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# BERTWave MP2110A

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# 1 BERTWave MP2110A

The all-in-one BERTWave MP2110A featuring simultaneous BER measurement and Eye pattern analysis has been added to the Anritsu BERTWave product line. Now, in addition to the MP2100B covering bit rates up to 12.5 Gbit/s, the MP2110A supports 25G-band measurements such as 100G Ethernet. The design pays attention to cost, stable operation, and correlation with other equipment, all of especial importance to customers with manufacturing infrastructure centered on optical transceivers. The MP2110A is the optimum solution for production-line PHY layer evaluations.



# 2 Position of Quick Start Guide

This guide shows typical basic measurement examples, setting methods, measurement methods and precautions when using the BERTWave MP2110A. For more details of the application uses, refer to the instruction manual provided with the instrument.

## 3 Evaluating 100GBASE-LR4 QSFP28 Transceiver

This section explains usage using the 100GBASE-LR4 QSFP28 transceiver as the device under test (DUT).

# 3.1 Evaluation Items

Table 1 lists the QSFP28 transceiver evaluation items explained in this guide.

Evaluation Target	Evaluation Item
Transmitter	Average Optical Power
	Extinction Ratio
	Crossing
	Jitter p-p
	Jitter rms
	Rise Time
	Fall Time
	Mask Margin
Receiver	Optical Rx Sensitivity

#### Table 1: QSFP28 Optical Transceiver Evaluation Items

# 3.2 Required Equipment

Table 2 lists the required instruments and peripheral equipment for starting the MP2110A.

Model/Code	Name	Remark	Qty	Check
MP2110A	BERTWave		1	
MP2110A-014	4 Channel BERT		1	
MP2110A-023	Optical/Single End Electrical Oscilloscope		1	
MP2110A-024	High Accuracy Trigger		1	
G0351F	Programmable Optical Attenuator (with SM9, FC/UPC, Power Monitor)		1	
_	100G LR4 1310 nm QSFP28	DUT	1	
_	100G LR4 1310 nm QSFP28	Reference Transceiver	1	
J1349A	Coaxial Cable 0.3 m	For trigger signal	1	
J1342A	Coaxial Cable 0.8m	For BER measurement	12	
J1439A	Coaxial Cable (0.8 m, K-connector)	For observing waveform	4	
J1139A	FC·PC-LC·PC-1M-SM		3	
_	LCD Monitor	HDMI/DP Resolution : 1920 dots x 800 lines or more	1	
—	QSFP28 Evaluation Board		2	
_	DC Stabilized Power Supply (3.3 V output)	For driving QSFP28	2	
_	PC for controlling QSFP28 evaluation board	For controlling lane output	1	

#### Table 2: Required Equipment

# 3.3 Equipment Installation

## 3.3.1 Installation Location

Install the MP2110A in a horizontal location at least 10 cm from walls and other objects so the internal cooling fan ventilation holes on both sides of the cabinet are not obstructed.

## 3.3.2 Grounding

Plug the power cord into a grounded power outlet and the power inlet on the back panel of the MP2110A. When connecting the power cord, be sure to use the 3-pin accessory power cord so the MP2110A is correctly grounded.

Check that the grounding connector of accessories connected to the MP2110A, such as the evaluation board, is securely connected to ground at the same potential as the MP2110A.

To protect all equipment against damage from ESD, the demonstrator must also wear a wrist strap connected to a grounded conductive mat or to the frame ground of the MP2110A





Fig. 1: Grounding Connected Equipment

## 3.4 Connecting Cables

This section explains the cable connection for evaluating the 100GBASE-LR4 QSFP28 transceiver.

## 3.4.1 Preventing ESD Damage

The core of a coaxial cable can become charged as a capacitor. To discharge it, touch the core of the coaxial cable to the grounded outside of the connector.



**Connector External View** 



Fig. 2: Discharging Coaxial Cable Core

## 3.4.2 Connecting Cables

Refer to the cables listed in Table 3 and the connections shown in Fig. 3 to make the cable connections.



Fig. 3: Setup for Evaluating 100G LR4 1310 nm QSFP28

		Table 5. Cables and Connec	tions		
Connected	Connected	Cable Type	Check	Connected	Connected
Equipment	Port			Port	Equipment
MP2110A	ChB	111304		Ty	
	Ontical SM In	FC+PC-IC+PC-1M-SM			001 Q311 28
	Triggor Clk In	112404		Clk Out	MD2110A
	Thyger Cik In	JIJ49A Copyial Cable 0.2 m		Cik. Out	WF2110A
					DUT
	PPGI(P)	J1459A Convint Cable (0.8 m. K. connector)		Laneu_IX_P	OSED28 Evaluation
				Lanal Ty D	Q3FF26 Evaluation
	PPGZ(P)	J1459A Convint Cable (0.8 m K connector)		Lanel_IX_P	Board
					_
	PPG3(P)	J1459A Convint Cable (0.8 m K connector)		Lanez_TX_P	
					_
	PPG4(P)	J1439A		Lanes_TX_P	
	DDC1(1)	Coaxial Cable (0.8 m, K-connector)		1 0 T N	
	PPGI(N)	JI342A		Laneu_TX_N	Reference
	PP CO (III)	Coaxial Cable 0.8 m			I ransceiver
	PPG2(N)	J1342A		Lane1_1x_N	QSFP28 Evaluation
		Coaxial Cable 0.8 m			BOATU
	PPG3(N)	J1342A		Lane2_Tx_N	
		Coaxial Cable 0.8 m			_
	PPG4(N)	J1342A		Lane3_Tx_N	
		Coaxial Cable 0.8 m			
	ED1(P)	J1342A		Lane0_Rx_P	DUT
		Coaxial Cable 0.8 m			QSFP28 Evaluation
	ED1(N)	J1342A		Lane0_Rx_N	Board
		Coaxial Cable 0.8 m			
	ED2(P)	J1342A		Lane1_Rx_P	
		Coaxial Cable 0.8 m			
	ED2(N)	J1342A		Lane1_Rx_N	
		Coaxial Cable 0.8 m			
	ED3(P)	J1342A		Lane2_Rx_P	
		Coaxial Cable 0.8 m			
	ED3(N)	J1342A		Lane2_Rx_N	
		Coaxial Cable 0.8 m			
	ED4(P)	J1342A		Lane3_Rx_P	
		Coaxial Cable 0.8 m			
	ED4(N)	J1342A		Lane3_Rx_N	
		Coaxial Cable 0.8 m			
	HDMI Out	HDMI Cable		HDMI In	LCD Monitor
Reference	Tx	[1139A		Optical In	G0351F
Transmitter		FC·PC-LC·PC-1M-SM		•	
QSFP28					
DUT	Rx	[1139A		Optical Out	
QSFP28		FC·PC-LC·PC-1M-SM			
DC Stabilized	GND	UL1007 AWG20		GND	DUT
Power Supply	+3.3 V	UI 1007 AWG20		+3.3 V	<b>OSFP28</b> Evaluation
					Board
DC Stabilized	GND	UL1007 AWG20		GND	Reference
Power Supply	+33V	UI 1007 AWG20		+3 3 V	Transmitter OSFP28
		021007741020			Evaluation Board
PC Controller for	USB	USB Cable		USB	DUT
<b>QSFP28</b> Evaluation					QSFP28 Evaluation
Board					Board
	USB	USB Cable		USB	Reference
					Transmitter
					QSFP28 Evaluation
					Board

#### Table 3: Cables and Connections

## 3.5 Powering On

After making the connections and powering-on, the required settings must be made.

### 3.5.1 QSFP28 Module Power-on Adjustment

After first removing the QSFP28 modules from the evaluation boards (reference transmitter and DUT), supply power from a DC stabilized power supply and adjust the voltage to +3.3 V. Then, cut the power for a moment and insert the QSFP28 modules. To prevent unexpected optical output at power-on, disconnect the optical fibers connected to G0351F Optical In and MP2110A ChB Optical SM In. Then, power-on the boards and use a cooling fan as necessary when the QSFP28 modules are being driven.

## 3.5.2 MP2110A Power-on

Power-on the MP2110A by pressing the [Power] switch and wait until the MX210000A Application Software starts automatically.

## 3.5.3 Programmable Optical Attenuator Power-on

Set the [Power] switch on the front panel of the Programmable Optical Attenuator G0351F to On to supply power.

## 3.6 QSFP28 Module Output Lane Control

The optical output default settings differ according to the QSFP28 manufacturer's design specifications. We recommend controlling output using the control software provided with the evaluation board as well to prevent unexpected optical output. Generally, an interface is provided for controlling the internal registers of the QFSP28 via USB. First, set optical output for all lanes to Off in accordance with the control specifications. After setting all lanes to Off, reconnect the previously disconnected optical fibers to G0351F Optical In and MP2110A ChB Optical SM In.

## 3.7 MP2110A Setting Parameters

There are three MP2110A setting methods as follows:

- Selection by button
- Input using arrow keys
- Direct numeric input

This section explains these setting methods using the BERT Bit Rate setting.

MX210000A			
System Menu     Off	acking All BER Results All Measurements	All Outputs Remote 02/14/2017 off on Measure Output 13:02:01	∕inritsu
» PPG/EDCh 1		W PPG/EDCh 2	
PPG Data/XData OFF Setup/Result	Reference CLK	PPG Data/XData OFF Setup/Result	Ch 1
100GbE/4 25781250 kb/s 0 ppm	Internal	100GbE/4 (25.78125G) 25781250 kbit/s 0 ppm	PPG/ED Ch 2
PPG Amplitude		PPG Amplitude	
0.30 Vp-p Ext ATT 0 dB 0.30 Vp-p		0.40 Vp-p Ext ATT 0 dB 0.40 Vp-p ED Input Condition	PPG/ED Ch 3
Electrical Single-Ended Data		Electrical Ext ATT 0 dB 0 mV	PPG/ED
Test Pattern	Output	Test Pattern	0114
PPG PRBS 2^31-1 POS	Sync Out PPG1_1/8Clk	PPG PRBS 2^31-1 POS	
ED PRBS 2^31.1 POS Tracking ON	Clk Out Ch1/2 1/4 Clock	ED PRBS 2^31-1 POS Tracking ON	
ED Result "All"	Error Addition	ED Result "All"	
Start Time::	Insert Error 20 bit	Start Time::	22
ER	Gating	ER	Scope
E-15 E-12 E-9 E-6 E-3 E-0	Gating Cycle Repeat	E-15 E-12 E-9 E-6 E-3 E-0	
EC Start/ Stop	0 Day 0 H 0 M 1 S	ECStart / Stop	
CC History Reset		CC History Reset	
FREQ(kHz) SYNC Loss	Current ON	FREQ(kHz) SYNC Loss	
0% Error		0% Error	

Fig. 4: MP2110A Parameter Setting methods

Fig. 4-[1]: Select PPG/ED Ch1 to display the setting screen.

Fig. 4-[2]: Select Bit Rate setting.

#### • Selecting with Pointer

Bit Rate Standard Value				×
[2] Variable (24.3.28.26) Variable (9.5.14.26) Uariable (9.5.14.26) Uogbe LAN (10.352) Uogbe LAN (10.352) Uogbe LAN (10.35280)	OTN OTU2e (10GbE FEC) (11.0957286) OTU2e (10GbE FEC) (11.0957266) OTU1e (10GbE FEC) OTU1e (10GbE FEC) OTU1e (10GbE FEC) OTU2 (10.491076)	SDH/SONET G.975 FEC (10.664228G) OC.192/STM-64 Ø.95528G)	Fibre Channel 32GFC (28.05G) 16GFC (14.025G) 10GFC FEC (11.3168G) 10GFC (10.51875G)	InfiniBand InfiniBand EDR (25.78125G) InfiniBand FDR (14.0625G) InfiniBand x4 (10G)

Fig. 5: Selecting with Pointer

⊠ 5-[1]: Since setting items are displayed as buttons, settings can be made by choosing the setting from the selection.

#### • Input using Arrow Keys

Fig. 5-[2]: Select the [Variable] button setting. Fig. 4-[2]: Click the Bit Rate setting window to display the numeric input panel.



Fig. 6: Input using Arrow Keys

Fig. 6-[1]: Press the button for switching the input method to toggle between input using the arrow keys and direct numeric input.

Fig. 6-[2]: Use the arrow keys for numeric input. Press the left and right arrow keys to select the numeric value to change and press the up and down arrow keys to change the value. This is a convenient method when wanting to change settings gradually.

• Direct Numeric Input



Fig. 7: Direct Numeric Input Method

Fig. 7: Input the numeric values directly. Since values and units can be input directly, this method is useful when making large changes.

# 3.8 Initializing

Initialization is performed to prevent measurement errors due to unintended settings.

MX210000A					Collicit x
Cystem Menu	Ch Tracking	All BER Results	All Measurements	All Outputs Remote 02/10/2017	
	off	open		off on Measure Output 13:36:56	
» PPG/EDCh 1				PPG/EDCh 2	PPG/ED
PPG Data/XData OFF Setup	Savo	Onon		PPG Data/XData OFF Setup/Result	Ch 1
Bit Rate	Save	Open		Bit Rate	BRC/ED
(24.3-28.2G) 25781250 kbit/s 0			rnal	(24.3-28.2G) 25781250 kbit/s 0 ppm	Ch 2
PPG Amplitude	Screen Copy	Initialize	[1]	PPG Amplitude	<u> </u>
0.40 Vp-p Ext ATT 0 dB 0	$\sim$			0.40 Vp-p Ext ATT 0 dB 0.40 Vp-p	PPG/ED Ch 3
ED Input Condition Threshold —				ED Input Condition Threshold	
Electrical Single-Ended Data Ext ATT 0 dB 0				Electrical Single-Ended Data Ext ATT 0 dB 0 mV	PPG/ED
Test Pattern		LessUDanal		Test Pattern	CII4
PPG PRBS 2^9-1 POS	Panel Lock		1/8Clk	PPG PRBS 2^9.1 POS	
ED PRBS 2*9-1 POS Tracking			Off	ED PRBS 2^9.1 POS Tracking ON	
	Before Use	Minimize			
ED Result All			20 bit 📕	ED Result "All"	
Start Time:-	Deskilledesk	Remote		Start Time:	<b>2</b>
ER	Dock/Undock	Control	7	ERE15 E.12 E.9 E.6 E.3 E.0	Scope
EC Start / Sto	Current			EC Start / Stop	
CC History Reset	Information	Exit	M 1 S	CC History Reset	
FREQ(kHz) SYNC Loss				FREQ(kHz) SYNC Loss	
0% Error				0% Error	

Fig. 8: Initialization Procedure

Fig. 8-[1]: Press [System Menu] to display the menu and press [Initialize].

## 3.9 BERT Settings

This section explains the BERT settings listed in Table 1 required for evaluating the QSFP transceiver.

System Menu Off	acking All BER Results All Measurements	All Outputs         Remote         02/14/2017           off         on         Measure         Output         13:02:01	
W PPG/EDCh 1	[4]	W PPG/EDCh 2	(IX
PPG Data/XData OFF Setup/Result	Peterenee CLK	PPG Data/XData OFF Setup/Result	PPG/ED Ch 1
100/GbE/4 (25.78125G) 25781250 kbit/s 0 ppm	Internal	100GbE/4 (25.78125G) 25781250 kbit/s 0 ppm	PPG/EI Ch 2
PPG Amplitude		PPG Amplitude	
0.30 Vp-p Ext ATT 0 dB 0.30 Vp-p	[2]	0.40 Vp-р Ext ATT 0 dB 0.40 Vp-р	PPG/E
ED Input Condition		ED Input Condition	Ch 3
Electrical E t ATT 0 dB 0 mV		Electrical Ext ATT 0 dB 0 mV	PPG/E
Test Pattern	Output	Test Pattern	
PPG PRBS 2^31-1 POS [3]	Sync Out PPG1_1/8Clk	PPG PRBS 2^31-1 POS	
ED PRBS 2^31-1 POS Tracking ON [6]	Cik Out Ch1/2 1/4 Clock	ED PRBS 2^31-1 POS Tracking ON	_
ED Result "All"	Error Addition	ED Result "All"	
	Insert Error 20 bit		
Start Time::		Start Time::	22
ER	Gating	ER	Scop
E-15 E-12 E-9 E-6 E-3 E-0	Gating Cycle Repeat	E-15 E-12 E-9 E-6 E-3 E-0	_
EC Start / Stop		EC Start / Stop	
CC History Reset	U Day U H U M 1 S	CC History Reset	
FREQ(kHz) SYNC Loss	Current ON	FREQ(kHz) SYNC Loss	
0% Error		0% Error	

Fig. 9: BERT Settings

#### 3.9.1 PPG

#### Bitrate

Fig. 9-[1]: Press the Bit Rate selection button. Fig. 10: Select 100GbE/4 25.78125G from the dialog.

Variable	Ethernet		SDH/SONET	Fibre Channel	InfiniBand
(24.3-28.2G)	100GDE/4 FEC	(27.952493G)	(10.664228G)	(28.05G)	(25.78125G)
Variable (9.5-14.2G)	100 GbE/4 (25.78125G)	OTU2e (10GbE FEC) (11.095728G)	OC-192/STM-64 (9.95328G)	16GFC (14.025G)	InfiniBand FDR (14.0625G)
	10GbE LAN/PHY (10.3125G)	OTU1e (10GbE FEC) (11.049107G)		10GFC FEC (11.3168G)	InfiniBand x4 (10G)
	10GbE WAN/PHY	0TU2 (10 709225C)		10GFC (10.51975C)	

Fig. 10: Bit Rate Standard Value

#### Amplitude

Fig. 9-[2]: Set PPG Amplitude to 0.3 Vp-p. Similarly, set the Amplitude for Ch2/Ch3/Ch4 to 0.3 Vp-p.

#### **Test Pattern**

Fig. 9-[3]: Press the Test Pattern selection button and set PPG to PRBS 2^31-1.

#### **Ch Tracking**

Fig. 9-[4]: The Ch Tracking setting can be used to synchronize the PPG Test Pattern and ED Gating for all channels. The default setting is On.

#### 3.9.2 ED

#### **Data Input Condition**

Fig. 9-[5]: Press [Electrical Single-Ended Data]. Similarly, select [Differential 50 Ohm] for Ch2/Ch3/Ch4.

#### Gating

Fig. 9-[6]: Set the Gating Cycle and measurement time. Select Single for the Gating Cycle. Since a time of 38.79 seconds is required to measure 1E-12 at 25.78125 Gbit/s, set a measurement time of 39 s.

## 3.10 Setting Sampling Oscilloscope

This section explains the Sampling Oscilloscope settings listed in Table 1 for evaluating the QSFP28 transceiver.

MX210000A									×
System Menu	Ch	Tracking	All BER Results	All Measureme	ents All (	Dutputs	Remote	04/05/2017	∕nnritsu
	off	on	open		off	on	Measure Output	17:28:19	05.00.00
Scope Setup	23	Scope		-216			Complee: 0	0.0s/10.0s	PPG/ED
General Utilities		CH A On (Electrical)	Setup	Measure	Amplitude O/E	Time	CH B On (SMF)	Sampling Hold	Ch 1
Sampling		+190mV					+2421uW		
Sampling Mode Eye		0.000000					SMF	Auto Scale	Ch 2
Number of Samples 2048									
Accumulation Type Persistency	[5]								PPG/ED Ch 3
Limit Type Time	[~]							Clear Display	
Time 10.0 sec							-	Amplitude	PPG/ED Ch 4
Samples 10 million							GND>	A Scale	
Waveforms 100 wfms		+1somv					-3000	Offset	
Averaging 10 wfms								Scale	141
								в	11
								Offset	122
								Time	Scope
		31.0 ps/div	r- GND				Precision Trigger Off 6 445 313 kbps	Scale	
								Offset	
							1		
								Marker	
		-							

Fig. 11: Setting Sampling Oscilloscope Sampling Mode

Fig. 11-[1]: Press [Scope] to set the sampling oscilloscope.

Fig. 11-[2]: Select the measurement channel. Set ChB On to monitor waveforms. The unused Ch A is set to Off.

Fig. 11-[3]: Sampling oscilloscope settings are consolidated at four buttons (Setup • Measure • Amplitude • Time) for ease of setting.

## 3.10.1 Setup

Basic settings such as measurement conditions and calibration are consolidated at the [Setup] button.

#### **Measurement Conditions**

Fig. 11-[4]: Set the sampling mode at General. For Eye pattern evaluation, select Eye. Fig. 11-[5]: Set Number of Samples/Limit Type. Since the number of samples is 1 million for 1UI, set Number of Samples to 1350, Accumulation Type to Limited, Limit Type to Waveforms, and Waveforms to 1482.

## 3.10.2 Amplitude OE

Optical-interface and amplitude-axis related settings are consolidated by the Amplitude OE button.

System Menu     Ch Tracking     All BER Results     All Measurements     All Outputs     Off     on     Open     All Measurements     All Outputs     Off     on     Open     Off     on     Off     on     Off     on     Off     On     Off     On     Off     Off     On     Off     O	itsu 0.00 i/ED 1
Scope Amplitur     [2]     Scope     Samples: 0 - 0.0s / 10.0s     [2]       Scale Offset     O/E     CH A On (Electrical)     Setup     Measure     Amplitude     Time     CH B On Soft     Sampling     Ch	i/ED 1
Scale Offset O/E CH A On Clectrical Setup Measure Amplitude Time CH B On Sampling Hold Ch	6/ED 1
Input Connector [3] SMF US SMF US SMF Auto Scale PPG	i/ED 2
Gain 330 V/W	i/ED 13
Calibration	/ED
Input Power -7.00 dBm Ch	4
Filter Filter Selection [4] No Filter	
Extinction Ratio Correction B Scale	
Correction 0.00 %	pe
31 0 ps/div         GND         64 43 13 Aps         Scale           Min 0.00 UI         GND         Max 20 UI         Gradie	
ViE Calibration Calibrate Module	
Marker	

#### **Setting Optical Interface**

Fig. 12: Setting Optical Interface

Fig. 12-[1]: Select the Amplitude tab. Fig. 12-[2]: Select the O/E tab.

#### Wavelength and Fiber Type

Select the DUT wavelength and fiber type. Fig. 13: Select SMF 1310 nm for the fiber type and wavelength.



Fig. 13: Selecting Optical Interface

#### **Bessel Low-Pass Filter**

Eye pattern evaluation is required for evaluating systems with an inserted Bessel Low-Pass Filter. The MP2110A can be used to select the specified filter for each bit rate.

Fig. 12-[4]: Press [Filter Selection].

Fig. 14: Select 100GbE/4 (25.78125G) from the dialog.



Fig. 14: Filter Selection

## 3.10.3 Time

Time-axis settings, such as Trigger, are consolidated at the [Time] button.

MX210000A							
System Menu	Ch Tracking	All BER Results	All Measurements	All Outputs	Remote Measure Output	04/05/2017	Anritsu
Scope Time	Scope	open			Samples: 0 -	- 0.0s / 10.0s	05.00.00
Rate Scale/Offset	CH A C	on Setup	Measure	O/E Time	CH B On (SMF)	Sampling Hold	Ch 1
Data Clock Rate	*190mV 0.8mV/Div			[1]	+2421 uW 484.8uW/Div SMF	Auto Scale	PPG/ED Ch 2
	[2]					Clear Display	PPG/ED Ch 3
Clock Rate 6 445 313 KHz						Amplitude Scale	PPG/ED Ch 4
Divide Ratio	+186mV				-3uW	A Offset	
Bit Rate 6 445 313 Kbps						B Scale	
Acquire Clock Rate					Precision Trigger Off	Time	Scope
Precision Trigger	31.0 ps/div Min 0.00 U	<b>₽</b> GND			6 445 313 kbps Max 2.00 UI	Scale Offset	
[3] Reset					<b>↑</b>	Marker	

Fig. 15: Setting Time Axis

Fig. 15-[1]: Press the [Time] button to display the Scope Time dialog.

#### Trigger

Accurate Eye pattern monitoring requires input of accurate trigger signal information. Like the MP2100B, the MP2110A has a Tracking function to simplify scope settings when using a BERT + scope configuration, so promote this feature supporting easy, mistake-free testing.

#### **Data Clock Rate**

Use the Tracking function to use the BERT Clock Output.

Fig. 15-[2]: Press the [Tracking] button.

Fig. 16: Select Bit Rate: PPG, and Divide Ratio: Clock Output.

Off
Bit Rate: PPG, Divide Ratio: Clock Output
Bit Rate: PPG, Divide Ratio: Sync Output
Bit Rate: PPG, Divide Ratio: User Defined

Fig. 16: Tracking

#### **Precision Trigger**

Setting [Precision Trigger] to On reduces the sampling scope Intrinsic Jitter to 200 fs rms.

Fig. 15-[3]: Press the [Precision Trigger] button.

#### 3.10.4 Measure

The evaluation item settings are integrated at the [Measure] button.



#### Select the Amplitude/Time Evaluation Items

Fig. 17: Setting Evaluation Items

Fig. 17-[1]: Press the [Measure] button to display the Setup Measure dialog. Fig. 17-[2]: Select Ch B at Active Channel Selection as the target channel for measurement.

Fig. 17-[3]: Select Amplitude/Time&Mask at Measure Item.

Fig. 17-[4]: Select Amp/Time.

Fig. 17-[5]: Select measurement parameters using the Item Selection [Add] button. (If the [Add] button is not displayed, press the Delete button to erase the unwanted item.)

Fig. 18: Since only up to four screens can be displayed on one screen at one time, first, select Average Power (dBm), Extinction Ratio, Crossing, and Jitter P-P. Select Ch B as the Active Channel.

Item Selection		
One Level	Zero Level	Eye Amplitude
Eye Height	Crossing	SNR
Average Power (dBm)	Average Power (mW)	Extinction Ratio
Jitter P.P	Jitter RMS	Rise Time
Fall Time	Eye Width	DCD
OMA (mW)	OMA (dBm)	

Fig. 18: Measurement Item

#### **Setting Mask Margin Test**

Fig. 17-[6]: Select the Mask Test tab and set the items required by the Mask Test.



Fig. 19: Setting Mask Margin Test

Fig. 19-[1]: Select the mask to be measured from Eye Mask Select. Select the 100GbE-LR4\_Tx.txt.

Fig. 19-[2]: Set the Mask Margin measurement method. Select Continuous. Fig. 19-[3]: The Mask Margin Test has variable measurement results depending on the Margin Type. At 100GbE-LR4, the specification uses Hit Ratio 5E-5.

The above settings are required prior to measurement.

# 3.11 Calibration and Aging (Warm-up)

Calibration and aging are required for accurate monitoring using a sampling oscilloscope. We recommend at least 1 hour of aging (warm-up) after power-on. Table lists calibration items and recommended calibration intervals.

Calibration Items	Calibration Contents	Recommended Calibration
		Conditions
Amplitude Linearity	Internally simulates DC voltage	After power-on warm-up
	input condition and calibrates	• At message display
	non-linearity based on that level	<ul> <li>At change of [Sampling Mode]</li> </ul>
		At ambient temperature
		change of 2.5°C or more
Output Level at No O/E	Calibrates monitored offset level	After power-on warm-up
Input	to 0 μW at no input	• At message display
		•At ambient temperature change
		of 2.5°C or more

Table 1.	Calibration	Itoms
Table 4:	Calibration	nems

## 3.11.1 Calibration Procedure



Fig. 20: Calibration Procedure

Fig. 20-[1]: Display the Setup dialog at the scope screen.

Fig. 20-[2]: Open the Utilities tab at the Setup dialog.

Fig. 20-[3]: Press the [Calibration] button at the Utilities tab.

Fig. 21 : Since confirmation is displayed when there is no signal input to the connector, disconnect the front-panel Data In (A In), Data In (B In), and Trigger Clk In connectors and press the [OK] button to execute calibration.



Fig. 21: Calibration Confirmation Screen

After completing calibration, reconnect the Data In (A In), Data In (B In), and Trigger Clk In connectors.

### 3.12 Programmable Optical Attenuator Related Settings



Fig. 22: G0351F Front Panel

The wavelength must be specified to obtain the correct attenuation.

Fig. 22-[2]: Press the  $[\lambda]$  button to display the set wavelength.

Fig. 22-[3]: Use the arrow keys to set the wavelength to 1310 nm.

Fig. 22-[1]: Press the [ATT/PWR] button to confirm the wavelength setting

To prevent unexpected optical output, set the shutter to ON when not in use to block any optical output.

Fig. 22-[4]: Press the  $[\infty]$  button so that the button LED is lit. The shutter is enabled to block optical output while the LED is lit.

Fig. 22-[1]: The G0351F has a built-in power monitor. Consequently, the attenuator output power [dBm] can be controlled. Press the [ATT/PWR] button until dBm is displayed on the screen.

## 4 Starting Measurement

Perform measurement after completing settings and calibration.

## 4.1 Outputting PPG Data

Input data for the QSFP transceiver using the PPG.



Fig. 23: Controlling PPG Data Output

Fig. 23 : Set All Outputs to On to enable PPG output from all 4ch.

## 4.2 Checking Reference QSFP28 Transceiver Optical Signal Output and Output Level

The optical output of the reference QSFP28 transceiver must be enabled to measure the Rx optical sensitivity of the DUT. Check the transceiver specifications for the optical signal output control method.

The Rx optical sensitivity measurement tests whether a BER of better than 1E-12 can be confirmed at –13.6 dBm with a 3dB margin from the –10.6 dBm specification in IEEE802.3 2015 100GbE-LR4 at the average receive power, and each lane (min) setting.

Check each lane at -13.6 dBm or less.

The optical output from lanes other than Lane 0 is blocked using the QSFP28 evaluation board control PC.

Disable the programmable optical attenuator shutter and confirm the input power.

If the power exceeds –13.6 dBm, increase the attenuation amount so that it becomes –13.6 dBm. Perform the same confirmation for each of Lane 1, Lane 2 and Lane 3.

Enable optical output for all of Lane 0, Lane 1, Lane 2, and Lane 3 and input the optical signal to the DUT QSFP28 module.

# 4.3 Outputting DUT QSFP28 Transceiver Optical Signal

Enable the DUT QSFP28 transceiver optical signal to perform DUT transmitter measurement. Confirm the transceiver specifications for the optical signal output control method.

Since transmitter evaluation is performed for each lane, use the QSFP28 evaluation board control PC to block optical output from all lanes except Lane 0.

# 4.4 Drawing Waveforms

Fig. 24: Press [Auto Scale] so that the correct settings are applied to draw the center of the Eye pattern at the screen center.



Fig. 24 : Starting Eye Pattern Drawing

## 4.5 Simultaneous BER and Eye Pattern Measurement

Fig. 25-[1]: Set any channel for the BERT setting (set channel 4 here).

Fig. 25-[2]: Press the BERT channel [Setup/Result] button to display the BER measurement results for all channels.

Fig. 25-[3]: Select [Scope] to display the BER 4ch measurement results and scope Eye pattern simultaneously.



Fig. 25: Simultaneous BER Eye Pattern Measurement

# 5 Evaluation

The MP2110A can perform BER measurement for four channels and evaluate the Eye patterns simultaneously.

Fig. 26 : Set All Measurements to Start to start BER measurement for all four channels and draw the Eye patterns.



Fig. 26 : Starting PPG Pattern Output/BER Measurement

# 5.1 Collecting Eye Pattern Measurement Results and Saving Waveform Data

Fig. 27-[1] : When capture of the specified samples is completed, the Sampling Run LED goes off and the measurement results are displayed.

Fig. 27-[2] : The Amplitude/Time measurement results are displayed at the screen bottom left; confirm the display measurement results at Average Power (dBm), Extinction Ratio, Crossing, Jitter p-p.

Fig. 27-[3]: The Mask Margin measurement results are displayed at the screen bottom right.



Fig. 27 : Collecting Eye Pattern Measurement Results

## 5.2 Saving Eye Pattern Waveform

The measurement results and waveform data are saved as screenshots in .png format.

MX210000A		
Ch Tracking All BER Results All Measurements	All Outputs Remote 02/10/2017	∕ınritsu
off open 🔹 🕨	off on Measure Output 13:36:56	
X PPG/EDCh 1	W PPG/EDCh 2	PPC/ED
PPG Data/XData OFF Setur	PPG Data/XData OFF Setup/Result	Ch 1
Bit Rate Save Open	Bit Rate	
Variable (24.3.28.2G) 25781250 kbit/s 0 mal	Variable (24.3-28.2G) 25781250 kbit/s 0 ppm	PPG/ED Ch 2
PPG Amplitude Screen Copy hitialize	PPG Amplitude	
	0.40 Vp-p Ext ATT 0 dB 0.40 Vp-p	PPG/ED
ED Input Condition	ED Input Condition	Ch 3
Electrical Single-Ended Data Ext ATT 0 dB 0	Electrical Single-Ended Data Ext ATT 0 dB 0 mV	PPG/ED
Test Pattern	Test Pattern	CIT 4
PPG PRBS 2^9.1 POS Panel Lock 18Clk	PPG PRBS 2^9.1 POS	
ED PRBS 2^9.1 POS Tracking Off	ED PRBS 2^9-1 POS Tracking ON	
ED Result "All" Before Use Minimize	ED Result "All"	
20 bit		
Start Time Remote	Start Time::	2
ER E-15 E-12 E-9 E-6 Control	E-15 E-12 E-9 E-6 E-3 E-0	Scope
EC Start / Sto	EC Start / Stop	
CC History Information Exit M 1 s	CC History Reset	
FREQ(kHz) SYNC Loss	FREQ(kHz) SYNC Loss	
0% Error	0% Error	

Fig. 28: Screen Copy Procedure

Fig. 28-[1] : Select Screen Copy from the System Menu.

File	
Drives Local Disk (C:) File Nan	me 07042017_102528140
	File Type PNG Files Screen Keyboard
Directories	File List
Anritsu MX210000A Log SysFile Tmp UserData Mask MATLAB Pattern Result Screen Copy	Save to C:\Users\Public\Documents\Anritsu\MX210000A\Use Default Name/Root
- Setting - Downloads	•

Fig. 29: Screen Copy Folder Selection

Fig. 29: Save is performed to the following folder by default.

<C:¥Users¥Public¥Documents¥Anritsu¥MX210000A¥UserData¥Screen Copy>

Change the file name as necessary and press the [OK] button to save as a screenshot.

Fig. 27-[2]: The Time/Amplitude measurement results can only display four items on the GUI but saving the measurement results permits confirmation of other results by overwriting the displayed data without re-measurement. (See Fig. 17 for details.)

Fig. 27-[4]: Select remaining items from Item Selection and confirm the displayed measurement results at Jitter (rms), Rise Time, and Fall Time.

# 5.3 Evaluating Lane 1/2/3 of DUT QSFP28 Transceiver

Switch the transmitter evaluation to Lane 1. Block optical output from lanes other than Lane 1 using the QSFP28 evaluation board control PC. Perform the same evaluations as Lane 0, and save the measurement results. Repeat the same measurements over for Lane 2 and Lane 3 and save the measurement results.

# 5.4 Displaying BER Measurement Results

BER measurement is completed for four channels 39 seconds after measurement is started. Fig. 30: Press the [All BER Results] button to confirm the measurement results for all four channels at once.



Fig. 30: Checking 4ch BERT Simultaneously

Save this with Screen Copy (see Fig. 28 for details).

# 6 Completing Measurement

The measurements listed in Table 1 are completed.

Fig. 22-[4]: Press the [∞] button so that the button LED lights and optical power output is blocked. Block all optical output for the DUT transceiver using the QSFP28 evaluation board control PC. Block all optical output for the reference transceiver using the QSFP28 evaluation board control PC. Fig. 31-[1]: Set the PPG output to Off.



Fig. 31: Turn off the PPG Output

Power-off the optical transceiver.

Pressing the MP2110A [Power] button automatically shuts down Windows and powers-down the instrument.

# 7 Fitting Terminators or Caps After Measurement

Fig. 32: Protect against damage by fitting terminators or caps to the connectors.

Fit terminators to output connectors.

Fit caps to input connectors.

Always fit the supplied protective caps to the optical input ports when not in use to prevent risk of damage or ingress of dust, etc.



Fig. 32: Terminators and Protective Caps

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