Product Introduction



BERTWave MP2100B





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Market Conditions

Market Conditions

- Global Data center IP traffic grows at a compound annual growth rate (CAGR) of 23 percent, resulting in increasing production of optical modules.(Production of optical modules exceeded 15 million units.)
- Full-scale mass production for 40GbE (4x10G) QSFP+ started from CY2015, and the predicted CAGR is 48%. 40GbE is expected to become the market mainstream for optical modules for data-center applications.

Introduction

All-In-One : 4ch-BERT + Sampling Oscilloscope

High Speed Measurement

- All-in-One 4ch-BER Measurements and Eye Pattern Analyses
 - No separate BERT and Eye pattern analyzer

High-speed measurement reduces measurement times

- Simultaneous 4ch-BER measurement is 4 times faster than legacy models
- Fast Sampling Mode for Scope increases sampling speed 150 ksample/s ,which is 1.5 times faster than legacy models

Compact and Lightweight

Compact 18cm design, weight < 7kg

Small footprint saves Benchtop space









Legacy Model 1 is a combination of a 2ch-BERT and sampling oscilloscope. Legacy Model 2 integrates a 2ch-BERT and sampling oscilloscope into one instrument (set). The MP2100B integrates a 4ch-BERT and sampling oscilloscope into one instrument (set). Capture BER for 3 points for each of 1E-3, 1E-5, 1E-7, 1E-8, 1E-9, and 1E-10 for 4ch × 10 Gbit/s Compare to the waveform of 1 Msample

Features (1/12) ~Shorten Measurement Times~

□ All-in-One 4ch-BER Measurements and Eye Pattern Analyses

BER measurements and Eye pattern analyses can be performed simultaneously with one MP2100B set, increasing measurement efficiency



Features (2/12) ~Shorten Measurement Times~

High-speed Eye Mask Test

- ◆ Fast Sampling Mode
 - The new Fast Sampling Mode installed as standard function increases sampling speed up to 150 ksample/s, supporting high-speed Eye pattern analyses
 - Electrical Mask tests require only about 8 s for 1 million samples at a bit rate of 10.3125 Gbit/s with a PRBS31 test pattern



Features (3/12) ~ Shorten Measurement Times ~

□ Simultaneous 4ch-BER Measurement

Build-in standard function for batch capture of measurement results up to 4ch reduces measure time by half

🗢 System Menu	Ch Tra	cking All BER F	Results Al	l Measurements	All Outpu	ts	System Remote		tsu
	off	on ope	in		off	on	Measure Output	04.00	0.36
All BER Measurements		Clos	se	Stop Start	History Reset			PPG/ Ch	/ED 1
ED Start / Stop	Bit Rate 10GbE LAN/PH Test Pattern PRBS 2^9-1 07/08/2015 16:19:25 80% E	IY(10.3125G) CR Unlock III III SYNC Loss III III Fror III III	ER Total EC Total	1.0000E-06 E-15 E-12 E-9 1.0000E-06 8250	E-6 E-3	E-0	ER INS 5.032 OMI 4.967 EC INS 0 OMI 0 CC 8.250 FREQ(kHz) 103	27E-07 22E-07 4152 4098 0E+09 12500 0E+09 12500	/ED 2 /ED 3
2 Start / Stop	Bit Rate 10GbE LAN/PH Test Pattern PRBS 2^9-1 07/08/2015 16:19:25 80% 80%	IY(10.3125G) CR Unlock 🗾 📕 SYNC Loss 📑 📕	ER Total EC Total	9.9393E-09 E-15 E-12 E-9 9.9393E-09 82	E-6 E-3	E-0	ER INS 5.699 OMI 4.242 EC INS OMI CC 8.250 FREQ(kHz) 103	99E-09 24E-09 47 35 0E+09 112499	/ED 4
BD Start / Stop 3 Start Time Progress	Bit Rate 10GbE LAN/PH Test Pattern PRBS 2^9-1 07/08/2015 16:19:25 80% E	IY(10.3125G) CR Unlock 🗾 📓 SYNC Loss 🔳 📓	ER Total EC Total	1.0000E-05 E-15 E-12 E-9 1.0000E-05 82500	E-6 E-3	E-0	ER INS 5.002 OMI 4.997 EC INS OMI CC 8.250 FREQ(kHz) 103	23E-06 0/1 76E-06 0/1 41269 0/1 41231 EYE/P 0E+09 Sco	E Pulse ope
ED Start / Stop 4 Start Time Progress	Bit Rate 10GbE LAN/PH Test Pattern PRBS 2^9-1 07/08/2015 16:19:25 80% E	IY(10.3125G) CR Unlock III III SYNC Loss III III Fror III III	ER Total EC Total	1.0000E-07 E-15 E-12 E-9 1.0000E-07 825	E-6 E-3	E-0	ER INS 4.933 OMI 5.066 EC INS OMI CC 8.250 FREQ(kHz) 103	33E-08 66E-08 407 418 0E+09 112500	

□ Wide Operation Frequency

- PPG/ED operation frequency (with Option 092)
 - > BERT operates the variable range(1 kbit/s step) of 125 Mbit/s to 12.5 Gbit/s
 - ✓ PPG/EDBERT function supports variable applications, such as OC-3/STM-1 and 10GFC
 - $\checkmark~$ Bit rates for other applications are also supported

Examples of Supported Dit Nates a	na Applications (with option 052)		
PPG/ED Supported Bit Rates	Application Example		
125 Mbit/s to 12.5Gbit/s	InfiniBand (SDR, DDR, QDR), Fibre Channel (1G, 2G, 4G, 8G, 10G, 10G FEC), GbE, 2 GbE, 10 GbE (WAN, LAN), XAUI (3.125G), 40 GbE (10 Gbit/s × 4), CPRI (×1, ×2, ×4, ×5, ×8, ×10), OBSAI (RP3, RP3 ×2, RP3 ×4, RP3 ×8), OC-3/STM-1, OC-12/STM-4, OC-24, OC-48/STM-16, OC-192/STM-64, OC-192/STM-64 FEC (G.975), OTU-1, OTU-2, OTU-1e, OTU-2e, SFP, SFP+, XFP, Active Optical Cable (AOC), QSFP/QSFP+, CFP, CXP, TOSA/ROSA		

Examples of Supported Bit Rates and Applications (with Option 092)

Clock Recovery

- ED Clock recovery function (standard function)
 - ➤ 125 Mbit/s ~ 12.5 Gbit/s
 - \checkmark Data signal input without clock, and BER analysis
 - > 4 Gbit/s ~ 6.25 Gbit/s, 8 Gbit/s ~ 12.5 Gbit/s
 - ✓ Supported as scope trigger
- Eye/Pulse Scope Clock recovery function
 - > 8.5 GHz ~ 12.5 GHz, 0.1 GHz ~ 2.7 GHz (Option 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 ra	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

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 require
- Supports pattern frequency up to 1677216 bits

Fast Auto-Scale

Auto-Scale Setting within 3 s



Auto-Scale



Pulse pattern

Built-in Low Pass Filter

Max. six types of Low Pass Filter for every measurement application

No filter : need Option 086

LPF	Application
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), 2GbE (2.5G)
2.6G	OTU-1 (2.666G)
3.1G	CPRI x5 (3.072G), OBSAI RP3 x4 (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)
$8.5G\sim$	8GFC (8.5Gbit/s) , OC-192/STM-64 (9.953G), 10GbE WAN (9.953G), 10GbE LAN (10.312G), Infiniband
11.32G	optical x4 (10G), 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), 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

Application Test

- Eye/Pulse Scope supports signal integrity analysis
 - Time/Amplitude Test
 - ✓ 0 Level, 1 Level, SNR, Eye Cross Ratio, Eye Amplitude, Eye Height, Eye width, Jitter (p-p), Jitter (rms), Extinction Ratio, Rise time, Fall time, Duty cycle distortion, OMA, Average Power (Note)
 - Mask Test/Mask Margin Test
 - ✓ Automatic Mask Margin Test
 - Histogram Test
 - 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

Mask/Mask Margin Test

- Automatically confirm product margin against standards to improve yield through Mask Margin Test
- Real-time mask margin measurements measure mask margin within 1 s after waveform input



Mask Margin Test

Features (10/12) ~ Ideal Extinction Ratio Measurement ~

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.



Features (11/12) ~High-quality waveform~

High-quality PPG, High-sensitivity ED

High-quality PPG (1 ps Jitter typ.) and high-sensitivity ED (10 mVp-p) simplify precision measurement of DUT characteristics.

PPG

- ➢ Jitter (RMS) *10.3125Gbit/s, Amplitude 0.4Vp-p✓ 1 ps(typ.), 2 ps(max.)
- Intrinsic RJ (RMS) *10.3125Gbit/s, Amplitude 0.4Vp-p 600 fs(typ.), 1 ps (max.)
- ➤ Tr/Tf **11.32Gbit/s, Amplitude 0.8Vp-p
 ✓ 24 ps(typ.), 28 ps(max.)

ED ED

- Input Sensitivity
 - ✓ 10 mVp-p(typ.)
 20 mVp-p(max.)



Features (12/12) ~ Simple Operation, High Durability, Eco-friendly Design ~

□ Improved Operability

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

High Reliability

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

Eco-design

- Compact 180-mm design (341 (W)× 221.5 (H)×180 (D) mm)
- Lightweight (Less than 7 kg)
- Low power consumption (Less than 300 VA)

Application Examples (1/3)

40 Gbit/s QSFP+ (4 × 10 Gbit/s) Measurement



Required 40Gbit/s QSFP+ Measurement Items

- All-in-one Simultaneous BER and Eye pattern Measurement
- 4ch Simultaneous BER measurements
- Fast Sampling Mode with high sampling speed up to 150 ksample/s
- High-quality PPG and high sensitivity ED



Comparison of 40 Gbit/s (10 Gbit/s × 4ch) QSFP+ BER Measurement Times

Application Examples (2/3)

Active Optical Cable (AOC) Measurement



High-speed Simultaneous Measurement

- Eye pattern analyses, Jitter measurements, and Eye Mask tests can all be performed simultaneously Fast DDJ measurement is supported using the fast triggering method Measurement times, including Jitter, are reduced by 90% compared to
- legacy models

Application Examples (3/3)

PON Device BOB (BOSA On Board) Evaluations



Required Items for Evaluating Transmission Equipment Phy Layer

Fast Mask Tests

- The new Fast Sampling Mode (150 ksample/s) reduces Eye Mask tests to about 8 s (Note), helping shorten measurement times
- Clock Recovery: With support for frequencies from 8.5 to 12.5 GHz, and 0.1 to 2.7 GHz, Mask tests can be run for nearly all applications

Full Line of Mask Patterns Tests

Acceptance inspection tests are supported for optical devices in transmission equipment for various applications, including 2G, 4G, and 8GFC

(Note) At bit rate of 10.3125 Gbit/s with PRBS31 test pattern and 1 million back-to-back samples

Block Diagram

MP2100B Block Diagram



Clock Recovery Option Block Diagram





Typical Waveform

Electrical Looped-back



Bit rate: 10.3125 Gbit/s, PRBS31, Amplitude: 0.5 Vp-p PPG to ED/Scope Looped back



Bit rate: 10.3125 Gbit/s, PRBS31, Power: -7 dBm An external optical transmitter

Summary

□ All-in-one BER and Eye Pattern Measurements

□ Simultaneous 4ch-BER Measurements and Eye Pattern Analysis

High-speed Mask Tests

Appendix

□ Wideband operating Frequency

> Supporting various applications such as 10GbE and 5G InfiniBand

PPG/ED Supported Bit Rates	Application Example		
8.5 Gbit/s to 11.32 Gbit/s	 *8GFC *10 GbE *10GFC *40 GbE (10 Gbit/s × 4) *10GFC FEC *10 GbE FEC *0TU-2 *0C-192/STM-64 *0TU-2e *0C-192/STM-64 FEC *0TU-1e 		
4.25 Gbit/s to 5.66 Gbit/s	•4GFC		
2.125 Gbit/s to 2.83 Gbit/s	• 2GFC • 2 GbE • InfiniBand • OC-48/STM-16 • OTU-1		
1.0625 Gbit/s to 1.415 Gbit/s	• 1 GbE • 1 GFC		
0.53125 Gbit/s to 0.7075 Gbit/s	• OC-12/STM-4		
0.265625 Gbit/s to 0.35375 Gbit/s			
0.132812 Gbit/s to 0.176875 Gbit/s	• OC-3/STM-1		

Examples of Supported Bit Rates and Applications (without Option 092)

Features ~Full-Featured Analysis Functions~Supports Analysis of Electrical and Optical Signals

- Custom configuration
 - ≻Interface:
 - ✓ Electrical, SFP+, optical receiver
 - > Scope:
 - ✓ Dual electrical receiver or optical/single-end electrical receiver
 - > BERT:



Anritsu envision : ensure

□ 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	X
Current Pattern File :	
10101010.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 ~ Reduces Measurement Times ~

□ Tracking Function

- Simplify BERT setting by using Ch Tracking function
- Supports easy BERT and Eye/Pulse Scope settings
 - Eliminates troublesome setting change for Tx and Rx signals

Ch Tra	on	All BER Re	sults A	II Measurements
e Amplitu	de T	San ime	nples: 39 Сн в с	3,312-2.0s/2.(
				Hold

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



D 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.

EYE/Pulse Scope Setu	ιp	×			
General Utilities	(
Sampling					
Sampling Mode	Pulse	==			
Number of Samples	Number of Samples 8191				
Accumulation Type					
Limit Type	Wavef	orm			
Time	10.0	sec			
Samples	10	million			
Waveforms	100	wfms			
Averaging	100	samples			
Option					
CRU Input ED1 Electrical Single-Ended Data					



Coherent Eye Mode

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



□ 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



Waveform Position Adjustment

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



Mask Position Adjustment

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



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 degrees, 0.1UI)

□ Arbitrary Mask Creation

- User-defined mask files
- Quickly support new applications

User Defined Mask	×	R			
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 ✓	2GFC 10GFC	4GFC 10GFC+FEC	8GFC 1GbE	8GFC_Elect_Tx 2GbE
	10GbE_WAN OC192/STM64 OTU-2 amplified	10GbE_LAN/PHY OC192/STM64 + FEC (G.975) User Defined	10GbE+FEC OTU-2 1310nm	OC48/STM16 OTU-2 1550nm	OTU-1 OTU-2 1550nm Expanded

□ Time/Amplitude Test

O Level, 1 Level, SNR, Eye Cross Ratio, Eye Amplitude, Eye Height, Eye width, Jitter (p-p), Jitter (rms), Extinction Ratio, Rise time, Fall time, Duty cycle distortion, OMA, Average Power (Note.)



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

Measurement Area Change for Levels 1 and 0

Changes measurement area for waveform levels 1 and 0

EYE/Pulse Scope Measure	X
Active Channel Selection	Channel A
Measure Item	
Off	Amplitude/Time
Histogram	Mask Test
Item Selection	
Add	Delete
1 (Ch. A) Extinction Ratio 2 (Ch. A) Eye Height	
3 (Ch. A) One Level	
	Move
Time	
Rise/Fall Time	20/80%
EVE Boundary	·····
Offset from Crossing	0.50 UI
Width	0.20 UI
N	······



D Histogram Test

- 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





Measurement Items

Measurement Items

	Measurement Items	MP2100B BERTWave	MS9740A Optical Spectrum Analyzer
Tx	Data Rate Tolerance	\checkmark	
	Center wavelength		\checkmark
	Side Mode Suppression Ratio		\checkmark
	Average Optical Output Power(min./max.)	\checkmark	\checkmark
	Extinction Ratio	\checkmark	
	Mask Test	\checkmark	
Rx	Input Sensitivity(10 ⁻¹²)	✓ (Note)	

(Note) Programmable optical attenuator is needed

Interface

Interface	MP2100B						
	Option 011	Option 012	Option 014	Option 021	Option 023		
1ch-BERT (Electrical Data 1, xData 1)	\checkmark	\checkmark	\checkmark				
2ch-BERT (Electrical Data 2, xData 2)		\checkmark	\checkmark				
4ch-BERT (Electrical Data 4, xData 4)			\checkmark				
Differential Electrical Scope				\checkmark			
O/E Scope					\checkmark		
Addition Interface							
SFP+ Slot	✓ (Note1)	✓ ((Note1)	✓ ((Note1)				

Functions

Interface	MP2100B				
	Option 011	Option 012	Option 014	Option 021	Option 023
Crosstalk tests		\checkmark	\checkmark		
Optical Module Simultaneous TRx measurement (QSFP+)			\checkmark		
Optical Module Simultaneous TRx measurement (SFP+)		\checkmark	\checkmark		
1ch-BER measurement	\checkmark				
2ch-BER measurements		\checkmark			
4ch-BER measurements			\checkmark		
 Eye pattern Analysis (Electrical) Time and Amplitude Tests Histogram Tests Eye Mask/Mask Margin Tests Jitter Analysis 				\checkmark	\checkmark
 Eye pattern Analysis (O/E) Time and Amplitude Tests Histogram Tests Eye Mask/Mask Margin Tests Jitter Analysis 					✓

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