Product Introduction

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MP2100A BERTWave Series

MP2100A BERTWave Series Product Introduction





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Slide 1



Contents

Introduction □ What is BERTWave? **Given Features** □ Application **Block Diagram** □ Interface Typical Waveform **Summary**



Introduction

~ Slim All-in-One Measurement for BERT and EYE/Pulse Scope ~

High Speed and Easy Operation

- One unit supports BER measurements and EYE-pattern analysis
 - No separate BERT and EYE-pattern analyzer

High-speed measurement reduces measurement times

- High-speed remote response supports 4x faster measurement
- Cuts BER measurement times by 30% (BERT)
- Supports three times faster 100 Ksample/s high-speed sampling (Scope)

Compact and Lightweight

- Compact 18-cm design, weight <7 kg
 - Small footprint saves benchtop space

Supports High Repeatability

- Supports ideal Bessel filters
 - Supports high-repeatability in eye-pattern analysis





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What is **BERTWave**?

□ Three configurations support signal integrity evaluations.

MP2100A BERTWave



Optical Communications Measurement Lineup



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Anritsu High-speed Pulse and Microwave Products

56 Gbit/s BERT

High-performance PPG and analysis technology





110 GHz VNA



Components

High-performance microwave technology

MP1800A Signal Quality Analyzer Ultra-fast BERT



MP1026B EYE Pattern Analyzer Based on high-performance sampler used with VNA





Anritsu ultra-fast transmission and high-accuracy microwave measurement technologies support accurate and fast EYE Pattern analysis.

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Features (1/13) ~ Cuts Measurement Times ~

BERTWave

□ All-in-one BERTS and EYE-Pattern Analysis

BER measurement and EYE-pattern analysis without switching connection supports efficient evaluation (Note)



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Features (2/13) ~ Cuts Measurement Times ~

☐ High-speed Remote Tests

Remote High Speed Mode and Cuts refreshed times of BER measurement

- > Cuts the measurement time by 33% for predecessors
- Mix remote function supports batch command setting
 - Batch setting of commands cuts setting times
 - Ex. Batch setting of operation frequency, bit rate offset, output amplifier, and test pattern cuts setting times by 75%



Gating time: 10 ms

- > ED BER results refreshed at 10-ms interval (conventional: 100 ms)
- Cuts BER curve measurement time by 90% (Note)

(Note) Bit Rate: 10 Gbit/s, Detection Threshold: 1.0E-8

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BERTWave

High-Speed Mask Tests

Supports 100 Ksample/s high-speed sampling

Bit Rate: 10.3125Gbit/s, Test Pattern: PRBS31, Electrical,

Supports fast mask tests in about 12 s for 1 million samples



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Scope

Features (4/13) ~ Various Analysis Functions ~

Operation Frequency

Supports key applications, such as 10 GbE and 5 G Infiniband

PPG Operation Bit Rate		Application samples	
8.5Gbit/s~11.32Gbit/s	✓8GFC ✓10GFC ✓10GFC FEC	✓10GbE ✓OC-192/STM-64 ✓OC-192/STM-64 FEC	
4.25Gbit/s~5.66Gbit/s	√4GFC		
2.125Gbit/s~2.83Gbit/s	✓2GFC ✓Infiniband	✓2GbE ✓0C-48/STM-16 ✓0TU-1	
1.0625 Gbit/s~1.415 Gbit/s	√1GbE √1GFC		
0.53125Gbit/s~0.7075Gbit/s	✓OC-12/STM-64		
0.265625Gbit/s~0.35375Gbit/s			
0.132812Gbit/s~0.176875Gbit/s	√0C-3/STM-1		
ED Operation Bit Rate		Applocation samples	
8.5Gbit/s~11.32Gbit/s	✓8GFC ✓10GFC ✓10GFC FEC	✓10GbE ✓OC-192/STM-64 ✓OC-192/STM-64 FEC	
4.25Gbit/s~5.66Gbit/s	✓4GFC		

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Features (5/13) ~ Various Analysis Functions ~

□ Wide Operation Frequency

- PPG/ED operation frequency (with Opt-090)
 - BERT function supports 125 Mbit/s to 12.5 Gbit/s applications, such as OC-3/STM-1 and 10GFC.

——— Supported bit rates and application examples (w/ Opt-090)					
PPG/ED Operation Bit Rate	Application samples				
8Gbit/s to 12.5Gbit/s	✓8GFC ✓10GFC ✓10GFC FEC	✓10GbE ✓OC-192/STM-64 ✓OC-192/STM-64 FEC			
4Gbit/s to 6.25Gbit/s	✓CPRI/OBSAI ✓4GFC				
2Gbit/s to 3.125Gbit/s	✓CPRI/OBSAI ✓2GFC ✓Infiniband	✓2GbE ✓OC-48/STM-16 ✓OTU-1			
1Gbit/s to 1.5625Gbit/s	✓1GbE ✓1GFC				
0.5Gbit/s to 0.78125Gbit/s	✓OC-12/STM-64				
0.25Gbit/s to 0.39625Gbit/s					
0.125Gbit/s to 0.195312Gbit/s	✓OC-3/STM-1				

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Features (6/13) ~ Various Analysis Functions ~

Clock Recovery

ED Clock recovery function (standard function)

- 125 to 195.312 Gbit/s, 250 to 390.625 Mbit/s, 781.25 to 500 Mbit/s, 1 to1.5625 Gbit/s, 2 to 3.125 Gbit/s, 4 to 6.25 Gbit/s, 8 to 12.5 Gbit/s
 - ✓ Data signal input without clock and BER analysis
- 4 to 6.25 Gbit/s, 8 to 12.5 Gbit/s
 - Supported as scope trigger
- Eye/Pulse Scope Clock recovery function
 - > 8.5 to 12.5 GHz, 0.1 to 2.7 GHz (Opt-055)
 - Supports evaluation of characteristics of long-distance transmissions and equipment without clock output
 - ✓ Variable loop band



Eye/Pulse Scope clock recovery setting screen

Eye/Pulse Scope clock recovery loop bandwidth

Bit rate		Loop bandwidth
8.5 to 12.5 GHz		1, 2, 4, 8 MHz
0.1 to 2.7 GHz	2488.32 MHz	200 kHz
	622 MHz	50 kHz
	156 MHz	20 kHz





Features (7/13) ~ Versatile Analysis Measurements ~

□ Simultaneous 2-channel BER Measurements

One unit supports simultaneous TRx measurements and crosstalk tests

BERT

- Simultaneous optical module TRx measurements
- Simultaneous two-module measurements
- Crosstalk tests
- Individual settings for Bit Rate, Test Pattern, etc.



Features (8/13) ~ Versatile Analysis Functions ~

□ Wide Analog Band EYE/Pulse Scope

- Supports electric DC to 25 GHz (typ.) and optical DC 9.5 GHz (typ.) band
 - Supports 100 Mbit/s to 12.5 Gbit/s applications, such as 1 GbE and 10 GbE

Pulse Pattern Measurements

- Pattern frequency trigger input not required
- Supports pattern frequency up to 1677216 bits

Given Scale

Auto-Scale setting within 3 s



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Pulse Pattern



Scope

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Features (9/13) ~ Various Analysis Functions ~

Built-in Low Pass Filters

Max. six types of LPF for every measurement application

LPF	Applications
156M	OC-3/STM-1 (155.52M)
622M	CPRI x1 (614.4M), OC-12/STM-4 (622.08M)
1.0G	FC (1.0625G)
1.2G	CPRI x2 (1.2288G), OC-24 (1.244G), GbE (1.25G)
2.1G	2GFC (2.125G)
2.5G	CPRI x4 (2.4576G), OC-48/STM-16 (2.488G), Infiniband Optical (2.5G), 2 GbE (2.5G)
2.6G	OTU-1 (2.666G)
3.1G	CPRI x5 (3.072G), OBSAI PR3 x3 (3.072G), 10GBASE-LX4 (3.125G), 10GFC-LX4 (3.1875G)
4.2G	4GFC (4.25G)
5.0G	CPRI x8 (4.9515G), Infiniband optical x2 (5G)
6.2G	CPRI x10 (6.144G), XAUI Optical x2 (6.25G)
9.9 to 10.3G	8GFC (8.5Gbit/s), OC-192/STM-64 (9.953G), 10 GbE WAN (9.953G), 10 GbE LAN (10.312G), Infiniband optical x4 (10G)
10.5 to 11.3G	10GFC (10.518G), 10GFC FEC (10.664G), OC-192/STM-64 FEC G.975 (10.664G) OTU-2 (10.709G), 10GbE FEC OTU1e (11.095G), 10GbE FEC OTU2e (11.316G)
9.9 to 10.7G	8GFC (8.5Gbit/s), 10GbE WAN (9.95328Gbit/s), 10GbE LAN/PHY (10.3125Gbit/s), OC-192/STM- 64 (9.95328Gbit/s), Infiniband Optical x 4 (10Gbit/s), 10GFC (10.51875Gbit/s), G975 FEC (10.664228Gbit/s), OTU-2 (10.709225Gbit/s)

Supports Wide Wavelength Range

Supports wavelengths from 750 to 1650 nm

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Features (10/13) ~ Versatile Analysis Functions ~

Application Tests

EYE/Pulse Scope supports signal integrity analysis

- Time/Amplitude Tests
 - ✓ 0 Level, 1 Level, SNR, Eye Cross Ratio, Eye Amplitude, Eye eight, Eye Width,
 - ✓ Jitter (p-p), Jitter (rms), Extinction Ratio, Rise Time, Fall Time, Duty Cycle,
 - ✓ Average Power (Note)
- Mask Tests/Mask Margin Tests
 - Automatic Mask Margin Tests
- Histogram Tests
 - Measure the mean, standard deviation, p-p, and total number of hits in the histogram
 - window



Time/Amplitude Test





Mask Test/Mask Margin Test

Histogram Test

(Note) Extinction ratio and average optical power measured using O/E converter

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Scope

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Features (11/13) ~ Various Analysis Functions ~

Mask/Mask Margin Test

- Confirm product margin against standards to improve yield (Note.)
- Real-time mask margin measurements measures mask margin within 1 s after waveform input



(Note) Bit Rate: 10.3125 Gbit/s, Test Pattern: PRBS31, back-to-back

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Features (12/13) ~ Ideal Extinction Ratio Measurements ~ Scope

High-accuracy Results

Calibration using reference light source holds error to less than ±0.05 dB (typ.)

- > Max. Error : + 0.05 dB
- SD (one-tail) : 1.1%
- 99% Conf. Lim. : ± 0.05 dB

Typical values based on average of each bit rate and set extinction ratio Normalized results of 162 samples Random sampling of actual measurements for multiple instruments



Correction Function

Same linearity as competing instruments, so extinction ratio can be corrected using offset. 12.00





Features (13/13) ~ Low Cost and Eco-friendly Design ~

Improved Operability

- Simple setting for PPG/ED
- 12.1-inch wide display
- Touch-panel operation

High Reliability

- Flash disk drive
 - Prevents data loss from hard-disk crashes

Eco-design

- Compact 180-mm design (221H x 341W x 180D mm)
- Lightweight (Less than 7 kg)
- Iow power consumption (Less than 300 VA)



Application Examples (1/3) ~ Model ~

Optical Module Evaluations



Application Examples (2/3)

MP2101A/MP2100A

Active Optical Cable Evaluation





Measurement Solution Simultaneous 2-channel BER Measurements Confirms simultaneous TRx measurements and crosstalk tests and improves crosstalk All-in-one BER and Eye Pattern Improves manufacturing yields (Note) Wide Operating Frequency Range With PPG and eye-pattern analysis supports eye mask tests using various applications, such as 2G, 4G, 8GFC (Note) (Note) With MP2100A Slide 21

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Application Examples (3/3)

Content Evaluation of Transmission Equipment Physical Layer



Note: Typical value when capturing 1 x 10⁶ samples at bit rate of 10.3125 Gbit/s with PRBS31 test pattern, back-to-back

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MP2102A

Block Diagram

□ MP2100A BERTWave



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Typical Waveform

0. 0. 0. 0. 0. 0. 0. 0.

Electrical Looped-back

Bit rate: 10.3125 Gbit/s, PRBS31, Amplitude: 0.5 Vp-p

PPG Data out

Scope CH_A Electrical Input

Filtered optical waveform

Scope CH_B Optical Input





Bit rate: 10.3125 Gbit/s, PRBS31, Power: -6dBm An external optical transmitter

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PPG to ED/Scope Looped back

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10 312 500 kbp

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Cuts Capital Investment

□ Scope (MP2102A BERTWave SS)

 Cut by 34% compared to conventional model (Filters, CDR + Optical/Electrical interface)



BERT (MP2101A BERTWave PE)

- Cut by 46% compared to conventional model (1ch BERT)
 - Price per channel when expanded to 2-channel BERT is <¥2 million</p>

Scope + BERT (MP2100A BERTWave)

Cut by 41% compared to conventional model





□ All-in-one BER and Eye Pattern Measurements

□ High-speed Remote Tests

□ Simultaneous 2-channel BER Measurements

□ High-speed Mask Tests

Flexible Measurement (Three Configurations)

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Supports Ideal Bessel Filter

Bessel filter characteristics greatly affect waveform, extinction ratio and mask margin

> Developed Bessel filter closer to Anritsu unique ideal value



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Scope

□ Supports Analysis of Electrical and Optical Signals

Custom configuration

- Interface:
 - Electrical, XFP/SFP+, optical receiver
- Scope:
 - ✓ Dual electrical receiver or optical/single-end electrical receiver

BERTWave





□ Full Range of Sample Patterns

Supports each PRBS pattern and User Data (1.3 Mbits)

- Create standard pattern library
- User-added User Data

X
PRBS 2^9-1
PRBS 2^23-1
User Data

PRBS Setting Display

User		×
Current Pattern File :		
101010.dat	_	
11001100.dat		
11110000.dat		
CJTPAT.dat		
CRPAT-10GbE.dat		
CRPAT-FC.dat		
CSPAT.dat		
D21_5.dat		
HFPAT.dat		
JTPAT.dat		
K28_5.dat		
K28_7.dat	ок	

Standard Pattern Selection Display



Features ~ Cuts Measurement Times ~

BERTWave

Tracking Function

- Supports easy BERT and EYE/Pulse Scope settings
 - Eliminates troublesome setting change for Tx and Rx signals

💥 PPG/ED	DCh 1				
PPG	ED	Main			
Tracking	ON	BitRate / Test Pattern to PPG			
1(GbE 25G)	1250000 kbit/s - 1/8 Rate			
Data Input	Condition	1 ————— Threshold			
Single-E Dat	nded"	0 mV			
External O dB					
Test Patte	rn —	lear Dattorn			

YE/Pulse Scope	Time 🔀
Unit	Time
Bits On Screen	2 Bits
Offset	7 ps
Data Clock Rate	
Tracking	On
Master	PPG1
Bit Rate	9 953 280 Kbps
Divide Ratio	64
Recalculate Option	Clock Rate
Clock Rate	155 520 KHz
Acquire Clock Rate	Set
Pattern Length	
Tracking	On
Master	PPG1
Length	127 bits

Tracking

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Features ~ Various Analysis Functions ~



Features ~ Various Analysis Functions ~

Built-in Multiple Sampling Completion Condition

- Select from time, number of samples, number of waveforms
- □ Variable Pulse Waveform Average Processing Times
 - The averaging processing count can be set at waveform measurement in the Pulse mode.
 - Averaging suppresses waveform noise.

General Utilities		
Sampling		
Sampling Mode	Pulse	
Number of Samples	8191	
Accumulation Type	Limite	ed
Limit Type	Wavef	orm "
Time	10.0	sec
Samples	10	million
Waveforms	100	wfms
Averaging	100	samples



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Coherent Eye Mode

- Conventional sampling oscilloscopes cannot monitor an eye pattern with added differential when skew between channels is changed.
- The BERTWave displays accurate eye waveforms using a coherent eye mode by superimposing pulse waveforms with added differential.



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□ Reference Trace Waveform

- Waveform data saving function supports comparison between saved data and measured waveform
- Visually identify phase and changes between standard and measured waveforms



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Waveform Position Adjustment

- Built-in skew function aligns phase between differential signal channels
- Measures differential signals accurately without delay





Features ~ Various Analysis Functions ~

Mask Position Adjustment

- Mask position adjusted automatically or manually
- Easy adjustment of waveforms without horizontal axis limits and threshold adjustment for waveforms



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Mask Area Change

- Change mask area for measurement
- Evaluate positions in open eye where mask margin maximum and minimum



Mask Area Restriction Off



Mask Area Restriction On (45°, 0.1UI)



MP2100A-E-L-1

Features ~ Various Analysis Functions ~

Arbitrary Mask Creation

- User-defined mask files
- Quickly support new applications

User Defined Mask	>				
Available Mask Files : 01xGbEthernet.msk 02xGbEthernet.msk 100BASE-BX_LX10.MSK 10GBASE-LX4.MSK 10GbE_10_3125_May02.msk 10GbEthernet_10_3125.msk 10xFiberChannel.msk 10xGbEthernet_12_5.msk Copy of SATA 1.5GB TX 5 CYCLES.MSK FC0133.msk FC0266.msk FC0531.msk	Ok Cancel 10GbE_WAN OC192/STM64 OTU-2 amplified	2GFC 10GFC 10GbE_LAN/PHY 0C192/STM64 + FEC (G.975) User Defined	4GFC 10GFC+FEC 10GbE+FEC 0TU-2 1310nm	8GFC 1GbE 0C48/STM16 0TU-2 1550nm	8GFC_Elect_Tx 2GbE 0TU-1 0TU-2 1550nm Expanded
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Time/Amplitude Tests

- O Level, 1 Level, SNR, Eye Cross Ratio, Eye Amplitude, Eye eight, Eye Width, Jitter (p-p), Jitter (rms), Extinction Ratio, Rise Time, Fall Time, Duty Cycle, Average Power (NOTE)
- Ideal Bessel filter supports accurate extinction ratio measurements

Amplitude/Time							
	Channel	Current	Average	Std Dev	Min	Max	
Jitter P-P	Α	44.94	44.52	0.48	43.87	45.29	pS
Jitter RMS	Α	5.97	5.98	0.01	5.97	6.01	pS
Crossing	Α	53.42	53.20	0.19	53.03	53.42	%
Eye Amplitude	А	101.51	101.44	0.04	101.38	101.51	mV

(Note) Extinction ratio and average optical power measured using O/E converter

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Sampling Run CH A On Setup CH B Off Amplitud Auto Scale Clear Display Scale Offset CH B Scale Offset Time Axis Scale Offset Marker Disp Off 45.29 pS 6.01 pS 53.42 % 101.51 mV 44.52 Jitter P-F Jitter RMS 5.98 53.20 101.44 0.01 5 97 53.42 53.03 Eye Mode Crossing Eye Amplitude

Time/Amplitude Tests



Measurement Area Change for Levels 1 and 0

Active Channel Selection	Channel A	
Measure Item		
Off	Amplitude/Time	
Histogram	Mask Test	← offset →
Item Selection		+544mV 108.5mVDiv
Add Del	ete	
1 (Ch. A) Extinction Ratio		
3 (Ch. A) One Level		
	Move	
Time		
Rise/Fall Time	20/80%	
		Min 0.31UI
EYE Boundary		
Offset from Crossing	0.50 UI	



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Histogram Tests

- Measure the mean, standard deviation, p-p, and total number of hits in the histogram window
- Contribute trouble shooting by element analysis of incoming signals



Sampling Setup Measure Amplitude Time CH B On Hold 4.8uW/D Auto Scale Clear Display Amplitude Scale Offset Scale Offset Time Scale 10 312 500 kbps Offset 123.75 pS 7.88 pS 44.33 pS 55926 Marker **Histogram Test (Time)**



Scope

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MP2100A

□ Measurement Items

Measurement Items		MP2100A BERTWave	MS9740A Optical Spectrum Analyzer
	Data Rate Tolerance	0	
Тх	Center Wavelength		0
	Side Mode Suppression Ratio		0
	Average Optical Output Power (min./Max.)	0	0
	Extinction Ratio	0	
	Mask Test	0	
Rx	Input Sensitivity (10 ⁻¹²)	O (Note)	

(Note) Programmable optical attenuator is needed.

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Block Diagram

□ MP2101A BERTWave PE

MP2101A w/ 011



MP2101A w/ 012

□ MP2102A BERTWave SS



Interface

Interface	MP2100A		MP2101A		MP2102A	
	BERTWave		BERTWave PE		BERTWave SS	
	Option- Option-		Option-	Option-	Option-	Option-
	001	003	011	012	021	023
2 Output (Electrical Data1, xData1)	•	•	•	•		
2 Input (Electrical Data1/Scope1, Electrical xData1/Scope1)	•				•	
2 Input (Electrical Data1/Scope1, Electrical Data2/Scope2)		•				
2 Input (Electrical Data1, xData1)			•	•		
2 Input (Electrical Scope1, Scope2)					•	
2 Input (Electrical Scope1, Optical Scope2)						•
Addition Interface						
2 Output (Electrical Data1, xData1)	• (Note 1)	• (Note 1)		•		
2 Input (Electrical Data1, xData1)	• (Note 1)	• (Note 1)		•		
XFP Slot	• (Note 2)	• (Note 2)	• (Note 2)	• (Note 2)		
SFP+Slot	• (Note 3)	• (Note 3)	• (Note 3)	• (Note 3)		

(Note 1): Option-005 Selected (Note 2): Option-050 Selected (Note 3): Option-051 Selected

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Functions

Interface	MP	MP2100A MP2		D1A	MP2	102A	
	BER	TWave	BERTWave PE		BERTV	lave SS	
	Option-	Option-	Option-	Option-	Option-	Option-	
	001	003	011	012	021	023	
Crosstalk tests	● (Note 1)	● (Note 1)		•			
Optical Module Simultaneous TRx measurement (XFP)		● (Note 1, 4)					
1ch BER measurement	•	•	•	•			
2ch BER measurement	● (Note 1)	• (Note 1)		•			
Electrical integrity of signals tests							
- Time and Amplitude Tests					-	-	
- Histogram Tests	•	•			•	•	
- Eye MaskMask Margin Tests							
Optical integrity of signals tests							
- Time and Amplitude Tests		•				•	(Note 1): Option-005 Selected
- Histogram Tests - Eye MaskMask Margin Tests							(Note 4): Option-050 or Option-051 Selected
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Note

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