BIT ERROR RATE TESTERS (BERT)/ OSCILLOSCOPES

Selection Guide

Model Application	Signal Quality Analyzer-R MP1900A	BERTWave MP2110A
10 GE-PON Optical Module Test		
10/40 Gbit/s Optical Module Test	✓	
25 Gbit/s to 800 Gbit/s Optical Module Test	✓	✓
Active Optical Cable (AOC) Test	✓	✓
16G/32G/64G FC, InfiniBand FDR/EDR/HDR	✓	✓
28G/32G bit/s Interconnect Test	✓	✓
26G/53G baud PAM4 Interconnect Test	✓	
PCI Express/USB/Thunderbolt/SAS/DP1.4 Receiver Test	✓	

Signal Quality Analyzer-R

MP1900A

Support 400 GbE/800 GbE and PCIe Gen4/5

Excellent Eco Product

SQA-R

Due to the explosive growth of data traffic resulting from the popularity of smartphones and mobile terminals, network interfaces are transitioning to faster 400G/800 GbE standards, and PCI bus interface speeds exceed 10G. In addition, the equipment and chipsets using these interfaces support multi-channels and multi-protocols. The MP1900A is a high-performance BERT with excellent expandability for supporting Physical layer evaluations of these high-speed interfaces. The all-in-one design is ideal for early stage R&D evaluations of all interfaces covering next-generation Ethernet networks to bus interconnects.

Wide Application Support

100 GbE/200 GbE/400 GbE/800 GbE, CEI-25G/28G/56G/112G, InfiniBand EDR/HDR, Fibre Channel
PCI Express Gen1 to 5, Thunderbolt 3, USB3.2/4 Type-C, SAS-3/-4, DP1.4
Optical module, SERDES, AOC, High-speed Interconnect

Excellent Expandability

All-in-One Support for Evaluating Next-Generation NRZ/PAM4 Network Interfaces and High-Speed Serial Buses

The Signal Quality Analyzer–R MP1900A is a modular Bit Error Rate Tester (BERT) supporting equipment external interfaces, such as next-generation Ethernet, by installing a pulse pattern generator (PPG) for outputting high-quality multi-channel NRZ/PAM4 signals over a wide bandwidth of 2.4 Gbaud to 64.2 Gbaud, a high-sensitivity input error detector (ED), Jitter modulation sources for Jitter Tolerance tests, etc.

Additionally, optional noise generation and 10Tap Emphasis functions can be installed for Voltage Noise Tolerance tests, etc., and installing the High-Speed Serial Data Test Software MX183000A software enables efficient design evaluation for increasingly faster PCIe, USB, Thunderbolt, SAS and DP receivers.
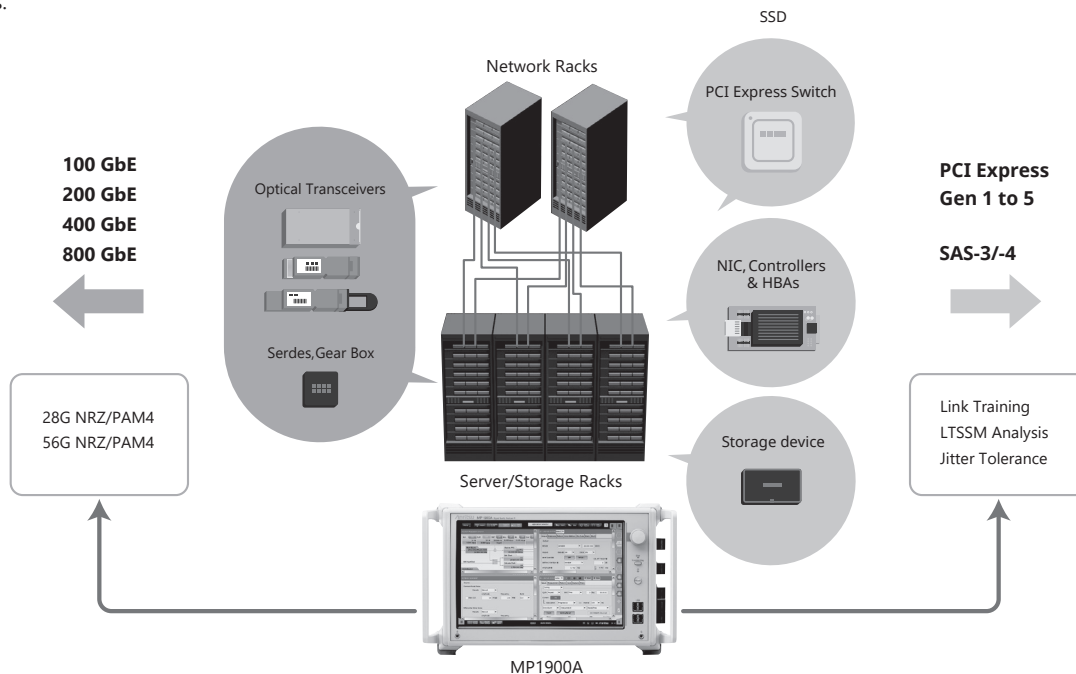
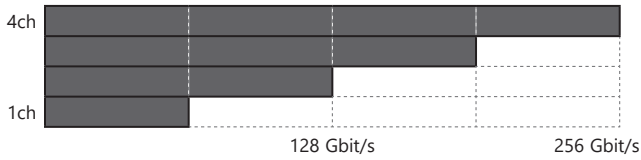## High Transmission Capacity and Excellent Expandability

Easy Multichannel Measurement Support

The MP1900A series is an 8-slot, modular, high-performance BERT.
Installing multiple 64G PAM4 PPG module boards in the slots provides the performance for measuring not only 400 GbE systems but also future 800 GbE systems as well. This flexible expandability helps customers maximize product development-cost efficiencies and bring products to market early.
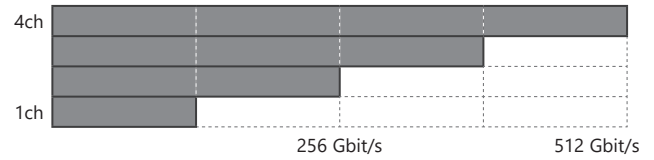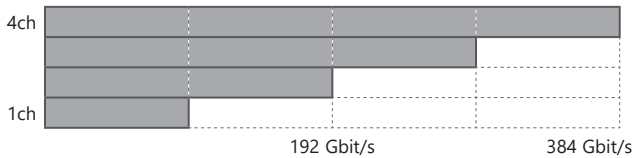
NRZ Solution

Max. 64 Gbit/s at 1ch

4ch

1ch

128 Gbit/s   256 Gbit/s

PAM4 Solution

Max. 64 Gbaud at 1ch

4ch

1ch

256 Gbit/s   512 Gbit/s

PAM3 Solution

Max. 64 Gbaud at 1ch

4ch

1ch

192 Gbit/s   384 Gbit/s

Improved Operability with New System View, User Interface, and Multi-windows

The MP1900A features easy intuitive operability based on a redesigned GUI and large 12.1-inch touch-panel LCD. Fast mistake-free settings help shorten measurement times.
The newly developed system view displays system functions as easy-to-understand blocks, supporting smooth settings and easy operation of each module.
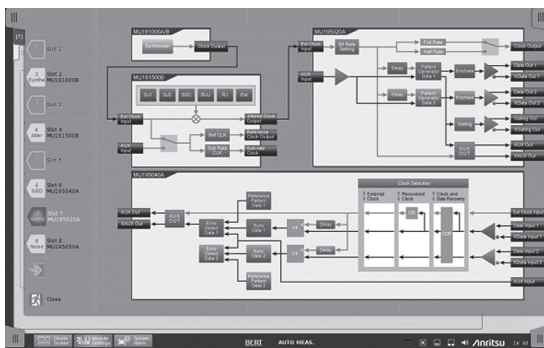
Four split screens help improve the efficiency of multi-channel measurements.

The Help function displays the remote commands corresponding to GUI operations, which simplifies automated system configurations.

https://www.anritsu.com
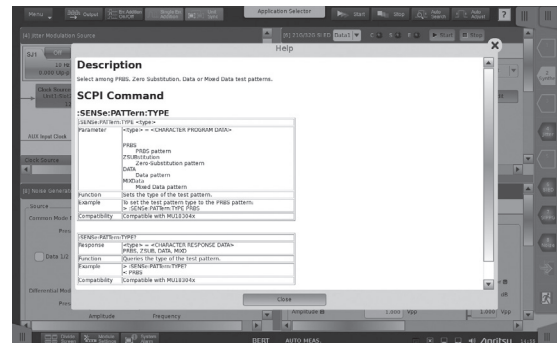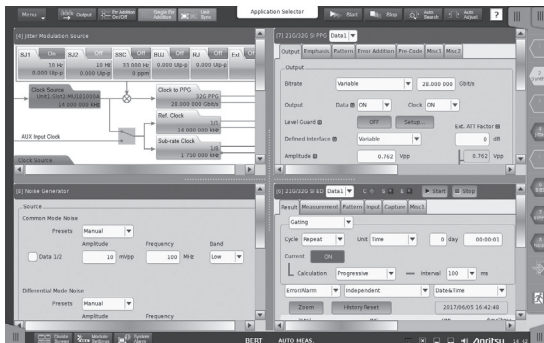
One Box PAM4 BER Test Solution

All-in-One Measurement Solution

8-slot main unit accommodates various modules, including PPG/ED, synthesizer, Jitter modulation source, and noise generator.
A compact, high cost-performance, next-generation, all-in-one measurement solution can be configured without other external instruments.

MP1900A

- 12.5 GHz 4 Port Synthesizer MU181000B
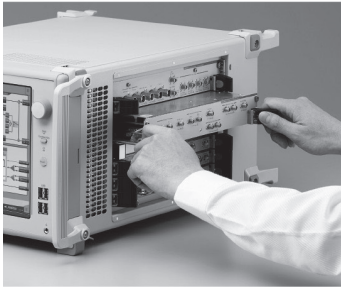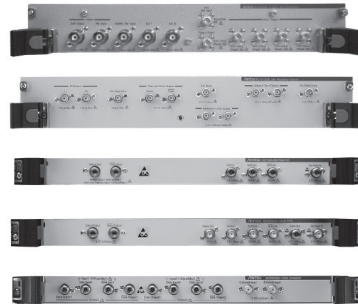- Jitter Modulation Source MU181500B
- PAM4 ED MU196040B
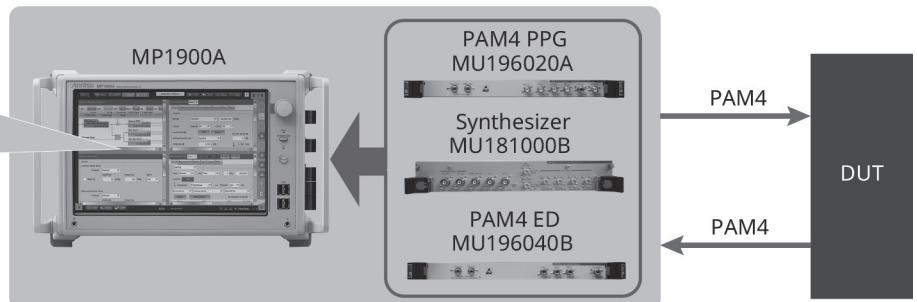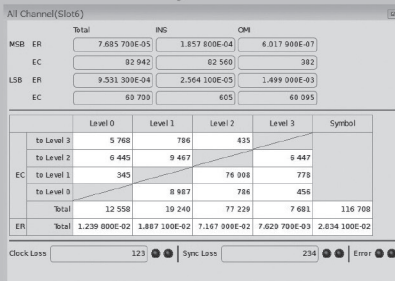- PAM4 PPG MU196020A
- Noise Generator MU195050A

∗: Refer to the MP1900A Selection Guide for details of supported multichannel configurations and module combinations.
   Consult your sales representative for module configurations not described in the MP1900A Selection Guide.

64 Gbaud All-in-One NRZ/PAM4 BER Measurement

BER can be measured in real-time without using external equipment. In addition, permits error evaluation at each PAM4 symbol.
- World-first all-in-one solution without requiring external equipment
- Baud rates of 2.4 Gbaud to 58.2 Gbaud (PAM4)/64.2 Gbaud (NRZ)
- Module with built-in Clock Recovery (MU196040B-021, 022, 023), 2.4 Gbaud to 32.1 Gbaud, 51 Gbaud to 58.2 Gbaud
- PAM4 Symbol BER evaluation (MU196040B-041)
- Real-time FEC Symbol Error(MU196040B-042) and FEC Based Jitter Tolerance Measurements

Error Rate Measurement Screen for Each Symbol Level

All Channel(Slot6)

		Total	INS	OMI
MSB	ER	7.685 700E-05	1.857 800E-04	6.017 900E-07
	EC	82 942	82 560	382
LSB	ER	9.531 300E-04	2.564 100E-05	1.499 000E-03
	EC	60 700	605	60 095

		Level 0	Level 1	Level 2	Level 3	Symbol
	to Level 3	5 768	786	435		
	to Level 2	6 445	9 467		6 447	
EC	to Level 1	345		76 008	778	
	to Level 0		8 987	786	456	
	Total	12 558	19 240	77 229	7 681	116 708
ER	Total	1.239 800E-02	1.887 100E-02	7.167 000E-02	7.620 700E-03	2.834 100E-02

Clock Loss 123 | Sync Loss 234 | Error

MP1900A

PAM4 PPG MU196020A

Synthesizer MU181000B

PAM4 ED MU196040B

PAM4 → DUT

PAM4 ←

Jitter Tolerance Measurement using DUT BER Counter (MX183000A-PL031)

When the DUT has a bit error counter, combination with the MP1900A PPG makes it easy to configure a highly cost-effective Jitter Tolerance measurement environment.


JTOL Measurement Screen

DUT

PCB Trace
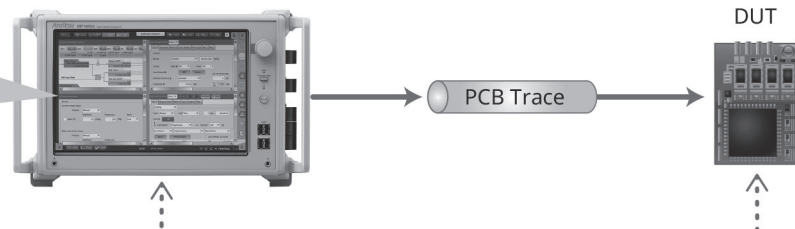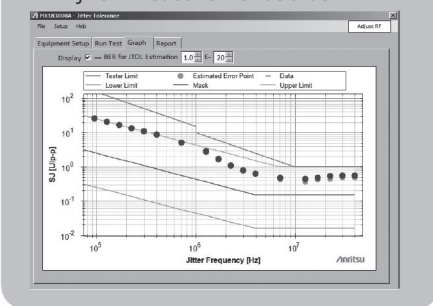
Measure Jitter Tolerance using captured error count ← Capture error count via USB or Ethernet connection

Versatile Jitter/Noise Addition Function for Jitter Tolerance Tests without Other External Equipment (MX183000A-PL001)

The DUT receiver input stress tolerance test measures the BER under the worst conditions using a stressed signal with added jitter and voltage noise. Adding the Jitter Modulation Source MU181500B and MU195050A for adding CM/DM/White Voltage Noise to the MP1900A series supports all-in-one receiver stress tests for various interface standards. Using the MP1900A high-quality signal prior to jitter and noise addition along with the high-linearity jitter and noise addition function offers powerful support for receiver stress tolerance tests.

• Easy Jitter Tolerance measurement
• PHY device Jitter Tolerance test with impressed SJ/RJ/BUJ
• Mask measurements supporting various standards
• Shorter measurement times using low error rate (1E-12, 1E-15, etc.) estimation function
• Tolerance measurement for device characteristics using four Binary, Upward, Downward, and Binary + Linear measurement methods
• Built-in Jitter Tolerance Mask standards for 200/400G including IEEE 802.3, CEI, etc.
• Support for both user-defined masks and new standards
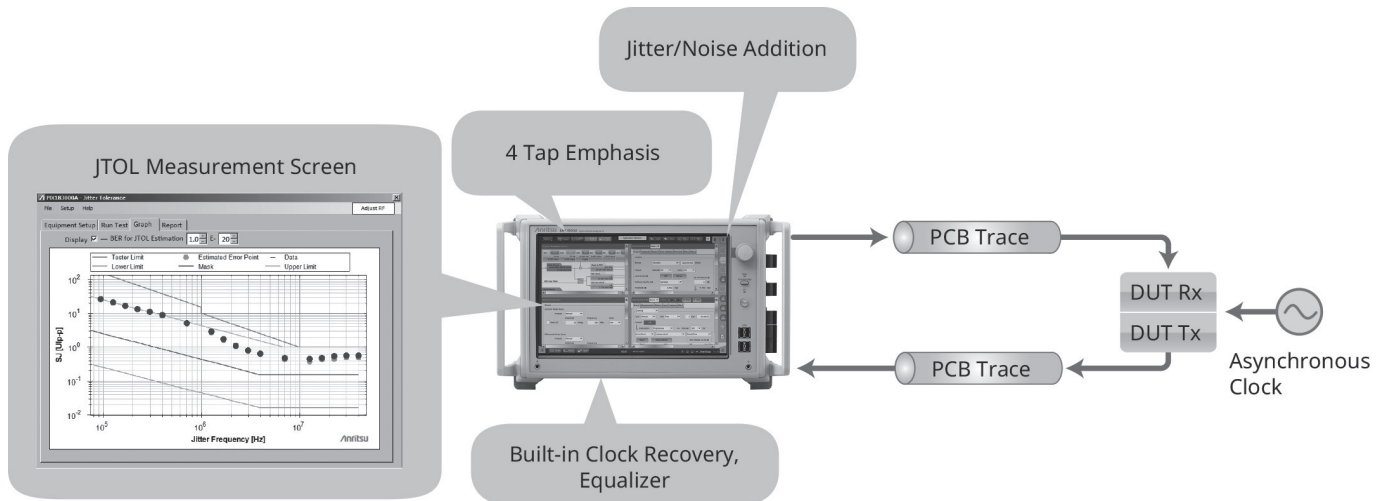
PAM4 Signal Jitter Tolerance Test using One MP1900A
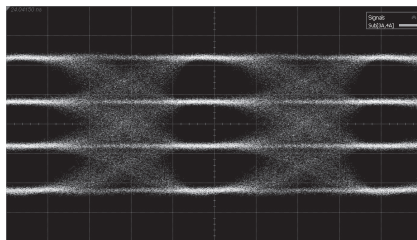
Sine Wave Jitter (SJ)
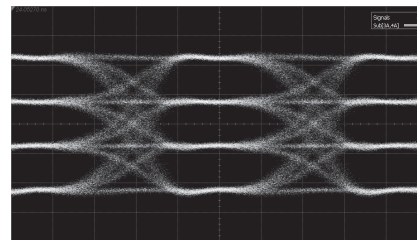
Random Jitter (RJ)
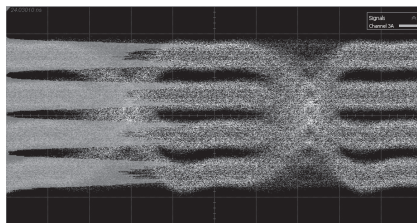
CM/DM Noise
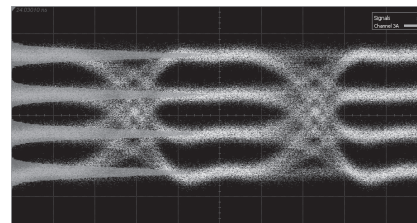
White Noise

Jitter/Noise Types*

*: The upper noise addition rate is 32.1G.

High-Quality Waveforms PAM4 PPG

High-Quality Data Output with High-Speed Tr/Tf and Low Intrinsic Jitter

The PAM4 PPG MU196020A supports high-quality data output with low noise and low distortion over high analog band with Tr/Tf of 8.5 ms and Intrinsic Jitter of 170 fs rms. High-reproducibility measurement supported by PAM4 signals with open 3-Eye waveform. Additionally, Emphasis and Linearity control functions optimize PAM4 data output to DUT.
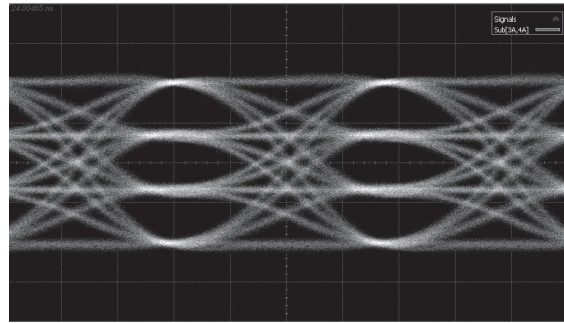
53.125 Gbaud PAM4
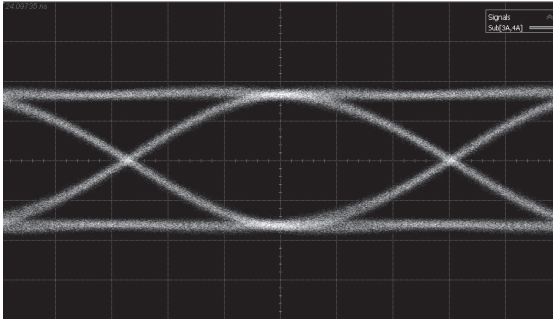
58 Gbaud NRZ
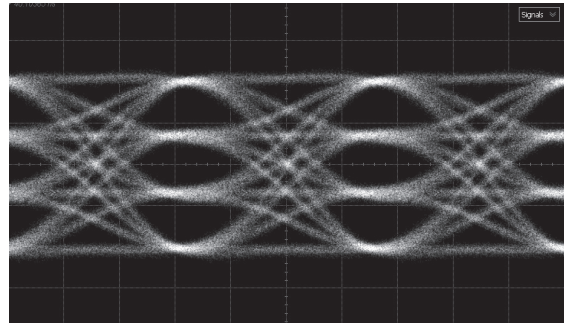
58 Gbaud PAM4

Typical Output Waveform (J1789A 40 cm Cable, 1400 mV Differential, PRBS15)

High-Sensitivity, Wideband PAM4 ED

116-Gbit/s PAM4 Signal Error-Free BER Measurement using High Input Sensitivity Function

Combining the PAM4 ED MU196040B with the PAM4 PPG supports BER measurements of 116-Gbit/s (58 Gbaud) PAM4 signals. Error-free BER measurement is achieved by the industry-best high sensitivity performance of 23 mV @26 Gbaud and 36 mV @53 Gbaud. The resulting high-accuracy BER measurements make it easy to troubleshoot previously difficult-to-analyze PAM4 devices. In addition, true DUT performance can be verified because even CEI-112G-VSR-defined worst-case stressed signals can be received at low-error rates (<E-8), exceeding the specifications.
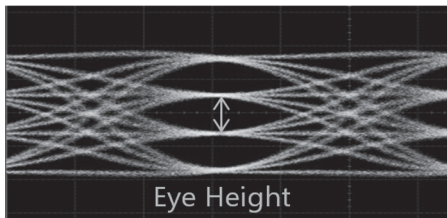
Error-Free Measurement of PAM3 Signals at 23 mV @26 Gbaud, and 36 mV @53Gbaud
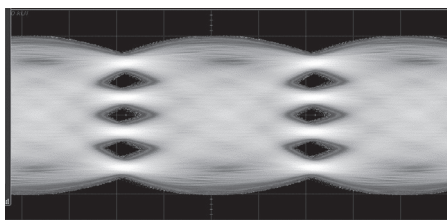
CEI-112G-VSR-defined Worst-Case Stressed PAM4 Signal
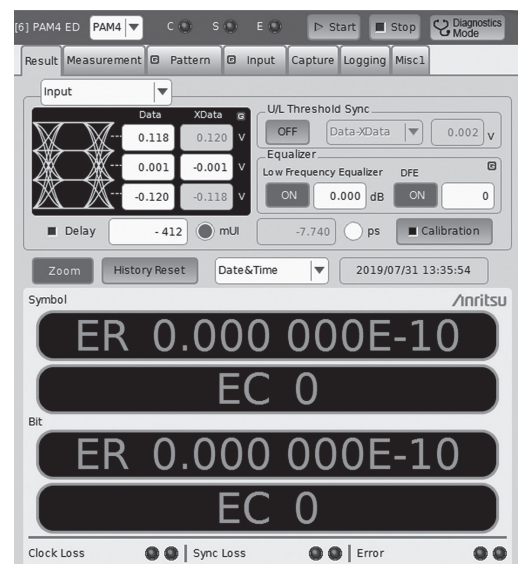
PAM4 BER Measurement Screen

https://www.anritsu.com

Real-time FEC Symbol Error and FEC Based Jitter Tolerance Measurement Functions

Uncorrectable Codeword and FEC Symbol Errors can be measured and displayed on one screen in real-time simultaneously with bit error measurements. Measurement of jitter tolerance and FEC Symbol Error per codeword distribution based on correctable/uncorrectable FEC is supported (MU196040B-042).

Both bit error and FEC Symbol Errors are measured at high speed.
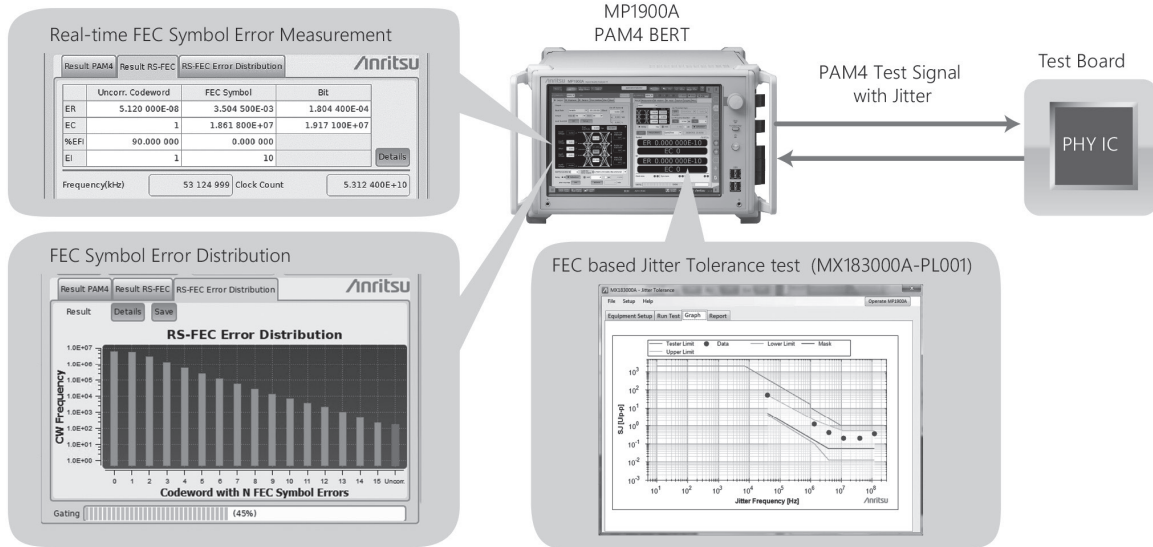
Multi Interface

Next-Generation High-Speed Digital Interface Receiver Test

The growth of IoT and Cloud computing applications is driving the need for digital equipment with high-speed serial interfaces handling large data volumes. To meet this need, the PCI Express (PCIe) and USB interfaces used by this digital equipment are transitioning to both next-generation PCIe Gen5 supporting speeds up to 32 GT/s as well as to Type-C USB3.2 Gen2 supporting 10 Gbit/s and USB4 supporting 20 Gbit/s, which is also compatible with Thunderbolt.

The MP1900A is a wideband BERT with a built-in Gbit/s-class PPG, ED, and Jitter/Noise addition functions as well as application software supporting measurement of next-generation, high-speed digital-interface standards (CEI-28G/56G/112G, InfiniBand, 100G/400G/800G Ethernet, Fibre Channel, Thunderbolt 3, PCIe, USB, SAS, DP) from development through to manufacturing.

**All-in-One
Test Support**

MP1900A

PCIe Gen3/4/5 Receiver Test
Base Specification
• Stressed Eye Test
CEM Specification
• Transmitter initial Tx Equalization
• Transmitter Link Equalization response
• Receiver Link Equalization
• PLL Bandwidth

**USB Type-C Receiver Test
(USB4, Thunderbolt3, DP1.4)**
Receiver Test
SJ Margin Test
Amplitude Margin Test
USB 3.2 Gen1/2 Receiver Test
Transmitter Eye Test
Receiver Jitter Tolerance Test

**Storage Receiver Test
(SAS-3/-4)**
Receiver Jitter Tolerance Test

Jitter Tolerance Test
SJ/RJ/BUJ Injection
Low-rate estimated BER measurement

Target Applications

General Interfaces
CEI-28G/56G/112G
InfiniBand
100G/400G/800G Ethernet
Fibre Channel
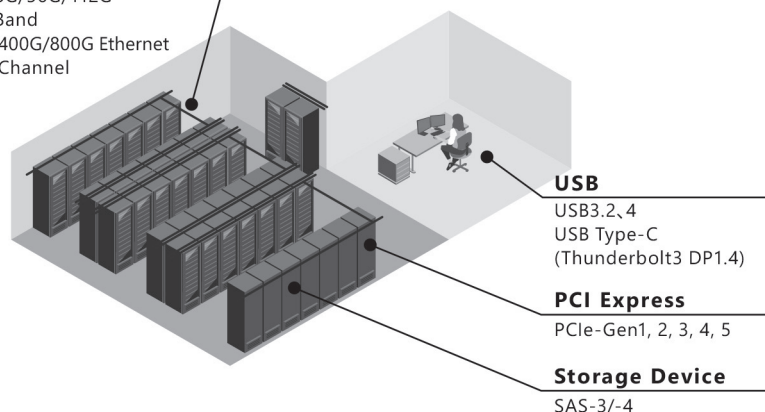
Various Applications

Internal and external interfaces, such as Ethernet, PCIe, and SAS, are supported along with USB3.2, 3.4, and Thunderbolt via USB Type-C connectors and cables, and Display Port.

MP1900A supports PCIe 3.0, 4.0 and 5.0 as well as SAS using the same configuration.

USB
USB3.2、4
USB Type-C
(Thunderbolt3 DP1.4)

PCI Express
PCIe-Gen1, 2, 3, 4, 5

Storage Device
SAS-3/-4

PAM4 PPG/ED Application Example

PAM4 SERDES IC, CDR IC Evaluations

Stress Function Built Into MP1900A Main Unit

PPG
- Multi-channels
- PAM4 Test Pattern
- PAM4 Level Control
- Emphasis Function
- Jitter/Noise Addition Function

Stress Addition

Calibrate and Confirm Test Signal at Oscilloscope

- Transmission Path Loss (ISI)
- Noise
- Jitter
- Crosstalk

Test Board

PHY IC

ED
- Clock Recovery
- Jitter Tolerance Measurement
- High Sensitivity
- <E-12 BER Rx Performance
- FEC Analysis, Capture

Required Test Items

- Stress Test
- BER and FEC Based Jitter Tolerance Test
- Burst error analysis with FEC symbol capture

TOSA, Driver IC Evaluations

Since the test-signal performance affects the IC performance at evaluation of parts such as TOSA and driver ICs used by optical transceivers requiring analog high-frequency performance, a reference test signal source with fast Tr/Tf and low Intrinsic Jitter is required.

Linear Driver 4 lane

TOSA 4 lane

53 Gbaud PAM4

53 Gbaud PAM4
53 Gbaud PAM4
53 Gbaud PAM4
53 Gbaud PAM4

E/O
E/O
E/O
E/O

MP1900A PPG modules

MP2110A Sampling Oscilloscope

PPG Emphasis adjusted automatically when MP2110A oscilloscope connected
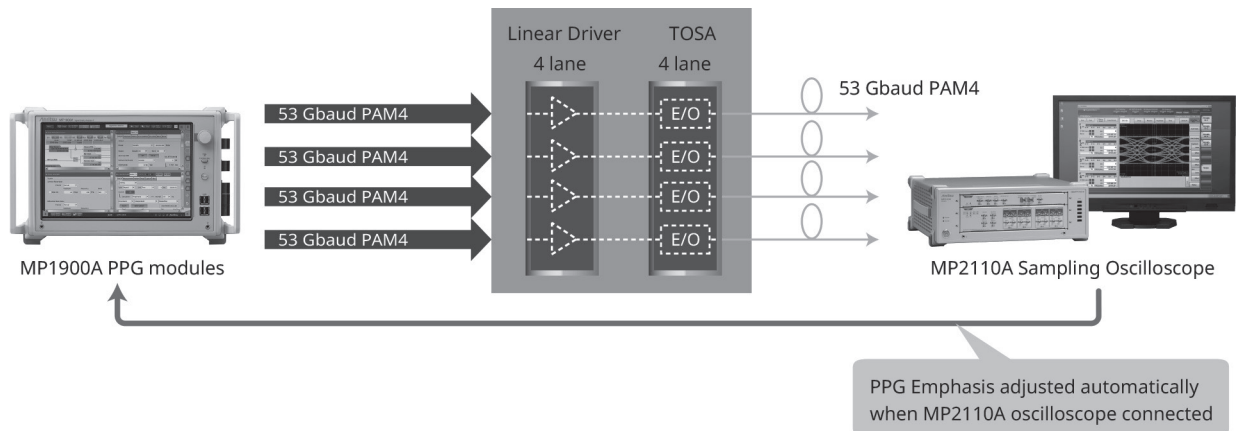
Required Test Items

- Multi-channel synchronous measurement
- Optimized TOSA TDECQ value using Emphasis and Linearity settings

Optical Module Evaluation

4ch PPG Synthesizer

PAM4 + Jitter

Optical Module

Quad Tx CDR

Quad Laser Driver

Quad Laser

MUX

53 Gbaud

4ch ED

Quad Rx CDR

Quad TIA

Quad PD

DEMUX

53 Gbaud × 4

MP1900A PPG/ED modules

MP2110A Sampling Oscilloscope
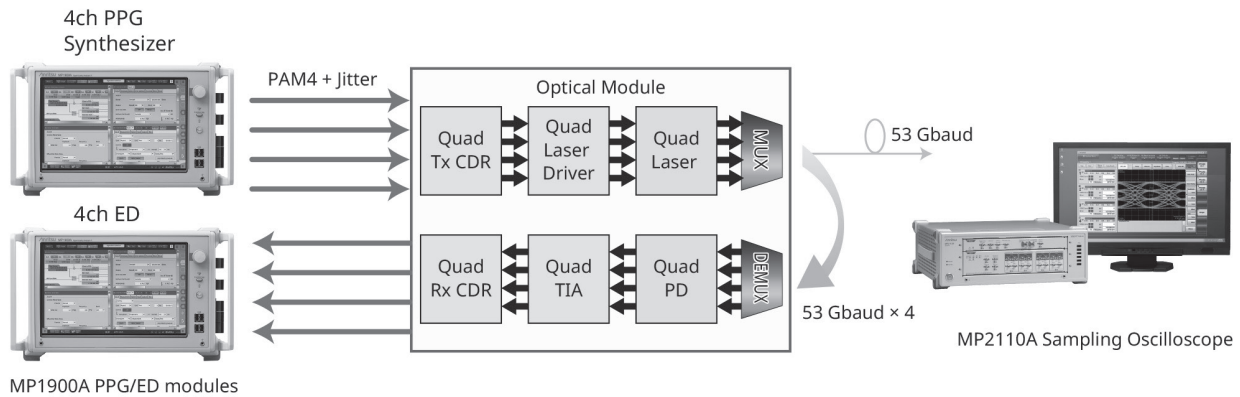
Required Test Items

• Simultaneous 4ch BER Measurement
• Optical output waveform optimized using Emphasis and Linearity Control
• Skew and Crosstalk Tests
• Jitter Tolerance Test

Multilane FEC Evaluation

FEC can be evaluated by combining the FEC pattern generation, error insertion, and reading the DUT bit error count.

Unit Sync. Control

800G Optical Transceiver

Rx   Tx

8 lanes

DSP/SERDES with FEC function

USB or Ethernet connection to capture error count

• 8ch Synchronization
• FEC Pattern Generation
• Synchronized Jitter Tolerance Test for All Channels
• Crosstalk Test
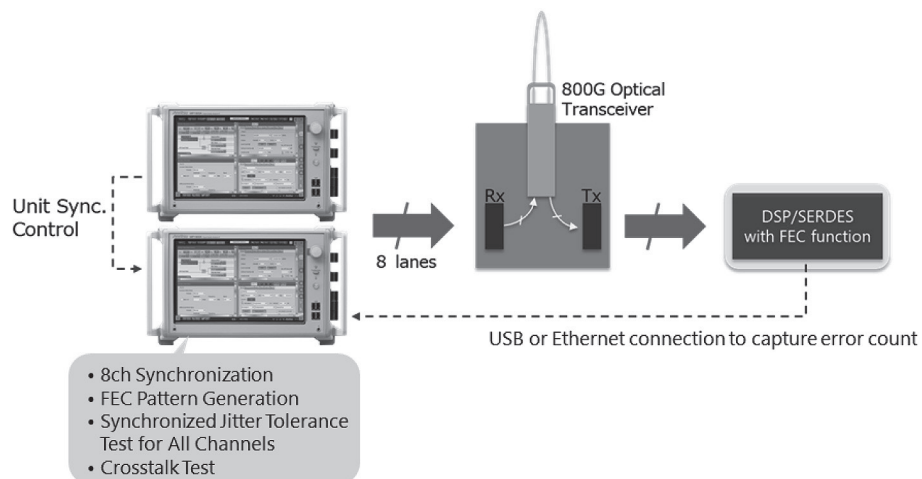
Required Test Items

• Generates synchronized multichannel FEC patterns for DUT-supported standards
• Supports shorter measurement time with simultaneous jittered and stressed measurement of all channels
• Measures FEC Symbol Error-based jitter tolerance
• Supports burst-error analysis and debugging using ED Capture Function

Active Cable Evaluation

4ch PPG
Jitter Modulation Source
Synthesizer

26.6 Gbaud × 8 Jittered Data

Clock

Data #1
Data #2
Data #3
Data #4

4ch ED

Data #1
Data #2
Data #3
Data #4

4ch PPG
Jitter Modulation Source

Data #5
Data #6
Data #7
Data #8

4ch 4ch

4ch 4ch

4ch ED

Data #5
Data #6
Data #7
Data #8

Required Test Items

- 8ch Simultaneous PAM4 BER Measurement (4ch both ways)
- Crosstalk Test
- Jitter Tolerance Test

PCIe Gen3/4/5 CEM Receiver Test

Automation Software

Remote Control for CAL

Oscilloscope

Link Training

Jitter Tolerance Test

For calibration

Rx in

CLB

PCIe5 Re-driver J1890A
+ AH54192A

Tx out

100 MHz Clock (Common)

DUT SYSTEM

MP1900A

PCIe CBB Controller
Z2025A

Synthesizer
Jitter Modulation Source
Noise Generation Source
PPG
ED

Required Items

- Link Training function
- Jitter Tolerance Test
- Emphasis Effect Validation
- Supports Common/Separate Clock Architecture

SAS-3/-4 Receiver Test

Automation Software

Test Report

SAS CM source (Optional)

DUT
(Storage Device)

to Error Detector

ISI
Generator*

Rx Signal

SAS
Receptacle Fixture

Test Signal +
Crosstalk Signal

Tx Signal

∗: Should use specified ISI generator by PCIe or SAS

Required Functions
- 12 Gbit/s to 22.5 Gbit/s BERTS
- Stressed Signal Calibration and Test
- Jitter Margin Test

USB Type-C Receiver Test (USB4, Thunderbolt3)

Automation Software

Test Report

Remote Control

Micro Controller

USB Cable

JTAG
Header Cable

ISI
Board

**Receptacle
Fixture**

DUT
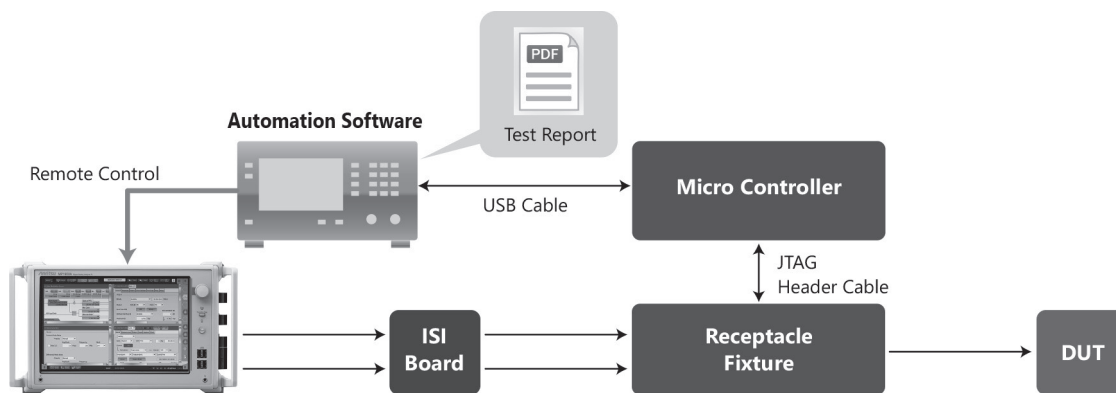
Required Functions
- 20 Gbit/s PPG
- Stressed Signal Calibration Function
- Jitter Tolerance Function

USB 3.2 Gen1/2 Receiver Test
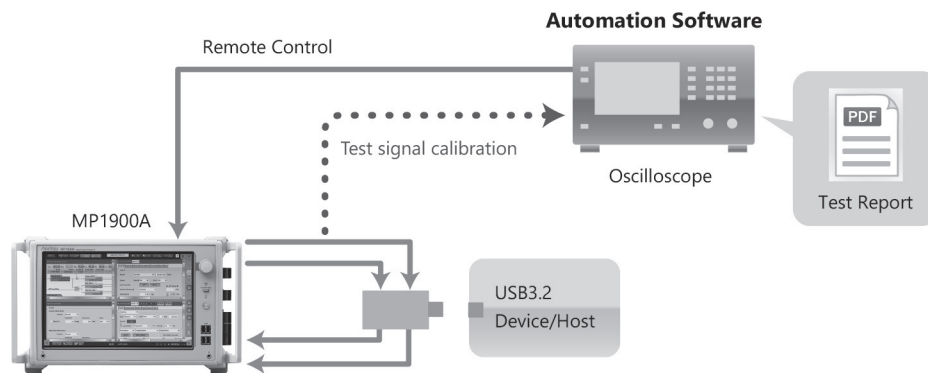
Required Functions
• Loopback State Setting Function
• Jitter Tolerance Function
• Automatic Receiver Test Function
• Link Training Function

DisplayPort1.4 Sink Test

Required Functions
• 2.7 Gbit/s to 8.1 Gbit/s PPG
• Stressed Signal Calibration and Test
• USB Type-C Alternative Mode Operation

Specifications
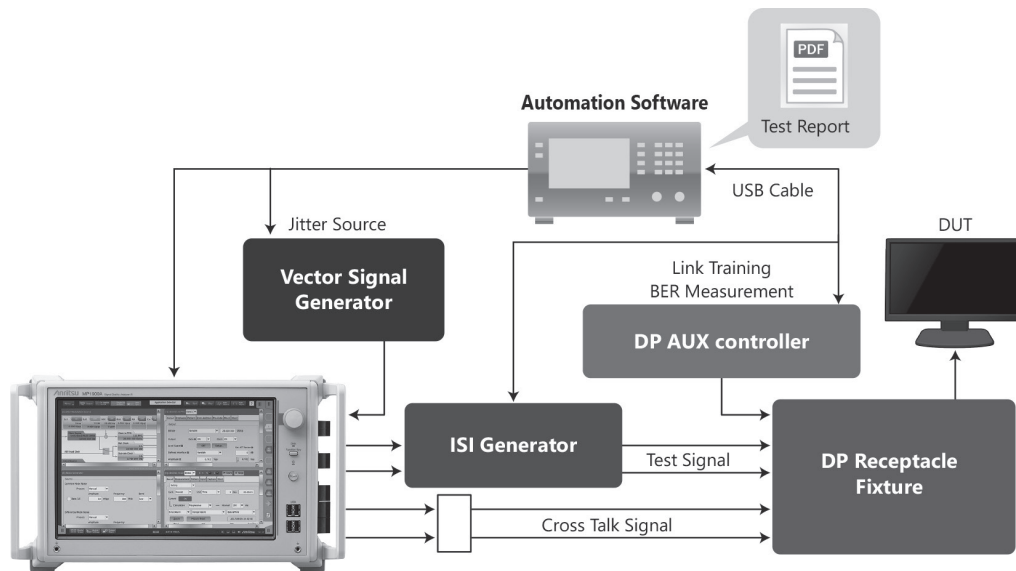
Refer to the MP1900A Data Sheet for detailed specifications.

Signal Quality Analyzer-R MP1900A

LCD		12.1" WXGA 1280 × 800
Remote Interface		GPIB, LAN
Module Slots		8
External Equipment Interface		USB × 6, VGA × 1, HDMI × 1
OS		Windows 10
Power Supply		100 VAC to 120 VAC, 200 VAC to 240 VAC, 50 Hz to 60 Hz Power consumption: 1350 VA max.
Dimensions and Mass		340 (W) × 222.5 (H) × 451 (D) mm, 20 kg (excluding modules)
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, (EU) 2015/863, EN IEC 63000: 2018

12.5 GHz 4 Port Synthesizer MU181000B

Clock Output	Number of Output: 4 Frequency Range: 0.1 GHz to 12.5 GHz, Steps: 1 kHz/1 MHz Level: 0.4 Vp-p to 1 Vp-p (AC) Connector: SMA (f), Termination: 50Ω/GND
10 MHz Input	Frequency: 10 MHz ±10 ppm Level: 0.5 Vp-p to 2.0 Vp-p Connector: BNC, Termination: 50Ω/GND
10 MHz Output	Level: 1.0 Vp-p ±30% (AC) Connector: BNC, Termination: 50Ω/GND
100 MHz Reference Signal Input (SSC Extension MU181000B-002)	Outputs either 100 MHz with phase deviation x25, x50, or x80 frequency-multiplied clock from Clock Output connector Supports PCI Express Host Reflclk input Modulation Frequency: 30 kHz to 33 kHz Level: 0.15 Vp-p to 1.3 Vp-p (AC) Connector: BNC

Jitter Modulation Source MU181500B

External Clock Input	Frequency Range: 0.800 000 GHz to 15.000 000 GHz Amplitude: 0.4 Vp-p to 1.0 Vp-p Connector: SMA (f), Termination: 50Ω/AC Coupling
Jittered Clock Output	Number of Output: 2 Amplitude: 0.4 Vp-p to 1.0 Vp-p Connector: SMA (f), Termination: 50Ω/AC Coupling
SJ1	Modulation Frequency: 10 Hz to 250 MHz Amplitude: 0 to 2000 UI @Modulation Frequency 10 kHz to 100 kHz 　　　　　　0 to 1 UI @Modulation Frequency 10 MHz to 250 MHz (Different depending on the operating bit rate)
Built-in SJ2	Modulation Frequency: 33 kHz, 87 MHz, 100 MHz, 210 MHz
Spread Spectrum Clocking (SSC)	Modulation Frequency: 28 kHz to 37 kHz Deviation: 0 to 7000 ppm
Random Jitter (RJ)	Bandwidth: 10 kHz to 1 GHz Amplitude: 0 to 0.5 UI (Different depending on the operating frequency)
Bounded Uncorrelated Jitter (BUJ)	PRBS Pattern Length: $2^n − 1$ (n = 7, 9, 11, 15, 23, or 31) BUJ Rate: 0.1 Gbit/s to 3.2 Gbit/s, 4.9 Gbit/s to 6.25 Gbit/s, 9.8 Gbit/s to 12.5 Gbit/s Filter Type (LPF 3 dB Bandwidth): 50, 100, 200, 300, 500 MHz, Through Amplitude: 0 to 0.5 UI (Different depending on the operating frequency)
External Jitter	Bandwidth: 10 kHz to 1 GHz

Noise Generator MU195050A

Number of Channels	2
Insertion Loss	−3 dB
CMI: Common Mode Noise	0.1 GHz to 6 GHz: Sinusoidal wave
DMI: Differential Mode Noise	2 GHz to 10 GHz: Sinusoidal wave
White Noise	10 MHz to 10 GHz
Crest Factor	>5

21G/32G bit/s SI PPG MU195020A

Operation Rate (NRZ)	2.4 Gbit/s to 21 Gbit/s or 32.1 Gbit/s
Number of Channels	1 or 2
Output Amplitude	0.1 Vp-p to 1.3 Vp-p (Single-end) 0.2 Vp-p to 2.6 Vp-p (Differential)
Emphasis	10Tap
Channel Emulator	Normal: Emulates Insertion Loss using S-parameter data Inverse: Performs De-Emphasis compensation for S-parameter Insertion Loss S-Parameter file: S2P,S4P
ISI	Emulates ISI output using CEI-28G/25G Nyquist frequency loss setting Supports loss control in combination with ISI Board J1758A accessory Insertion Loss setting: 1.5 to 25 dB, 0.01 dB step, Nyquist frequency 0 to 25 dB, 0.01 dB step, 1/2 Nyquist frequency
Tr/Tf (20 to 80%)	12 ps (typ.)
Random Jitter	115 fs rms (typ.)
PCIe, USB Link Training	Supported (MX183000A-PL021, MX183000A-PL022)
Output Connector	K (f)

21G/32G bit/s SI ED MU195040A

Operation Rate (NRZ)	2.4 Gbit/s to 21 Gbit/s or 32.1 Gbit/s
Number of Channels	1 or 2
Input Attitude	0.05 Vp-p to 1.0 Vp-p (Single-End) 0.1 Vp-p to 2.0 Vp-p (Differential)
Input Sensitivity (Eye Height)	15 mV (28.1 Gbit/s, NRZ) 30 mV/Eye (28.1 Gbaud, PRBS15, PAM4)
CTLE	Peak Frequency: 14, 8, 4 GHz Gain: 0 to –12 dB
Clock Recovery	Yes, supports SSC
PCIe, USB Link Training	Supported (MX183000A-PL021, MX183000A-PL022)
Input Connector	K (f)

PAM4 PPG MU196020A

Operation Rate (PAM4/NRZ)	2.4 Gbaud to 32.1/58.2/64.2 Gbaud (option selection)
No. of Channels	1
Output Amplitude	70 mVp-p to 800 mVp-p (Single-end) 140 mVp-p to 1600 mVp-p (Differential)
Offset	–2 V to +3.3 V
Emphasis	4 Tap, –20 to +20 dB
Channel Emulator	Generates waveform with insertion loss and simulates waveform with corrected insertion loss Set by loading S-Parameter file (S2 P, S4 P)
ISI	Simulates ISI generation waveform Set using loss (–8.00 to 8.00 dB) at CEI-specified Nyquist frequency Used in combination with channel board, such as J1800A/J1758A (optional accessories parts), or Noise Module MU195050A
Independently Variable PAM4 3 Eye	20 to 50% (PAM4 Amplitude 0/3 level = 100%)
PAM4 Pattern	SSPRQ, PRBS13Q, PRBS31Q, RS-FEC, etc.
PAM4 Pattern Error Addition	MSB Error, LSB Error, LSB&MSB Error, RS-FEC Symbol Error
Tr/Tf (20 to 80%)	8.5 ps (typ., NRZ)
Random Jitter	170 fs rms (typ., NRZ)
Output Connector	V (f)

PAM4 ED MU196040B

Operation Rates (PAM4/NRZ)	2.4 Gbaud to either 32.1 Gbaud, or 58.2 Gbaud (PAM4)/64.2 Gbaud (NRZ) (option selection)
No. of Channels	1
Input Amplitude	NRZ: ≤32.1G: 0.05 Vp-p to 1.0 Vp-p, >32.1G: 0.1 Vp-p to 1.0 Vp-p PAM4: ≤32.1G: 0.3 Vp-p to 1.0 Vp-p, >32.1G: 0.4 Vp-p to 1.0 Vp-p
Input Sensitivity (Eye Height)	NRZ: 19 mV @ 26.5625 Gbaud, 21 mV @ 53.125 Gbaud PAM4: 23 mV @ 26.5625 Gbaud, 36 mV @ 53.125 Gbaud
Clock Recovery (Option)	2.4 Gbaud to 32.1 Gbaud, 51 Gbaud to 58.2 Gbaud
Equalizer (Option)	Low-frequency Equalizer (≤1 GHz, 2 dB typ.) + DFE (1.4 dB typ.)
PAM4 Patterns	SSPRQ, PRBS13Q, PRBS31Q, etc.
PAM4 Counter	MSB, LSB, Symbol 0 to 3 (Option)
Input Connector	V (f)

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

MP1900A

Model/Order No.	Name	
	Main Frame*1	
MP1900A	Signal Quality Analyzer-R	
	Standard Accessories	
G0342A	ESD DISCHARGER:	1
J1211	POWER CORD. 3M:	1
J1627A	GND connection cable:	1
P0031A	USB Memory:	1
Z0306A	Wrist Strap:	1
	Retrofit Option	
MP1900A-110	Windows10 Upgrade Retrofit*2	
	Maintenance Service	
MP1900A-ES310	Three Years Extended Warranty Service	
MP1900A-ES510	Five Years Extended Warranty Service	

*1: The Windows 10 OS will be installed in all orders from July 1, 2020.
*2: MP1900A main units running Windows Embedded Standard 7 are retrofitted
to Windows 10 using a hardware upgrade. Anritsu destroys the unnecessary,
post-upgrade Windows Embedded Standard 7 parts.
For details, contact our sales representative

MU181000B

Model/Order No.	Name	
	Module	
MU181000B	12.5 GHz 4port Synthesizer	
	Standard Accessories	
J1624A	Coaxial Cable 0.3 m (SMA, DC to 18 GHz):	4 pcs
	Option	
MU181000B-001	Jitter Modulation	
MU181000B-002	SSC Extension	
	Retrofit Option	
MU181000B-101	Jitter Modulation Retrofit	
MU181000B-102	SSC Extension Retrofit	
	Maintenance Service	
MU181000B-ES310	Three Years Extended Warranty Service	
MU181000B-ES510	Five Years Extended Warranty Service	

MU181500B

Model/Order No.	Name	
	Module	
MU181500B	Jitter Modulation Source	
	Standard Accessories	
J1624A	Coaxial Cable 0.3 m (SMA, DC to 18 GHz):	1 pc
J1508A	BNC-SMA Connector Cable (30 cm):	2 pcs
J1137	Terminator:	6 pcs
J1341A	Open:	2 pcs
Z0897A	MP1800A Manual CD:	1 pc
Z0918A	MX180000A Software CD:	1 pc
	Maintenance Service	
MU181500B-ES310	Three Years Extended Warranty Service	
MU181500B-ES510	Five Years Extended Warranty Service	

MU195050A

Model/Order No.	Name	
	Module	
MU195050A	Noise Generator	
	Standard Accessories	
J1632A	Terminator:	4
J1359A	Coaxial Adapter (K-P, K-J, SMA):	4
J1717A	COAXIAL ADAPTOR (SMA-P, SMA-J):	2
J1341A	Open:	6
J1746A	Skew Match Pair Semrigid Cable	
	(K connector, Data Input1):	1 set
J1747A	Skew Match Pair Semrigid Cable	
	(K connector, Data Input2):	1 set
J1792A	Skew Match Pair Semrigid Cable	
	(V-K connector, MU196020A PPG Output to	
	MU195050A Noise Data Input1):	1 set
	Option	
MU195050A-001	White Noise	
	Retrofit Option	
MU195050A-101	White Noise Retrofit	
	Maintenance Service	
MU195050A-ES310	Three Years Extended Warranty Service	
MU195050A-ES510	Five Years Extended Warranty Service	

MU195020A

Model/Order No.	Name	
	Module	
MU195020A	21G/32G bit/s SI PPG	
	Standard Accessories	
J1632A	Terminator:	5
J1341A	Open:	2
J1359A	Coaxial Adapter (K-P, K-J, SMA):	1
J1717A	COAXIAL ADAPTOR (SMA-P, SMA-J):	6
	Option	
MU195020A-001	32G bit/s Extension	
MU195020A-010	1ch Data Output	
MU195020A-020	2ch Data Output	
MU195020A-011	1ch 10Tap Emphasis	
MU195020A-021	2ch 10Tap Emphasis	
MU195020A-030	1ch Data Delay	
MU195020A-031	2ch Data Delay	
MU195020A-040	1ch Variable ISI	
MU195020A-041	2ch Variable ISI	
MU195020A-050	Sequence Editor Function*3	
MU195020A-051	Sequence Editor Function PCIe 5 Extension*3	
	Retrofit Options	
MU195020A-101	32G bit/s Extension Retrofit	
MU195020A-120	2ch Data Output Retrofit	
MU195020A-111	1ch 10Tap Emphasis Retrofit	
MU195020A-121	2ch 10Tap Emphasis Retrofit	
MU195020A-130	1ch Data Delay Retrofit	
MU195020A-131	2ch Data Delay Retrofit	
MU195020A-140	1ch Variable ISI Retrofit	
MU195020A-141	2ch Variable ISI Retrofit	
MU195020A-350	Sequence Editor Function Retrofit	
	When Option 010/110 Installed	
J1632A	Terminator:	2
J1359A	Coaxial Adapter (K-P, K-J, SMA):	2
	When Option 020/120 Installed	
J1632A	Terminator:	4
J1359A	Coaxial Adapter (K-P, K-J, SMA):	4
	Maintenance Service	
MU195020A-ES310	Three Years Extended Warranty Service	
MU195020A-ES510	Five Years Extended Warranty Service	

*3: Option 050 supports PCIe Gen 1 to Gen 4, and USB 3.2 ×1.
Option 051 supports PCIe Gen5. Option 050 is required when adding Option 051.

MU196020A*8

Model/Order No.	Name	
	Module	
MU196020A	PAM4 PPG	
	Standard Accessories	
J1632A	TERMINATOR:	4
V210	TERMINATOR (V):	2
J1341A	OPEN:	2
J1359A	COAXIAL ADAPTOR (K-P.K-J,SMA):	1
J1717A	COAXIAL ADAPTOR(SMA-P.SMA-J):	5
	Option	
MU196020A-001	32G baud*	
MU196020A-002	58G baud*	
MU196020A-003	64G baud*	
MU196020A-011	4Tap Emphasis	
MU196020A-030	Data Delay	
MU196020A-040	Adjustable ISI	
MU196020A-042	FEC Pattern Generation	
MU196020A-050	Inter-Module Synchronization	
	Retrofit Options	
MU196020A-112	32G to 58G baud Extension Retrofit	
MU196020A-113	32G to 64G baud Retrofit	
MU196020A-123	58G to 64G baud Retrofit	
MU196020A-111	4Tap Emphasis Retrofit	
MU196020A-130	Data Delay Retrofit	
MU196020A-140	Adjustable ISI Retrofit	
MU196020A-142	FEC Pattern Generation Retrofit	
MU196020A-150	Inter-Module Synchronization Retrofit	
	Maintenance Service	
MU196020A-ES310	Three Years Extended Warranty Service	
MU196020A-ES510	Five Years Extended Warranty Service	

*: Select any one

MU195040A

Model/Order No.	Name	
	Module	
MU195040A	21G/32G bit/s SI ED	
	Standard Accessories	
J1632A	Terminator:	2
J1341A	Open:	1
J1717A	COAXIAL ADAPTOR (SMA-P, SMA-J):	4
	Option	
MU195040A-001	32G bit/s Extension	
MU195040A-010	1ch ED	
MU195040A-020	2ch ED	
MU195040A-011	1ch CTLE	
MU195040A-021	2ch CTLE	
MU195040A-022	Clock Recovery	
	Retrofit Options	
MU195040A-101	32G bit/s Extension Retrofit	
MU195040A-120	2ch ED Retrofit	
MU195040A-111	1ch CTLE Retrofit	
MU195040A-121	2ch CTLE Retrofit	
MU195040A-122	Clock Recovery Retrofit	
	When Option 010/110 Installed	
J1341A	Open:	3
J1359A	Coaxial Adapter (K-P, K-J, SMA):	2
41KC-6	Fixed Attenuator 6 dB:	2
	When Option 020/120 Installed	
J1341A	Open:	5
J1359A	Coaxial Adapter (K-P, K-J, SMA):	4
41KC-6	Fixed Attenuator 6 dB:	4
	Maintenance Service	
MU195040A-ES310	Three Years Extended Warranty Service	
MU195040A-ES510	Five Years Extended Warranty Service	

MU196040B*8

Model/Order No.	Name	
	Module	
MU196040B	PAM4 ED	
	Standard Accessories	
J1632A	TERMINATOR:	2
V210	TERMINATOR (V):	2
J1341A	OPEN:	2
J1359A	COAXIAL ADAPTOR (K-P.K-J,SMA):	1
J1717A	COAXIAL ADAPTOR (SMA-P.SMA-J):	3
41V-6	Fixed Attenuator 6 dB:	2
	Option	
MU196040B-001	32G baud (2.4G to 32.1G)	
MU196040B-002	58G baud (NRZ: 2.4G to 64.2G, PAM4: 2.4G to 58.2G)	
MU196040B-011	Equalizer	
MU196040B-021	29G baud Clock Recovery (2.4G to 29G)	
MU196040B-022	32G baud Clock Recovery (2.4G to 32.1G)	
MU196040B-023	58G baud Clock Recovery Extension (51G to 58.2G)	
MU196040B-041	SER Measurement	
MU196040B-042	FEC Analysis	
	Retrofit Options	
MU196040B-111	Equalizer Retrofit	
MU196040B-112	32G to 58G baud Extension Retrofit	
MU196040B-121	29G baud Clock Recovery Retrofit	
MU196040B-122	32G baud Clock Recovery Retrofit	
MU196040B-123	58G baud Clock Recovery Extension Retrofit	
MU196040B-124	32G baud Clock Recovery Extension Retrofit	
MU196040B-141	SER Measurement Retrofit	
MU196040B-342	FEC Analysis Retrofit	
	Maintenance Service	
MU196040B-ES310	Three Years Extended Warranty Service	
MU196040B-ES510	Five Years Extended Warranty Service	

MU183020A

Model/Order No.	Name	
	Module	
MU183020A	28G/32G bit/s PPG	
	Standard Accessories	
J1137	Terminator:	3 pcs
J1359A	Coaxial Adaptor (K-P, K-J, SMA):	1 pc
J1341A	Open:	1 pc
J0541E	6 dB Fixed Attenuator:	1 pc
Z0897A	MP1800A Manual CD:	1 pc
Z0918A	MX180000A Software CD:	1 pc
	Options	
MU183020A-001	32G bit/s Extension	
MU183020A-012	1ch 2 V Data Output	
MU183020A-013	1ch 3.5 V Data Output	
MU183020A-022	2ch 2 V Data Output	
MU183020A-023	2ch 3.5 V Data Output	
MU183020A-030	1ch Data Delay	
MU183020A-031	2ch Data Delay	
	Retrofit Options	
MU183020A-101	32G bit/s Extension Retrofit	
MU183020A-112	1ch 2 V Data Output Retrofit	
MU183020A-113	1ch 3.5 V Data Output Retrofit	
MU183020A-122	2ch 2 V Data Output Retrofit	
MU183020A-123	2ch 3.5 V Data Output Retrofit	
MU183020A-130	1ch Data Delay Retrofit	
MU183020A-131	2ch Data Delay Retrofit	
	Standard Accessories for MU183020A-x12, x13	
J1137	Terminator:	2 pcs
J1359A	Coaxial Adaptor (K-P, K-J, SMA):	2 pcs
	Standard Accessories for MU183020A-x22, x23	
J1137	Terminator:	4 pcs
J1359A	Coaxial Adaptor (K-P, K-J, SMA):	4 pcs
	Maintenance Service	
MU183020A-ES310	Three Years Extended Warranty Service	
MU183020A-ES510	Five Years Extended Warranty Service	

MU183040B

Model/Order No.	Name	
	Module	
MU183040B	28G/32G bit/s High Sensitivity ED	
	Standard Accessories	
J1137	Terminator:	2 pcs
J1341A	Open:	1 pc
Z0897A	MP1800A Manual CD:	1 pc
Z0918A	MX180000A Software CD:	1 pc
	Options	
MU183040B-001	32 Gbit/s Extension	
MU183040B-010	1ch ED	
MU183040B-020	2ch ED	
MU183040B-022	2.4G to 28.1G bit/s Clock Recovery	
MU183040B-023	25.5G to 32.1G bit/s Clock Recovery	
	Retrofit Options	
MU183040B-101	32 Gbit/s Extension Retrofit	
MU183040B-110	1ch ED Retrofit	
MU183040B-120	2ch ED Retrofit	
MU183040B-122	2.4G to 28.1G bit/s Clock Recover Retrofit	
MU183040B-123	25.5G to 32.1G bit/s Clock Recovery Retrofit	
	Standard Accessories for MU183040B-x10	
J1341A	Open:	2 pcs
J1359A	Coaxial Adaptor (K-P, K-J, SMA):	2 pcs
41KC-6	Precision Fixed Attenuator 6 dB:	2 pcs
	Standard Accessories for MU183040B-x20	
J1341A	Open:	4 pcs
J1359A	Coaxial Adaptor (K-P, K-J, SMA):	4 pcs
41KC-6	Precision Fixed Attenuator 6 dB:	4 pcs
	Maintenance Service	
MU183040B-ES310	Three Years Extended Warranty Service	
MU183040B-ES510	Five Years Extended Warranty Service	

Software

Model/Order No.	Name
MX183000A	High-Speed Serial Data Test Software
MX183000A-PL001	Jitter Tolerance Test
MX183000A-PL011	PCIe Link Sequence
MX183000A-PL021	PCIe Link Training*4
MX183000A-PL022	USB Link Training*5
MX183000A-PL023	USB 3.2 × 2 Link Training*5
MX183000A-PL025	PCIe 5 Link Training*4
MX183000A-PL031	DUT Error Counts Import

*4: The PL021 option supports PCIe Gen1 to Gen4.
   The PL025 option supports PCIe Gen5. PL021 is required to add PL025.

*5: PL022 supports USB 3.2 ×1. PL023 supports USB 3.2 ×2.
   PL022 is required to add PL023.

On Using VISA*6

The National Instruments™ (NI hereafter) NI-VISA*7 software must be installed to use the MX183000A (this product hereafter). We recommend using NI-VISA saved on the product USB memory stick. Customers may only use NI-VISA saved on the product memory stick. NI-VISA on the memory stick may not be used for other applications with other products.
When uninstalling this product from the controller PC, etc., also uninstall NI-VISA from the USB memory.

*6: Abbreviation for Virtual Instrument Software Architecture. This is I/O software for remote control of measuring instruments via GPIB, Ethernet and USB interfaces.

*7: NI-VISA was developed by National Instruments for VXI Plug&Play Alliance standards compliant I/O interfaces.
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Optional Accessories

| Model/Order No.	Name
J1632A	Terminator
V210	TERMINATOR (V)
J1678A	ESD Protection Adapter-K
J1679A	ESD Protection Adapter-V
J1359A	Coaxial Adapter (K-P, K-J, SMA)
34VFK50A	Fixed Adapter (V-F, K-M)*8
34VKF50A	Fixed Adapter (V-M. K-F)
41KC-3	Fixed Attenuator 3 dB
41KC-6	Fixed Attenuator 6 dB
41KC-10	Fixed Attenuator 10 dB
41KC-20	Fixed Attenuator 20 dB
41VA-3	Fixed Attenuator 3 dB
41VA-6	Fixed Attenuator 6 dB
41VA-10	Fixed Attenuator 10 dB
41VA-20	Fixed Attenuator 20 dB
J1758A	ISI Board
J1800A	ISI Board V
K261	DC Block
K240C	Precision Power Divider
V240C	Fixed Power divider

Model/Order No.	Name
J1510A	Pick OFF Tee (K)
J1793A	Pick OFF Tee (V)
K241C	Power Splitter
J1748A	Power Splitter (1.5 GHz to 18 GHz, SMA, using MU195020A × 4 to MU181500B connection)
J1624A	COAXIAL CABLE 0.3 m (18 GHz and SMA)
J1342A	COAXIAL CABLE 0.8 m (APC3.5 connector)
J1439A	Coaxial cable (0.8 m, K connector)
J1625A	Coaxial Cable 1 m (18 GHz, SMA)
J1449A	Measurement kit (J1324A × 2, J1439A × 2, J1625A × 1)
J1550A	Coaxial skew match cable (0.8 m, APC3.5 connector)
J1551A	Coaxial skew match cable (0.8 m, K connector)
J1728A	Electrical Length Specified Coaxial Cable (0.4 m, K connector)
J1741A	Electrical Length Specified Coaxial Cable (0.8 m, K Connector)
J1789A	Electrical Length Specified Coaxial Cable*8 (0.4 m, V connector)
J1790A	Electrical Length Specified Coaxial Cable*8 (0.8 m, V connector)
J1792A	Skew match pair semirigid cable (V-K connector, MU196020A PPG Output to MU195050A Noise Data Input1)
J1761A	PCIe Reference Clock Cable Kit
Z2025A	PCIe CBB Controller
Z2029A	PCIe Reference Clock Buffer
J1890A	PCIe5 Re-Driver Set
AH54192A	56Gbaud Differential Linear Amplifier
W3911AE	MP1900A Operation Manual
W3913AE	MX190000A Operation Manual
W3813AE	MX183000A Operation Manual
W3915AE	MU195020/40/50A Operation Manual
W3976AE	MU196020/40A OPERATION MANUAL
B0576A	Blank Panel
B0736A	Front Cover (For MP1900A)
B0737A	Carrying Case (For MP1900A, with B0736A)
B0738A	Rack Mount Kit (For MP1900A)
Z1746A	Stylus
Z0541A	USB Mouse
J0008	GPIB CABLE, 2.0 m
Z0917A	Shielded LAN Cable, 5 m
Z1953A	Gigabit Ethernet Switch (5 Port)
Z0306A	Wrist Strap
Z1964A	Torque Wrench (Right Angle)

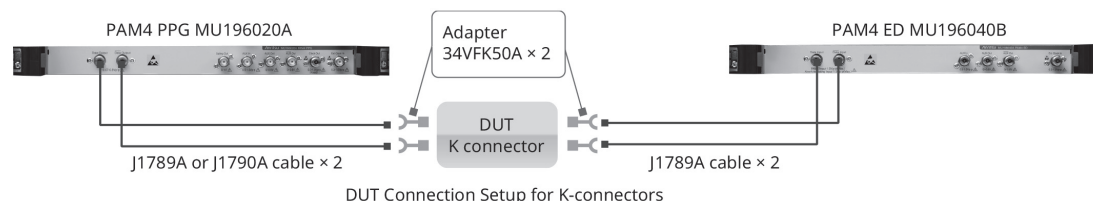### J1815A MP1900A PCIe Measurement Component Set

The following table lists the component set required by the PCIe Tx/Rx LEQ test.

Model/Order No.	Name	Qty.	Application
J1551A	Coaxial skew match cable (0.8 m, K connector)	4	Tx LEQ, Rx LEQ
J1625A	Coaxial cable (1 m, SMA connector)	2	Tx LEQ, Rx LEQ
J1510A	Pick OFF Tee	2	Tx LEQ
J1761A	PCIe Reference Clock Cable Kit	2	Tx LEQ, Rx LEQ
K261	DC Block	2	Tx LEQ
K241C	Power Splitter	2	Tx LEQ

*8: We recommend using either the J1789A or J1790A as the coaxial cable for the MU196020A data output. Recommend using coaxial cable J1789A for MU196040B Data IN. The MU196020A data output specifications are defined based on the performance observed using a 70-GHz bandwidth oscilloscope connected as shown below.

PAM4 PPG MU196020A
J1789A or J1790A cable × 2
Test point
70 GHz BW Sampling Oscilloscope
DUT
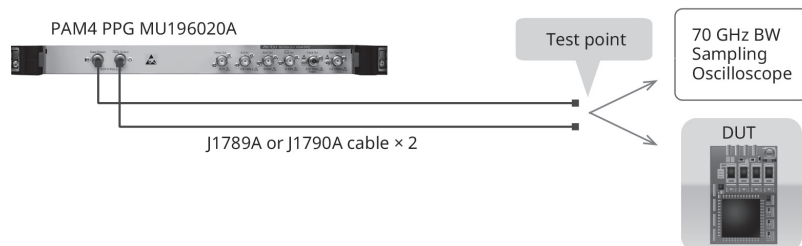
The MU196020A Data OUT and MU196040B Data IN connectors, and the J1789A/J1790A cables all use V-connectors. Consequently, for K-connectors, use 34VFK50A adapters as shown in the following figure.

PAM4 PPG MU196020A
Adapter 34VFK50A × 2
PAM4 ED MU196040B
J1789A or J1790A cable × 2
DUT K connector
J1789A cable × 2

DUT Connection Setup for K-connectors

BERTWave™

MP2110A

Development and Manufacturing of Multi-channel Optical Modules for 10G to 800G

Excellent Eco Product

Data traffic volumes are exploding with the spread of fixed-rate video streaming and cloud services.
As a result, there is a need for optical interfaces for transmission equipment supporting speeds of more than 10 Gbit/s as 100 GbE and even 400 GbE and 800 GbE networks are deployed. However, there are increasing requests for less-expensive optical interfaces due to major problems with how to increase line productivity and cut costs.
The BERTWave MP2110A is an all-in-one instrument with built-in BERT (Bit Error Rate Tester) and Sampling Oscilloscope (Eye pattern analysis) designed for manufacturing inspection of 10G to 800G optical modules.
It helps increase line productivity and cuts costs.

All In One
All-in-one 4ch 28.2Gbit/s BERT + 4ch sampling oscilloscope
There is a built-in Clock Recovery Unit for
Sampling Oscilloscope

Low Cost
Easy, fast and high-sensitivity analysis of PAM4 signals including TDECQ with support for clock recovery

NRZ/ PAM4 Analysis
Customized test systems can be configured as necessary by combining options freely.

250 ksamples/s
The high-speed sampling oscilloscope captures 1 million samples in 4 seconds.
Measurement times are slashed by measuring four channels in parallel. Built-in PC for Stable Operation

-15 dBm Sensitivity
The high-sensitivity sampling oscilloscope supports accurate performance even for PAM4 signals with a closed Eye opening, and for optical signals attenuated by optical switches, etc.

Supported Applications:
Evaluation of physical-layer performance for 10G/25G/50G/100G/200G/400G/800G optical transport modules, optical cables, and associated parts used by data centers, Core/Metro networks, 4G/5G mobile backhaul, and 5G mobile fronthaul

Transmission Paths:
 Ethernet, eCPRI/RoE, CPRI, SDH/SONET, OTN, InfiniBand, Fibre Channel
Optical Transceiver Modules:
 SFP28, QSFP28, CFP2/4/8, SFP56, QSFP56, OSFP, QSFP-DD
Cables:
 Active Optical Cables (AOC), Direct Attach Cables (DAC)
Devices:
 TOSA, ROSA, High-Speed Optical Engine, PHY, Driver ICs

Configuring Efficient Measurement System: Integrated BERT and Sampling Oscilloscope

Previous measurement systems were extremely complex due to the need for a separate BERT as the signal source and a sampling oscilloscope for Eye pattern analysis. Incorporating a BERT and sampling oscilloscope into the All-in-one BERTWave MP2110A greatly simplifies measurement system configuration.

Installing the BERT and sampling-oscilloscope options for up to 4ch in one unit makes it easy to implement simultaneous TRx measurements of optical modules, such as multichannel QSFP, and devices using an easily configured and controlled measurement system. This helps cut growing measurement times as the number of channels increases with development of multichannel optical modules and devices.

Previous — Switching — BERT ▶ Oscilloscope
Poor Efficiency, Long Time

MP2110A — BERT Oscilloscope CRU
No Switching Necessary, Simple Measurement System

With a BERT and sampling oscilloscope in one box, measurement results can be captured all at once along with simultaneous Eye pattern display. As a result, all the measurement results needed to evaluate multi-channel optical modules and devices can be seen at a glance, reducing measurement times by large margins.

BER measurement results (left) and Eye Pattern analysis results (right) are displayed simultaneously.
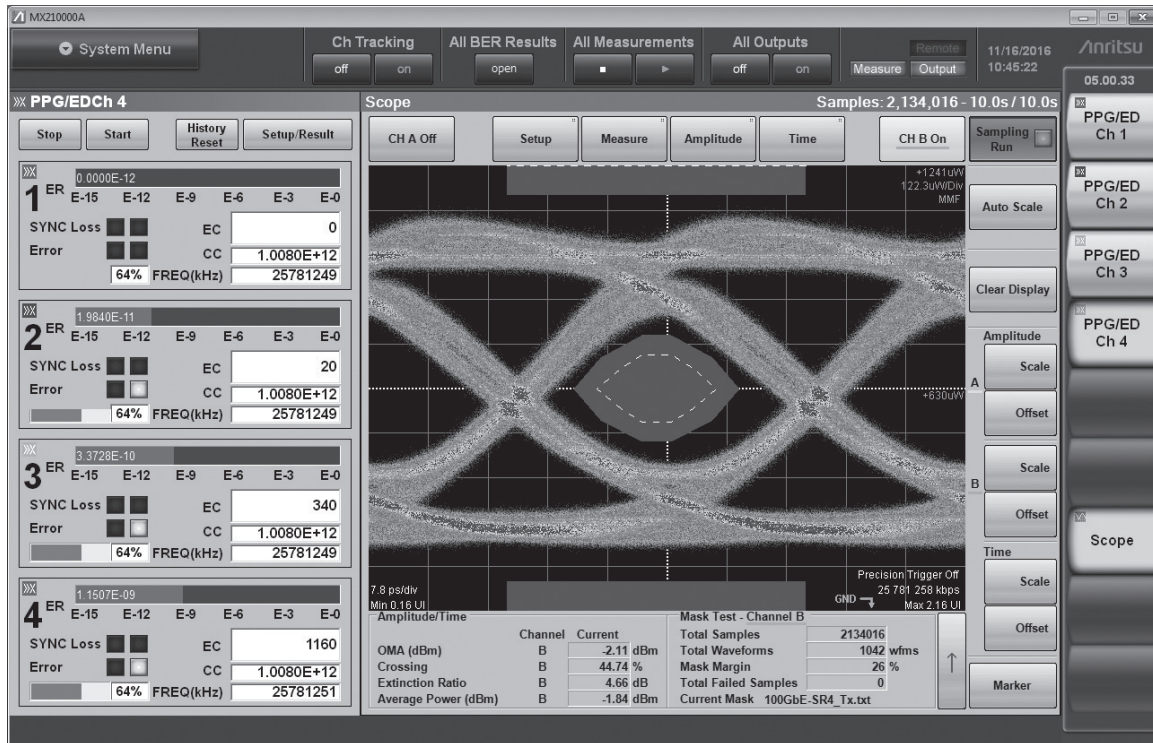
Simply setting one channel of the MP2110A sets all channels simultaneously.
Operation is easy with simple settings and user interface. Remote commands are backwards-compatible with all BERTWave series, such as the MP2100B, facilitating instrument upgrades.

Configuring Efficient Measurement System: Both Simultaneous All-Channel and Individual-Channel Measurement

As well as all-at-once simultaneous measurement of all channels using the sampling oscilloscope and BERT, individual channels can be measured separately. An evaluation system matching the application can be configured easily because both multichannel modules and multiple single-channel modules can be measured all at once.
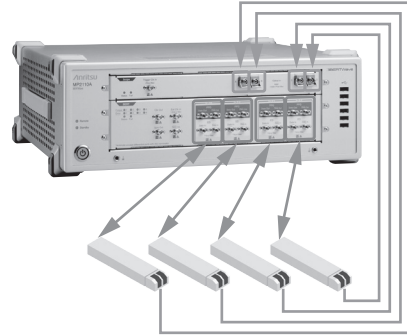
Simultaneous All-Channel Measurement

4 Lane

4 Lane
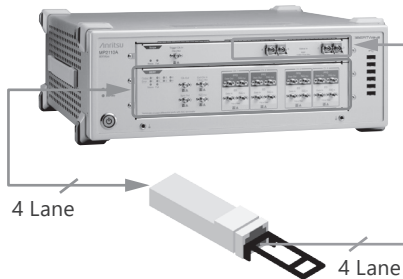
All-at-once test of quad-lane module using simultaneous measurement of all channels

↓

Shorter test times increase throughput

Parallel-Channel Measurement

Parallel test of four single-lane modules using separate measurement of each channel

↓

Reduced cost per channel cuts capital investment

Supports both simultaneous and parallel test methods
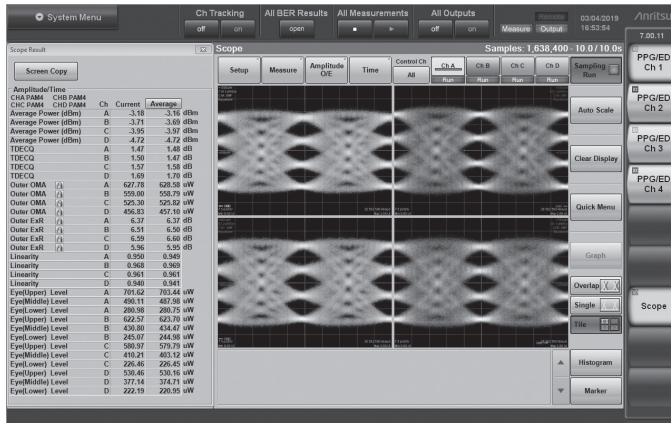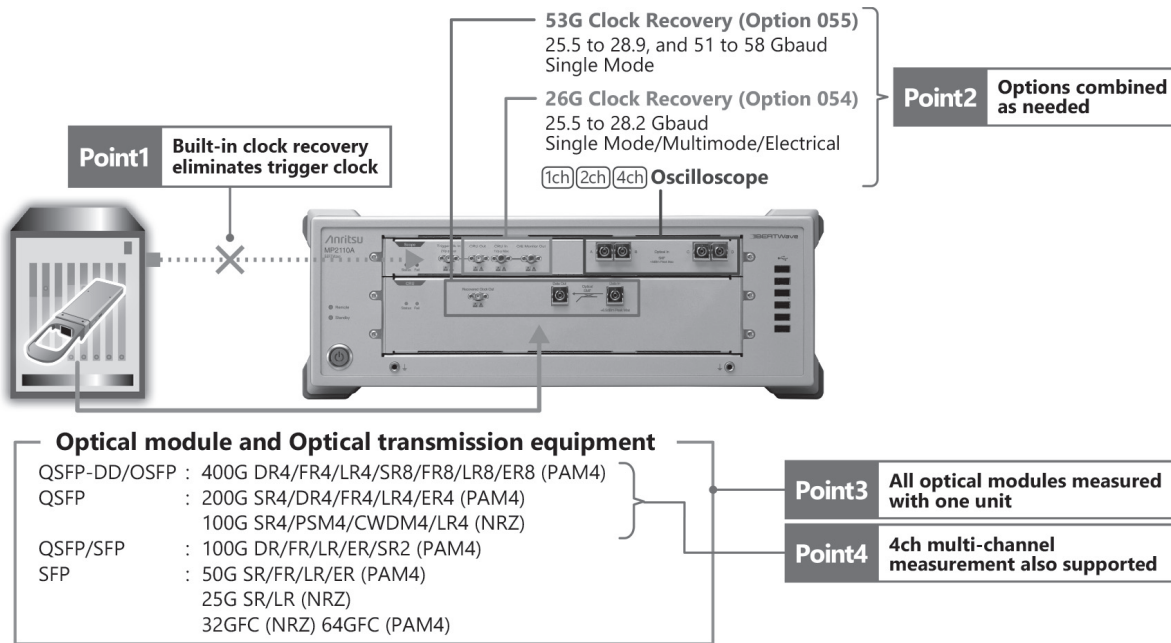

4ch PAM4 TDECQ Measurement
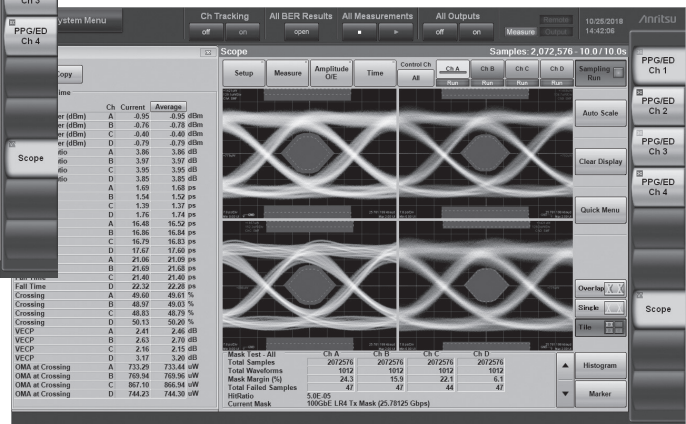
4ch NRZ Mask Margin Measurement

Supports both NRZ and PAM4

Configuring Efficient Measurement System: Built-in Clock Recovery

Accommodates Built-in NRZ/PAM4 Clock Recovery Unit (CRU)

Sampling oscilloscopes for signal waveform quality evaluation require a separate trigger clock signal synchronized with the data signal, but transmission equipment with built-in optical modules and 50G to 800G optical modules outputting PAM4 signals sometimes do not have a trigger signal. In this case, the trigger signal is generated from the data signal using clock recovery. This optional Clock Recovery Unit (CRU) can be installed in the BERTWave MP2110A Sampling Oscilloscope.

53G Clock Recovery (Option 055)
25.5 to 28.9, and 51 to 58 Gbaud
Single Mode

26G Clock Recovery (Option 054)
25.5 to 28.2 Gbaud
Single Mode/Multimode/Electrical

1ch 2ch 4ch **Oscilloscope**

Point1 Built-in clock recovery eliminates trigger clock

Point2 Options combined as needed

Optical module and Optical transmission equipment

QSFP-DD/OSFP : 400G DR4/FR4/LR4/SR8/FR8/LR8/ER8 (PAM4)
QSFP : 200G SR4/DR4/FR4/LR4/ER4 (PAM4)
100G SR4/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

MP2110A Optical Module Measurement Solution using Clock Recovery Options

Excellent Operability at Lower Cost

Since this clock recovery is built-in, it offers excellent operability at a lower price. The space-saving design and reduced need for complex cable connections as well as the easy-to-use settings help cut initial capital costs.

Wide Range of High-Performance Applications

The following clock recovery unit options are available:

• Option 055: Supports newest 53 Gbaud PAM4 signals (106 Gbit/s)
• Option 054: Supports 26 Gbaud multimode signals

These options can be combined freely to configure a flexible test system matching the site requirements at optimum cost. When all options are installed, various types of 100/200/400 GbE optical modules can be evaluated without a trigger clock using one MP2110A unit.
In addition, combination with a 4ch oscilloscope supports all-at-once measurement using the recovered trigger signal to help cut evaluation times for multichannel optical modules.
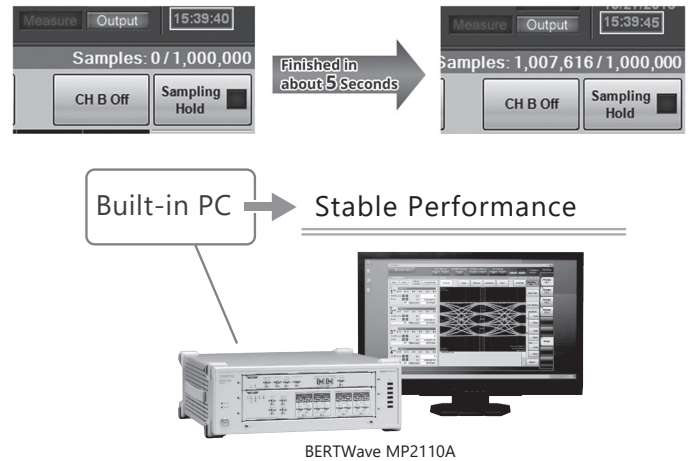
High Performance

When using high-sensitivity modules, the impact of insertion loss on the data waveform is minimized by optimizing internal division ratios, demonstrating its usefulness when monitoring signal waveforms requiring high sensitivity. Additionally, there is no waveform degradation due to multimode splitting because Option 054 performs signal splitting for input to the CRU and oscilloscope using electrical signals after O/E conversion.

Without CRU

With CRU

Almost no impact on Mask Margin*

*: Waveform comparison at −2 dBm input
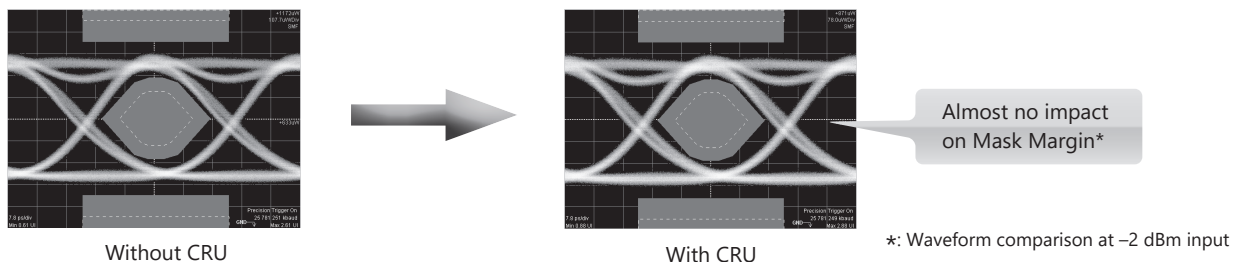
Fast and Stable Measurement Performance

The MP2110A supports high-speed sampling at 250 ksamples/s. Measurement of 1 million samples can be completed in about 5 s, cutting pattern analysis time by about 65% compared to previous instruments.

The MP2110A requires no external Windows PC controller, because it has a built-in PC for measurement processing.
It supports high-speed processing irrespective of external PC controller specifications.

BERTWave MP2110A

More Accurate Performance Confirmation: Sampling Oscilloscope Performance

Sampling Oscilloscope Functions

The MP2110A sampling oscilloscope has all the performance necessary for measuring optical modules such as 10G to 800G, and optical devices used by optical modules.

• Bandwidth:
  Optical: 35 GHz (SMF), 25 GHz (MMF)
  Electrical: 40 GHz

The low-noise and high-sensitivity O/E plus low-jitter trigger support more accurate measurements of narrow Eye openings of PAM4 signals as well as attenuated signals passing through optical switches, etc., helping improve production-line yields.
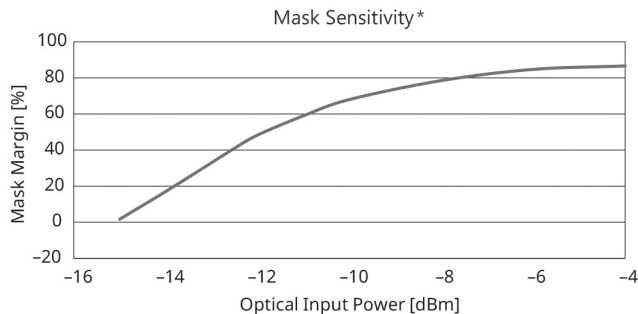
Mask Sensitivity*

* Estimated optical power when Mask Margin (Hit Count 0) reaches 0% (calculated from optical noise)

• High Sensitivity: –15 dBm (typ. SMF)*
• Low Noise: 3.4 µW (typ. SMF)
• Low-Jitter: 200 fs rms (typ.)

In comparison to conventional instruments, the wideband O/E draws accurate patterns of the characteristics of directly driven optical signals and optical modules for long-distance transmissions.

Conventional Instrument
(Filter Off)
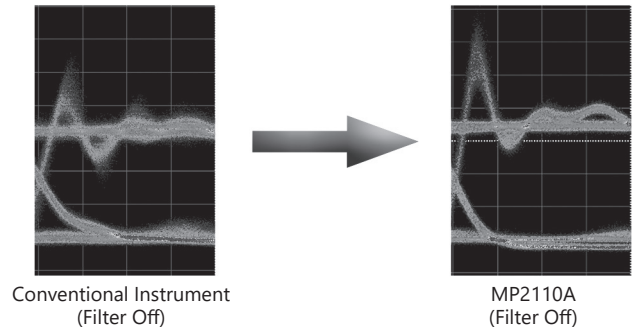
MP2110A
(Filter Off)

## More Accurate Performance Confirmation: BERT Performance

Wideband Operation Frequency

In the standard configuration, the MP2110A BERT operates at bit rates of 24.3 Gbit/s to 28.2 Gbit/s. This range can be extended optionally to support bit rates of 9.5 Gbit/s to 14.2 Gbit/s, enabling use for various applications including 10 GbE and 100 GbE.

| PPG/ED Supported Bit Rates	Application Example
24.3 Gbit/s to 28.2 Gbit/s	32G Fibre Channel, CPRI (Option 10), InfiniBand EDR, 100 GbE, 100 GbE FEC, OTU4
9.5 Gbit/s to 14.2 Gbit/s (Option 093)	InfiniBand FDR/QDR, Fibre Channel (16G, 10G, 10G FEC), 10 GbE (WAN, LAN), 40 GbE (4 × 10 Gbit/s), CPRI (Option 8, 9), OC-192/STM-64, OC-192/STM-64 FEC (G.975), OTU1e, OTU2, OTU2e

Excellent PPG/ED Performance

The MP2110A PPG has a low data Jitter of 600 fs rms (typ.) for accurate measurement of the characteristics of optical modules, optical devices, etc. Additionally, the 25 mV (typ.) ED supports BER measurement of low-amplitude signals resulting from transmission path losses, helping improve DUT yields.
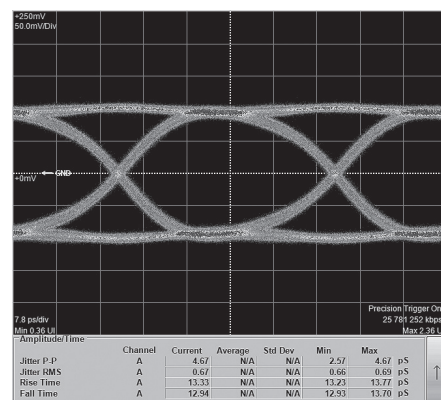
Typical PPG Waveform, 25.78125 Gbit/s Electrical Loopback Waveform
(at PRBS 31, 200 mV Amplitude, and Precision Trigger Option On)

Full Range of Measurement Functions (Sampling Oscilloscope)

Sampling oscilloscope supports both NRZ and PAM4 analysis.
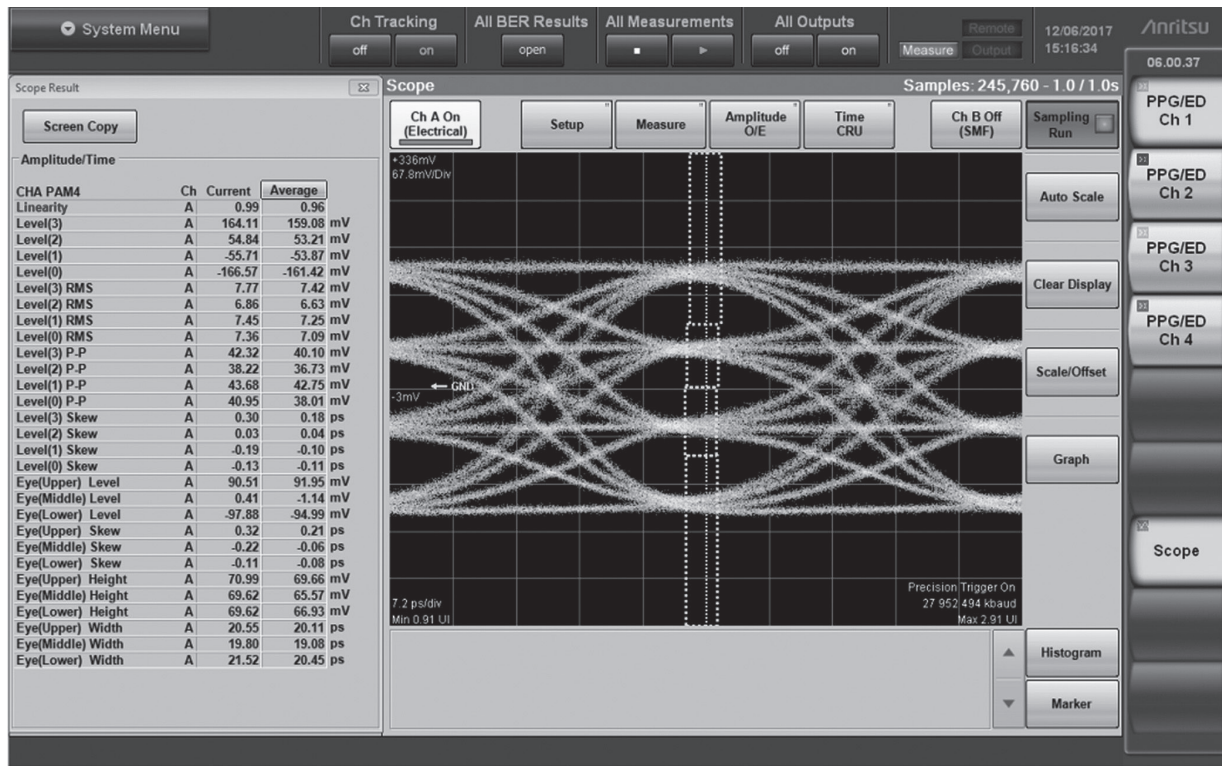
Selection of displays for up to 32 measurement items supports confirmation of multiple PAM measurement results at one screen. Additionally, all measurement results, including items not displayed on-screen, can be captured simultaneously using remote control.

NRZ

Average Power (dBm, mW)[1]
Mask Margin (%)
Extinction Ratio (dB)[1]
OMA (dBm, mW)[1], VMA (mV)[2]
VECP (dB)
RIN OMA (dB/Hz)[1, 4]
TDEC (dB)[3]
One Level, Zero Leve l (μW, mV)[6]
Eye Amplitude, Eye Height (μW, mV)[6]
Eye Height Ratio
Crossing (%)
SNR
Jitter P-P, RMS (ps)
Rise Time, Fall Time (ps)
Eye Width (ps)
DCD (%)

NRZ Jitter (Option 096)

TJ (J2, J4, J9, User Defined BER), Eye Opening (mUI)
RJ RMS (d-d), RJ RMS (mUI)[5]
DJ (d-d) (mUI)
PJ P-P (mUI)[5], PJ Frequency (kHz)[5]
DDJ P-P (mUI)[5], DDPWS (mUI)[5]
DCD (mUI)[5]
ISI P-P (mUI)[5]

PAM4 (Option 095)

Average Power (dBm, mW)[1]
TDECQ, Partial TDECQ, Ceq (dB)
Noise Margin, Partial Noise Margin (μW, mV)[6]
Outer Extinction Ratio (dB)[1]
Outer OMA (dBm, μW)[1], Outer VMA (mV)[2]
RIN OMA (dB/Hz)[1]
Transition Time (Rise/Fall/Slowest) (ps)
Over/Under-shoot (%)
Peak-to-Peak Power (dBm)[1]
Power Excursion (dBm)
Linearity
Levels 0/1/2/3 (μW, mV)[6]
Levels P-P, RMS 0/1/2/3 (μW, mV)[6]
Level Skews 0/1/2/3 (ps)
Eye Levels Upper/Middle/Lower (μW, mV)[6]
Eye Heights Upper/Middle/Lower (μW, mV)[6]
Eye Widths Upper/Middle/Lower (ps)
Eye Skews Upper/Middle/Lower (ps)

*1: Optical channel only
*2: Electrical channel only
*3: No IEEE-compliant 12.6-GHz hardware filter
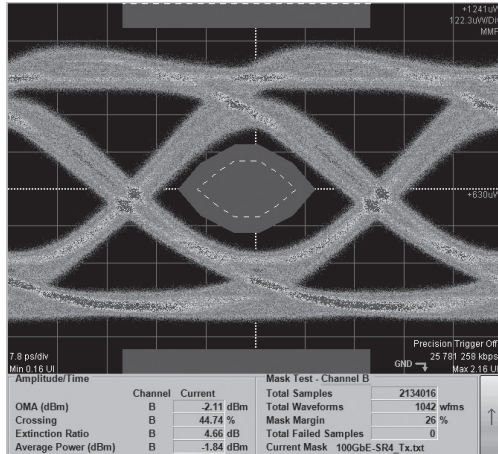*4: Option 095 or Option 098
*5: Enabled when Advanced Jitter Mode
*6: μW for optical channels and mV for electrical channels

NRZ Mask Margin Measurement

Testing is simple because Mask Margin tests are performed automatically. Furthermore, since the time required for Mask Margin tests is only about 1 second, line productivity is improved because standards-compliant measurements are performed at high speed in a shorter time.

- Automatic measurement within 1 second
- Real-time margin measurements
- Selectable Count and Rate at Mask Hit

PAM4 TDECQ Measurement (Option 095)

Easy capture of measurement results without complex settings. The low-noise (3.4 µW, typ.) high-sensitivity oscilloscope supports high-reproducibility measurement of even small Eye margin PAM4 signals. High-speed sampling shortens the time required for data collection for TDECQ analysis. Shorter measurement times help improve productivity even at PAM4 signal evaluation.
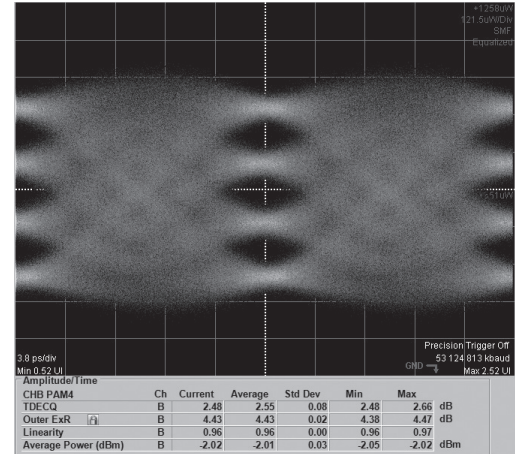

53 Gbaud PAM4 TDECQ Measurement

NRZ Jitter Analysis (Option 096)

This option supports separate analysis of Jitter components such as TJ, DJ, RJ, etc., with display in various graph formats.

- Fast, easy J2/J9/etc. measurements for manufacturing inspections (Eye Mode)
- Detailed analyses for DJ (Advanced Jitter Mode)
- Simultaneous Jitter Analysis and Eye Mask tests help cut measurement times
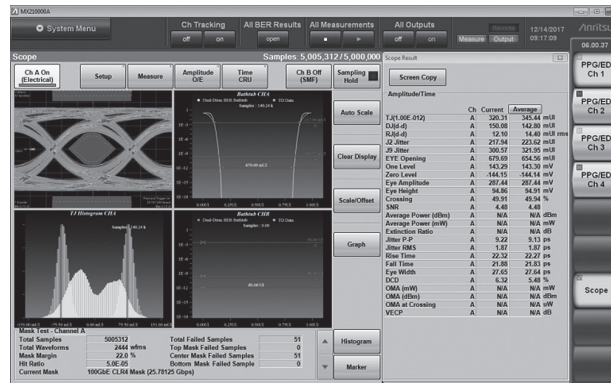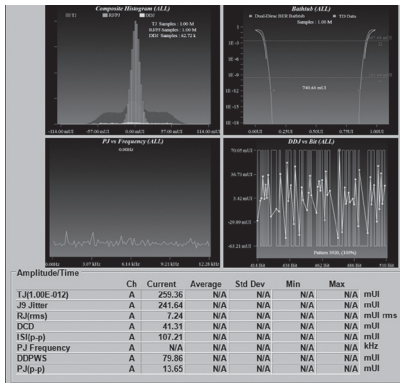
Histogram Measurement

Troubleshooting is made easier because waveform data component analysis can be performed using the mean, standard error, and scatter within the set data distribution.
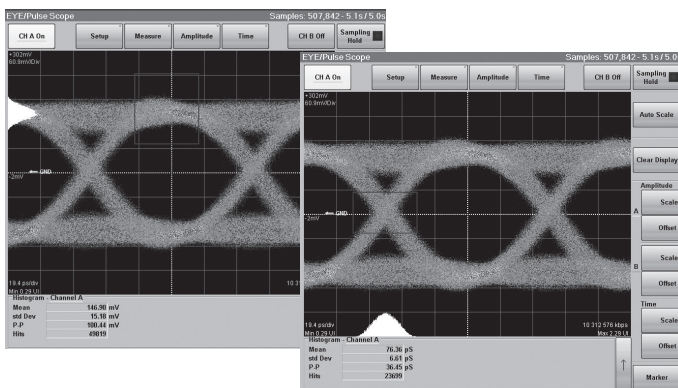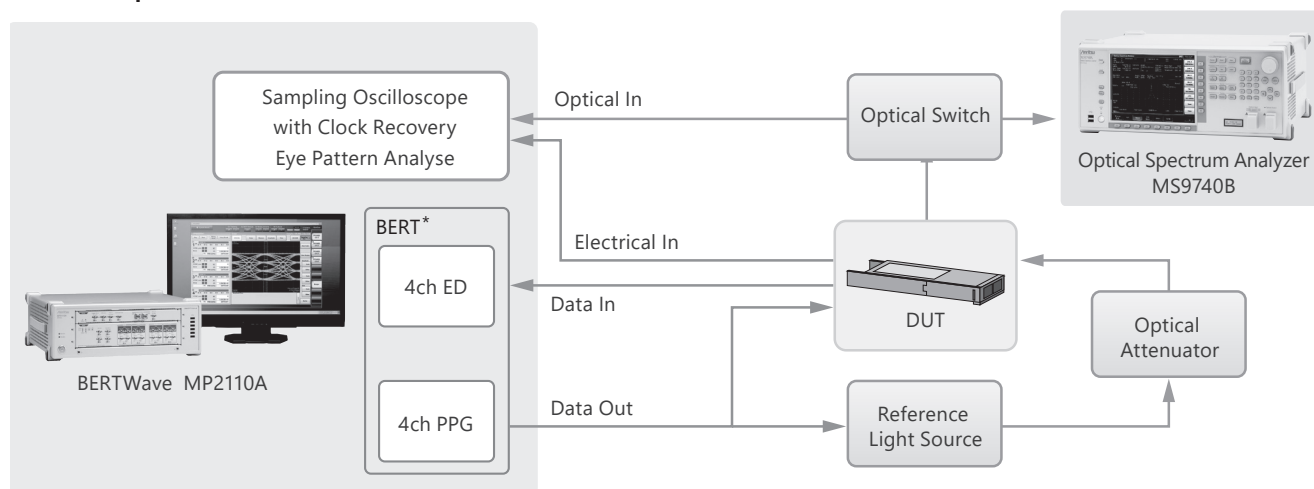

Reference Trace Function

Saving measured waveform data for reference enables comparison of current data with previous data.
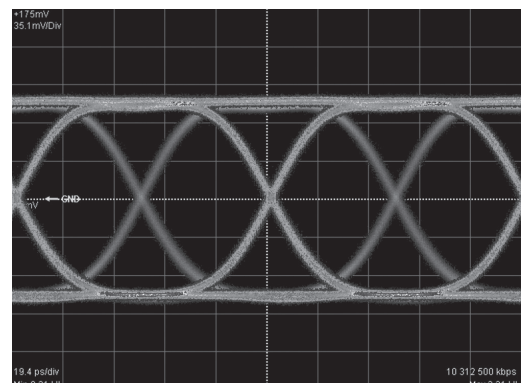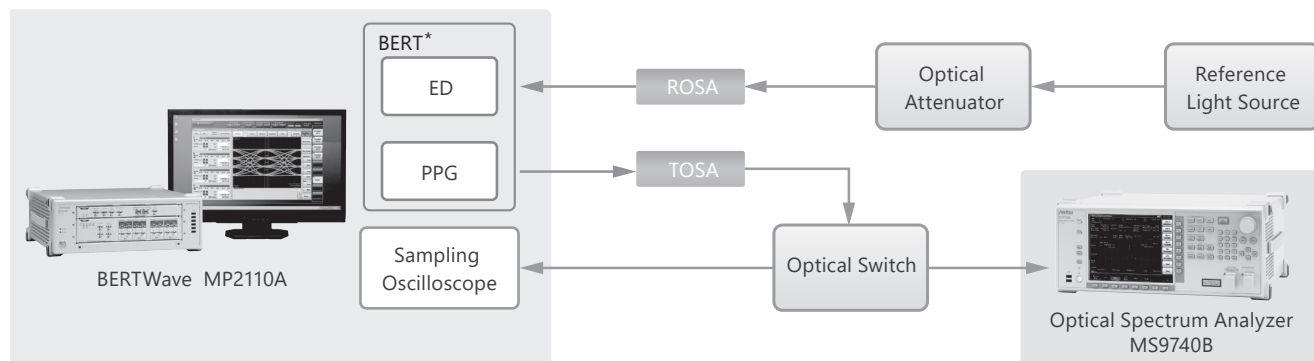
Application Examples

Multi-channel Optical Module Evaluation

Required Test Items
- Rx Electrical Signal Eye Pattern Analysis (NRZ: Mask Margin, Jitter, Tr/Tf, etc.)
- Tx Optical Signal Eye Pattern Analysis
  (Optical Power, NRZ: Mask Margin, Jitter, Tr/Tf, Extinction Ratio, PAM4: TDECQ, Outer OMA/Extinction Ratio, Linearity etc.)
- Rx Signal Rx Sensitivity Test (BER Measurement)

TOSA/ROSA Evaluation

Required Test Items
- Tx Optical Signal Eye Pattern Analysis
  (Optical Power, NRZ: Mask Margin, Jitter, Tr/Tf, Extinction Ratio, PAM4: TDECQ, Outer OMA/Extinction Ratio, Linearity etc.)
- Rx Signal Rx Sensitivity Test (BER Measurement)

＊: Use MP1900A/MP1800A PPG/ED, etc., at PAM4 signal evaluation.

Active Optical Cables (AOC)/Direct Attach Cables (DAC) Evaluation
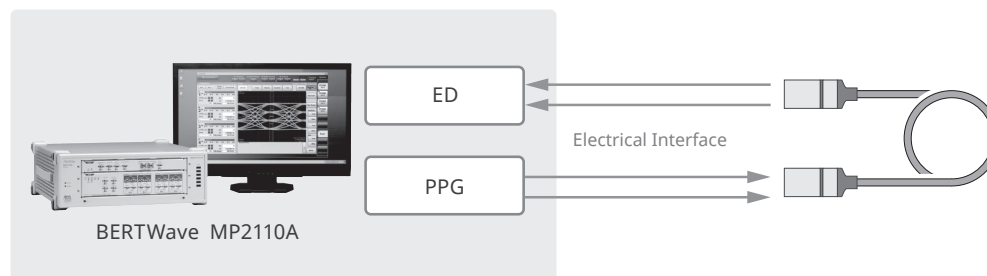
Required Test Items
- 4ch Simultaneous BER Measurement (Crosstalk Test)
- Differential Electrical Signal Eye Pattern Analysis
- Differential Electrical Signal Jitter Analysis

https://www.anritsu.com

Specifications

Common

Operating System	Windows 10		
Internal Storage Devices	SSD (60 GB or more)		
Input and Output	HDMI, Display Port USB2.0 × 6 (Front), USB3.0 × 4 (Rear) Ethernet × 2 (10/100/1000BASE-T) GPIB		
Remote Control	Ethernet, GPIB		
Power Voltage	100 VAC to 240 VAC, 50 Hz/60 Hz		
Power Consumption	300 VA max.		
Operating Temperature	+5°C to +40°C		
Storage Temperature	−20°C to +60°C		
Dimensions	422 (W) × 142.5 (H) × 389.4 (D) mm (excluding projections)		
Mass	11 kg max.		
CE	EMC	2014/30/EU, EN61326-1, EN61000-3-2	
	LVD	2014/35/EU, EN61010-1	
	RoHS	2011/65/EU, (EU) 2015/863, EN IEC 63000: 2018	

BERT

Operation Bit Rates		24.3 Gbit/s to 28.2 Gbit/s 9.5 Gbit/s to 14.2 Gbit/s (Option 093)
Number of Channels		1, 2, 4 (Differential)
Connector		K (f)
Output	Amplitude	0.1 Vp-p to 0.8 Vp-p (Single-end) 0.2 Vp-p to 1.6 Vp-p (Differential)
	Jitter	600 fs rms (typ.)
	Tr/Tf (20 to 80%)	15 ps (typ.)
Input	Amplitude	0.05 Vp-p to 0.8 Vp-p
	Sensitivity	25 mVp-p (typ.)
Test Pattern		PRBS7, PRBS9, PRBS15, PRBS23, PRBS31 1/2 Clock Pattern, 1/16 Clock Pattern (Output Only)

Sampling Oscilloscope

Optical Channel	Wavelength Range	SMF: 860 nm to 1650 nm, MMF: 800 nm to 860 nm
	Bandwidth	SMF: 35 GHz, MMF: 25 GHz (typ.)
	RMS Noise	SMF: 3.4 μW, MMF: 6.7 μW (typ.)
	Reference Receiver Filter (NRZ)	Built-in: 100 GbE, 100 GbE FEC, OTU4, 32GFC
Electrical Channel	Bandwidth	40 GHz (typ.)
	RMS Noise	1.5 mV (typ.)
Jitter		400 fs rms (typ.), 200 fs rms (typ., Precision Trigger MP2110A-024 On)
Sampling Rate		250 ksamples/s (nominal)
Clock Recovery (Option)		NRZ/PAM4, 25.5 Gbaud to 28.9 Gbaud, 51 Gbaud to 58 Gbaud

NRZ/PAM4 Differential Electrical Signal Evaluation
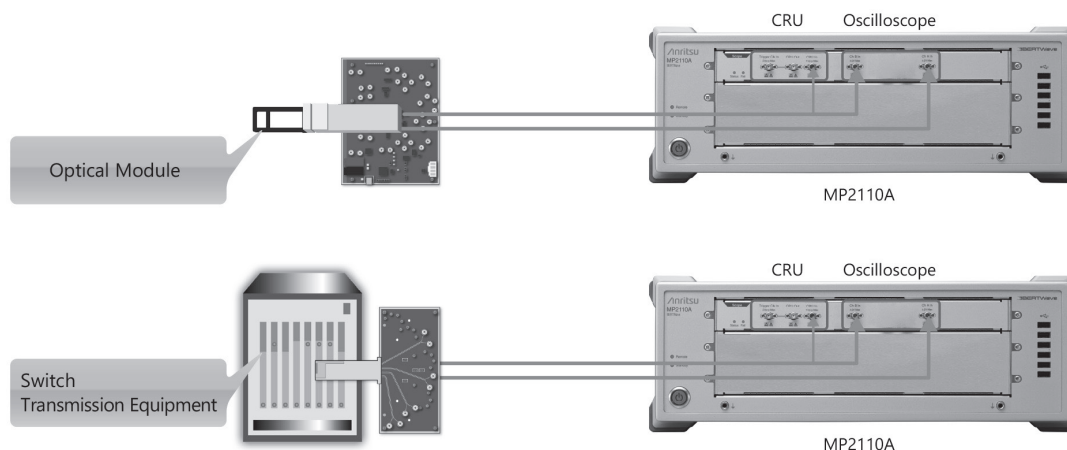
The Eye pattern of differential electrical signals can be analyzed using the Differential Electrical Channel Oscilloscope (Option 021) and Signal Processing Option (Option 098).
• A standards-compliant band filter and equalizer, such as CTLE, can be applied.
• The measurement system, such as cables, can be calibrated using the De-embedding function.
Additionally, installing the Clock Recovery Unit (CRU, Option 054) eliminates the need to provide a trigger signal.

Selection Guide

Selection Conditions and Function					Selection/Option Addition
Select any one or both.	Oscilloscope	Select any one.	Electrical 2ch		MP2110A-021
			Electrical 1ch + Optical 1ch	SMF&MMF	MP2110A-033 or 043*1
			Optical 1ch	SMF	MP2110A-035 or 045*1
				MMF	MP2110A-036 or 046*1
			Optical 2ch	SMF&MMF	MP2110A-032 or 042*1
			Optical 4ch	SMF	MP2110A-030 or 040*1
				MMF	MP2110A-039 or 049*1
		Select additions.	Refer to the Software Option Selection Guide		
			Precision Trigger (1ch/2ch)*2		MP2110A-024*2
			26G Clock Recovery (25.5G to 28.2G, SMF/MMF/Electrical)		MP2110A-054
			26G/53G Clock Recovery (25.5G to 28.9G/51G to 58G, SMF)		MP2110A-055
	Select any one.	BERT	Select any one.	1ch	MP2110A-011
				2ch	MP2110A-012
				4ch	MP2110A-014
		Select additions.	Bit Rate Extension (Adds 10G band)		MP2110A-093

*1: Only the optical channel reference receiver (Bessel filter approximation characteristics) are different for Option 04x and Option 03x.
*2: Either 1ch or 2ch can be selected for Option 024 Precision Trigger. Cannot be added for 4ch oscilloscope (Option 030/039/040/049).

Option Selection Guide

Optical Channel

Feature Description	NRZ	PAM4
Pattern Lock with Fast Sampling		
Waveform data export (for Offline Analysis)	095 or 098	095 or 098
Reference Bessel Digital Filter		
RIN OMA Measurement	095 or 098	095
PAM4 Analysis	—	095
NRZ Jitter Analysis	096	—

Electrical Channel

Feature Description	NRZ	PAM4
Pattern Lock with Fast Sampling		
Waveform data export (for Offline Analysis)	095 or 098	095 or 098
Differential Skew Adjustment (Software)		
Reference Bessel Digital Filter		
Embedding/De-embedding	098	098
CTLE		
PAM4 Analysis	—	095
NRZ Jitter Analysis	096	—

Ordering Information

When making a contract, determine the configuration by referencing the selection guide and specify the type, model, name, and quantity.
The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name	
MP2110A	**Main Frame** BERTWave	
J1627A	**Standard Accessories** Power Cord GND Connection Cable: MX210000A BERTWave Control Software CD-ROM:	1 1
MP2110A-011 MP2110A-012 MP2110A-014	**Options** 1ch BERT 2ch BERT 4ch BERT	
MP2110A-021	Dual Electrical Scope	
MP2110A-024	Precision Trigger	
MP2110A-030 MP2110A-032 MP2110A-033 MP2110A-035 MP2110A-036 MP2110A-039	Quad Optical Scope for Singlemode Baseband Flat Dual Optical Scope Baseband Flat Optical and Single-ended Electrical Scope Baseband Flat Optical Scope for Singlemode Baseband Flat Optical Scope for Multimode Baseband Flat Quad Optical Scope for Multimode Baseband Flat	
MP2110A-040 MP2110A-042 MP2110A-043 MP2110A-045 MP2110A-046 MP2110A-049	Quad Optical Scope for Singlemode Dual Optical Scope Optical and Single-ended Electrical Scope Optical Scope for Singlemode Optical Scope for Multimode Quad Optical Scope for Multimode	
MP2110A-054 MP2110A-055	Clock Recovery (Electrical/Optical) 26G/53Gbaud Clock Recovery (SM Optical)	
MP2110A-060	Optical Scope Custom Gain Adjustment	
MP2110A-093	PPG/ED Bit Rate Extension	
MP2110A-095	PAM4 Analysis Software	
MP2110A-096	Jitter Analysis Software	
MP2110A-098	Signal Processing Software	

Model/Order No.	Name
MP2110A-110	**Retrofit Options*1, *2** Windows10 Upgrade Retrofit*3
MP2110A-111 MP2110A-112 MP2110A-114	1ch BERT Retrofit 2ch BERT Retrofit 4ch BERT Retrofit
MP2110A-121	Dual Electrical Scope Retrofit
MP2110A-124	Precision Trigger Retrofit
MP2110A-130 MP2110A-132 MP2110A-133 MP2110A-135 MP2110A-136 MP2110A-139	Quad Optical Scope for Singlemode Baseband Flat Retrofit Dual Optical Scope Baseband Flat Retrofit Optical and Single-ended Electrical Scope Baseband Flat Retrofit Optical Scope for Singlemode Baseband Flat Retrofit Optical Scope for Multimode Baseband Flat Retrofit Quad Optical Scope for Multimode Baseband Flat Retrofit
MP2110A-140 MP2110A-142 MP2110A-143 MP2110A-145 MP2110A-146 MP2110A-149	Quad Optical Scope for Singlemode Retrofit Dual Optical Scope Retrofit Optical and Single-ended Electrical Scope Retrofit Optical Scope for Singlemode Retrofit Optical Scope for Multimode Retrofit Quad Optical Scope for Multimode Retrofit
MP2110A-154 MP2110A-155	Clock Recovery (Electrical/Optical) Retrofit 26G/53Gbaud Clock Recovery (SM Optical) Retrofit*4
MP2110A-193	PPG/ED Bit Rate Extension Retrofit
MP2110A-195 MP2110A-395	PAM4 Analysis Software Retrofit PAM4 Analysis Software Retrofit*5
MP2110A-196 MP2110A-396	Jitter Analysis Software Retrofit Jitter Analysis Software Retrofit
MP2110A-198 MP2110A-398	Signal Processing Software Retrofit Signal Processing Software Retrofit*6

*1: BERT retrofit supported when BERT not installed or to increase number of channels
*2: Oscilloscope retrofit supported when oscilloscope not installed or when changing Option 03x and 04x, same channel configuration.
*3: This option upgrades the Windows Embedded Standard 7 to the Windows 10 Enterprise LTSC. It is performed by Anritsu factory or service center return.
*4: This retrofit supported when BERT not installed
*5: Option 395 can be ordered for serial numbers 6261844875 or larger.
*6: Option 398 can be ordered only for optical-channel configurations, or for serial numbers 6272280900 or larger.

In addition, refer to Selection Guide for any restrictions on option configurations.

Model/Order No.	Name	
	Standard Accessories MP2110A-011	
J1632A	Terminator:	3
J1341A	Open:	5
	Standard Accessories MP2110A-012	
J1632A	Terminator:	5
J1341A	Open:	7
	Standard Accessories MP2110A-014	
J1632A	Terminator:	9
J1341A	Open:	11
	Standard Accessories MP2110A-021	
J1341A	Open:	3
	Standard Accessories **MP2110A-030/032/039/040/042/049**	
J0617B	Replaceable Optical Connector (FC-PC):	4
Z0397A	FC ADAPTER CAP:	4
J1341A	Open:	1
	Standard Accessories MP2110A-033/043	
J0617B	Replaceable Optical Connector (FC-PC):	2
Z0397A	FC ADAPTER CAP:	2
J1341A	Open:	2
	Standard Accessories MP2110A-035/036/045/046	
J0617B	Replaceable Optical Connector (FC-PC):	1
Z0397A	FC ADAPTER CAP:	1
J1341A	Open:	1
	Standard Accessories MP2110A-054	
J1632A	Terminator:	1
J1341A	Open:	2
J1763A	U Link Coaxial Cable (K):	1
J1764A	U Link Coaxial Cable (SMA):	1
	Standard Accessories MP2110A-055	
J1341A	Open:	1
Z0397A	FC ADAPTER CAP:	2
	Maintenance Service	
MP2110A-ES310	3 Years Extended Warranty Service	
MP2110A-ES510	5 Years Extended Warranty Service	

Model/Order No.	Name
	Optional Accessories
J1341A	Open (Coaxial connector cover)
J1632A	Terminator
J1359A	Coaxial Adaptor (K-P · K-J, SMA compatible)
J1349A	Coaxial Cable (0.3 m, SMA connector)
J1342A	Coaxial Cable (0.8 m, SMA connector)
J1343A	Coaxial Cable (1 m, SMA connector)
J1439A	Coaxial Cable (0.8 m, K connector)
J1551A	Coaxial Skew Match Cable (0.8 m, K connector)
J1763A	U Link Coaxial Cable for Option 054 (K connector)
J1764A	U Link Coaxial Cable for Option 054 (SMA connector)
J1819A	U Link Coaxial Cable for Option 055 (SMA connector)
J1510A	Pick OFF Tee
Z0397A	FC ADAPTER CAP
J1824A	Fixed Optical Attenuator (SM, 1 dB)
J1825A	Fixed Optical Attenuator (SM, 2 dB)
J1826A	Fixed Optical Attenuator (SM, 3 dB)
J1827A	Fixed Optical Attenuator (SM, 5 dB)
J0617B	Replaceable Optical Connector (FC-PC)
J0618D	Replaceable Optical Connector (ST)
J0618E	Replaceable Optical Connector (DIN)
J0619B	Replaceable Optical Connector (SC)
J0635A	FC/PC-FC/PC-1M-SM
J1139A	FC/PC-LC/PC-1M-SM
J1344A	LC/PC-LC/PC-1M-SM
J1345A	SC/PC-LC/PC-1M-SM
J0660A	SC/PC-SC/PC-1M-SM
J0893A	FC/PC-FC/PC-1M-GI (50/125)
J1347A	FC/PC-LC/PC-1M-GI (62.5/125)
J1346A	LC/PC-LC/PC-1M-GI (62.5/125)
J1348A	SC/PC-LC/PC-1M-GI (62.5/125)
J0839A	SC/PC-SC/PC-1M-GI (50/125)
J1519A	Optical Fiber Cord (MM, 12FIBER, MPO,3 m)
J1681A	MPO Loopback Cable
J1682A	MPO to FC convert cable
G0364A	100G LR4 1310 nm QSFP28
G0366A	100G SR4 850 nm QSFP28
Z0914A	Ferrule Cleaner
Z0915A	Replacement Reel for Ferrule Cleaner
G0306B	Video Inspection Probe
G0342A	ESD DISCHARGER
Z0306A	Wrist Strap
Z0541A	USB Mouse
Z1944A	LCD Monitor
B0734A	Carrying Case
B0735A	Rack Mount Kit
W3831AE	MP2110A BERTWave Operation Manual
W3773AE	BERTWave Series Remote Control Operation Manual