Anritsu envision:ensure

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.

BERTWave

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.

Table 1: QSFP28 Optical Transceiver Evaluation Items

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

3.2 Required Equipment

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

Table 2: Required Equipment

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	

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

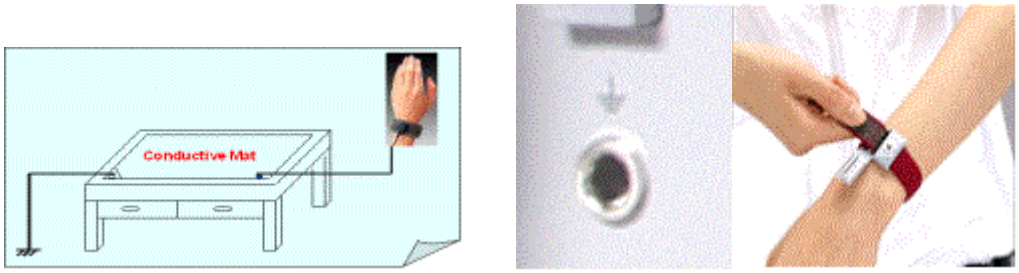

Fig. 1: Grounding Connected Equipment

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.

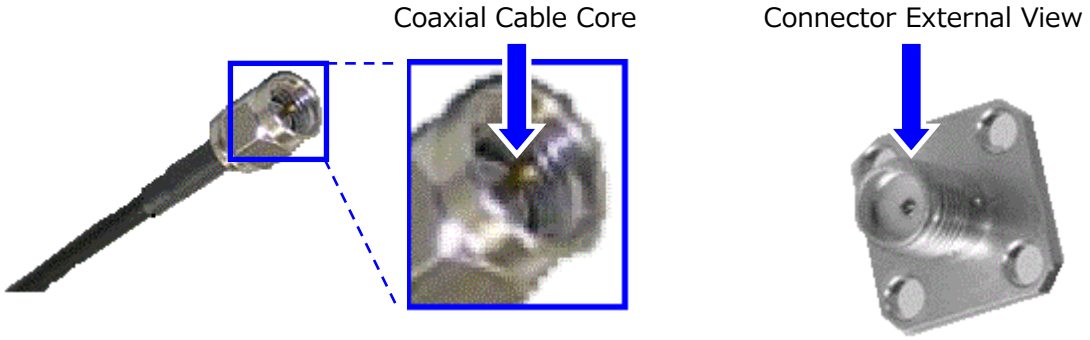

Fig. 2: Discharging Coaxial Cable Core

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.

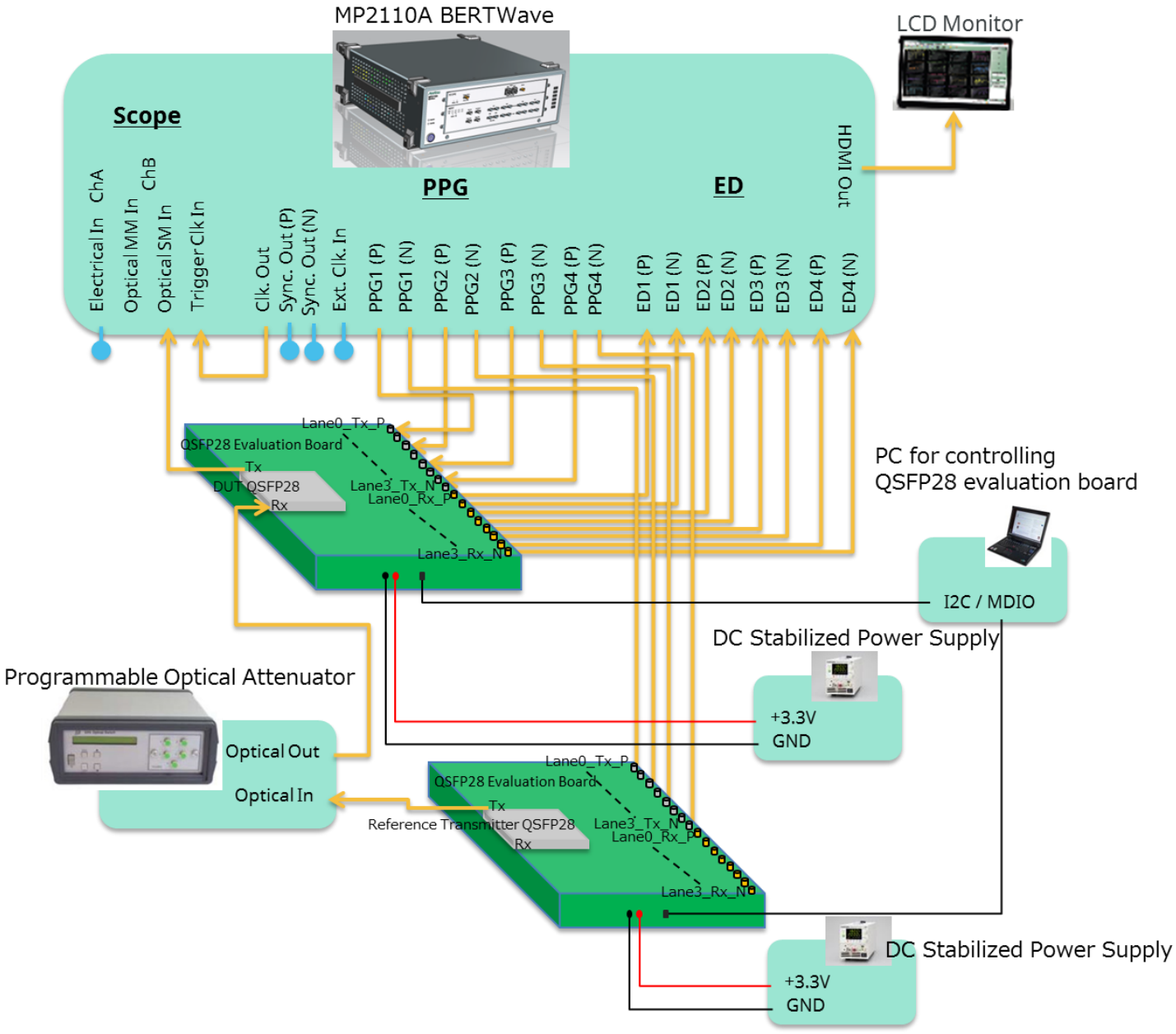

Fig. 3: Setup for Evaluating 100G LR4 1310 nm QSFP28

Table 3: Cables and Connections

Connected Equipment	Connected Port	Cable Type	Check	Connected Port	Connected Equipment
MP2110A	ChB Optical SM In	J1139A FC･PC-LC･PC-1M-SM		Tx	DUT QSFP28
	Trigger Clk In	J1349A Coaxial Cable 0.3 m		Clk. Out	MP2110A
	PPG1(P)	J1439A Coaxial Cable (0.8 m, K-connector)		Lane0_Tx_P	DUT QSFP28 Evaluation Board
	PPG2(P)	J1439A Coaxial Cable (0.8 m, K-connector)		Lane1_Tx_P	
	PPG3(P)	J1439A Coaxial Cable (0.8 m, K-connector)		Lane2_Tx_P	
	PPG4(P)	J1439A Coaxial Cable (0.8 m, K-connector)		Lane3_Tx_P	
	PPG1(N)	J1342A Coaxial Cable 0.8 m		Lane0_Tx_N	Reference Transceiver QSFP28 Evaluation Board
	PPG2(N)	J1342A Coaxial Cable 0.8 m		Lane1_Tx_N	
	PPG3(N)	J1342A Coaxial Cable 0.8 m		Lane2_Tx_N	
	PPG4(N)	J1342A Coaxial Cable 0.8 m		Lane3_Tx_N	
	ED1(P)	J1342A Coaxial Cable 0.8 m		Lane0_Rx_P	DUT QSFP28 Evaluation Board
	ED1(N)	J1342A Coaxial Cable 0.8 m		Lane0_Rx_N	
	ED2(P)	J1342A Coaxial Cable 0.8 m		Lane1_Rx_P	
	ED2(N)	J1342A Coaxial Cable 0.8 m		Lane1_Rx_N	
	ED3(P)	J1342A Coaxial Cable 0.8 m		Lane2_Rx_P	
	ED3(N)	J1342A Coaxial Cable 0.8 m		Lane2_Rx_N	
	ED4(P)	J1342A Coaxial Cable 0.8 m		Lane3_Rx_P	
	ED4(N)	J1342A Coaxial Cable 0.8 m		Lane3_Rx_N	
	HDMI Out	HDMI Cable		HDMI In	LCD Monitor
Reference Transmitter QSFP28	Tx	J1139A FC･PC-LC･PC-1M-SM		Optical In	G0351F
DUT QSFP28	Rx	J1139A FC･PC-LC･PC-1M-SM		Optical Out	
DC Stabilized Power Supply	GND	UL1007 AWG20		GND	DUT QSFP28 Evaluation Board
	+3.3 V	UL1007 AWG20		+3.3 V	
DC Stabilized Power Supply	GND	UL1007 AWG20		GND	Reference Transmitter QSFP28 Evaluation Board
	+3.3 V	UL1007 AWG20		+3.3 V	
PC Controller for QSFP28 Evaluation Board	USB	USB Cable		USB	DUT QSFP28 Evaluation Board
	USB	USB Cable		USB	Reference Transmitter QSFP28 Evaluation Board

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.

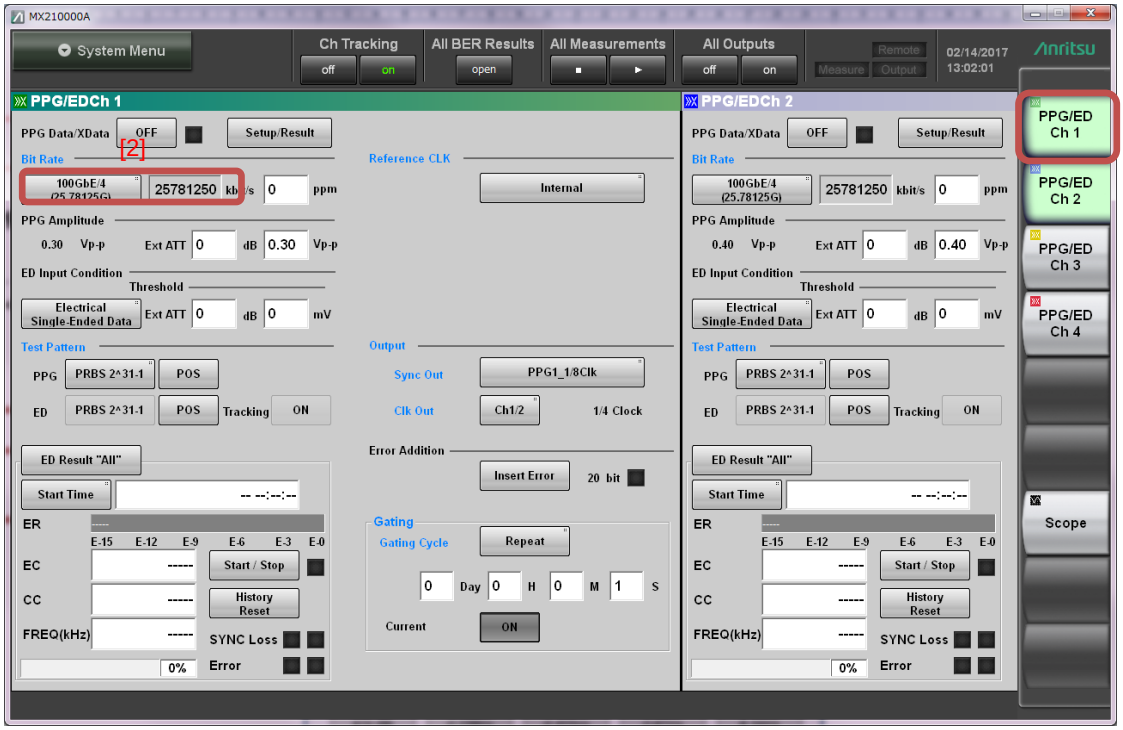

Fig. 4: MP2110A Parameter Setting methods

Fig. 4-[1]: Select PPG/ED Ch1 to display the setting screen.
Fig. 4-[2]: Select Bit Rate setting.

Selecting with Pointer

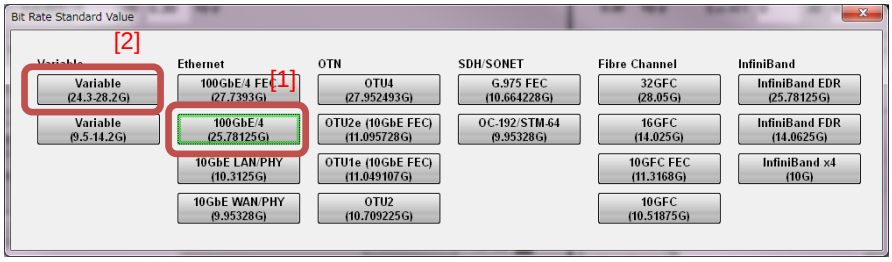

Fig. 5: Selecting with Pointer

図 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.

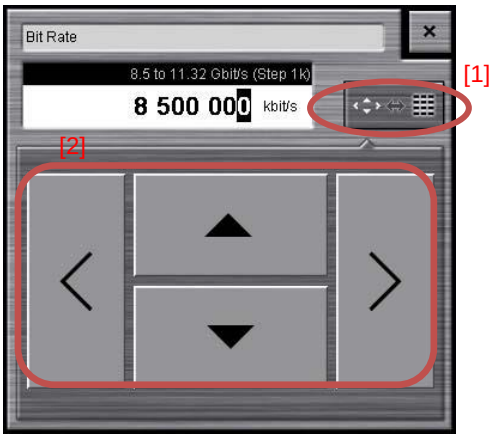

Fig. 6: Input using Arrow Keys

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.

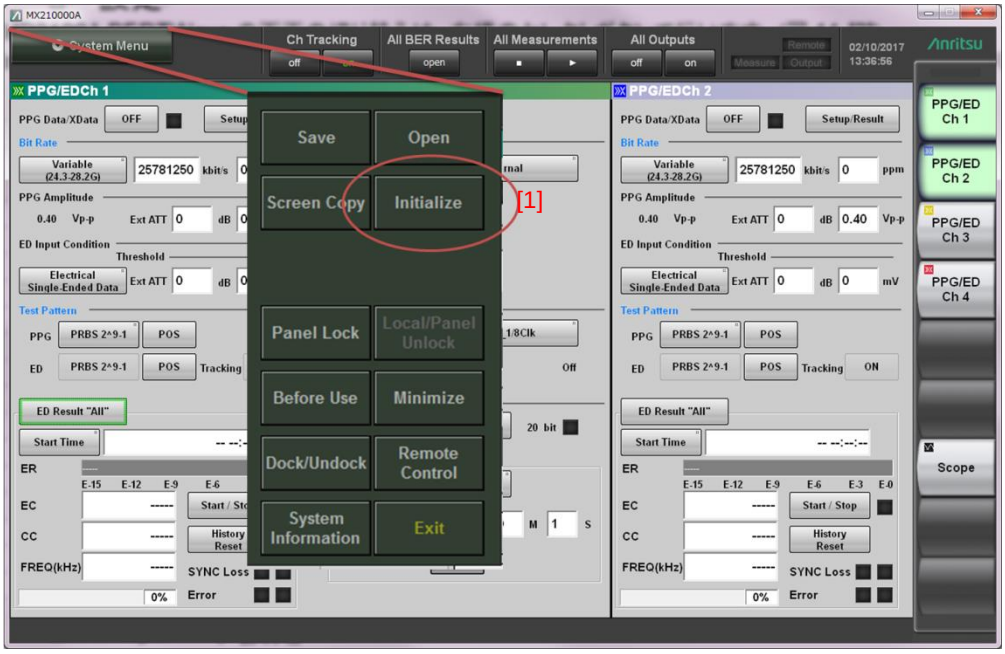

Fig. 8: Initialization Procedure

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.

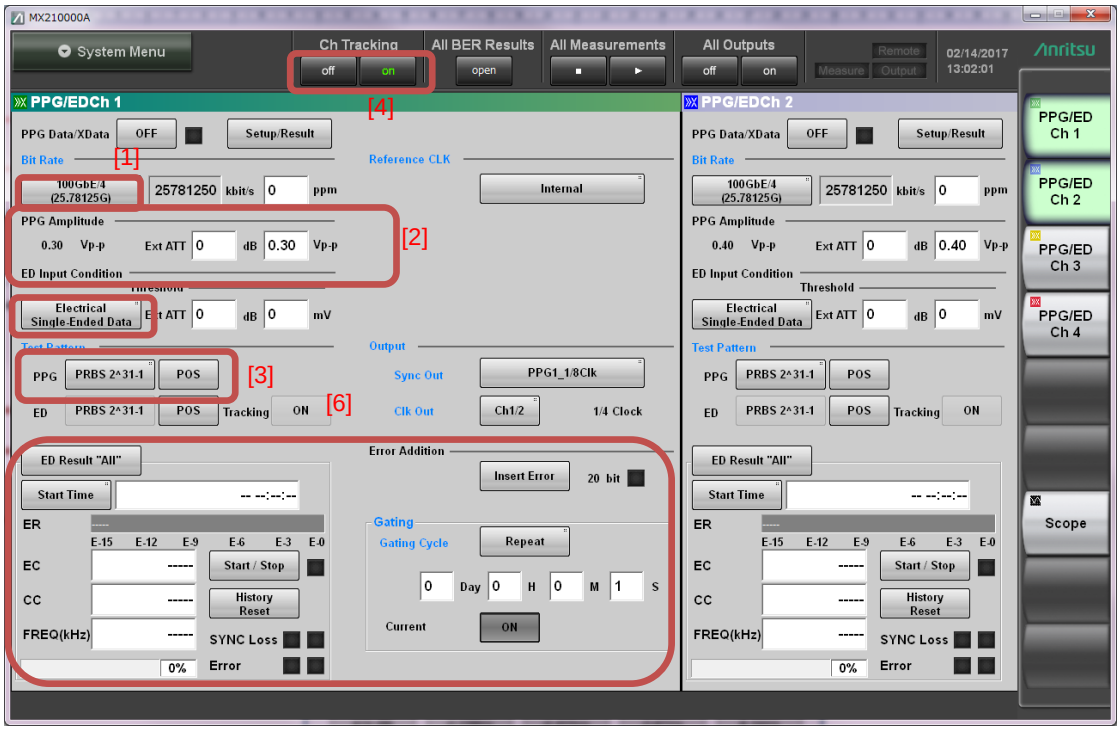

Fig. 9: BERT Settings

3.9.1 PPG

Bitrate

Fig. 9-[1]: Press the Bit Rate selection button.

Fig. 10: Select 100GbE/4 25.78125G from the dialog.

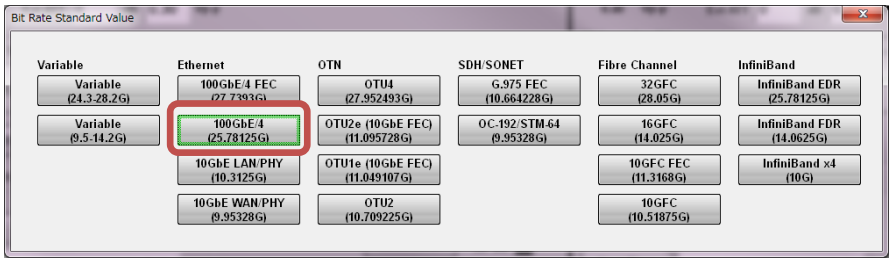

Fig. 10: Bit Rate Standard Value

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.

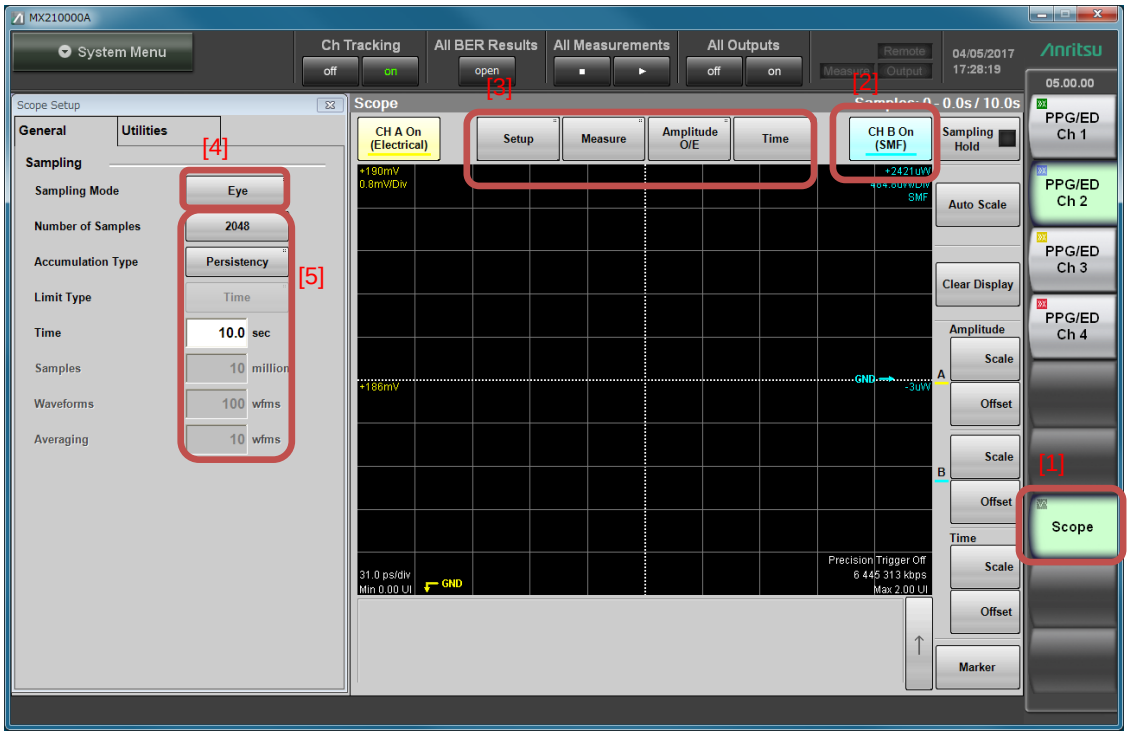

Fig. 11: Setting Sampling Oscilloscope Sampling Mode

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.

Setting Optical Interface

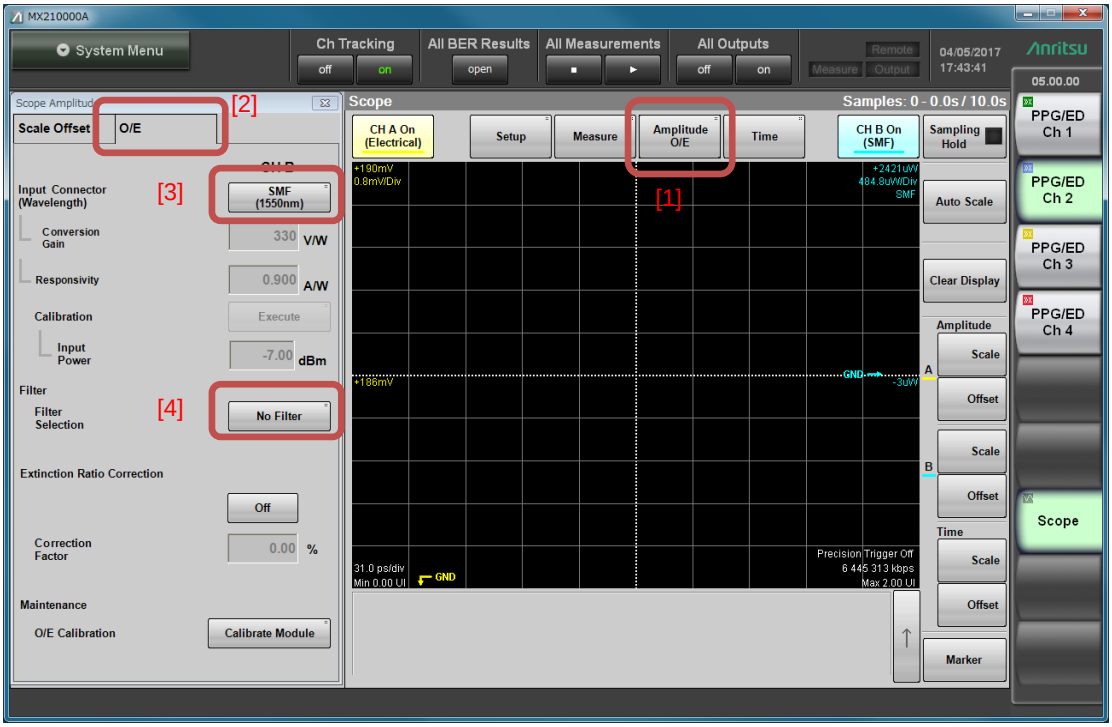

Fig. 12: Setting Optical Interface

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.

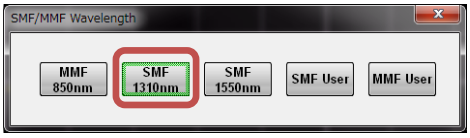

Fig. 13: Selecting Optical Interface

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.

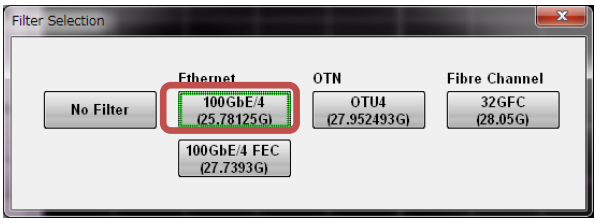

Fig. 14: Filter Selection

3.10.3 Time

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

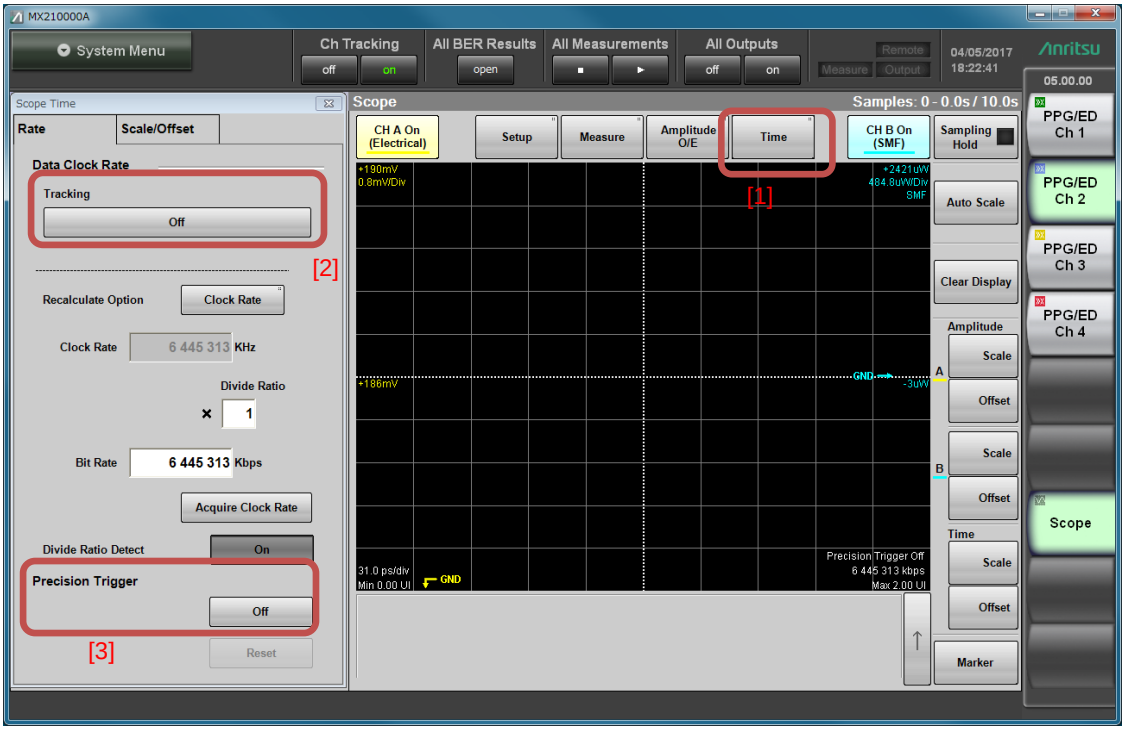

Fig. 15: Setting Time Axis

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.

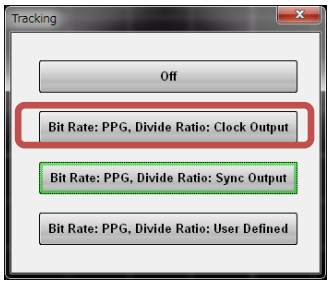

Fig. 16: Tracking

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

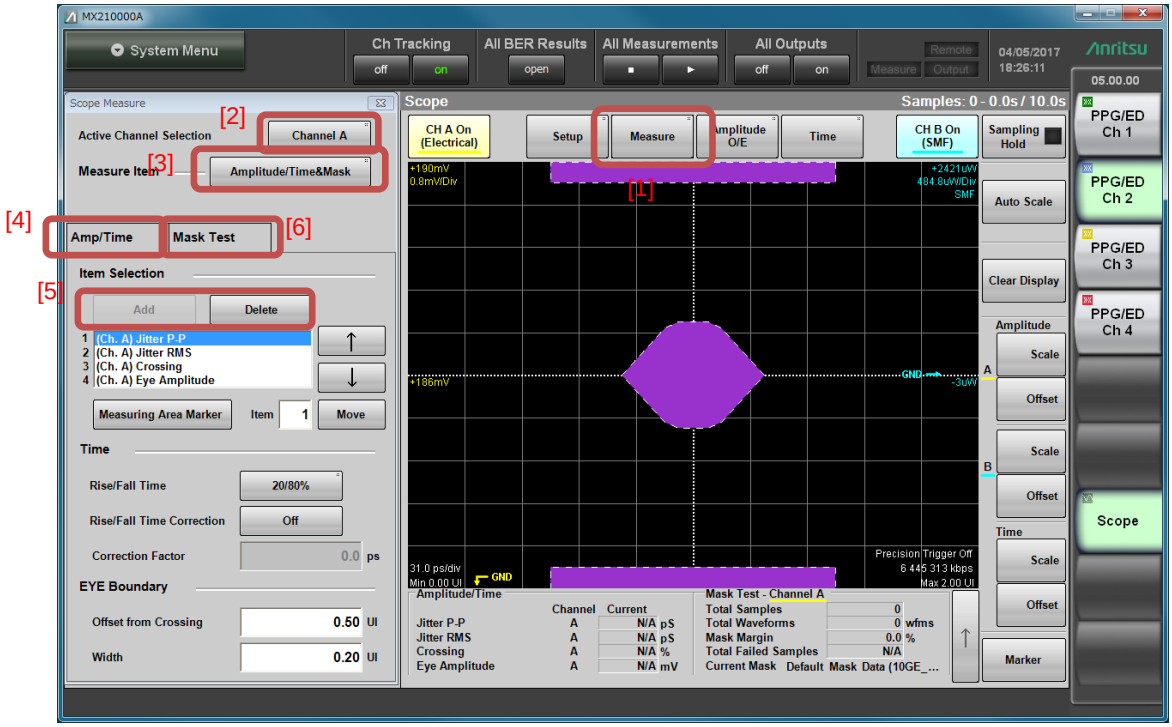

Fig. 17: Setting Evaluation Items

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.

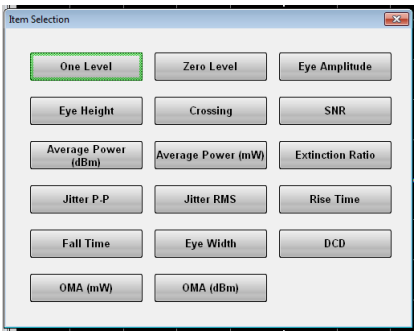

Fig. 18: Measurement Item

Setting Mask Margin Test

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

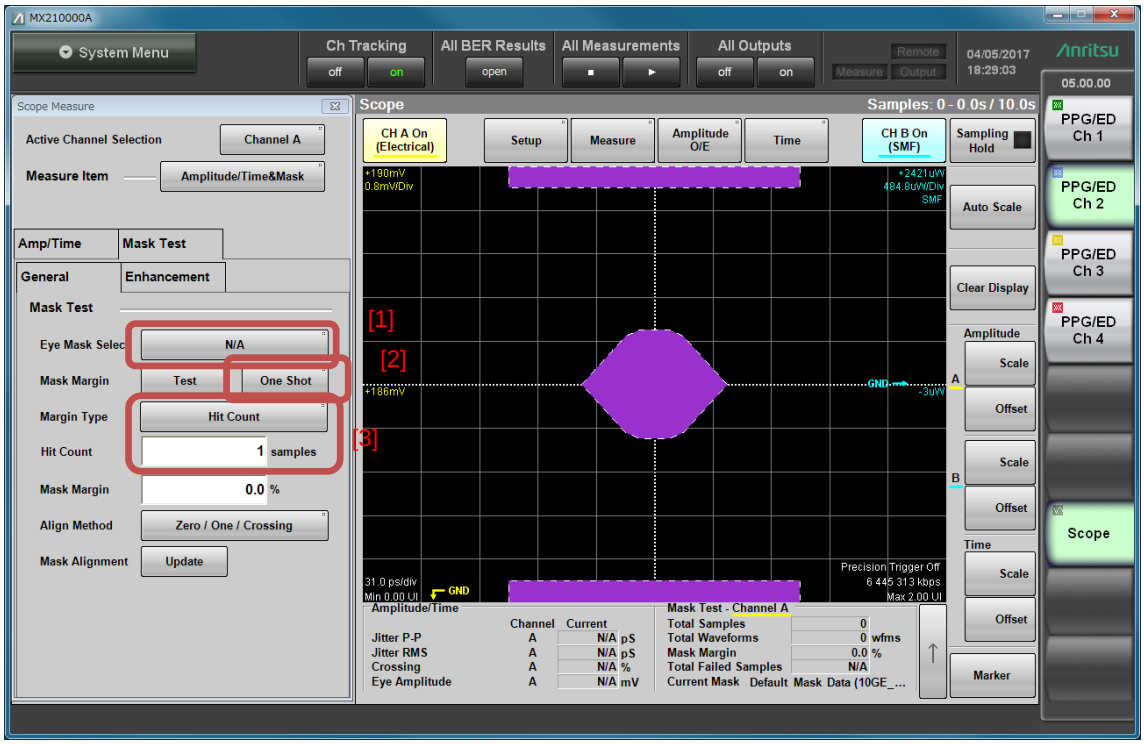

Fig. 19: Setting Mask Margin Test

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.

Table 4: Calibration Items

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

3.11.1 Calibration Procedure

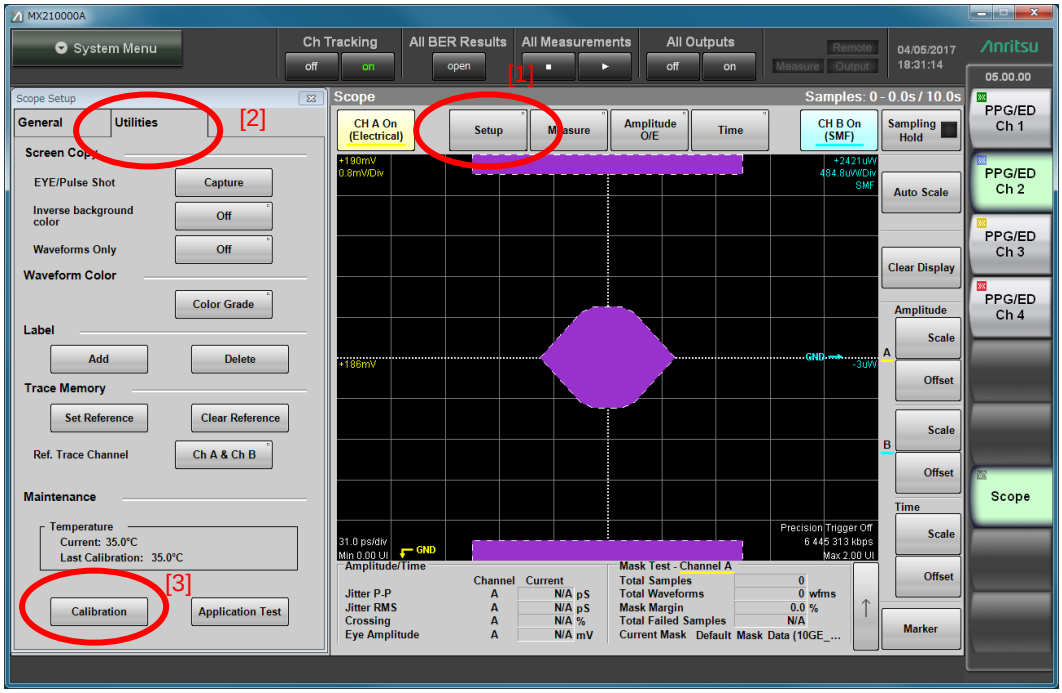

Fig. 20: Calibration Procedure

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.

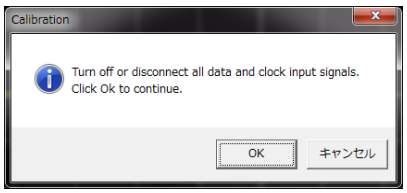

Fig. 21: Calibration Confirmation Screen

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

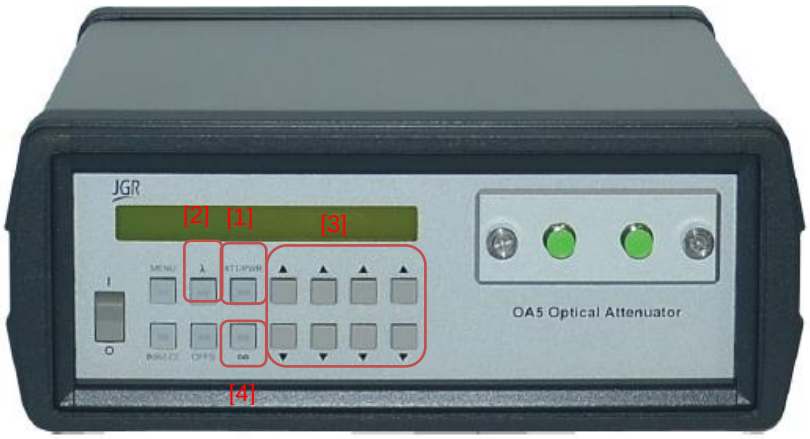

Fig. 22: G0351F Front Panel

The wavelength must be specified to obtain the correct attenuation.

Fig. 22-[2]: Press the [λ] 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 [∞]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.

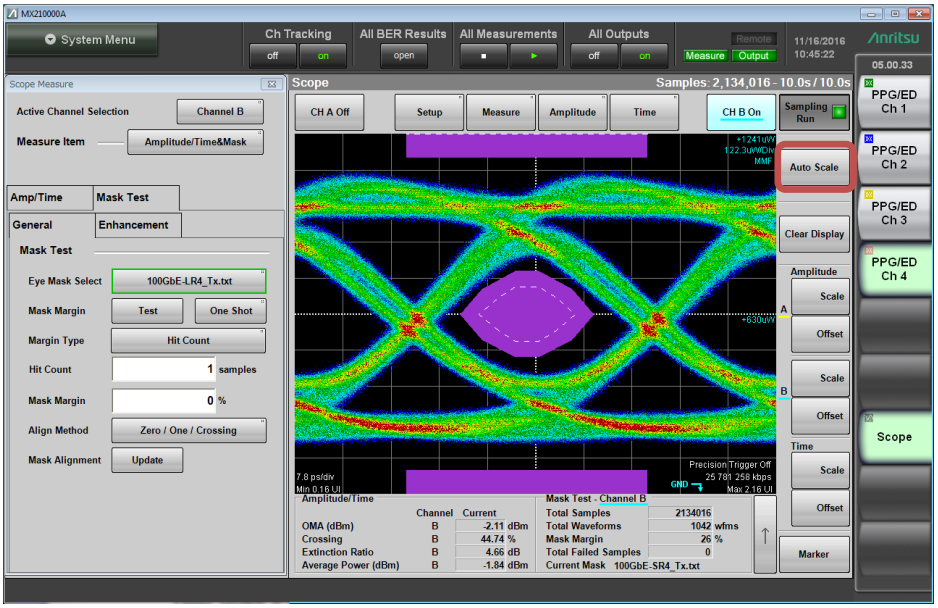

Fig. 24 : Starting Eye Pattern Drawing

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.

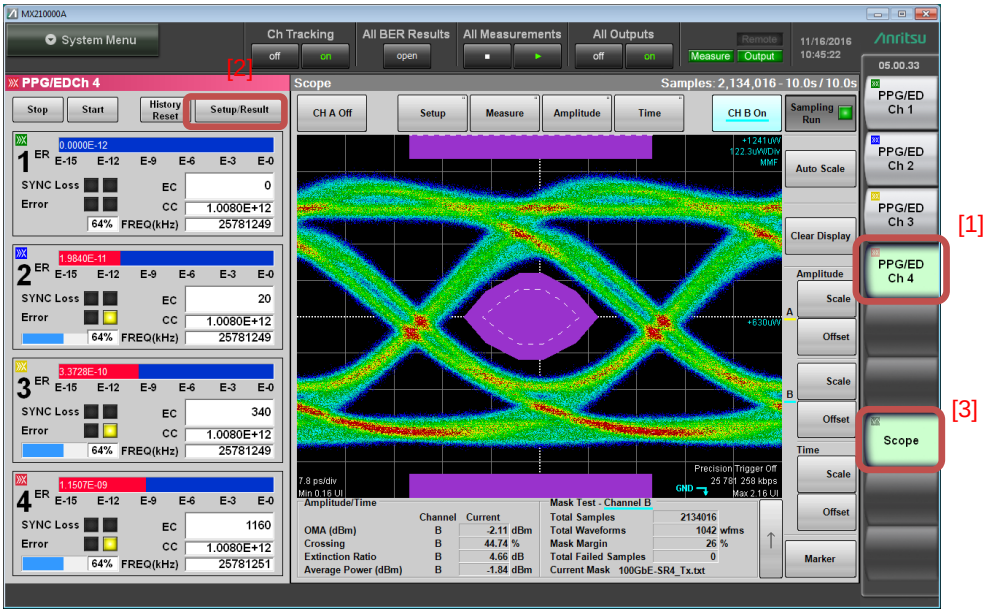

Fig. 25: Simultaneous BER Eye Pattern Measurement

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.

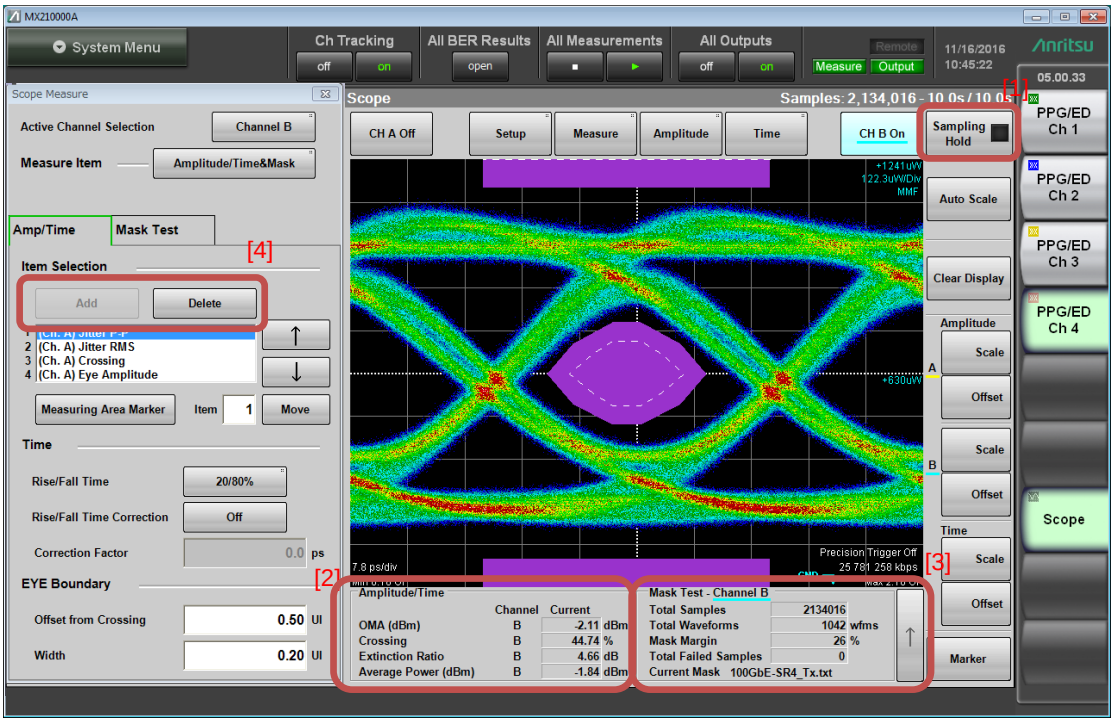

Fig. 27 : Collecting Eye Pattern Measurement Results

5.2 Saving Eye Pattern Waveform

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

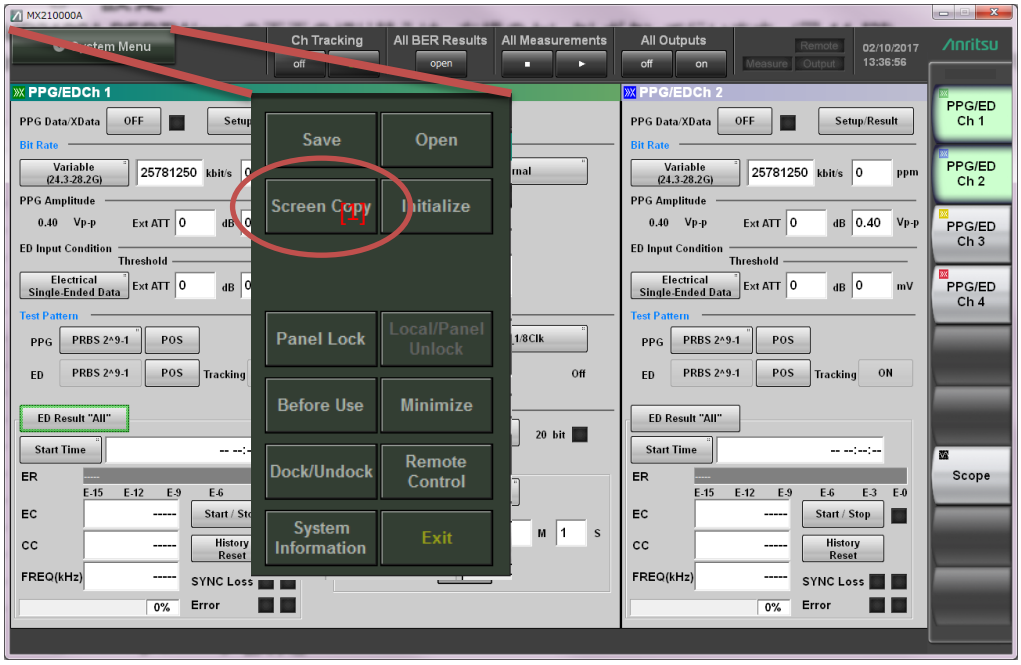

Fig. 28: Screen Copy Procedure

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

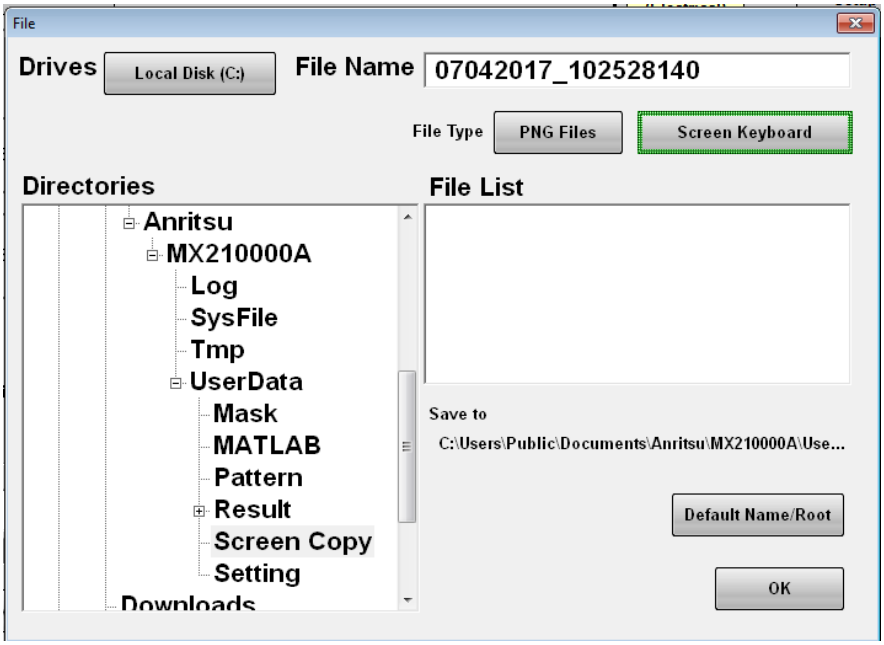

Fig. 29: Screen Copy Folder Selection

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.

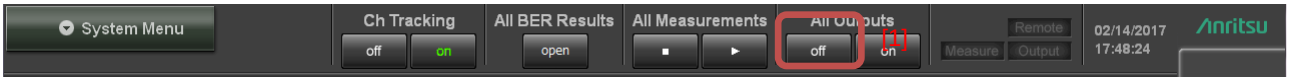

Fig. 31: Turn off the PPG Output

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.

■: SMA Terminators
●: SMA Cap
●: Optical Connector Cap

Fig. 32: Terminators and Protective Caps

Anritsu envision : ensure

Specifications are subject to change without notice.

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