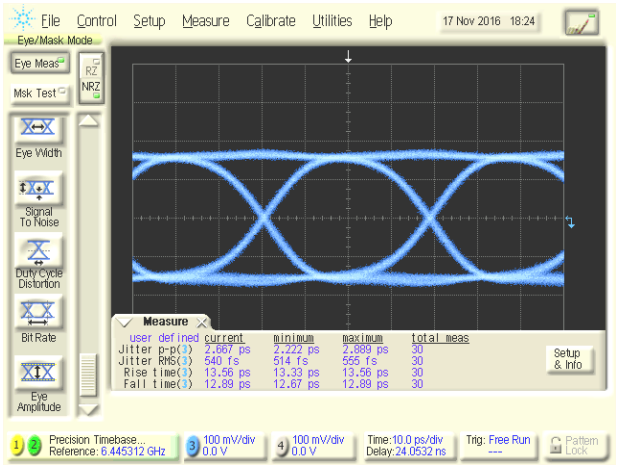
BERT – Good Functions and Performance –

Anritsu
Advancing beyond

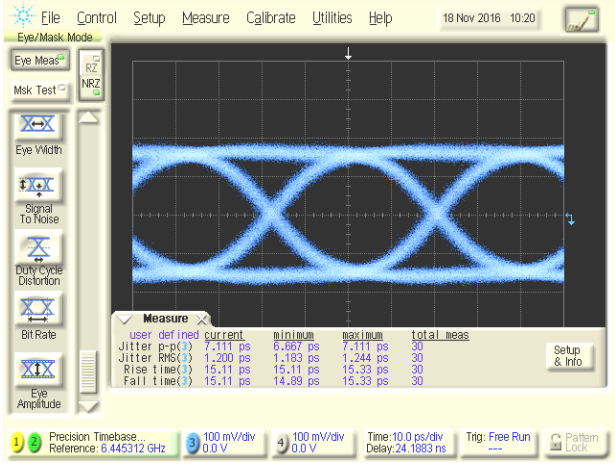
- NRZ PPG (Pulse Pattern Generator)
  - Low Jitter
    - Low jitter (600 fs rms (typ.)) minimizes impact of DUT performance, supporting accurate measurement of DUT performance
  - Variable Amplitude
    - Easy-to-set amplitude from 100 to 800 mV in 10-mV units with easy generation optimized for DUT for attenuator-free sensitivity tests
- NRZ ED (Error Detector)
  - High Sensitivity
    - High-sensitivity ED (25 mV typ.) supports accurate BER measurement of low-amplitude DUT, such as post transmission
  - Built-in Clock Recovery Unit
    - BER measurement uses built-in clock recovery and automatic optimum phase adjustment supporting BER measurement under optimum conditions
- Other
  - Variable bit rate: 24.3 to 28.2 Gbit/s, 9.5 to 14.2 Gbit/s (Option)
  - ESD protection diodes at inputs and outputs
  - Multi-unit synchronization using external clock (1/16, 1/40)

MP2110A BERT PPG – Low-Jitter High-Quality Waveforms –

@25.78 Gbit/s



MP2110A PPG Waveform
Jitter rms: 540 fs
Jitter p-p: 2.667 ps
Rise time: 13.56 ps
Fall time: 12.89 ps



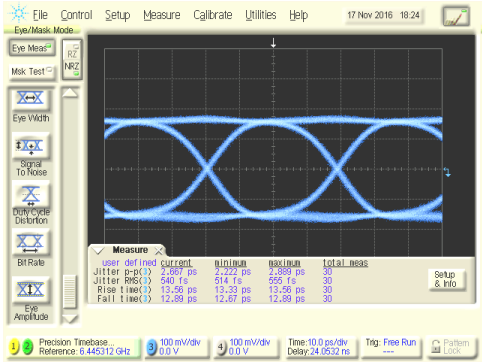
Gearbox Integrated PPG Waveform
Jitter rms: 1200 fs
Jitter p-p: 7.111 ps
Rise time: 15.11 ps
Fall time: 15.11 ps

Using PPG with high-quality output waveforms improves Mask Margin and receiver sensitivity for better yields

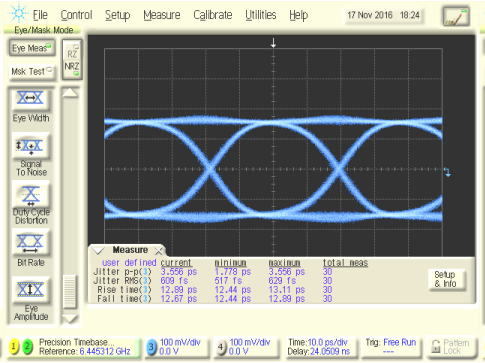
Demonstrate more accurate DUT evaluation results to end-user customers.

MP2110A BERT PPG – Small Instrument Variability –

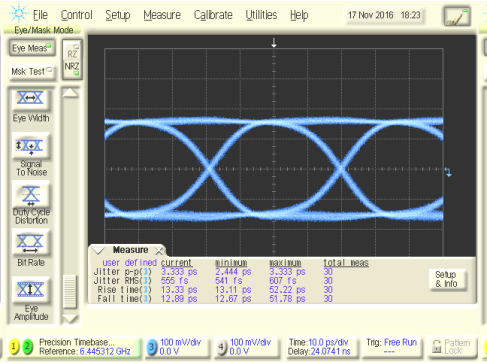
@25.78 Gbit/s



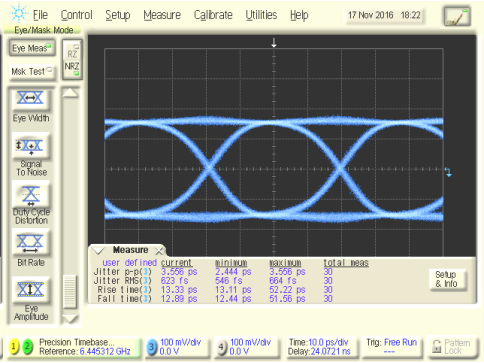
MP2110A (1ch)



MP2110A (2ch)



MP2110A (3ch)

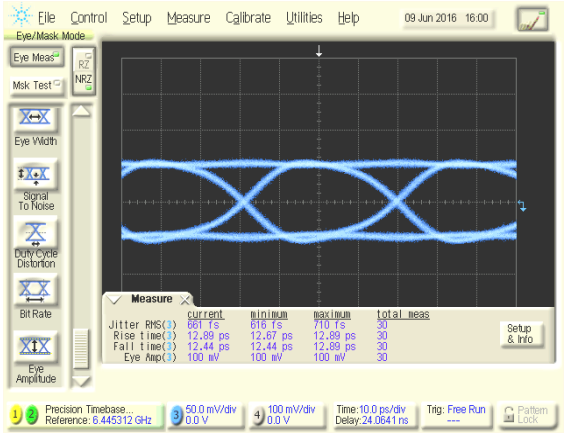


MP2110A (4ch)

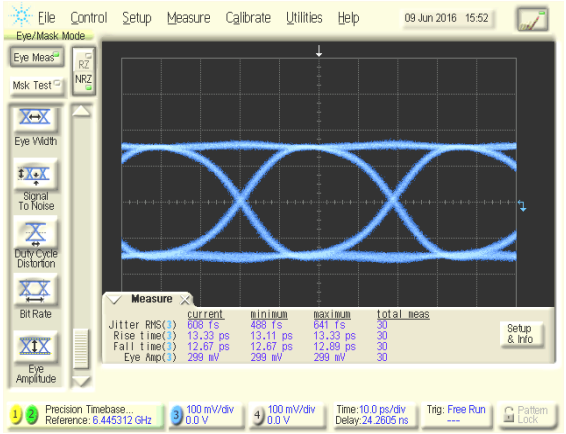
Measurement Item	MP2110A			
	1ch	2ch	3ch	4ch
Jitter peak-peak [ps]	2.667	3.556	3.333	3.556
Jitter rms [fs]	540	609	555	623
Rise time (20%-80%) [ps]	13.56	12.89	13.33	13.33
Fall time (20%-80%) [ps]	12.89	12.67	12.89	12.89

Very small Jitter p-p variability (<900 fs) between PPG output channels
Stable measurement results assure PPG output waveforms with small randomness.

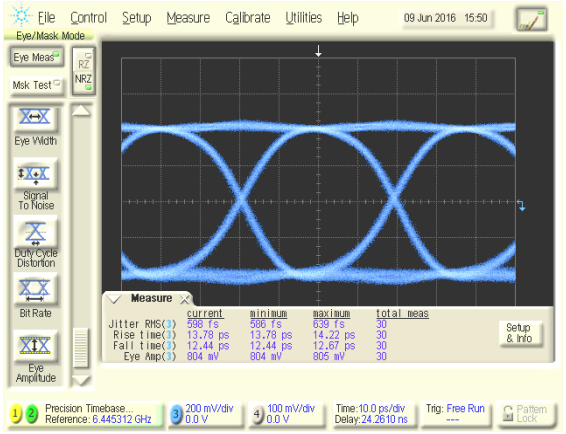
BERT PPG – Variable Amplitude –



Amplitude Setting 100 mVp-p
Jitter rms 661 fs



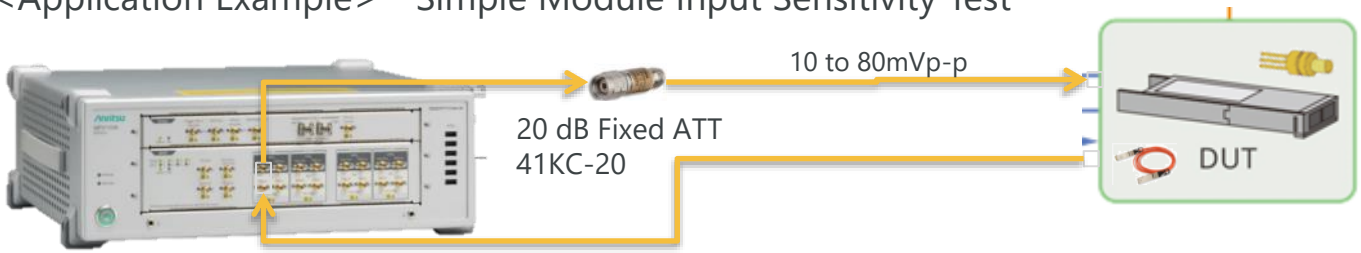
Amplitude Setting 300 mVp-p
Jitter rms 608 fs



Amplitude Setting 800 mVp-p
Jitter rms 598 fs

Changing amplitude does not greatly change waveform deterioration and jitter

<Application Example> Simple Module Input Sensitivity Test



The sensitivity test is easily configured just by inserting a fixed attenuator.

BERT ED – High Sensitivity and Small Instrument Variability –

Anritsu Advancing beyond

Loopback Sensitivity @25.78 Gbit/s

[mVp-p]

PPG	MP2110A			
	1ch	2ch	3ch	4ch
MP2110A	14.54	14.75	15.40	14.56

High-sensitivity ED with very low variability (<0.9 mVp-p) between channels

High sensitivity and small variability are key to ascertaining the performance of equipment without retiming functions (CDR), such as low-priced optical engines.

Contents

- Anritsu products for optical transmission market
- BERTWave MP2110A Features
  - Sampling Oscilloscope Functions and Performance
  - BERT Functions and Performance
- Optimum MP2110A Cost-Performance Results

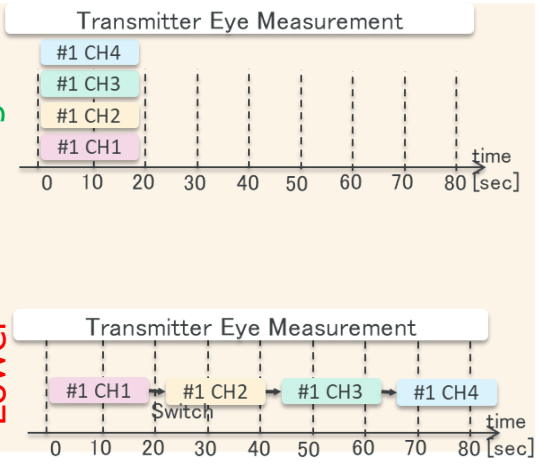
Optimum Oscilloscope Investment Configuration Options

Although line productivity per unit time increases with more channels, the increasing equipment cost requires careful selection of the best configuration matching production volumes.

- There are various available interface options to choose the best investment configuration matching the customer's DUT evaluation.
- Even expensive 4ch systems can cost less by choosing the optimum configuration tailored to the application

High-cost 4ch configuration becomes less expensive by limiting to SM or MM fiber I/F

Option No.	Channel			Optical Interface		Price	Through-put
	4	2	1	SM	MM		
MP2110A-030/040	✓			✓		Higher	Higher
MP2110A-039/049	✓				✓		
MP2110A-032/042		✓		✓	✓		
MP2110A-033/043			✓	✓	✓		
MP2110A-035/045			✓	✓		Lower	Lower
MP2110A-036/046			✓		✓		

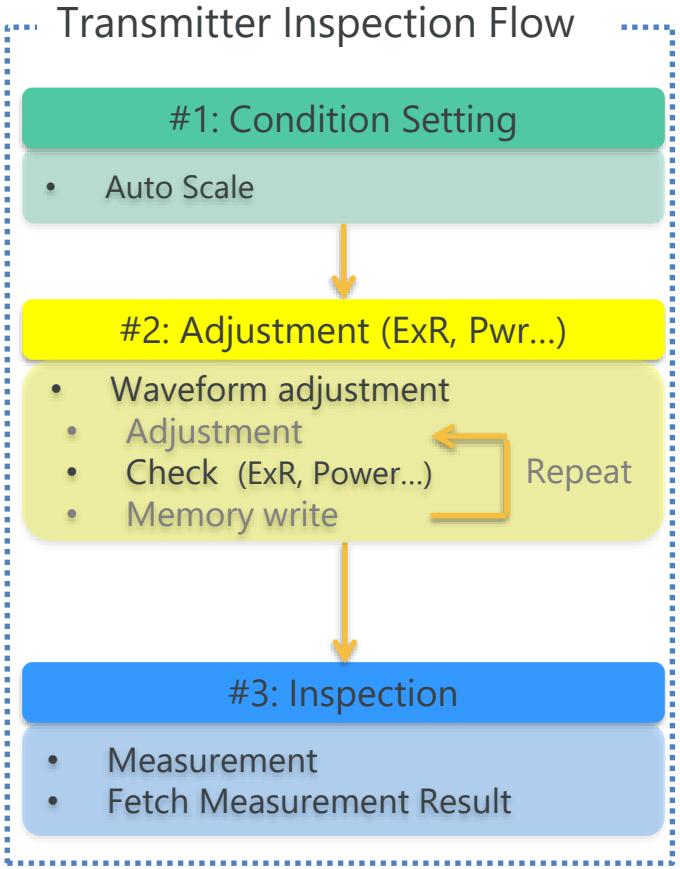


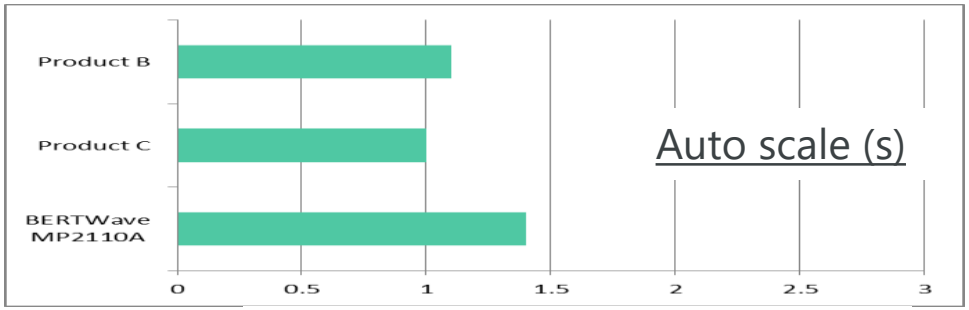
Base configuration supporting SMF or MMF

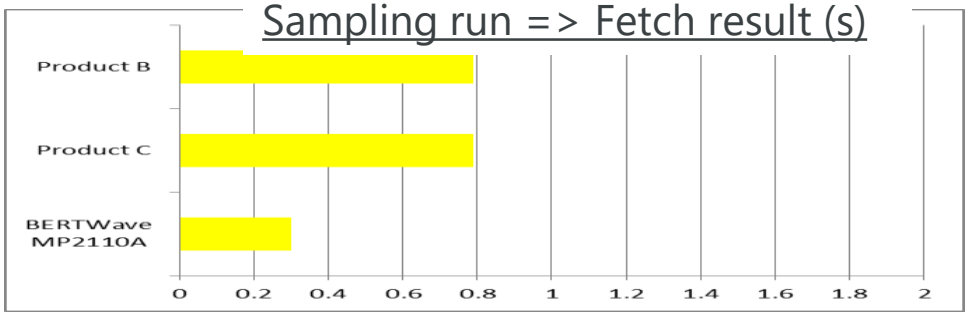
Cutting Transmitter Evaluation Time

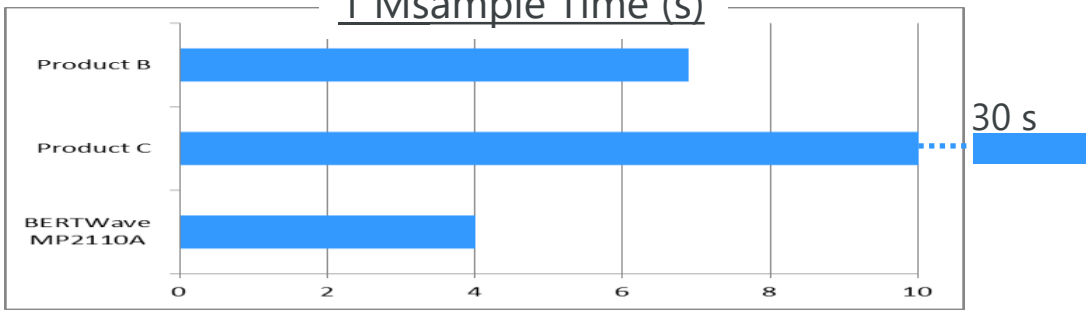
Anritsu
Advancing beyond

Generally, transmitter evaluation performs adjustment and inspection using the sampling oscilloscope Eye waveform drawing function. Cutting the time just a little at each stage can have a major positive effect on monthly production volumes.





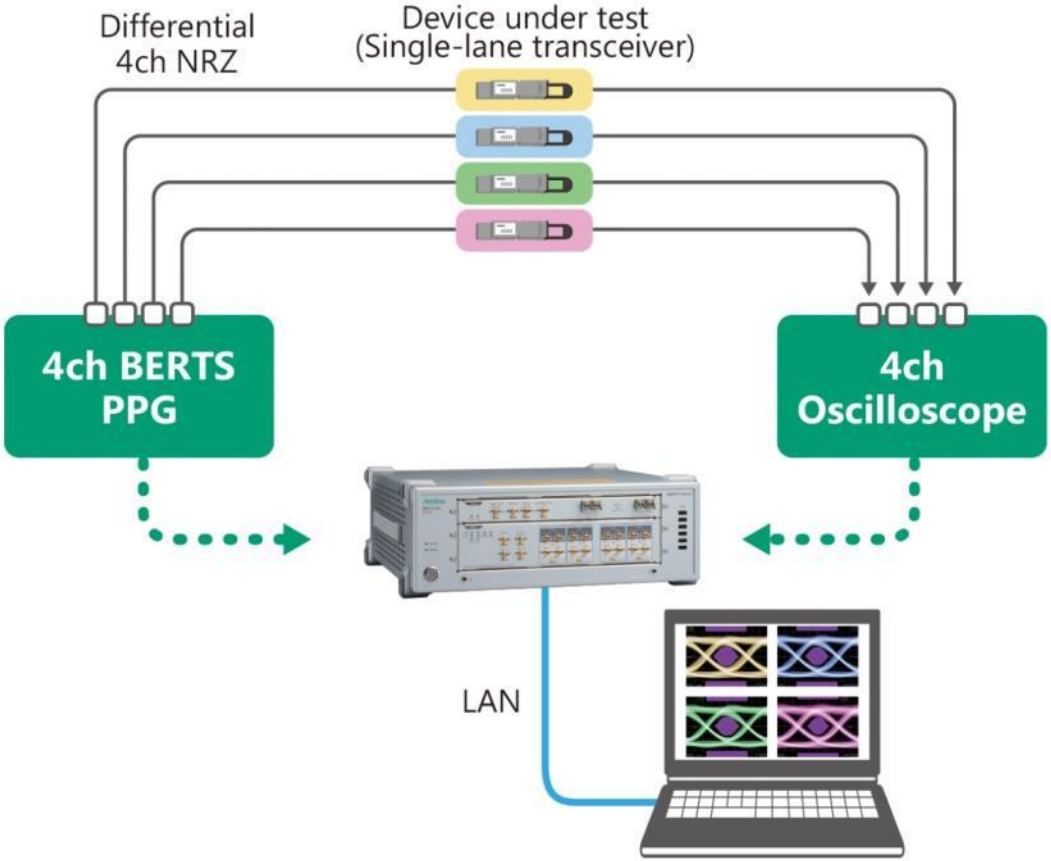


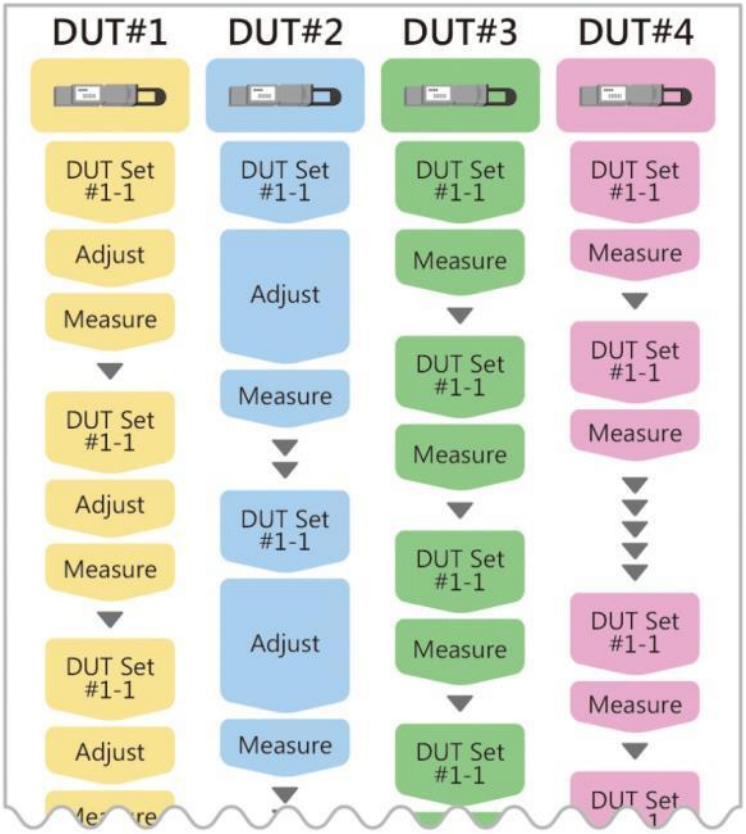


Improved Usage Efficiency by Independent Multichannel Measurement

Anritsu
Advancing beyond

With a multichannel sampling oscilloscope configuration, not only are measurement times cut by all-at-once measurement, but also throughput is improved by better usage efficiency resulting from independent control of each measured channel.





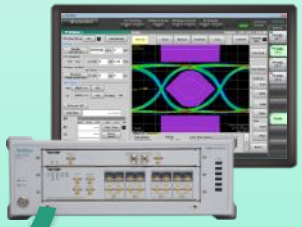
Independent channel conditions improve channel usage efficiency.

Estimating Module Production Volume

Anritsu
Advancing beyond

・Estimated tact time unit: 100GbE NRZ QSFP28 One Tx adjustment + inspection

MP2110A Quad Optical	MP2110A 1xSingle Optical	Competitor 1xSingle Optical
・Estimated Tact Time: 34.0 s →1 hour: 105.9 pcs 1 day (18 h): 1906.2 pcs 1 month (20 days): 38,124 pcs	・Estimated Tact Time: 100.5 s → 1 hour: 35.8 pcs 1 day (18 h): 644.7 pcs 1ヶ月(20 days): 12,895 pcs	・Estimated Tact Time: 113.9 s → 1 hour: 31.6 pcs 1 day (18 h): 568.9 pcs 1 month (20 days): 11,378 pcs
・No of Lines: 1 ・PC controllers: 1 ・No. of instruments →MP2110A:1	・No of Lines: 1 ・PC controllers: 1 ・No. of instruments →MP2110A:1	・No of Lines: 1 ・PC controllers: 1 ・No. of instruments →Product B:1



3.0x Volume

13%Improved

- Using the MP2110A with 4ch independent measurement function eliminates wasteful wait times in each lane and assures increased production volumes for more lines.
- The same impact can be expected for both NRZ and PAM4 adjustment and inspection.

Anritsu

Advancing beyond

公知 2022-2 MJM No. MP2110A-E-L-2-(8.00)