MX183000A
High-Speed Serial Data
Test Software
Operation Manual

23rd Edition

- **For safety and warning information, please read this manual before attempting to use the equipment.**
- **Additional safety and warning information is provided in the MP1800A Signal Quality Analyzer Installation Guide, the MP1900A Signal Quality Analyzer-R Operation Manual, and the MT1810A 4 Slot Chassis Installation Guide. Please also refer to them before using the equipment.**
- **Keep this manual with the equipment.**

ANRITSU CORPORATION

Document No.: M-W3813AE-23.0

Safety Symbols

To prevent the risk of personal injury or loss related to equipment malfunction, Anritsu Corporation uses the following safety symbols to indicate safety-related information. Ensure that you clearly understand the meanings of the symbols BEFORE using the equipment. Some or all of the following symbols may be used on all Anritsu equipment. In addition, there may be other labels attached to products that are not shown in the diagrams in this manual.

Symbols used in manual

⚠ **DANGER**	This indicates a very dangerous procedure that could result in serious injury or death if not performed properly.
⚠ **WARNING**	This indicates a hazardous procedure that could result in serious injury or death if not performed properly.
⚠ **CAUTION**	This indicates a hazardous procedure or danger that could result in light-to-severe injury, or loss related to equipment malfunction, if proper precautions are not taken.

Safety Symbols Used on Equipment and in Manual

The following safety symbols are used inside or on the equipment near operation locations to provide information about safety items and operation precautions. Ensure that you clearly understand the meanings of the symbols and take the necessary precautions BEFORE using the equipment.

⃠	This indicates a prohibited operation. The prohibited operation is indicated symbolically in or near the barred circle.
○	This indicates an obligatory safety precaution. The obligatory operation is indicated symbolically in or near the circle.
△	This indicates a warning or caution. The contents are indicated symbolically in or near the triangle.
□	This indicates a note. The contents are described in the box.
 	These indicate that the marked part should be recycled.

MX183000A
High-Speed Serial Data Test Software
Operation Manual

1 February 2016 (First Edition)
19 April 2023 (23rd Edition)

The operational instructions of this manual may be changed without prior notice.
Printed in Japan

Equipment Certificate

Anritsu Corporation guarantees that this equipment was inspected at shipment and meets the published specifications.

Anritsu Warranty

- During the warranty period, Anritsu Corporation will repair or exchange this software free-of-charge if it proves defective when used as described in the operation manual.
- The warranty period is 6 months from the purchase date.
- The warranty period after repair or exchange will remain 6 months from the original purchase date, or 30 days from the date of repair or exchange, depending on whichever is longer.
- This warranty does not cover damage to this software caused by Acts of God, natural disasters, and misuse or mishandling by the customer.

In addition, this warranty is valid only for the original equipment purchaser. It is not transferable if the equipment is resold.

Anritsu Corporation shall assume no liability for damage or financial loss of the customer due to the use of or a failure to use this equipment, unless the damage or loss is caused due to Anritsu Corporation’s intentional or gross negligence.

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In the event of this equipment malfunctions, please contact an Anritsu Service and Sales office. Contact information can be found on the last page of the printed version of this manual, and is available in a separate file on the PDF version.
Also, the Anritsu website provides you with contact information and a contact form.

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1. If a fault (bug) is discovered in this Software, making this Software unable to operate as described in the operation manual or specifications even though you have used this Software as described in the manual, Anritsu shall at its own discretion, fix the bug, or replace the software, or suggest a workaround, free-of-charge, provided, however, that the faults caused by the following items and any of your lost or damaged data whatsoever shall be excluded from repair and the warranty.
    - i) If this Software is deemed to be used for purposes not described in the operation manual or specifications.
    - ii) If this Software has been used in conjunction with other non-Anritsu-approved software.
    - iii) If this Software or the Equipment has been modified, repaired, or otherwise altered without Anritsu's prior approval.
    - iv) For any other reasons out of Anritsu's direct control and responsibility, such as but not limited to, natural disasters, software virus infections, or any devices other than this Equipment, etc.
2. Expenses incurred for transport, hotel, daily allowance, etc., for on-site repairs or replacement by Anritsu engineers necessitated by the above faults shall be borne by you.
3. The warranty period for faults listed in Section 1 of this Article shall be either 6 months from the date of purchase of this Software or 30 days after the date of repair or replacement, whichever is longer.

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You shall not use or otherwise export or re-export directly or indirectly this Software except as authorized by the laws and regulations of Japan and the United States, etc. In particular, this Software shall not be exported or re-exported (a) into any Japan or US embargoed countries or (b) to anyone restricted by the Japanese export control regulations, or the US Treasury Department's list of Specially Designated Nationals or the US Department of Commerce Denied Persons List or Entity List. In using this Software, you warrant that you are not located in any such embargoed countries or on any such lists. You also agree that you will not use or otherwise export or re-export this Software for any purposes prohibited by the Japanese and US laws and regulations, including, without limitation, the development, design and manufacture or production of missiles or nuclear, chemical or biological weapons of mass destruction, and conventional weapons.

Article 5. Change of Terms

Anritsu may change without your approval the terms of this EULA if the changes are for the benefit of general customers, or are reasonable in light of the purpose of this EULA and circumstances of the changes. At the time of change, Anritsu will inform you of those changes and its effective date, as a general rule 45 days, in advance on its website, or in writing or by e-mail.

Article 6. Termination

1. Anritsu may terminate this EULA immediately if you violate any conditions described herein. This EULA shall also be terminated immediately by Anritsu if there is any good reason that it is deemed difficult to continue this EULA, such as your violation of Anritsu copyrights, patents, etc. or any laws and ordinances, or if it turns out that you belong to an antisocial organization or has a socially inappropriate relationship with members of such organization.
2. You and Anritsu may terminate this EULA by a written notice to the other party 30 days in advance.

Article 7. Damages

If Anritsu suffers any damages or loss, financial or otherwise, due to your violation of the terms of this EULA, Anritsu shall have the right to seek proportional damages from you.

Article 8. Responsibility after Termination

Upon termination of this EULA in accordance with Article 6, you shall cease all uses of this Software immediately and shall as directed by Anritsu either destroy or return this Software and any backup copies, full or partial, to Anritsu.

Article 9. Negotiation for Dispute Resolution

If matters of interpretational dispute or items not covered under this EULA arise, they shall be resolved by negotiations in good faith between you and Anritsu.

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This EULA shall be governed by and interpreted in accordance with the laws of Japan without regard to the principles of the conflict of laws thereof, and any disputes arising from or in relation to this EULA that cannot be resolved by negotiation described in Article 9 shall be subject to and be settled by the exclusive agreed jurisdiction of the Tokyo District Court of Japan.

Revision History:

February 29th, 2020
December 17th, 2021

Before Using VISA*1

For Those Who Use MP1800A and MP1900A

To use the MX183000A High-Speed Serial Data Test Software (hereafter MX183000A), you are required to install National Instruments™ (hereafter NI™) NI-VISA™*2 on the PC controller. We recommend using NI-VISA™*2 provided in the USB flash drive that contains MX183000A.

You are allowed to use NI-VISA™*2 contained in the USB flash drive only for the purpose of using it for MX183000A. Use of NI-VISA™*2 for any other product or purpose is prohibited.
When uninstalling MX183000A from the PC controller, uninstall NI-VISA™ that was installed from the USB flash drive as well.

Glossary of Terms:

*1: VISA: Virtual Instrument Software Architecture
I/O software specification for remote control of measuring instruments using interfaces such as GPIB, Ethernet, USB, etc.

*2: NI-VISA™
World de facto standard I/O software interface developed by NI and standardized by the VXI Plug&Play Alliance.

Trademarks:

- National Instruments™, NI™, NI-VISA™ and National Instruments Corporation are all trademarks of National Instruments Corporation.

Before Using VISA*[1]

For Those Who Use MT1810A

To use the MX183000A High-Speed Serial Data Test Software (hereafter MX183000A), you are required to install National Instruments™ (hereafter NI™) NI-VISA™*[2] on the PC controller.

You need to get the NI-VISA™ Installer yourself.
The USB flash drive for MX183000A does not contain NI-VISA™ because MT1810A does not include any NI™ hardware.

Glossary of Terms:

*1: VISA: Virtual Instrument Software Architecture
I/O software specification for remote control of measuring instruments using interfaces such as GPIB, Ethernet, USB, etc.

*2: NI-VISA™
World de facto standard I/O software interface developed by NI and standardized by the VXI Plug&Play Alliance.

Trademarks:

- National Instruments™, NI™, NI-VISA™ and National Instruments Corporation are all trademarks of National Instruments Corporation.

Protection Against Computer Virus Infections

Prior to the software installation

Before installing this software or any other software recommended or approved by Anritsu, run a virus scan on your computer, including removable media (e.g. USB flash drive and CF memory card) you want to connect to your computer.

When using this software and connecting with the measuring instrument

- Copying files and data
  On your computer, do not save any copies other than the following:
  - Files and data provided by Anritsu
  - Files created by this software
  - Files specified in this document

  Before copying these files and/or data, run a virus scan, including removable media (e.g. USB flash drive and CF memory card).
- Connecting to network
  Connect your computer to the network that provides adequate protection against computer viruses.
- Protection against malware (malicious software such as viruses).
  To connect your computer to network, the following is advised.
  - Activate Firewall.
  - Install important updates of Windows.
  - Use antivirus software.

Cautions on Proper Operation of Software

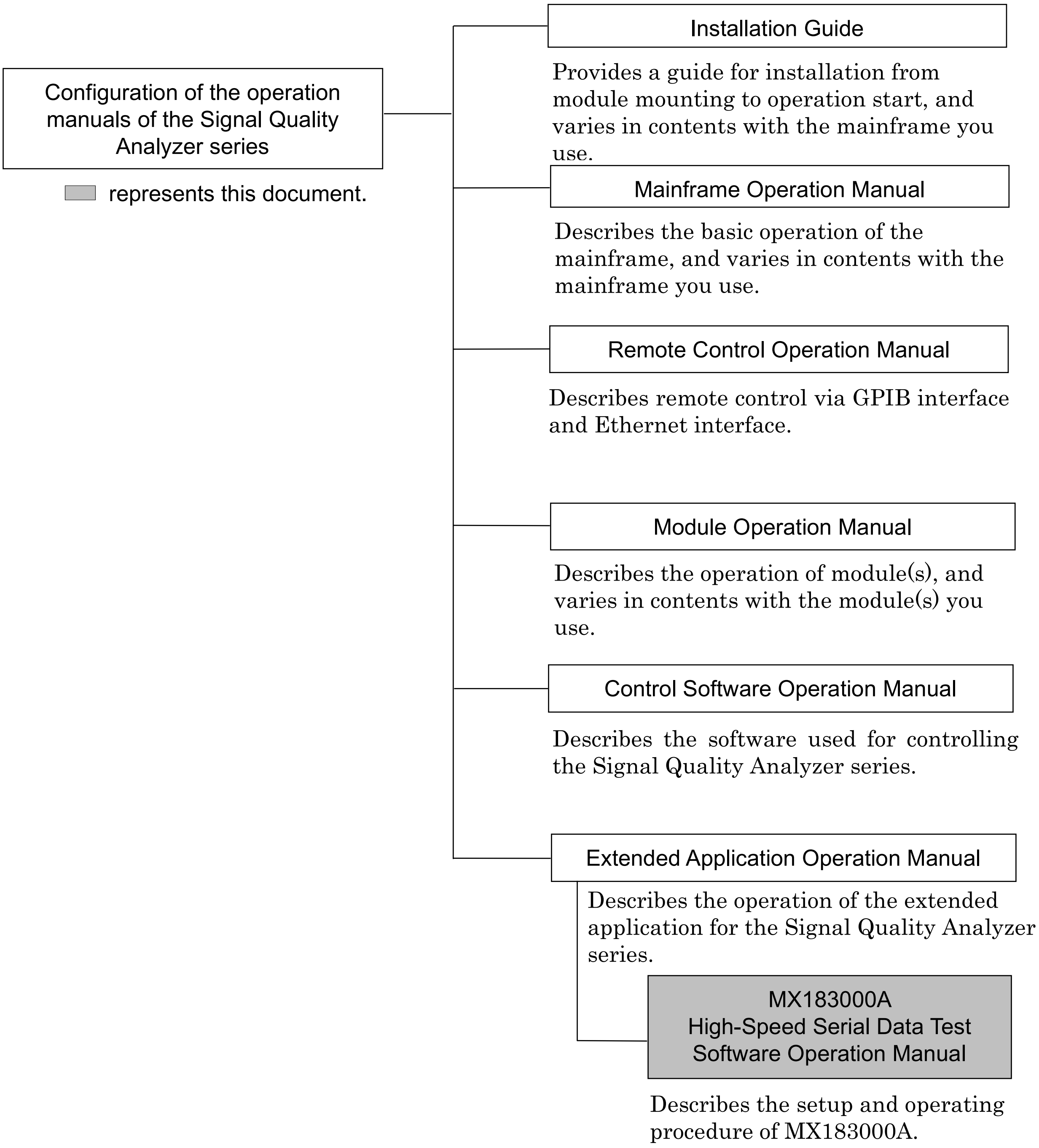
This software may not operate normally if any of the following operations are performed on your computer:

- Simultaneously running any software other than that recommended or approved by Anritsu
- Closing the lid (Laptop computer)
- Turning on the screen saver function
- Turning on the battery-power saving function (Laptop computer)

For how to turn off the functions, refer to the operation manual that came with your computer.

About This Manual

A testing system comprised of the MP1800A Signal Quality Analyzer, MT1810A 4-Slot Chassis, module(s), and control software is called the Signal Quality Analyzer series. A set of operation manuals of the Signal Quality Analyzer series consists of separate documents about installation guide, the mainframe, remote control operation, module(s), control software, and extended applications as shown below.



Configuration of the operation manuals of the Signal Quality Analyzer series

▨ represents this document.

Installation Guide

Provides a guide for installation from module mounting to operation start, and varies in contents with the mainframe you use.

Mainframe Operation Manual

Describes the basic operation of the mainframe, and varies in contents with the mainframe you use.

Remote Control Operation Manual

Describes remote control via GPIB interface and Ethernet interface.

Module Operation Manual

Describes the operation of module(s), and varies in contents with the module(s) you use.

Control Software Operation Manual

Describes the software used for controlling the Signal Quality Analyzer series.

Extended Application Operation Manual

Describes the operation of the extended application for the Signal Quality Analyzer series.

MX183000A
High-Speed Serial Data Test
Software Operation Manual

Describes the setup and operating procedure of MX183000A.

A test system combining an MP1900A Signal Quality Analyzer-R, module(s), and control software is called a Signal Quality Analyzer-R Series. The operation manuals of the Signal Quality Analyzer-R Series consist of separate documents for the MP1900A, module(s), and control software as shown below.

Configuration of Signal Quality Analyzer-R Series Operation

▨ indicates this document.

- MP1900A Signal Quality Analyzer-R Operation Manual

  Describes the basic operations, panel details, and maintenance of the MP1900A, as well as the steps from module installation to the start of use.

- Module Operation Manual
  - MU195020A 21G/32G bit/s SI PPG MU195040A 21G/32G bit/s SI ED MU195050A Noise Generator Operation Manual

    Describes the panel details, how to operate, performance test, maintenance, and troubleshooting of the module to be installed on the MP1900A.
  - MU196020A PAM4 PPG MU196040A PAM4 ED MU196040B PAM4 ED Operation Manual

    Describes the panel details, performance test, maintenance, and troubleshooting of the MU196020A, MU196040A, and MU196040B.
  - MU181000A 12.5GHz Synthesizer MU181000B 12.5GHz 4 port Synthesizer Operation Manual

    Describes the panel details, how to operate, performance test, maintenance, and troubleshooting of the MU181000A and MU181000B.
  - MU181500B Jitter Modulation Source Operation Manual

    Describes the panel details, how to operate, performance test and maintenance of the MU181500B.
  - MU183020A 28G/32G bit/s PPG MU183021A 28G/32G bit/s 4ch PPG Operation Manual

    Describes the panel details, performance test, maintenance, and troubleshooting of the MU183020A and MU183021A.
  - MU183040A 28G/32G bit/s ED MU183041A 28G/32G bit/s 4ch ED MU183040B 28G/32G bit/s High Sensitivity ED MU183041B 28G/32G bit/s 4ch High Sensitivity ED Operation Manual

    Describes the panel details, how to operate, performance test, maintenance, and troubleshooting of the MU183040A, MU183041A, MU183040B, and MU183041B.

Configuration of Signal Quality Analyzer-R Series Operation Manuals (Cont’d)

▨ indicates this document.

- MX190000A Signal Quality Analyzer-R Control Software Operation Manual

  Describes the operation of the software that controls the Signal Quality Analyzer-R Series.

- Extended Application Operation Manual

  Describes the operation of the extended application for the Signal Quality Analyzer-R Series.

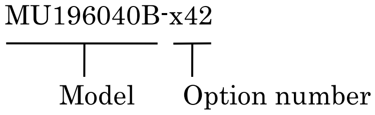
  - ▨ MX183000A High-Speed Serial Data Test Software Operation Manual

    Describes the setup and operating procedure of MX183000A.

The models and names of the modules are described using the following abbreviations.

Abbreviation	Model/Name
MU181000A	MU181000A 12.5GHz Synthesizer
MU181000B	MU181000B 12.5GHz 4 port Synthesizer
MU181000A/B	MU181000A 12.5GHz Synthesizer or MU181000B 12.5GHz 4 port Synthesizer
MU181500B	MU181500B Jitter Modulation Source
MU183020A or 28G/32G PPG	MU183020A 28G/32G bit/s PPG
MU183021A or 28G/32G PPG	MU183021A 28G/32G bit/s 4ch PPG
MU183040A or 28G/32G ED	MU183040A 28G/32G bit/s ED
MU183040B or 28G/32G ED	MU183040B 28G/32G bit/s High Sensitivity ED
MU183040A/B or 28G/32G ED	MU183040A 28G/32G bit/s ED or MU183040B 28G/32G bit/s High Sensitivity ED
MU183041A or 28G/32G ED	MU183041A 28G/32G bit/s 4ch ED
MU183041B or 28G/32G ED	MU183041B 28G/32G bit/s 4ch High Sensitivity ED
MU183041A/B or 28G/32G ED	MU183041A 28G/32G bit/s 4ch ED or MU183041B 28G/32G bit/s 4ch High Sensitivity ED
MU195020A or SI PPG	MU195020A 21G/32G bit/s SI PPG
MU195040A or SI ED	MU195040A 21G/32G bit/s SI ED
MU195050A	MU195050A Noise Generator
MU196020A or PAM4 PPG	MU196020A PAM4 PPG
MU196040A or PAM4 ED	MU196040A PAM4 ED
MU196040B or PAM4 ED	MU196040B PAM4 ED
MU196040A/B	MU196040A PAM4 ED or MU196040B PAM4 ED

“x” in an option number represents any numeral. For details of option numbers, refer to each of module operation manuals.



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Chapter 1 Outline

This section outlines the details of the MX183000A High-Speed Serial Data Test Software.

1.1 Outline

The MX183000A High-Speed Serial Data Test Software (hereinafter referred to as “MX183000A”) controls the following devices and allows jitter tolerance to be measured in compliance with the relevant standards for the 10 Gbit/s and 20 Gbit/s bands, together with generation of PCIe/USB link sequences.

- MP1800A Signal Quality Analyzer (hereinafter referred to as “MP1800A”), MT1810A 4-slot Chassis (hereinafter referred to as “MT1810A”) or MP1900A Signal Quality Analyzer-R (hereinafter referred to as “MP1900A”)
- MU181000A 12.5 GHz Synthesizer or
  MU181000B 12.5 GHz 4-port Synthesizer
- MU181500B Jitter Modulation Source
- MU183020A 28G/32G bit/s PPG or
  MU183021A 28G/32G bit/s 4ch PPG
- MU183040A 28G/32G bit/s ED,
  MU183041A 28G/32G bit/s 4ch ED,
  MU183040B 28G/32G bit/s High Sensitivity ED, or
  MU183041B 28G/32G bit/s 4ch High Sensitivity ED
- MU195020A 21G/32G bit/s SI PPG
- MU195040A 21G/32G bit/s SI ED
- G0375A 32Gbaud PAM4 Converter (hereinafter referred to as “PAM4 Converter”)
- G0376A 32Gbaud PAM4 Decoder with CTLE (hereinafter referred to as “PAM4 Decoder”)
- MU196020A PAM4 PPG
- MU196040A PAM4 ED
- MU196040B PAM4 ED

MX183000A controls MP1800A, MT1810A or MP1900A via Ethernet. Jitter Tolerance Measurement mode measures the bit error rate or bit error while varying the MU181500B jitter frequency and amplitude.

PCIe/USB Link Sequence mode generates data sequences for setting the target device to loop-back state using 28G/32G PPG.

Also, PAM4 Control mode allows transmission/reception settings and real time BER measurement of PAM4 signal.

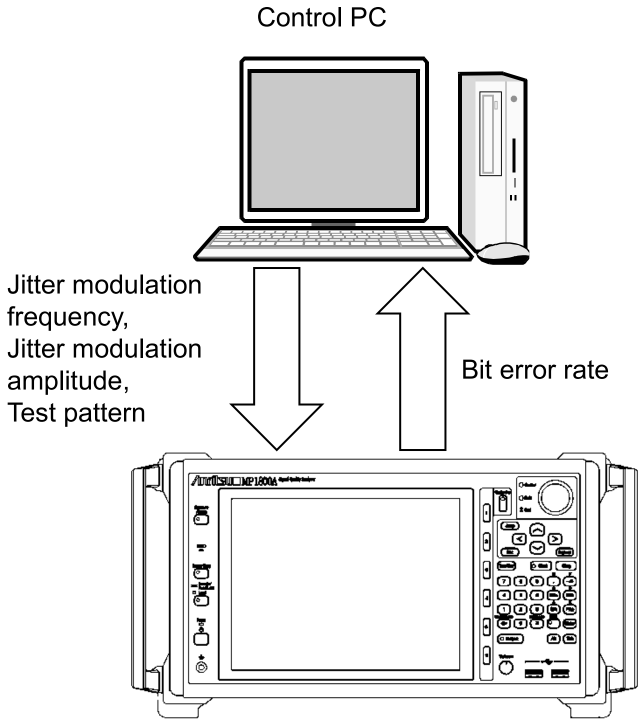


Figure 1.1-1 Setup and Measurement Items of MX183000A

MX183000A features the following four measurement functions.

PCIe Link Sequence
The PCIe Link Sequence function generates data sequences for setting the target device to loop-back state using 28G/32G PPG or SI PPG.

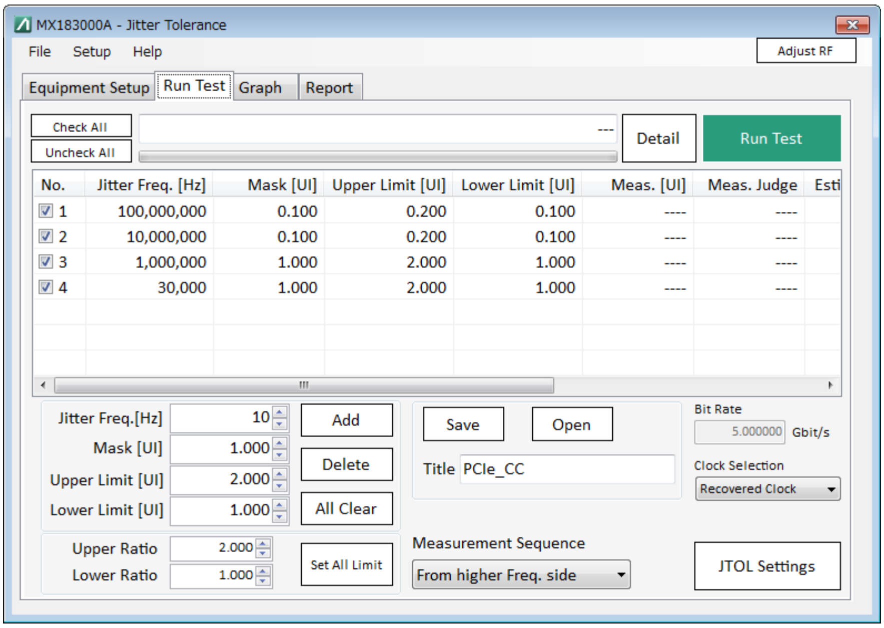
PCIe Link Training
The PCIe Link Training function executes the link training with the target device for setting it to loop-back state using SI PPG, PAM4 PPG, and SI ED.

USB Link Sequence
The USB Link Sequence function generates data sequences for setting the target device to loop-back state using 28G/32G PPG.

USB Link Training
The USB Link Training function executes the link training with the target device for setting it to loop-back state using SI PPG and SI ED.

Jitter Tolerance Test
The Jitter Tolerance Test sends the jitter modulated data to the target device, and measures the tolerance point indicated by the maximum jitter amplitude under the specified bit error rate. The high-rate jitter tolerance point can also be used to estimate the low-rate jitter tolerance point such as E–20.

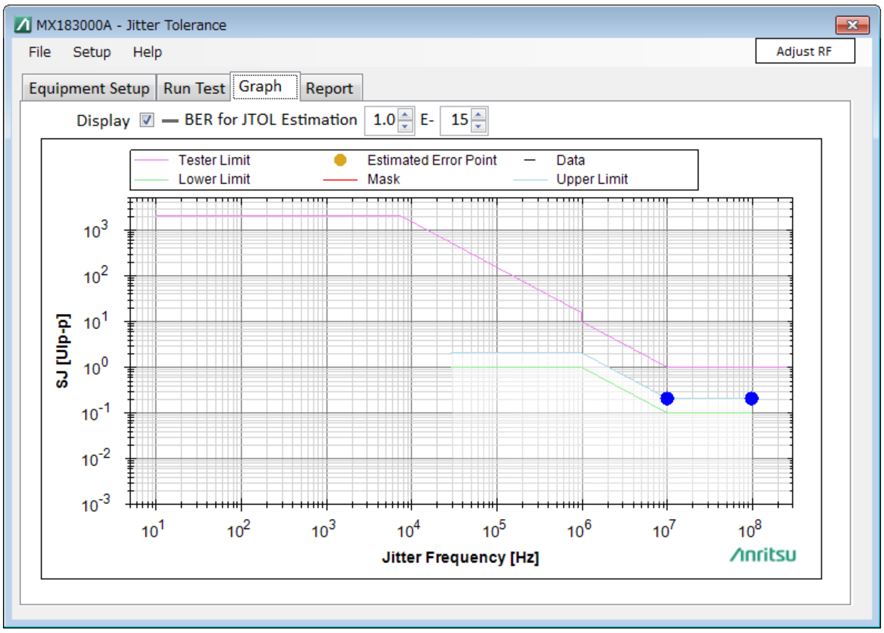
The Jitter Tolerance test displays the jitter modulation frequency and amplitude in graph and table form.



No.	Jitter Freq. [Hz]	Mask [UI]	Upper Limit [UI]	Lower Limit [UI]	Meas. [UI]	Meas. Judge	Esti
☑ 1	100,000,000	0.100	0.200	0.100	----	----	
☑ 2	10,000,000	0.100	0.200	0.100	----	----	
☑ 3	1,000,000	1.000	2.000	1.000	----	----	
☑ 4	30,000	1.000	2.000	1.000	----	----	

Jitter Freq.[Hz] 10
Mask [UI] 1.000
Upper Limit [UI] 2.000
Lower Limit [UI] 1.000
Upper Ratio 2.000
Lower Ratio 1.000
Title PCIe_CC
Bit Rate 5.000000 Gbit/s
Clock Selection Recovered Clock
Measurement Sequence From higher Freq. side

Figure 1.1-2 Jitter Tolerance Run Test Tab Screen



Display ☑ BER for JTOL Estimation 1.0 E- 15

Figure 1.1-3 Jitter Tolerance Graph Screen

DUT Error Counts Import

The DUT Error Counts Import function acquires information about errors and alarms from the internal counter of device under test (hereafter, DUT) and displays the measurement results.

1.2 Features

MX183000A has the following features.

- Link sequence generation is available for setting the PCIe device to loop-back state.
- Link training is available for setting the PCIe device to loop-back state.
- Generating logs is available for showing LTSSM transition state of PCIe device under Link Training.
- Generating link sequence is available for setting the USB3.0/3.1/3.2 device to loop-back state.
- Link Training is available for setting the USB3.0/3.1/3.2 device to loop-back state.
- Generating logs is available for showing LTSSM transition state of USB3.0/3.1 device under Link Training.
- Jitter tolerance measurement involves testing by controlling the MU181500B and varying SJ while adding jitter such as RJ or BUJ at a fixed value.
- Jitter tolerance measurement provides three methods for varying jitter amplitude depending on the characteristics of Serdes, as shown below.
  Binary search
  Downward search from the upper limit value to the lower limit value
  Upward search from the lower limit value to the upper limit value
- With the PAM4 PPG (with MU196020A-x42) and PAM4 ED (with MU196040B-x42) installed, the jitter tolerance measurement supporting FEC Analysis is available.
- Estimation of low-rate jitter tolerance results
- Mask measurement according to various standards is available.
- MX183000A can control up to three MP1800A, MT1810A, or MP1900A.
- Measurement results can be output in the html or CSV format.
- MX183000A allows transmission/reception setting and BER measurement of PAM4 signal.
- MX183000A can acquire the error information from the internal counter of DUT and display the measurement results.

1.3 Model Names and Options

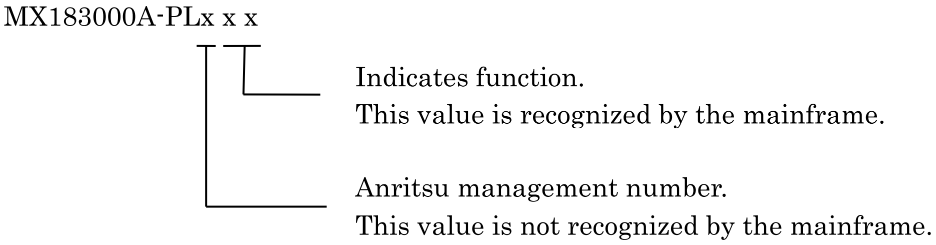
Table 1.3-1 shows the model names and options for MX183000A. Options can be added by entering a license key. Refer to 2.4 “License Key Activation” for details.

Table 1.3-1 MX183000A Model Names and Options

Model	Name	Remarks
MX183000A	High-Speed Serial Data Test Software	At least one of the following options must be included. All the options can be installed at the same time.
MX183000A-PL001	Jitter Tolerance Test	
MX183000A-PL011	PCIe Link Sequence	
MX183000A-PL012	USB Link Sequence	
MX183000A-PL021	PCIe Link Training	
MX183000A-PL022	USB Link Training	
MX183000A-PL023	USB3.2 x 2 Link Training	The MX183000A-PL022 USB Link Training must be installed.
MX183000A-PL025	PCIe 5 Link Training	The MX183000A-PL021 PCIe Link Training must be installed.
MX183000A-PL031	DUT Error Counts Import	

Note:

Option name format is as follows:



MX183000A-PLx x x

Indicates function.
This value is recognized by the mainframe.

Anritsu management number.
This value is not recognized by the mainframe.

1.4 Uses

MX183000A is used for the following purposes:

- PCIe link sequence generation
- PCIe link training execution
- USB link sequence generation
- USB link training execution
- Serdes device jitter tolerance measurement in compliance with the relevant standards in the 2.4 to 32 Gbit/s band.
- Error and alarm measurement and jitter tolerance measurement of the device receiver that comply with various standards for 2.4 to 56 Gbaud band.
- Jitter tolerance measurement supporting FEC Analysis

Table 1.4-1 shows the test items MX183000A supports for the relevant standards and DUTs.

Table 1.4-1 MX183000A Supported Standards and DUTs

Supported Standard		DUT	Link Sequence Generation	Jitter Tolerance Measurement
PCIe Sequence	1.x/2.0/3.x/4.0	Addin Card	✓	✓
		System Board		
PCIe Training	1.x/2.0/3.x/4.0/5.0	Addin Card	✓	✓
		System Board	✓	✓
USB Sequence	3.0/3.1/3.2	Device	✓	
		Host	✓	
USB Training		Device	✓	✓
		Host	✓	✓
FEC Analysis*	IEEE802.3 bs/cd/ck	Serdes		✓

*: Available only when the PAM4 PPG (MU196020A-x42) and PAM4 ED (MU196040B-x42) are installed.

1.5 Glossary

The following table contains the abbreviations used in this document and MX183000A.

Table 1.5-1 Abbreviation

Abbreviation	Full Term
BER	Bit Error Rate
BUJ	Bounded Uncorrelated Jitter
CBB	Compliance Base Board
CLB	Compliance Load Board
CP	Compliance Pattern
CSV	Comma Separated Value
DE	De-emphasis
DEMUX	De-multiplexer
DUT	Device Under Test
ED	Error Detector
EIEOS	Electrical Idle End Ordered Set
FEC	Forward Error Correction
FTS	Fast Training Sequence
GPIB	General Purpose Interface Bus
HPF	High Pass Filter
HTML	Hyper Text Markup Language
JTMP	Jitter Tolerance Measurement Pattern
JTOL	Jitter Tolerance
LBPM	LFPS-Based PWM Messaging
LFPS	Low Frequency Periodic Signaling
LPF	Low Pass Filter
LTSSM	Link Training and Status State Machine
MCP	Modified Compliance Pattern
MUX	Multiplexer
OS	Ordered Set
PAM	Pulse Amplitude Modulation
PCIe	PCI Express
PPG	Pulse Pattern Generator
PRBS	Pseudo-Random Bit Sequence
PS	Pre-shoot
RJ	Random Jitter
RX	Receiver
Serdes	Serializer/Deserializer
SSC	Spread Spectrum Clock
SI	System Integrity
SJ	Sinusoidal Jitter
SKP	Skip
SRIS	Separate Reference Clocks with Independent SSC
SRNS	Separate Reference Clocks with No SSC

Table 1.5-1 Abbreviation (Cont'd)

Abbreviation	Full Term
TS	Training Sequence
TX	Transmitter
UI	Unit Interval
USB	Universal Serial Bus

Chapter 2 Before Use

This chapter describes preparation required before using MX183000A.

2.1 Unpacking

At unpacking, refer to the standard configuration list shown in Table A-1 “Configuration”. Contact your Anritsu Service and Sales Office or an agent if any part is missing or damaged.

2.2 Operating Environment

As for the operating environment of a control personal computer (hereinafter “PC”), refer to Table A-2 “Operation Environment”.

MX183000A can be run on a control PC as well as on the MP1800A or MP1900A (hereinafter “SQA”). When you install MX183000A on SQA, use the mouse to operate the software.

⚠ **CAUTION**

When either one of the following operations starts during the startup process of MX183000A, it might not work well.

- **Running another application at the same time**
- **Closing the lid of a laptop PC**
- **Using Screen Saver**
- **Battery saving operation in a laptop PC**

Refer to the PC operation manual to disable each feature.

2.3 Installation/Uninstallation

MX183000A can be used in two installation modes: installation on SQA and installation on a control PC.

This section describes how to install MX183000A when using SQA.
When using SQA, use the NI-VISA Installer in the USB flash drive that contains MX183000A (see page vi "Before Using VISA For Those Who Use MP1800A and MP1900A").
When using MT1810A, you need to obtain the NI-VISA Installer yourself.

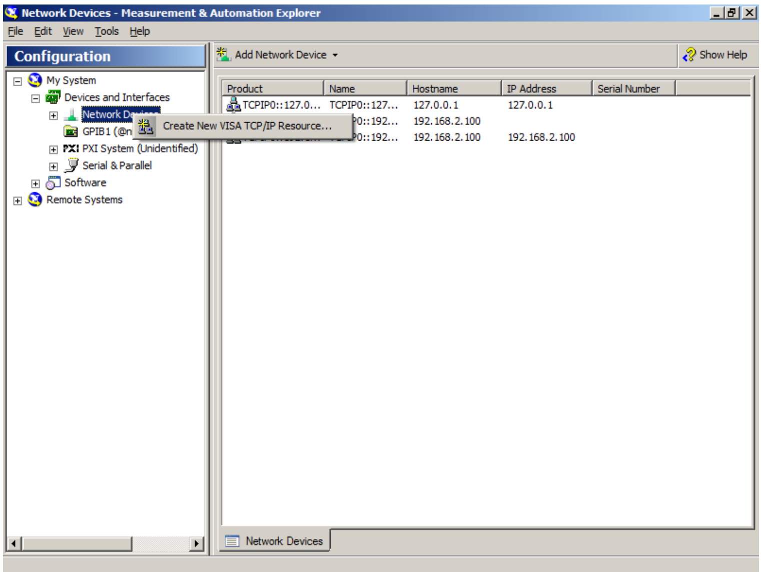
2.3.1 Installing

1. Install NI-VISA on the SQA or the control PC on which the MX183000A is to be installed. If NI-VISA is already installed, skip steps 2 to 4 and proceed to step 5.
2. To install NI-VISA on the SQA, insert the USB flash drive into the SQA and copy the installation file to the built-in HDD. To install NI-VISA on the control PC, insert the USB flash drive into the control PC.
3 End all active applications. End Main application, and click the **Close (×)** on the Selector screen.
4. Execute visa462full.exe to start installation.

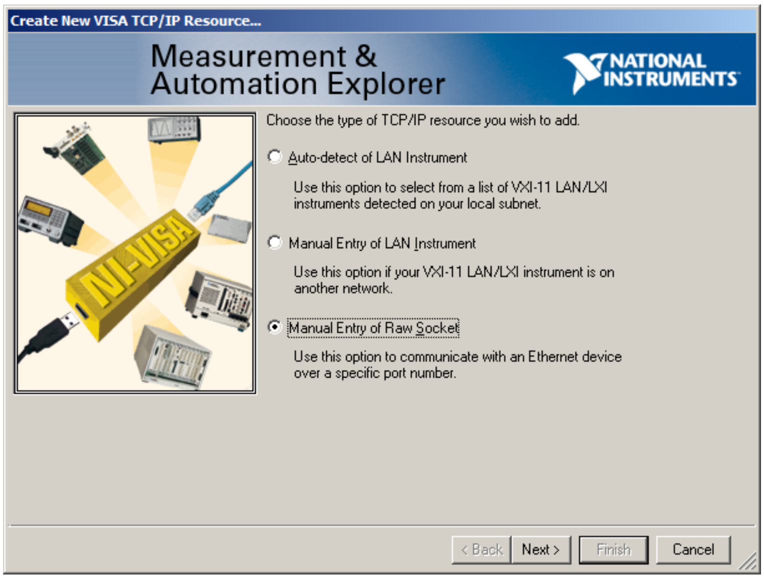
   The file is stored in the following folder in the USB flash drive.
   \Software\visa462full.exe

   Install as instructed on the screen.
5. Set up NI-VISA. Click **Measurement & Automation Explorer** on the **Start** menu.

6. Right-click **Network Devices** and click **Create New VISA TCP/IP Resource…**.



7. Select **Manual Entry or Raw Socket**, and then click **Next**.


Create New VISA TCP/IP Resource...
Measurement & Automation Explorer
NATIONAL INSTRUMENTS
NI-VISA

Choose the type of TCP/IP resource you wish to add.

○ Auto-detect of LAN Instrument

Use this option to select from a list of VXI-11 LAN/LXI instruments detected on your local subnet.

○ Manual Entry of LAN Instrument

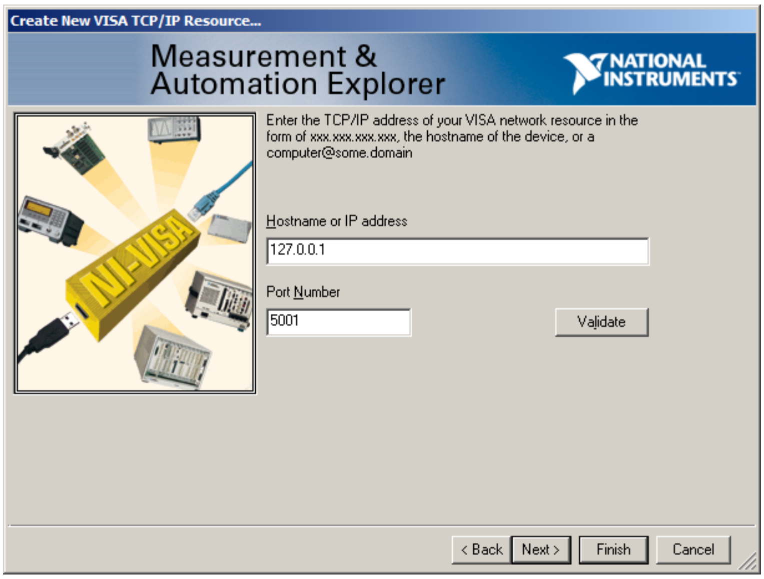
Use this option if your VXI-11 LAN/LXI instrument is on another network.

● Manual Entry of Raw Socket

Use this option to communicate with an Ethernet device over a specific port number.

8. Enter the appropriate values for SQA* in Hostname or IP address and Port Number, and then click **Next**.

   *: The default values for SQA are IP:192.168.2.100 and Port:5001.

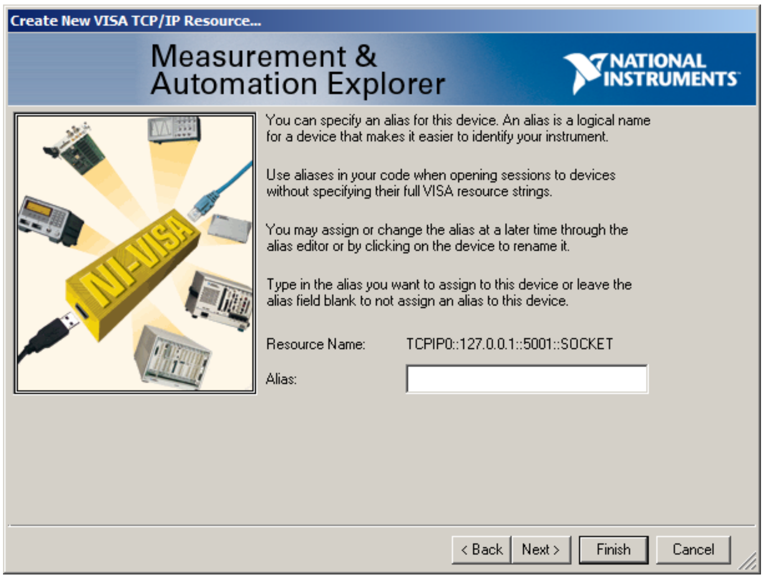

Create New VISA TCP/IP Resource...
Measurement & Automation Explorer
NATIONAL INSTRUMENTS
NI-VISA
Validate
< Back
Next >
Finish
Cancel

Enter the TCP/IP address of your VISA network resource in the form of xxx.xxx.xxx.xxx, the hostname of the device, or a computer@some.domain

Hostname or IP address: 127.0.0.1

Port Number: 5001

9. Confirm that the IP address and Port Number values entered in step 8 are shown for Resource Name, and then click **Finish**.


Create New VISA TCP/IP Resource...
Measurement & Automation Explorer
NATIONAL INSTRUMENTS
NI-VISA
< Back
Next >
Finish
Cancel

You can specify an alias for this device. An alias is a logical name for a device that makes it easier to identify your instrument.

Use aliases in your code when opening sessions to devices without specifying their full VISA resource strings.

You may assign or change the alias at a later time through the alias editor or by clicking on the device to rename it.

Type in the alias you want to assign to this device or leave the alias field blank to not assign an alias to this device.

Resource Name: TCPIP0::127.0.0.1::5001::SOCKET

Alias:

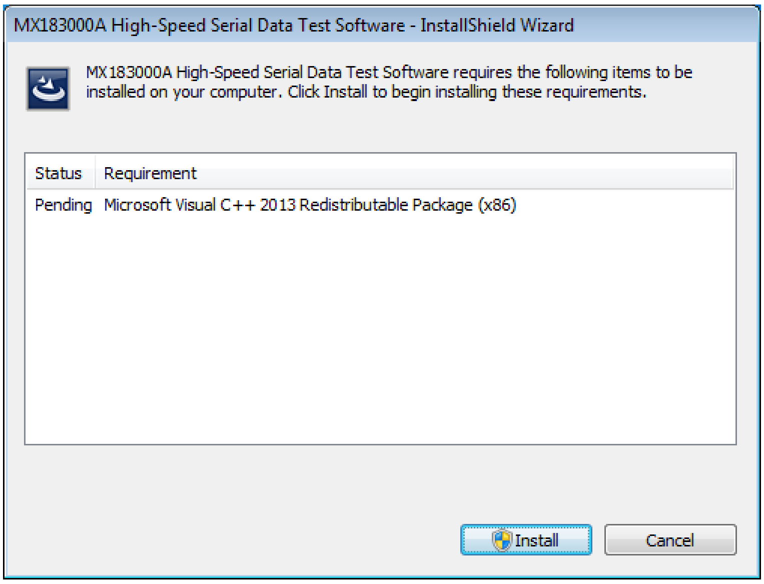
10. Install MX183000A. Run the following file on the PC or SQA on which NI-VISA is installed.

    \Installer\MX183000A_VER_x_xx_xx.exe

    "x_xx_xx" here corresponds to the software version.

    If the MX183000A is already installed, a message dialog box saying "Reinstall all program features installed by the previous setup." will appear when you attempt to install by overwriting. To continue with the installation, click **Yes**. (Skip steps 11 to 15 and proceed to step 16.)

11. Click **Install** on the following screen.

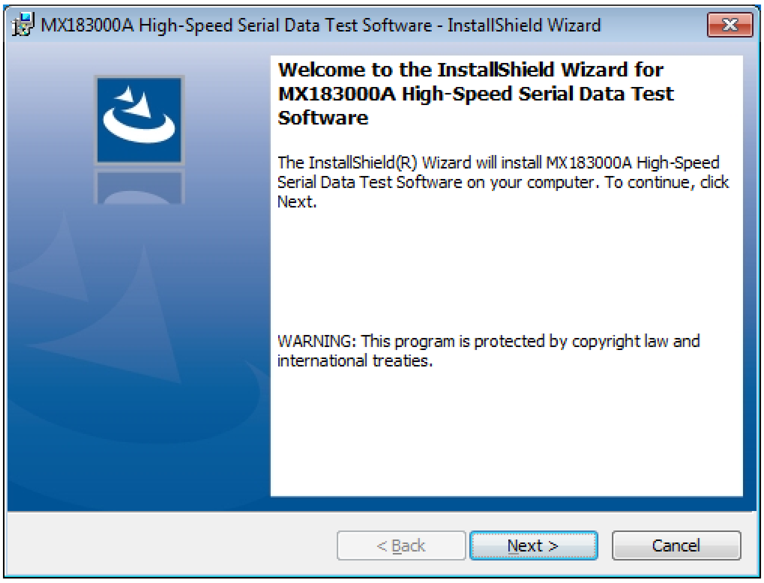


MX183000A High-Speed Serial Data Test Software - InstallShield Wizard

MX183000A High-Speed Serial Data Test Software requires the following items to be installed on your computer. Click Install to begin installing these requirements.

Status	Requirement
Pending	Microsoft Visual C++ 2013 Redistributable Package (x86)

12. The installer is activated. Click **Next**.



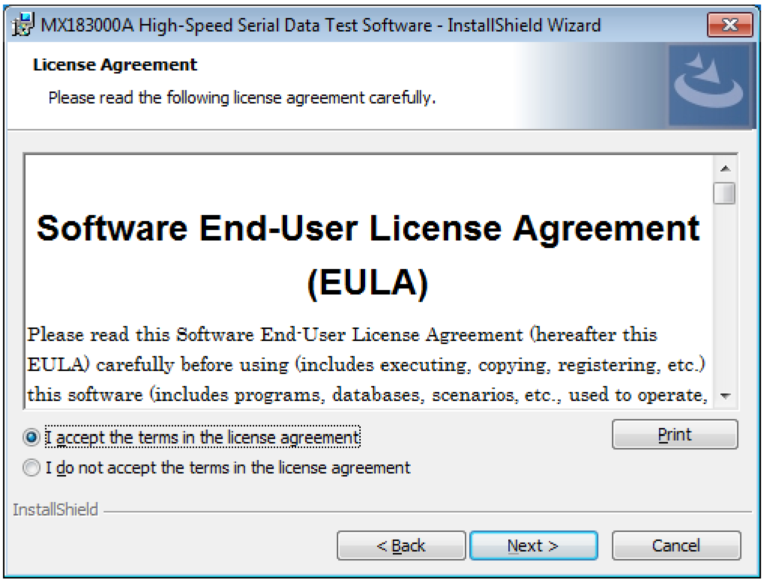
MX183000A High-Speed Serial Data Test Software - InstallShield Wizard

Welcome to the InstallShield Wizard for MX183000A High-Speed Serial Data Test Software

The InstallShield(R) Wizard will install MX183000A High-Speed Serial Data Test Software on your computer. To continue, click Next.

WARNING: This program is protected by copyright law and international treaties.

13. Select **I accept the terms in the license agreement**, and then click **Next**.



MX183000A High-Speed Serial Data Test Software - InstallShield Wizard

License Agreement

Please read the following license agreement carefully.

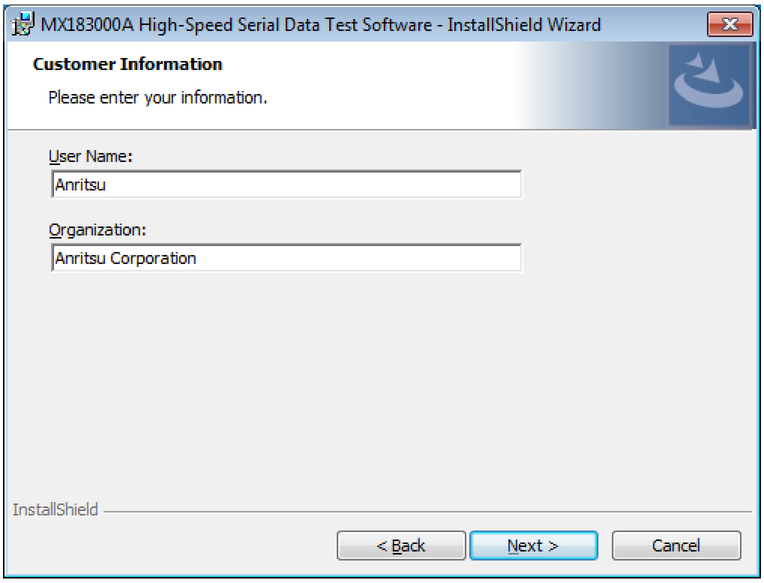
Software End-User License Agreement (EULA)

Please read this Software End-User License Agreement (hereafter this EULA) carefully before using (includes executing, copying, registering, etc.) this software (includes programs, databases, scenarios, etc., used to operate,

● I accept the terms in the license agreement

○ I do not accept the terms in the license agreement

14. Enter User Name and Organization and then click **Next**.



MX183000A High-Speed Serial Data Test Software - InstallShield Wizard

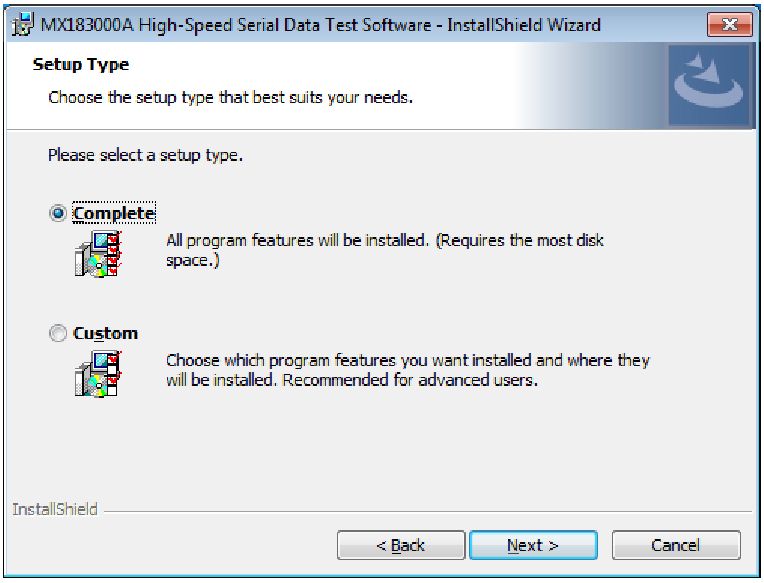
Customer Information

Please enter your information.

User Name: Anritsu

Organization: Anritsu Corporation

15. Select a setup type and click **Next**.
    If **Custom** is selected, you can select the location where you want to install* MX183000A.
    If **Complete** is selected, proceed to step 16.
    *: The default installation location is C:\Anritsu\MX183000A\.



MX183000A High-Speed Serial Data Test Software - InstallShield Wizard

Setup Type

Choose the setup type that best suits your needs.

Please select a setup type.

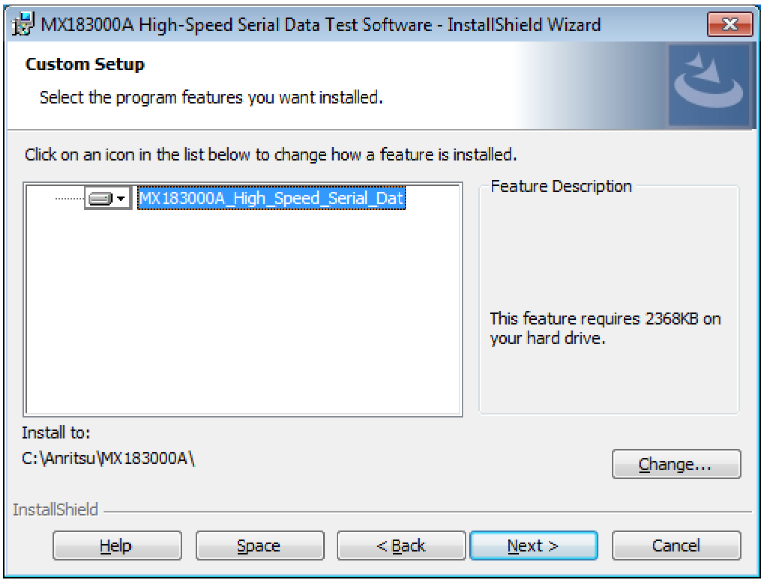
● **Complete**

All program features will be installed. (Requires the most disk space.)

○ **Custom**

Choose which program features you want installed and where they will be installed. Recommended for advanced users.

16. Click **Change** to select the installation location. Then click **Next**.



MX183000A High-Speed Serial Data Test Software - InstallShield Wizard

Custom Setup

Select the program features you want installed.

Click on an icon in the list below to change how a feature is installed.

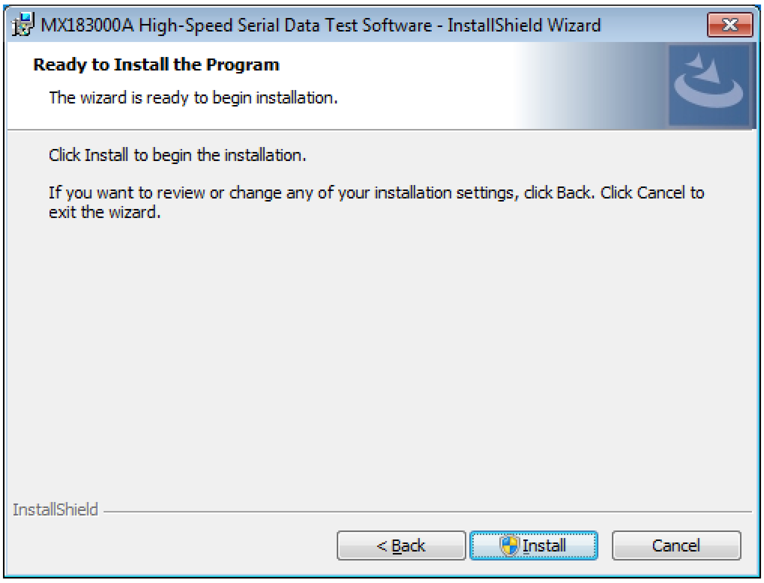
MX183000A_High_Speed_Serial_Dat

Feature Description

This feature requires 2368KB on your hard drive.

Install to:
C:\Anritsu\MX183000A\

17. Click **Install**.



MX183000A High-Speed Serial Data Test Software - InstallShield Wizard

Ready to Install the Program

The wizard is ready to begin installation.

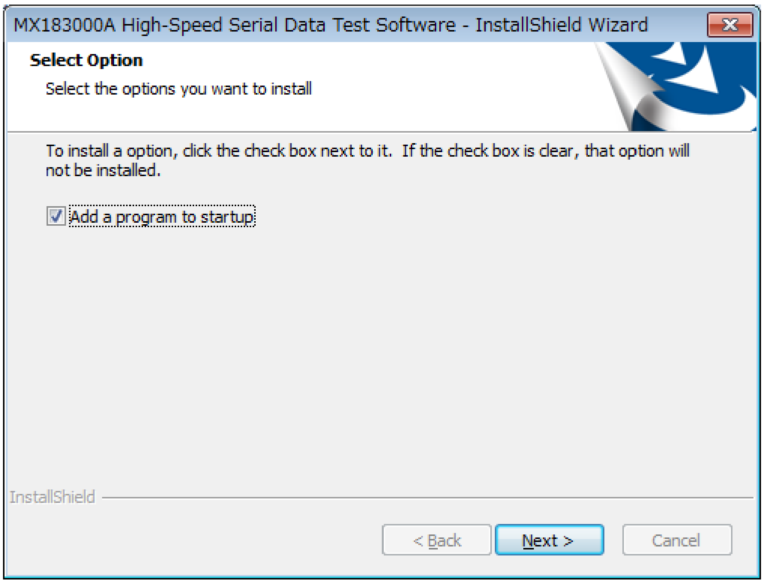
Click Install to begin the installation.

If you want to review or change any of your installation settings, click Back. Click Cancel to exit the wizard.

18. Make sure **Add a program to startup** is selected and click the **Next** button.

Note:

When the installer version is 2.00.00 or later, the following window is not displayed. Also, the application is not added to the Start menu. For how to start the application, refer to 4.1 "Start up and Exit".



MX183000A High-Speed Serial Data Test Software - InstallShield Wizard

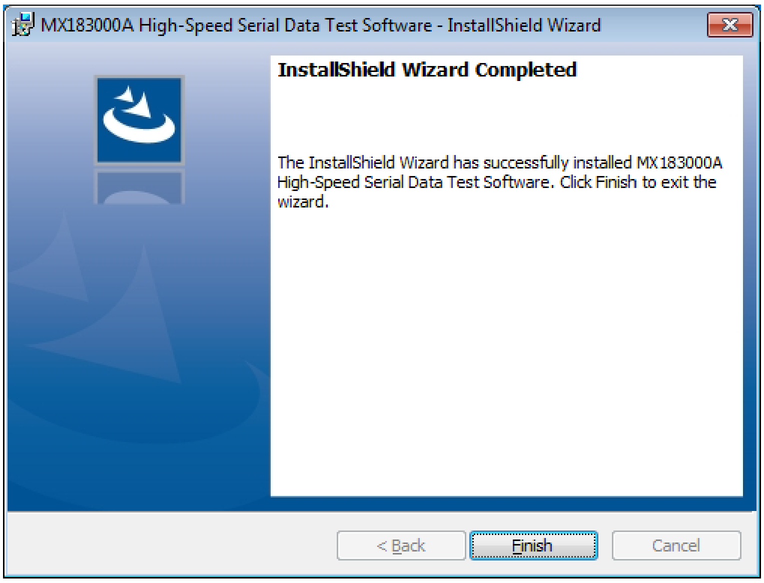
Select Option

Select the options you want to install

To install a option, click the check box next to it. If the check box is clear, that option will not be installed.

☑ Add a program to startup

19. When the installation completes successfully, the following window appears. Click **Finish** to end installation.



MX183000A High-Speed Serial Data Test Software - InstallShield Wizard

InstallShield Wizard Completed

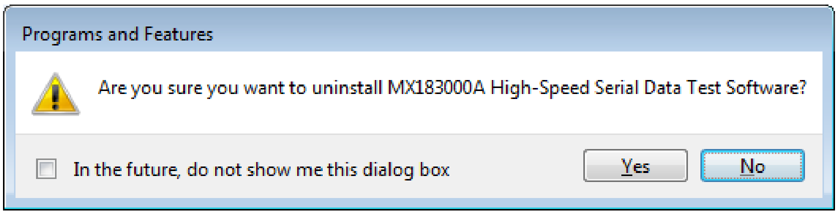
The InstallShield Wizard has successfully installed MX183000A High-Speed Serial Data Test Software. Click Finish to exit the wizard.

2.3.2 Uninstallation

This section describes the procedure for uninstalling MX183000A. Do the following procedure in SQA or control PC.

1. Select **Control Panel** in the **Start** menu to open the Control Panel.
2. Click **Programs and Features** in the Control Panel.
3. Select MX183000A in the list box and click **Uninstall** to start uninstallation.

   When the following dialog box appears, click **Yes**.



Programs and Features

Are you sure you want to uninstall MX183000A High-Speed Serial Data Test Software?

☐ In the future, do not show me this dialog box

2.4 License Key Activation

The paid options for MX183000A (options PL001, PL011, PL012, PL021, PL022, PL023, PL025, and PL031) are activated using a license key.

Even if the license is not activated, all the options are available for 30-day trial period from the first installation date.

A license is specific data of each SQA or PC. The license file saved in a USB flash drive can be used only for a specific SQA or PC. To transfer the license file, refer to 2.4.3 “Transferring license”.

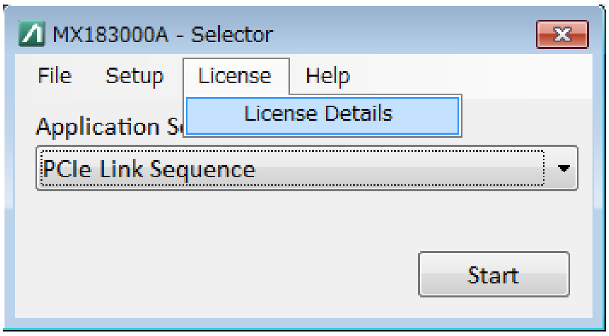
Note:

If either MP1900A-110 or MP1900A-210 Windows10 Upgrade Retrofit is added during the trial license period, the trial license expires.

2.4.1 Purchasing license

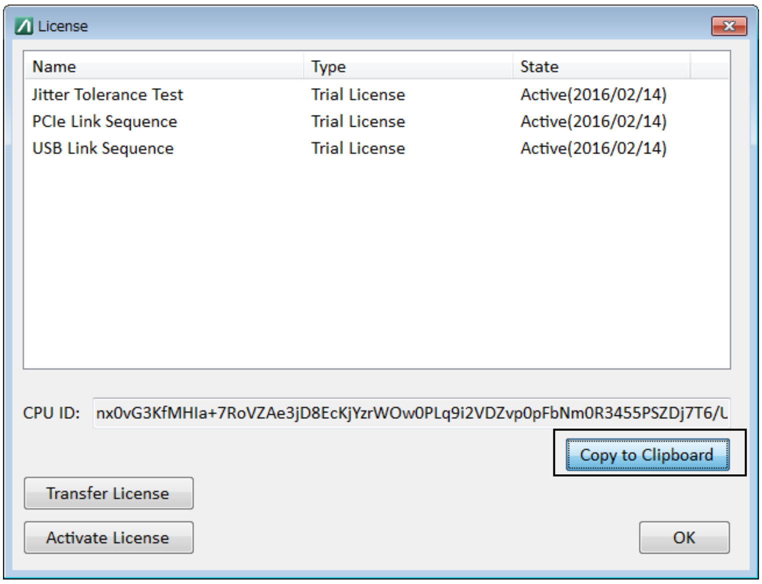
To purchase a license, the CPU ID of the SQA or PC on which you use MX183000A is required. Perform the following steps to obtain a CPU ID.

1. Start the MX183000A on the SQA or PC for which the license is to be validated. Select **License** → **License Details**.



PCIe Link Sequence

2. Click **Copy to Clipboard** on the License window to obtain a CPU ID.



Name	Type	State
Jitter Tolerance Test	Trial License	Active(2016/02/14)
PCIe Link Sequence	Trial License	Active(2016/02/14)
USB Link Sequence	Trial License	Active(2016/02/14)

CPU ID: nx0vG3KfMHIa+7RoVZAe3jD8EcKjYzrWOw0PLq9i2VDZvp0pFbNm0R3455PSZDj7T6/

3. Please provide the CPU ID and serial number of your SQA or PC to our sales representative.

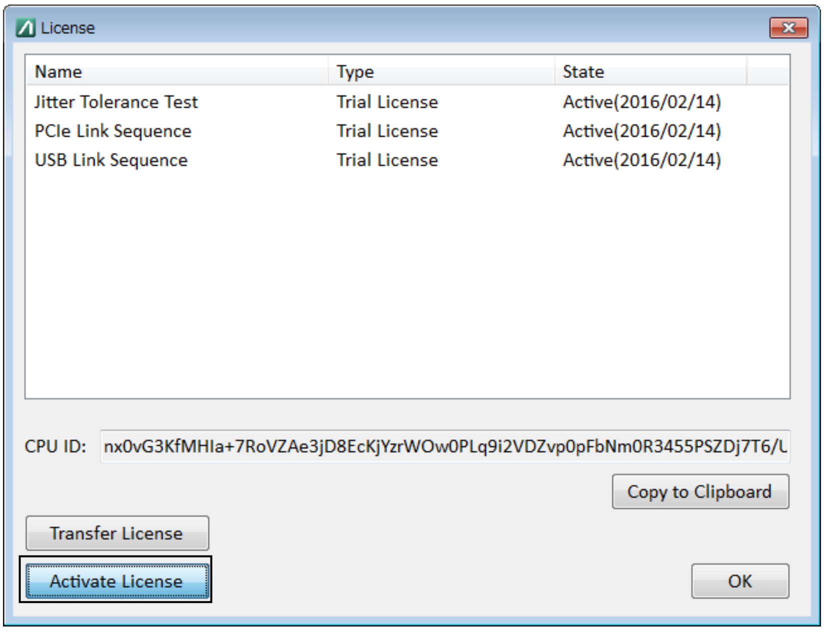
   When the license file is provided by Anritsu, save it to the following folder.

   C:\anritsu\MX183000A

2.4.2 Activating license

Perform the following steps to activate the license.

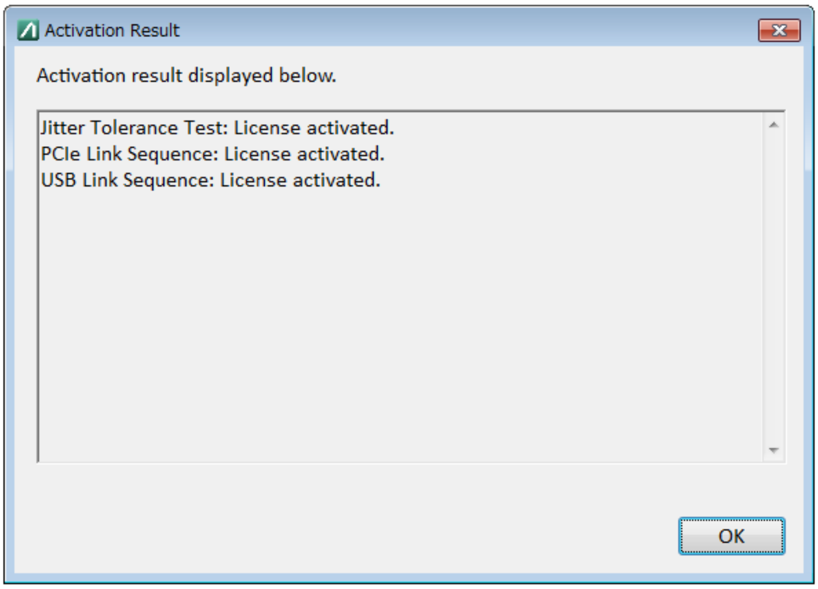
1. Start up the MX183000A and select **License** → **License Details**.
2. Click **Activate Licenses** on the License window.



Name	Type	State
Jitter Tolerance Test	Trial License	Active(2016/02/14)
PCIe Link Sequence	Trial License	Active(2016/02/14)
USB Link Sequence	Trial License	Active(2016/02/14)

CPU ID: nx0vG3KfMHIa+7RoVZAe3jD8EcKjYzrWOw0PLq9i2VDZvp0pFbNm0R3455PSZDj7T6/

3. When inputting a license file is prompted, load the license file provided by Anritsu. When the activation is completed, the license is valid.



Activation result displayed below.

Jitter Tolerance Test: License activated.
PCIe Link Sequence: License activated.
USB Link Sequence: License activated.

2.4.3 Transferring license

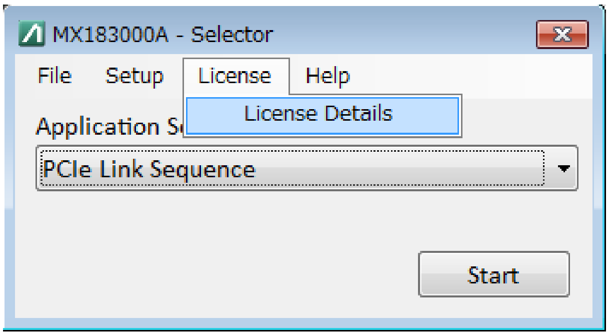
How to transfer the MX183000A to another SQA or PC is explained below. The transfer destination and source are both PCs in the example here.

Notes:

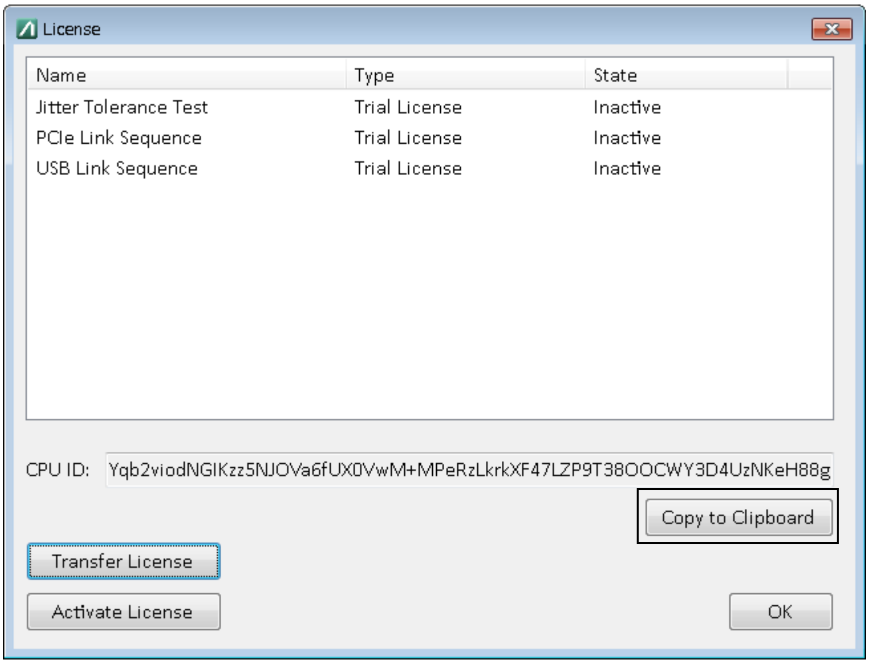
A file made after the license transfer is necessary to activate the license, so store the file with care.

After transferring the file, the license on the source PC becomes invalid and its functions are no longer usable.

1. Start up the MX183000A on the destination PC and select **License** → **License Details**.



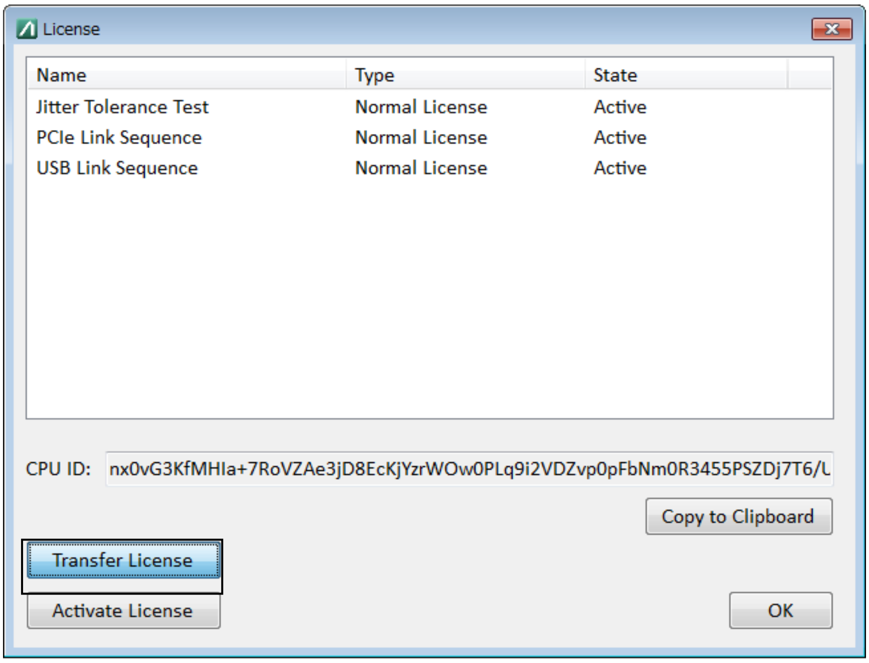
2. Click **Copy to Clipboard** on the License window to obtain a CPU ID.



Name	Type	State
Jitter Tolerance Test	Trial License	Inactive
PCIe Link Sequence	Trial License	Inactive
USB Link Sequence	Trial License	Inactive

CPU ID: Yqb2viodNGIKzz5NJOVa6fUX0VwM+MPeRzLkrkXF47LZP9T38OOCWY3D4UzNKeH88g

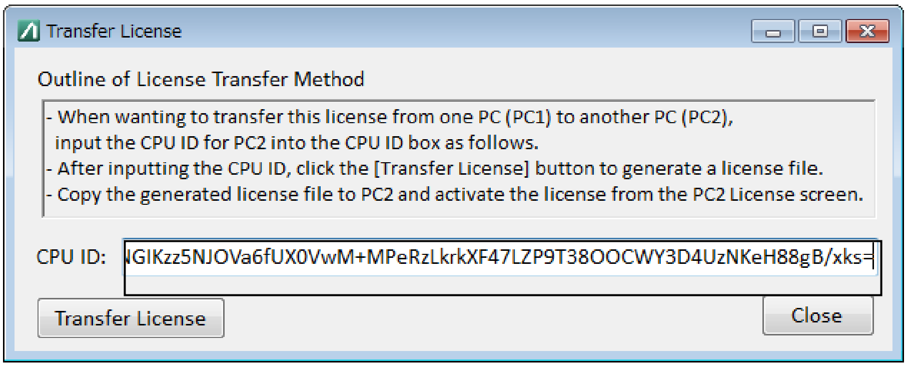
3. Paste the obtained CPU ID on a text editor file, etc. and save. Move the file to the source PC.
4. Start up the MX183000A on the source PC and select **License** → **License Details**.
5. Click **Transfer License**.



Name	Type	State
Jitter Tolerance Test	Normal License	Active
PCIe Link Sequence	Normal License	Active
USB Link Sequence	Normal License	Active

CPU ID: nx0vG3KfMHIa+7RoVZAe3jD8EcKjYzrWOw0PLq9i2VDZvp0pFbNm0R3455PSZDj7T6/U

6. When inputting a CPU ID is prompted on the **Transfer License** window, paste the CPU ID obtained at Step 3.



Outline of License Transfer Method

- When wanting to transfer this license from one PC (PC1) to another PC (PC2),
  input the CPU ID for PC2 into the CPU ID box as follows.
- After inputting the CPU ID, click the [Transfer License] button to generate a license file.
- Copy the generated license file to PC2 and activate the license from the PC2 License screen.

CPU ID: GIKzz5NJOVa6fUX0VwM+MPeRzLkrkXF47LZP9T38OOCWY3D4UzNKeH88gB/xks=

7. Click the **Transfer License** button. Store the license file in an arbitrary place on the PC. Give an arbitrary name to the license file.
8. Transfer the saved license file to the destination PC. For how to activate the license on the destination PC, refer to 2.4.2 “Activating license”.

2.4.4 Precautions when recovering MP1900A

Note:

MX183000A license key becomes invalid if a system recovery is performed on the MP1900A where the software is installed. To continue using the license key after system recovery, perform a system recovery according to 8.3 “System Recovery Function” in the *MP1900A Signal Quality Analyzer-R Operation Manual*.

If the operating system of the MP1900A is WES7 and the version of the MX183000A you are using is earlier than 3.07.00, be sure to transfer the licenses on the MP1900A to a PC or another MP1900A according to the following procedure. Then, perform a system recovery according to 8.3 “System Recovery Function” in the *MP1900A Signal Quality Analyzer-R Operation Manual*.

<Procedure>

1. Prepare a PC or another MP1900A for the license to be transferred.
2. Transfer the license to the prepared PC or MP1900A according to the procedure given in 2.4.3 “Transferring license”.
3. Perform a system recovery according to 8.3 “System Recovery Function” in the *MP1900A Signal Quality Analyzer-R Operation Manual*.
4. Retransfer the license stored on the PC (or MP1900A) to the MP1900A where the system recovery has been completed
5. On the MP1900A where the system recovery has been completed, activate the license again. For details of the procedure, refer to 2.4.2 “Activating license”.

If the operating system of the MP1900A is WES7 and the version of the MX183000A you are using is 3.07.00 or later, you do not need to transfer the licenses. Perform a system recovery according to 8.3 “System Recovery Function” in the *MP1900A Signal Quality Analyzer-R Operation Manual*.

If the operating system of the MP1900A is Win10, you need to transfer the licenses regardless of the version of the MX183000A you are using. Perform a system recovery according to 8.3 “System Recovery Function” in the *MP1900A Signal Quality Analyzer-R Operation Manual*.

If you perform a system recovery without transferring the license, contact an Anritsu Service and Sales office. Contact information can be found on the last page of the printed version of this manual, and is available in a separate file on the PDF version.

Chapter 3 Connecting Equipment

This chapter describes the types of equipment to be controlled by MX183000A and connecting procedures.

3.1 Target Equipment

Shown below are the models of equipment to be controlled by MX183000A and the number of equipment required for each connection. Equipment marked as "-" in the Quality column are not used. The number in parentheses is the quantity required for the measurement, and these components are standard accessories for the equipment to be controlled.

Note:

MP1800A and MT1810A support PL001, PL011, and PL012.

Table 3.1-1 Equipment Configuration for Each Measurement Type (When MP1800A Is Used)

Equipment Type	Model	Options	Necessary Quantity for Each Connection Type		
			Jitter Tolerance Test	PCIe Link Sequence	USB Link Sequence
Signal Quality Analyzer	MP1800A	x02, x07*2, x32	1	1	1
12.5GHz Synthesizer	MU181000A/B*1		–	–	1
		x01*5	1	1	–
Jitter Source	MU181500B		1	1	1
28G/32G bit/s PPG	MU183020A/21A		1	–	–
		x30/x31	–	1	1
28G/32G bit/s ED	MU183040A/41A/40B/41B		1*3	–	–
	MU183040B/41B	x22		1	–
		x23		–	–
4 Tap Emphasis	MP1825B*1	x02	–	1	1
Vector signal generator	MG3710A*1	x02, x36, x41, x66, x71	–	2	–
PCIe Measurement Component Set	J1722A		–	1*4	–
USB Measurement Component Set	J1721A		–	–	1

*1: Cannot be controlled directly from MX183000A.

*2: Not required if controlling from an external PC.

*3: Exclude MU183040B-x22 or MU183040B-x23 or both of them from the equipment configuration.

*4: Refer to CAUTION described in Section 3.3 "PCIe Link Sequence/Training Connection Procedure" for handling the SMP connector.

*5: Required for SJ Dual Tone measurement.

Table 3.1-1 Equipment Configuration for Each Measurement Type (When MP1800A Is Used) (Cont'd)

Equipment Type	Model	Options	Necessary Quantity for Each Connection Type Jitter Tolerance Test	Necessary Quantity for Each Connection Type PCIe Link Sequence	Necessary Quantity for Each Connection Type USB Link Sequence
USB3.1 Receiver Test Adapter	G0373A		–	–	1
BNC-SMA connector cable	J1508A		(2)*6	(2)*6	(2)*6
Coaxial Cable set	J1615A		–	(1)*6	–
Coaxial cable 0.3m	J1624A		(2)*6	(2)*6	(2)*6
GND connection cable	J1627A		(1)*6	(1)*6	–

*6: These components are standard accessories for the MP1800A, MT1810A, MP1825B, MU181500B, and MU181000A.

Table 3.1-2 Equipment Configuration for Each Measurement Type (When MT1810A Is Used)

Equipment Type	Model	Options	Necessary Quantity for Each Connection Type		
			Jitter Tolerance Test	**PCIe Link Sequence**	**USB Link Sequence**
4Slot Chassis	MT1810A	x02, x32	2	2	1
12.5GHz Synthesizer	MU181000A/B*1		–	–	1
		x01*4	1	1	–
Jitter Source	MU181500B		1	1	1
28G/32G bit/s PPG	MU183020A/21A		1	–	–
		x30/x31	–	1	1
28G/32G bit/s ED	MU183040A/41A /40B/41B		1*2	–	–
	MU183040B/41B	x22		1	–
		x23		–	–
4TapEmphasis	MP1825B*1	x02	–	1	1
Vector signal generator	MG3710A*1	x02, x36, x41, x66, x71	–	2	–
PCIe Measurement Component Set	J1722A		–	1*3	–
USB Measurement Component Set	J1721A		–	–	1

*1: Cannot be controlled directly from MX183000A.

*2: Exclude MU183040B-x22 or MU183040B-x23 or both of them from the equipment configuration.

*3: Refer to CAUTION described in Section 3.3 “PCIe Link Sequence/Training Connection Procedure” for handling the SMP connector.

*4: Required for SJ Dual Tone measurement.

Table 3.1-2 Equipment Configuration for Each Measurement Type (When MT1810A Is Used) (Cont'd)

Equipment Type	Model	Options	Necessary Quantity for Each Connection Type		
			Jitter Tolerance Test	PCIe Link Sequence	USB Link Sequence
USB3.1 Receiver Test Adapter	G0373A		–	–	1
BNC-SMA connector cable	J1508A		(2)*5	(2)*5	(2)*5
Coaxial Cable set	J1615A		–	(1)*5	–
Coaxial cable 0.3m	J1624A		(2)*5	(2)*5	(2)*5
GND connection cable	J1627A		(1)*5	(1)*5	–

*5: These components are standard accessories for the MP1800A, MT1810A, MP1825B, MU181500B, and MU181000A.

Table 3.1-3 Equipment Configuration for Each Measurement Type (When MP1900A Is Used)

Equipment Type	Model	Options	Necessary Quantity for Each Connection Type				
			Jitter Tolerance Test	PCIe Link Sequence	PCIe (5) Link Training	USB Link Training	DUT Error Counts Import
Signal Quality Analyzer-R	MP1900A		1	1	1	1	1*11
12.5GHz Synthesizer	MU181000A/B *1		–	–	–	–	–
		x01*14	1	1	–	1	1*11
	MU181000B	x02	–	–	1	–	–
Jitter Modulation Source	MU181500B		1	1	1	1	1*11
21G/32G bit/s SI PPG	MU195020A		1	–	–	–	1*11
		x01*2, x11/x21	–	1	1*3	1*4	–
21G/32G bit/s SI ED	MU195040A	x01*2, x22	1	1	1	1*5	–
Noise Generator	MU195050A		(1)*6	1	1	(1)*6	(1)*11
PAM4 PPG	MU196020A	x11*7, x42*12	1	–	1*3	–	1*11
PAM4 ED	MU196040A/B	x42*13	1	–	–	–	–
PCIe Measurement Component Set	J1722A		–	1*8	–	–	–
BNC-SMA connector cable	J1508A		(2)*9	(2)*9	(2)*9	(2)*9	–
Coaxial skew match cable (0.8 m, K connector)	J1551A		–	–	–	2	–
Coaxial cable (Noise-SI PPG)	J1746A		–	(1)*9	(1)*9	(1)*9	(1)*11
Coaxial cable 0.3 m	J1624A		(2)*9	(2)*9	(2)*9	2 +(2) *9	–
Coaxial cable 1 m	J1625A		–	–	3	–	–
Pick Off Tee	J1510A		–	–	–	(2)*10	–
MP1900A PCIe Measurement Component Set	J1815A		–	–	1	–	–
PCIe Reference Clock Buffer	Z2029A		–	–	1	–	–
GND connection cable	J1627A		(1)*9	(1)*9	(1)*9	(1)*9	–

*1: Cannot be controlled directly from the MX183000A.

*2: The MX183000A-PL025 PCIe 5 Link Training is available only when the MU195020A-x01 32Gbit/s Extension and MU195040A-x01 32Gbit/s Extension are added.

*3: Either MU195020A or MU196020A is necessary for MX183000A-PL021 PCIe Link Training.

*4: The MX183000A-PL023 USB3.2 x 2 Link Training is available only when the MU195020A-x20, MU195020A-x21, and MU195020A-x31 are added.

*5: The MX183000A-PL023 USB3.2 x 2 Link Training is available only when the MU195040A-x20 and MU195040A-x22 are added.

*6: Necessary when the MX183000A-PL022 USB Link Training uses a noise generator.

*7: Necessary for the MX183000A-PL021 PCIe Link Training.

*8: Refer to CAUTION described in Section 3.3 “PCIe Link Sequence/Training Connection Procedure” for handling the SMP connector.

*9: These components are standard accessories for the MP1900A, MU181500B, and MU181000A.

*10: Necessary when the MX183000A-PL022 USB Link Training uses the Pick Off Tee.

*11: The equipment configuration for MX183000A-PL031 DUT Error Counts Import indicates the transmitting devices for error or alarm measurement or Jitter Tolerance Test.

*12: Necessary for FEC Analysis using the MU196020A.

*13: Necessary for FEC Analysis using the MU196040B. This option is not supported by the MU196040A.

*14: Required for SJ Dual Tone measurement.

Table 3.1-4 J1722A PCIe Measurement Component Set Configuration

Model	Name	Quantity
J1398A	N-SMA ADAPTOR	4
41KC-3	Fixed Attenuator 3 dB	2
41KC-6	Fixed Attenuator 6 dB	2
41KC-20	Fixed Attenuator 20 dB	2
K241C	Power Splitter	2
J1510A	Pick Off Tee	2
J1551A	Coaxial skew match cable (0.8 m, K connector)	2
J1625A	Coaxial Cable 1 m (SMA connector)	6
J1715A	Coaxial skew match cable (0.1 m, SMP-J, SMA-J)	4
K261	DC Block	2

Table 3.1-5 J1721A USB Measurement Component Set Configuration

Model	Name	Quantity
J1510A	Pick Off Tee	2
J1551A	Coaxial skew match cable (0.8 m, K connector)	2
J1625A	Coaxial Cable 1 m (SMA connector)	3
J1624A	Coaxial Cable 0.3 m (SMA connector)	2

3.2　Jitter Tolerance Test Connection Procedure

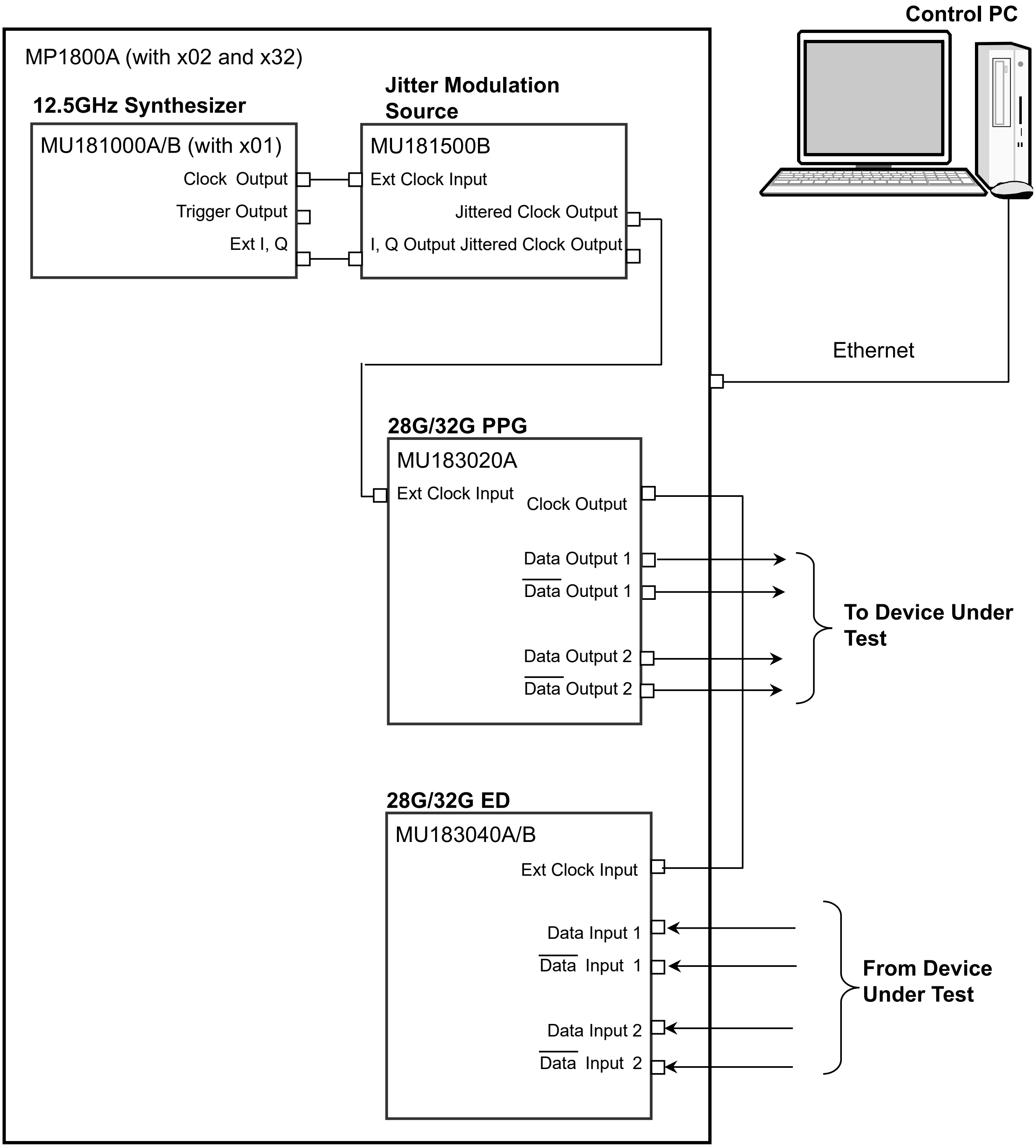


Figure 3.2-1　Jitter Tolerance Test Connection Procedure

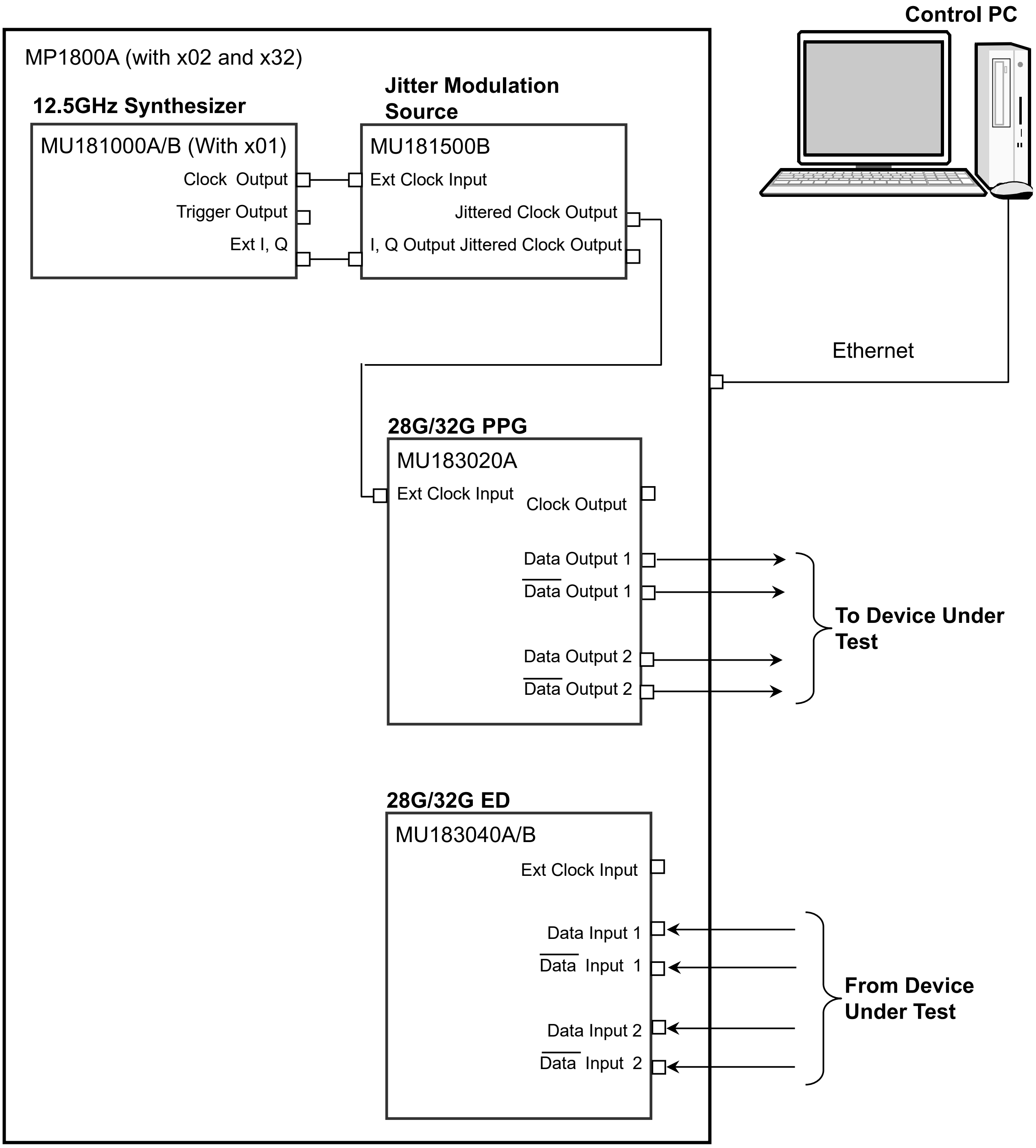


Figure 3.2-2 Jitter Tolerance Test Connection Procedure (Using Clock Recovery)

1. When MX183000A is installed on a control PC, connect the control PC to MP1800A with an Ethernet cable.
   When MX183000A is installed on MP1800A, Ethernet cable connection is not required.
   MP1800A requires the MP1800A-x02 LAN.
2. Set up as follows using the **Remote Control** tab on Setup Utility.
   Activate Interface: Ethernet
   Performance: Enhanced
3. Mount MU181000A/B and MU181500B in MP1800A.
4. Mount MU183020A in Slot 3 of MP1800A.
5. Mount MU183040A/B in Slot 4 of MP1800A.
6. Connect the Clock Output connector of MU181000A/B to the Ext Clock Input connector of MU181500B with a coaxial cable.
7. Use BNC-SMA cables (J1508A) to connect the Ext.I, Q connector of the MU181000A/B and the I, Q Output connector of the MU181500B. (2 connections)
8. Connect the Jittered Clock Output connector of MU181500B and the Ext. Clock Input connector of MU183020A using a coaxial cable.
9. If using Clock Recovery, proceed to Step 10. Use a coaxial cable to connect the Clock Output connector of the MU183020A and the Ext Clock Input connector of the MU183040A/B.
10. Connect the Data Output, $\overline{\text{Data}}$ Output connectors of MU183020A to the Data Input, $\overline{\text{Data}}$ Input connectors of a device under test with four coaxial cables.
11. Use coaxial cables to connect the Data Output and $\overline{\text{Data}}$ Output connectors of the DUT and the Data Input and $\overline{\text{Data}}$ Input connectors of the MU183040A/B.
12. Select MU181000A/B for Synthesizer Clock Source for the MU181500B.

☞ 3.3 “Input Signal Settings” in the *MU181500B Jitter Modulation Source Operation Manual*

13. Select MU181500B in Clock Setting of the **Misc2** tab of MU183020A.

☞ 5.6 “Misc2 Function” in the *MU183020A 28G/32G PPG MU183021A 28G/32G 4ch PPG Operation Manual*

3.2.1 Jitter tolerance test connection procedure for FEC analysis

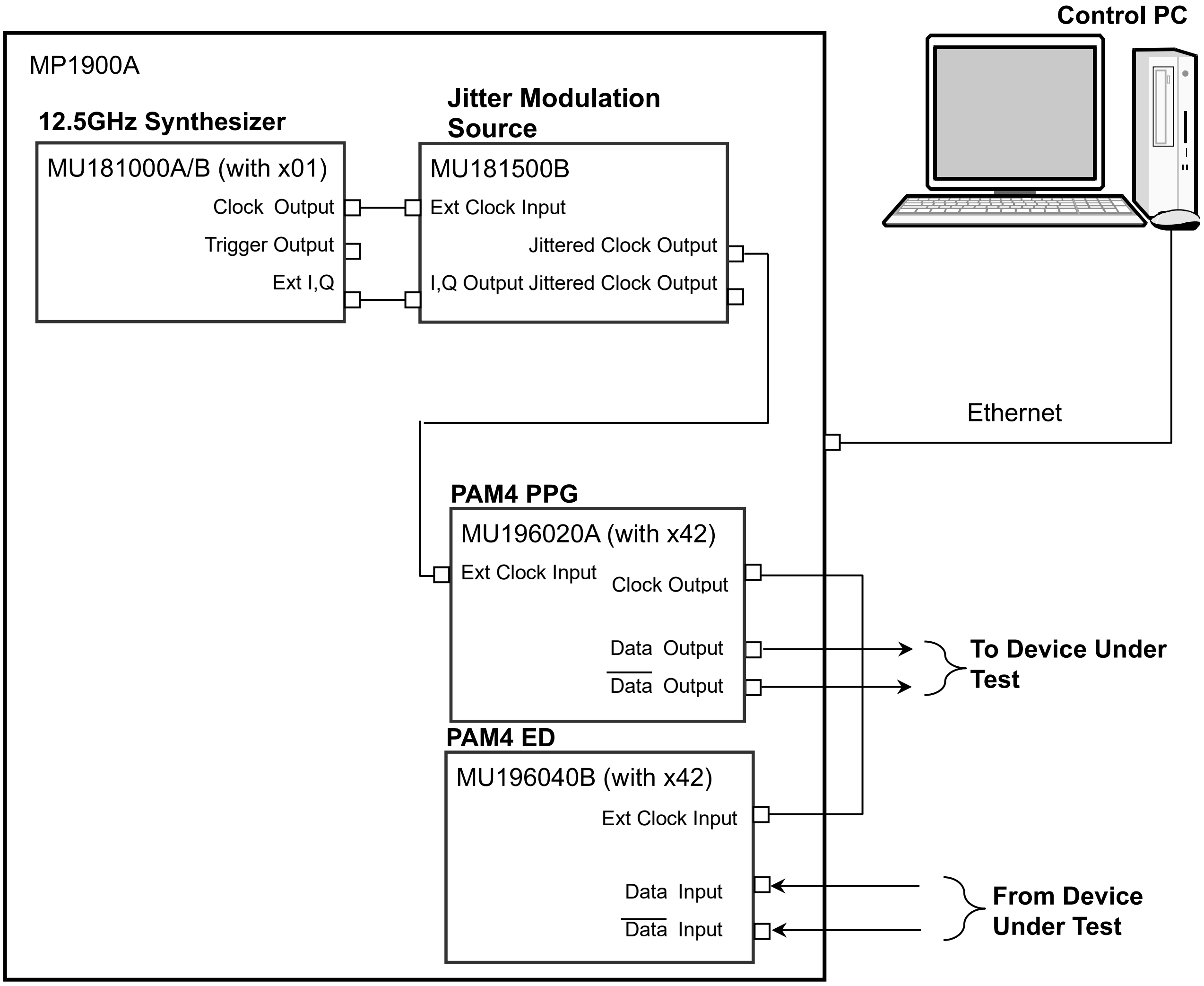


Figure 3.2.1-1 Jitter Tolerance Test Connection Procedure for FEC Analysis

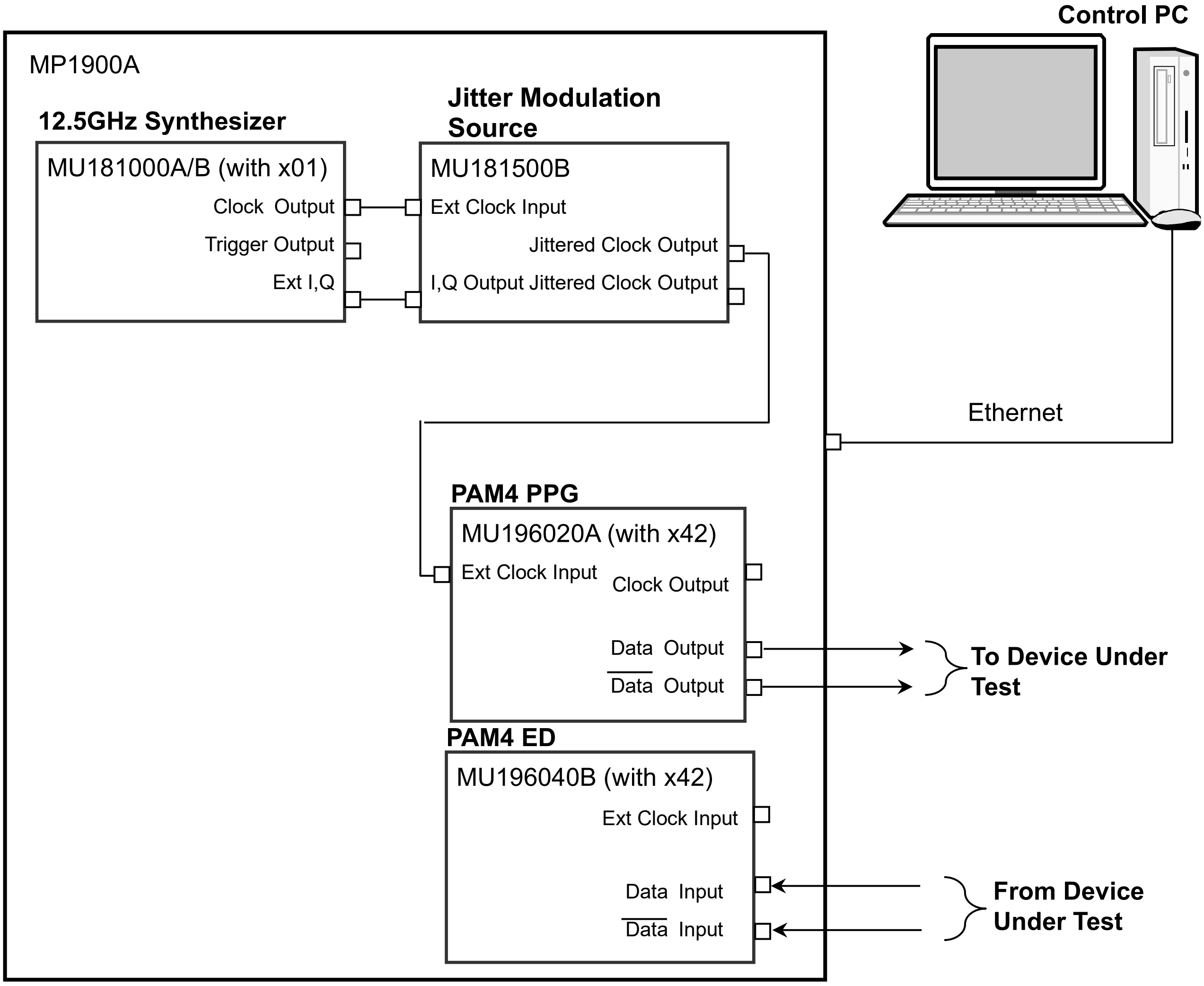


Figure 3.2.1-2 Jitter Tolerance Test Connection Procedure for FEC Analysis (When Using Clock Recovery)

1. When MX183000A is installed on a control PC, connect the control PC to MP1900A with an Ethernet cable.
   When MX183000A is installed on MP1900A, Ethernet cable connection is not required.
2. Install the MU181000A/B in Slots 1 and 2 of the MP1900A, and the MU181500B in Slots 3 and 4.
3. Mount MU196040B in Slot 6 of MP1900A.
4. Mount MU196020A in Slot 7 of MP1900A.
5. Connect the Clock Output connector of MU181000A/B to the Ext Clock Input connector of MU181500B with a coaxial cable
6. Use BNC-SMA cables (J1508A) to connect the Ext.I, Q connector of the MU181000A/B and the I, Q Output connector of the MU181500B. (2 connections)
7. Connect the Jittered Clock Output connector of MU181500B and the Ext. Clock Input connector of MU196020A using a coaxial cable.
8. If using Clock Recovery, proceed to Step 9. Use a coaxial cable to connect the Clock Output connector of the MU196020A and the Ext Clock Input connector of the MU196040B.
9. Connect the Data Output, $\overline{\text{Data}}$ Output connectors of MU196020A to the Data Input, $\overline{\text{Data}}$ Input connectors of a device under test with four coaxial cables.
10. Use coaxial cables to connect the Data Output and $\overline{\text{Data}}$ Output connectors of the DUT and the Data Input and $\overline{\text{Data}}$ Input connectors of the MU196040B.
11. Start the Standard Bert Application for the MX190000A.

☞ 4.1 “Standard Bert Application” in the *MX190000A Signal Quality Analyzer-R Control Software Operation Manual*

3.3 PCIe Link Sequence/Training Connection Procedure

3.3.1 Connection using MP1800A

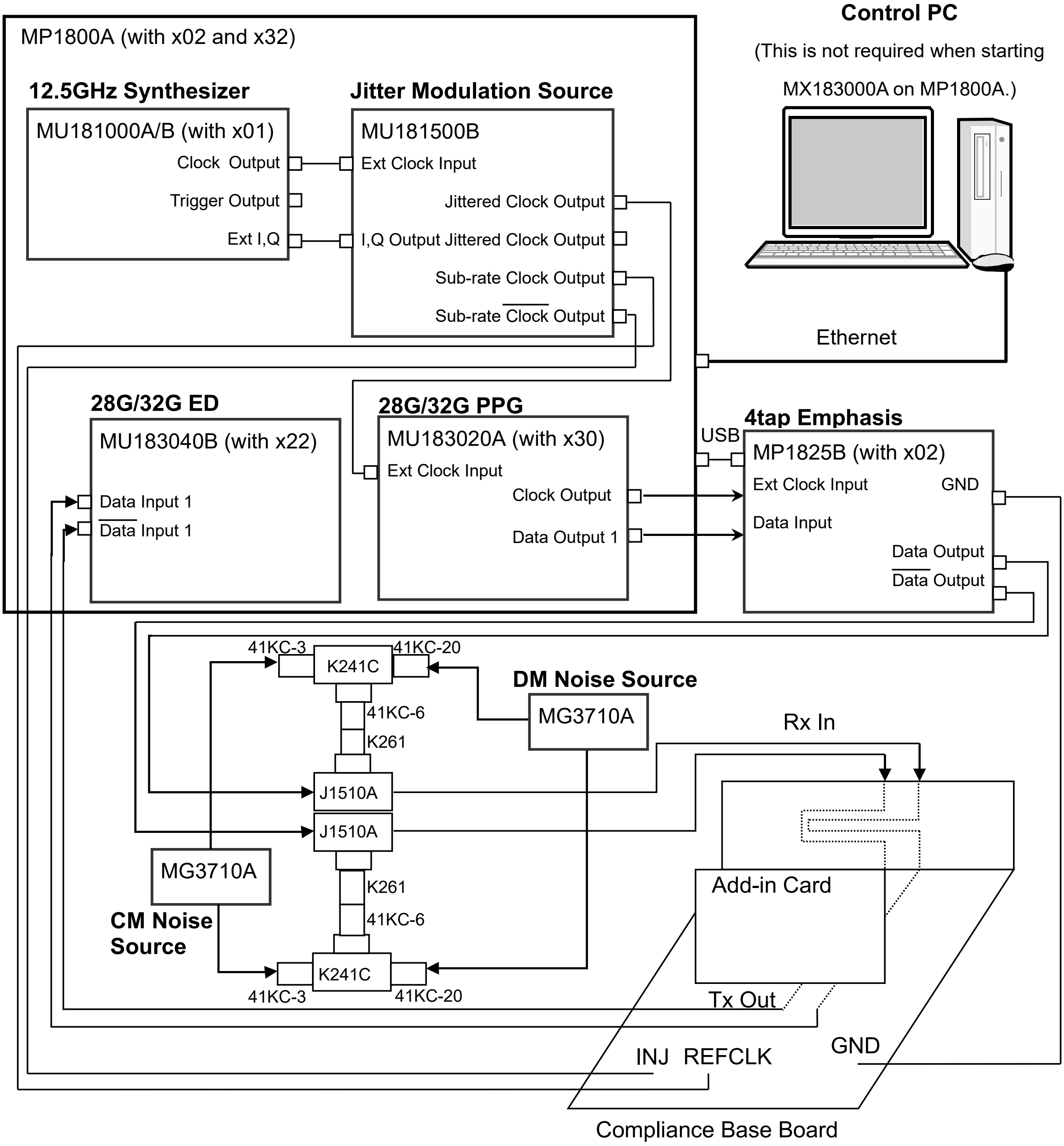


Figure 3.3.1-1 PCIe Link Sequence Connection Using MP1800A

1. When MX183000A is installed on a control PC, connect the control PC to MP1800A with an Ethernet cable. Or connect the MP1800A to the MP1825B with a USB cable.
   When MX183000A is installed on MP1800A, Ethernet cable connection is not required.
   MP1800A requires the MP1800A-x02 LAN.
2. Set up as follows using the **Remote Control** tab on Setup Utility.
   Performance: Enhanced
3. Mount MU181000A/B and MU181500B in MP1800A.
4. Mount MU183020A in Slot 3 of MP1800A.
5. Mount MU183040B in Slot 4 of MP1800A.
6. Connect the Clock Output connector of MU181000A/B to the Ext Clock Input connector of MU181500B with a coaxial cable.
7. Use BNC-SMA cables (J1508A) to connect the Ext.I, Q connector of the MU181000A/B and the I, Q Output connector of the MU181500B. (2 connections)
8. Connect the Jittered Clock Output connector of the MU181500B and the Ext. Clock Input connector of the MU183020A using a coaxial cable.
9. Use coaxial cables to connect the Sub-rate Clock Output and XClock Output of the MU181500B to the DUT REFCLK and INJ connectors.
10. Use a 1.3 m coaxial cable (J1611A) to connect the Clock Output connector of the MU183020A and the Ext Clock Input connector of the MP1825B.
11. Use a 0.8 m coaxial cable (J1612A) to connect the Data Output connector of the MU183020A and the Data Input connector of the MP1825B.
12. Connect MG3710A to 41KC-3, 41KC-6, 41KC-20, K241C and J1510A as shown in Figure 3.3.1-1. The MG3710A output is the RF Output connector.
13. Set the MG3710A IP address, and connect to the PC.
14. Connect the J1510A to the MP1825B Data Output and $\overline{\text{Data}}$ Output connector.
15. Use a 0.8 m coaxial cable (J1551A) to connect the J1510A and the Compliance Base Board input (Rx In). (2 connections) Do not mount the Add-in Card at this stage.
16. Use a GND connector cable (J1627A) to connect the DUT GND and MP1825B GND jacks.

17. Select MU181000A/B for Clock Source for the MU181500B.

☞ 3.3 “Input Signal Settings” in the *MU181500B Jitter Modulation Source Operation Manual*

18. Select MU181500B in Clock Setting of the **Misc2** tab of MU183020A.

☞ 5.6 “Misc2 Function” in the *MU183020A 28G/32G PPG MU183021A 28G/32G 4ch PPG Operation Manual*

19. On the **Misc2** tab of MU183020A, select **Full Rate** in the Output Clock Rate box.

☞ 5.6 “Misc2 Function” in the *MU183020A 28G/32G PPG MU183021A 28G/32G 4ch PPG Operation Manual*

20. Select the PPG connected for MP1825B Data Input.

☞ 3.3 “Input Signal Settings” in the *MP1825B 4Tap Emphasis Operation Manual*

21. Select **Full Rate** for MP1825B Clock Input.

☞ 3.3 “Input Signal Settings” in the *MP1825B 4Tap Emphasis Operation Manual*

22. Connect the Compliance Base Board output (Tx Out) to a real-time oscilloscope, and calibrate the Eye Pattern (amplitude, Jitter, and Emphasis settings).
23. Once Eye Pattern calibration is complete, connect the Compliance Base Board output (Tx Out) to the MU183040B Data Input and $\overline{\text{Data}}$ Input connector with a 0.8 m coaxial cable (J1551A).
24. Select Recovery Clock from Clock Setup Selection in the MU183040B **Input** tab.

☞ 5.4 “Input Signal Settings” in the *MU183040A/MU183041A/MU183040B/MU183041B Operation Manual*

⚠ CAUTION

The SMP connector can withstand 100 insertion/removal cycles. Do not exceed this limit when you need to insert and remove the connector repeatedly. Exceeding the limit may cause performance deterioration by contact failure or connector damage.

3.3.2 Connection using MP1900A

3.3.2.1 Connection to test Add-in card

Note:

When using MU195020A, MX183000A-PL025 PCIe5 Link Training test requires the MU195020A-x01 and MU195040A-x01.

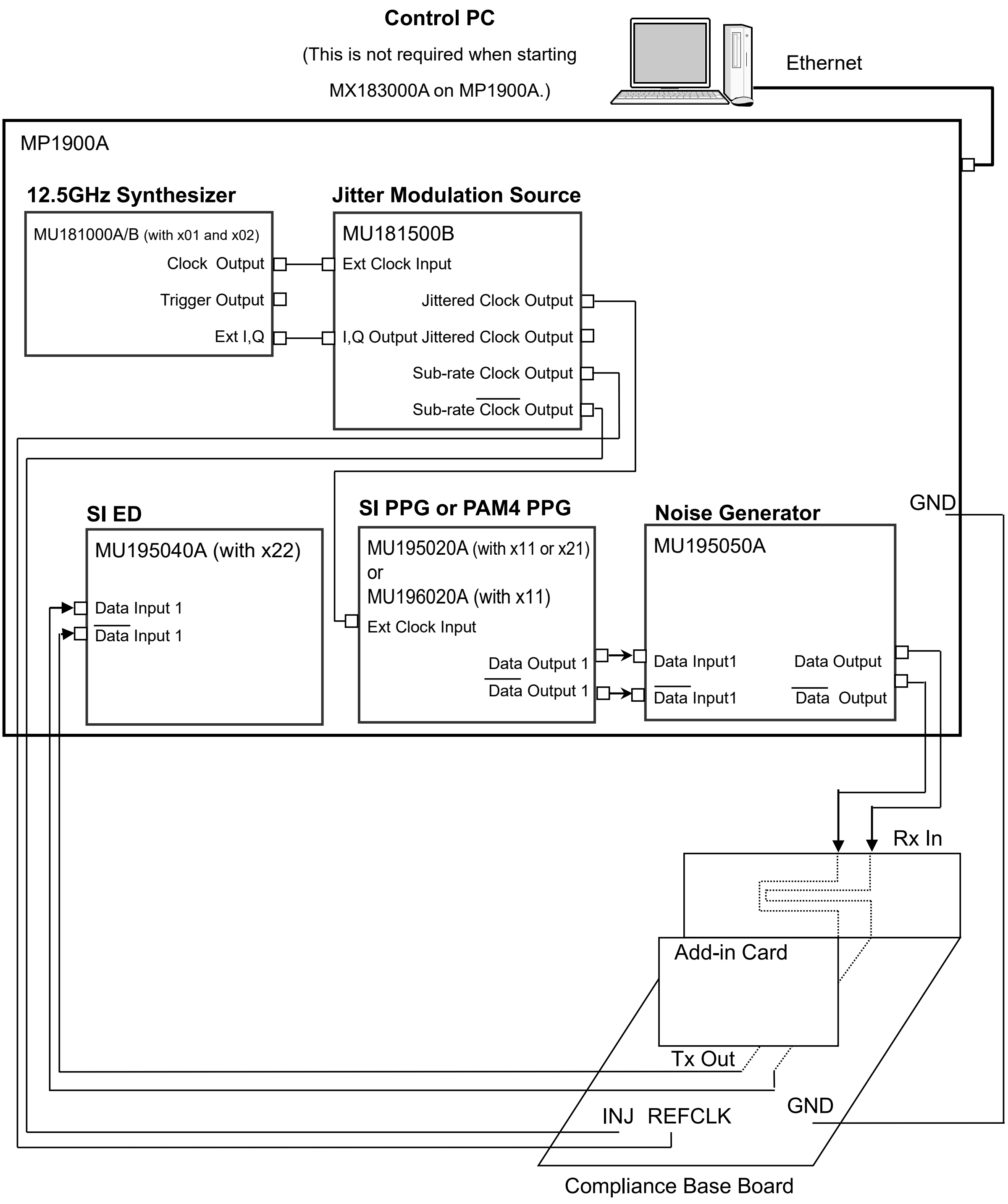


Figure 3.3.2.1-1 PCIe Link Sequence/Training (Add-in Card) Connection Using MP1900A

1. When MX183000A is installed on Control PC, connect it to the Ethernet External Port of MP1900A with an Ethernet cable.
   When MX183000A is installed on MP1900A, Ethernet cable connection is not required.
2. Mount MU181000A/B in Slot 1 and 2, MU181500B in slot 3 and 4 of MP1900A.
3. Mount MU195040A in Slot 6 of MP1900A.
4. Mount MU195020A or MU196020A in Slot 7 of MP1900A.
5. Mount MU195050A into Slot 8 of MP1900A.
6. Connect the Clock Output connector of MU181000A/B and the Ext Clock Input connector of MU181500B with a coaxial cable.
7. Use BNC-SMA cables (J1508A) to connect the Ext.I, Q connector of the MU181000A/B and the I, Q Output connector of the MU181500B. (2 connections)
8. Connect the Jittered Clock Output connector of the MU181500B and the Ext. Clock Input connector of the MU195020A using a coaxial cable.
9. Use coaxial cables to connect the Sub-rate Clock Output and XClock Output of the MU181500B to the DUT REFCLK and INJ connectors.
10. Connect the Data Output and $\overline{\text{Data}}$ Output connectors of MU195020A or MU196020A to the Data Input and $\overline{\text{Data}}$ Input connectors of MU195050A with coaxial cables (J1746A) respectively.
11. Connect the Data Output and $\overline{\text{Data}}$ Output connectors of MU195050A to two input connectors (Rx In) of the Compliance Base Board with 0.8 m coaxial cables (J1551A). Do not install the Add-in Card yet.
12. Use a GND connector cable (J1627A) to connect the DUT GND and MP1900A GND jacks.
13. Start Standard Bert Application of MX190000A. Start the Standard BERT for SI and PAM4 Application when the MU196020A is used.

☞ 4.1 “Standard Bert Application” in the *MX190000A Signal Quality Analyzer-R Control Software Operation Manual*

14. Connect the Compliance Base Board output (Tx Out) to a real-time oscilloscope, and calibrate the Eye Pattern (amplitude, Jitter, and Emphasis settings).
15. Once Eye Pattern calibration is complete, connect the Compliance Base Board output (Tx Out) to the MU195040A Data Input and $\overline{\text{Data}}$ Input connector with a 0.8 m coaxial cable (J1551A).

⚠ CAUTION

The SMP connector can withstand 100 insertion/removal cycles. Do not exceed this limit when you need to insert and remove the connector repeatedly. Exceeding the limit may cause performance deterioration by contact failure or connector damage.

3.3.2.2 Connection to test System Board

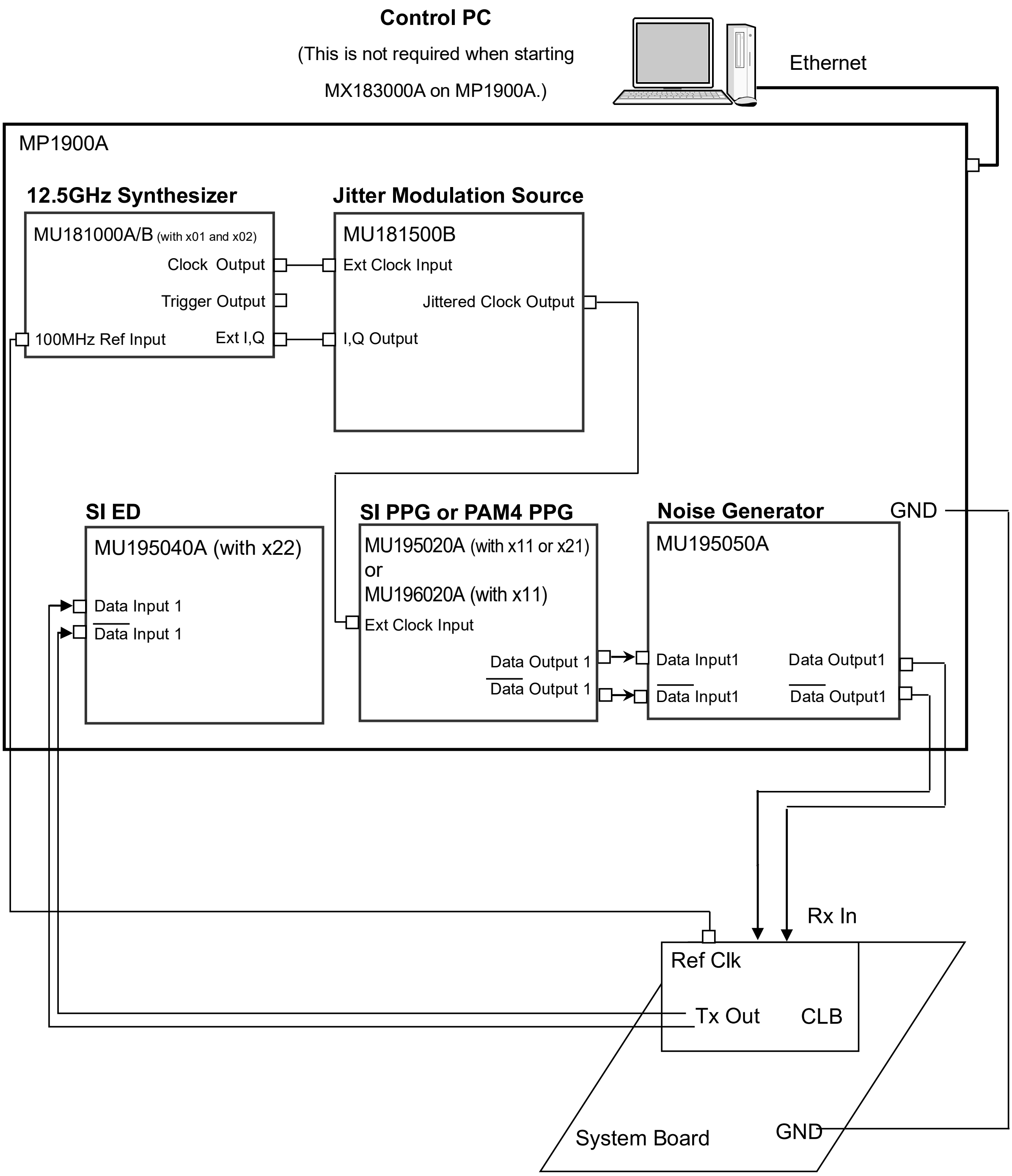


Figure 3.3.2.2-1 PCIe Link Sequence/Training (System Board) Connection Using MP1900A

1. When MX183000A is installed on Control PC, connect it to the Ethernet External Port of MP1900A with an Ethernet cable. When MX183000A is installed on MP1900A, Ethernet cable connection is not required.

2. Mount MU181000A/B in Slot 1 and 2, MU181500B in slot 3 and 4 of MP1900A.
3. Mount MU195040A in Slot 6 of MP1900A.
4. Mount MU195020A or MU196020A in Slot 7 of MP1900A.
5. Mount MU195050A into Slot 8 of MP1900A.
6. Connect the Clock Output connector of MU181000A/B and the Ext Clock Input connector of MU181500B with a coaxial cable.
7. Use BNC-SMA cables (J1508A) to connect the Ext.I, Q connector of the MU181000A/B and the I, Q Output connector of the MU181500B. (2 connections)
8. Connect the Jittered Clock Output connector of the MU181500B and the Ext. Clock Input connector of the MU195020A using a coaxial cable.
9. Connect the Data Output and $\overline{\text{Data}}$ Output connectors of MU195020A to the Data Input and $\overline{\text{Data}}$ Input connectors of MU195050A with coaxial cables (J1746A) respectively.
10. Connect the Data Output and $\overline{\text{Data}}$ Output connectors of MU195050A to two input connectors (Rx In) of the Compliance Base Board with 0.8 m coaxial cables (J1551A).
11. At PCIe Link Training, connect the 100 MHz Ref Input connector of MU181000B and the Ref Clk connector on Compliance Load Board using the PCIe Reference Clock Cable kit (J1761A).
12. Use a GND connector cable (J1627A) to connect the System Board GND and MP1900A GND jacks.
13. Start Standard Bert Application of MX190000A. Start the Standard BERT for SI and PAM4 Application when the MU196020A is used.

☞ 4.1 “Standard Bert Application” in the *MX190000A Signal Quality Analyzer-R Control Software Operation Manual*

14. Connect the Compliance Base Board output (Tx Out) to a real-time oscilloscope, and calibrate the Eye Pattern (amplitude, Jitter, and Emphasis settings).
15. Once Eye Pattern calibration is complete, connect the Compliance Base Board output (Tx Out) to the MU195040A Data Input and $\overline{\text{Data}}$ Input connector with a 0.8 m coaxial cable (J1551A).

Note:

The System Board (Root Complex) can be tested only in Separate Refclock.

Refer to the description of DUT in Table 4.8.2-1 “PCIe Link Training Setting Items”.

⚠ CAUTION

The SMP connector can withstand 100 insertion/removal cycles. Do not exceed this limit when you need to insert and remove the connector repeatedly. Exceeding the limit may cause performance deterioration by contact failure or connector damage.

3.4 USB Link Sequence/Training Connection Procedure

3.4.1 Connection using MP1800A

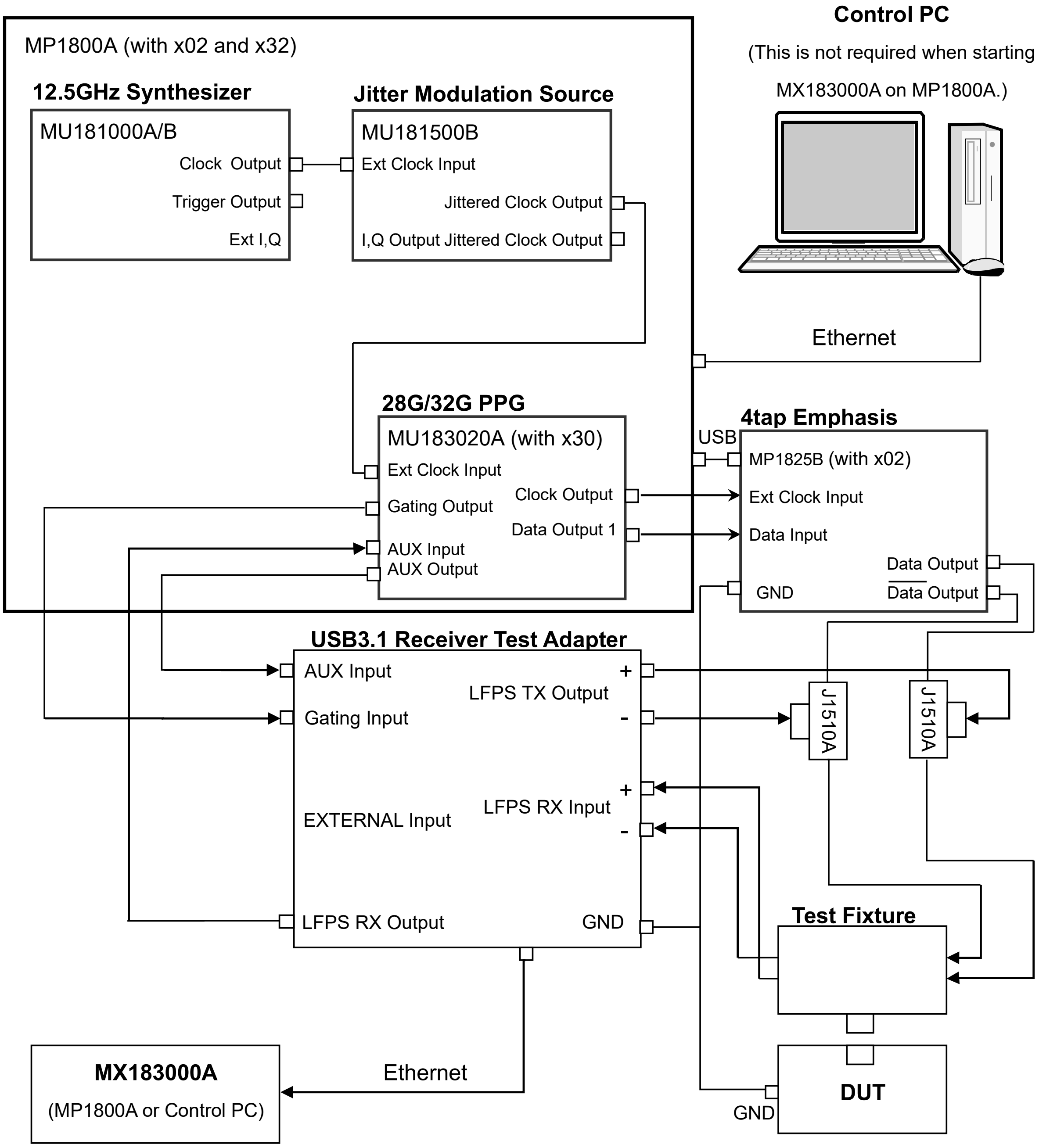


Figure 3.4.1-1 USB Link Sequence Connection Using MP1800A

1. When MX183000A is installed on a control PC, connect the control PC to MP1800A with an Ethernet cable. Or connect the MP1800A to the MP1825B with a USB cable.
   When MX183000A is installed on MP1800A, Ethernet cable connection is not required.
   MP1800A requires the MP1800A-x02 LAN.
2. Set up as follows using the **Remote Control** tab on Setup Utility.
   Activate Interface: Ethernet
   Performance: Enhanced
3. Mount MU181000A/B and MU181500B in MP1800A.
4. Mount MU183020A in Slot 3 of MP1800A.
5. Connect the Clock Output connector of MU181000A/B to the Ext Clock Input connector of MU181500B with a coaxial cable.
6. Connect the Jittered Clock Output connector of the MU181500B and the Ext. Clock Input connector of the MU183020A using a coaxial cable.
7. Use a 1.3 m coaxial cable (J1611A) to connect the Clock Output connector of the MU183020A and the Ext Clock Input connector of the MP1825B.
8. Use a 0.8 m coaxial cable (J1612A) to connect the Data Output connector of the MU183020A and the Data Input connector of the MP1825B.
9. Connect the Data Output and $\overline{\text{Data}}$ Output connectors of the MP1825B and the Pick Off Tee (J1510A) (2 connections).
10. Connect the J1510A and the LFPS TX Output connector of the USB3.1 Receiver Test Adapter with a 0.3 m coaxial cable (J1624A) as in Figure 3.4.1-1 (2 connections).
11. Connect the J1510A and Test Fixture with 0.8 m coaxial cable (J1612A) as in Figure 3.4.1-1 (2 connections).
12. Use a GND connector cable (J1627A) to connect the DUT GND and MP1825B GND jacks.
13. Use a cable supplied with the USB3.1 Receiver Test Adapter to connect the USB3.1 Receiver Test Adapter GND and MP1825B GND jacks.
14. Use a 1 m coaxial cable (J1625A) to connect the AUX Output connector of the MU183020A and the AUX Input connector of the USB3.1 Receiver Test Adapter.
15. Use a 1 m coaxial cable (J1625A) to connect the Gating Output connector of the MU183020A and the Gating Input connector of the USB3.1 Receiver Test Adapter.

16. Use a 1 m coaxial cable (J1625A) to connect the AUX Input connector of the MU183020A and the LFPS RX Output connector of the USB3.1 Receiver Test Adapter.
17. Use a 0.8 m coaxial cable (J1551A) to connect the LFPS RX Input connector of the USB3.1 Receiver Test Adapter and the USB3.1 Receiver Test Adapter (2 connections).
18. Select MU181000A/B for Clock Source for the MU181500B.

☞ 3.3 “Input Signal Settings” in the *MU181500B Jitter Modulation Source Operation Manual*

19. Select MU181500B in Clock Setting of the **Misc2** tab of MU183020A.

☞ 5.6 “Misc2 Function” in the *MU183020A 28G/32G PPG MU183021A 28G/32G 4ch PPG Operation Manual*

20. On the **Misc2** tab of MU183020A, select **Full Rate** in the Output Clock Rate box.

☞ 5.6 “Misc2 Function” in the *MU183020A 28G/32G PPG MU183021A 28G/32G 4ch PPG Operation Manual*

21. Select the PPG connected for MP1825B Data Input.

☞ 3.3 “Input Signal Settings” in the *MP1825B 4Tap Emphasis Operation Manual*

22. Select **Full Rate** for MP1825B Clock Input.

☞ 3.3 “Input Signal Settings” in the MP1825B 4Tap Emphasis Operation *Manual*

3.4.2 Connection using MP1900A

3.4.2.1 Connection using Pick Off Tee

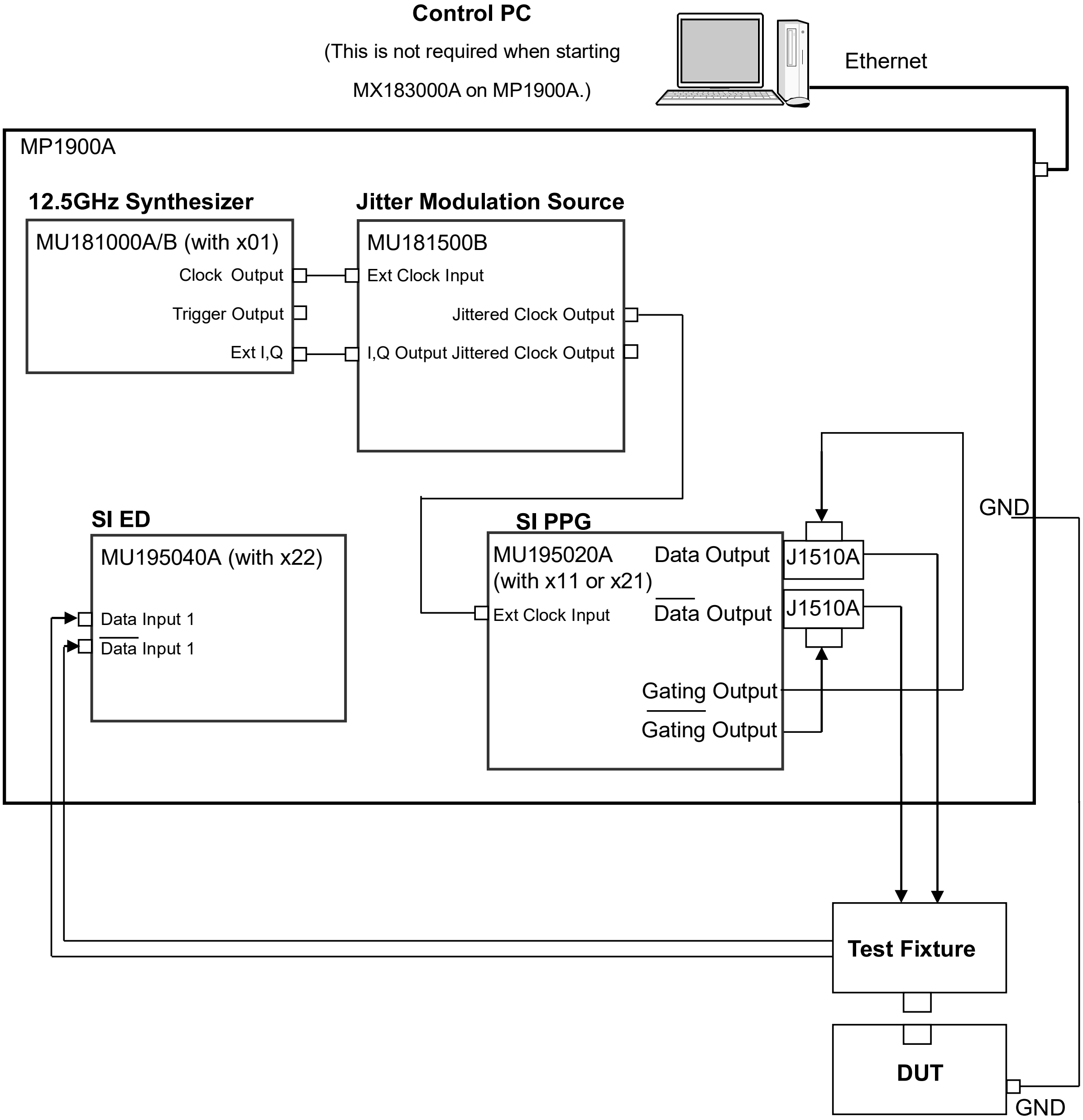


Figure 3.4.2.1-1 USB Link Training Connection Using MP1900A (Pick Off Tee)

1. When MX183000A is installed on a control PC, connect the control PC to MP1900A with an Ethernet cable.
   When MX183000A is installed on MP1900A, Ethernet cable connection is not required.
2. Mount MU181000A/B in Slot 1 and 2, MU181500B in Slot 3 and 4 of MP1900A.
3. Mount MU195040A in Slot 6 of MP1900A.
4. Mount MU195020A in Slot 7 of MP1900A.
5. Connect the Clock Output connector of MU181000A/B to the Ext Clock Input connector of MU181500B with a coaxial cable.
6. Use BNC-SMA cables (J1508A) to connect the Ext.I, Q connector of the MU181000A/B and the I, Q Output connector of the MU181500B. (2 connections)
7. Connect the Jittered Clock Output connector of MU181500B and the Ext. Clock Input connector of MU195020A using a coaxial cable.
8. Connect MU195020A Data Output and $\overline{\text{Data}}$ Output connectors and Pick Off Tee (J1510A).
9. Connect MU195020A Gating Out and $\overline{\text{Gating}}$ Output connectors to Pick Off Tee (J1510A) with the 0.3 m coaxial cable (J1624A).
10. Connect DUT GND to MP1900A GND jack with GND connection cable (J1627A).
11. Connect the output connectors of Pick Off Tees (J1510A) to the Test Fixture with 0.8 m coaxial cables (J1551A). (2 connections).
12. Connect the Test Fixture to MU195040A Data Input and $\overline{\text{Data}}$ Input connectors with 0.8 m coaxial cable (J1551A).
13. Launch MX190000A Standard Bert Application.

☞4.1 “Standard Bert Application” in the *MX190000A Signal Quality Analyzer-R Control Software Operation Manual*

3.4.2.2 Connection using MU195050A

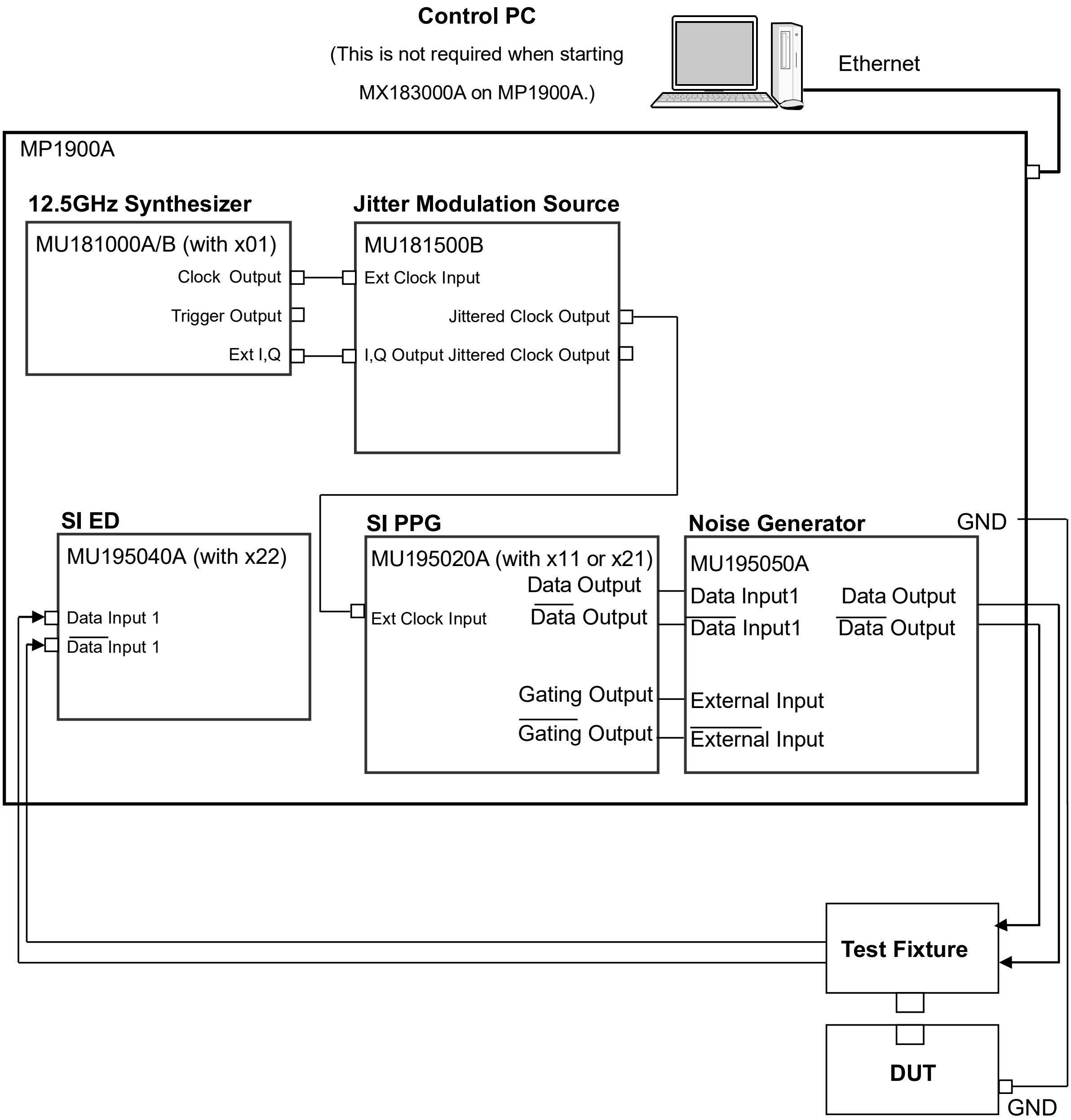


Figure 3.4.2.2-1 USB Link Training Connection Using MP1900A (MU195050A)

1. When MX183000A is installed on a control PC, connect the control PC to MP1900A with an Ethernet cable.
   When MX183000A is installed on MP1900A, Ethernet cable connection is not required.
2. Mount MU181000A/B in Slot 1 and 2, MU181500B in slot 3 and 4 of MP1900A.
3. Mount MU195040A in Slot 6 of MP1900A.
4. Mount MU195020A in Slot 7 of MP1900A.
5. Mount MU195050A in Slot 8 of MP1900A.
6. Connect the Clock Output connector of MU181000A/B to the Ext Clock Input connector of MU181500B with a coaxial cable.
7. Use BNC-SMA cables (J1508A) to connect the Ext.I, Q connector of the MU181000A/B and the I, Q Output connector of the MU181500B. (2 connections)
8. Connect the Jittered Clock Output connector of MU181500B and the Ext. Clock Input connector of MU195020A using a coaxial cable.
9. Connect the Data Output and $\overline{\text{Data}}$ Output connectors of MU195020A to the Data Input1 and $\overline{\text{Data}}$ Input1 connectors of MU195050A respectively.
10. Connect the External Input and $\overline{\text{External}}$ Input connectors of MU195050A to the Gating Out and $\overline{\text{Gating}}$ Output connectors respectively with 0.3m coaxial cables (J1624A).
11. Connect DUT GND to MP1900A GND jack with GND connection cable (J1627A).
12. Connect the Data Output and $\overline{\text{Data}}$ Output connectors of MU195050A to the test fixture with 0.8 m coaxial cables (J1551A) at two places.
13. Connect the Test Fixture to MU195040A Data Input and $\overline{\text{Data}}$ Input connectors with 0.8 m coaxial cable (J1551A).
14. Launch MX190000A Standard Bert Application.

☞4.1 “Standard Bert Application” in the *MX190000A Signal Quality Analyzer-R Control Software Operation Manual*

3.5 PAM4 Control Connection Procedure

3.5.1 Connection for transmitting and receiving linear PAM4 signal

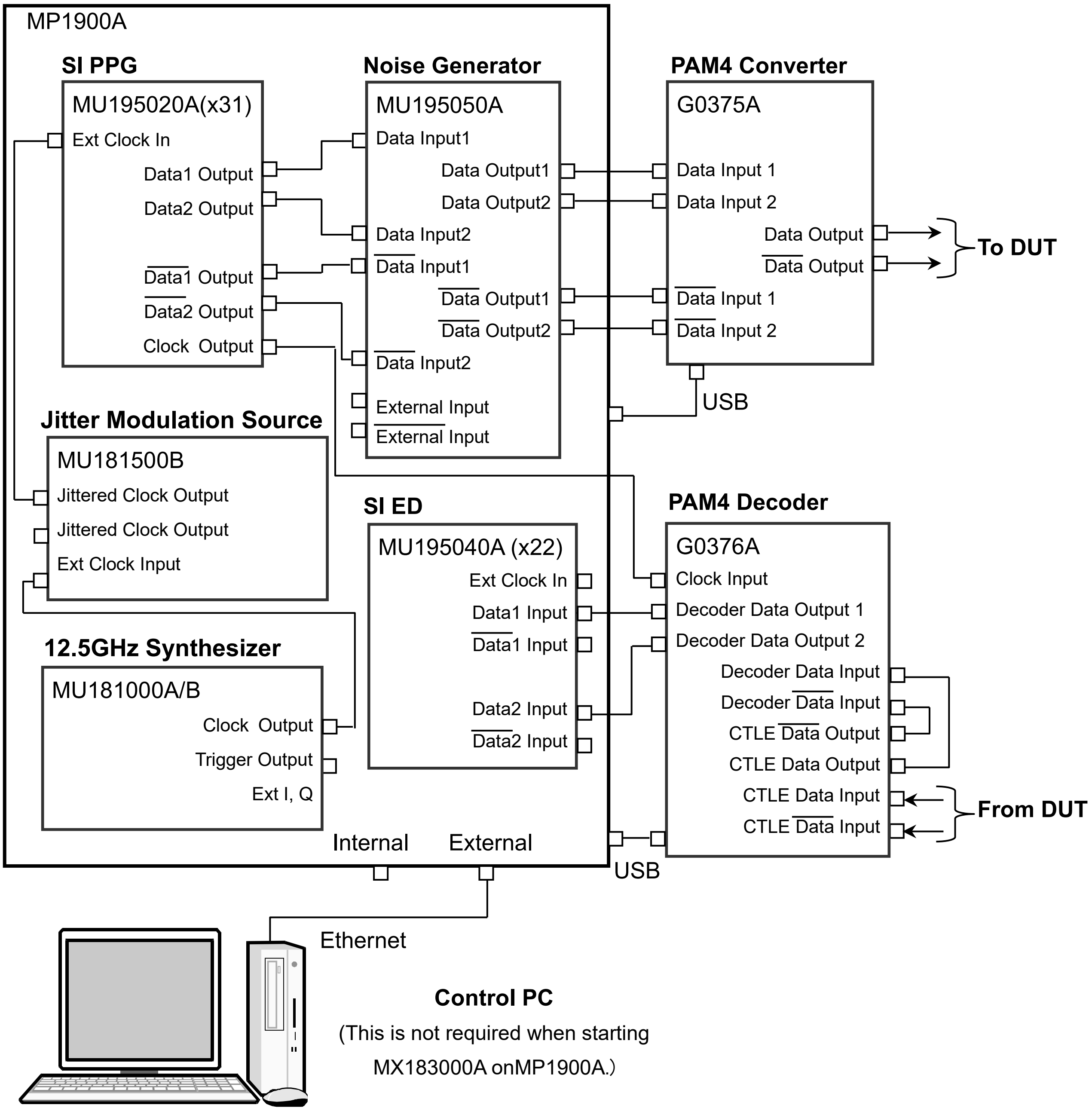


Figure 3.5.1-1 Cable Connection for Linear PAM4 Signal

1. When MX183000A is installed on a control PC, connect the control PC to MP1900A with an Ethernet cable. Connect the Ethernet cable to the External port on the MP1900A rear panel. When MX183000A is installed on MP1900A, the Ethernet cable connection is not required.

2. Mount MU181000A/B in Slot 1 and 2, MU181500B in Slot 3 and 4, MU195040A in Slot 7, and MU195050A in Slot 8 of MP1900A.
3. Connect G0375A and G0376A to MP1900A with USB cables. To control MX183000A by an external PC, connect G0375A and G0376A to the control PC with USB cables.
4. Connect the Clock Output connector of MU181000A/B and the Ext Clock Input connector of MU181500B with a coaxial cable.
5. Connect the Jittered Clock Output connector of the MU181500B and the Ext. Clock In connector of the MU195020A using a coaxial cable.
6. Connect the Data1 Output, $\overline{\text{Data1}}$ Output, Data2 Output, and $\overline{\text{Data2}}$ Output connectors of MU195020A to the Data Input1, $\overline{\text{Data}}$ Input1, Data Input2, and $\overline{\text{Data}}$ Input2 connectors of MU195050A respectively with coaxial adapters (J1717A).
7. Connect the Data Output1, $\overline{\text{Data}}$ Output1, Data Output2, $\overline{\text{Data}}$ Output2 connectors of MU195050A to the Data Input1, $\overline{\text{Data}}$ Input1, Data Input2, and $\overline{\text{Data}}$ Input2 connectors of G0375A respectively with coaxial cables (J1741A).
8. Connect the Data Output and $\overline{\text{Data}}$ Output connectors of G0375A to the DUT with coaxial cables.
9. Connect the DUT signal to the CTLE Data Input and CTLE $\overline{\text{Data}}$ Input connectors of G0376A. If CTLE is not used, connect the DUT signal directly to the Decoder Data Input and Decoder $\overline{\text{Data}}$ Input connectors with coaxial cables. Then go to Step 11.
10. Connect the CTLE Data Output and CTLE $\overline{\text{Data}}$ Output connectors to the Decoder Data input and Decoder $\overline{\text{Data}}$ Input connectors with U Link cables.
11. Connect the Decoder Data Output1 and Decoder Data Output2 connectors of G0376A to the Data1 Input and Data2 Input connectors of MU195040A with coaxial cables (J1728A).
12. Connect the Clock Input connector of G0376A and the Clock Output connector of MU195020A with a coaxial cable.
13. Connect the DUT GND and the GND jack of G0375A or G0376A with a GND connection cable (J1627A).
14. Select MU181000A/B for Clock Source for the MU181500B.
15. In the clock setting on the **Misc2** tab of MU195020A, select MU181500B for Clock Source. Specify a bit rate for the measurement.

3.5.2 Connection for transmitting and receiving non-linear PAM4 signal

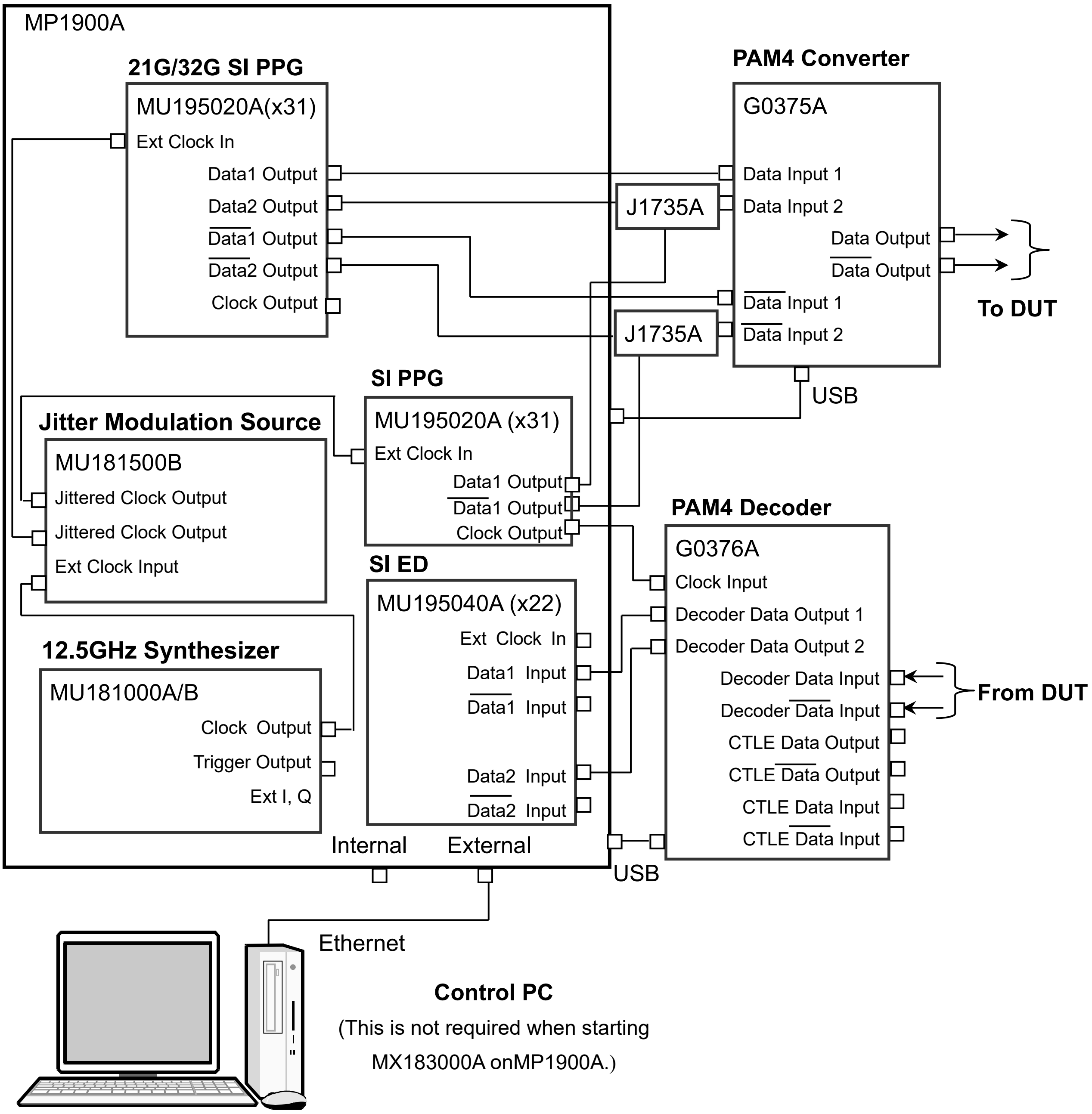


Figure 3.5.2-1 Cable Connection for Transmitting and Receiving Non-linear PAM4 Signal

1. When MX183000A is installed on a control PC, connect the control PC to MP1900A with an Ethernet cable. Connect the Ethernet cable to the External port. When MX183000A is installed on MP1900A, the Ethernet cable connection is not required.

2. Mount MU195020A in Slot 1 and 2, MU181500B and MU181000A/B into empty slots of MP1900A.
3. Connect G0375A and G0376A to MP1900A with a USB cable. To control MX183000A by an external PC, connect G0375A and G0376A to the control PC with USB cables.
4. Connect the Clock Output connector of MU181000A/B and the Ext Clock Input connector of MU181500B with a coaxial cable.
5. Connect the Jittered Clock Output connector of the MU181500B and the Ext. Clock In connector of the MU195020A using a coaxial cable. Use the cables of equal length for connecting two units of MU195020A.
6. Connect the Data1 Output, $\overline{\text{Data1}}$ Output connectors of MU195020A to the Data Input1, $\overline{\text{Data}}$ Input1 connectors with coaxial cables (J1742A).
7. Connect J1735A Combiners to the Data Input2 and $\overline{\text{Data}}$ Input2 connectors of G0375A respectively.
8. Connect the Data2 Output and $\overline{\text{Data2}}$ Output connectors of MU195020A in Slot 1, the Data1 Output and $\overline{\text{Data1}}$ Output connectors of MU195020A in Slot 2, and J1735As respectively with coaxial cables (J1741A).
9. Connect the Data Output and $\overline{\text{Data}}$ Output connectors of G0375A to DUT with coaxial cables.
10. Connect the DUT signal to the Decoder Data Input and Decoder $\overline{\text{Data}}$ Input connectors with coaxial cables.
11. Connect the Decoder Data Output1 and Decoder Data Output2 connectors of G0376A to the Data1 Input and Data2 Input connectors of MU195040A with coaxial cables (J1728A).
12. Connect the Clock Input connector of G0376A and the Clock Output connector of MU195020A with a coaxial cable.
13. Connect the DUT GND and the GND jack of G0375A or G0376A with a GND connection cable (J1627A).
14. Select MU181000A/B for Clock Source for the MU181500B.
15. In the clock setting on the **Misc2** tab of MU195020A, select MU181500B for Clock Source. Specify a bit rate for the measurement.
16. Select Combination Setting from the MX190000A menu and select Synchronization and 2ch Combination for Inter module combination.
17. Perform multi-channel calibration, following the on-screen instructions.

3.6 DUT Error Counts Import Connection Procedure

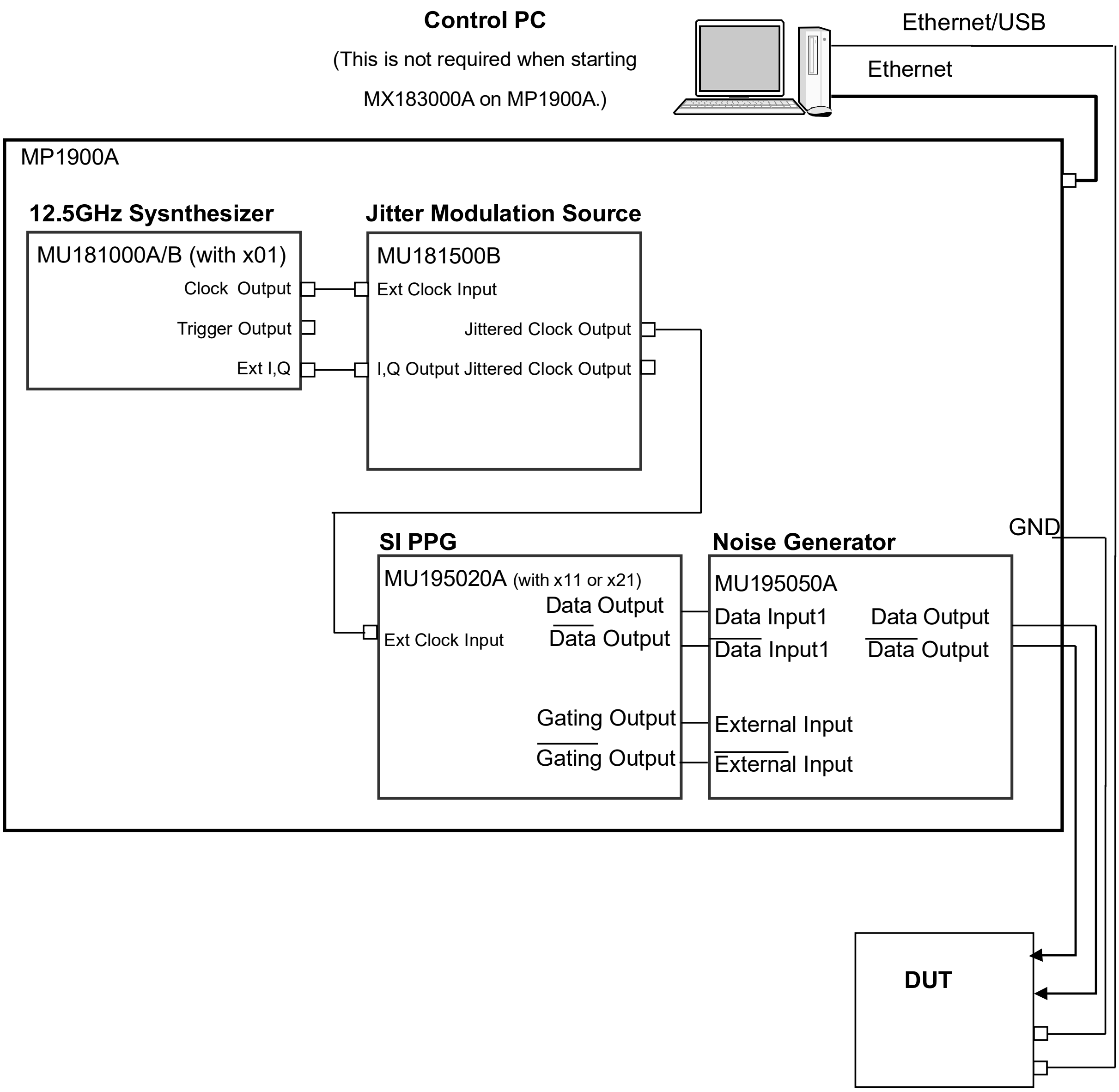


Figure 3.6-1 DUT Error Counts Import Connection Using MP1900A (with SI PPG installed)

Note:

To communicate with DUT, configure the control PC or MP1900A in advance for Ethernet connection, USB driver and other settings.

1. When MX183000A is installed on a control PC, connect the control PC to MP1900A with an Ethernet cable.
   When MX183000A is installed on MP1900A, Ethernet cable connection is not required.
2. Mount MU181000A/B in Slot 1 and 2, MU181500B in Slot 3 and 4 of MP1900A.
3. Mount MU195040A in Slot 6 of MP1900A.
4. Mount MU195020A in Slot 7 of MP1900A.
5. Mount MU195050A in Slot 8 of MP1900A.
6. Connect the Clock Output connector of MU181000A/B to the Ext Clock Input connector of MU181500B with a coaxial cable.
7. Use BNC-SMA cables (J1508A) to connect the Ext.I, Q connector of the MU181000A/B and the I, Q Output connector of the MU181500B. (2 connections)
8. Connect the Jittered Clock Output connector of MU181500B and the Ext. Clock Input connector of MU195020A using a coaxial cable.
9. Connect the Data Output and $\overline{\text{Data}}$ Output connectors of MU195020A to the Data Input1 and $\overline{\text{Data}}$ Input1 connectors of MU195050A respectively.
10. Connect the External Input and $\overline{\text{External}}$ Input connectors of MU195050A to the Gating Out and $\overline{\text{Gating}}$ Output connectors of MU195020A respectively with 0.3 m coaxial cables (J1624A).
11. Connect DUT GND to MP1900A GND jack with GND connection cable (J1627A).
12. Connect the Data Output and $\overline{\text{Data}}$ Output connectors of MU195050A to DUT with 0.8 m coaxial cables (J1551A).
13. Connect DUT to the control PC or MP1900A with an Ethernet cable or a USB cable.
14. Launch MX190000A Expert Bert Application.

4.2 “Expert Bert Application” in the *MX190000A Signal Quality Analyzer-R Control Software Operation Manual*

Chapter 4 Operation

This chapter describes the methods for measurement and the procedures for screen operation.

4.1 Start up and Exit

This section explains the startup and exit procedures for cases where MX183000A is installed on SQA and cases where it is installed on an external PC.

4.1.1 When using on MP1800A

MX183000A is launched automatically when the MP1800A is started. The following procedures describe how to start up for the first time after installing or after closing the software.

Startup procedure

(1) Click the **Auto Measurement** on the tool bar of the MX180000A Signal Quality Analyzer Control Software (hereafter, MX180000A). The Auto Measurement Select screen appears.

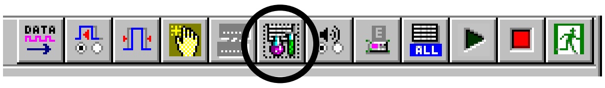


Figure 4.1.1-1 Auto Measurement button

(2) In the Auto Measurement Select dialog box, click **High Speed Serial Data Test Software**. MX183000A starts and displays the Main screen.

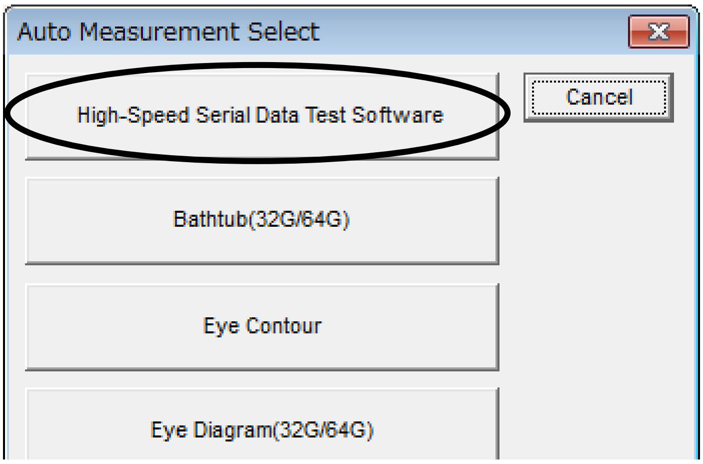


Figure 4.1.1-2 Auto Measurement Select Dialog Box

When **High-Speed Serial Data Test Software** is not displayed on the above screen, add MX183000A by Auto Measurement Setup.

☞ 5.4.2 “Customizing automatic measurement functions” in the *MX180000A Signal Quality Analyzer Control Software Operation Manual*

Exit procedure

(1) Open the **File** menu and then click **Exit**.

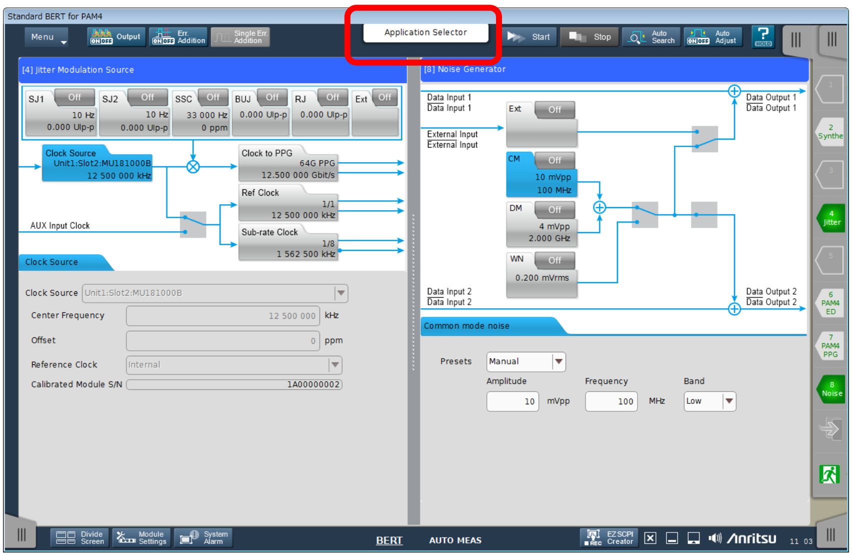
(2) In the Main screen, click the **Close** button to exit MX183000A.

(3) Turn off the power of all instruments.

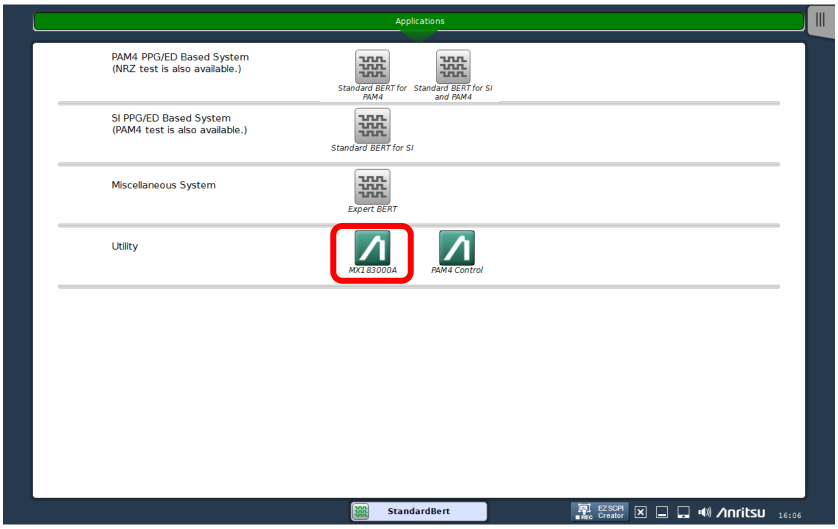
4.1.2 When using on MP1900A

Startup procedure

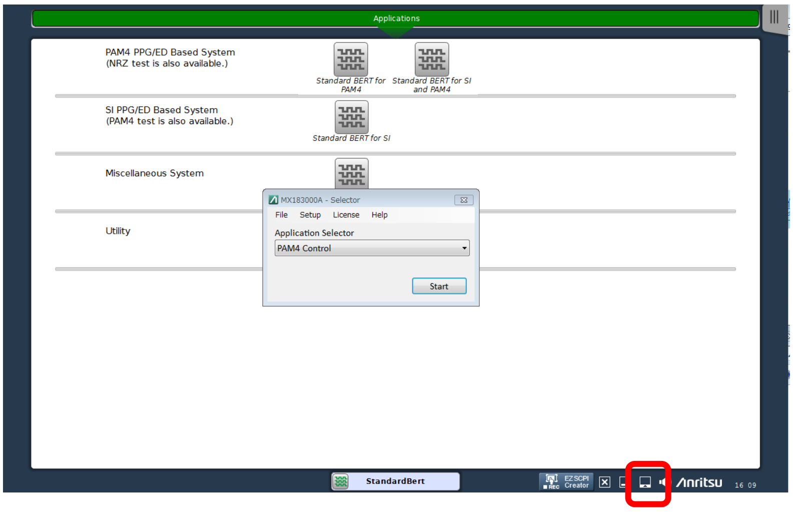
(1) Start Standard Bert of the MX190000A Signal Quality Analyzer-R Control Software (hereinafter “MX190000A”) and display the Application Selector window.



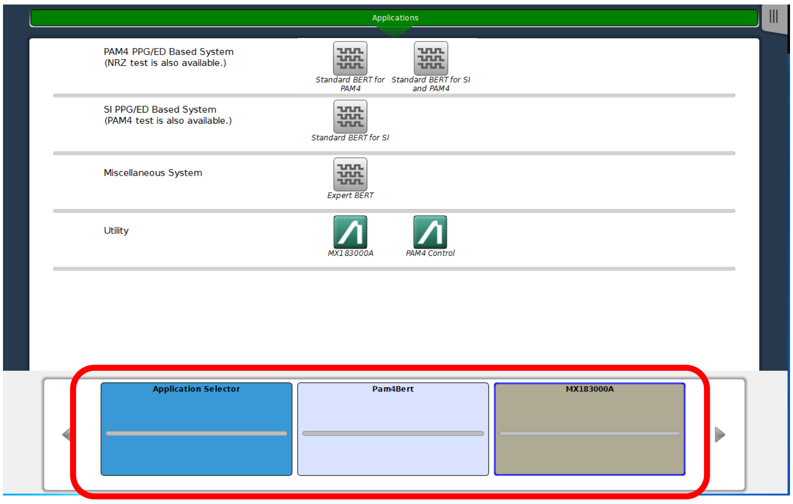
(2) At Utility, click the **MX183000A** icon. The MX183000A starts and the Main screen is displayed.



(3) Change the application to be shown on the display using the MX190000A taskbar.



Application Selector
PAM4 Control



Exit procedure

(1) Open the **File** menu and then click **Exit**.

(2) In the Main screen, click the **Close** to exit MX183000A.

(3) Turn off the power of all instruments.

4.1.3 When using on an external PC

Startup procedure

Start MX183000A by clicking **Start**, **All programs**, **MX183000A**, and then **High Speed Serial Data Test Software** in this order.
If you have created a shortcut on your desk top, double-click the shortcut.
Start MX183000A to display the Main screen.

Exit procedure

(1) Open the **File** menu and then click **Exit**.

(2) In the Main screen, click the **Close** to exit MX183000A.

(3) Turn off the power of all instruments.

4.2 Setup Procedure and Editing Values

4.2.1 Setup procedure

Figure 4.2.1-1 shows the basic setup procedure.

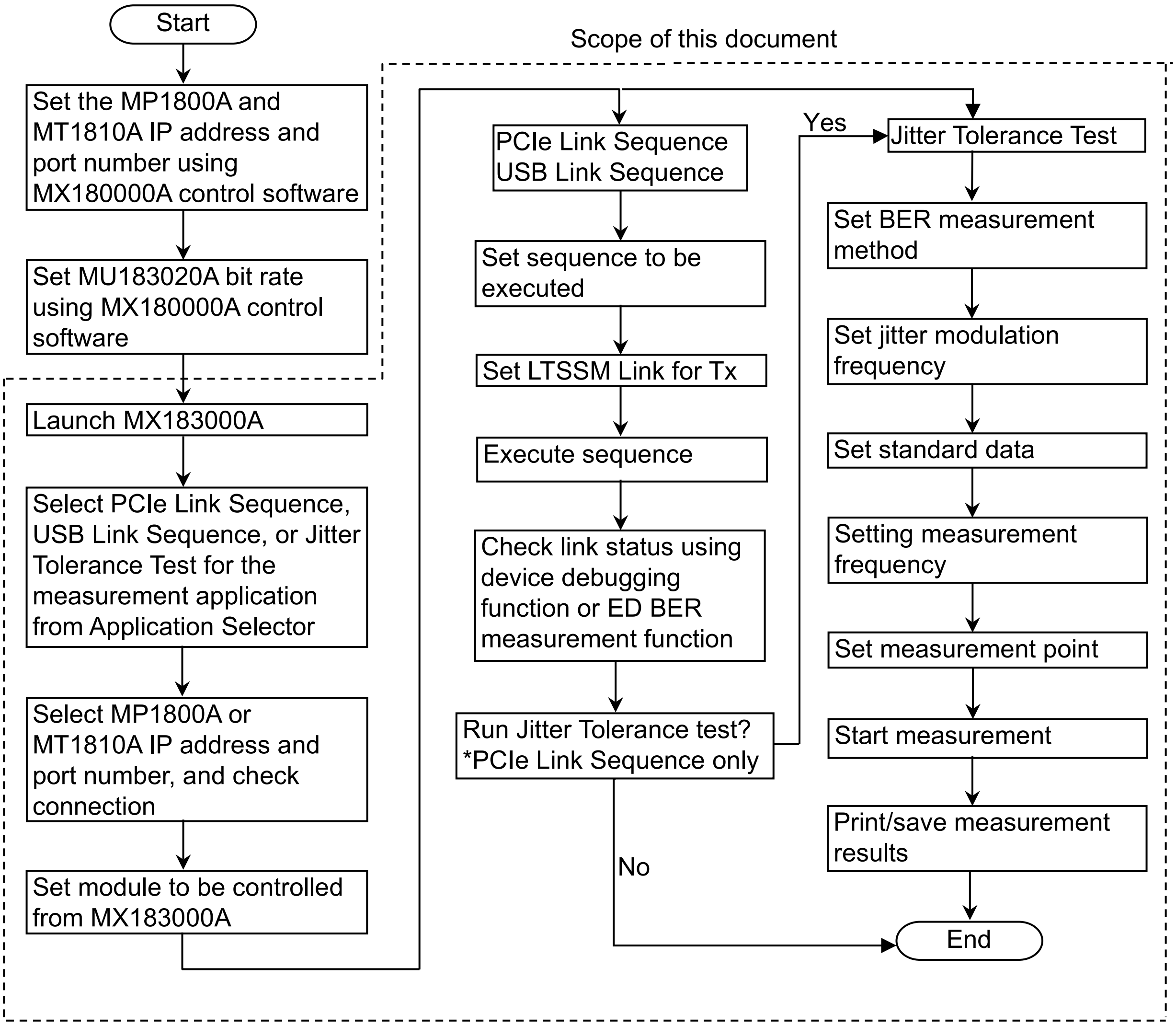
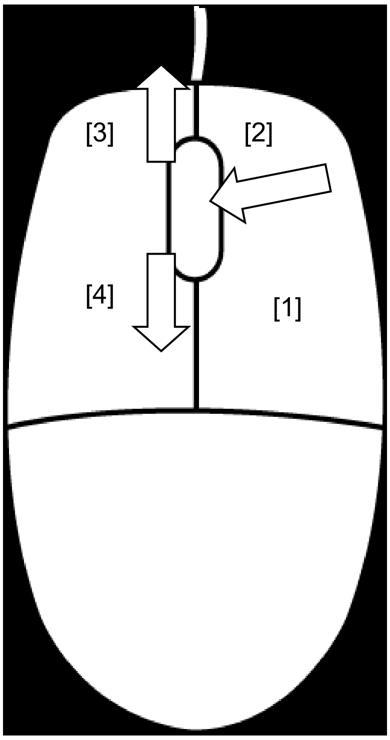

Start
Scope of this document
Set the MP1800A and MT1810A IP address and port number using MX180000A control software
Set MU183020A bit rate using MX180000A control software
Launch MX183000A
Select PCIe Link Sequence, USB Link Sequence, or Jitter Tolerance Test for the measurement application from Application Selector
Select MP1800A or MT1810A IP address and port number, and check connection
Set module to be controlled from MX183000A
PCIe Link Sequence
USB Link Sequence
Set sequence to be executed
Set LTSSM Link for Tx
Execute sequence
Check link status using device debugging function or ED BER measurement function
Run Jitter Tolerance test?
*PCIe Link Sequence only
Yes
No
Jitter Tolerance Test
Set BER measurement method
Set jitter modulation frequency
Set standard data
Setting measurement frequency
Set measurement point
Start measurement
Print/save measurement results
End

Figure 4.2.1-1 Setup procedure

4.2.2 Editing values

The numeric values of MX183000A can be set only by using a mouse with center wheel.

This function is available in Version 2.03.00 or later of MX183000A.



[1] Right click

[2] Clicking center wheel

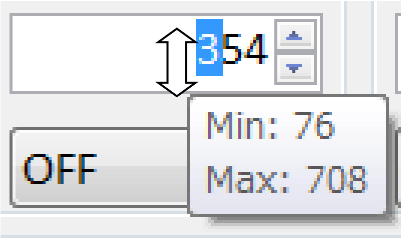
[3] Rotating center wheel upward

[4] Rotating center wheel downward

Figure 4.2.2-1 How to Operate Mouse

[1] Right click

Right click on the mouse button allows you to go to Value Edit mode. In Value Edit mode, numeric values can be edited by rotating the mouse wheel.
The upper and lower limits pop out on the screen while editing.



354

Min: 76
Max: 708

OFF

Figure 4.2.2-2 Value Edit Mode

[2] Clicking center wheel

Clicking the center wheel allows you to go to Digit Place mode. In Digit Place mode, a desired digit place can be selected by rotating the wheel.
Clicking the wheel in Digit Place mode allows you to go to Value Edit mode. The upper and lower limits pop out on the screen while editing.

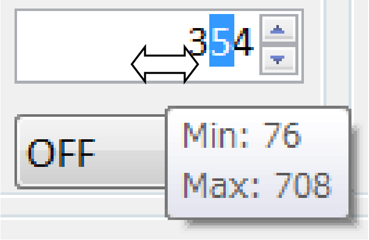


Figure 4.2.2-3 Digit Place Mode

[3] Rotating center wheel upward

- In Value Edit mode
  The number under the cursor is increased.

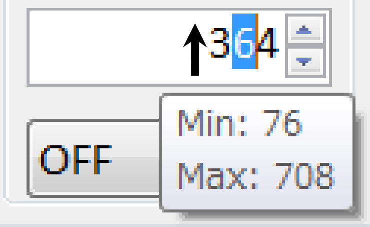


Figure 4.2.2-4 Number Increase

- In Digit Place mode
  The cursor moves to the left.

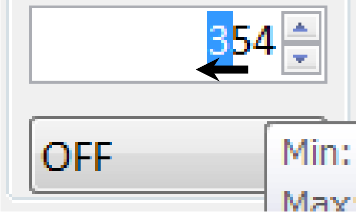


Figure 4.2.2-5 Cursor Moving to the Left

[4] Rotating center wheel downward

- In Value Edit mode
  The number under the cursor is decreased.

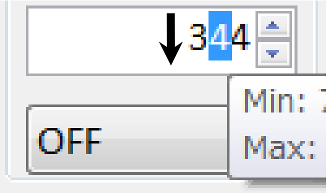


Figure 4.2.2-6 Number Decrease

- In Digit Place mode
  The cursor moves to the right.

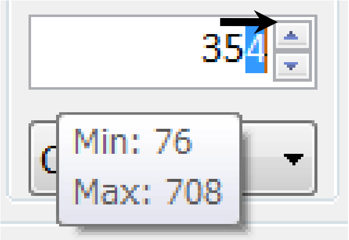


Figure 4.2.2-7 Cursor Moving to the Right

4.3 Measurement System Configuration

4.3.1 Selecting application

On launching MX183000A, the Selector screen is displayed. The Selector screen allows you to select the application for measurement.

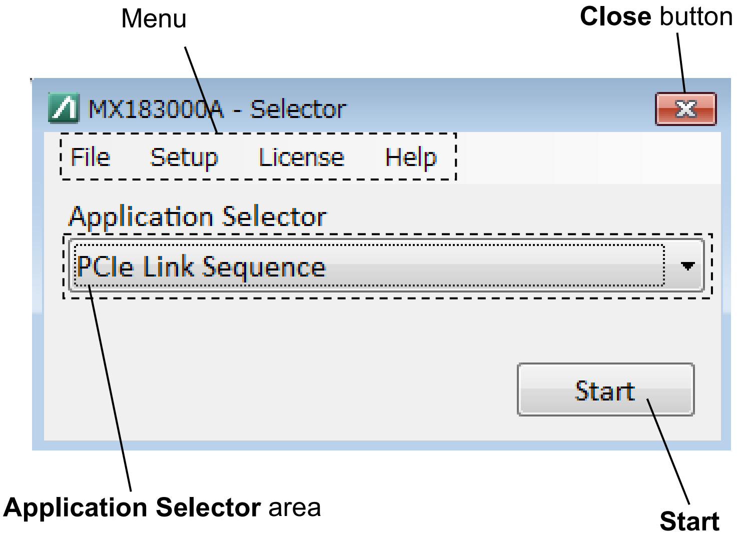


Figure 4.3.1-1 Selector Window

Table 4.3.1-1 Selector Window

Item	Description
Application selection area	Selects the application for measurement. The applications available for selection will vary depending on the options installed. ● PCIe Link Sequence Refer to 4.4 "PCIe Link Sequence". ● USB Link Sequence Refer to 4.5 "USB Link Sequence". ● Jitter Tolerance Test Refer to 4.6 "Jitter Tolerance Test". ● PCIe Link Training Refer to 4.8 "PCIe Link Training". ● PAM4 Control (with G0375/6A) Refer to 4.9 "PAM4 Control (with G0375/6A)". ● USB Link Training Refer to 4.10 "USB Link Training". ● DUT Error Counts Import Refer to 4.10.6 "Setting up USB Link Training BER Measurement".
Start	Displays the measurement screen for the corresponding application.
Close button	Exits MX183000A.

The menu includes the following items.

Table 4.3.1-2 Menu Items

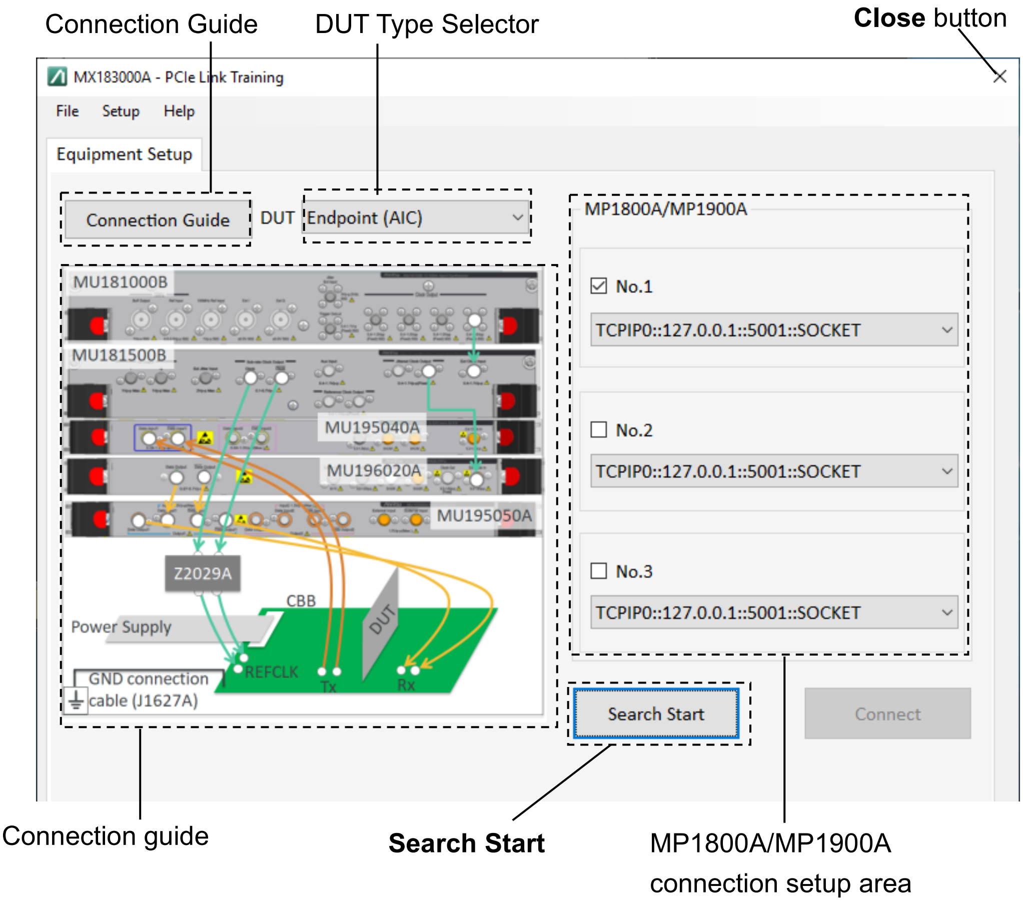
Menu		Description
File		
	Exit	Exits MX183000A.
Setup		
	Remote	Displays the remote setup for MX183000A and external PC.
License		
	License Details	Displays the screen for adding license keys for MX183000A.
Help		
	About	Displays the version information and options.
	Manual	Displays the MX183000A operation manual.

4.3.2 Connecting measurement equipment

When the application is started, the Equipment Setup screen is displayed. The Equipment Setup screen allows you to set the connections to equipment, select connected equipment, and select the type of measurement.

1. Click **Connection Guide**. The measurement equipment connection diagram is displayed. Connect the measurement equipment, referring to the connection diagram and the details in Chapter 3.
2. Click **Search Start**. The software searches for equipment, and displays the equipment currently connected in the connected equipment display area.
3. Click **Connect** to connect the required equipment.

If the equipment connected has been changed, repeat the equipment search.



DUT Endpoint (AIC)

☑ No.1 TCPIP0::127.0.0.1::5001::SOCKET

☐ No.2 TCPIP0::127.0.0.1::5001::SOCKET

☐ No.3 TCPIP0::127.0.0.1::5001::SOCKET

Figure 4.3.2-1 Equipment Setup Screen (Before Starting Search)

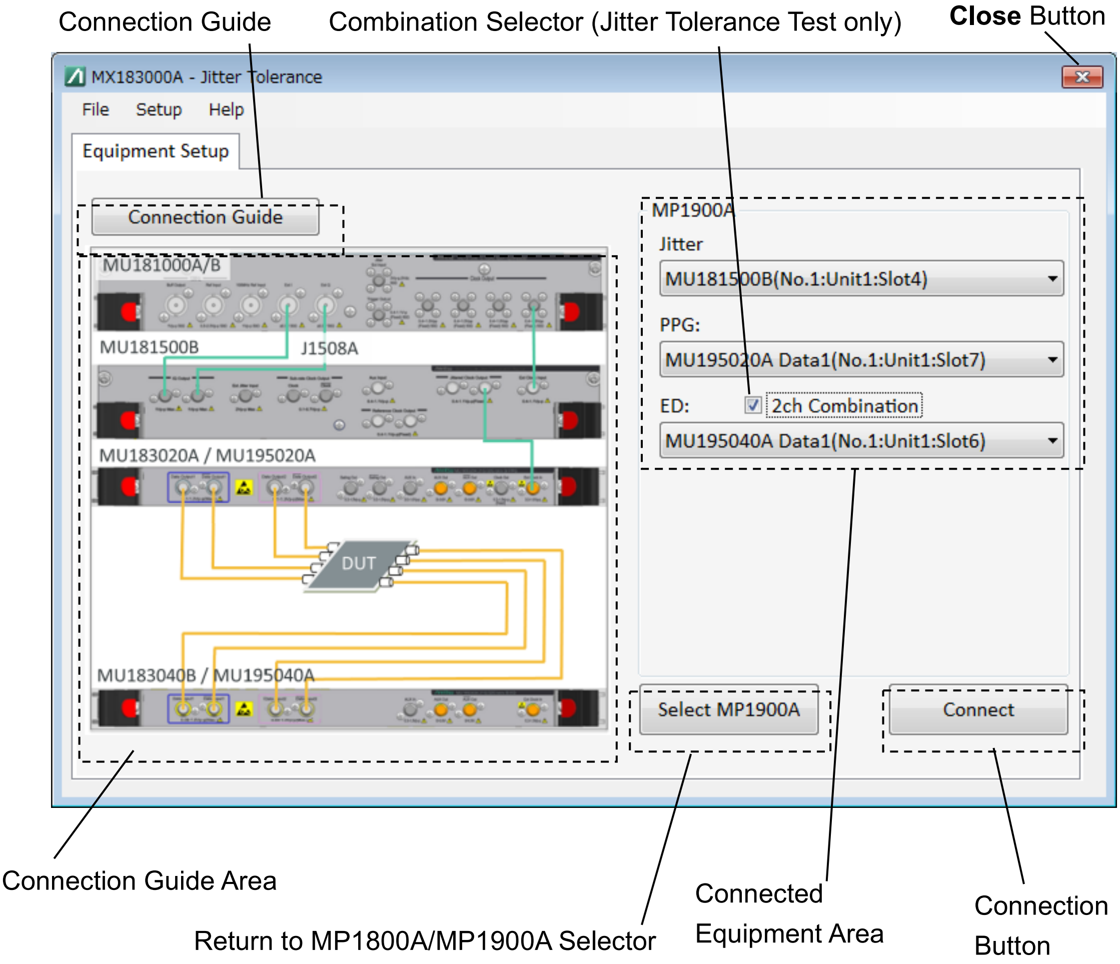
Jitter Tolerance Test can be executed in 2ch combination only when Jitter Tolerance Test Application is selected. Perform the following steps.

1. Set the equipment to 2ch combination.

   ☞ 3.3 “Multi Channel Function” in the *MX190000A Signal Quality Analyzer-R Control Software Operation Manual*

2. Select 2ch combination in the Connected Equipment Area.
3. Click the **Connect** button.

When connected, this button displays Disconnect.



Jitter: MU181500B(No.1:Unit1:Slot4)

PPG: MU195020A Data1(No.1:Unit1:Slot7)

ED: ☑ 2ch Combination

MU195040A Data1(No.1:Unit1:Slot6)

Figure 4.3.2-2 Equipment Setup Screen (After Searching)

Note:

Do not disconnect the Ethernet cable connecting the SQA or MT1810A while equipment searching is in progress. MX183000A cannot recognize equipment correctly if the cable is disconnected.

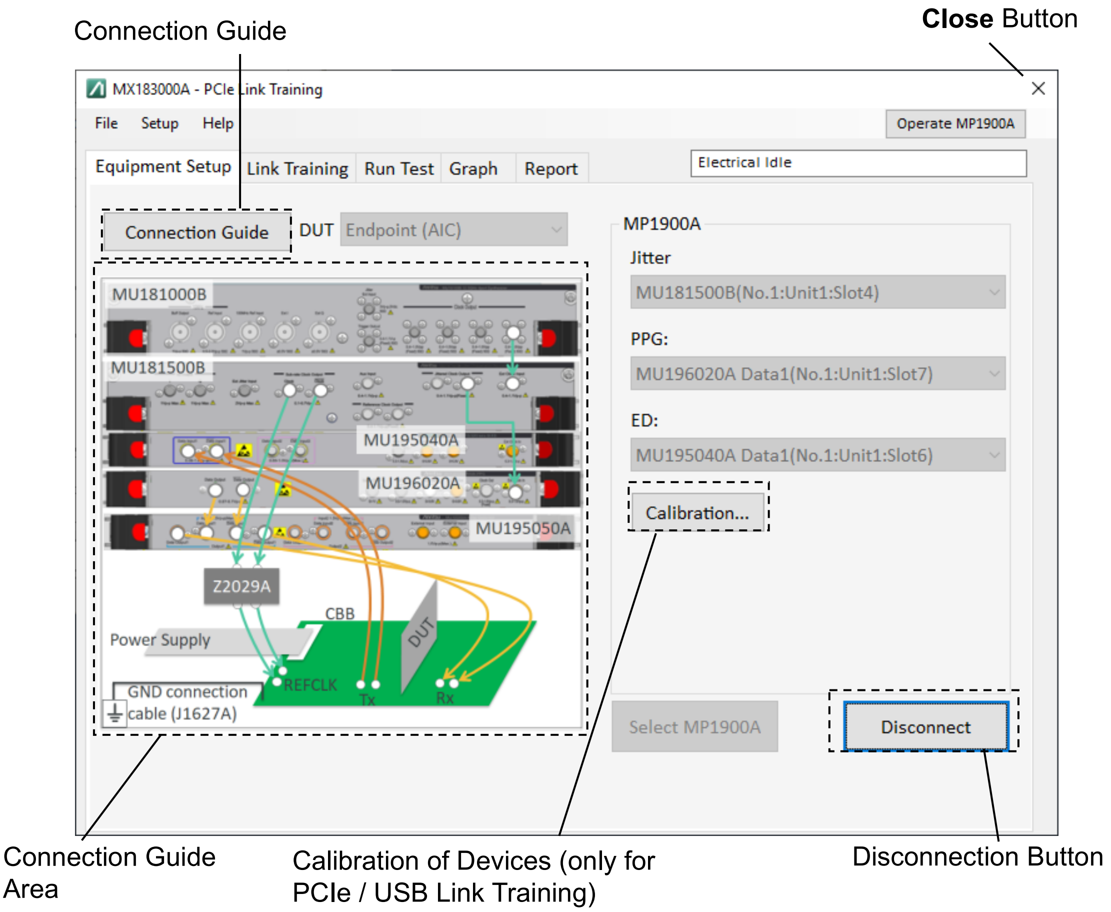
When selecting **PAM4 Control (with G0375/6A)** on the Selector screen (Figure 4.3.1-1), the G0375A/G0376A selector screen is displayed. Perform the following steps.

1. Set the equipment to 2ch combination.

   ☞ 3.3 "Multi Channel Function" in the *MX190000A Signal Quality Analyzer-R Control Software Operation Manual*

2. Select 2ch combination in the Connected Equipment Area.
3. Click the Disconnect button.

When **PCIe Link Training** or **USB Link Training** is selected on the Selector screen (Figure 4.3.1-1), the **Calibration** button is displayed under the ED box after the connection is completed.
The calibration sets an optimum value to Clock Delay of SI ED. Perform the calibration to complete Link Training successfully.
When the equipment configuration is changed or the software version is updated, perform the calibration as follows.



Connection Guide

Close Button

MX183000A - PCIe Link Training

DUT: Endpoint (AIC)

MP1900A

Jitter: MU181500B(No.1:Unit1:Slot4)

PPG: MU196020A Data1(No.1:Unit1:Slot7)

ED: MU195040A Data1(No.1:Unit1:Slot6)

Electrical Idle

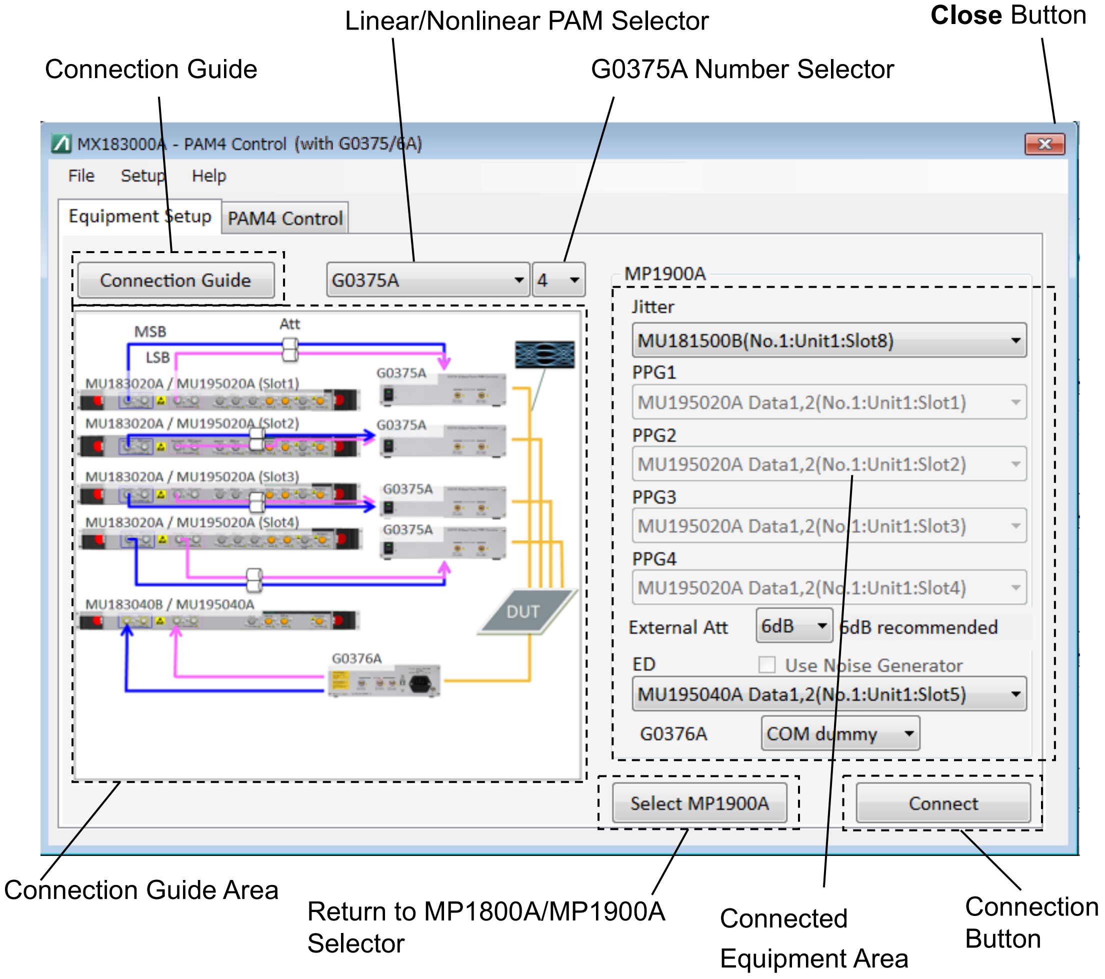
Connection Guide Area

Calibration of Devices (only for PCIe / USB Link Training)

Disconnection Button

Figure 4.3.2-3 Equipment Setup Screen (After Connect)

1. Click the **Calibration**.
2. As displayed in GUI, connect the Data Output / XData Output connectors of PPG or Noise module to Data Input / XData Input connectors of the ED using coaxial cables.
3. Click **OK** in the confirmation dialog box.
4. The calibration will be completed within four minutes.



MX183000A - PAM4 Control (with G0375/6A)

G0375A 4

MP1900A

Jitter: MU181500B(No.1:Unit1:Slot8)

PPG1: MU195020A Data1,2(No.1:Unit1:Slot1)

PPG2: MU195020A Data1,2(No.1:Unit1:Slot2)

PPG3: MU195020A Data1,2(No.1:Unit1:Slot3)

PPG4: MU195020A Data1,2(No.1:Unit1:Slot4)

External Att: 6dB 6dB recommended

ED ☐ Use Noise Generator

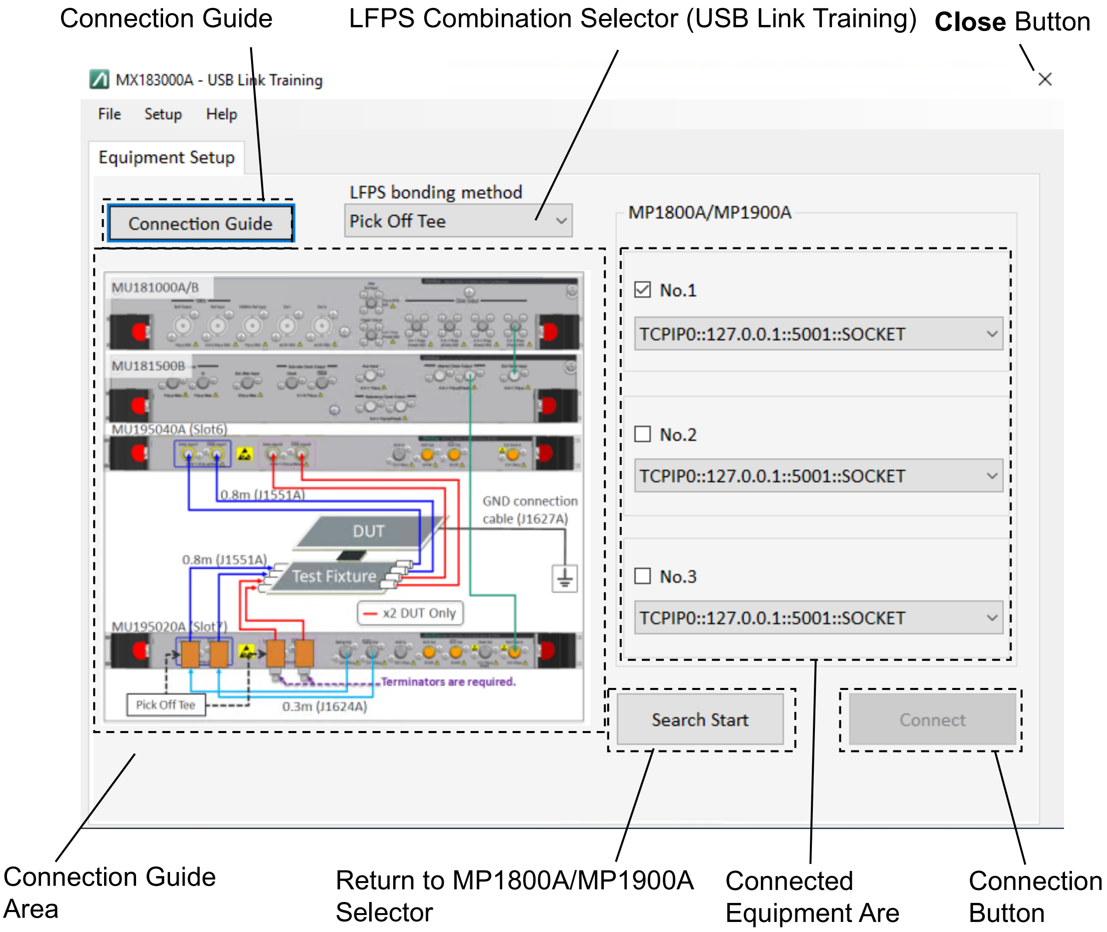
MU195040A Data1,2(No.1:Unit1:Slot5)

G0376A: COM dummy

Figure 4.3.2-4 Equipment Setup Screen (After PAM4 Control Search)

Note:

Do not disconnect the Ethernet cable connecting the SQA or MT1810A while equipment searching is in progress. MX183000A cannot recognize equipment correctly if the cable is disconnected.



LFPS bonding method: Pick Off Tee

☑ No.1 TCPIP0::127.0.0.1::5001::SOCKET

☐ No.2 TCPIP0::127.0.0.1::5001::SOCKET

☐ No.3 TCPIP0::127.0.0.1::5001::SOCKET

Figure 4.3.2-5 Equipment Setup Screen (After USB Link Training Search)

Note:

Do not disconnect the Ethernet cable connecting the SQA or MT1810A while equipment searching is in progress. MX183000A cannot recognize equipment correctly if the cable is disconnected.

4.3.3 Entering Compliance Test Mode

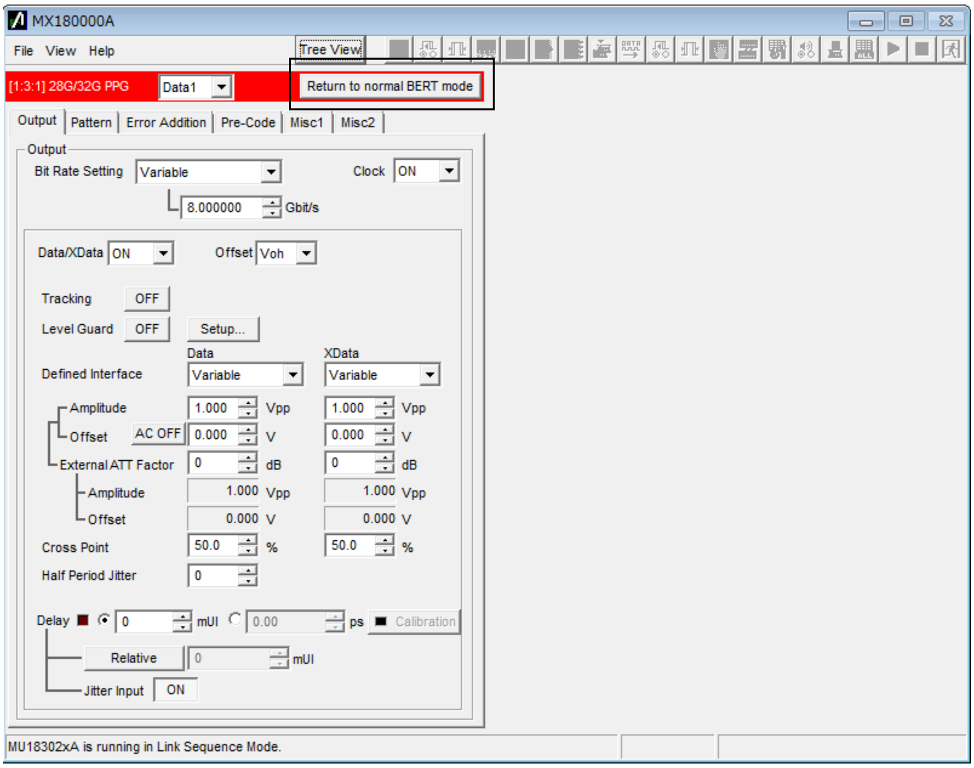
When MX183000A is connected to the MX180000A, the 28G/32G PPG enters Compliance Test Mode and the screen is displayed as Figure 4.3.3-1.

The 28G/32G PPG is operating in Compliance Test Mode, so the normal test pattern cannot be sent.

Notes:

- **Return to normal BERT mode** appears as below while operating (Refer to Section 4.3.4 “RF Setting of MX180000A and MX190000A”), but do not click this button. If clicked, click **Disconnect** and click **Connect** of MX183000A. (Refer to 4.3.2 “Connecting Measurement Equipment”.)

- If **Return to normal BERT mode** is displayed even after disconnecting MX183000A from the MX180000A, click **Return to normal BERT mode** to return the 28G/32G PPG to normal mode.



Output

Bit Rate Setting: Variable

8.000000 Gbit/s

Clock: ON

Data/XData: ON

Offset: Voh

Tracking: OFF

Level Guard: OFF

	Data		XData	
Defined Interface	Variable		Variable	
Amplitude	1.000	Vpp	1.000	Vpp
Offset (AC OFF)	0.000	V	0.000	V
External ATT Factor	0	dB	0	dB
Amplitude	1.000	Vpp	1.000	Vpp
Offset	0.000	V	0.000	V
Cross Point	50.0	%	50.0	%
Half Period Jitter	0			

Delay: ● 0 mUI ○ 0.00 ps

Relative: 0 mUI

Jitter Input: ON

MU18302xA is running in Link Sequence Mode.

Figure 4.3.3-1 28G/32G PPG Window (after connecting from MX183000A)

4.3.4 RF setting of MX180000A and MX190000A

When MX183000A is connected to MX180000A, **Operate MP1800A/MP1900A** appears in the upper right of the screen shown in Figure 4.3.2-2. Click **Operate MP1800A/MP1900A** to display the **Operating** dialog box of Figure 4.3.4-1 below.

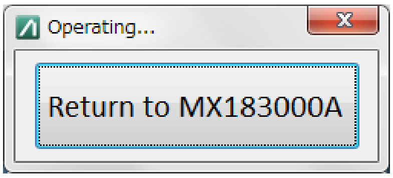


Figure 4.3.4-1 Operating Dialog Box

While the **Operating** dialog box is displayed, the settings of the MU181500B, MP1825B, MU195020A, MU195040A, and MU196020A that are installed on the SQA can be edited.
For setting items, refer to Table 4.3.4-1.

Note:

> While the Operating dialog box is displayed, do not use the functions or parameters other than the items listed in Table 4.3.4-1. Otherwise, MX183000A may not be operated properly. If you have used something other than the items listed in Table 4.3.4-1, click **Disconnect** and click **Connect** of MX183000A. (Refer to 4.3.2 "Connecting Measurement Equipment".)

Click **Return to MX183000A** after Operating is completed.

Table 4.3.4-1 Setting Items for Operating

Module	Setting Items
MU181500B Jitter Modulation Source	SJ/SJ2
	SSC
	RJ
	BUJ
MP1825B 4Tap Emphasis	Cursor or coefficient values
	Eye Amplitude value
MU195020A 21G/32G bit/s SI PPG	Eye Amplitude value
MU196020A PAM4 PPG	Eye Amplitude value
MU195040A 21G/32G bit/s SI ED	Measurement start and BER checking

For details of settings, refer to the following:

☞ 3.4 "Setting Jitter" in the *MU181500B Jitter Modulation Source Operation Manual*

☞ 7.10.3 "Jitter Setting Commands" in the *MX180000A Signal Quality Analyzer Control Software Remote Control Operation Manual*

☞ 3.1.3 “MP1825B Control Screens” in the *MP1825B 4Tap Emphasis Operation Manual*

5.5.2 “Waveform Settings” in the *MP1825B 4Tap Emphasis Operation Manual*

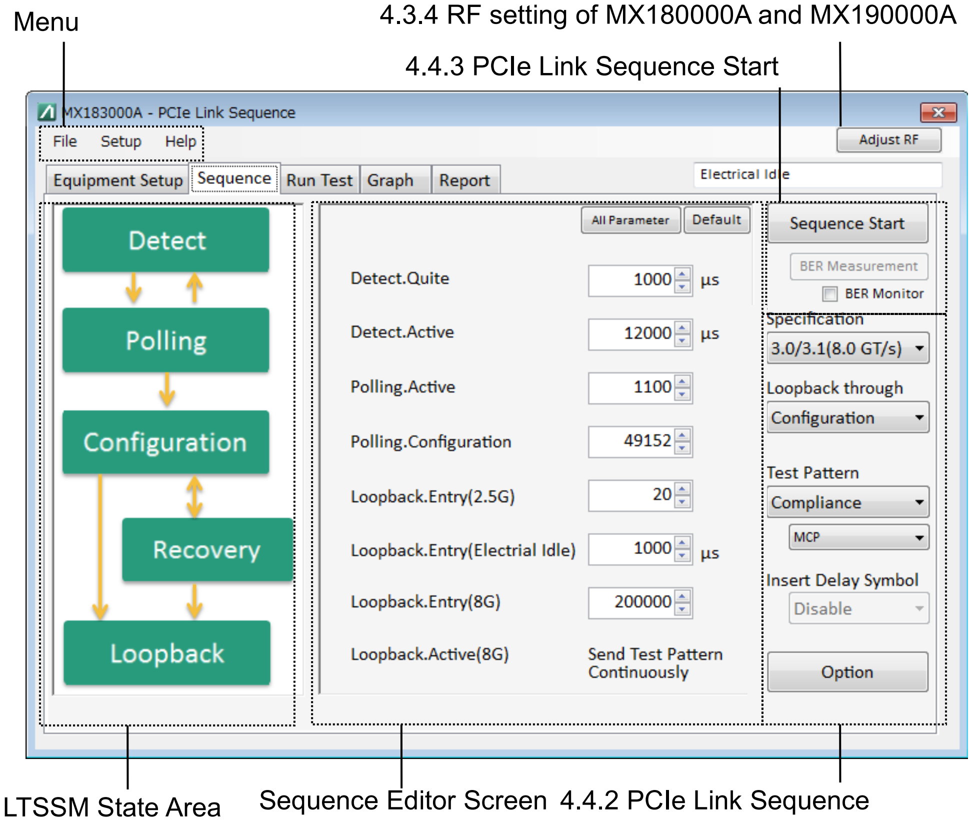
☞ Chapter 5 “Operation Method” in the *MU195020A21G/32G bit/s SI PPG MU195040A 21G/32G bit/s SI ED MU195050A Noise Generator Operation Manual*

☞On-line help or Chapter 4 “Usage Examples” in the *MU196020A PAM4 PPG MU196040A PAM4 ED MU196040B PAM4 ED Operation Manual*

4.4 PCIe Link Sequence

4.4.1 PCIe Link Sequence setup screen

On the **Sequence** tab, you can view the following PCIe Link Sequence settings. The references for each setup area are shown in the figure.



Detect.Quite 1000 µs
Detect.Active 12000 µs
Polling.Active 1100
Polling.Configuration 49152
Loopback.Entry(2.5G) 20
Loopback.Entry(Electrial Idle) 1000 µs
Loopback.Entry(8G) 200000
Loopback.Active(8G) Send Test Pattern Continuously

☐ BER Monitor
Specification: 3.0/3.1(8.0 GT/s)
Loopback through: Configuration
Test Pattern: Compliance
MCP
Insert Delay Symbol: Disable

Figure 4.4.1-1 PCIe Link Sequence Setup Screen

The screen menu includes the following items. For details of items other than files, refer to “Table 4.3.1-2 Menu Items”, as these are the same as for the Selector screen.

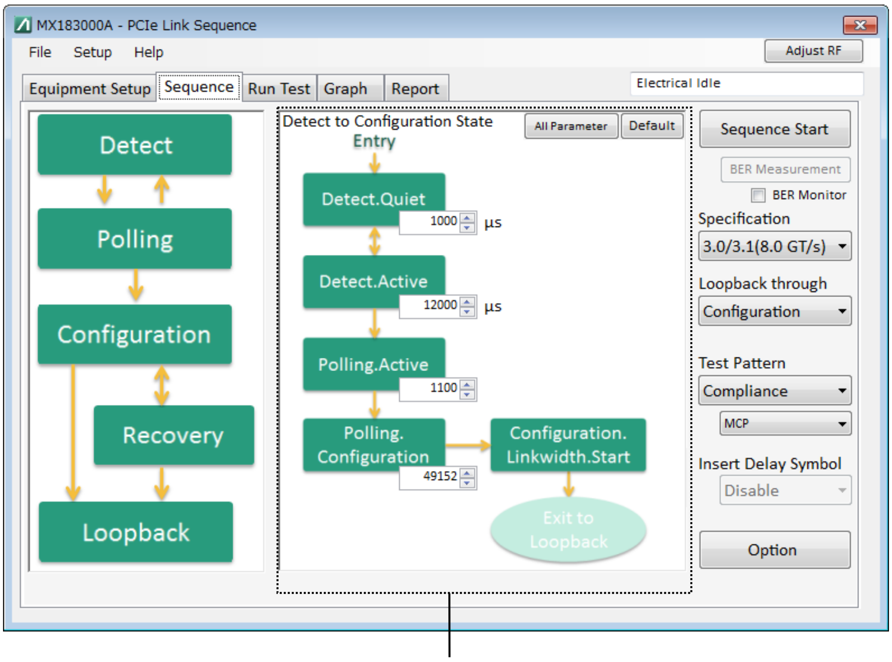
Table 4.4.1-1 Menu Items

Menu			Description
File			
	Load	Only MX183000A parameters	Loads MX183000A measurement parameters from a file.
		Both MX183000A and MX190000A parameters	Loads both MX183000A and MX190000A measurement parameters from files.
	Save	Only MX183000A parameters	Saves the MX183000A measurement parameters to a file.
		Both MX183000A and MX190000A parameters	Saves both MX183000A and MX190000A measurement parameters to files.
	Initialize	Only MX183000A parameters	Initializes the MX183000A parameters.
		Both MX183000A and MX190000A parameters	Initializes both MX183000A and MX190000A parameters.
	Exit		Exits the MX183000A. Measurement results are not saved.

The abbreviations used in PCIe Link Sequence are listed below.

EIEOS:	Electrical Idle Exit Ordered Set
FTS:	Fast Training Sequence
LTSSM:	Link Training and Status State Machine
TS:	Training sequences

The LTSSM State area displays an overview of the LTSSM State. Clicking a state displays the corresponding LTSSM Sub State on the Sequence Editor screen.



Detect.Quiet: 1000 µs

Detect.Active: 12000 µs

Polling.Active: 1100

Polling.Configuration: 49152

☐ BER Monitor

Specification: 3.0/3.1(8.0 GT/s)

Loopback through: Configuration

Test Pattern: Compliance, MCP

Insert Delay Symbol: Disable

Sequence Editor Screen

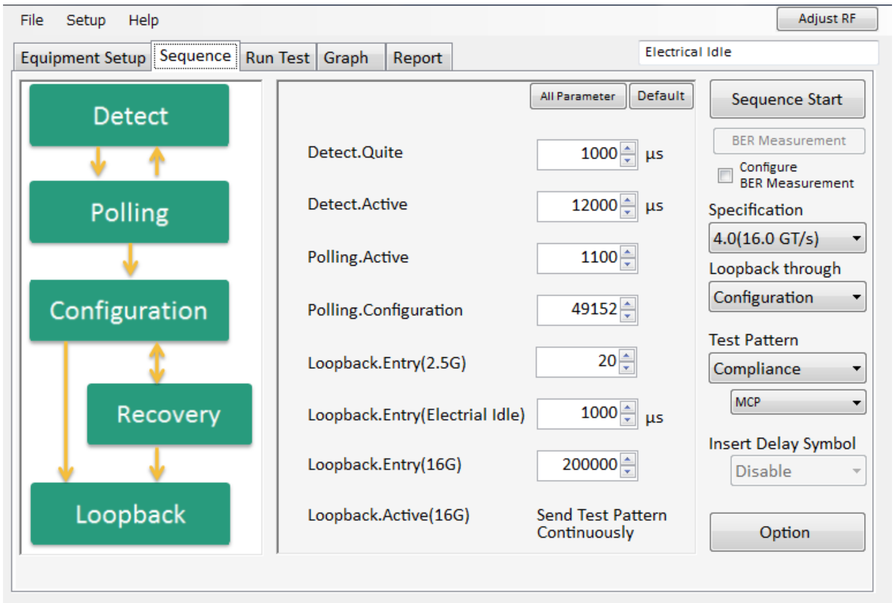
Figure 4.4.1-2 PCIe Link Sequence Setup Screen (2)

Table 4.4.1-2 Sequence Editor Setup Items

Menu	Description
All Parameter	Returns from the Sequence Editor screen to the All Parameter display.
Default	Resets values entered in Sequence Editor to their default values.

4.4.2 PCIe Link Sequence setup

This section describes how to set the PCIe link training sequence parameters, and test pattern for measurement.



Electrical Idle

Detect.Quite 1000 µs

Detect.Active 12000 µs

Polling.Active 1100

Polling.Configuration 49152

Loopback.Entry(2.5G) 20

Loopback.Entry(Electrial Idle) 1000 µs

Loopback.Entry(16G) 200000

Loopback.Active(16G) Send Test Pattern Continuously

Specification 4.0(16.0 GT/s)

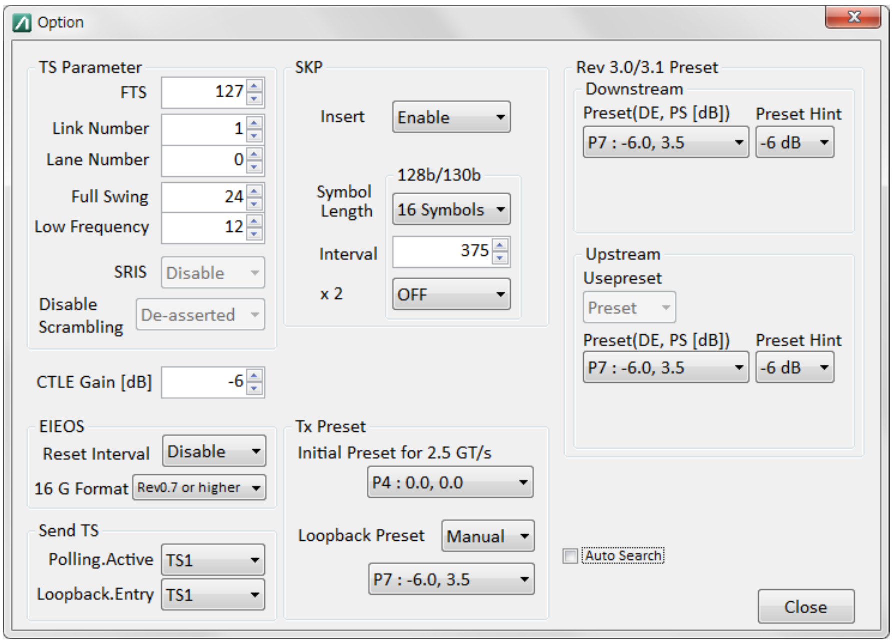
Loopback through Configuration

Test Pattern Compliance, MCP

Insert Delay Symbol Disable

Figure 4.4.2-1 PCIe Link Sequence Setup Screen (Rev 4.0 Configuration)

Clicking **Option** displays the individual PCIe setup dialog box shown in Figure 4.4.2-2.



TS Parameter

FTS 127

Link Number 1

Lane Number 0

Full Swing 24

Low Frequency 12

SRIS Disable

Disable Scrambling De-asserted

CTLE Gain [dB] -6

EIEOS

Reset Interval Disable

16 G Format Rev0.7 or higher

Send TS

Polling.Active TS1

Loopback.Entry TS1

SKP

Insert Enable

128b/130b

Symbol Length 16 Symbols

Interval 375

x 2 OFF

Tx Preset

Initial Preset for 2.5 GT/s P4 : 0.0, 0.0

Loopback Preset Manual, P7 : -6.0, 3.5

Rev 3.0/3.1 Preset

Downstream

Preset(DE, PS [dB]) P7 : -6.0, 3.5

Preset Hint -6 dB

Upstream

Usepreset Preset

Preset(DE, PS [dB]) P7 : -6.0, 3.5

Preset Hint -6 dB

Figure 4.4.2-2 PCIe Link Sequence Option Dialog Box (Rev 3.0/3.1)

The setting items on the Option dialog box are common with PCIe 4.0.

Table 4.4.2-1 PCIe Link Sequence Setup Items

<table>
<tr><th colspan="2">Item</th><th>Description</th></tr>
<tr><td colspan="2">Specification</td><td>Selects the PCIe specification from Rev1.0/1.1(2.5 GT/s), 2.0(5.0 GT/s), 3.0/3.1(8.0 GT/s), and 4.0(16.0 GT/s).
If MU181000A/B is installed, set the 28G/32G PPG or SI PPG Operation Bitrate to Rev1.x:2.5 Gbit/s, Rev2.0:5.0 Gbit/s, Rev3.x:8.0 Gbit/s, and Rev4.0:16 Gbit/s respectively.
Altering this item changes the link training sequence displayed in Sequence Editor.</td></tr>
<tr><td colspan="2">Loopback through</td><td>Sets the sequence type for looping back DUT. Altering this item changes the link training sequence displayed in Sequence Editor.
The following selections are available depending on the Specification Rev. setting.
<table>
<tr><td>Revision</td><td>Configuration</td><td>Recovery</td></tr>
<tr><td>1.0/1.1(2.5 GT/s)</td><td>✓</td><td></td></tr>
<tr><td>2.0(5.0 GT/s)</td><td>✓</td><td>✓</td></tr>
<tr><td>3.0/3.1(8.0 GT/s)</td><td>✓</td><td>✓</td></tr>
<tr><td>4.0(16.0 GT/s)</td><td>✓</td><td>✓</td></tr>
</table></td></tr>
<tr><td colspan="2">Test Pattern</td><td>Selects the test pattern output repeatedly from Compliance or PRBS after completing the link training sequence transmission.
Selecting Compliance displays the PCIe standard test pattern selection controller, and selecting PRBS displays the PRBS level setting controller.
Depending on the settings for <b>Compliance</b> and <b>PRBS</b>, the patterns that match the conditions are automatically set for 28G/32G PPG and 28G/32G ED or SI PPG and SI ED.</td></tr>
<tr><td></td><td>PRBS</td><td>Sets the number of the PRBS pattern stages for PPG/ED.
Because a pattern for synchronization is not inserted into a PRBS pattern, DUT in Loopback state may not recognize the pattern.</td></tr>
<tr><td></td><td>Compliance</td><td>Set the standard test pattern for PCIe.
MCP: Test pattern for BER measurement.
CP: Test pattern for waveform calibration or Init Tx EQ and Tx LEQ Response Time Tests. Use MCP for BER measurement.
Jitter Meas (Jitter Measurement Pattern):
1,0 pattern for jitter measurement. Use MCP for BER measurement. When the SI PPG is installed and the specification is set to 3.0/3.1(8.0 GT/s) or 4.0 (16.0 GT/s), Jitter Meas (Jitter Measurement Pattern) can be set.</td></tr>
<tr><td></td><td>Insert Delay Symbol</td><td>Sets whether to insert Delay Symbol in MCP.
Cannot be set if the Specification Rev. setting is 3.0/3.1 (8.0 GT/s) or 4.0 (16.0 GT/s).</td></tr>
</table>

Table 4.4.2-2 Loopback Through Configuration Setup Items

Item			Description
Option			Opens the dialog box (Figure 4.4.2-2), where you can edit specific PCIe link training sequence settings.
Rev1.x/2.0/3.x/4.0 Loopback through “Configuration”			
	Detect.Quiet		Sets the waiting time for Detect.Quiet.
	Detect.Active		Sets the waiting time for Detect.Active.
	Polling.Active		Sets the number of times patterns are sent for Polling.Active.
	Polling.Configuration		Sets the number of times patterns are sent for Polling.Configuration.
	Recovery.Equalization (Electrical Idle)*1		Sets the waiting time for Loopback.Entry(Electrical Idle).
	Loopback.Entry		Sets the number of times patterns are sent for Loopback.Entry.
	Loopback.Active		Sends a pattern specified for Test Pattern.
Rev2.0/3.x/4.0 Loopback through “Recovery”			
	Detect		
		Quiet	Sets the waiting time for Detect.Quiet.
		Active	Sets the waiting time for Detect.Active.
	Polling		
		Active	Sets the number of times patterns are sent for Active.
		Configuration	Sets the number of times patterns are sent for Configuration.
	Configuration		
		Linkwidth.Start	Sets the number of times patterns are sent for Linkwidth.Start.
		Linkwidth.Accept	Sets the number of times patterns are sent for Linkwidth.Accept.
		Lane.Wait	Sets the number of times patterns are sent for Lane.Wait.
		Lane.Accept	Sets the number of times patterns are sent for Lane.Accept.
		Complete	Sets the number of times patterns are sent for Complete.
		Idle	Sets the waiting time for Idle.
	Recovery		
		RcvrLock	Sets the number of times patterns are sent for Rcvr.Lock.
		Rcvr.Cfg(EQTS2)	Sets the number of times patterns are sent for RcvrCfg.
		Speed*2	Sets the waiting time for Speed.
		Equalization.Phase1*1	Sets the number of times patterns are sent for Equalization.Phase1.
		RcvrCfg(TS2)	Sets the number of times patterns are sent for RcvrCfg.
		Idle	Sets the waiting time for Idle.
	Loopback		
		Entry*2	Sets the number of times patterns are sent for Entry.
		Active*2	Sends a pattern specified for Test Pattern.

*1: Available for Rev 2.0 and Rev 3.x.

*2: Three types are available: 5G, 8G, and 16G.

Table 4.4.2-3 Option Setup Items

Item		Description
TS Parameter		
	FTS	Sets the TS FTS Number.
	Link Number	Sets the TS Link Number.
	Lane Number	Sets the TS Lane Number.
	Full Swing	Sets the TS Full Swing.
	Low Frequency	Sets the TS Low Frequency.
Disable Scrambling		Sets whether to use scrambling for TS.
EIEOS		
	Reset Interval	Sets the TS Reset EIEOS Interval.
	16 G Format*	Sets whether to use the EIEOS format of Base Spec Rev 0.7 or later.
SKP		Symbol Length, Interval, and Double SKP can be set for 8b10b (2.5G, 5.0GT/s) and for 128b130b (8.0G, 16.0GT/s) separately.
	Insert	Sets whether to insert SKP OS while sending TS.
	Symbol Length	Specifies the SKP OS length.
	Interval	Specifies the SKP OS interval.
	Double SKP*	Sets whether to insert double SKP into the test pattern (MCP) to send in Loopback.Active state.
Send TS		
	Polling.Active	Sets the type of TS sent for Polling.Active State.
	Loopback.Entry	Sets the type of TS sent for Loopback.Entry State.
Tx Preset		
	Initial Preset for 2.5 GT/s*	Sets the preset value at linking start (in 2.5 GT/s operation).
	Loopback Preset Select*	Sets whether to manually set Emphasis Preset in the test pattern to send in Loopback.Active state. When set to **Auto**, the value specified for Downstream Preset(DE,PS[dB] is used. When set to **Manual**, the value specified for Loopback Preset is used.
	Loopback Preset*	Selects the Emphasis Preset value in the test pattern to send in Loopback.Active state. This is available when **Manual** is selected for Loopback Preset Select.
Auto Search		Selects whether to adjust ED data reception to the optimal state after sending the link sequence. When set to ON, it takes several tens of seconds to execute Auto Search after sending the link sequence.
CTLE Gain		Sets CTLE gain for PCIe 3.0 or PCIe 4.0 operation. This is available only when SI ED (with MU195040A-x11 or x21) is installed.

*: The function is available only when SI PPG is installed.

Table 4.4.2-3 Option Setup Items (Cont'd)

Item		Description
Rev 2.0 Preset		
	De-emphasis*	Sets De-emphasis that is specified in TS which PPG sends and is notified to DUT.
Rev 3.x/Rev 4.0 Preset Downstream*		Sets the parameters that Downstream Port (PPG) uses in TS that PPG sends. When Loopback Preset Select of Tx Preset is set to **Auto**, Emphasis set by this item is added to the signals that are sent in Loopback.Active state.
	Preset(DE, PS [dB])	Sets Transmitter Preset.
	Preset Hint	Sets Receiver Preset Hint. Displayed only when Rev 3.x is selected.
Rev 3.x/Rev 4.0 Preset Upstream*		Sets the parameters that will be set in the TS which PPG sends and that PPG requests for DUT (Upstream Port).
	Usepreset	Displays the parameters that should be used for Upstream Port. Only Preset is displayed currently.
	Preset(DE, PS [dB])	Sets Transmitter Preset.
	Preset Hint	Sets Receiver Preset Hint. Displayed only when Rev 3.x is selected.

4.4.3 PCIe Link Sequence Start

Press the PCIe Compliance Base Board reset switch before starting measurement. Then click **Sequence Start** to start the link training sequence.

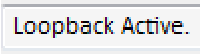
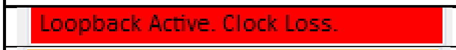
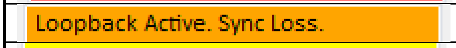
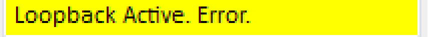
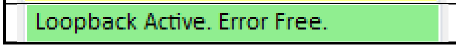
The button name changes to **Stop** while the link training sequence is being sent. The button name changes to **Unlink** once the link training sequence is successfully sent and the PPG status changes from Electrical Idle to Loopback Active. A test pattern is sent from the PPG here. Clicking **Unlink** while the test pattern is being sent aborts the test pattern transmission, and the PPG returns to Electrical Idle status. Successful linking can be confirmed using the device debugging function or MX183000A screen. The Loopback Active display will change as follows depending on the ED status. When MX183000A is not connected ED,  Loopback Active. is displayed.

Table 4.4.3-1 Link Status Confirmation

Loopback Active. display	ED status
 Loopback Active. Clock Loss.	Clock Loss
 Loopback Active. Sync Loss.	Sync Loss
 Loopback Active. Error.	Error
 Loopback Active. Error Free.	Error Free

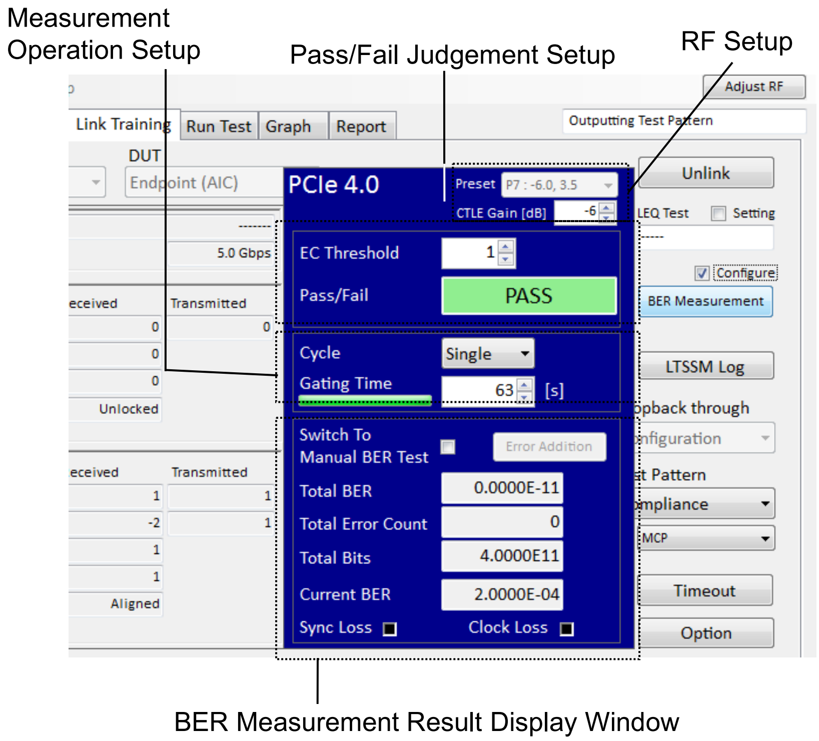
If you wish to measure Jitter Tolerance after this, refer to 4.6 “Jitter Tolerance Test” for details of the **Run Test** tab, **Graph** tab, and **Report** tab.

If you wish to measure BER after this, click **BER Measurement**. For details of the BER Measurement, refer to 4.4.4 “Setting Up PCIe BER Measurement” and 4.4.5 “Starting PCIe BER Measurement”.

4.4.4 Setting up PCIe BER Measurement

BER Measurement function is enabled in Loopback.Active state after link training sequence transmission is completed. Also, it is enabled when ED is installed.

When **Configure BER Measurement** is selected, the BER Measurement Setup Screen is displayed.



Preset: P7 : -6.0, 3.5
CTLE Gain [dB]: -6
EC Threshold: 1
Pass/Fail: PASS
Cycle: Single
Gating Time: 63 [s]
Switch To Manual BER Test: ☐
Total BER: 0.0000E-11
Total Error Count: 0
Total Bits: 4.0000E11
Current BER: 2.0000E-04
Sync Loss ■ Clock Loss ■

Figure 4.4.4-1 PCIe BER Measurement Setup Screen

Table 4.4.4-1 Pass/Fail Judgment Setting Items

Item	Description
EC Threshold	Sets a pass/fail threshold of the BER measurement.
Pass/Fail	Pass: Passed, Fail: Failed It is judged as "Fail" if Total Error Count exceeds EC Threshold when the measurement of the time set by Gating Time has completed.

Table 4.4.4-2 Measurement Operation Setting Items

Item	Description
Cycle	Sets the measurement operation. Repeat: Repeats the measurement in the cycle specified at Gating Time. Single: Ends the measurement in one cycle.
Gating Time [s]	Sets the measurement cycle by seconds.
Measurement Progress Bar	Displays the measurement progress rate.

Table 4.4.4-3 BER Measurement Result Display Window

Item	Description
Switch To Manual BER Test	Displays the Manual BER Test dialog box (Figure 4.4.4-2) so that BER can be checked on the MX190000A screen.
Error Addition	Add single bit error to test pattern during BER measurement. This function is enabled when MU195020A is installed.
Total BER	Displays the error rate.
Total Error Count	Displays the error count.
Total Bits	Displays the amount of measurement data.
Current BER	Displays the error rate in 100 ms.
Sync Loss	Lights up in red in the sync loss status.
Clock Loss	Lights up in red when the clock is not reproduced from the data input in ED.

When **Switch To Manual BER Test** is clicked, the dialog box shown in Figure 4.4.4-2 is displayed. While this dialog box is displayed, the MU181500B, MP1825B, and MU195020A settings can be changed checking BER on the MU183040B or MU195040A. Refer to "Table 4.3.4-1 Setting Items for Operating" for the main setting items.

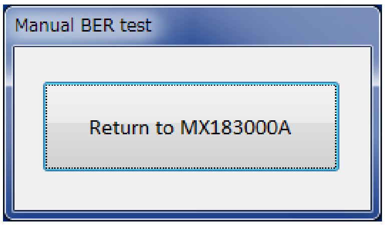


Figure 4.4.4-2 Manual BER Test Dialog Box

Table 4.4.4-4 RF Setting Items

Item	Description
Preset	Selects the Emphasis Preset value of Test Pattern to transmit in Loopback.Active. This value is enabled only when **Manual** is selected for Loopback Preset Select on the Option screen and SI PPG (with MU195020A-x11 or x21) is installed.
CTLE Gain [dB]	Sets CTLE gain for PCIe 3.0 or PCIe 4.0 operation. It is a common item with CTLE Gain on the option screen. It is enabled only when SI ED with MU195040A-x11 or x21 is installed.

4.4.5 Starting PCIe BER Measurement

Clicking **Start BER Measurement** starts measurement.
The measurement results are displayed in the BER measurement result display window, and Pass or Fail is displayed. Clicking **Stop BER Measurement** stops the measurement.

When the DUT is already in the Loopback state, the **Total BER**, **Total Error Count**, **Total Bits** counters start counting.

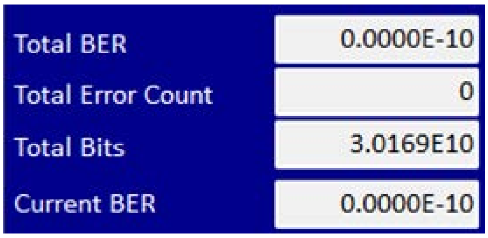

Total BER 0.0000E-10
Total Error Count 0
Total Bits 3.0169E10
Current BER 0.0000E-10

Figure 4.4.5-1 BER Measurement Result Display (When Link Establishment is Successful)

When the DUT is not in the Loopback state or failed to send the test pattern normally, **Sync Loss** and **Clock Loss** indicators turn red.

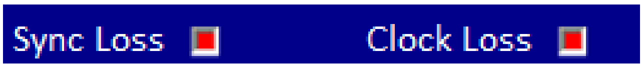


Figure 4.4.5-2 BER Measurement Result Display (When Link Establishment is Failed)

4.5 USB Link Sequence

4.5.1 USB Link Sequence setup screen

On the **Sequence** tab, you can view the following USB Link Sequence settings. The references for each setup area are shown in the figure.

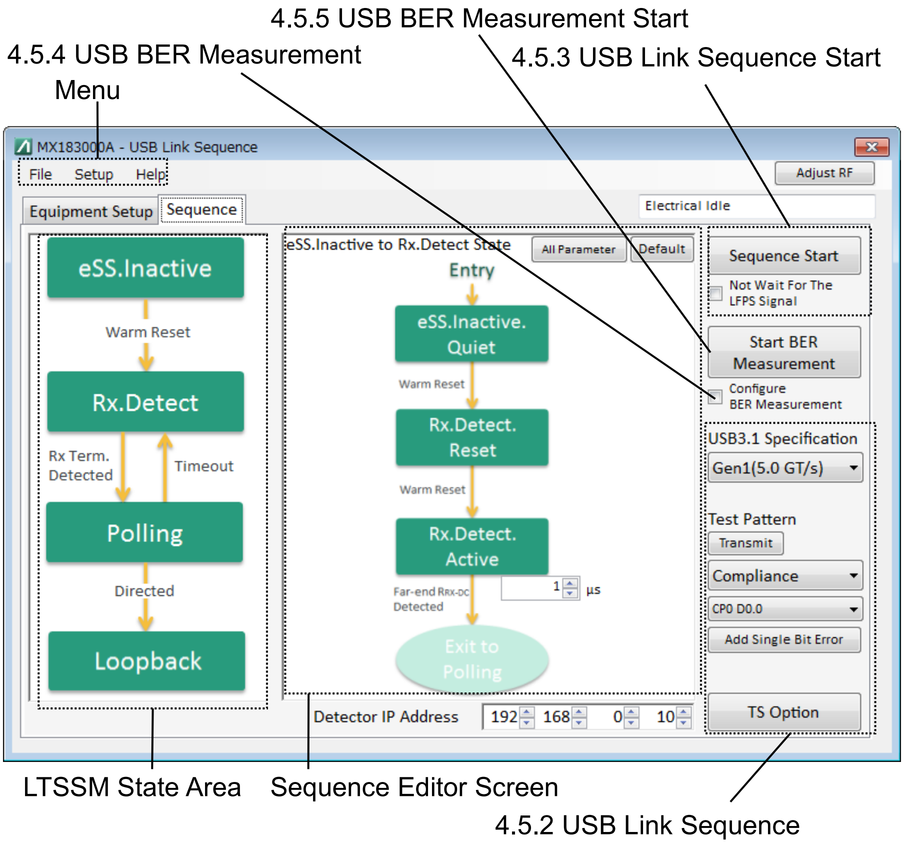


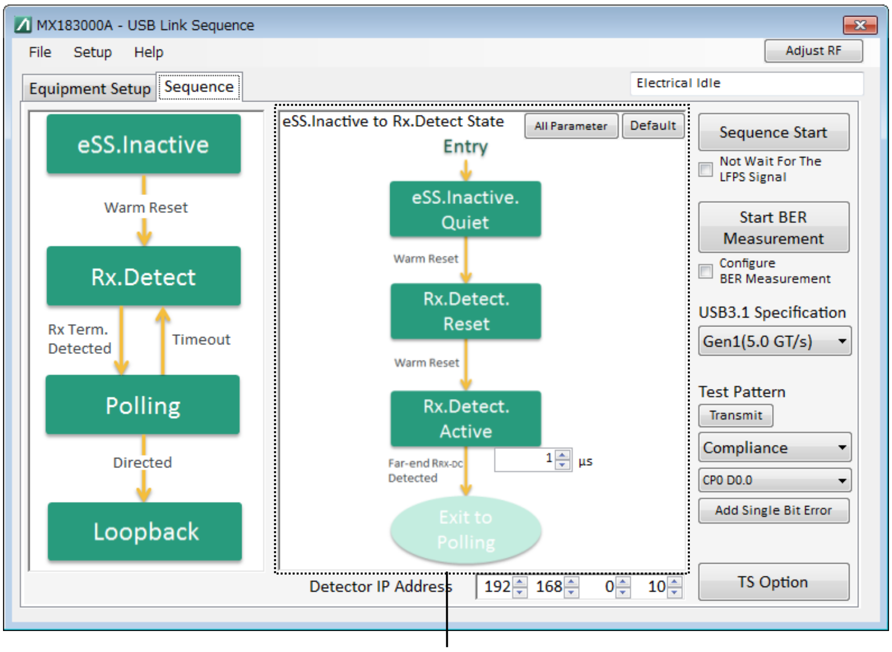
Figure 4.5.1-1 USB Link Sequence Setup Screen

The screen menu is the same as in Table 4.4.1-1.

The abbreviations used in USB Link Sequence are listed below.

LBPM:	SuperSpeedPlus LFPS Based PWM Message
LBPS:	Introduction to LFPS Based PWM Signaling
LFPS:	Low Frequency Periodic Signaling
LTSSM:	Link Training and Status State Machine
PWM:	Pulse Width Modulation
SCD:	SuperSpeedPlus Capability Declaration
TS:	Training Sequences

The LTSSM State area displays an overview of the LTSSM State. Clicking a state displays the corresponding LTSSM Sub State on the Sequence Editor screen.



Sequence Editor Screen

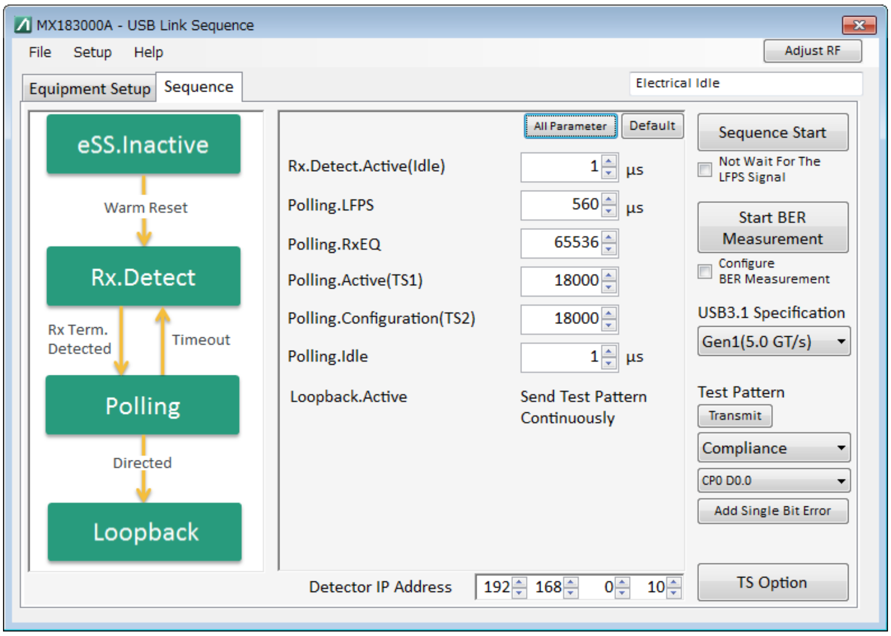
Figure 4.5.1-2 USB Link Sequence Setup Screen (2)

Table 4.5.1-1 Sequence Editor Setup Items

Menu	Description
All Parameter	Returns from the Sequence Editor screen to the All Parameter display.
Default	Resets values entered in Sequence Editor to their default values.

4.5.2 USB Link Sequence setup

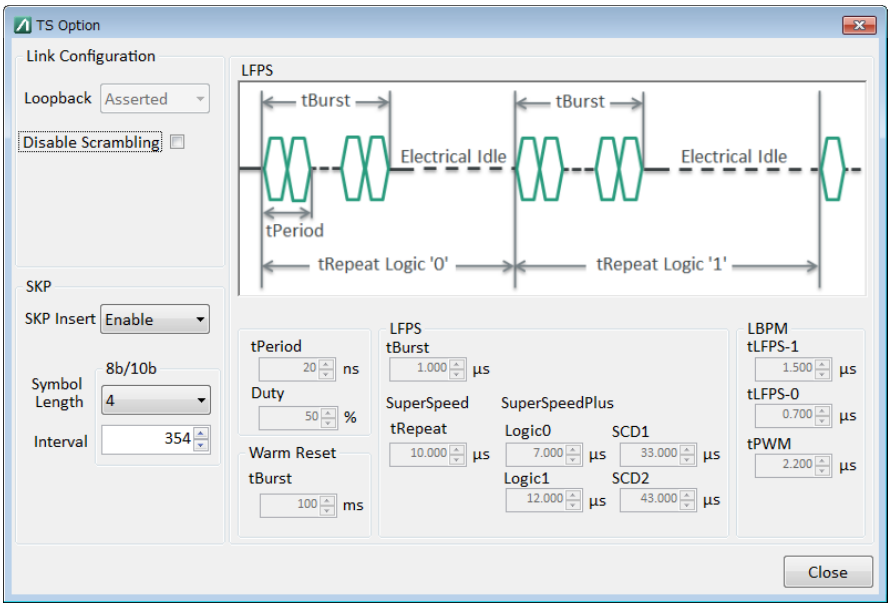
This section describes how to set the USB link training sequence, and test pattern for measurement.



Rx.Detect.Active(Idle) 1 µs
Polling.LFPS 560 µs
Polling.RxEQ 65536
Polling.Active(TS1) 18000
Polling.Configuration(TS2) 18000
Polling.Idle 1 µs
Loopback.Active Send Test Pattern Continuously
☐ Not Wait For The LFPS Signal
☐ Configure BER Measurement
USB3.1 Specification: Gen1(5.0 GT/s)
Test Pattern: Compliance
CP0 D0.0
Detector IP Address 192 168 0 10

Figure 4.5.2-1 USB Sequence Setup Screen (Gen1(5.0 GT/s))

Clicking **TS Option** displays the individual USB Sequence setup dialog box shown in Figure 4.5.2-2.



Loopback: Asserted
Disable Scrambling ☐
SKP Insert: Enable
Symbol Length 8b/10b: 4
Interval 354
tPeriod 20 ns
Duty 50 %
Warm Reset tBurst 100 ms
LFPS tBurst 1.000 µs
SuperSpeed tRepeat 10.000 µs
SuperSpeedPlus Logic0 7.000 µs
SuperSpeedPlus Logic1 12.000 µs
SCD1 33.000 µs
SCD2 43.000 µs
LBPM tLFPS-1 1.500 µs
tLFPS-0 0.700 µs
tPWM 2.200 µs

Figure 4.5.2-2 TS Option Dialog Box (Gen1)

Table 4.5.2-1 USB Link Sequence Setting Items

Item	Description
USB3.1 Specification	Selects and sets the USB specification from Gen1(5.0 GT/s) and Gen2(10.0 GT/s). If MU181000A/B is installed, set the 28G/32G PPG Operation Bitrate to Gen1:5.0 GT/s and Gen2:10 GT/s respectively. Altering this item changes the sequence displayed in Sequence Editor.
Test Pattern	Selects the test pattern output repeatedly from Compliance or USER after completing the link training sequence transmission. Selecting Compliance displays the USB standard test pattern selection controller. Selecting USER automatically sets a test pattern for 28G/32G PPG on the MX180000A. If Compliance is set, the pattern is set automatically in accordance with 28G/32G PPG.* Selectable value changes depending on the value set for USB 3.1 Specification.
Transmit/Stop	Starts sending a pattern selected at Test Pattern. The button display is changed to **Stop** while the pattern is sent. When **Stop** is clicked, sending the pattern is stopped. When **Sequence Start** is clicked, sending the pattern is stopped automatically. The button display is changed to **Transmit**.
Add Single Bit Error	Inserts a 1-bit error to the sending pattern. This function is enabled in one of the following conditions. ● Gen1(5.0 GT/s), Compliance, CP0 ● Gen2(10.0 GT/s), Compliance, CP9
TS Option	Enables the setting screen display and setting status for the USB Link Sequence in Figure 4.5.2-2 to be altered.

*: Selecting CP5 or CP6 does not change de-emphasis setting that is actually output.

Table 4.5.2-2 Sequence Editor Setup Items

Item	Description
Gen1(5.0GT/s)	
Rx.Detect.Active(Idle)	Sets the Electrical Idle time for Rx.Detect.Active.
Polling.LFPS	Sets the LFPS time for transmission in Polling.LFPS state.
Polling.RxEQ	Sets the TSEQ times for transmission in Polling.RxEQ state.
Polling.Active(TS1)	Sets the number of TS1 cycles for transmission in Polling.Active state.
Polling.Configuration(TS2)	Sets the number of TS2 cycles for transmission in Polling.Configuration state.
Polling.Idle	Sets the Electrical Idle time for Polling.Idle.
Loopback.Active	Sends a pattern specified for Test Pattern.
Gen2(10.0GT/s)	
Rx.Detect.Active(Idle)	Sets the Electrical Idle time for Rx.Detect.Active.
Polling.LFPS(SCD1)	Sets the LFPS(SCD1) time for transmission in Polling.LFPS state.
Polling.LFPS(SCD2)	Sets the LFPS(SCD2) time for transmission in Polling.LFPS state.
Polling.PortMatch(PHY Capability LBPM)	Sets the LBPM time for transmission in Polling. PortMatch state.
Polling.PortConfig(PHY Ready LBPM)	Sets the LBPM time for transmission in Polling. PortConfig state.
Polling.RxEQ	Sets the TSEQ times for transmission in Polling.RxEQ state.
Polling.Active(TS1)	Sets the number of TS1 cycles for transmission in Polling.Active state.
Polling.Configuration(TS2)	Sets the number of TS2 cycles for transmission in Polling.Configuration state.
Polling.Idle	Sets the Electrical Idle time for Polling.Idle.
Loopback.Active	Sends a pattern specified for Test Pattern.

Table 4.5.2-3 TS Option Setup Items

Item	Description
Link Configuration	
Loopback	Displays the TS Loopback Bit to be transmitted.
Disable Scrambling	Enables or disables scrambling.
SKP	
SKP Insert	Sets whether SKP OS insertion while sending TS.
Symbol Length	Sets the SKP OS symbol length.
SKP Interval	Sets the interval for inserting SKP OS.
Warm Reset	
tBurst	Displays the tBurst time (ms).
tPeriod	Displays the tPeriod time (ns).
Duty	Displays Duty (%).
LFPS	
tBurst	Displays the tBurst time (ms).
SuperSpeed tRepeat	Displays SuperSpeed tRepeat.
SuperSpeedPlus	
Logic0	Displays the SuperSpeedPlus Logic0 time (μs).
Logic1	Displays the SuperSpeedPlus Logic1 time (μs).
SCD1	Displays the SuperSpeedPlus SCD1 cycle (μs).
SCD2	Displays the SuperSpeedPlus SCD2 cycle (μs).
LBPM	
tLFPS-1	Displays the LFPS One Burst time (μs).
tLFPS-0	Displays the LBPS Zero Burst time (μs).
tPWM	Displays the LBPM Repeat time (μs).

4.5.3 USB Link Sequence Start

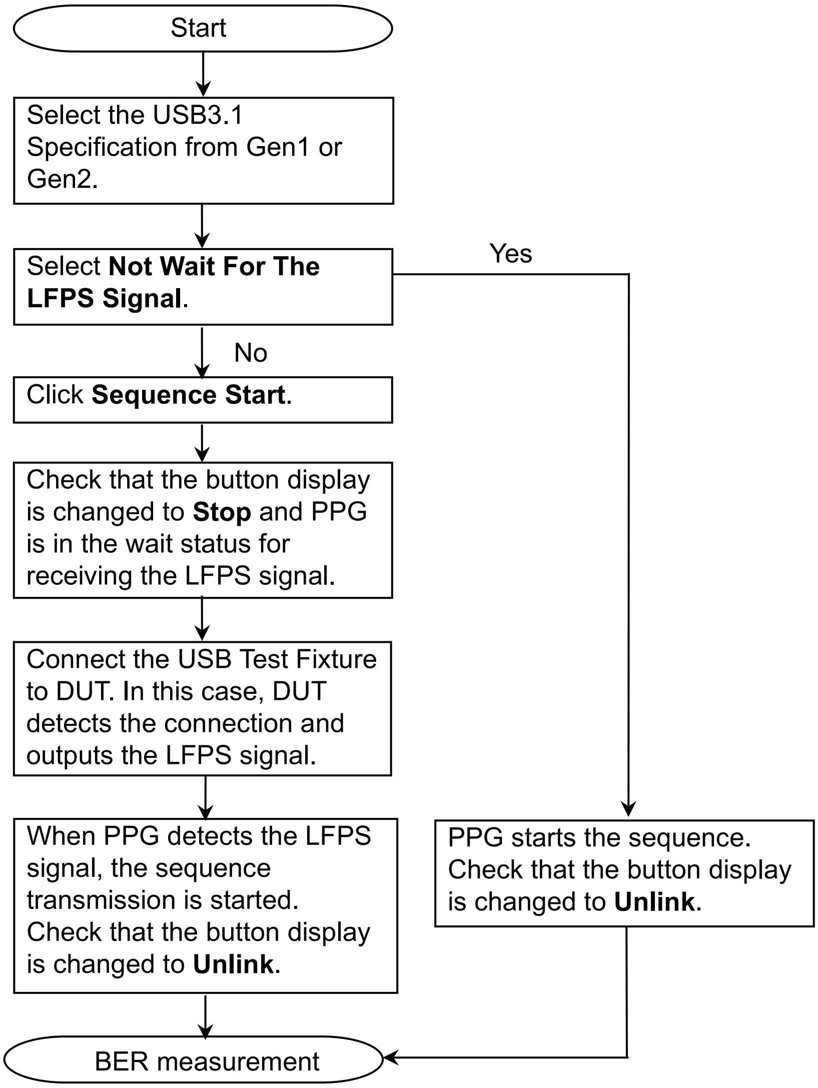

Start
Select the USB3.1 Specification from Gen1 or Gen2.
Select **Not Wait For The LFPS Signal**.
Yes
No
Click **Sequence Start**.
Check that the button display is changed to **Stop** and PPG is in the wait status for receiving the LFPS signal.
Connect the USB Test Fixture to DUT. In this case, DUT detects the connection and outputs the LFPS signal.
When PPG detects the LFPS signal, the sequence transmission is started. Check that the button display is changed to **Unlink**.
PPG starts the sequence. Check that the button display is changed to **Unlink**.
BER measurement

Figure 4.5.3-1 USB Link Sequence Transmission Procedure

When **Sequence Start** is clicked, PPG is in the wait status for receiving the LFPS signal and the button display is changed to **Stop**.
Connect the USB Test Fixture connector to DUT in this condition.
DUT detects the connection of the USB connector and outputs the LFPS signal.
PPG receives the LFPS signal output from DUT at AUX Input and starts the link training sequence.
When the link training sequence transmission is completed, the button display is changed to **Unlink** and the test pattern is sent from PPG.

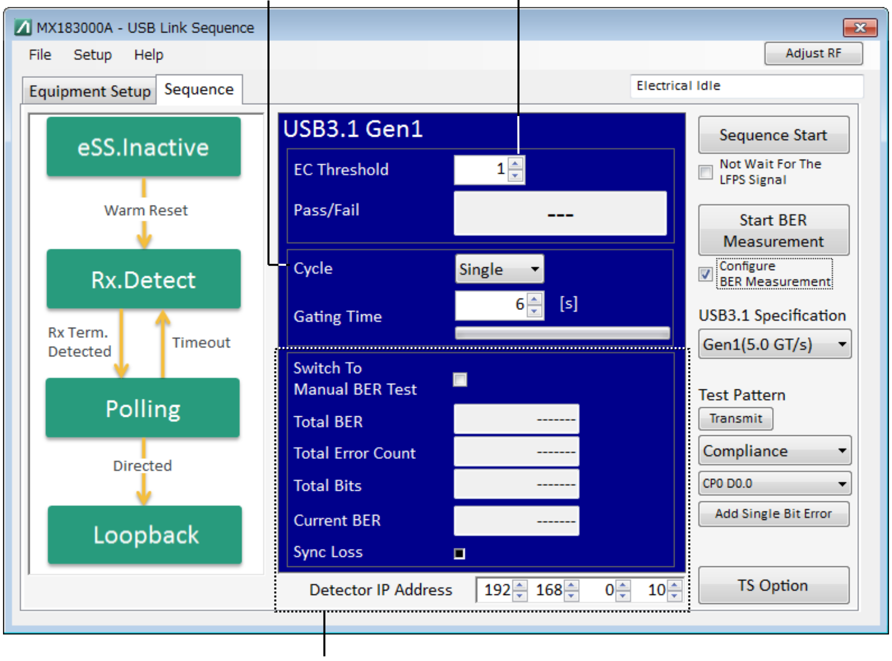
When **Unlink** is clicked while the test pattern is sent, sending the test pattern is stopped and PPG is in the Electrical Idle status.

Refer to Section 4.5.5 “USB BER Measurement Start” for details of success or failure of the link establishment.

4.5.4 USB BER Measurement setup

The BER measurement can be performed using the USB3.1 Receiver Test Adapter.

When **Configure BER Measurement** is selected, the BER measurement setting window is displayed.



Setting measurement operation

Setting Pass/Fail judgment

BER measurement result display window

EC Threshold 1

Pass/Fail ---

Cycle Single

Gating Time 6 [s]

Switch To Manual BER Test ☐

Total BER -------

Total Error Count -------

Total Bits -------

Current BER -------

Sync Loss ☐

Detector IP Address 192 168 0 10

☐ Not Wait For The LFPS Signal

☑ Configure BER Measurement

USB3.1 Specification Gen1(5.0 GT/s)

Test Pattern Compliance

CP0 D0.0

Electrical Idle

Figure 4.5.4-1 USB BER Measurement Setting Window

Table 4.5.4-1 Pass/Fail Judgment Setting Item

Item	Description
EC Threshold	Sets an evaluation threshold of the BER measurement.
Pass/Fail	Pass: Passed, Fail: Failed When the number of bit errors exceeds the evaluation threshold, the BER measurement is judged as Fail.

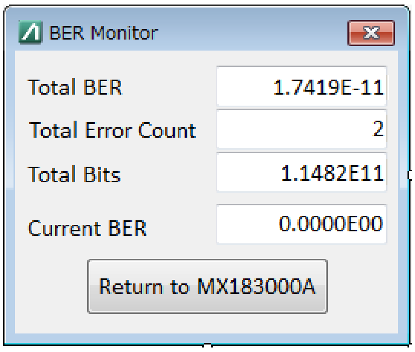
Table 4.5.4-2 Measurement Operation Setting Item

Item	Description
Cycle	Sets the measurement operation. Repeat: Repeats the measurement in the period specified at Gating Time. Single: Ends the measurement in one cycle.
Gating Time [s]	Sets the measurement period in one second units.
Measurement progress bar	Displays the measurement progress.

Table 4.5.4-3 BER Measurement Result Display Window

Item	Description
Switch To Manual BER Test	Displays the BER Monitor dialog box (Figure 4.5.4-2).
Total BER	Displays the error rate.
Total Error Count	Displays the error count.
Total Bits	Displays the amount of measurement data.
Current BER	Displays the error rate in 100 ms.
Sync Loss	Lights in red in the sync loss status.
Detector IP Address	Input the IP address specified at G0373A USB3.1 Receiver Test Adapter. The initial value of the IP address specified at G0373A is “192.168.0.10”.

When **Switch To Manual BER Test** is clicked, the BER Monitor dialog box shown in Figure 4.5.4-2 is displayed. The MU181500B and MP1825B settings can be changed while checking BER in this dialog box. Refer to “Table 4.3.4-1 Setting Items for Operating” for the main setting items.



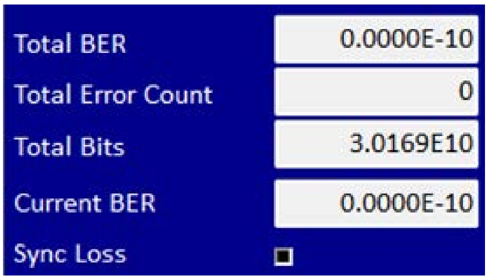
Total BER 1.7419E-11
Total Error Count 2
Total Bits 1.1482E11
Current BER 0.0000E00

Figure 4.5.4-2 BER Monitor Dialog Box

4.5.5 USB BER Measurement Start

The BER measurement is started by clicking **Start BER Measurement**. The measurement results are displayed in the BER measurement result display window, and Pass or Fail is displayed. When **Stop BER Measurement** is clicked, the measurement is stopped.

When the link establishment of DUT is successful, counting **Total BER**, **Total Error Count**, and **Total Bits** starts.



Total BER 0.0000E-10

Total Error Count 0

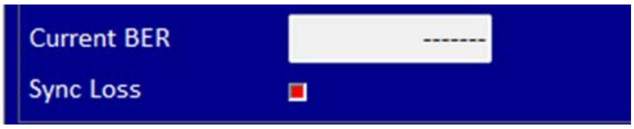
Total Bits 3.0169E10

Current BER 0.0000E-10

Sync Loss ■

Figure 4.5.5-1 BER Measurement Result Display (When Link Establishment is Successful)

When the link establishment of DUT is failed, the **Sync Loss** indicator lights in red.



Current BER -------

Sync Loss 🟥

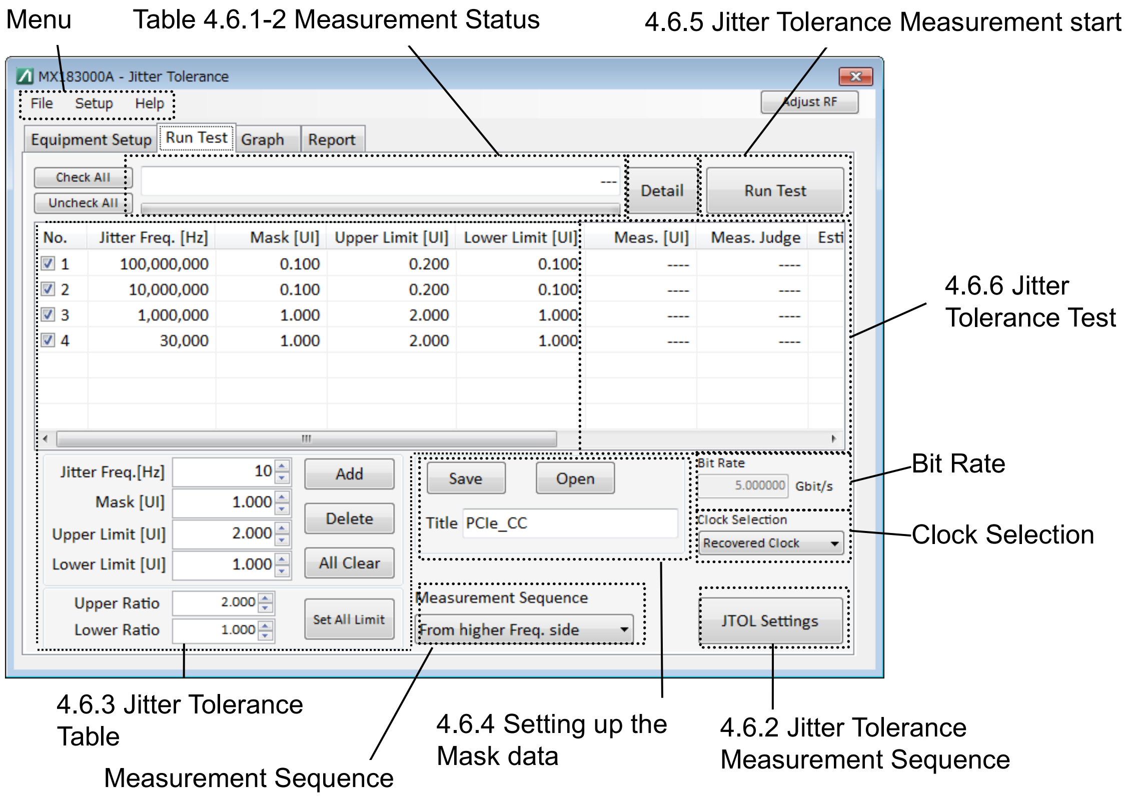
Figure 4.5.5-2 BER Measurement Result Display (When Link Establishment is Failed)

4.6 Jitter Tolerance Test

The Jitter Tolerance Test measures the jitter tolerance by controlling the MU181500B and changing the amplitude and frequency of the SJ while adding fixed jitters such as RJ and BUJ. Additionally, when the PAM4 PPG (with MU196020A-x42) and PAM4 ED (with MU196040B-x42) are installed, the jitter tolerance measurement supporting FEC Analysis is available.

4.6.1 Jitter Tolerance Test setup screen

On the **Run Test** tab, you can view the following Jitter Tolerance settings. The references for each setup area are shown in the figure.


Menu
Table 4.6.1-2 Measurement Status
4.6.5 Jitter Tolerance Measurement start
MX183000A - Jitter Tolerance
File
Setup
Help
Adjust RF
Equipment Setup
Run Test
Graph
Report
Check All
Uncheck All

Detail
Run Test
4.6.6 Jitter Tolerance Test
Bit Rate
Clock Selection
Add
Delete
All Clear
Set All Limit
Save
Open
JTOL Settings
4.6.3 Jitter Tolerance Table
Measurement Sequence
4.6.4 Setting up the Mask data
4.6.2 Jitter Tolerance Measurement Sequence

No.	Jitter Freq. [Hz]	Mask [UI]	Upper Limit [UI]	Lower Limit [UI]	Meas. [UI]	Meas. Judge	Esti
☑ 1	100,000,000	0.100	0.200	0.100	----	----	
☑ 2	10,000,000	0.100	0.200	0.100	----	----	
☑ 3	1,000,000	1.000	2.000	1.000	----	----	
☑ 4	30,000	1.000	2.000	1.000	----	----	

Jitter Freq.[Hz] 10
Mask [UI] 1.000
Upper Limit [UI] 2.000
Lower Limit [UI] 1.000
Upper Ratio 2.000
Lower Ratio 1.000
Title PCIe_CC
Bit Rate 5.000000 Gbit/s
Clock Selection Recovered Clock
Measurement Sequence From higher Freq. side

Figure 4.6.1-1 Jitter Tolerance Setup Screen

Table 4.6.1-1 Measurement Sequence Setting Items

Item	Description
Measurement Sequence	Specifies the measurement sequence direction. From higher Freq.side: Measure s from the higher modulation frequency side. From lower Freq.side: Measures from the lower modulation frequency side.
Lane*	Specifies the lane under test. This is available when **Gen1x2 (5.0 GT/s x2)** or **Gen2x2 (10.0 GT/s x2)** is selected for USB 3.2 Specification.
BitRate	Displays the current bit rate.
Clock Selection	Selects Recovered Clock or External Clock for the clock.

*: Displayed when the USB Link Training application is selected.
In addition, **Lane** is available when both of the following conditions are met.

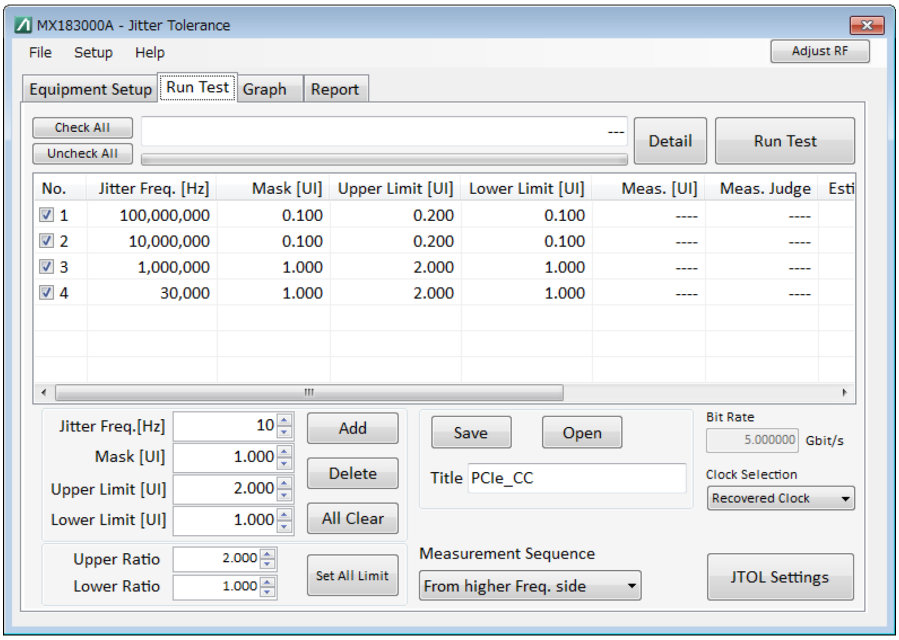
- The MX183000A-PL023 USB 3.2 x 2 Link Training is activated.
- **Gen1x2 (5.0 GT/s x2)** or **Gen2x2 (10.0 GT/s x2)** is selected for USB 3.2 Specification.

Table 4.6.1-2 Measurement Status

Item	Description
Measurement progress bar	Displays the measurement progress.
Measurement Status	Displays the current measurement status.

4.6.2 Jitter Tolerance Measurement Sequence setup

When measuring Jitter Tolerance, set parameters for the test pattern, stable time, executing/not executing auto search, Pass/Fail judgment condition, error judgment unit, Pass/Fail judgment error threshold, and measurement time.

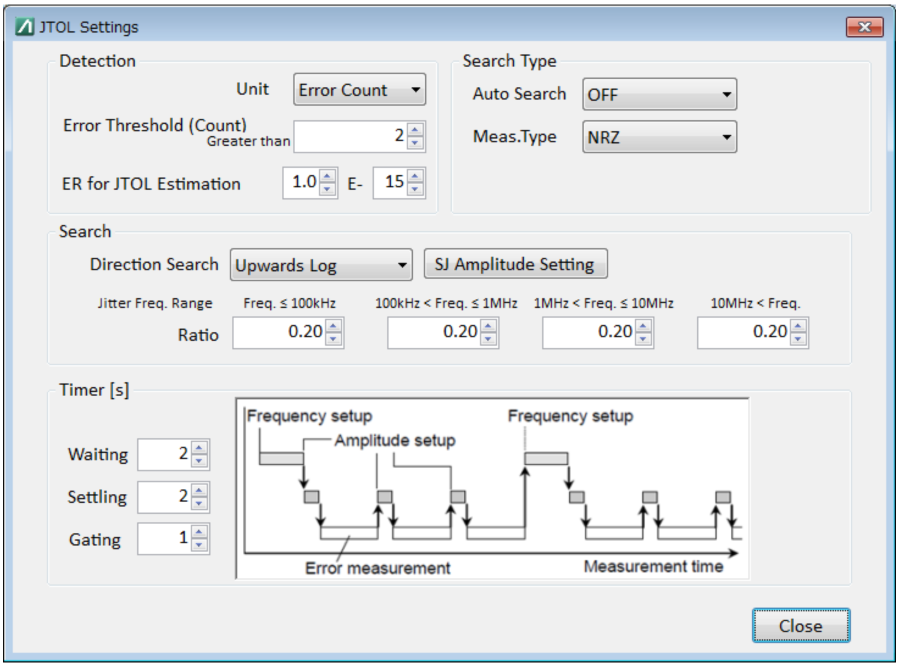


No.	Jitter Freq. [Hz]	Mask [UI]	Upper Limit [UI]	Lower Limit [UI]	Meas. [UI]	Meas. Judge	Esti
☑ 1	100,000,000	0.100	0.200	0.100	----	----	
☑ 2	10,000,000	0.100	0.200	0.100	----	----	
☑ 3	1,000,000	1.000	2.000	1.000	----	----	
☑ 4	30,000	1.000	2.000	1.000	----	----	

Jitter Freq.[Hz] 10
Mask [UI] 1.000
Upper Limit [UI] 2.000
Lower Limit [UI] 1.000
Upper Ratio 2.000
Lower Ratio 1.000
Title PCIe_CC
Bit Rate 5.000000 Gbit/s
Clock Selection Recovered Clock
Measurement Sequence From higher Freq. side

Figure 4.6.2-1 Jitter Tolerance Setup Screen

Clicking **JTOL Settings** displays the individual Jitter Tolerance setup dialog box shown in Figure 4.6.2-2, and allows the settings to be altered. Additionally, with the PAM4 PPG (with MU196020A-x42) and PAM4 ED (with MU196040B-x42) installed, the parameters can be set for the jitter tolerance measurement supporting FEC Analysis.


JTOL Settings

Detection

Unit: Error Count

Error Threshold (Count) Greater than: 2

ER for JTOL Estimation: 1.0 E- 15

Search Type

Auto Search: OFF

Meas.Type: NRZ

Search

Direction Search: Upwards Log

Jitter Freq. Range	Freq. ≤ 100kHz	100kHz < Freq. ≤ 1MHz	1MHz < Freq. ≤ 10MHz	10MHz < Freq.
Ratio	0.20	0.20	0.20	0.20

Timer [s]

Waiting: 2

Settling: 2

Gating: 1

Figure 4.6.2-2 JTOL Settings Dialog Box

Table 4.6.2-1 JTOL Settings Items

Item	Description
Detection	
Unit	Sets one of error rate and error count as a pass/fail criterion. Error Rate: Error rate Error Count: Error bit count (Default) Uncorrectable CW (Rate)*1: Performs the jitter tolerance measurement supporting FEC Analysis by evaluating the Uncorrectable Codeword based on the rate. Uncorrectable CW (Count)*1: Performs the jitter tolerance measurement supporting FEC Analysis by evaluating the Uncorrectable Codeword based on the count. Estimate: Error rate for jitter tolerance estimation Measures jitter tolerance using the error rate determined from the Direction Search setting such as 1E–6 as the target. The measurement results from this process are used to estimate the jitter tolerance for the value specified by BER for JTOL Estimation. ***Note:*** A BER for a rate lower than the intermediate measurement is estimated even using the Error Rate/Count Rate setting, but estimation may not be possible for certain intermediate results. Setting to Estimate allows BER to be estimated reliably. For details, refer to Section 4.7.3 “Jitter Tolerance Estimate”. In PAM4 PPG/ED PAM4 mode, select one of the following as a pass/fail criterion: Symbol: Symbol error rate Bit: Bit error rate only (Without correlating to symbol) MSB: MSB error rate LSB: LSB error rate
Error Count/ Error Threshold	Sets the threshold for judgment using the judgment method selected in Unit. The judgment will be Fail if the bit error value exceeds the threshold. When Unit is set to Error Rate: 1E–3 to E–12 1E–1 Step (Default: 1E–12) When Unit is set to Error Count: 0 to 10000000/Step 1 (default: 2) When Unit is set to Estimate: Cannot be changed.
BER for JTOL Estimation*2	The error rate used for Estimate can be changed. The results will be refreshed even if this value is changed after the Jitter Tolerance Test.

*1: Available only when the PAM4 PPG (with MU196020A-x42) and PAM4 ED (with MU196040B-x42) are installed.

*2: Not displayed when **Uncorrectable CW (Rate)** or **Uncorrectable CW (Count)** is selected for **Unit**.

Table 4.6.2-1 JTOL Settings Items (Cont'd)

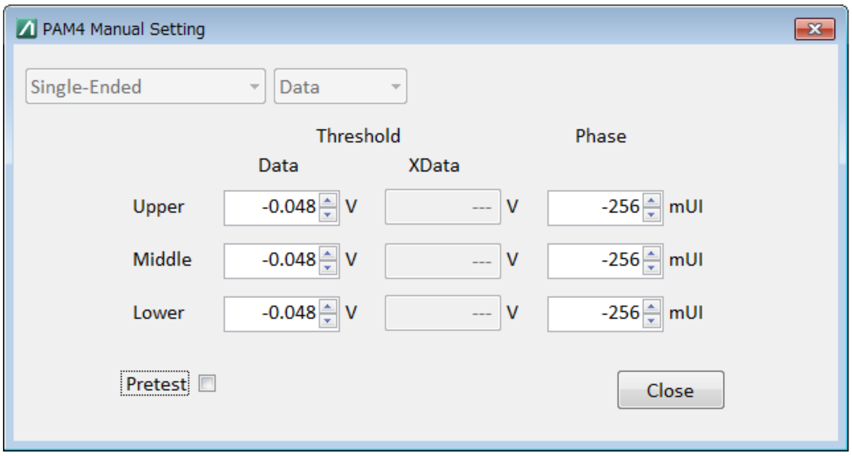
Item	Description
Search Type	
Auto Search	Selects whether Auto Search for 32G ED and SI ED is executed before measurement. OFF: Auto Search is not performed before measurement. (default) When **Meas. Type** is **PAM4**, click **Manual**, and then in the **PAM4 Threshold/Phase Settings** dialog box (Figure 4.6.2-3), configure threshold (Upper/Middle/Lower) and phase settings for PAM4 signal eyes. FINE: Auto Search (FINE) is performed before measurement. COARSE: Auto Search (COARSE) is performed before measurement. This operation is not available in the following cases, as Auto Search cannot be executed. ● Auto Adjustment is executed by the DUT. ● Auto Sync is set to **Off**.
Meas. Type	Select the type of signal (**NRZ** or **PAM4**) to be measured.
Selection of PAM4 Pattern	When **PAM4** is selected in the **Meas. Type** box, select the test pattern to be set for ED. For the patterns you can select, refer to "Appendix F" in the *MU183040B Operation Manual*.

Table 4.6.2-1 JTOL Settings Items (Cont'd)

Item	Description
Direction Search	Sets jitter modulation amplitude change direction and method. Refer to the description in 4.7.1 "Measurement Sequence". ● Binary ● Downwards Linear ● Downwards Log ● Upwards Linear ● Upwards Log ● Binary + Linear ***Note:*** Only the following three selections are available when Estimate is selected. (1) Binary Measures BER with 1E–6 as the target for the measurement range. Calculates the estimate curve from the data obtained in the measurement process. (2) Downwards Linear Measures BER with 1E–7 as the target. Calculates the estimate curve in the same way as for (1). (3) Upwards Linear Measures BER with 1E–5 as the target. Calculates the estimate curve in the same way as for (1). Also, when **PAM4** is selected for Meas. Type, the following selections are available. When Unit is Estimate: Upwards Linear only When Unit is Error Rate: Upwards Linear, Upwards Log
Step	Enabled when **Downwards Linear** or **Upwards Linear** is selected. Sets change ratio of jitter amplitude for each modulation frequency band below. Jitter Freq.≤100 kHz 100 kHz<Jitter Freq.≤1 MHz 1 MHz <Jitter Freq.≤10 MHz 10 MHz<Jitter Freq.
Ratio	Enabled when **Downwards Log** or **Upwards Log** is selected. Sets change ratio of jitter amplitude for each modulation frequency band below. Jitter Freq.≤100 kHz 100 kHz<Jitter Freq.≤1 MHz 1 MHz <Jitter Freq.≤10 MHz 10 MHz<Jitter Freq.
SJ Amplitude setting	Allows you to set the jitter modulation amplitude to be changed in steps when the frequency is changed during the measurement. The SJ Amplitude Setting Dialog Box (Figure 4.6.2-5) appears after clicking this button.

Table 4.6.2-1 JTOL Settings Items (Cont'd)

Item		Description
Timer [s]		
	Waiting	Sets the waiting time after changing the jitter modulation frequency until the next process starts. Refer to 4.7.2 "Measurement time".
	Settling	Sets the waiting time after changing the jitter modulation amplitude until the BER measurement starts.
	Gating	Sets the measurement time until judgment ends. Fixed at 1 second when **Estimate** is selected for Direction Unit.



	Data	XData	Phase
Upper	-0.048 V	--- V	-256 mUI
Middle	-0.048 V	--- V	-256 mUI
Lower	-0.048 V	--- V	-256 mUI

Pretest ☐

Figure 4.6.2-3 PAM4 Threshold/Phase Settings Dialog Box

Table 4.6.2-2 PAM4 Threshold/Phase Settings Items

Item		Description
Manual Setting		
	Data Input Condition	Displays the Input Condition settings of ED to be used for measurement. ● Single-End Data or XData ● Differential 50Ohm ● Differential 100Ohm
	Threshold/Phase	Configure threshold and phase settings for Upper/Middle/Lower eyes of PAM4 signal.
	Pretest ON/OFF	When selecting the Pretest checkbox: Verifies whether the measurement can be started using the threshold and phase value specified by Auto Search or manually before starting the AM4 Jitter Tolerance measurement. If verified to be Sync Loss, you will be notified that measurement does not start.

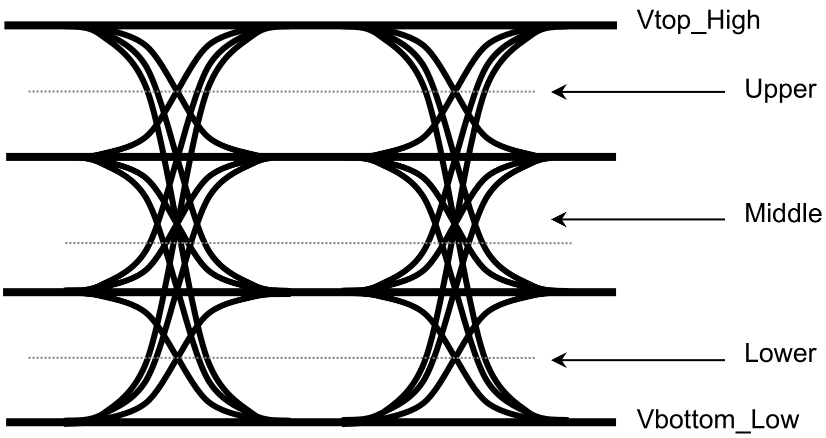
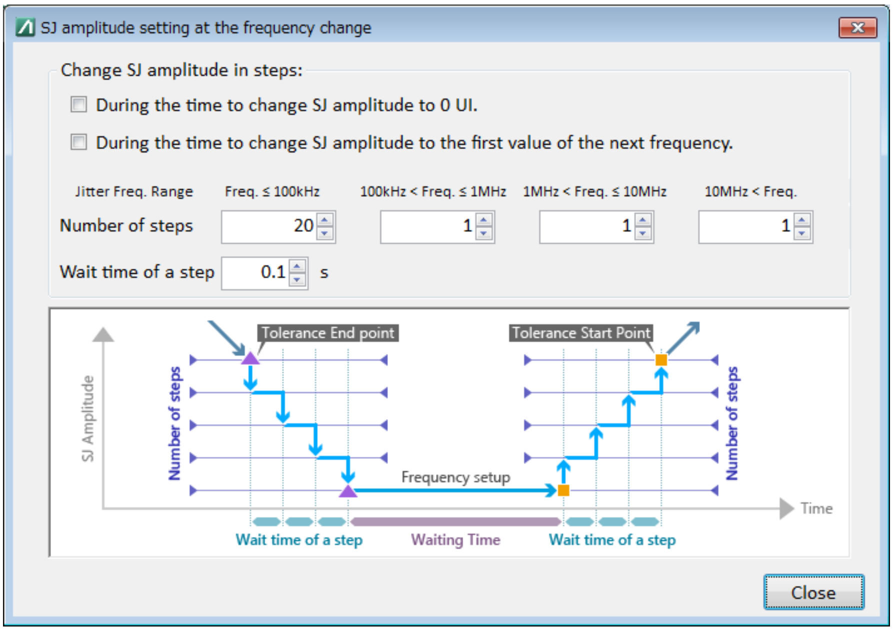


Figure 4.6.2-4 Definition of PAM4 Threshold Levels



SJ amplitude setting at the frequency change

Change SJ amplitude in steps:

☐ During the time to change SJ amplitude to 0 UI.

☐ During the time to change SJ amplitude to the first value of the next frequency.

Jitter Freq. Range	Freq. ≤ 100kHz	100kHz < Freq. ≤ 1MHz	1MHz < Freq. ≤ 10MHz	10MHz < Freq.
Number of steps	20	1	1	1

Wait time of a step 0.1 s

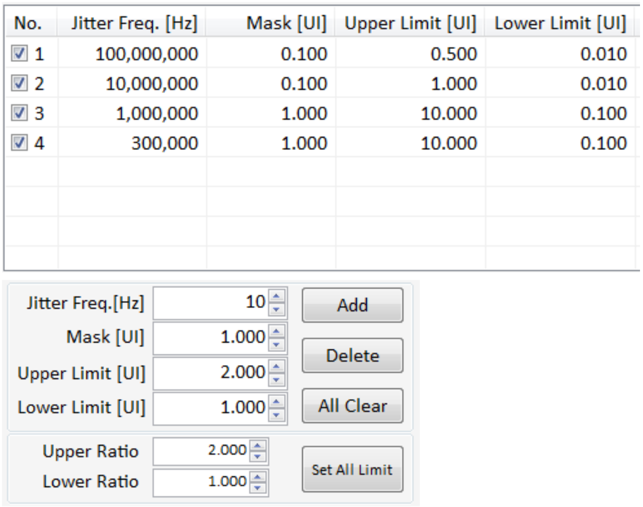
Figure 4.6.2-5 SJ Amplitude Setting Dialog Box

Table 4.6.2-3 SJ Amplitude Setting Items

Item	Description
Change SJ amplitude in steps:	
SJ amplitude setting ON/OFF	Selecting a check box applies the SJ amplitude settings that allow the jitter amplitude to be increased or decreased in steps to prevent from changing drastically when the SJ modulation frequency is changed in the jitter tolerance measurement. During the time to change SJ amplitude to 0 UI.: Applies the specified SJ amplitude settings when the jitter modulation amplitude returns to 0 UI after the jitter tolerance measurement at a certain modulation frequency. During the time to change SJ amplitude to the first value of the next frequency.: Applies the specified SJ amplitude settings when setting the jitter modulation amplitude for the next measurement after changing the modulation frequency.
Number of steps	Allows setting the number of steps of the jitter modulation amplitude setting for each of the following modulation frequency bands. Number of steps: 1 to 20 Jitter Freq.≤100 kHz 100 kHz<Jitter Freq.≤1 MHz 1 MHz <Jitter Freq.≤10 MHz 10 MHz<Jitter Freq.
Wait time of a step	Allows setting the waiting time for each step. 0.1 to 1.0 s / 0.1 s step

4.6.3 Jitter Tolerance Table setup

The Jitter Tolerance Table setting area is used to set the SJ modulation frequency for measuring jitter tolerance.



No.	Jitter Freq. [Hz]	Mask [UI]	Upper Limit [UI]	Lower Limit [UI]
☑ 1	100,000,000	0.100	0.500	0.010
☑ 2	10,000,000	0.100	1.000	0.010
☑ 3	1,000,000	1.000	10.000	0.100
☑ 4	300,000	1.000	10.000	0.100

Jitter Freq.[Hz] 10

Mask [UI] 1.000

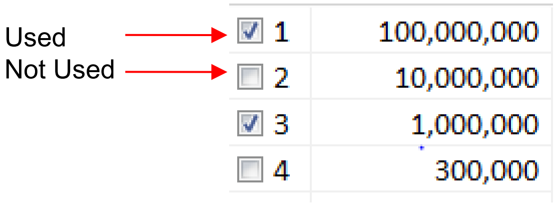
Upper Limit [UI] 2.000

Lower Limit [UI] 1.000

Upper Ratio 2.000

Lower Ratio 1.000

Figure 4.6.3-1 Jitter Tolerance Table Setting Area



☑ 1	100,000,000
☐ 2	10,000,000
☑ 3	1,000,000
☐ 4	300,000

The column on the left is for the check boxes, as shown in the figure above. The frequencies selected will be used for measurement.

Table 4.6.3-1 Jitter Tolerance Table Setting Items

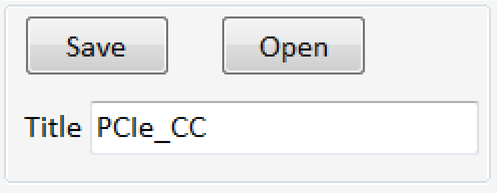
<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>Jitter Freq. [Hz]</td><td>Sets the jitter modulation frequency.
The setting range is equal to the setting range of the modulation frequency of MU181500B.
<table>
<tr><th>Range [Hz]</th><th>Resolution [Hz]</th></tr>
<tr><td>10 to 10 000</td><td>1</td></tr>
<tr><td>10 010 to 100 000</td><td>10</td></tr>
<tr><td>100 100 to 1 000 000</td><td>100</td></tr>
<tr><td>1 001 000 to 10 000 000</td><td>1 000</td></tr>
<tr><td>10 010 000 to 100 000 000</td><td>10 000</td></tr>
<tr><td>100 100 000 to 250 000 000</td><td>100 000</td></tr>
</table>
</td></tr>
<tr><td>Mask [UI]</td><td>Sets the mask for the modulation frequency.
The setting range is the setting range for the MU181500B amplitude.
The available ranges and resolutions will vary depending on the 28G/32G PPG or SI PPG Bit Rate and Clock Setting.
For Bit Rate: 30.000004 to 32.1 Gbit/s
<table>
<tr><th>Frequency [Hz]</th><th>Range [UIp-p]</th><th>Resolution [UIp-p]</th></tr>
<tr><td>10 to 100 000</td><td>0 to 1000</td><td>0.004</td></tr>
<tr><td>100 100 to 1 000 000</td><td>0 to 100</td><td>0.004</td></tr>
<tr><td>1 001 000 to 10 000 000</td><td>0 to 8</td><td>0.004</td></tr>
<tr><td>10 010 000 to 250 000 000</td><td>0 to 0.5</td><td>0.004</td></tr>
</table>
For Bit Rate: 15.000002 to 30 Gbit/s, Clock Setting: Full Rate or
Bit Rate: 2.4 to 30 Gbit/s, Clock Setting: Half Rate
<table>
<tr><th>Frequency [Hz]</th><th>Range [UIp-p]</th><th>Resolution [UIp-p]</th></tr>
<tr><td>10 to 100 000</td><td>0 to 2000</td><td>0.002</td></tr>
<tr><td>100 100 to 1 000 000</td><td>0 to 200</td><td>0.002</td></tr>
<tr><td>1 001 000 to 10 000 000</td><td>0 to 16</td><td>0.002</td></tr>
<tr><td>10 010 000 to 250 000 000</td><td>0 to 1</td><td>0.002</td></tr>
</table>
For Bit Rate: 4.000002 to 15 Gbit/s, Clock Setting: Full Rate
<table>
<tr><th>Frequency [Hz]</th><th>Range [UIp-p]</th><th>Resolution [UIp-p]</th></tr>
<tr><td>10 to 100 000</td><td>0 to 1000</td><td>0.001</td></tr>
<tr><td>100 100 to 1 000 000</td><td>0 to 100</td><td>0.001</td></tr>
<tr><td>1 001 000 to 10 000 000</td><td>0 to 8</td><td>0.001</td></tr>
<tr><td>10 010 000 to 250 000 000</td><td>0 to 0.5</td><td>0.001</td></tr>
</table>
</td></tr>
</table>

Table 4.6.3-1 Jitter Tolerance Table Setting Items (Cont'd)

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>Max Limit [UI]
(Cont’d)</td><td>For Bit Rate: 2.4 to 4 Gbit/s, Clock Setting: Full Rate
<table>
<tr><th>Frequency [Hz]</th><th>Range [UIp-p]</th><th>Resolution [UIp-p]</th></tr>
<tr><td>10 to 100 000</td><td>0 to 500</td><td>0.001</td></tr>
<tr><td>100 100 to 1 000 000</td><td>0 to 100</td><td>0.001</td></tr>
<tr><td>1 001 000 to 10 000 000</td><td>0 to 8</td><td>0.001</td></tr>
<tr><td>10 010 000 to 250 000 000</td><td>0 to 0.5</td><td>0.001</td></tr>
</table></td></tr>
<tr><td>Upper Limit [UI]</td><td>Sets the upper limit. Be sure to enter a value not less than the value set for Mask.
The setting range is the same as the setting range above.</td></tr>
<tr><td>Lower Limit [UI]</td><td>Sets the lower limit. Be sure to enter a value not exceeding the value set for Mask.
The setting range is the same as the setting range above.</td></tr>
<tr><td>Add</td><td>Adds the value entered above to the Jitter Tolerance Table.</td></tr>
<tr><td>Delete</td><td>Deletes selected jitter modulation frequency data.</td></tr>
<tr><td>All Clear</td><td>Deletes all jitter modulation frequency data.</td></tr>
<tr><td>Upper Ratio</td><td>Resets the Upper Limit value as a ratio of the value set for Mask.
Click **Set All Limit** to update the changes.</td></tr>
<tr><td>Lower Ratio</td><td>Resets the Lower Limit value as a ratio of the value set for Mask.
Click **Set All Limit** to update the changes.</td></tr>
<tr><td>Set All Limit</td><td>Resets all of the Upper Limit [UI] and Lower Limit [UI] values for the frequencies selected in the Jitter Tolerance Table.</td></tr>
</table>

4.6.4 Setting up the Mask data

Mask data is the amplitude value with which the Pass/Fail judgment is made on the Jitter Tolerance measurement value. If the jitter amplitude measurement value is smaller than the value of the mask data, the judgment result will be Fail.



Title PCIe_CC

Figure 4.6.4-1 Mask Data Table Setup Area

Table 4.6.4-1 Mask Data Table Setup Items

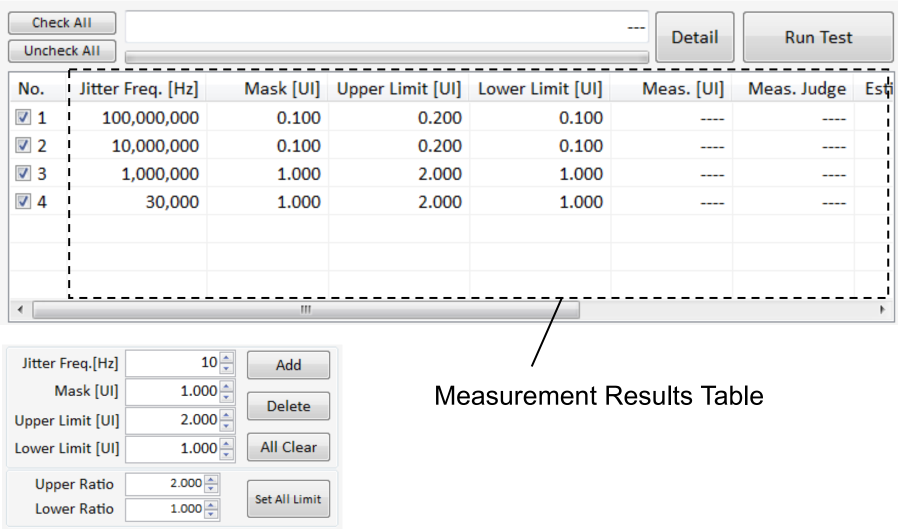
Item	Description
Save	Saves the table data edited by a user to a user data file (extension: umsk).
Open	Opens the dialog box, where you can select a mask file.

4.6.5 Jitter Tolerance Measurement start

Click **Run Test** to start measurement.
The measurement results are displayed in the Jitter Tolerance Table, and the results are displayed as a graph on the **Graph** tab.

The button name changes to **Stop Test** while measurement is in progress. When measurement is complete, the button name returns to **Run Test**. Clicking **Stop Test** aborts measurement.

4.6.6 Jitter Tolerance Test result

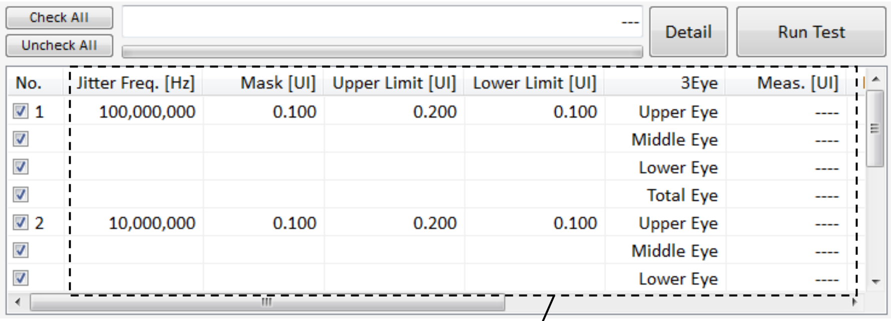


No.	Jitter Freq. [Hz]	Mask [UI]	Upper Limit [UI]	Lower Limit [UI]	Meas. [UI]	Meas. Judge	Esti
☑ 1	100,000,000	0.100	0.200	0.100	----	----	
☑ 2	10,000,000	0.100	0.200	0.100	----	----	
☑ 3	1,000,000	1.000	2.000	1.000	----	----	
☑ 4	30,000	1.000	2.000	1.000	----	----	

Jitter Freq.[Hz] 10
Mask [UI] 1.000
Upper Limit [UI] 2.000
Lower Limit [UI] 1.000
Upper Ratio 2.000
Lower Ratio 1.000

Measurement Results Table

Figure 4.6.6-1 Jitter Tolerance Table



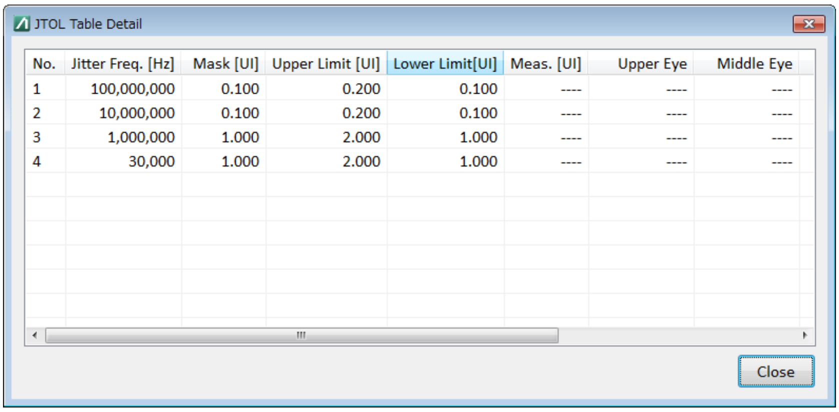
No.	Jitter Freq. [Hz]	Mask [UI]	Upper Limit [UI]	Lower Limit [UI]	3Eye	Meas. [UI]
☑ 1	100,000,000	0.100	0.200	0.100	Upper Eye	----
☑					Middle Eye	----
☑					Lower Eye	----
☑					Total Eye	----
☑ 2	10,000,000	0.100	0.200	0.100	Upper Eye	----
☑					Middle Eye	----
☑					Lower Eye	----

Measurement Results Table

Figure 4.6.6-2 Jitter Tolerance Table (For PAM4 Measurement)

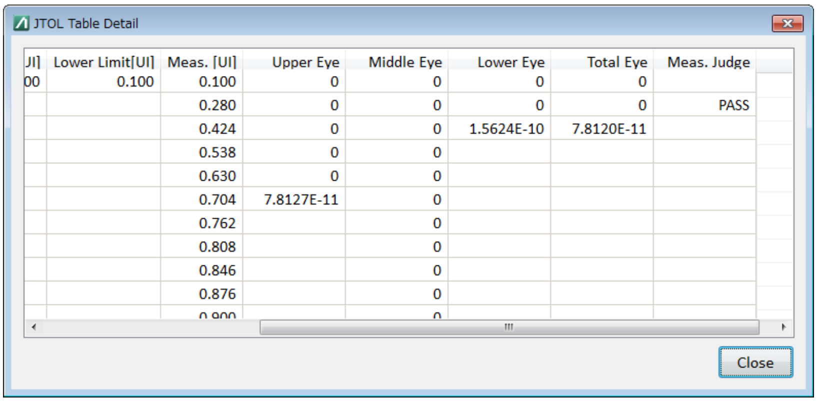
Table 4.6.6-1 Jitter Tolerance Table

Item	Description
Meas. [UI]	Displays measured results. When **Meas. Type** is **PAM4**, the following are displayed: ● Upper/Middle/Lower Eye measurement results ● Total of three eye measurement results
Meas.Judge	Pass: Pass, Fail: Fail The pass/fail judgment is determined as fail if the jitter tolerance point is below the Mask set. If the modulation frequency is outside the frequency range set for the Mask Data Table, the specification for Mask Data Table modulation frequency closest to that modulation frequency is used as the pass/fail judgment datum. When **Meas. Type** is **PAM4**, pass/fail evaluation of the following is displayed: ● Upper/Middle/Lower Eye measurement ● Total of three eye measurement
Estimate [UI]	Displays the estimate for the error rate specified for BER for JTOL Estimation.
Adjusted R-Squared	Displays R^2 (free-adjusted coefficient of determination).
Estimate.Judge	Judges the estimate in the same way as Meas.Judge.
FL	The following message is displayed if the measurement result matches the Upper Limit of fails due to the Lower Limit. Upper Limit ≥ Measurement result: OVF Lower Limit < Measurement result: UNF
Detail	The detailed measurement results table for the measurement points selected in Figure 4.6.6-1 is shown in a separate window. Figure 4.6.6-3 shows a typical window. When **Meas. Type** is **PAM4**, Upper/Middle/Lower eye measurement results are displayed. Figure 4.6.6-4 shows the image of how the detailed measurement results are displayed. In PAM4 PPG/ED PAM4 mode, the following measurement results are displayed: Symbol, Bit, MSB, LSB When the PAM4 PPG (with MU196020A-x42) and PAM4 ED (with MU196040B-x42) are installed, the results of the FEC Analysis Measurement are displayed at UCW Count and CW Count: N0 to 31. ***Note:*** At CW Count: N0 to 31, the codeword count is displayed by the number of FEC Symbol Errors contained per codeword. All codewords containing more than 32 FEC Symbol Errors will be counted as Uncorrectable Codewords.



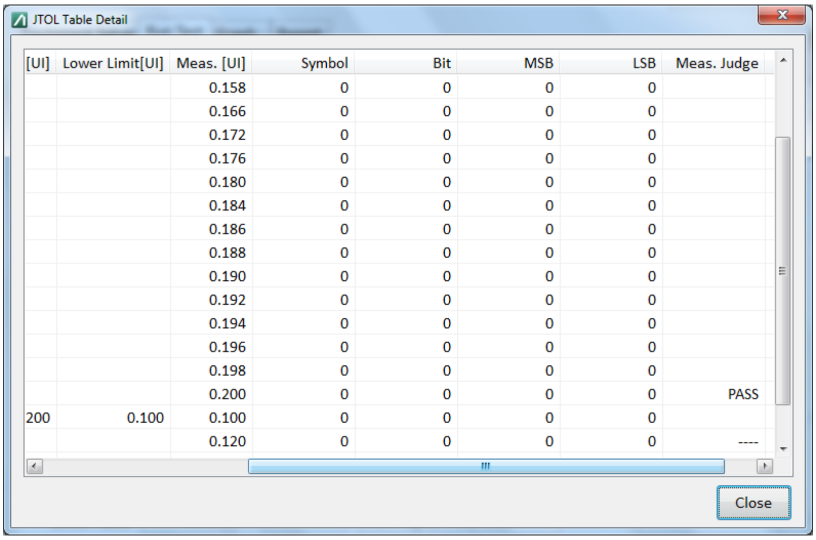
No.	Jitter Freq. [Hz]	Mask [UI]	Upper Limit [UI]	Lower Limit[UI]	Meas. [UI]	Upper Eye	Middle Eye
1	100,000,000	0.100	0.200	0.100	----	----	----
2	10,000,000	0.100	0.200	0.100	----	----	----
3	1,000,000	1.000	2.000	1.000	----	----	----
4	30,000	1.000	2.000	1.000	----	----	----

Figure 4.6.6-3 Jitter Tolerance Table Detail



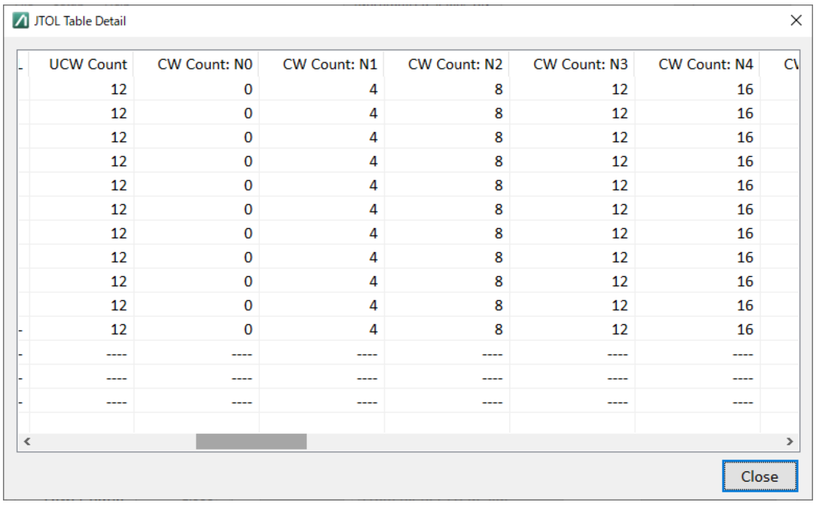
JI]	Lower Limit[UI]	Meas. [UI]	Upper Eye	Middle Eye	Lower Eye	Total Eye	Meas. Judge
00	0.100	0.100	0	0	0	0	
		0.280	0	0	0	0	PASS
		0.424	0	0	1.5624E-10	7.8120E-11	
		0.538	0	0			
		0.630	0	0			
		0.704	7.8127E-11	0			
		0.762		0			
		0.808		0			
		0.846		0			
		0.876		0			
		0.900		0			

Figure 4.6.6-4 Jitter Tolerance Table Detail (For PAM4 Measurement)



[UI]	Lower Limit[UI]	Meas. [UI]	Symbol	Bit	MSB	LSB	Meas. Judge
		0.158	0	0	0	0	
		0.166	0	0	0	0	
		0.172	0	0	0	0	
		0.176	0	0	0	0	
		0.180	0	0	0	0	
		0.184	0	0	0	0	
		0.186	0	0	0	0	
		0.188	0	0	0	0	
		0.190	0	0	0	0	
		0.192	0	0	0	0	
		0.194	0	0	0	0	
		0.196	0	0	0	0	
		0.198	0	0	0	0	
		0.200	0	0	0	0	PASS
200	0.100	0.100	0	0	0	0	
		0.120	0	0	0	0	----

Figure 4.6.6-5 Jitter Tolerance Table Detail (In PAM4 PPG/ED Mode)



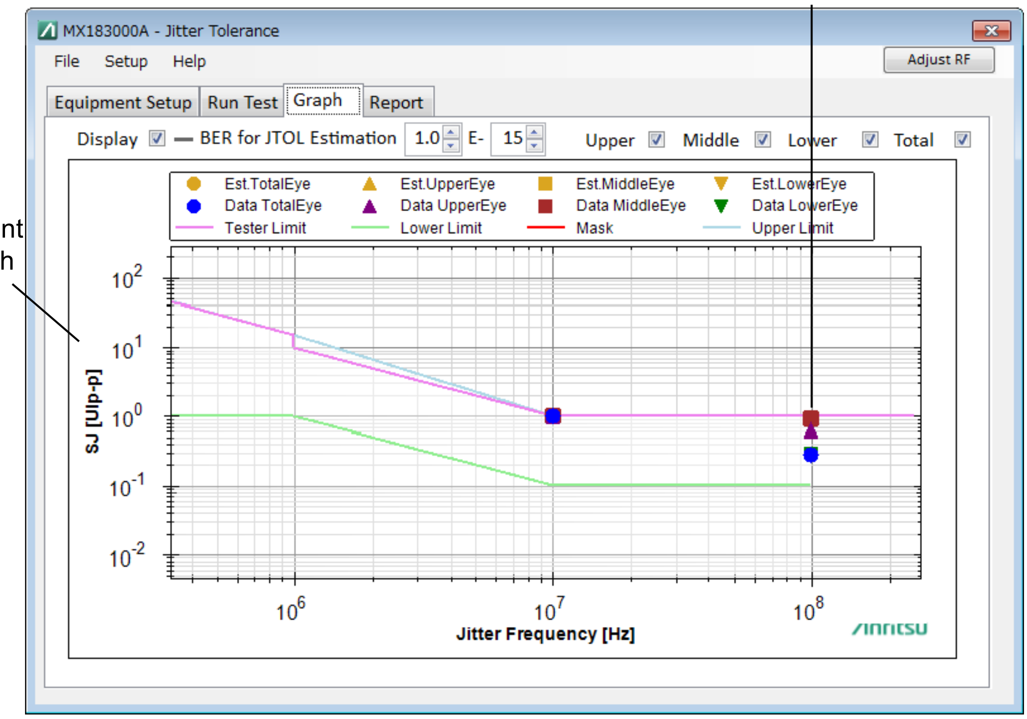
JTOL Table Detail

UCW Count	CW Count: N0	CW Count: N1	CW Count: N2	CW Count: N3	CW Count: N4
12	0	4	8	12	16
12	0	4	8	12	16
12	0	4	8	12	16
12	0	4	8	12	16
12	0	4	8	12	16
12	0	4	8	12	16
12	0	4	8	12	16
12	0	4	8	12	16
12	0	4	8	12	16
12	0	4	8	12	16
12	0	4	8	12	16
----	----	----	----	----	----
----	----	----	----	----	----
----	----	----	----	----	----

Figure 4.6.6-6 Jitter Tolerance Table Detail (For FEC Analysis Measurement)

Current measurement point display

Measurement results graph



MX183000A - Jitter Tolerance

Display ☑ — BER for JTOL Estimation 1.0 E- 15

Upper ☑ Middle ☑ Lower ☑ Total ☑

Figure 4.6.6-7 Jitter Tolerance Graph Tab

The estimate curve specified for BER for JTOL Estimation is displayed on the graph on the **Graph** tab. The estimate curve can be displayed or hidden by selecting or clearing the **Display** check box.
When **Meas. Type** is **PAM4**, the Upper/Middle/Lower Eye measurement results and total of three eye measurement results are plotted. They can be displayed or hidden by selecting or cleaning the check boxes.

4.6.7 Saving the graph and setting up the scale

Right-click in the measurement result graph display area on the Result screen, a submenu will appear.

You can copy and save the graph, or change the graph display from the submenu.

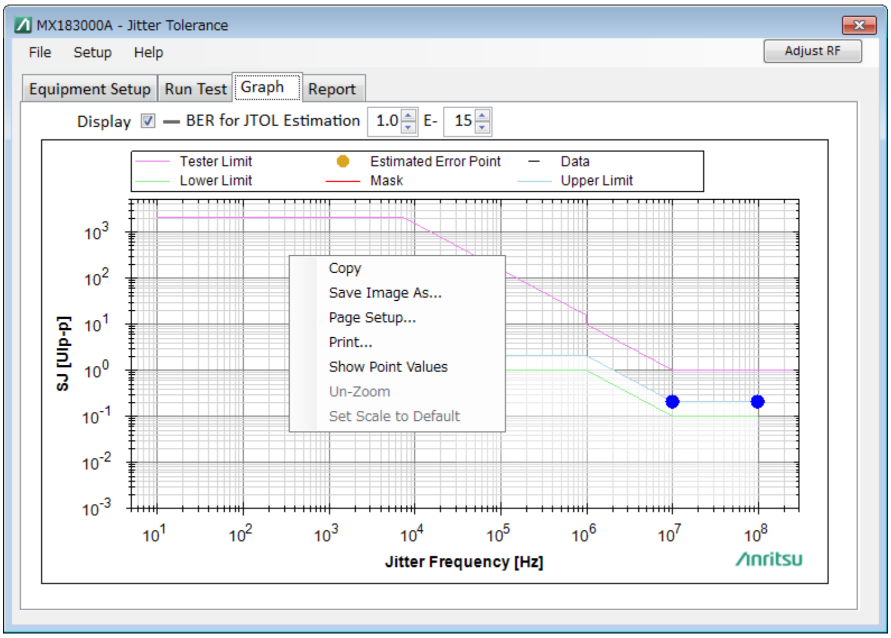


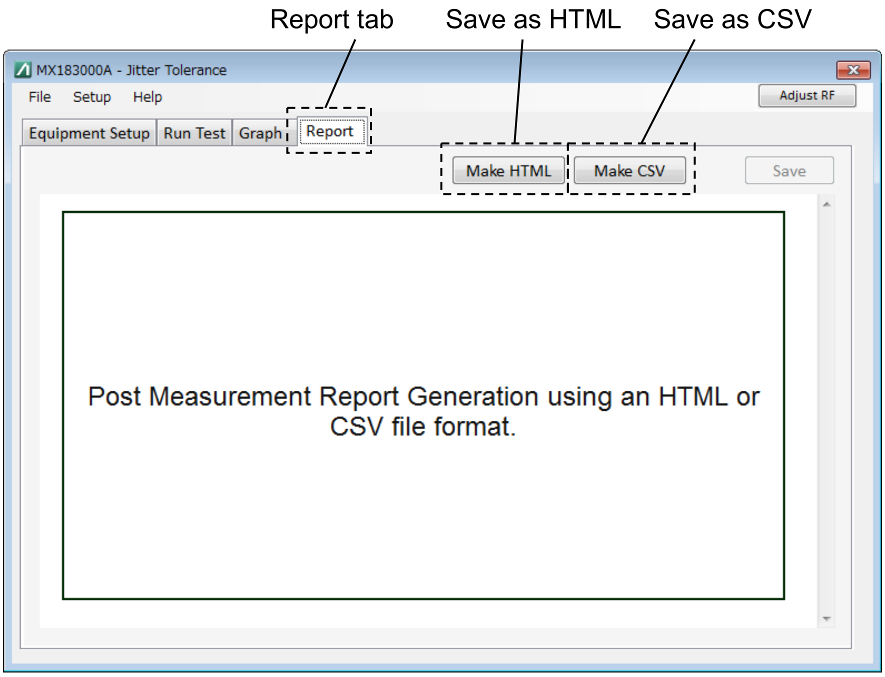
Figure 4.6.7-1 Submenu in the Measurement Result Graph Display Area

Table 4.6.7-1 Submenu in the Measurement Result Graph Display

Item	Description
Copy	Copies the graph display area to the clip board.
Save Image As…	Saves the graph display area as a file in the specified format.
Page Setup…	Opens the graph printing settings.
Print	Prints out the graph.
Show Point Values	Displays the coordinates at the mouse cursor position.
Un-Zoom	Zooms out the graph.
Set Scale to Default	Displays the entire graph.

4.6.8 File operation and printing

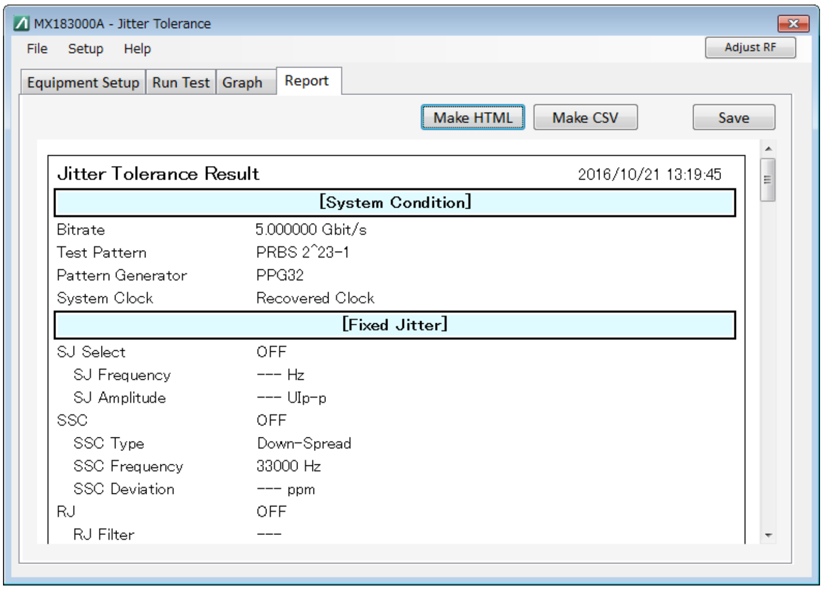
On the **Report** tab, you can save measurement result data.



Post Measurement Report Generation using an HTML or CSV file format.

Figure 4.6.8-1 Report Tab

1. Click the **Report** tab.
2. Click **Make HTML** to print/save the data in the HTML format.
   The print image will appear.
3. Click **Make CSV** to print/save the data in the CSV format.
   The print image will appear.
4. Click **Save** to save as a file in the format specified in steps 2 and 3.



Jitter Tolerance Result 2016/10/21 13:19:45

[System Condition]	
Bitrate	5.000000 Gbit/s
Test Pattern	PRBS 2^23-1
Pattern Generator	PPG32
System Clock	Recovered Clock

[Fixed Jitter]	
SJ Select	OFF
SJ Frequency	--- Hz
SJ Amplitude	--- UIp-p
SSC	OFF
SSC Type	Down-Spread
SSC Frequency	33000 Hz
SSC Deviation	--- ppm
RJ	OFF
RJ Filter	---

Figure 4.6.8-2 Result Tab-Report (Make HTML)

When you saved the data, the following files are created:

(1) HTML data

- Specified file name.htm
- conf.css
- IMG folder: A png file of the waveform and the graph will be created.
  The name of the file will be created in the specified file name xx.png. xx will be replaced by a number.
  If you double-click the htm file, you can display the saved result on a Web browser such as the Internet Explorer.
  Required file size to save HTML may sometimes be up to about 20MB. Verify the amount of free space on the hard disk before executing Save.

(2) CSV data

- Specified file name.csv

4.7 Jitter Tolerance Test Procedure

4.7.1 Measurement sequence

Jitter Tolerance measures the tolerance of jitter per each listed jitter frequency.
Jitter tolerance is the maximum jitter amplitude at which the number of errors or the error rate becomes equal to or below the Pass/Fail Threshold. The following types of measurement methods are available:

- Binary

The binary search method is used to search for the target jitter amplitude.
The binary search method decreases its searching range of jitter amplitude by half for every measurement execution. If the error measurement value is equal to or below the value of Threshold, the jitter amplitude is increased; if it exceeds the value of Threshold, the jitter amplitude is decreased. The search ends when the amount of searching range becomes equal to or below the value of the permitted resolution setting. In the Figure 4.7.1-1, the jitter amplitude of the fourth measurement represents the final measurement result.

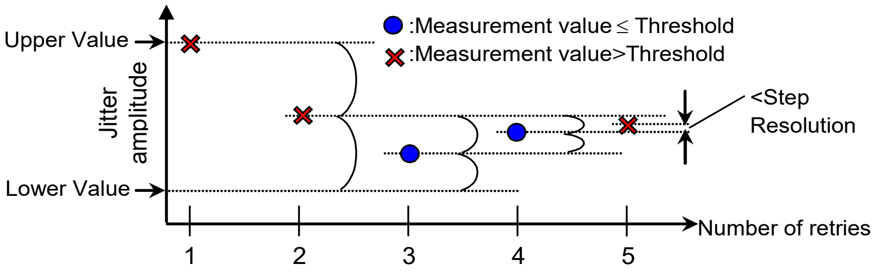


Figure 4.7.1-1 Procedure for the Binary Search Measurement Method

- Downwards

The jitter amplitude is decreased from the Start Value until the error measurement value becomes equal to or below the value of Threshold.
In the case of Downwards Linear, the jitter amplitude is decreased by the value set in Step.
In the case of Downwards Log, the jitter amplitude is decreased by the magnification set in Ratio.
In cases that the error measurement value still exceeds the Threshold even when the jitter amplitude becomes equal to or below Lower Value, the next step jitter amplitude will be taken as the final measurement value.

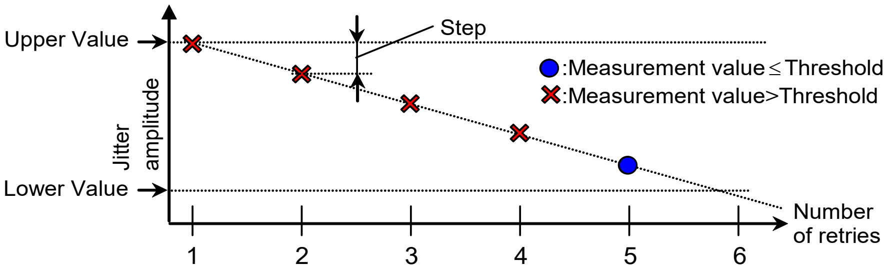


Figure 4.7.1-2 Procedure for Downwards Linear Measurement

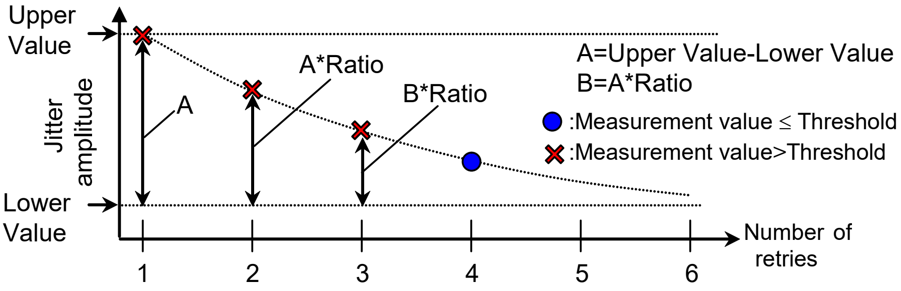

Upper Value
A*Ratio
B*Ratio
A=Upper Value-Lower Value
B=A*Ratio
A
●:Measurement value ≤ Threshold
✕:Measurement value>Threshold
Jitter amplitude
Lower Value
Number of retries
1
2
3
4
5
6

Figure 4.7.1-3 Procedure for Downwards Log Measurement

- Upwards

The jitter amplitude is increased from the Start Value until the error measurement value exceeds the value of Threshold.

In the case of Upwards Linear, the jitter amplitude is increased by the value set in Step.

In the case of Upwards Log, the jitter amplitude is increased by the magnification set in Ratio.

In cases that the error measurement value still does not exceed the Threshold even when the jitter amplitude becomes equal to or above Upper Value, the next step jitter amplitude will be taken as the final measurement value.

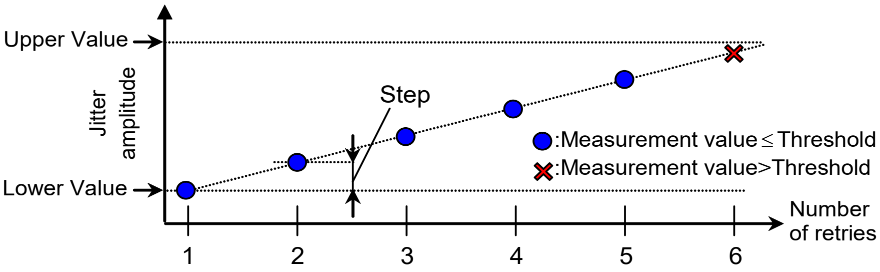


Figure 4.7.1-4 Procedure for Upwards Linear Measurement

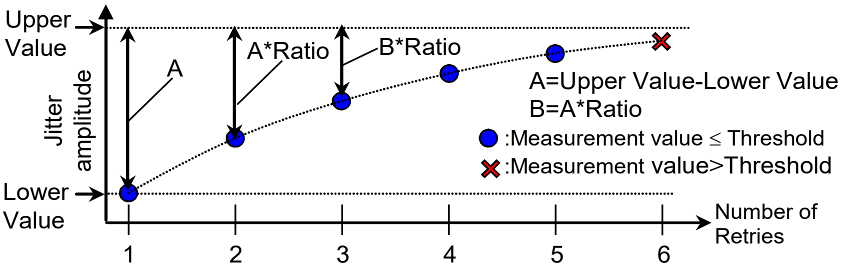

Upper Value
A
A*Ratio
B*Ratio
A=Upper Value-Lower Value
B=A*Ratio
Jitter amplitude
●:Measurement value ≤ Threshold
✕:Measurement value>Threshold
Lower Value
Number of Retries
1
2
3
4
5
6

Figure 4.7.1-5 Procedure for Upwards Log Measurement

- Binary + Linear

After searching the jitter amplitude from the lower value by the binary search method, the Upwards Linear measurement is executed.

From the point searched by the binary search method, the jitter amplitude is increased at a step of the value, which is a half of the value set for Step Resolution, until the error measurement value exceeds the Threshold value.

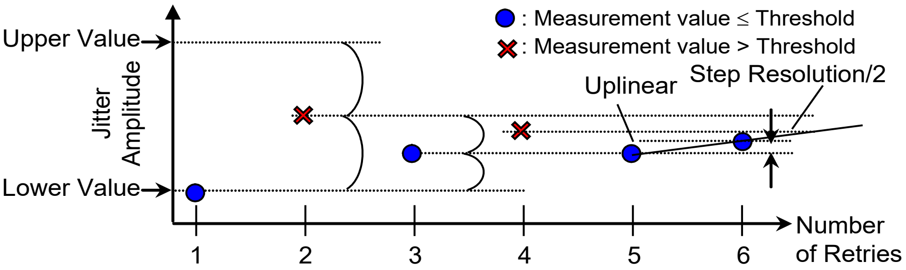


Figure 4.7.1-6 Procedure for Binary + Linear Measurement

4.7.2 Measurement time

Repeat the process for measuring the bit error rate by changing the jitter frequency and jitter amplitude.

MX183000A sets up the jitter frequency, the waiting time after changing the jitter amplitude, and the bit error rate measurement time under the following names:

Waiting:	Waiting time after changing the jitter frequency
Settling:	Waiting time after changing the jitter amplitude
Gating:	Bit error rate measurement time

The time relationship in the Jitter Tolerance measurement is as shown in the figure below:

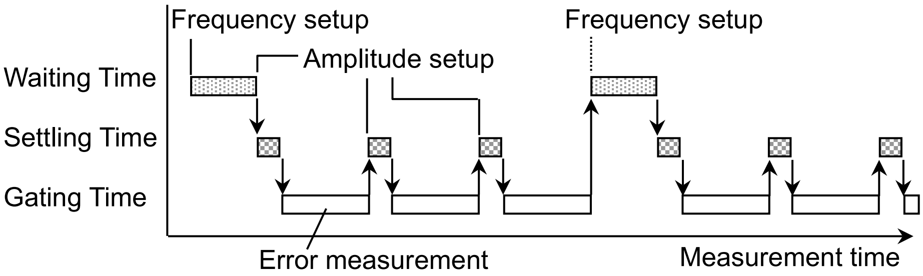


Figure 4.7.2-1　Setup Time Relationship

Moreover, if the **Change SJ amplitude in steps** function is enabled, MX183000A repeats processing of the measurement for the bit error rate, with changing the jitter amplitude in steps when changing the jitter frequency.

MX183000A allows you to configure the following settings:

Waiting:	Waiting time after changing the jitter frequency (described above)
Wait time of a step:	Waiting time for each step

The following figure shows the relationship of “Waiting” and “Wait time of a step” when changing the jitter frequency.

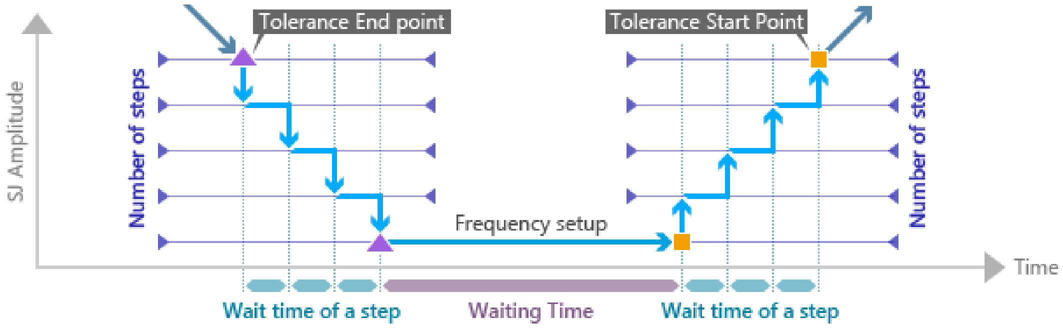
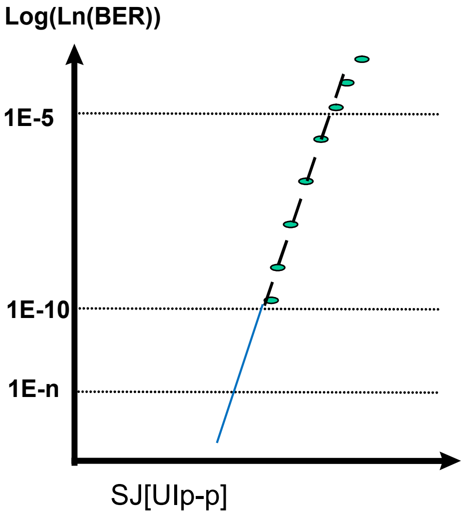


Figure 4.7.2-2　Setup Time Relationship

4.7.3 Jitter Tolerance estimate

The MX183000A allows BER to be estimated for high rates such as 1E–6 and for low rates such as 1E–20.
For example, the BER for E–20 cannot be measured practically, as the error rate produces errors of 1 bit in 10^{10} seconds (>317 years) even with a 10 Gbit/s signal.

The distribution parameters σ and μ can be determined by measuring the correlation with jitter modulation amplitude (SJ) for bitter error rate over a particular range as shown in Figure 4.7.3-1. Jitter modulation amplitude estimate curves for jitter modulation frequencies can be calculated for any particular error rate using the equation in the distribution Figure 4.7.3-1.



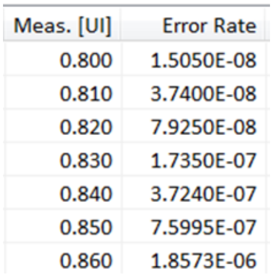
$$\mathrm{BER}(D) = \frac{1}{2}\left\{ \frac{e^{-\frac{\left(\frac{|\mu - D|}{\sigma}\right)^2}{2}}}{\left(\frac{|\mu - D|}{\sigma}\right)\sqrt{2\pi}} \right\}$$

Figure 4.7.3-1 Noise Distribution Estimate and BER Estimate Calculation

The MX183000A allows an estimate curve to be plotted if three or more measurement results have an error rate between 1.0E–6 and 1.0E–9 while measuring Jitter Tolerance.

Intermediate results as shown in Figure 4.7.3-2 can be obtained for settings as shown in Table 4.6.2-1.

Unit: Estimate
Direction Search: Upwards Linear



Meas. [UI]	Error Rate
0.800	1.5050E-08
0.810	3.7400E-08
0.820	7.9250E-08
0.830	1.7350E-07
0.840	3.7240E-07
0.850	7.5995E-07
0.860	1.8573E-06

Figure 4.7.3-2 Example Intermediate Measurement Results for Upwards Linear (Unit Setting: Estimate)

As there are at least three measurement results with an error rate between 1.0E–6 and 1.0E–9, the approximation line shown in Figure 4.7.3-1 can be drawn, allowing estimation of BER for low rates such as E–20.

If Unit is Estimate, even if there are less than three measurement results with an error rate between 1.0E–6 and 1.0E–9, measurement is continued until there are three measurement results with an error rate between 1.0E–6 and 1.0E–9 by measuring with additional SJ values. If you wish to determine jitter tolerance estimate results accurately for low rates, set Unit to Estimate.

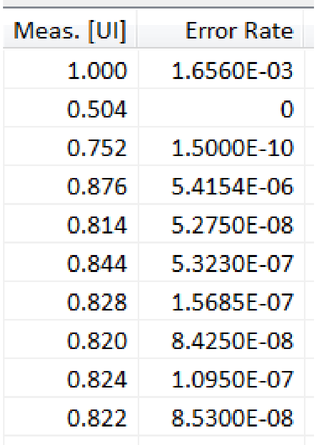
Note:

Three or more measurement results between 1.0E–6 and 1.0E–9 cannot be obtained if the jitter amplitude reaches the Upper Limit, and the Error Rate at this point is 1.0E–9 or less. For this reason, jitter tolerance cannot be estimated for low rates.

Estimate curves can be drawn for intermediate measurement results even when Unit is set to Error Rate or Error Count.

Intermediate results as shown in Figure 4.7.3-3 can be obtained for settings as shown in Table 4.6.2-1.

Unit:	Error Rate
Error Threshold:	1.0E–7
Direction Search:	Binary



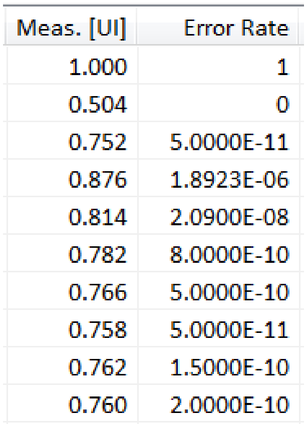
Meas. [UI]	Error Rate
1.000	1.6560E-03
0.504	0
0.752	1.5000E-10
0.876	5.4154E-06
0.814	5.2750E-08
0.844	5.3230E-07
0.828	1.5685E-07
0.820	8.4250E-08
0.824	1.0950E-07
0.822	8.5300E-08

Figure 4.7.3-3 Example Intermediate Measurement Results for Binary, Error Threshold 1.0E–7

In this case, as there are at least three measurement results with an error rate between 1.0E–6 and 1.0E–9, the approximation line shown in Figure 4.7.3-1 can be drawn, even without setting Unit to Estimate. BER can therefore be estimated for low rates such as E–20.

Intermediate results as shown in Figure 4.7.3-4 can be obtained for settings as shown in Table 4.6.2-1.

Unit: Error Rate
Error Threshold: 1.0E–10
Direction Search: Binary



Meas. [UI]	Error Rate
1.000	1
0.504	0
0.752	5.0000E-11
0.876	1.8923E-06
0.814	2.0900E-08
0.782	8.0000E-10
0.766	5.0000E-10
0.758	5.0000E-11
0.762	1.5000E-10
0.760	2.0000E-10

Figure 4.7.3-4 Example Intermediate Measurement Results for Binary, Error Threshold 1.0E–10

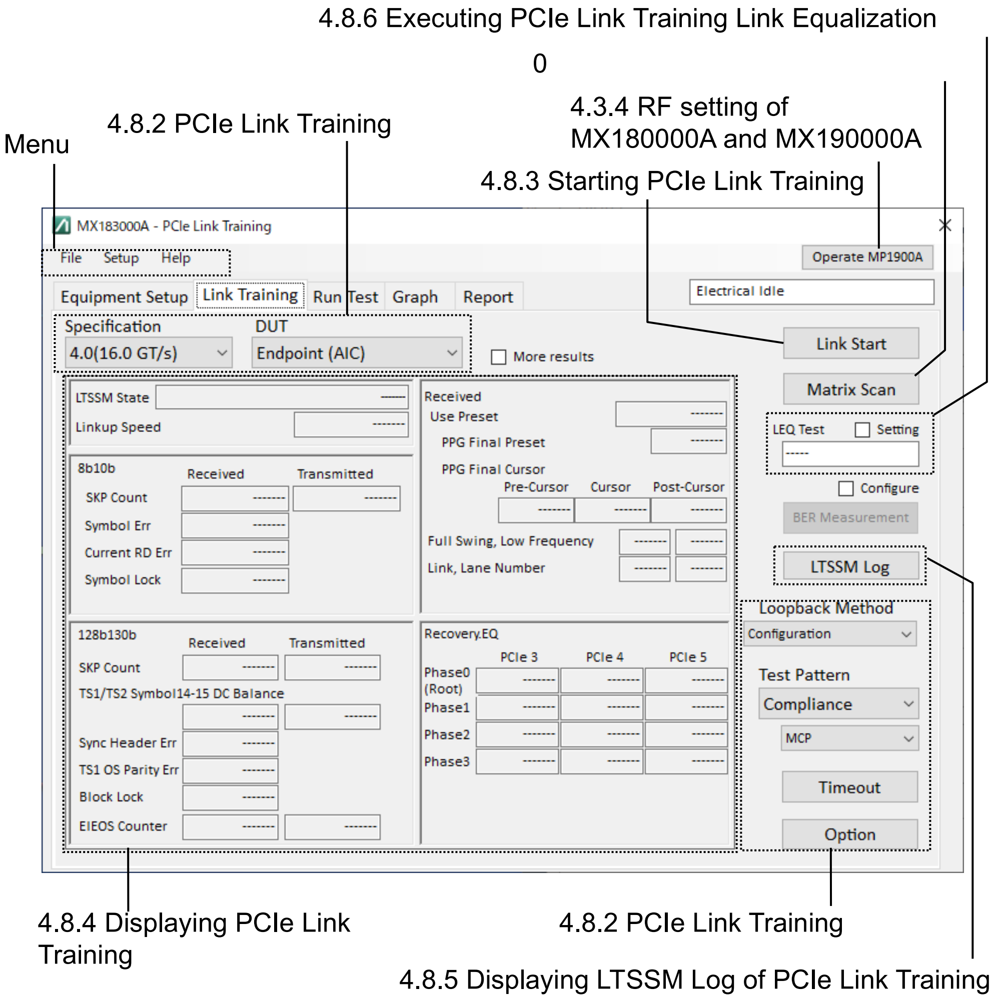
In this case, as there are only two measurement results with an error rate between 1.0E–6 and 1.0E–9, the approximation line shown in Figure 4.7.3-1 cannot be drawn, and BER cannot be estimated for low rates such as E–20.

If Unit is set to Estimate, measurement can be continued until three measurements are obtained between 1.0E–6 and 1.0E–9 by adding SJ values, but additional measurement is not performed when Unit is set other than to Estimate.
If you wish to determine jitter tolerance estimate results accurately for low rates, set Unit to Estimate.

4.8 PCIe Link Training

4.8.1 PCIe Link Training setup screen

On the **Link Training** tab, you can view the following PCIe Link Training settings. The references for each setup area are shown in the figure.



4.8.6 Executing PCIe Link Training Link Equalization

0

4.3.4 RF setting of MX180000A and MX190000A

4.8.2 PCIe Link Training

Menu

4.8.3 Starting PCIe Link Training

MX183000A - PCIe Link Training

Specification: 4.0(16.0 GT/s)

DUT: Endpoint (AIC)

Electrical Idle

Loopback Method: Configuration

Test Pattern: Compliance

MCP

4.8.4 Displaying PCIe Link Training

4.8.2 PCIe Link Training

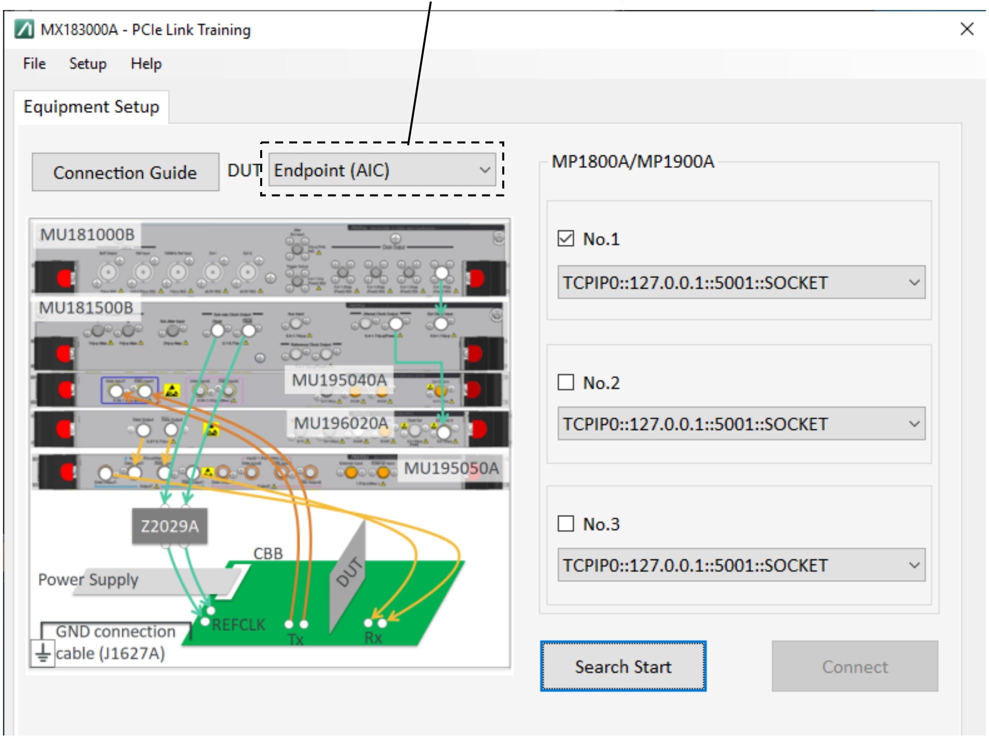
4.8.5 Displaying LTSSM Log of PCIe Link Training

Figure 4.8.1-1 PCIe Link Training Setup Screen

For details of menus and abbreviations on the above screen, refer to 4.4.1 “PCIe Link Sequence Setup Screen,” since they are common in these screens.

On the **Equipment Setup** tab, you can check the connection image by making a selection of DUT type. This selection does not affect the setting in the **DUT** box of the **Link Training** tab appearing after connecting with the DUT. The setting is the value backed up automatically at the last time the MX183000A was closed.

Selection of DUT Type



DUT: Endpoint (AIC)

☑ No.1
TCPIP0::127.0.0.1::5001::SOCKET

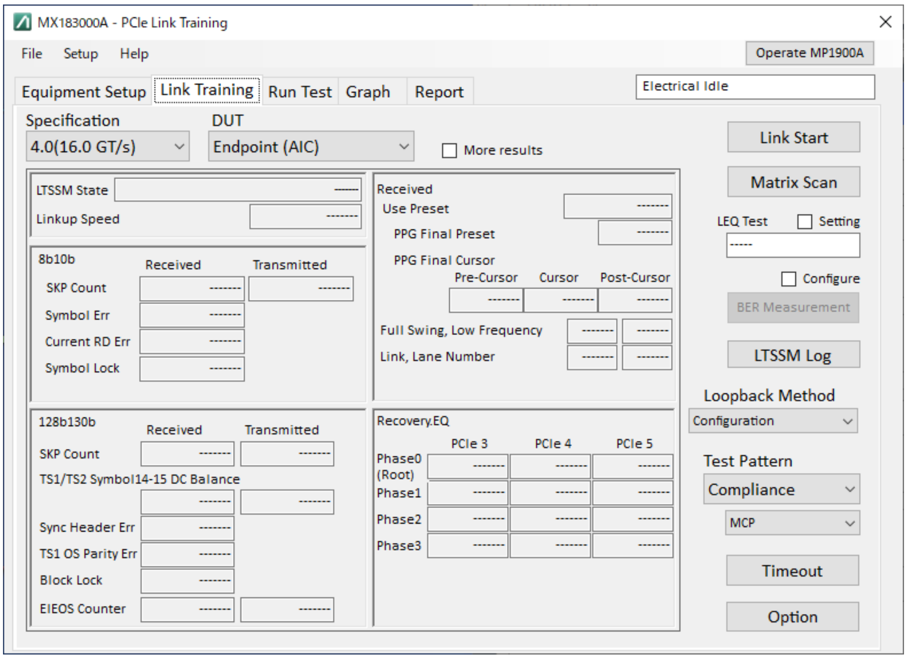
☐ No.2
TCPIP0::127.0.0.1::5001::SOCKET

☐ No.3
TCPIP0::127.0.0.1::5001::SOCKET

Figure 4.8.1-2 Equipment Setup Tab

4.8.2 PCIe Link Training setup

This section explains how to set the link training parameters and test patterns for PCIe measurement.


MX183000A - PCIe Link Training

Specification: 4.0(16.0 GT/s)

DUT: Endpoint (AIC)

☐ More results

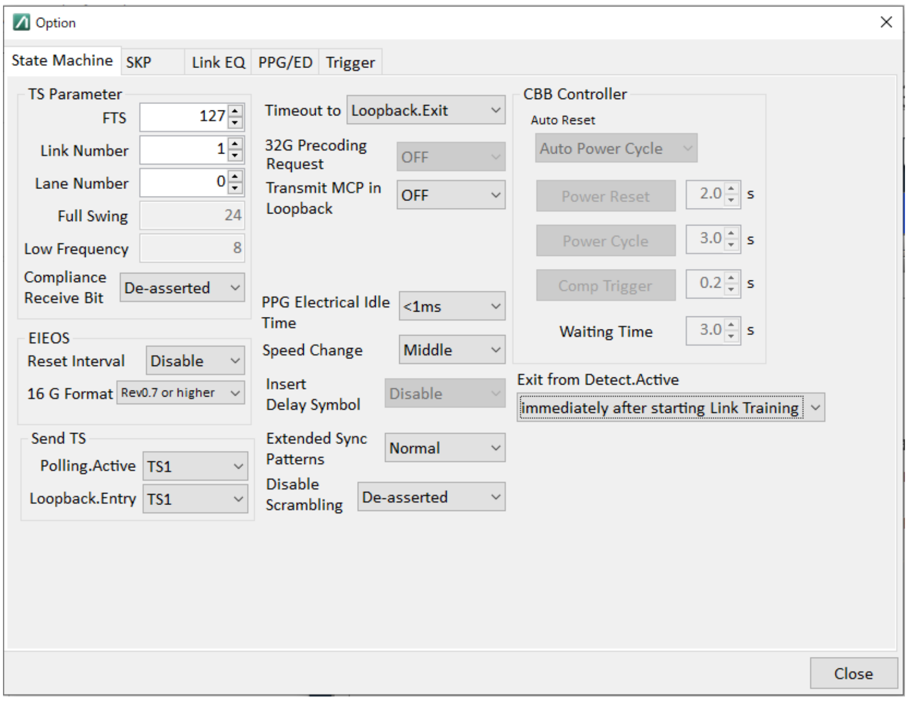
Electrical Idle

Loopback Method: Configuration

Test Pattern: Compliance, MCP

Figure 4.8.2-1 PCIe Link Training Setup Screen

Click **Option** shown in Figure 4.8.2-1 to display the PCIe Setup dialog box shown in Figure 4.8.2-2.


Option

TS Parameter

FTS: 127

Link Number: 1

Lane Number: 0

Full Swing: 24

Low Frequency: 8

Compliance Receive Bit: De-asserted

EIEOS

Reset Interval: Disable

16 G Format: Rev0.7 or higher

Send TS

Polling.Active: TS1

Loopback.Entry: TS1

Timeout to: Loopback.Exit

32G Precoding Request: OFF

Transmit MCP in Loopback: OFF

PPG Electrical Idle Time: <1ms

Speed Change: Middle

Insert Delay Symbol: Disable

Extended Sync Patterns: Normal

Disable Scrambling: De-asserted

CBB Controller

Auto Reset: Auto Power Cycle

Power Reset: 2.0 s

Power Cycle: 3.0 s

Comp Trigger: 0.2 s

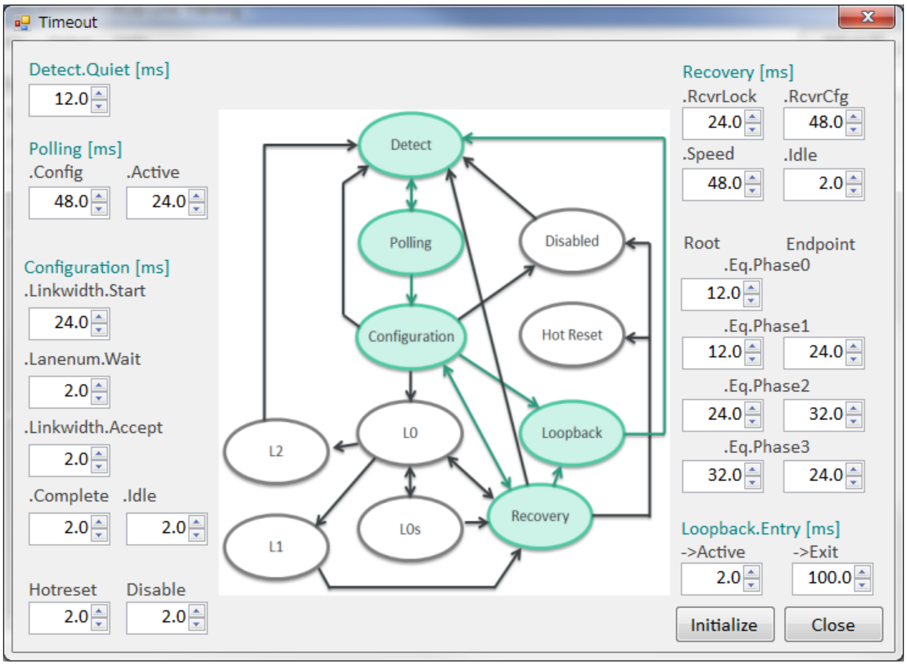
Waiting Time: 3.0 s

Exit from Detect.Active: immediately after starting Link Training

Figure 4.8.2-2 PCIe Link Training Option Setup Dialog Box

The setting items on the Option Setup dialog box are common with PCIe 4.0.

Click **Timeout** shown in Figure 4.8.2-1 to display the LTSSM Timeout setup dialog box shown in Figure 4.8.2-3.



Detect.Quiet [ms]
12.0

Polling [ms]
.Config 48.0
.Active 24.0

Configuration [ms]
.Linkwidth.Start 24.0
.Lanenum.Wait 2.0
.Linkwidth.Accept 2.0
.Complete 2.0
.Idle 2.0

Hotreset 2.0
Disable 2.0

Recovery [ms]
.RcvrLock 24.0
.RcvrCfg 48.0
.Speed 48.0
.Idle 2.0

	Root	Endpoint
.Eq.Phase0	12.0	
.Eq.Phase1	12.0	24.0
.Eq.Phase2	24.0	32.0
.Eq.Phase3	32.0	24.0

Loopback.Entry [ms]
->Active 2.0
->Exit 100.0

Figure 4.8.2-3　PCIe Link Training Timeout Dialog Box

Table 4.8.2-1 shows the setting items of Figure 4.8.2-1.

Table 4.8.2-1　PCIe Link Training Setup Items

Item	Description
Specification	Select PCIe specification from PCIe 1.0/1.1(2.5 GT/s), 2.0(5.0 GT/s), 3.0/3.1(8.0 GT/s), 4.0(16.0 GT/s), and 5.0(32 GT/s). When the MU181000A/B is installed, set PPG operation bitrate to PCIe 1.x:2.5 Gbit/s, PCIe 2.0:5.0 Gbit/s, PCIe 3.0/3.1:8.0 Gbit/s, and PCIe 4.0:16 Gbit/s.
DUT	Selects type of device under test (DUT). When set to Root Complex, DUT operates only with Separate Reference clock. On the **SKP** tab of the Option screen, set Clock Architecture to **SRIS** or **SRNS**. ***Note:*** The selection of DUT type in “Figure 4.8.1-2 Equipment Setup Tab” allows you to check the connection image. The DUT type selected on the **Equipment Setup** tab does not affect this setting. This is set to the value backed up automatically at the last time the MX183000A was closed.

Table 4.8.2-1 PCIe Link Training Setup Items (Cont'd)

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>LTSSM Log</td><td>Open the screen that displays log captured during training. For details, refer to 4.8.4 "Displaying PCIe Link Training Results".</td></tr>
<tr><td>Loopback Method</td><td>Selects the state to go through until DUT transition to the Loopback state is completed.
To perform Link Training in loopback between PPG and ED, set this item to "Configuration".
The following can be selected depending on Specification Rev.
<table>
<tr><th>Revision</th><th>Configuration</th><th>Recovery</th><th>Configuration EQ Bypass to 32G</th><th>Configuration No EQ</th><th>Recovery EQ Bypass to 32G</th><th>Recovery Full EQ</th></tr>
<tr><td>1.0/1.1(2.5 GT/s)</td><td>✓</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2.0(5.0 GT/s)</td><td>✓</td><td>✓</td><td></td><td></td><td></td><td></td></tr>
<tr><td>3.0/3.1(8.0 GT/s)</td><td>✓</td><td>✓</td><td></td><td></td><td></td><td></td></tr>
<tr><td>4.0(16.0 GT/s)</td><td>✓</td><td>✓</td><td></td><td></td><td></td><td></td></tr>
<tr><td>5.0(32 GT/s)</td><td></td><td></td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
</table>
Perform Link Equalization* when the following three conditions are met:
● Revision 3.0 or higher is selected.
● <b>Recovery</b> is selected.
● On the <b>Link EQ</b> tab of the Option screen, Recovery Phase2, 3 is set to <b>Try</b>.

To perform link training by using a loopback connection between PPG and ED, select <b>Configuration</b>.</td></tr>
</table>

*: Link Equalization:
A procedure of requesting the transmitter of each measuring instrument and DUT to change to the preset or coefficient optimal for the destination receiver. This procedure is performed in the Recovery.Equalization state. To perform link equalization in all of PCIe revisions 3, 4 and 5, on the **Link EQ** tab shown in Figure 4.8.2-2 "PCIe Link Training Option Setup Dialog Box", set Recovery Phase2, 3 to **Try**.

Table 4.8.2-1 PCIe Link Training Setup Items (Cont'd)

Item	Description
Loopback Method (Cont'd)	When PCIe 5.0 is selected, the following options are also available: Configuration EQ Bypass to 32G Changes the bit rate from 2.5G to 32G directly via the Configuration.Linkwidth.Start state, performs link equalization*, and then causes the DUT to enter the Loopback.Active state. Configuration No EQ Changes the bit rate from 2.5G to 32G via the Configuration.Linkwidth.Start state, and then causes the DUT to enter the Loopback.Active state. Recovery EQ Bypass to 32G Performs link equalization* for the bit rate of 32G only, not 8G or 16G, and then causes the DUT to enter the Loopback.Active state via the L0 state. Recovery Full EQ Performs link equalization* for the bit rate of 8G, 16G and 32G, and then causes the DUT to enter the Loopback.Active state via the L0 state.
Test Pattern	Selects the test pattern output repeatedly from Compliance or PRBS after completing the link training sequence transmission. When Compliance is selected, selection controller of PCIe standard test pattern is displayed. When PRBS is selected, PRBS pattern stage setup controller is displayed.
PRBS	Sets the number of the PRBS pattern stages for PPG/ED. Because PRBS pattern does not follow 8b10b or 128b130b encoding rules, a SKP pattern or a pattern for synchronization is not inserted into a PRBS pattern. Thus, the DUT in Loopback state may not recognize the pattern. To measure BER in a PRBS pattern, disable SKP Insert/Filter of the SKP items on the Option screen.
Compliance	Sets the standard test pattern of PCIe. MCP: Test pattern for BER measurement. CP: Test pattern for waveform calibration or Init Tx EQ and Tx LEQ Response Time Tests. Use MCP for BER measurement. Jitter Meas (Jitter Measurement Pattern): 1,0 pattern for jitter measurement. Use MCP for BER measurement. When the specification is set to 3.0/3.1 (8.0 GT/s) or higher, Jitter Meas (Jitter Measurement Pattern) can be set.
Timeout	The window of Figure 4.8.2-3 is displayed, and timeout can be set for LTSSM that transits during link training.
Option	The window of Figure 4.8.2-2 is displayed and proper setting of PCIe link training can be performed.

Table 4.8.2-2 shows the setting items of Figure 4.8.2-2.

Table 4.8.2-2 Option Setup Items

Item	Description
State Machine tab	
TS Parameter	
FTS	Sets the TS FTS Number. FTS is used for locking bit and symbol when transferring from L0 to L0.
Link Number	Sets the TS Link Number.
Lane Number	Sets the TS Lane Number.
Full Swing	Displays the Full Swing value for TS.
Low Frequency	Displays the Low Frequency value for TS.
Compliance Receive Bit	Sets the Compliance Receive bit in TS. It corresponds to bit 4 of symbol 5 in TS1 OS.
Disable Scrambling	Sets whether to use scrambling for TS.
EIEOS	
Reset Interval	Enables or disables Reset EIEOS Interval that is used in TS Recovery.Equalization State. Disable it in general cases. To use a longer PRBS pattern, enable Reset EIEOS Interval and obtain Block Alignment.
16 G Format	Sets whether to use EIEOS format of Base Spec Rev 0.7 or later. If this value is different from what DUT expects, the measuring instrument cannot transmit/receive data properly to/from DUT, because EIEOS is used for data block alignment.
Send TS	
Polling.Active	Sets the type of TS sent for Polling.Active State.
Loopback.Entry	Sets the type of TS sent for Loopback.Entry State.
Timeout to	When the measuring instrument is timed out in Loopback.Entry State, set a LTSSM state for next transition. When Loopback.Active is set and timed out in Loopback.Entry State, the measuring instrument is forced to be in Loopback.Active State, regardless of the DUT state.
32G Precoding Request	Sets whether to send a precoding request to the DUT. It corresponds to bit 0 of symbol 6 in EQ TS2 OS.
Transmit MCP in Loopback	Sets whether to request the DUT to transmit the MCP when it operates at 32.0GT/s and is in any lane other than the lane under test. It corresponds to bit 5 of symbol 5 in TS1 OS.
Insert Delay Symbol	Sets whether to insert Delay Symbol in MCP. It cannot be set when Specification is set to 3.0/3.1 (8.0 GT/s) or higher.
Extended Sync Patterns	Sets Normal or Extended. When set to Extended, “at least 1024 TS1 Ordered Sets are transmitted” is added to the transition conditions from Recovery.RcvrLock to Recovery.RcvrCfg.

Table 4.8.2-2 Option Setup Items (Cont'd)

Item	Description
State Machine tab (Cont'd)	
PPG Electrical Idle Time	Sets the period of time the signal from the PPG's Output connector is Electrical Idle before the MP1900A changes the bit rate. <1ms: Sets the Electrical Idle time to less than 1 ms. This is the Electrical Idle time specified in the PCIe Base Specification. ≥1ms: Sets the Electrical Idle time to 1 ms or more. During the period of time specified by **Speed Change**, the signal from the PPG's Output connector is Electrical Idle. With this setting, you can measure the tolerance of the DUT receiver to the Electrical Idle time.
Speed Change	Sets the time for changing the bit rate by the MP1900A. It is used to check the operation of the DUT Timeout time. Fast: Typ. 2.0 ms This is used to measure a special DUT whose Timeout time in the LTSSM state for changing the bit rate is faster than the value specified in the PCIe base specifications. When this setting is selected, set SSC of the MP1900A to OFF. Middle: Typ. 6.5 ms This is the recommended setting value. Low: Typ. 11 ms This is used to check the operation of the DUT Timeout time.

Table 4.8.2-2 Option Setup Items (Cont'd)

Item	Description
State Machine tab (Cont'd)	
CBB Controller	Controls the power supply to DUT connected to CBB 4.0 (Compliance Base Board) through CBB 4.0 control pins. This function allows you to omit manually resetting the power supply. Using this function in combination with remote commands enables the operation tests of DUT to be fully automated. For preparations before using this function, refer to 4.8.2.2 "About CBB ".
Auto Reset	Allows you to select a signal type to be sent to the CBB control pins when clicking **Link Start**, from the following. Auto Power Reset: Sends a signal to reset the power supply to DUT to the CBB control pins. Auto Power Cycle: Sends a signal to power on or off DUT to the CBB control pins. No: Sends no signal to any CBB control pins after clicking **Link Start**.
Power Reset	Clicking the button sends a Power Reset signal to CBB during the specified time (seconds). The time specified here is also applied to the power reset time after clicking **Link Start**, when **Auto Power Reset** is selected for **Auto Reset**.
Power Cycle	Clicking the button sends a Power OFF signal to CBB during the specified time (seconds). The time specified here is also applied to the power off time after clicking **Link Start**, when **Auto Power Cycle** is selected for **Auto Reset**.
Comp. Trigger	Clicking the button sends a Compliance Trigger signal to CBB during the specified time (seconds).
Waiting Time	Allows setting the waiting time after DUT is powered on again after resetting the power supply or turning the power off by clicking **Link Start**. Use this function for DUT that needs a time to be stable after turning the power on.

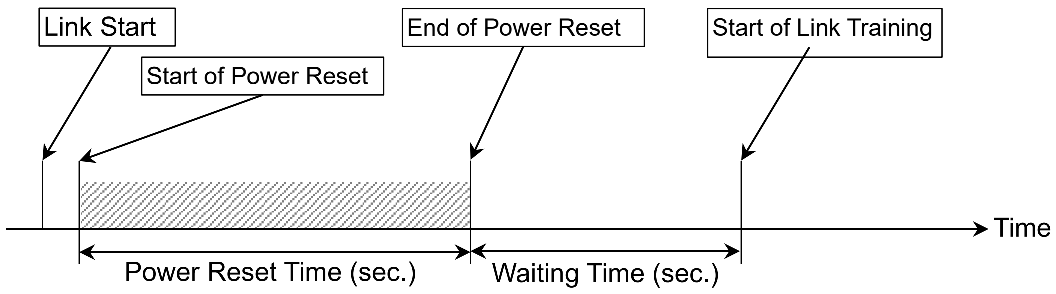


Figure 4.8.2-4 Control Flow for Link Start
(When Auto Power Reset Is Selected for Auto Reset)

Table 4.8.2-2 Option Setup Items (Cont'd)

Item	Description
State Machine tab (Cont'd)	
Exit from Detect.Active	Set the condition to make a transition from Detect.Active state to Polling.Active state during Link Training. immediately after starting Link Training: Makes a transition immediately after clicking **Link Start**. When detecting DUT 8b10b signal: Makes a transition when ED receives 8b10 signal from DUT after clicking **Link Start**.

Table 4.8.2-2 Option Setup Items (Cont'd)

Item	Description
SKP tab	Invalid when Test Pattern is set to **PRBS**. Symbol Length, Interval, and Double SKP can be set for 8b10b (2.5G, 5.0GT/s) and 128b130b (8.0G, 16.0GT/s) separately.
Clock Architecture	Select from the following three: Common (Common Reference Clock) SRIS (Separate Reference clocks with Independent SSC) SRNS (Separate Reference clocks with No SSC) In general, a compliance test is performed in Common Reference Clock Architecture. When switching this parameter, SKP OS-related items are set to their recommended values respectively. The MU181000B-x02 of the MU181000B Synthesizer is required when Common Reference Clock and DUT are operated by the **System** (Synchronize MP1900A with Ref Clock of DUT system). Common Reference Clock is not available when the items shown inFigure 4.8.2-1 are set as follows: Specification: PCIe 1.0 or PCIe 2.0 DUT: System
SSC	Sets whether to apply SSC (Spread Spectrum Clocking) to the data and clock output from the measuring instrument. When DUT is **System** and Clock Architecture is **Common**, **SSC** cannot be set to **ON** because the MP1900A synchronizes with the DUT clock.
Insert	Sets whether to insert SKP OS while sending TS. It is used for compensating the bit rate difference between the measuring instrument and DUT. Disable this parameter when Test Pattern is PRBS.
Symbol Length	Specifies the SKP OS length. When the speed difference between the measuring instrument and DUT is big, for example, when operating in Separate Reference Clock, set this value bigger.
Interval	Specifies the SKP OS interval. When the speed difference between the measuring instrument and DUT is big, for example, when operating in Separate Reference Clock, set the value smaller. This value does not apply to MCP to be transmitted in the Loopback.Active state because SKP Interval is specified.
Double SKP	Sets whether to insert double SKP into the test pattern (MCP) to send in Loopback.Active state.
Filter	Sets whether to remove the received SKP OS. Disable this parameter when Test Pattern is PRBS.

Table 4.8.2-2 Option Setup Items (Cont'd)

Item	Description
PPG/ED tab	
CTLE Gain	Sets CTLE gain for PCIe 3.0 or higher operation. Set CTLE gain to **OFF** for measuring systems with low insertion loss.
Tx Precoding	Sets whether to precode the data to be transmitted from Data Output of PPG. It corresponds to bit 6 of symbol 7 in TS1 OS.
Rx Precoding	Sets whether to precode the data to be received by Data Input of ED.
Tx Preset	
Tx Equalization for 2.5 GT/s	Sets the preset value at link start (in 2.5 GT/s operation).
Tx Equalization for Loopback.Active State (Auto/Manual)	Selects how to set Equalization of the test pattern to send in Loopback.Active state. Auto: Uses the Equalization figured out by Link Training (Recovery.Equalization state). The Equalization value is displayed at the location shown in "Figure 4.8.4-1 PCIe Link Training Results". When **Use Preset** is **Preset**: PPG Final Preset When **Use Preset** is **Cursor**: PPG Final Cursor Manual: The value specified by Loopback Preset is used.
Tx Equalization for Loopback.Active State	Selects Equalization for Test Pattern to be sent in Loopback.Active state, from Preset, Cursor and User. This value can be selected when **Manual** is selected for Loopback Preset Select. For details of this function, refer to 4.8.7 "Configuring BER Measurement settings for PCIe Link Training".

Table 4.8.2-2 Option Setup Items (Cont'd)

Item	Description
Trigger tab	Selects a signal to be output from PPG Aux output. It is used for observing waveforms on oscilloscope.
Trigger	Selects a trigger type.
Link Speed	Outputs trigger signal (pulse) when the measuring instrument transits to the link speed specified by this item and to the conditions specified by State or Change Preset during link training.
State	Outputs trigger signal (pulse) from PPG Aux Out when the measuring instrument transits to the LTSSM State that was specified by this item during link training. This parameter is enabled when **LTSSM** is selected for Trigger. Because the pulse signal output from Aux Out changes from 0 to –1 during the transition to the specified state, set the Scope trigger to Fall Edge. When transits from the specified state to the next state, the pulse signal changes from –1 to 0. Set the Scope trigger to Rise Edge. When using the negative side of the Aux Out connector, the operation is reversed.
Change Preset	Outputs trigger signal (pulse) from Aux output when the measuring instrument exchanges the Change Preset signals in Link Equalization (Phase 2 or 3). It is used for measuring the time from transmission or reception of Change Preset until the Preset value is actually changed in Tx LEQ Response Test. It is enabled when **Link EQ** is selected by Trigger.

Table 4.8.2-2 Option Setup Items (Cont'd)

Item	Description
Link EQ tab	These parameters are used after the Preset value is changed in Recovery.Equalization. They are used when Loopback Method is set to **Recovery** on the PCIe Link Training Setup screen (Figure 4.8.1-1).
Link EQ (Recovery Phase2, 3)	Sets whether to execute (Try) or skip (Bypass) Recovery.Equalization. When "skip" is selected, Phase2 through 4 of Recovery.Equalization are skipped.
Algorithm	Selects a method where the measuring instrument requests DUT to change Preset in Recovery.Equalization State. When **Increment** is selected, the measuring instrument requests DUT to increase Preset one by one. When **Change Preset** is selected, the measuring instrument requests DUT to change Preset directly to the value specified for Change Preset.
Repeat	Specifies a count where the measuring instrument requests DUT to change Preset in Recovery.Equalization State.
PCIe 2.0 Preset	
De-emphasis	Sets De-emphasis that is specified in TS that PPG sends and is notified to DUT. It is displayed when **PCIe 2.0** is selected for Specification.
PCIe 3.0/3.1, PCIe 4.0, PCIe 5.0	
Use Preset*1, *2	Select the equalizer specification for DUT from Preset, Cursor, Saved Cursor, and User Cursor. Use Preset for Rx Test, and Preset and Saved Cursor for Tx LEQ Response Test. When tested by Preset, obtain the cursor value from DUT corresponding to the specified Preset value through link equalization and saves it in Saved Cursor. Saved Cursor is used for Tx LEQ Response Test. For how to use the function, refer to 4.8.2.1 "Saved Cursor" or 4.8.6.3 "Transmitter Link Equalization Response (Tx LEQ Response)". Cursor can be used for Tx LEQ Response Test by notifying DUT of the Cursor value corresponding to the Preset value hard-coded to MP1900A. User Cursor is a method to notify DUT of any Cursor value. If User Cursor is selected, set the value to notify from DUT to FS. For C-1 and C+1, set the cursor values that are notified to Tx of DUT. C0 displays the value obtaind by C0 = FS – C-1 – C+1.

Table 4.8.2-2 Option Setup Items (Cont'd)

Item	Description
Link EQ tab (Cont'd)	
PCIe 3.0/3.1, PCIe 4.0, PCIe 5.0 (Cont'd)	
Saved Cursor*1, *2	Opens the dialog box described in 4.8.2.1, " Saved Cursor".
Downstream*1	
DUT is AIC: Starting Preset*2 DUT is Host: Preset Hint (Tx)*2	Starting Preset: Sets Preset of the measuring instrument at Recovery.EQ start. The measuring instrument is set to the requested Preset when receiving a Preset change request from DUT (AIC) in Recovery.EQ.Phase2. Preset Hint (Tx): Sets a desired Preset for transmitting DUT (System) at Recovery.EQ start. By setting Link EQ to "Try" and selecting a value for Algorithm, the operation of Recovery.EQ.Phase2 is as below. Increment: Tries to change the Preset value for the number of times specified for Recovery.EQ. For example, when Preset Hint is set to Preset7 and Repeat is set to 1 only Preset7 is tried. When it is set to Preset7 and Repeat is set to 3, Preset7, 8, and 9 are tried. Change Preset: Changes the Preset value from the value specified for Preset Hint to the value specified by Change Preset in Recovery.EQ. It is used for Rx LEQ Test.
Preset Hint (Rx)*2	Sets Receiver Preset Hint (Rx). Displayed only when Rev 3.x is selected.
Recovery.EQ.Phase2	Enabled when DUT is Root Complex (System) and Algorithm is set to **Change Preset**.
Change Preset*2	Sets the Preset value which the measurement instrument requests DUT (System) to change from Preset Hint (Tx) value in Recovery.EQ.Phase2.

*1: These values are displayed in PCIe 3.0/3.1, PCIe 4.0, or PCIe 5.0.

*2: These values are set for LEQ Test described in 4.8.6, "Executing PCIe Link Training Link Equalization test". When **Apply** is clicked in the **LEQ Test** area, the parameters in the **LEQ Test** area are applied to those used for Link Training.

Also, when "PCIe Link Training Matrix Scan" in 4.8.8 is performed, the values in the **LEQ Test** area are set to the parameters used for Link Training.

Table 4.8.2-2 Option Setup Items (Cont'd)

Item	Description
Link EQ tab (Cont'd)	
PCIe 3.0/3.1, PCIe 4.0, PCIe 5.0 (Cont'd)	
Upstream	
DUT is AIC: Preset Hint (Tx)*2 DUT is Host: Starting Preset*2	Starting Preset: Sets Preset of the measuring instrument at Recovery.EQ start. Preset Hint (Tx): Sets a desired Preset for transmitting DUT (AIC) at Recovery.EQ start. By setting Link EQ to "Try" and selecting a value for Algorithm, the operation of Recovery.EQ.Phase3 is as below. Increment: Tries to change the Preset value for the number of times specified for Repeat in Recovery.EQ. For example, when Preset Hint is set to Preset7 and Repeat is set to 1, only Preset7 is tried. When it is set as Preset7 and Repeat is set to 3, Preset7, 8, and 9 are tried. Change Preset: Changes the Preset value from the value specified here to the value specified by Change Preset in Recovery.EQ. It is used for Rx LEQ Test.
Preset Hint (Rx)*2	Sets Receiver Preset Hint (Rx). Displayed only when Rev 3.x is selected.
Recovery.EQ.Phase3	Enabled when DUT is Endpoint (AIC) and Algorithm is set to Change Preset.
Change Preset*2	Sets the Preset value which the measurement instrument requests DUT (AIC) to change from Preset Hint (Tx) value in Recovery.EQ.Phase3.

Table 4.8.2-3 shows the setting items of Figure 4.8.2-3.

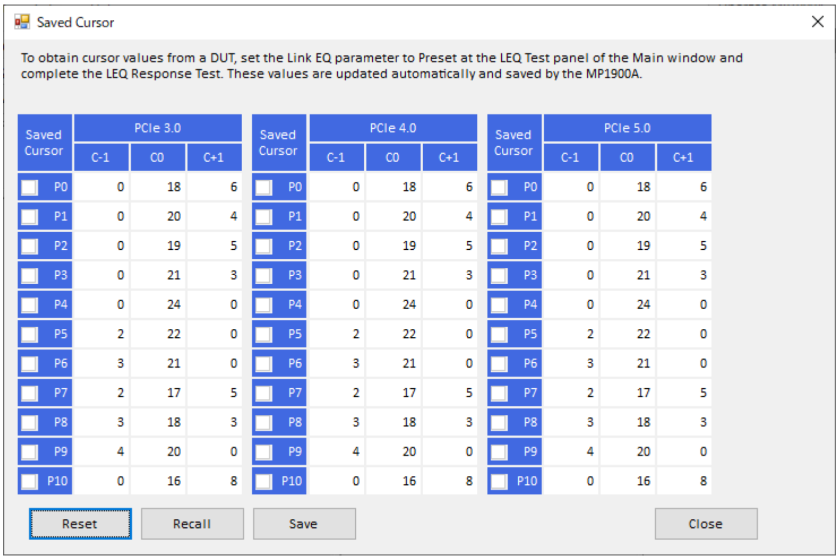
Table 4.8.2-3 Timeout Setup Items

Item	Description
Detect	Sets the timeout (ms) for each state.
Quiet	
Polling	
Config	
Active	
Configuration	
Linkwidth.Start	
Lanenum.Wait	
Linkwidth.Accept	
Complete	
Idle	
Recovery	
RcvrLock	
RcvrCfg	
Speed	
Idle	
Equalizaion.Phase1-3	
Equalizaion.Phase0-3 (DUT is in Root Complex)	
Loopback	
Entry (to Active)	
Entry (to Exit)	
Hotreset	
Disable	
Initialize	Resets the Timeout setting items to defaults.
Close	Closes the Timeout setup screen.

4.8.2.1 Saved Cursor

This function is to execute Transmitter Link Equalization Response Test. MP1900A keeps the cursor value corresponding to the Preset value notified from DUT during link training, and uses it to specify the Equalizer setting for DUT by cursor value. These functions are valid only in PCIe 3.0 or higher.

To display the Saved Cursor dialog box, click Saved Cursor... on the **Link EQ** tab of the LEQ test or Option screen.



To obtain cursor values from a DUT, set the Link EQ parameter to Preset at the LEQ Test panel of the Main window and complete the LEQ Response Test. These values are updated automatically and saved by the MP1900A.

Saved Cursor	PCIe 3.0			Saved Cursor	PCIe 4.0			Saved Cursor	PCIe 5.0		
	C-1	C0	C+1		C-1	C0	C+1		C-1	C0	C+1
☐ P0	0	18	6	☐ P0	0	18	6	☐ P0	0	18	6
☐ P1	0	20	4	☐ P1	0	20	4	☐ P1	0	20	4
☐ P2	0	19	5	☐ P2	0	19	5	☐ P2	0	19	5
☐ P3	0	21	3	☐ P3	0	21	3	☐ P3	0	21	3
☐ P4	0	24	0	☐ P4	0	24	0	☐ P4	0	24	0
☐ P5	2	22	0	☐ P5	2	22	0	☐ P5	2	22	0
☐ P6	3	21	0	☐ P6	3	21	0	☐ P6	3	21	0
☐ P7	2	17	5	☐ P7	2	17	5	☐ P7	2	17	5
☐ P8	3	18	3	☐ P8	3	18	3	☐ P8	3	18	3
☐ P9	4	20	0	☐ P9	4	20	0	☐ P9	4	20	0
☐ P10	0	16	8	☐ P10	0	16	8	☐ P10	0	16	8

Figure 4.8.2.1-1 Saved Cursor Dialog Box

Table 4.8.2.1-1 Saved Cursor Setup Items

Item	Description
Reset	Resets Saved Cursor values to their initial values.
Recall	Recalls Saved Cursor values from a file.
Save	Saves Saved Cursor values to a file
Close	Closes the Saved Cursor dialog box.

Saved Cursor is updated when one of the following conditions is met.

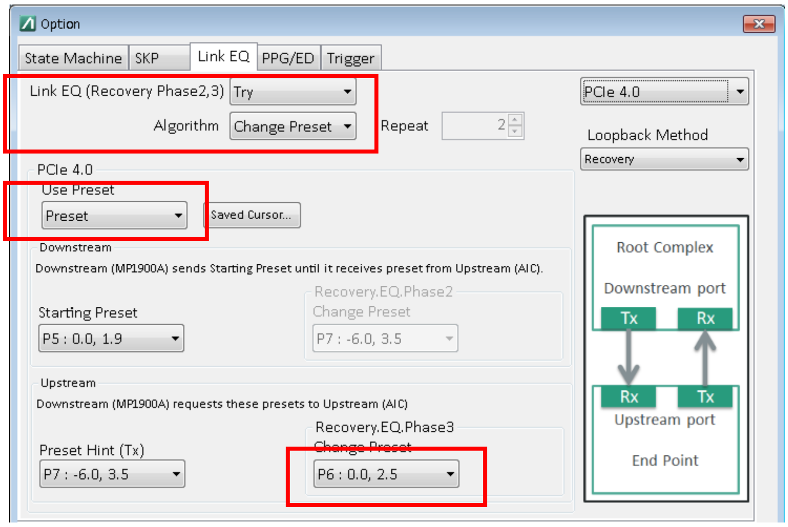
1 Loopback Method is set to **Recovery** on the PCIe Link Training Setup Screen (Figure 4.8.2-1).

2 UsePreset is set to **Preset** on the **Link EQ** tab of the Option dialog box. Also, Link EQ (Recovery Phase2, 3) is set to **Try** (See Figure 4.8.2.1-2).

3 When the above conditions 1 and 2 are met together, **Link Start** is clicked on the PCIe Link Training Setup Screen (Figure 4.8.2-1) and

the cursor value is transmitted/received normally in Phase2 or 3 of Recovery.Equalization State.

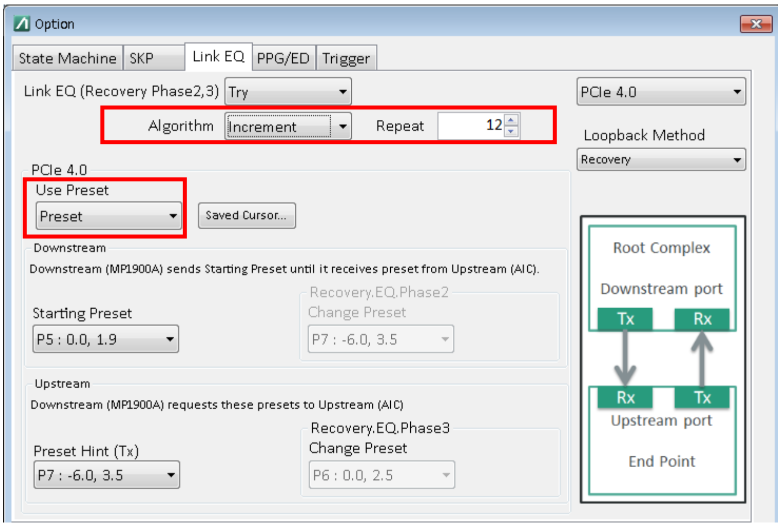
For example, if Link Training is performed with the following settings, the Saved Cursor value of Preset0 specified at Change Preset of PCIe 4.0 is updated.



Link EQ (Recovery Phase2,3): Try
Algorithm: Change Preset
Repeat: 2
PCIe 4.0
Loopback Method: Recovery
PCIe 4.0
Use Preset: Preset
Downstream
Downstream (MP1900A) sends Starting Preset until it receives preset from Upstream (AIC).
Starting Preset: P5 : 0.0, 1.9
Recovery.EQ.Phase2 Change Preset: P7 : -6.0, 3.5
Upstream
Downstream (MP1900A) requests these presets to Upstream (AIC)
Preset Hint (Tx): P7 : -6.0, 3.5
Recovery.EQ.Phase3 Change Preset: P6 : 0.0, 2.5

Figure 4.8.2.1-2 Preset Setting Example

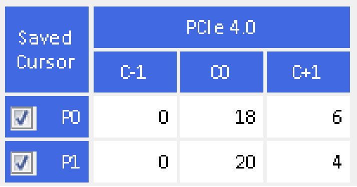
When Algorithm is set to **Increment** and Repeat is set to **12** as in the figure below, The cursor values corresponding to all preset values can be updated collectively by one link training.



Link EQ (Recovery Phase2,3): Try
Algorithm: Increment
Repeat: 12
PCIe 4.0
Loopback Method: Recovery
PCIe 4.0
Use Preset: Preset
Downstream
Downstream (MP1900A) sends Starting Preset until it receives preset from Upstream (AIC).
Starting Preset: P5 : 0.0, 1.9
Recovery.EQ.Phase2 Change Preset: P7 : -6.0, 3.5
Upstream
Downstream (MP1900A) requests these presets to Upstream (AIC)
Preset Hint (Tx): P7 : -6.0, 3.5
Recovery.EQ.Phase3 Change Preset: P6 : 0.0, 2.5

Figure 4.8.2.1-3 Algorithm Setting Example

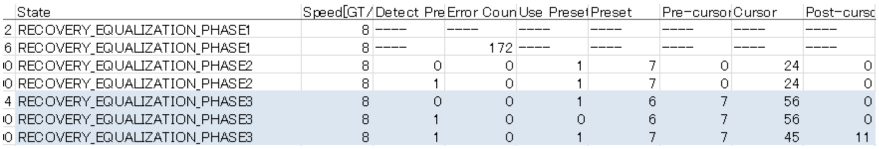
When the values notified by DUT are saved, the checkboxes are selected as in the figure below.



Saved Cursor		PCIe 4.0		
		C-1	C0	C+1
☑	P0	0	18	6
☑	P1	0	20	4

Figure 4.8.2.1-4 Saved Cursor Checkboxes

The cursor values sent to/received from DUT can be checked in the LTSSM log.

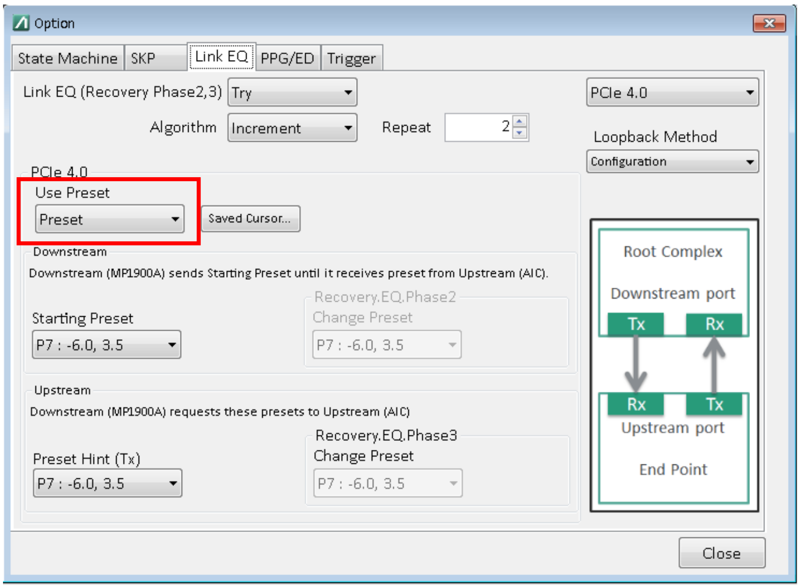


	State	Speed[GT/	Detect Pre	Error Coun	Use Preset	Preset	Pre-cursor	Cursor	Post-cursc
2	RECOVERY_EQUALIZATION_PHASE1	8	----	----	----	----	----	----	----
6	RECOVERY_EQUALIZATION_PHASE1	8	----	172	----	----	----	----	----
0	RECOVERY_EQUALIZATION_PHASE2	8	0	0	1	7	0	24	0
0	RECOVERY_EQUALIZATION_PHASE2	8	1	0	1	7	0	24	0
4	RECOVERY_EQUALIZATION_PHASE3	8	0	0	1	6	7	56	0
0	RECOVERY_EQUALIZATION_PHASE3	8	1	0	0	6	7	56	0
0	RECOVERY_EQUALIZATION_PHASE3	8	1	0	1	7	7	45	11

Figure 4.8.2.1-5 LTSSM Log

How to use acquired values

Change Use Preset to **Saved Cursor** as in the following figure and start link training when the values notified by DUT are saved. This commands DUT to change the equalizer by the cursor values corresponding to the set Preset Hint and Change Preset values.



Link EQ (Recovery Phase2,3): Try
Algorithm: Increment
Repeat: 2
PCIe 4.0
Loopback Method: Configuration

PCIe 4.0
Use Preset: Preset

Downstream
Downstream (MP1900A) sends Starting Preset until it receives preset from Upstream (AIC).
Starting Preset: P7 : -6.0, 3.5
Recovery.EQ.Phase2
Change Preset: P7 : -6.0, 3.5

Upstream
Downstream (MP1900A) requests these presets to Upstream (AIC)
Preset Hint (Tx): P7 : -6.0, 3.5
Recovery.EQ.Phase3
Change Preset: P7 : -6.0, 3.5

Figure 4.8.2.1-6 Link EQ Tab

To perform a test according to the compliance test, refer to 4.8.6.3 “Transmitter Link Equalization Response (Tx LEQ Response)”.

4.8.2.2 About CBB controller

This function allows you to automatically run the operation tests of DUT by controlling the power supplies connected to CBB 4.0 through CBB 4.0 control pins without resetting the power supplies manually. Using this function in combination with remote commands enables the operation tests of DUT to be fully automated. Z2025A must be installed to use this function.
This function is assumed to control DUT through CBB 4.0 and is valid for DUT that can be implemented in CBB 4.0
This function is available only for PCIe Link Training (PL-021).

For how to activate this function, refer to the Installation Guide that came with Z2025A.

4.8.3 Starting PCIe Link Training

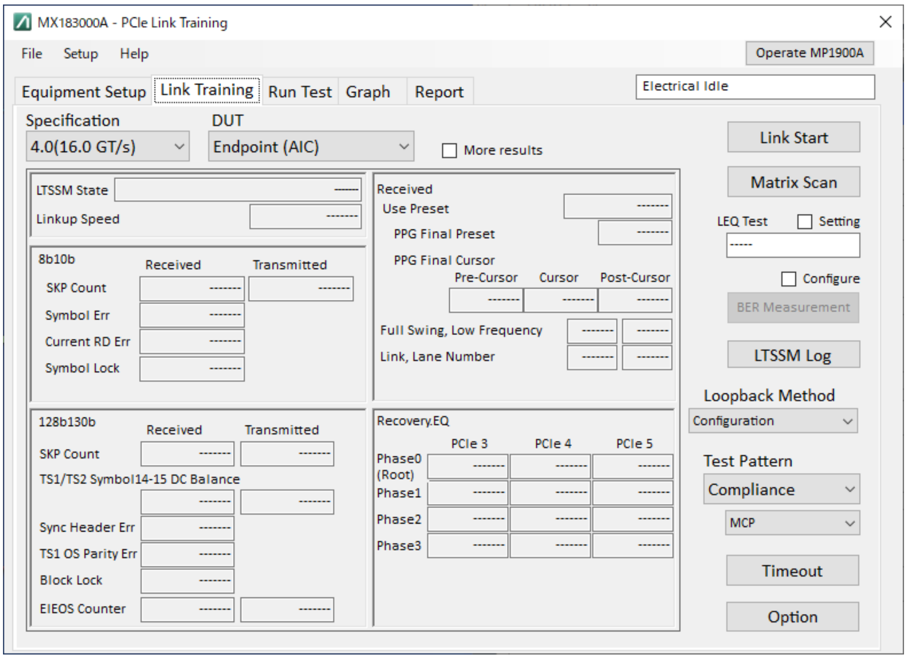
1. Press the PCIe Compliance Base Board reset switch before starting measurement.
2. Click **Link Start**. Link training with DUT starts.

   Link Start changes to **Stop** during link training. It changes to **Unlink** when the link training is completed and the PPG status changes from Electrical Idle to Loopback Active. At that time, PPG sends a test pattern.
3. Clicking **Unlink** while the test pattern is being sent aborts the test pattern transmission, and the PPG returns to Electrical Idle status.

   For how to display link success/failure or LTSSM transition log, refer to 4.8.4 “Displaying PCIe Link Training results” and 4.8.5 “Displaying LTSSM Log of PCIe Link Training”.
4. If you wish to measure Jitter Tolerance after this, refer to 4.6 “Jitter Tolerance Test” for details of the **Run Test** tab, **Graph** tab, and **Report** tab.
5. If you wish to measure BER after this, click **BER Measurement**. For details of the BER Measurement, refer to 4.4.4 “Setting Up PCIe BER Measurement” and 4.4.5 “Starting PCIe BER Measurement”.

4.8.4 Displaying PCIe Link Training results

After performing link training as explained in 4.8.3, the results can be displayed.



Electrical Idle

Specification: 4.0(16.0 GT/s)

DUT: Endpoint (AIC)

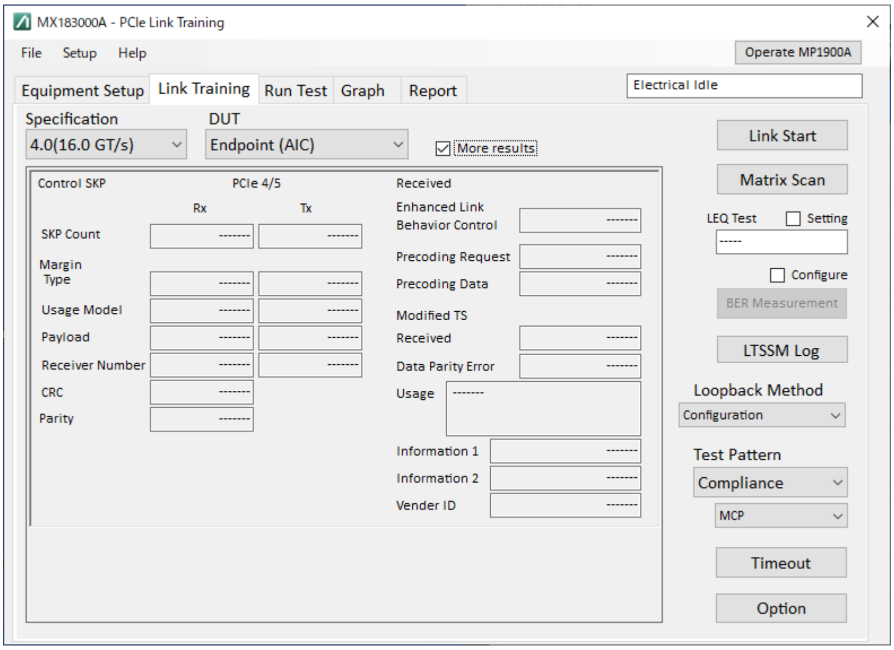
☐ More results

Loopback Method: Configuration

Test Pattern: Compliance

MCP

Figure 4.8.4-1 PCIe Link Training Results



Electrical Idle

Specification: 4.0(16.0 GT/s)

DUT: Endpoint (AIC)

☑ More results

Loopback Method: Configuration

Test Pattern: Compliance

MCP

Figure 4.8.4-2 PCIe Link Training Results
(When the More results Check Box is Selected)

Table 4.8.4-1 PCIe Link Training Results

Item	Description
Common Parameter	
LTSSM State	Displays LTSSM State of measuring instrument.
Linkup Speed	Displays Link Speed (2.5, 5.0, 8.0, 16.0, or 32.0 GT/s).
SKP 128b/130b	
SKP Count (Rx, Tx)	Displays the SKP OS number counted during link training or in the Loopback.Active state. Rx and Tx have separate counts
TS1/TS2 Symbol 14-15 DC Balance (Rx, Tx)	Displays the DC balance obtained during link training. If the data stream contains more 1s than 0s, the difference is counted as a positive value. If more 0s than 1s, a negative value. Rx and Tx have separate counts.
Sync Header Error	Displays the Sync Header Error number counted during link training or in the Loopback.Active state.
TS1 OS Parity Error	Displays the Parity Error number counted during link training.
Block Lock	Displays the Block Lock number counted during link training.
EIEOS Counter (Rx, Tx)	Displays the number of EIEOS counted during Link Training or in the Loopback.Active state. Rx and Tx have separate counts
SKP 8b/10b	
SKP Count (Rx, Tx)	Displays the SKP OS number counted during link training. Rx and Tx have separate counts
Symbol Error	Displays the Symbol Error number counted during link training.
Current RD Error	Displays the Running Disparity number during link training.
Symbol Lock	Displays the Symbol Lock state.

Table 4.8.4-1 PCIe Link Training Results (Cont'd)

Item	Description
Link Equalization	Displays the Link Equalization state. Displayed when the specification is set to 3.0/3.1 or higher. Also, each specification has its own value.
Phase0	Displays the Link Equalization result of each phase. Phase0 is displayed when **Root Complex** is selected for DUT. All phases are Incomplete when one of the following conditions is met. ● Loopback Method is set to **Configuration**. ● Recovery and Link EQ (Recovery Phase2, 3) are set to **Skip**. (in case of Tx EQ Initial Test) ● Transition to another phase failed due to an error.
Phase1	
Phase2	
Phase3	
Received	
Use Preset	Displays the method (Preset or Cursor) of EQ to be used by PPG notified from the DUT.
PPG Final Preset	Displays the Preset used by PPG notified from the DUT. It is displayed only when Specification 3.0/3.1 or higher is selected. When Use Preset is **Preset**, this value is valid.
PPG Final Cursor	Displays the Cursor sent from PPG notified from the DUT. It is displayed only when Specification 3.0/3.1 or higher is selected. When Use Preset is **Cursor**, this value is valid.
Full Swing	Displays the Full Swing notified from the DUT.
Low Frequency	Displays the Low Frequency notified from the DUT.
Link Number	Displays the Link Number notified from the DUT.
Lane Number	Displays the Lane Number notified from the DUT.
Request Equalization	Displays the Request Equalization notified from the DUT. It is displayed when the DUT is Root Complex.
PCIe 4.0 / 5.0 Control SKP	
Count (Rx/Tx)	Displays the count value of Control SKP OS.
Margin Type (Rx/Tx)	Displays Margin Type in Control SKP OS (Symbol 4*N+2, Bits 5:3).*
Usage Model (Rx/Tx)	Displays Usage Model in Control SKP OS (Symbol 4*N+2, Bit 6).
Payload (Rx/Tx)	Displays Margin Payload in Control SKP OS (Symbol 4*N+3, Bits 7:0).*
Receiver Number (Rx/Tx)	Displays Receiver Number in Control SKP OS (Symbol 4*N+2, Bits 2:0).*
CRC	Displays Margin CRC Error count in Control SKP OS.
Parity	Displays Margin Parity Error count in Control SKP OS (Symbol 4*N+2, Bit 7).*

*: N represents an integer from 1 to 5.

Table 4.8.4-1 PCIe Link Training Results (Cont'd)

Item		Description
PCIe 5.0 TS		
	Enhanced Link Behavior Control	Displays the information on whether to perform Link Equalization or whether Modified TS1/TS2 for using an alternative standard for PCIe is supported. It corresponds to bits 7:6 of symbol 5 in TS1/2 OS. Full EQ: Full Equalization required Link Equalization is performed. Note that Modified TS1/TS2 Ordered Sets are not supported. Bypass EQ: Equalization bypass to highest rate support Link Equalization is performed at 32 GT/s when set by Loopback Lead. Note that Modified TS1/TS2 Ordered Sets are not supported. No EQ: No Equalization Needed Link Equalization is not performed. Note that Modified TS1/TS2 Ordered Sets are not supported. Modified TS1/TS2: Modified TS1/TS2 Ordered Sets supported Modified TS1/TS2 Ordered Sets used for Link Training in an alternate protocol are supported.
	Precoding Request	Displays whether the measuring instrument received a precoding requested from the DUT.
	Precoding Data	Displays whether the measuring instrument received TS1/TS2 OS for Precoding ON from the DUT.

Table 4.8.4-1 PCIe Link Training Results (Cont'd)

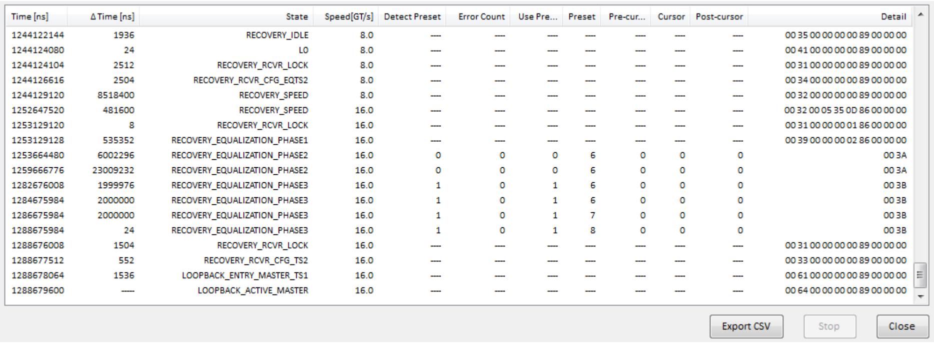
Item	Description
Modified TS	MP1900A does not support Alternate Protocol Negotiation.
Received Number	Displays the number of Modified TS1/TS2 OS received per 100 ms.
Data Parity Error	Displays the number of data parity errors detected per 100 ms.
Usage	Displays the information of bits 2:0 of symbols 8 to 9 in Modified TS1/TS2 OS. 000b: PCIe protocol only 001b: PCIe protocol only with vendor defined Training Set Messages 010b: Alternate Protocol Negotiation
Information 1	Displays the information of bits 15:3 of symbols 8 to 9 in Modified TS1/TS2 OS. When Modified TS Usage is 001b or 010b, they respectively indicate the information corresponding to Usage. If the received value is other than those shown above, it is displayed but meaningless because it is reserved for future standardization.
Information 2	Displays the information of symbols 12 to 14 in Modified TS1/TS2 OS. When Modified TS Usage is 001b or 010b, they respectively indicate the information corresponding to Usage. If the received value is other than those shown above, it is displayed but meaningless because it is reserved for future standardization.
Vender ID	Displays the information of symbols 10 to 11 in Modified TS1/TS2 OS. The Vendor ID to be displayed depends on the value of Modified TS Usage. 001b: Training Set Message Vendor ID 010b: Alternate Protocol Vendor ID If the received value is other than those shown above, it is displayed but meaningless because it is reserved for future standardization.

4.8.5　Displaying LTSSM Log of PCIe Link Training

After performing link training as explained in 4.8.3, click **LTSSM Log** to display log.

The Log Data is recorded when one of the following condition is met.

- When LTSSM State is switched
- When changing Preset is requested at Recovery.Equalization State



Time [ns]	ΔTime [ns]	State	Speed[GT/s]	Detect Preset	Error Count	Use Pre...	Preset	Pre-cur...	Cursor	Post-cursor	Detail
1244122144	1936	RECOVERY_IDLE	8.0	----	----	----	----	----	----	----	00 35 00 00 00 00 89 00 00 00
1244124080	24	L0	8.0	----	----	----	----	----	----	----	00 41 00 00 00 00 89 00 00 00
1244124104	2512	RECOVERY_RCVR_LOCK	8.0	----	----	----	----	----	----	----	00 31 00 00 00 00 89 00 00 00
1244126616	2504	RECOVERY_RCVR_CFG_EQTS2	8.0	----	----	----	----	----	----	----	00 34 00 00 00 00 89 00 00 00
1244129120	8518400	RECOVERY_SPEED	8.0	----	----	----	----	----	----	----	00 32 00 00 00 00 89 00 00 00
1252647520	481600	RECOVERY_SPEED	16.0	----	----	----	----	----	----	----	00 32 00 05 35 0D 86 00 00 00
1253129120	8	RECOVERY_RCVR_LOCK	16.0	----	----	----	----	----	----	----	00 31 00 00 00 01 86 00 00 00
1253129128	535352	RECOVERY_EQUALIZATION_PHASE1	16.0	----	----	----	----	----	----	----	00 39 00 00 00 02 86 00 00 00
1253664480	6002296	RECOVERY_EQUALIZATION_PHASE2	16.0	0	0	0	6	0	0	0	00 3A
1259666776	23009232	RECOVERY_EQUALIZATION_PHASE2	16.0	0	0	0	6	0	0	0	00 3A
1282676008	1999976	RECOVERY_EQUALIZATION_PHASE3	16.0	1	0	1	6	0	0	0	00 3B
1284675984	2000000	RECOVERY_EQUALIZATION_PHASE3	16.0	1	0	1	6	0	0	0	00 3B
1286675984	2000000	RECOVERY_EQUALIZATION_PHASE3	16.0	1	0	1	7	0	0	0	00 3B
1288675984	24	RECOVERY_EQUALIZATION_PHASE3	16.0	1	0	1	8	0	0	0	00 3B
1288676008	1504	RECOVERY_RCVR_LOCK	16.0	----	----	----	----	----	----	----	00 31 00 00 00 00 89 00 00 00
1288677512	552	RECOVERY_RCVR_CFG_TS2	16.0	----	----	----	----	----	----	----	00 33 00 00 00 00 89 00 00 00
1288678064	1536	LOOPBACK_ENTRY_MASTER_TS1	16.0	----	----	----	----	----	----	----	00 61 00 00 00 00 89 00 00 00
1288679600	-----	LOOPBACK_ACTIVE_MASTER	16.0	----	----	----	----	----	----	----	00 64 00 00 00 00 89 00 00 00

Figure 4.8.5-1　LTSSM Log Viewer

Table 4.8.5-1　LTSSM Log Viewer

Item	Description
Time [ns]	Displays the time the log data was acquired. The start of acquisition is zero.
ΔTime [ns]	Displays the time interval between when the log data was acquired and when next log data was acquired.
State	Displays LTSSM State.
Speed[GT/s]	Displays Link Speed [GT/s].
Detect Preset*	Displays whether the Preset information in the LTSSM log is the value sent from the MP1900A or sent from the DUT. 0: Indicates the Preset-related value was sent from MP1900A to DUT. 1: Indicates the Preset-related value was received by MP1900A from DUT.
Error Count*	Displays error count of the following cases. ● When a bit error is detected in Recovery.EQ.Phase2 or Recovery.EQ.Phase3.
Use Preset*	Displays the Use Preset value selected at Recovery.EQ State. 1 means Preset, and 0 means Cursor.
Preset*	Displays the Preset value selected at Recovery.EQ State. When Detect Preset is 0, the Preset value sent from the MP1900A to the DUT is displayed. When Detect Preset is 1, the Preset value sent from the DUT to the MP1900A is displayed.

*:　The value is displayed when the following conditions are met:
Loopback Method is set to **Recovery**, and DUT goes through Recovery.Equalization Phase3 (at End Point test) or Phase2 (at Root Complex test) of LTSSM State.
Specification Rev is set to 3.0/3.1, 4.0, or 5.0.

Table 4.8.5-1 LTSSM Log Viewer (Cont'd)

Item	Description
Postcursor*	Displays the Precursor value selected at Recovery EQ State. When Detect Preset is 0, the Prescursor/Cursor/Postcursor value notified from the MP1900A to the DUT is displayed. When Detect Preset is 1, the Prescursor/Cursor/Postcursor value notified from the DUT to the MP1900A is displayed.
Cursor*	
Postcursor*	
FS	Displays the FS and LF values notified from the DUT at Recovery.EQ State.
LF	
Precoding Request	Displays whether the measuring instrument received a precoding request from the DUT.
Precoding Data	Displays whether the measuring instrument received TS1/TS2 OS for Precoding ON from the DUT.
Export CSV	Saves logs in the csv format. This is enabled when the log decoding is completed.
Detail	Displays the management code.
Progress bar	Displays log decoding progress. It disappears when the decoding is completed.
Stop	Aborts log decoding.
Close	Closes Log Viewer.

4.8.6 Executing PCIe Link Training Link Equalization test

This is a test function to perform the following Link Equalization Tests defined in *PCI Express® Architecture PHY Test Specification Revision 3.0, Ver. 1.0* published by PCI-SIG.

2.3. Add-in Card Transmitter Initial TX EQ test
2.4. Add-in Card Transmitter Link Equalization Response Test
2.7. System Board Transmitter Link Equalization Response Test
2.10. Add-in Card Receiver Link Equalization Test
2.11. System Receiver Link Equalization Test

Take the following steps to perform Link Equalization Test (LEQ Test). Click the Setting checkbox next to LEQ Test on the **Link Training** tab to display the Setup screen.
The values set by this function are automatically applied to the parameters of this application. The general flow to use this function is as below.

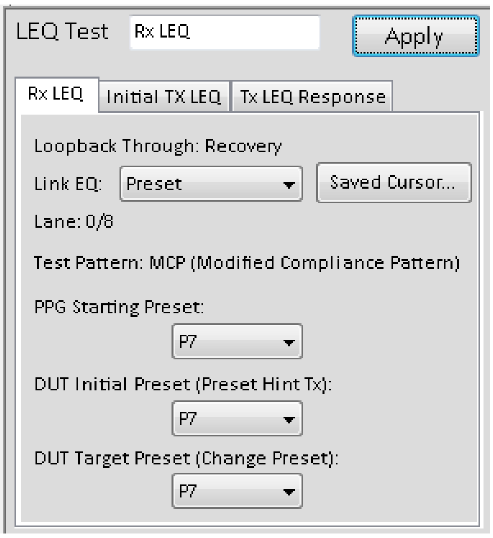
- Initialize this application.
- Select a desired Specification (ex. PCIe 4.0).
- Select a desired LEQ Test and click **Apply**.
- Click **Link Start**.

4.8.6.1 Receiver Link Equalization test (Rx LEQ)

This is a test function to perform the following tests.

2.10. Add-in Card Receiver Link Equalization Test
2.11. System Receiver Link Equalization Test

It checks that DUT is changed to the Preset value specified by the measuring instrument (Change Preset) and that the measurement result is error-free in Recovery.Equalization.Phase2 or 3.


LEQ Test: Rx LEQ

Loopback Through: Recovery

Link EQ: Preset

Lane: 0/8

Test Pattern: MCP (Modified Compliance Pattern)

PPG Starting Preset: P7

DUT Initial Preset (Preset Hint Tx): P7

DUT Target Preset (Change Preset): P7

Figure 4.8.6.1-1 Rx LEQ Tab

1. Connect the devices as the following figure.

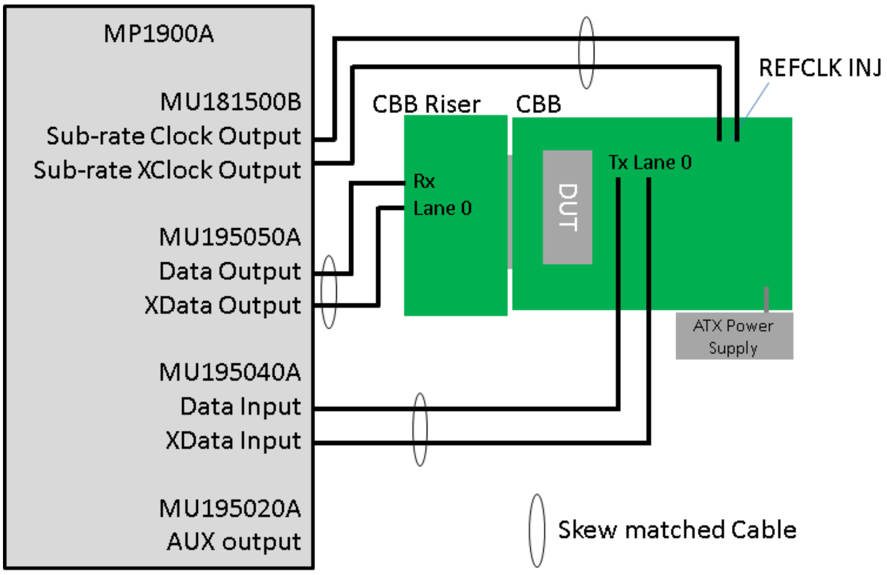


Figure 4.8.6.1-2 DUT is Endpoint (AIC)

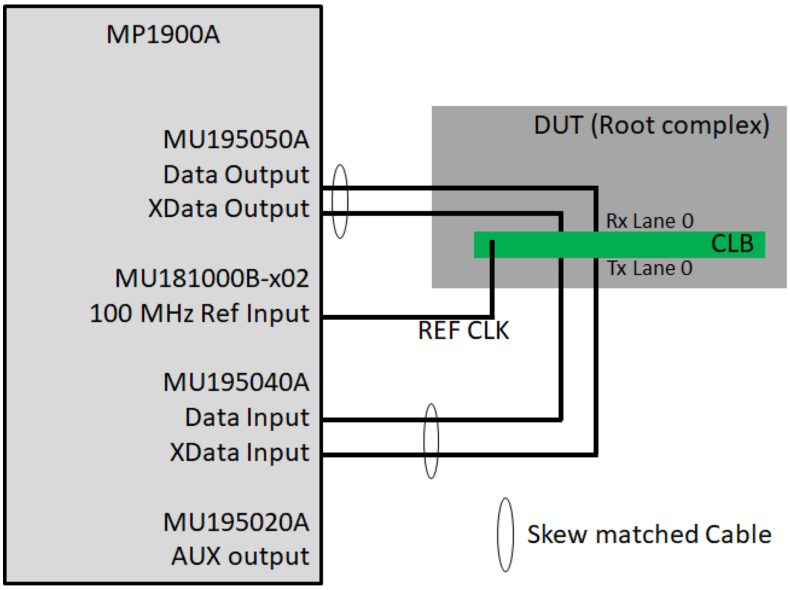


Figure 4.8.6.1-3 DUT is Root Complex (System)

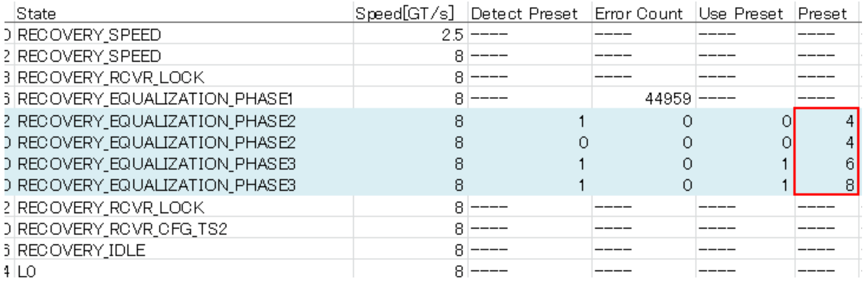
2. Execute File > Initialize > Only MX183000A parameters.
3. Click the **Rx LEQ** tab.
4. Set the parameters in Table 4.8.6.1-1 and click **Apply**.

Table 4.8.6.1-1 LEQ Parameters

Item	Description
Link EQ	Specify how to change Tx EQ for the DUT. Specify as follows: RxLEQ: Select **Preset**. Initial Tx LEQ: Can be selected only when DUT is set to AIC. Tx LEQ Response: Select **Preset** and click **Saved Cursor**.
Starting Preset	Set the Preset value that the measuring instrument uses in Recovery.Equalization.
Preset Hint Tx	Set the Preset value that the DUT uses in Recovery.Equalization.
Change Preset	Set the Preset value that the DUT changes in Recovery.Equalization.

5. Perform Link Training following 4.8.3 “Starting PCIe Link Training”.
6. It is completed when LTSSM State is Loopback.Active and the BER measurement result is “Pass”. If the result is “Fail”, change the Loopback Preset to **Manual** on the Option dialog box, and find out the Preset value to make Error Free.
   - How to check Preset

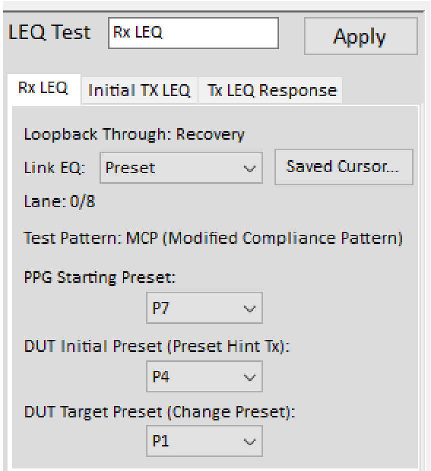
     When DUT is AIC, check that the Preset value is changed from Preset Hint to Change Preset in Recovery.Equalization.Phase3. When DUT is System, check that the Preset value is changed from Preset Hint to Change Preset in Recovery.Equalization.Phase2.
     Figure 4.8.6.1-4 shows an example of LTSSM Log when AIC was tested. Recovery.Equalization.Phase2 shows the Preset value that the measuring instrument is transmitting and Recovery.Equalization.Phase3 shows the status where DUT changes from Preset Hint Tx (P6 in the figure) to Change Preset (P8).



State	Speed[GT/s]	Detect Preset	Error Count	Use Preset	Preset
RECOVERY_SPEED	2.5	----	----	----	----
RECOVERY_SPEED	8	----	----	----	----
RECOVERY_RCVR_LOCK	8	----	----	----	----
RECOVERY_EQUALIZATION_PHASE1	8	----	44959	----	----
RECOVERY_EQUALIZATION_PHASE2	8	1	0	0	4
RECOVERY_EQUALIZATION_PHASE2	8	0	0	0	4
RECOVERY_EQUALIZATION_PHASE3	8	1	0	1	6
RECOVERY_EQUALIZATION_PHASE3	8	1	0	1	8
RECOVERY_RCVR_LOCK	8	----	----	----	----
RECOVERY_RCVR_CFG_TS2	8	----	----	----	----
RECOVERY_IDLE	8	----	----	----	----
L0	8	----	----	----	----

Figure 4.8.6.1-4 Example of LTSSM Log after Rx LEQ Test for AIC (Preset Hint Tx: P6, Change Preset: P8)

When **Apply** is clicked in the LEQ Test area, the parameters in the LEQ Test area are applied to those used for Link Training.
If, after **Apply** is clicked, changes are made to the parameters in the Option screen, they will be applied to the parameters used for Link Training.



LEQ Test: Rx LEQ

Loopback Through: Recovery

Link EQ: Preset

Lane: 0/8

Test Pattern: MCP (Modified Compliance Pattern)

PPG Starting Preset: P7

DUT Initial Preset (Preset Hint Tx): P4

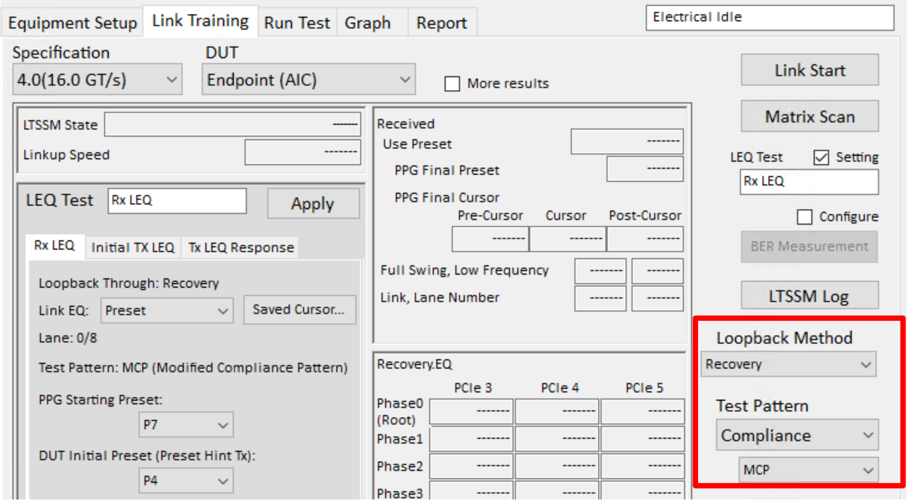
DUT Target Preset (Change Preset): P1

Figure 4.8.6.1-5 Example Settings for Rx LEQ Tab

For example, if **Apply** is clicked with the settings made as above, the parameters will be set as follows on the **Link Training** tab and in the Option screen.

Parameters set for PCIe Link Training (if DUT is Endpoint)

Loopback Method:	Recovery
Test Pattern:	Compliance, MCP



Electrical Idle

Specification: 4.0(16.0 GT/s)

DUT: Endpoint (AIC)

☐ More results

LEQ Test ☑ Setting: Rx LEQ

☐ Configure

LEQ Test: Rx LEQ

Loopback Through: Recovery

Link EQ: Preset

Lane: 0/8

Test Pattern: MCP (Modified Compliance Pattern)

PPG Starting Preset: P7

DUT Initial Preset (Preset Hint Tx): P4

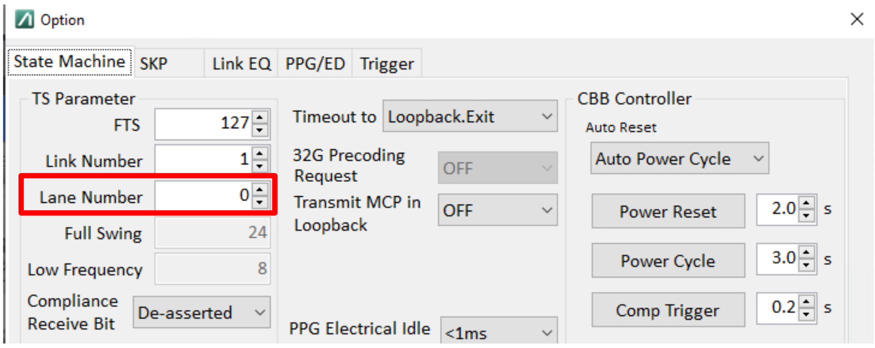
Loopback Method: Recovery

Test Pattern: Compliance, MCP

Figure 4.8.6.1-6 Settings for Link Training Tab

Parameters set in the Option screen

Lane Number: 0



FTS: 127

Link Number: 1

Lane Number: 0

Full Swing: 24

Low Frequency: 8

Compliance Receive Bit: De-asserted

Timeout to: Loopback.Exit

32G Precoding Request: OFF

Transmit MCP in Loopback: OFF

PPG Electrical Idle: <1ms

Auto Reset: Auto Power Cycle

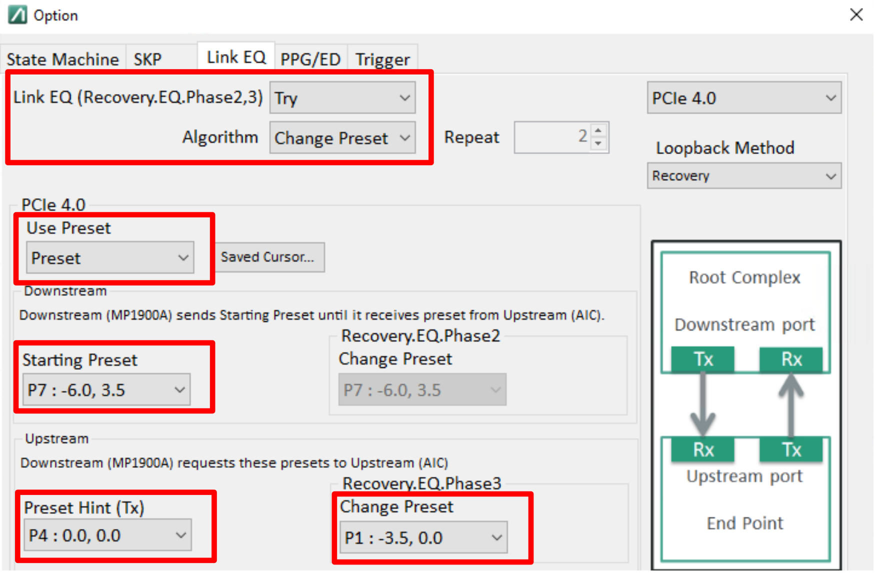
Power Reset: 2.0 s

Power Cycle: 3.0 s

Comp Trigger: 0.2 s

Figure 4.8.6.1-7 Settings for State Machine Tab

Link EQ (Recovery.EQ.Phase2,3):	Try, Change Preset
Use Preset:	Preset
Starting Preset:	P7
Preset Hint:	P4
Change Preset:	P1



Link EQ (Recovery.EQ.Phase2,3): Try

Algorithm: Change Preset

Repeat: 2

PCIe 4.0

Loopback Method: Recovery

Use Preset: Preset

Downstream (MP1900A) sends Starting Preset until it receives preset from Upstream (AIC).

Starting Preset: P7 : -6.0, 3.5

Recovery.EQ.Phase2 Change Preset: P7 : -6.0, 3.5

Downstream (MP1900A) requests these presets to Upstream (AIC)

Preset Hint (Tx): P4 : 0.0, 0.0

Recovery.EQ.Phase3 Change Preset: P1 : -3.5, 0.0

Figure 4.8.6.1-8 Settings for Link EQ Tab

If, after **Apply** is clicked, changes are made to the parameters enclosed in red boxes, the old parameters on the **Link Training** tab are updated by new ones.

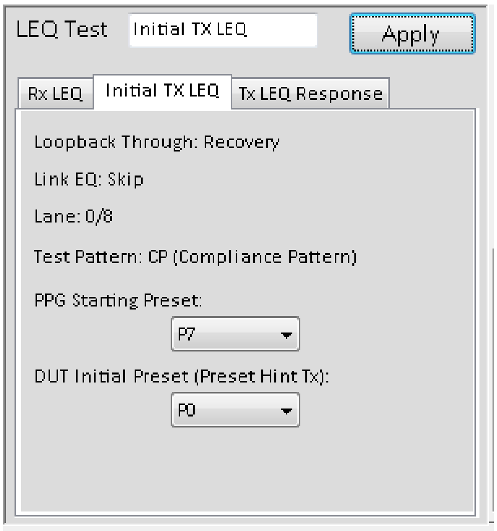
4.8.6.2 Transmitter Initial Tx EQ test (Initial TX LEQ)

This is a test function to perform the following test.

2.3. Add-in Card Transmitter Initial TX EQ test

It skips (Bypass) Recovery.Equalization.Phase2 and 3 and checks that DUT is changed to the Preset value (Preset Hint Tx) specified by the measuring instrument using the oscilloscope.

This test is designed for AIC only, and not for the system.



LEQ Test: Initial TX LEQ

Loopback Through: Recovery

Link EQ: Skip

Lane: 0/8

Test Pattern: CP (Compliance Pattern)

PPG Starting Preset: P7

DUT Initial Preset (Preset Hint Tx): P0

Figure 4.8.6.2-1 Initial TX LEQ Tab

1. Connect the devices as the following figure.

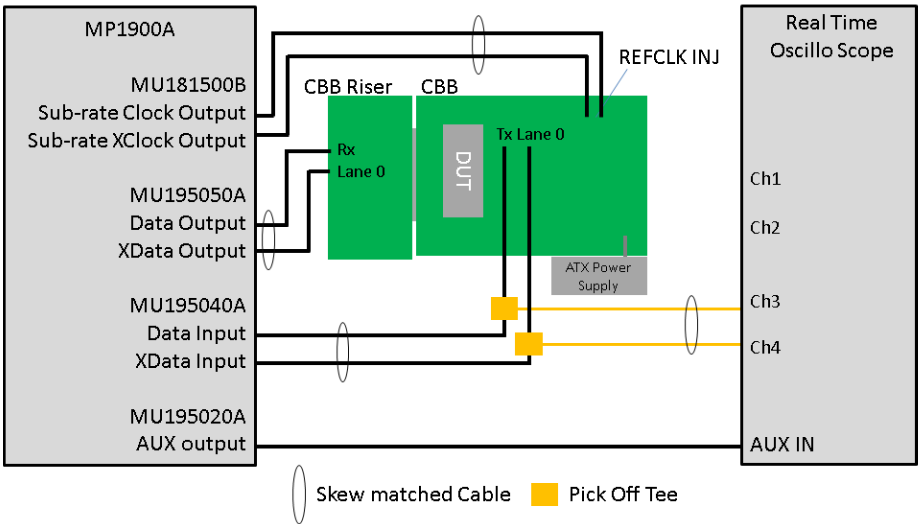


Figure 4.8.6.2-2 Device Connection for Endpoint (AIC) and Target Initial TX LEQ Test

2. Execute File > Initialize > Only MX183000A parameters.
3. Click the **Initial TX LEQ** tab.
4. Set parameters in Table 4.8.6.1-1 (Change Preset is unnecessary for this test) and click **Apply**.
5. Perform Link Training following 4.8.3 “Starting PCIe Link Training”.
6. Check that LTSSM State is Loopback.Active and the BER measurement result is Error Free.
7. Save the output signal at real-time oscilloscope*1 (Timedivision 10 us) under the above conditions.
8. Perform Steps 3 through 5 for **P0** to **P9** of DUT Initial Preset.
9. Using SIGTEST*2, judge the result of every Preset waveform saved by real-time oscilloscope.

*1: Use the scope that meets the following performance or above. Also, this value can be changed depending on the PCIe specification trend.

Gen3: 4ch, Bandwidth: 13 GHz, Sampling rate: 40GS/s

Gen4: 4ch, Bandwidth: 25 GHz, Sampling rate: 80GS/s

*2: SIGTEST is available on the PCI-SIG website. For how to use SIGTEST, refer to the SIGTEST manual.

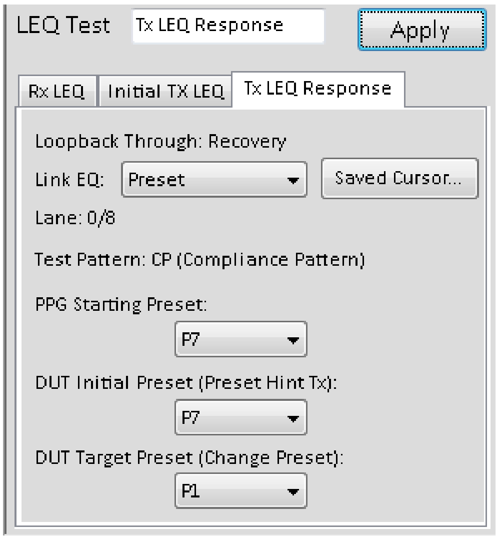
4.8.6.3 Transmitter Link Equalization Response (Tx LEQ Response)

This is a test function to perform the following tests.

2.4. Add-in Card Transmitter Link Equalization Response Test
2.7. System Board Transmitter Link Equalization Response Test

These tests are to measure the response time from a preset change request from the measuring instrument to DUT until DUT's actual change to the specified value (Change Preset) and to measure the changed waveform amplitude to check if they meet the specifications. They are measured in Recovery.Equalization.Phase2 and 3 using the oscilloscope.

Tx LEQ Response is performed with Link EQ set to **Preset** and **Saved Cursor**. When starting a test with Link EQ set to **Preset** only, the cursor values corresponding to Preset are notified from DUT, and they are saved in MP1900A. Thus, perform the test with Link EQ set to Preset only first and then perform it with the settings of **Saved Cursor**.



LEQ Test: Tx LEQ Response

Loopback Through: Recovery

Link EQ: Preset

Lane: 0/8

Test Pattern: CP (Compliance Pattern)

PPG Starting Preset: P7

DUT Initial Preset (Preset Hint Tx): P7

DUT Target Preset (Change Preset): P1

Figure 4.8.6.3-1 Tx LEQ Response Tab

1. Connect the devices as the following figure.

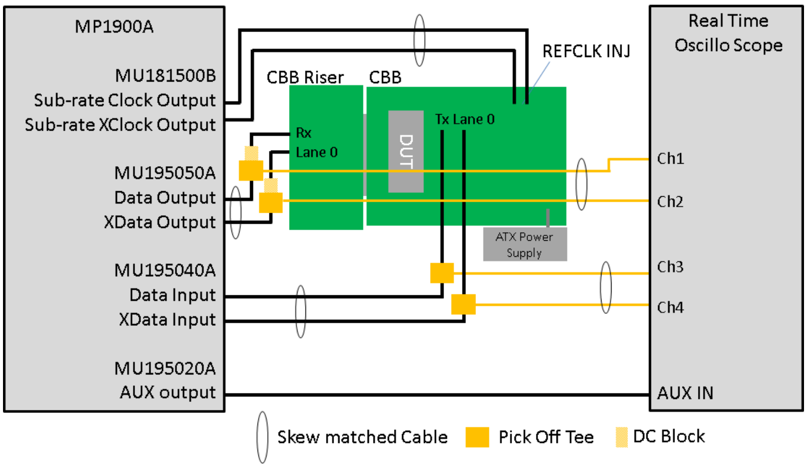


Figure 4.8.6.3-2 DUT Is Endpoint (AIC)

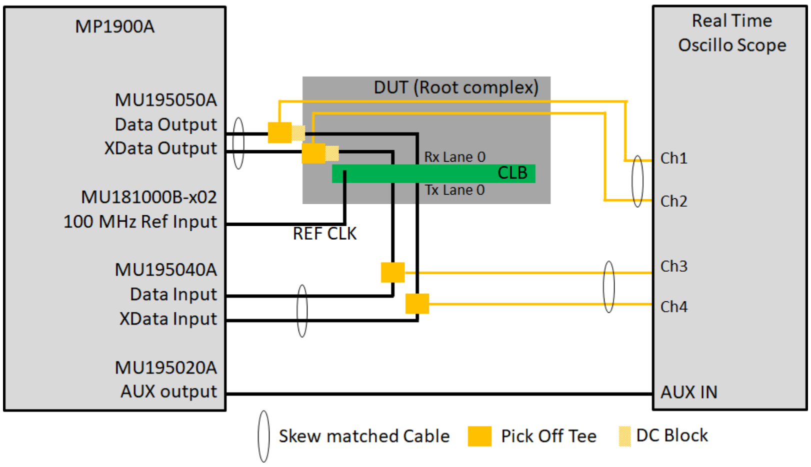


Figure 4.8.6.3-3 DUT Is Root Complex (Host)

2. Execute File > Initialize > Only MX183000A parameters.
3. Click the **Tx LEQ Response** tab and set LinkEQ to **Preset**.
4. Set DUT Target Preset to **P0** and click **Apply**.
5. Set the measurement start (trigger waiting) on real-time oscilloscope (Time division 100 ns).
6. Perform Link Training following 4.8.3 “Starting PCIe Link Training”.
7. Check that LTSSM State is Loopback.Active and the waveform is captured by real-time oscilloscope*.
8. Check the time from the trigger start until DUT Preset change by the Marker function. It is “Pass” if the time is 500 ns or under.

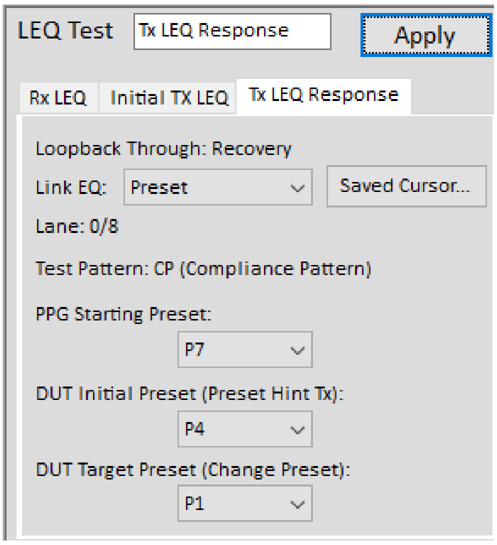
9. Capture waveforms by scope in the same manner as described in 4.8.6.2 “Transmitter Initial Tx EQ Test (Initial TX LEQ)”.
10. Change DUT Target Preset (Step 4) to **P1** to **P9** by turns and perform Steps 4 through 9 respectively. When this test is completed, the cursor value corresponding to the Preset value notified from DUT is saved inside the MP1900A.
11. Set Link EQ to **Saved Cursor** (Step 3) and repeat Steps 4 through 10.

*: Use the scope that meets the following performance or above. Also, this value can be changed depending on the PCIe specification trend.

Gen3: 4ch, Bandwidth: 13 GHz, Sampling rate: 40GS/s

Gen4: 4ch, Bandwidth: 25 GHz, Sampling rate: 80GS/s

When **Apply** is clicked in the LEQ Test area, the parameters in the LEQ Test area are applied to those used for Link Training.
If, after **Apply** is clicked, changes are made to the parameters in the Option screen, they will be applied to the parameters used for Link Training.



LEQ Test: Tx LEQ Response

Loopback Through: Recovery

Link EQ: Preset

Lane: 0/8

Test Pattern: CP (Compliance Pattern)

PPG Starting Preset: P7

DUT Initial Preset (Preset Hint Tx): P4

DUT Target Preset (Change Preset): P1

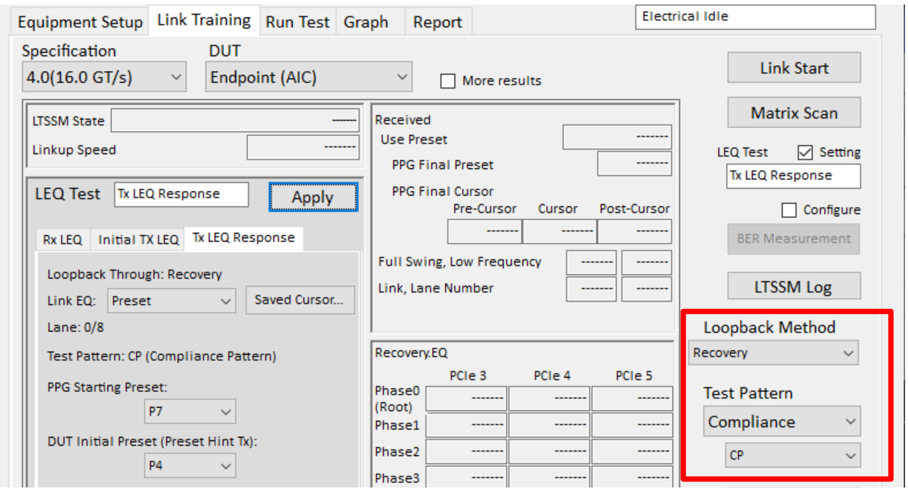
Figure 4.8.6.3-4 Example Settings for Rx LEQ Response Tab

For example, if **Apply** is clicked with the settings made as above, the parameters will be set as follows on the **Link Training** tab and in the Option screen.

Parameters set for PCIe Link Training (if DUT is Endpoint)

Loopback Method: Recovery

Test Pattern: Compliance, CP



Electrical Idle

Specification: 4.0(16.0 GT/s)

DUT: Endpoint (AIC)

☐ More results

LTSSM State: -------

Linkup Speed: -------

LEQ Test: Tx LEQ Response

Loopback Through: Recovery

Link EQ: Preset

Lane: 0/8

Test Pattern: CP (Compliance Pattern)

PPG Starting Preset: P7

DUT Initial Preset (Preset Hint Tx): P4

Use Preset: -------

PPG Final Preset: -------

PPG Final Cursor

Full Swing, Low Frequency: ------- -------

Link, Lane Number: ------- -------

LEQ Test ☑ Setting: Tx LEQ Response

☐ Configure

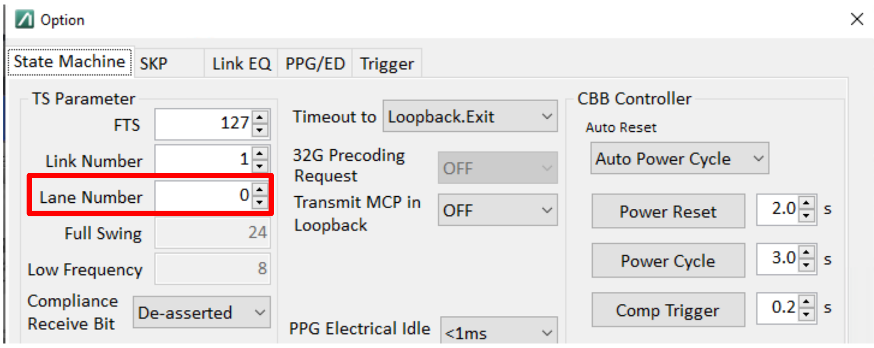
Loopback Method: Recovery

Test Pattern: Compliance, CP

Figure 4.8.6.3-5 Settings for Link Training Tab

Parameters set in the Option screen

Lane Number: 0



FTS: 127

Link Number: 1

Lane Number: 0

Full Swing: 24

Low Frequency: 8

Compliance Receive Bit: De-asserted

Timeout to: Loopback.Exit

32G Precoding Request: OFF

Transmit MCP in Loopback: OFF

PPG Electrical Idle: <1ms

Auto Reset: Auto Power Cycle

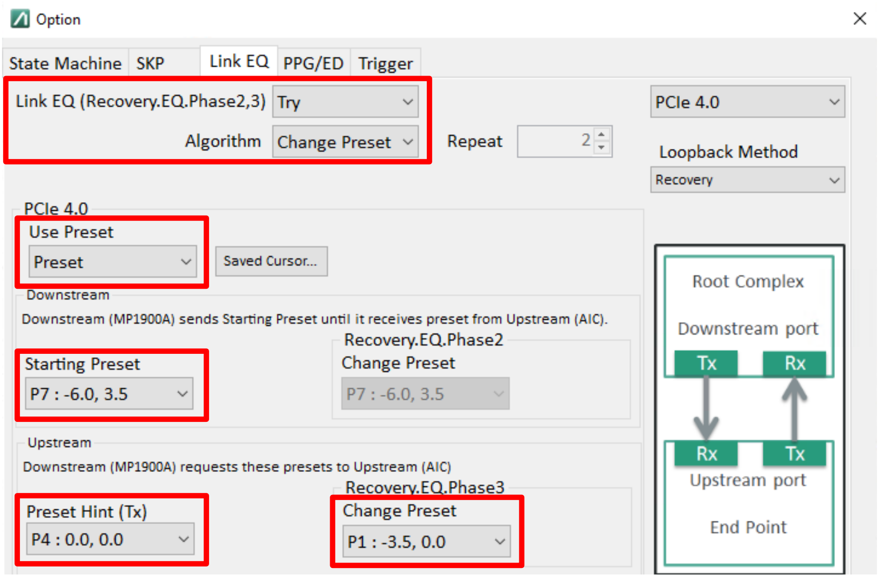
Power Reset: 2.0 s

Power Cycle: 3.0 s

Comp Trigger: 0.2 s

Figure 4.8.6.3-6 Settings for State Machine Tab

Link EQ (Recovery.EQ.Phase2,3): Try, Change Preset
Use Preset: Preset
Starting Preset: P7
Preset Hint: P4
Change Preset: P1



Link EQ (Recovery.EQ.Phase2,3) Try
Algorithm Change Preset
Repeat 2
PCIe 4.0
Loopback Method
Recovery

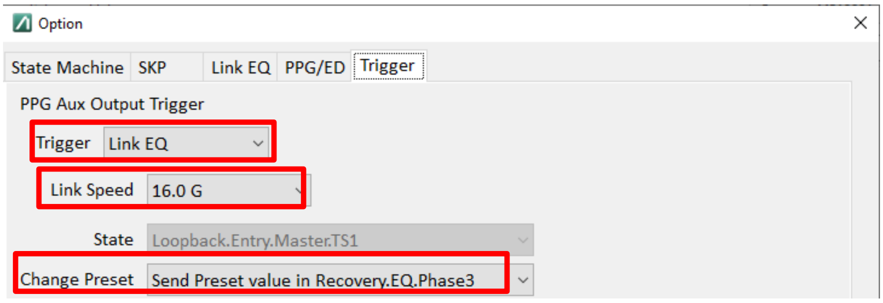
PCIe 4.0
Use Preset
Preset

Downstream
Downstream (MP1900A) sends Starting Preset until it receives preset from Upstream (AIC).
Starting Preset
P7 : -6.0, 3.5
Recovery.EQ.Phase2
Change Preset
P7 : -6.0, 3.5

Upstream
Downstream (MP1900A) requests these presets to Upstream (AIC)
Preset Hint (Tx)
P4 : 0.0, 0.0
Recovery.EQ.Phase3
Change Preset
P1 : -3.5, 0.0

Figure 4.8.6.3-7 Settings for Link EQ Tab

Trigger: Link EQ
Link Speed: Target Specification
Change Preset: Send Preset value in Recovery.EQ.Phase3



PPG Aux Output Trigger
Trigger Link EQ
Link Speed 16.0 G
State Loopback.Entry.Master.TS1
Change Preset Send Preset value in Recovery.EQ.Phase3

Figure 4.8.6.3-8 Settings for Trigger Tab

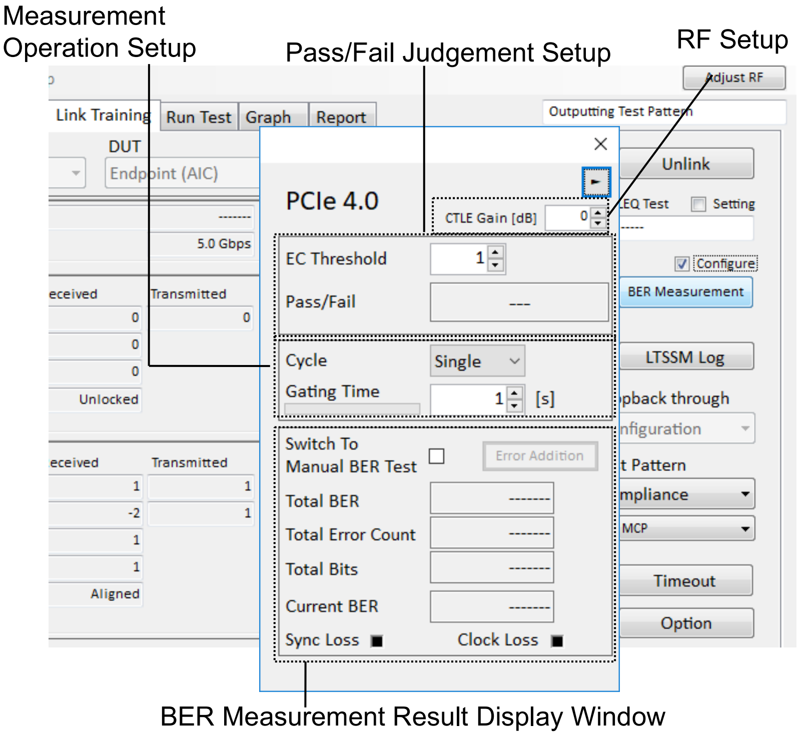
If, after **Apply** is clicked, changes are made to the parameters enclosed in red boxes, the old parameters on the **Link Training** tab are updated by new ones.

4.8.7 Configuring BER Measurement settings for PCIe Link Training

The BER Measurement function is enabled when all of the following conditions are met:

- Link Training is complete.
- PPG is in Loopback.Active state.
- ED is installed.

Select the **Configure** check box, and you will see the BER Measurement Setup screen.
For how to start the BER measurement, refer to 4.4.5, “Starting PCIe BER Measurement”.



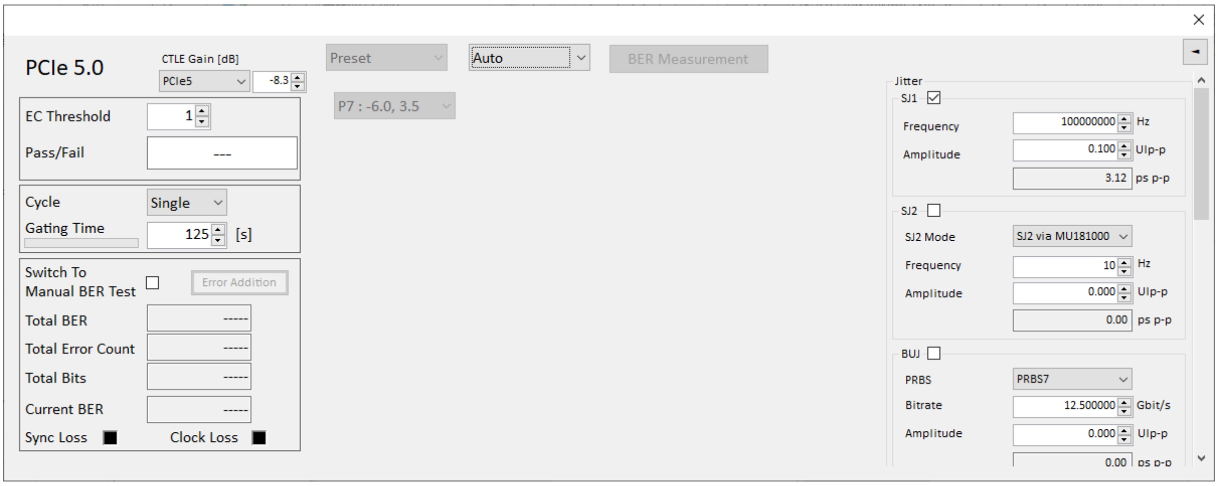
PCIe 4.0
CTLE Gain [dB] 0
EC Threshold 1
Pass/Fail ---
Cycle Single
Gating Time 1 [s]
Switch To Manual BER Test ☐
Total BER -------
Total Error Count -------
Total Bits -------
Current BER -------
Sync Loss ■ Clock Loss ■

DUT Endpoint (AIC)
5.0 Gbps
Outputting Test Pattern
EQ Test ☐ Setting
☑ Configure

Figure 4.8.7-1 PCIe BER Measurement Setup Screen

This setup screen has the same functions as 4.4.4, “Setting up PCIe BER Measurement”. Refer to Table 4.4.4-1 to Table 4.4.4-3.

Click on ⇤ at the upper right of the screen to show the area for configuring PPG Equalization settings.



PCIe 5.0

CTLE Gain [dB]: PCIe5, -8.3

Preset

Auto

P7 : -6.0, 3.5

EC Threshold: 1

Pass/Fail: ---

Cycle: Single

Gating Time: 125 [s]

Switch To Manual BER Test ☐

Total BER: -----

Total Error Count: -----

Total Bits: -----

Current BER: -----

Sync Loss ■ Clock Loss ■

Jitter

SJ1 ☑

Frequency: 100000000 Hz

Amplitude: 0.100 UIp-p

3.12 ps p-p

SJ2 ☐

SJ2 Mode: SJ2 via MU181000

Frequency: 10 Hz

Amplitude: 0.000 UIp-p

0.00 ps p-p

BUJ ☐

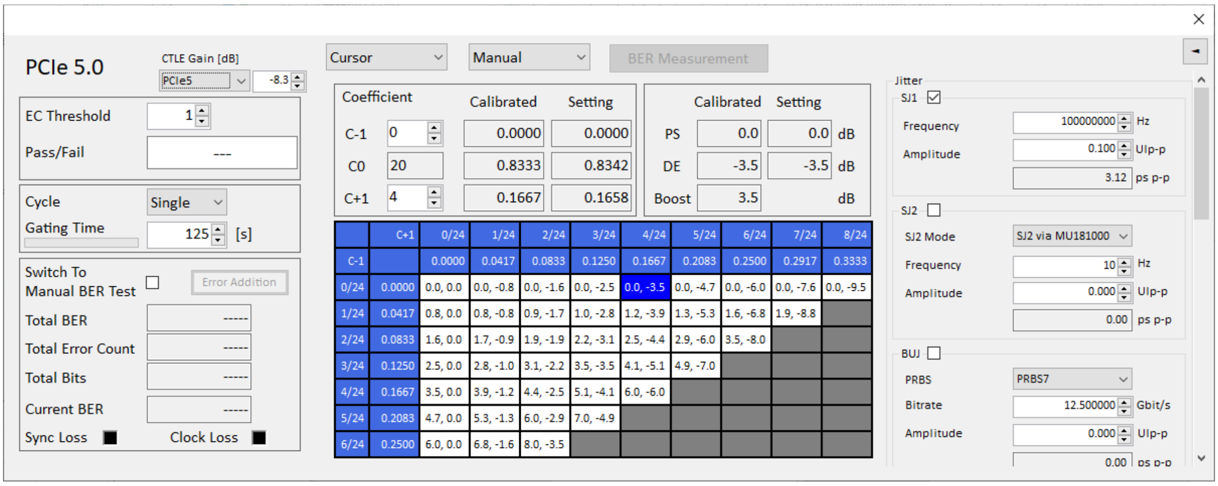
PRBS: PRBS7

Bitrate: 12.500000 Gbit/s

Amplitude: 0.000 UIp-p

0.00 ps p-p

Figure 4.8.7-2 Equalization Setup Screen (Preset)



PCIe 5.0

CTLE Gain [dB]: PCIe5, -8.3

Cursor

Manual

Coefficient		Calibrated	Setting
C-1	0	0.0000	0.0000
C0	20	0.8333	0.8342
C+1	4	0.1667	0.1658

	Calibrated	Setting	
PS	0.0	0.0	dB
DE	-3.5	-3.5	dB
Boost	3.5		dB

	C+1	0/24	1/24	2/24	3/24	4/24	5/24	6/24	7/24	8/24
C-1		0.0000	0.0417	0.0833	0.1250	0.1667	0.2083	0.2500	0.2917	0.3333
0/24	0.0000	0.0, 0.0	0.0, -0.8	0.0, -1.6	0.0, -2.5	0.0, -3.5	0.0, -4.7	0.0, -6.0	0.0, -7.6	0.0, -9.5
1/24	0.0417	0.8, 0.0	0.8, -0.8	0.9, -1.7	1.0, -2.8	1.2, -3.9	1.3, -5.3	1.6, -6.8	1.9, -8.8	
2/24	0.0833	1.6, 0.0	1.7, -0.9	1.9, -1.9	2.2, -3.1	2.5, -4.4	2.9, -6.0	3.5, -8.0		
3/24	0.1250	2.5, 0.0	2.8, -1.0	3.1, -2.2	3.5, -3.5	4.1, -5.1	4.9, -7.0			
4/24	0.1667	3.5, 0.0	3.9, -1.2	4.4, -2.5	5.1, -4.1	6.0, -6.0				
5/24	0.2083	4.7, 0.0	5.3, -1.3	6.0, -2.9	7.0, -4.9					
6/24	0.2500	6.0, 0.0	6.8, -1.6	8.0, -3.5						

EC Threshold: 1

Pass/Fail: ---

Cycle: Single

Gating Time: 125 [s]

Switch To Manual BER Test ☐

Total BER: -----

Total Error Count: -----

Total Bits: -----

Current BER: -----

Sync Loss ■ Clock Loss ■

Jitter

SJ1 ☑

Frequency: 100000000 Hz

Amplitude: 0.100 UIp-p

3.12 ps p-p

SJ2 ☐

SJ2 Mode: SJ2 via MU181000

Frequency: 10 Hz

Amplitude: 0.000 UIp-p

0.00 ps p-p

BUJ ☐

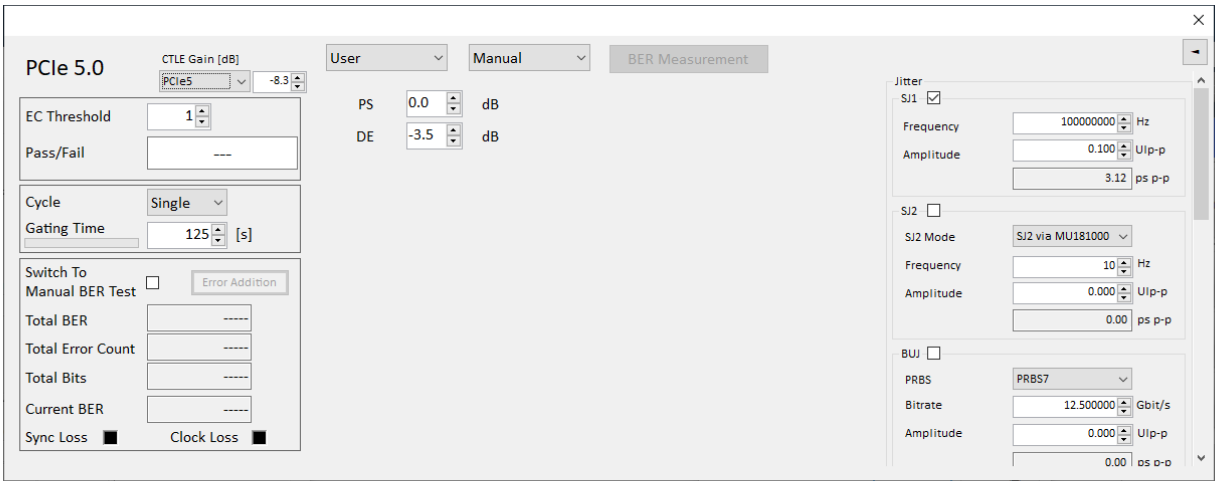
PRBS: PRBS7

Bitrate: 12.500000 Gbit/s

Amplitude: 0.000 UIp-p

0.00 ps p-p

Figure 4.8.7-3 Equalization Setup Screen (Cursor)



PCIe 5.0

CTLE Gain [dB]: PCIe5, -8.3

User

Manual

PS: 0.0 dB

DE: -3.5 dB

EC Threshold: 1

Pass/Fail: ---

Cycle: Single

Gating Time: 125 [s]

Switch To Manual BER Test ☐

Total BER: -----

Total Error Count: -----

Total Bits: -----

Current BER: -----

Sync Loss ■ Clock Loss ■

Jitter

SJ1 ☑

Frequency: 100000000 Hz

Amplitude: 0.100 UIp-p

3.12 ps p-p

SJ2 ☐

SJ2 Mode: SJ2 via MU181000

Frequency: 10 Hz

Amplitude: 0.000 UIp-p

0.00 ps p-p

BUJ ☐

PRBS: PRBS7

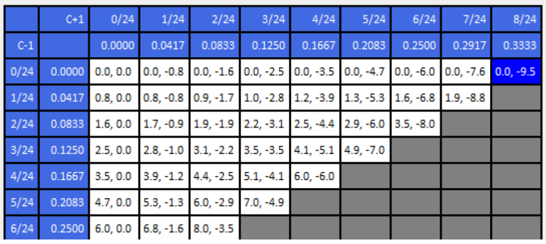
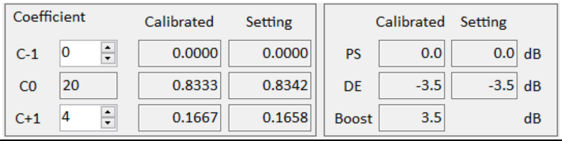
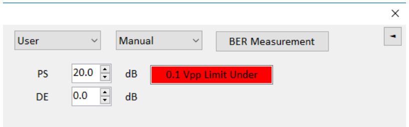
Bitrate: 12.500000 Gbit/s

Amplitude: 0.000 UIp-p

0.00 ps p-p

Figure 4.8.7-4 Equalization Setup Screen (User)

Table 4.8.7-1 Equalization Setting Items

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>► ◄</td><td>Shows and hides the area where you can configure settings for PPG Equalization.</td></tr>
<tr><td>Auto / Manual</td><td>Selects the PPG Equalization setup mode. To switch to Auto, click <b>Apply</b> shown in “Figure 4.8.6.1-1 Rx LEQ Tab”, “Figure 4.8.6.2-1 Initial TX LEQ Tab”, or “Figure 4.8.6.3-1 Tx LEQ Response Tab”.
Auto: Automatically sets the value requested from the DUT in Recovery.Equalization Phase2/3 state, for the PPG.
Manual: Sets the PPG Equalization via the MX183000A GUI. Select this mode for searching for the Equalization optimal for the DUT's receiver after Loopback.Active.</td></tr>
<tr><td>Equalization type</td><td>Selects the PPG Equalization setup mode. When <b>Auto</b> is selected at <b>Auto / Manual</b>, this is set automatically and cannot be changed.</td></tr>
<tr><td>Preset
(Figure 4.8.7-2)</td><td>Sets the level of Equalization signal output from the PPG by selecting from the drop-down menu under <b>Preset</b>. Range: Preset 0 to 10</td></tr>
<tr><td>Cursor
(Figure 4.8.7-3)</td><td>Sets the level of Equalization signal output from the PPG by selecting a cursor (white cell, calculated with Full Swing set to 24) in the table.
When a cell is clicked, its background color turns blue and the Coefficient values are changed.

<table>
<tr><th></th><th>C+1</th><th>0/24</th><th>1/24</th><th>2/24</th><th>3/24</th><th>4/24</th><th>5/24</th><th>6/24</th><th>7/24</th><th>8/24</th></tr>
<tr><td>C-1</td><td></td><td>0.0000</td><td>0.0417</td><td>0.0833</td><td>0.1250</td><td>0.1667</td><td>0.2083</td><td>0.2500</td><td>0.2917</td><td>0.3333</td></tr>
<tr><td>0/24</td><td>0.0000</td><td>0.0, 0.0</td><td>0.0, -0.8</td><td>0.0, -1.6</td><td>0.0, -2.5</td><td>0.0, -3.5</td><td>0.0, -4.7</td><td>0.0, -6.0</td><td>0.0, -7.6</td><td>0.0, -9.5</td></tr>
<tr><td>1/24</td><td>0.0417</td><td>0.8, 0.0</td><td>0.8, -0.8</td><td>0.9, -1.7</td><td>1.0, -2.8</td><td>1.2, -3.9</td><td>1.3, -5.3</td><td>1.6, -6.8</td><td>1.9, -8.8</td><td></td></tr>
<tr><td>2/24</td><td>0.0833</td><td>1.6, 0.0</td><td>1.7, -0.9</td><td>1.9, -1.9</td><td>2.2, -3.1</td><td>2.5, -4.4</td><td>2.9, -6.0</td><td>3.5, -8.0</td><td></td><td></td></tr>
<tr><td>3/24</td><td>0.1250</td><td>2.5, 0.0</td><td>2.8, -1.0</td><td>3.1, -2.2</td><td>3.5, -3.5</td><td>4.1, -5.1</td><td>4.9, -7.0</td><td></td><td></td><td></td></tr>
<tr><td>4/24</td><td>0.1667</td><td>3.5, 0.0</td><td>3.9, -1.2</td><td>4.4, -2.5</td><td>5.1, -4.1</td><td>6.0, -6.0</td><td></td><td></td><td></td><td></td></tr>
<tr><td>5/24</td><td>0.2083</td><td>4.7, 0.0</td><td>5.3, -1.3</td><td>6.0, -2.9</td><td>7.0, -4.9</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>6/24</td><td>0.2500</td><td>6.0, 0.0</td><td>6.8, -1.6</td><td>8.0, -3.5</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
Also, in the numerical value boxes below, <b>C-1</b> can be set in the range of 0 to 6 and <b>C+1</b> in the range of 0 to 8. C0 cannot be set because it is calculated automatically from <b>C–1</b> and <b>C+1</b>.
Depending on the selected cursor, the Coefficient, PS, DE and Boost values vary.
Calibrated: Calibration values obtained from the Preset values for PCIe X on the <b>Emphasis</b> tab in the PPG screen of MX190000A.
Setting: Values to actually set for <b>Post</b> and <b>Pre Cursor</b> on the <b>Emphasis</b> tab in the PPG screen of MX190000A.

<table>
<tr><th>Coefficient</th><th></th><th>Calibrated</th><th>Setting</th></tr>
<tr><td>C-1</td><td>0</td><td>0.0000</td><td>0.0000</td></tr>
<tr><td>C0</td><td>20</td><td>0.8333</td><td>0.8342</td></tr>
<tr><td>C+1</td><td>4</td><td>0.1667</td><td>0.1658</td></tr>
</table>
<table>
<tr><th></th><th>Calibrated</th><th>Setting</th><th></th></tr>
<tr><td>PS</td><td>0.0</td><td>0.0</td><td>dB</td></tr>
<tr><td>DE</td><td>-3.5</td><td>-3.5</td><td>dB</td></tr>
<tr><td>Boost</td><td>3.5</td><td></td><td>dB</td></tr>
</table></td></tr>
<tr><td>User
(Figure 4.8.7-4)</td><td>Sets Tx Equalization level of the PPG while finely adjusting in the following ranges:
PS: 0 to 20 dB, 0.1 dB step
DE: –20 to 0 dB, 0.1 dB step
You will receive a warning if the emphasis peak voltage is out of the range due to these settings.


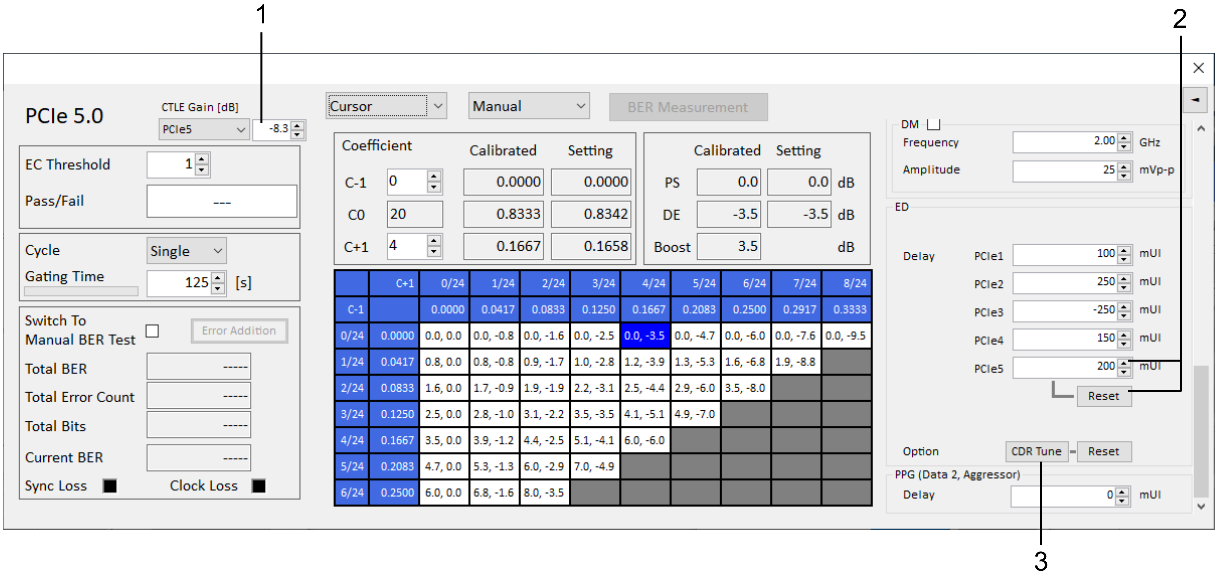
PS 20.0 dB 0.1 Vpp Limit Under
DE 0.0 dB</td></tr>
</table>

Though the specification is PCIe 5.0 and the DUT has entered the Loopback.Active state, if the reading of Total Error Count or Total BER located on the left side of the Equalization Setup screen does not become 0, search for the conditions that cause the reading to become 0 according to the following procedure:

1. Clear the **SJ1**, **SJ2**, **RJ**, **DM-I**, and **CM-I** check boxes for Jitter.
2. Set the equalization type to **Manual**, and then adjust the Preset and Coefficient values.
3. If the PCIe Test Fixture is used to degrade the output waveform of the DUT, shorten its trace.

If the reading of Total Error Count becomes 0 after performing this procedure, it is determined that an error is detected at the receiver of the DUT. If the value of Total Error Count and/or Total BER does not improve, perform the following procedure.

1. Adjust the CTLE Gain value to minimize Total BER.
2. Adjust the PCIe5 value for ED – Delay to minimize Total BER.
   If the error remains unchanged or increases, click **Reset** to reset to the Delay value obtained by clicking **Calibration** in the Equipment Setup screen.
3. Check that Total BER is minimized in steps 1 and 2, and then click **CDR-Tune**.



PCIe 5.0

CTLE Gain [dB]: PCIe5 -8.3

EC Threshold: 1

Pass/Fail: ---

Cycle: Single

Gating Time: 125 [s]

Switch To Manual BER Test ☐

Total BER: -----

Total Error Count: -----

Total Bits: -----

Current BER: -----

Sync Loss ■ Clock Loss ■

Cursor

Manual

Coefficient		Calibrated	Setting
C-1	0	0.0000	0.0000
C0	20	0.8333	0.8342
C+1	4	0.1667	0.1658

	Calibrated	Setting	
PS	0.0	0.0	dB
DE	-3.5	-3.5	dB
Boost	3.5		dB

	C+1	0/24	1/24	2/24	3/24	4/24	5/24	6/24	7/24	8/24
C-1		0.0000	0.0417	0.0833	0.1250	0.1667	0.2083	0.2500	0.2917	0.3333
0/24	0.0000	0.0, 0.0	0.0, -0.8	0.0, -1.6	0.0, -2.5	0.0, -3.5	0.0, -4.7	0.0, -6.0	0.0, -7.6	0.0, -9.5
1/24	0.0417	0.8, 0.0	0.8, -0.8	0.9, -1.7	1.0, -2.8	1.2, -3.9	1.3, -5.3	1.6, -6.8	1.9, -8.8	
2/24	0.0833	1.6, 0.0	1.7, -0.9	1.9, -1.9	2.2, -3.1	2.5, -4.4	2.9, -6.0	3.5, -8.0		
3/24	0.1250	2.5, 0.0	2.8, -1.0	3.1, -2.2	3.5, -3.5	4.1, -5.1	4.9, -7.0			
4/24	0.1667	3.5, 0.0	3.9, -1.2	4.4, -2.5	5.1, -4.1	6.0, -6.0				
5/24	0.2083	4.7, 0.0	5.3, -1.3	6.0, -2.9	7.0, -4.9					
6/24	0.2500	6.0, 0.0	6.8, -1.6	8.0, -3.5						

DM ☐

Frequency: 2.00 GHz

Amplitude: 25 mVp-p

ED

Delay PCIe1: 100 mUI

PCIe2: 250 mUI

PCIe3: -250 mUI

PCIe4: 150 mUI

PCIe5: 200 mUI

Option

PPG (Data 2, Aggressor)

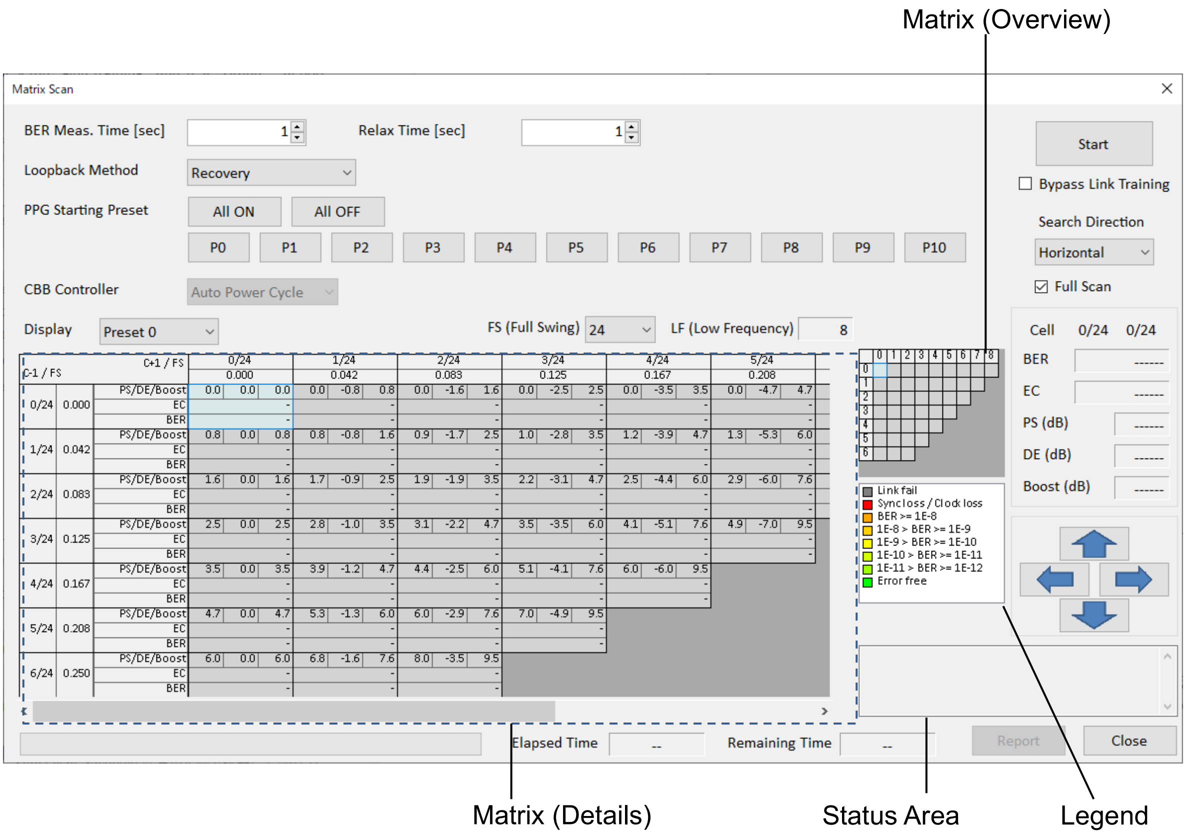
Delay: 0 mUI

Figure 4.8.7-5 Adjusting BER

4.8.8 PCIe Link Training Matrix Scan

Matrix Scan automatically performs the BER measurement of the cursor value in Loopback.Active state after it completes link training.

Click the **Matrix Scan** on the PCIe Link Training Setup Screen (Figure 4.8.1-1) to display the setup screen.



BER Meas. Time [sec] 1

Relax Time [sec] 1

Loopback Method: Recovery

PPG Starting Preset

CBB Controller: Auto Power Cycle

Display: Preset 0

FS (Full Swing): 24

LF (Low Frequency): 8

☐ Bypass Link Training

Search Direction: Horizontal

☑ Full Scan

C-1 / FS		C+1 / FS	0/24 0.000	1/24 0.042	2/24 0.083	3/24 0.125	4/24 0.167	5/24 0.208
0/24	0.000	PS/DE/Boost	0.0 0.0 0.0	0.0 -0.8 0.8	0.0 -1.6 1.6	0.0 -2.5 2.5	0.0 -3.5 3.5	0.0 -4.7 4.7
		EC	-	-	-	-	-	-
		BER	-	-	-	-	-	-
1/24	0.042	PS/DE/Boost	0.8 0.0 0.8	0.8 -0.8 1.6	0.9 -1.7 2.5	1.0 -2.8 3.5	1.2 -3.9 4.7	1.3 -5.3 6.0
		EC	-	-	-	-	-	-
		BER	-	-	-	-	-	-
2/24	0.083	PS/DE/Boost	1.6 0.0 1.6	1.7 -0.9 2.5	1.9 -1.9 3.5	2.2 -3.1 4.7	2.5 -4.4 6.0	2.9 -6.0 7.6
		EC	-	-	-	-	-	-
		BER	-	-	-	-	-	-
3/24	0.125	PS/DE/Boost	2.5 0.0 2.5	2.8 -1.0 3.5	3.1 -2.2 4.7	3.5 -3.5 6.0	4.1 -5.1 7.6	4.9 -7.0 9.5
		EC	-	-	-	-	-	-
		BER	-	-	-	-	-	-
4/24	0.167	PS/DE/Boost	3.5 0.0 3.5	3.9 -1.2 4.7	4.4 -2.5 6.0	5.1 -4.1 7.6	6.0 -6.0 9.5	
		EC	-	-	-	-	-	
		BER	-	-	-	-	-	
5/24	0.208	PS/DE/Boost	4.7 0.0 4.7	5.3 -1.3 6.0	6.0 -2.9 7.6	7.0 -4.9 9.5		
		EC	-	-	-	-		
		BER	-	-	-	-		
6/24	0.250	PS/DE/Boost	6.0 0.0 6.0	6.8 -1.6 7.6	8.0 -3.5 9.5			
		EC	-	-	-			
		BER	-	-	-			

- ■ Link fail
- 🟥 Sync loss / Clock loss
- 🟧 BER >= 1E-8
- 🟨 1E-8 > BER >= 1E-9
- 🟨 1E-9 > BER >= 1E-10
- 🟩 1E-10 > BER >= 1E-11
- 🟩 1E-11 > BER >= 1E-12
- 🟩 Error free

Cell	0/24	0/24
BER	------	
EC	------	
PS (dB)	------	
DE (dB)	------	
Boost (dB)	------	

Elapsed Time --

Remaining Time --

Figure 4.8.8-1 Matrix Scan Setup Screen

Table 4.8.8-1 Matrix Scan Setting Items

Item	Description
Start*	Starts the Matrix Scan measurement. When one of the following conditions is met, the dialog box appears to prompt you to reset DUT. In that case, reset DUT and click **OK** in the dialog box. ● CBB Controller is invalid. (Z2025A is not connected) ● CBB Controller is set to **No**. Link training starts in ascending order from the smallest Starting Preset selected by PPG Starting Preset. If DUT enters Loopback.Active state as a result of the link training, Matrix Scan starts subsequently. When Matrix Scan of one Preset has completed, link training starts at the next Starting Preset and Matrix Scan follows. When you interrupt the scan and click the **Start** again, you can select whether to clear the measurement results before resuming the measurement.
Bypass Link Training	Bypasses Link Training when starting Matrix Scan with **Start** if the check box is selected. If so, perform the measurement according to the following procedure: 1. Close the Matrix Scan Setup Screen. 2. Click **Link Start** to make the DUT to enter the Loopback.Active state. 3. For debugging, adjust the CTLE and other parameters for MX183000A or DUT, as needed. 4. In the PCIe Link Training Setup screen, click **Matrix Scan**. 5. In the Matrix Scan Setup screen, click **Start**.
BER Meas. time [sec]	Sets the BER measurement time for each condition. Setting Range: 1 to 300 sec 1 sec/step
Relax time [sec]	Sets the time from setting the Cursor value of SI PPG or PAM4 PPG to starting BER measurement. Setting Range: 0 to 60 sec 1 sec/step
Loopback Through	Sets the LTSSM route to pass through until DUT enters Loopback.Active state.
PPG Starting Preset	Selects PPG Starting Preset for performing link training before Matrix Scan starts.* All ON: Sets all Presets to ON. All OFF: Sets all Presets to OFF. P0 to P10: Select a preset value defined in the standard. If measurement is started with all Presets set to OFF, P7 is selected automatically. If multiple Presets are selected, they are measured in the order of size, the smallest value first. When the **Bypass Link Training** check box is selected, **User** is displayed.
CBB Controller	Controls the power supply to DUT connected to CBB 4.0 (Compliance Base Board) through CBB 4.0 control pins. This function allows you to omit manually resetting the power supply. Refer to the description of CBB Controller in Table 4.8.2-2 “Option Setup Items”.

Table 4.8.8-1 Matrix Scan Setting Items (Cont'd)

Item	Description
Search Direction	Sets the order of cells in which Matrix Scan is performed. Horizontal: Performs measurement horizontally in the C–1, C+1 order as [0,0], [0,1], [0,2]…[0,8], [1,0], [1,1], [1,2]… Vertical: Performs measurement vertically in the C–1, C+1 order as [0,0], [1,0], [2,0]…[6,0], [0,1], [1,1], [2,1]…. Boost: Performs measurement making the same boost values; in the C–1, C+1 order as [0,0], [0,1], [1,0], [0,2], [1,1], [2,0], [0,3], [1,2], [2,1], [3,0]….
Full Scan	Selecting the checkbox starts Matrix Scan from the cell whose C–1, C+1 is zero (top-left cell). Clearing the checkbox starts Matrix Scan from the cell selected by Matrix in the Matrix Scan area.
FS (Full Swing)	Select 24, 48, or 63. Different from Full Swing on the Option screen, the value is used for creating a cursor matrix table in Loopback.Active state after link training is completed. The bigger the Full Swing value becomes, the bigger the matrix table becomes. This allows specifying the cursor value in more detailed steps.
LF (Low Frequency)	The value is set automatically according to FS. 8, 16, and 21 are set when FS is 24, 48, and 63 respectively.
Arrow Keys	Selects a cell on the matrix.
Report	When the measurement is completed, a report file can be saved in csv or html format. If you want to save a table with colors, use html format.
Close	Closes the Matrix Scan Setup Screen.

*: When **Start** is clicked in the Matrix Scan Setup screen, the value of the selected Preset is set to PPG Starting Preset on the **Rx LEQ** Tab. After the parameter is set on the **Link Training** tab and in the Option screen and Link Training is performed, the Matrix Scan measurement is started.
For details of items on the **Rx LEQ** tab in the LEQ Test area, refer to, "Receiver Link Equalization test (Rx LEQ) ".

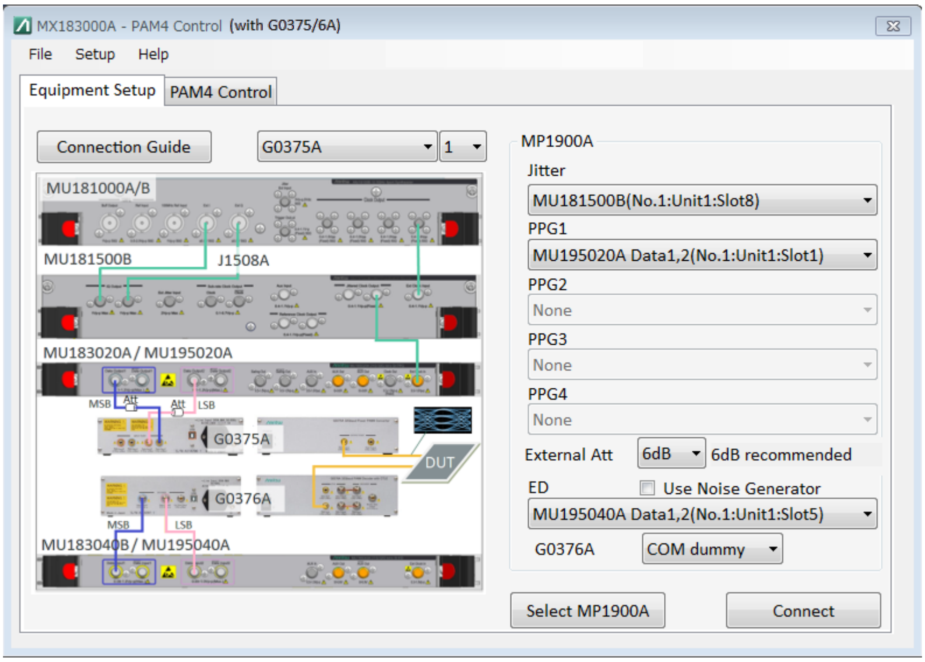
Table 4.8.8-2 Matrix Scan Display Area

Item	Description
Matrix (Details)	Displays the scan result of Starting Preset selected by Display. PS: Displays Pre Shoot value figured out from the cursor value of the selected cell. DE: Displays De Emphasis value figured out from the cursor value of the selected cell. Boost: Displays Boost value figured out from the cursor value of the selected cell. EC: Displays the Error Count measurement result of the selected cell. BER: Displays the BER measurement result of the selected cell.
Matrix (Overview)	The result of the entire matrix can be checked by colors. Clicking the specific cell changes the color of the corresponding cell on Matrix (Overview).
Legend	Displays the correspondence between Matrix cell colors and BER values.
Status Area	Displays the measurement details with statuses.
Elapsed Time	Displays the elapsed time from the start of measurement.
Remaining Time	Displays the assumed remaining time until the measurement ends.

4.9 PAM4 Control (with G0375/6A)

4.9.1 Selecting Equipment to use

This section explains selection of equipment to use for PAM4 Control. For details of MP1800A/MP1900A search, refer to 4.3.2 “Connecting Measurement Equipment”.



G0375A 1

MP1900A

Jitter: MU181500B(No.1:Unit1:Slot8)

PPG1: MU195020A Data1,2(No.1:Unit1:Slot1)

PPG2: None

PPG3: None

PPG4: None

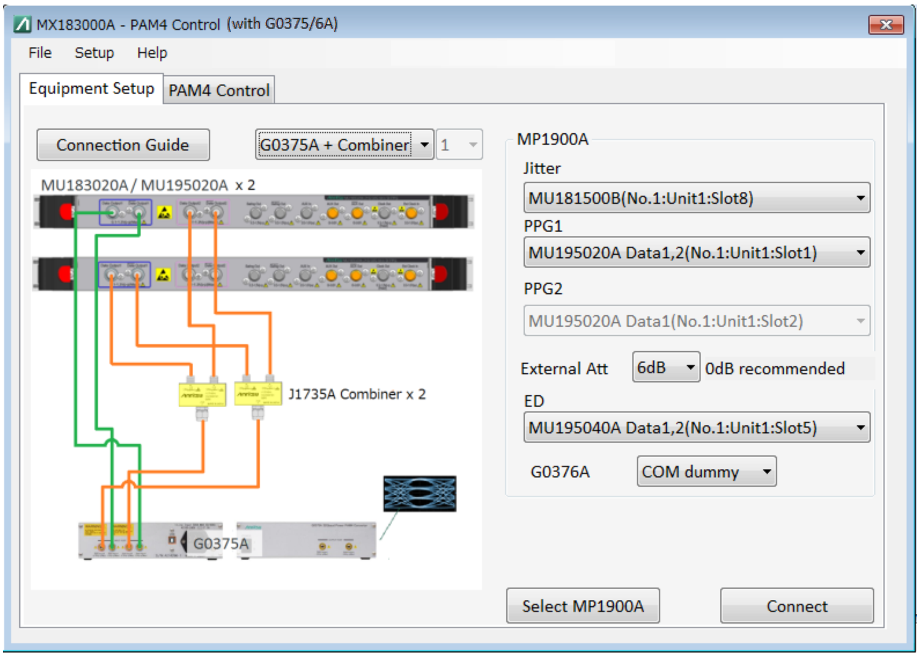
External Att: 6dB 6dB recommended

ED ☐ Use Noise Generator

MU195040A Data1,2(No.1:Unit1:Slot5)

G0376A: COM dummy

Figure 4.9.1-1 Equipment Setup Screen (When G0375A Is Selected)



G0375A + Combiner 1

MP1900A

Jitter: MU181500B(No.1:Unit1:Slot8)

PPG1: MU195020A Data1,2(No.1:Unit1:Slot1)

PPG2: MU195020A Data1(No.1:Unit1:Slot2)

External Att: 6dB 0dB recommended

ED: MU195040A Data1,2(No.1:Unit1:Slot5)

G0376A: COM dummy

Figure 4.9.1-2 Equipment Setup Screen (When G0375A + Combiner Is Selected)

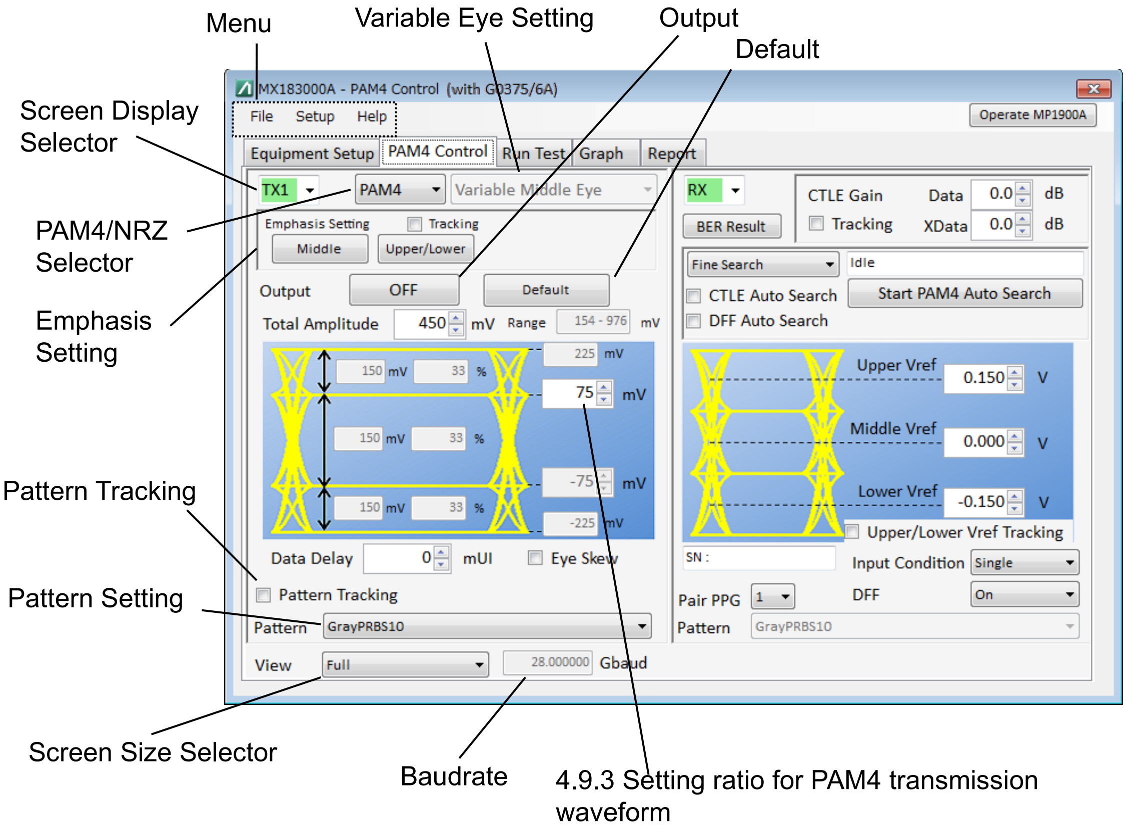
Table 4.9.1-1 Equipment Setup Items

Item	Description
Converter	Selects a PAM4 Converter. Select equipment that is actually connected. G0375A: For generating linear PAM4 signal. G0375A+J1735A Combiner: For generating non-linear PAM4 signal.
G0375A Number Selector	Select a number of PAM4 converters to use. Up to 4 units can be controlled. A 28G/32G PPG or SI PPG is required for each G0375A to be controlled.
Jitter	Selects whether to use MU181500B. When MU181500B is selected and MX183000A PL001 Jitter Tolerance Test is installed, the Jitter Tolerance measurement of PAM4 signal is available.
Input1&2 Input1&Combiner1	Selects PPG for Data1 (MSB) and Data2 (LSB). The selections are MU195020A, MU183020A, and MU183021A.
Combiner2	Selects PPG for Data3 to generate non-linear PAM4 signal. The selections are MU195020A, MU183020A, and MU183021A. It is enabled only when **G0375A+Combiner** is selected for Converter.
Use Noise Generator	Selects whether to use MU195050A. It is available only when G0375A is selected for Converter and MU195020A is used as PPG.
ED	Selects ED for Data1 (MSB) and Data2 (LSB). The selections are MU195040A, MU183040B, and MU183041B.
Extenal Att	Sets a value for the external attenuator connected between PPG and the converter. The following is recommended attenuator values* for PPGs. Select a value corresponding to the actually connected attenuator. MU195020A: 0 dB (linear/non-linear) MU183020A (with MU183020A-x12 or x22): 0 dB (linear/non-linear) MU183021A (with MU183021A-x12 or x22): 0 dB (linear/non-linear) MU183020A (with MU183020A-x13 or x23): 6 dB (linear), 0 dB (non-linear) MU183021A (with MU183021A-x13 or x23): 6 dB (linear), 0 dB (non-linear) However, when PPG:MU195020A and Noise: MU195050A are selected, the MU195050A's internal loss of 3.3 dB is added to the external attenuator value.
G0376A	Selects a G0376A Decoder.

*: The recommended attenuator value between PPG and the converter maximizes the amplitude variable range of G0375A PAM4 signal. When the selected value for the External Att and the actually connected attenuator do not match, the screen settings and output signals will not match.

4.9.2 PAM4 Transmitter setup screen

Clicking the **PAM4 Control** tab displays the PAM4 Transmitter setup and Receiver setup screen. The references for Transmitter setup areas are shown in the following figure.



TX1
PAM4
Variable Middle Eye
Emphasis Setting ☐ Tracking
Output OFF
Total Amplitude 450 mV Range 154 - 976 mV
150 mV 33 %
150 mV 33 %
150 mV 33 %
225 mV
75 mV
-75 mV
-225 mV
Data Delay 0 mUI ☐ Eye Skew
☐ Pattern Tracking
Pattern GrayPRBS10
View Full
28.000000 Gbaud

RX
CTLE Gain Data 0.0 dB
☐ Tracking XData 0.0 dB
Fine Search
Idle
☐ CTLE Auto Search
☐ DFF Auto Search
Upper Vref 0.150 V
Middle Vref 0.000 V
Lower Vref -0.150 V
☐ Upper/Lower Vref Tracking
SN :
Input Condition Single
Pair PPG 1
DFF On
Pattern GrayPRBS10

Figure 4.9.2-1 PAM4 Transmitter Setup Screen

Table 4.9.2-1 PAM4 Transmitter Setup Items

Item	Description
Screen Display Selector	Changes the screen display. TX1 to 4: Displays the transmission setting. RX: Displays the reception setting.
PAM4/NRZ	Switches the transmission signal between PAM4 and NRZ. Default: PAM4
Variable Eye*1	Selects Eye to enlarge. Enlarge Upper Eye: Enlarges the upper part of Non-Linear Eye. Variable Middle Eye: Enlarges the Middle Eye. Enlarge Lower Eye: Enlarges the lower part of Non-Linear Eye. Default: Enlarge Upper Eye
Output	Outputs the set waveform. Default: OFF
Emphasis Setting	When SI PPG (with MU195020A-x21) is used as PPG, the Emphasis Setting is available for Middle Eye (MSB), Upper/Lower Eye (LSB), and Non-Linear Eye. To display the Emphasis Setting screen of Data1 (Middle Eye), Data2 (Upper/Lower Eye), or Data3 (Non Linear Eye) of MU195020A, click the corresponding button.
Tracking	Sets tracking for the Emphasis Setting of PPG Data1 and 2. When set to On, Data1 and 2 have common values in the Emphasis Setting. Default: OFF
Data Delay	Sets Delay of PAM4 waveform. –64000 to +64000 mUI 2 mUI step Default: 0 mUI
Eye Skew	Turns On/Off the output of PPG Data1 (MSB), Data2 (LSB), or Data3 (non-linear) to input to the converter and the Skew adjustment between channels. Data1-Middle EYE: Data1 output and skew setting. Data2-Upper&Lower EYE: Data2 output and skew setting. Data3-Non Linear EYE: Data3 output and skew setting.
Baudrate	Displays Baudrate of PAM4 signal.
Pattern*2	Sets TX pattern and RX pattern.
Pattern Tracking	Applies the TX pattern of the selected PPG to all PPGs.
Default	Restore the Transmitter setting to default.
Screen Size Selector	Switches the screen size. Full: Displays two interfaces. Half: Displays one interface.

*1: When G0375A is selected for Converter on the Equipment Setup screen, only Variable Middle Eye can be set.

*2: When G0376A is not selected for Decoder on the Equipment Setup screen, the RX pattern is not set.

4.9.3 Setting ratio for PAM4 transmission waveform amplitude

This section explains how to set the ratios for the total amplitude and each eye of PAM4 signal to transmit.

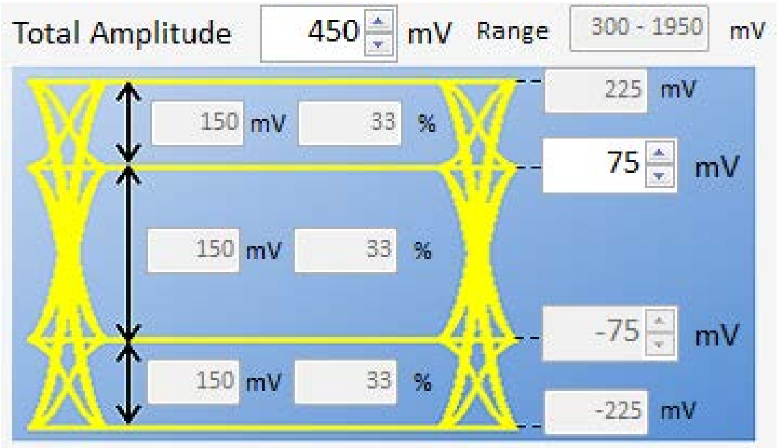


Figure 4.9.3-1 PAM4 Transmitter Dialog Box

Table 4.9.3-1 PAM4 Transmitter Setup Items in the Dialog Box

Item	Description
Total Amplitude [mV]	Sets PAM4 total amplitude. The setting range depends on the PPG, Ext. ATT, Converter, presence of noise, and Variable Eye Setting. Table 4.9.3-2 shows the Total Amplitude setting range according to the conditions.
2 Level [mV]*	Sets 2 Level amplitude as PAM4 Symbol. When Total Amplitude is changed, 2 Level adjusts itself so that the Eye ratio stays the same. If the same value cannot be set, it is rounded to the closest possible value. The setting range depends on the PPG, Ext. ATT, Converter, presence of noise, and Variable Eye Setting.
1 Level [mV]*	Sets 1 Level amplitude as PAM4 Symbol. When Total Amplitude is changed, 1 Level adjusts itself so that the Eye ratio stays the same. If the same value cannot be set, it is rounded to the closest possible value. The setting range depends on the PPG, Ext. ATT, Converter, presence of noise, and Variable Eye Setting.
Eye Amplitude[mV], [%] (calculated value)	Displays the calculated value of 0 Level and 3 Level in [mV]. Also, displays the Amplitude monitor value of Upper/Middle/Lower Eye in [mV] [%]. Table 4.9.3-3 shows the Eye ranges [%].

*: When Variable Middle Eye is set, editing 2 Level amplitude changes 1 Level amplitude simultaneously so that Upper Eye and Lower Eye will have the same amplitude.

Table 4.9.3-2 G0375A Total Amplitude Setting Range

Converter	PPG	Ext. ATT (dB)	Total Amplitude (mV)	Recommended Ext.ATT
G0375A	MU183020A*1, MU183021A*2	0	1500 to 2200	–
		6	754 to 1502	✓
	MU183020A*3, MU183021A*4	0	1500 to 2200	–
		6	754 to 2200	✓
	MU195020A	0	300 to 1950	–
		6	154 to 976	✓
G0375A + J1735A Combiner (Enlarge Upper/Lower Eye)	MU183020A*1, MU183021A*2	0	910 to 2200	✓
		6	458 to 1142	–
	MU183020A*3, MU183021A*4	0	910 to 2200	✓
		6	458 to 2000	–
	MU195020A	0	182 to 1482	✓
		6	94 to 742	–
G0375A + J1735A Combiner (Variable Middle Eye)	MU183020A*1, MU183021A*2	0	750 to 1506	✓
		6	378 to 752	–
	MU183020A*3, MU183021A*4	0	750 to 2200	✓
		6	378 to 1320	–
	MU195020A	0	150 to 978	✓
		6	78 to 488	–
G0375A+Noise	MU195020A	3.3*5	106 to 1332	✓

*1: With MU183020A-x12 or x22.

*2: With MU183021A-x12 or x22.

*3: With MU183020A-x13 or x23.

*4: With MU183021A-x13 or x23.

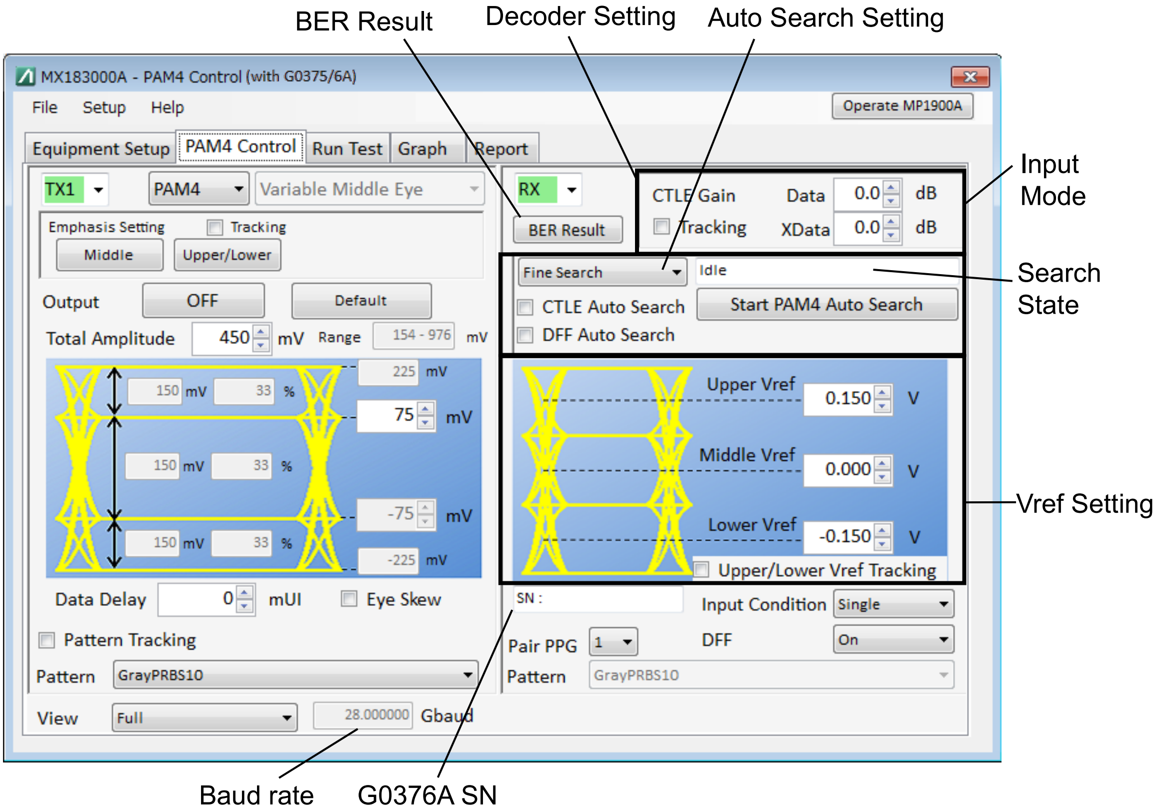
*5: When using G0375A+MU195020A+Noise, the recommended Ext ATT is the Noise module attenuation (3.3 dB).

Table 4.9.3-3 Upper/Middle/Lower Eye Ranges

Variable Eye Setting	Upper Eye Range	Middle Eye Range	Lower Eye Range
Enlarge Upper Eye	35 to 50%	20 to 35%	20 to 30%
Variable Middle Eye	20 to 40%	20 to 60%	20 to 40%
Enlarge Lower Eye	20 to 30%	20 to 35%	35 to 50%

4.9.4 PAM4 Receiver setup screen

Clicking the **PAM4 Control** tab displays the PAM4 Transmitter setup and Receiver setup screen. The references for Receiver setup areas are shown in the following figure.



TX1 · PAM4 · Variable Middle Eye

☐ Tracking

Output: OFF

Total Amplitude: 450 mV Range: 154 - 976 mV

225 mV · 150 mV 33 % · 75 mV · 150 mV 33 % · -75 mV · 150 mV 33 % · -225 mV

Data Delay: 0 mUI ☐ Eye Skew

☐ Pattern Tracking

Pattern: GrayPRBS10

View: Full 28.000000 Gbaud

RX

CTLE Gain Data: 0.0 dB

☐ Tracking XData: 0.0 dB

Fine Search Idle

☐ CTLE Auto Search

☐ DFF Auto Search

Upper Vref: 0.150 V

Middle Vref: 0.000 V

Lower Vref: -0.150 V

☐ Upper/Lower Vref Tracking

SN :

Input Condition: Single

Pair PPG: 1

DFF: On

Pattern: GrayPRBS10

Figure 4.9.4-1 PAM4 Receiver Setup Screen

Table 4.9.4-1 PAM4 Receiver Setup Items

Item	Description
Decoder Setting	Setting for G0376A Decoder.
Data*1	CTLE gain setting for Data. –12.0 to 0.0 dB, 0.1 dB step Default: 0.0 dB
XData*1	CTLE gain setting for XData. –12.0 to 0.0 dB, 0.1 dB step Default: 0.0 dB
Tracking	Tracking setting for CTLE Data and XData Input. When set to On, the gain values of Data and XData will be the same. Default: ON
Input Mode	Selects the input mode for Decoder Input. Differential, Single Ended Default: Differential
DFF	Turns On/Off the DFF inside the decoder. When the DFF is On, input the PPG Fullrate clock signal to the Clock Input connector. Default: ON
Auto Search Setting	Setting for searching the optimal parameters for reception.
Search State	Displays what is being processed in Auto Search.
CTLE Auto Search	Sets whether to search CTLE in Auto Search. Default: OFF
Short Time Search	Sets whether to perform the optimal Vref value search with shortened sequence in Auto Search. Default: ON
Start PAM Auto Search*2	Clicking the button starts Auto Search for the optimal Vref value of PAM4 signal. When DFF is On, the DFF Delay search is performed. When the CTLE search is selected, the CTLE optimal search is also performed.
Vref Setting	Vref setting for PAM4 signal.
Middle/Upper/Lower Vref Setting.	Vref is set for Middle, Upper, and Lower individually. Upper: –0.400 to 0.400 V, 0.001 V step Default: 0.100 V Middle: –0.400 to 0.400 V, 0.001 V step Default: 0.000 V Lower: –0.400 to 0.400 V, 0.001 V step Default: –0.100 V Note that the setting for Lower is invalid when Tracking is ON. POS value can be edited, but NEG value is read-only.
Upper/Lower Vref Tracking	Tracking setting for Upper and Lower Vref. When it is On, the Upper and Lower values work in positive and negative symmetrically. Example) Upper: +0.050 mV, Lower: –0.050 mV Default: ON

*1: When CTLE Gain is 0 dB, it is recommended to input the signal directly to the G0376A Decoder without using CTLE Input/Output.

*2: PAM4 Auto Search is available only if PAM4 signal is equivalent to AC, meaning Middle Vref is around 0.000 V.

Table 4.9.4-1 PAM4 Receiver Setup Items (Cont'd)

Item	Description
Others	Displays other parameters.
Pair PPG	Set the same pattern as the selected TX for RX.
BER Result	Clicking the button minimizes the MX183000A screen and displays the result screen of ED that is used for the BER measurement.
Baud Rate	Displays the Baud rate of PAM4 signal.
G0376A SN	Displays a serial number of the connected G0376A.

4.9.5 BER measurement using PAM4 Control

This section explains the procedure to connect and set up devices as the module configuration described in 3.5.1 “Connection for transmitting and receiving linear PAM4 signal” as an example.

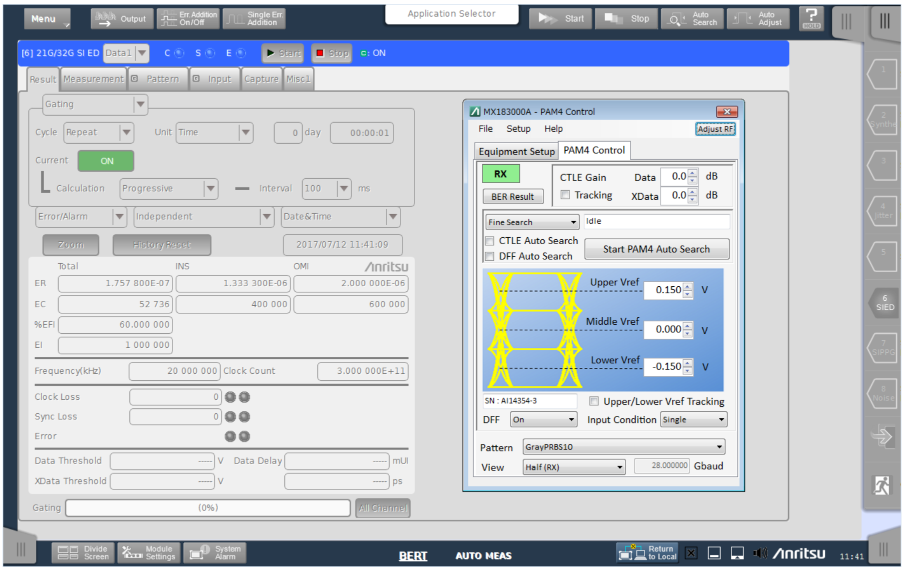
1. Start MX183000A and select **PAM4 Control (with G0375/6A)** on the Figure 4.3.1-1 Selector Screen. Then select equipment to use on the Equipment Setup Screen (Before Starting Search) (Figure 4.3.2-1).

   Jitter: MU181500B
   Noise: MU195050A
   PPG: MU195020A
   Converter: G0375A
   Ext. ATT: 0 dB
   ED: MU195040A
   Decoder: G0376A

   Select the equipment above and click **Connect**.
2. Select a test pattern to use for the measurement. Select **GrayPRBS13Q-IEEE200G_400G [Draft2]** in this case.
3. Refer to 4.9.2 “PAM4 Transmitter Setup Screen” and 4.9.3 “Setting Ratio for PAM4 Transmission Waveform Amplitude”, and set PAM4 signal amplitude. If clicking **Emphasis Setting** and editing the MU195020A setting, or if going back to the MU195020A screen after clicking **Operate MP1800A/MP1900A** and editing other module setting, click **Return to MX183000A** on the Operating dialog box. When the PAM4 waveform setting is completed, set **Output** to **ON**.

   Additionally, before **Output** is set to **ON**, it is recommended to check the amplitude by oscilloscope to make sure it is good for DUT input.
4. After inputting the DUT output to CTLE Input of G0376A, refer to 4.9.4 “PAM4 Receiver Setup Screen” and set CTLE and Decoder. Clicking **Start PAM Auto Search** starts the optimal Vref search of each Eye.
5. The status of BER measurement can be checked on the MU195040A screen by clicking **Operate MP1800A/MP1900A**. After starting the measurement, the 2ch combination results that MU195040A displays are the total BER measurement results of PAM4 signal. The BER measurement result of Data1 is for MSB and Data2 is for LSB. Displaying All Channel screen of MU195040A is convenient to check the results of Data1 and Data2.

6. If set to RX, only Receiver Setup Screen is displayed on the MU195040A. It is convenient to adjust the Vref of each eye in detail seeing the BER measurement results of ED.



Data1
C: ON

Gating
Cycle: Repeat Unit: Time 0 day 00:00:01
Current: ON
Calculation: Progressive Interval: 100 ms
Error/Alarm Independent Date&Time
2017/07/12 11:41:09

	Total	INS	OMI
ER	1.757 800E-07	1.333 300E-06	2.000 000E-06
EC	52 736	400 000	600 000
%EFI	60.000 000		
EI	1 000 000		

Frequency(kHz): 20 000 000 Clock Count: 3.000 000E+11
Clock Loss: 0
Sync Loss: 0
Error
Data Threshold: ----- V Data Delay: ----- mUI
XData Threshold: ----- V ----- ps
Gating: (0%)

CTLE Gain Data: 0.0 dB
☐ Tracking XData: 0.0 dB
Fine Search: Idle
☐ CTLE Auto Search
☐ DFF Auto Search
Upper Vref: 0.150 V
Middle Vref: 0.000 V
Lower Vref: -0.150 V
SN : AI14354-3
☐ Upper/Lower Vref Tracking
DFF: On Input Condition: Single
Pattern: GrayPRBS10
View: Half (RX) 28.000000 Gbaud

Figure 4.9.5-1 PAM4 RX Setup Screen and SI ED Result Screen

4.10 USB Link Training

4.10.1 USB Link Training setup screen

On the **Link Training** tab, you can view the following USB Link Training settings. The references for each setup area are shown in the figure. When the MX183000A-PL023 USB 3.2 x 2 Link Training is activated, link training and measurement can be carried out for USB 3.2 GenXx2-compatible DUT.

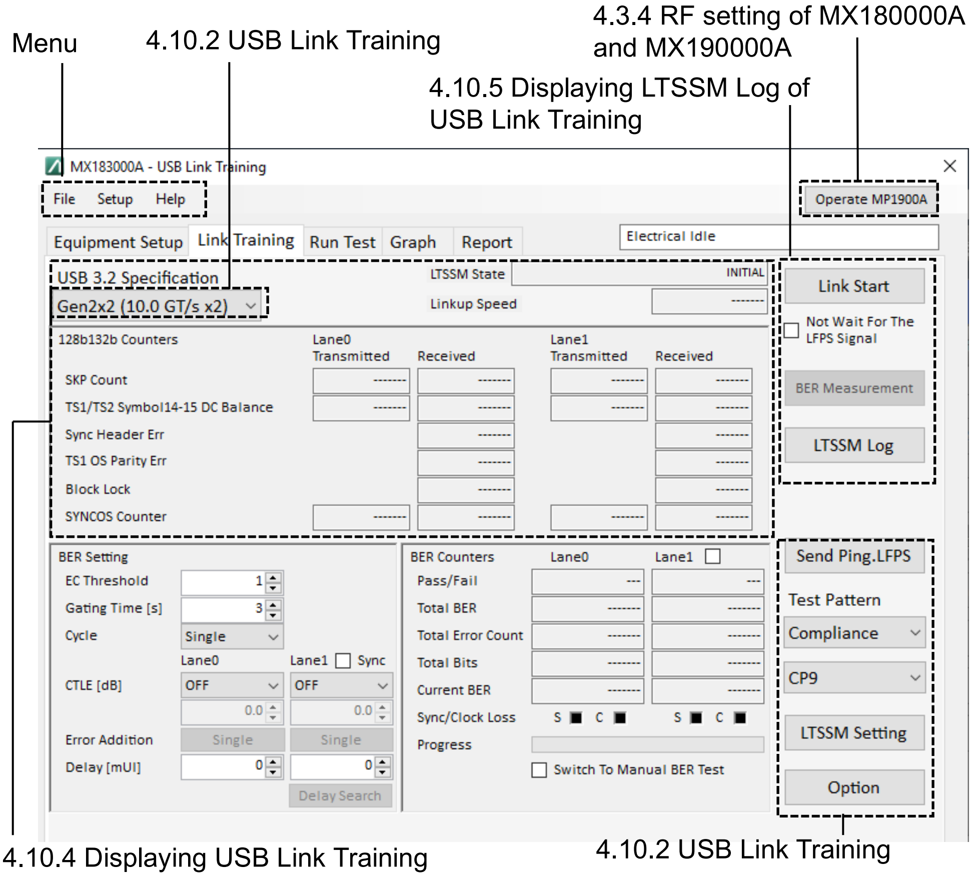
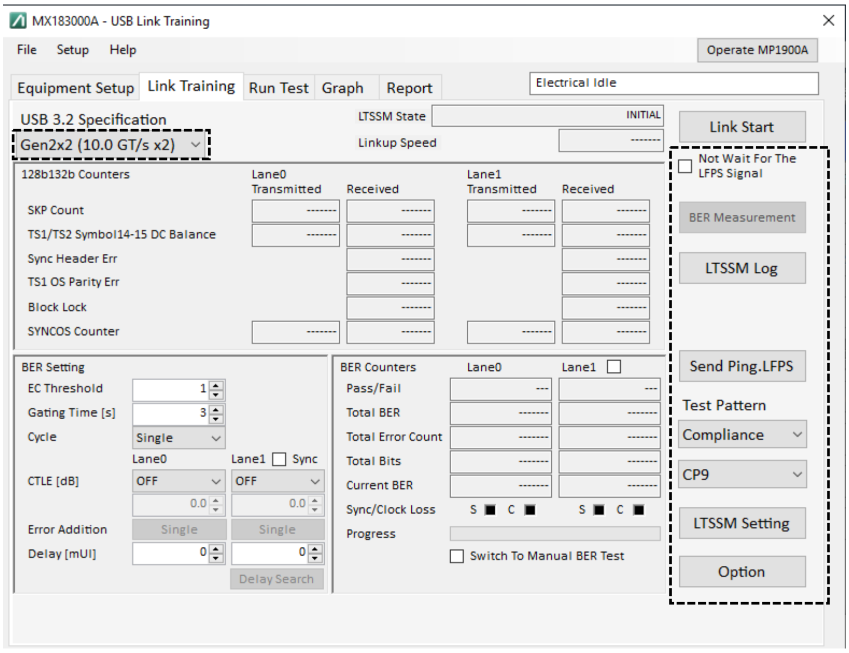


Figure 4.10.1-1 USB Link Training Setup Screen

For details of menus and abbreviations on the above screen, refer to 4.5.1 "USB Link Sequence Setup Screen", since they are common in these screens.

4.10.2 USB Link Training setup

This section explains how to set the link training parameters and test patterns for USB measurement.



Electrical Idle

USB 3.2 Specification: Gen2x2 (10.0 GT/s x2)

LTSSM State: INITIAL

Linkup Speed: -------

BER Setting

EC Threshold: 1

Gating Time [s]: 3

Cycle: Single

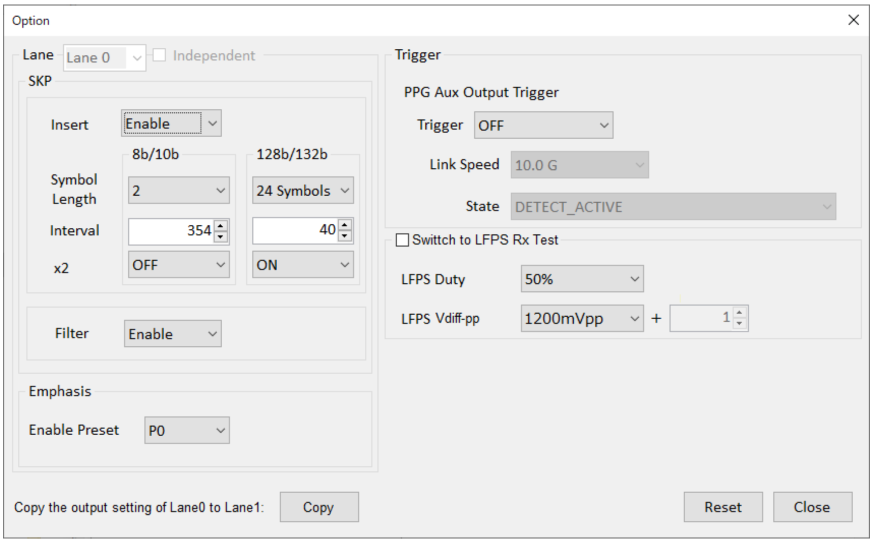
CTLE [dB]: Lane0 OFF 0.0, Lane1 OFF 0.0

Delay [mUI]: 0, 0

Test Pattern: Compliance, CP9

Figure 4.10.2-1 USB Link Training Setup Screen

Click **Option** (see Figure 4.10.2-1) to display the USB Link Training Option dialog box (Figure 4.10.2-2).



Lane: Lane 0 ☐ Independent

Insert: Enable

Symbol Length: 2 (8b/10b), 24 Symbols (128b/132b)

Interval: 354 (8b/10b), 40 (128b/132b)

x2: OFF (8b/10b), ON (128b/132b)

Filter: Enable

Enable Preset: P0

Trigger: OFF

Link Speed: 10.0 G

State: DETECT_ACTIVE

☐ Switch to LFPS Rx Test

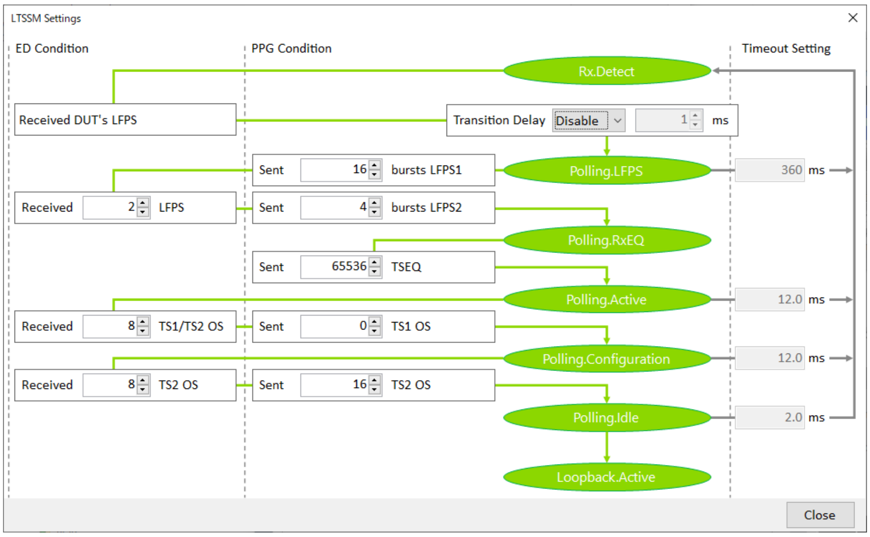
LFPS Duty: 50%

LFPS Vdiff-pp: 1200mVpp + 1

Copy the output setting of Lane0 to Lane1:

Figure 4.10.2-2 USB Link Training Option Dialog Box

By clicking **LTSSM Setting** shown in Figure 4.10.2-1 when **Gen1x1 (5.0 GT/s x1)** is selected for USB3.2 Specification, you will see the **LTSSM Settings** dialog box shown in Figure 4.10.2-3, where you can set the state transition conditions of LTSSM.



Received DUT's LFPS

Transition Delay Disable 1 ms

Sent 16 bursts LFPS1

Received 2 LFPS

Sent 4 bursts LFPS2

Sent 65536 TSEQ

Received 8 TS1/TS2 OS

Sent 0 TS1 OS

Received 8 TS2 OS

Sent 16 TS2 OS

Polling.LFPS 360 ms

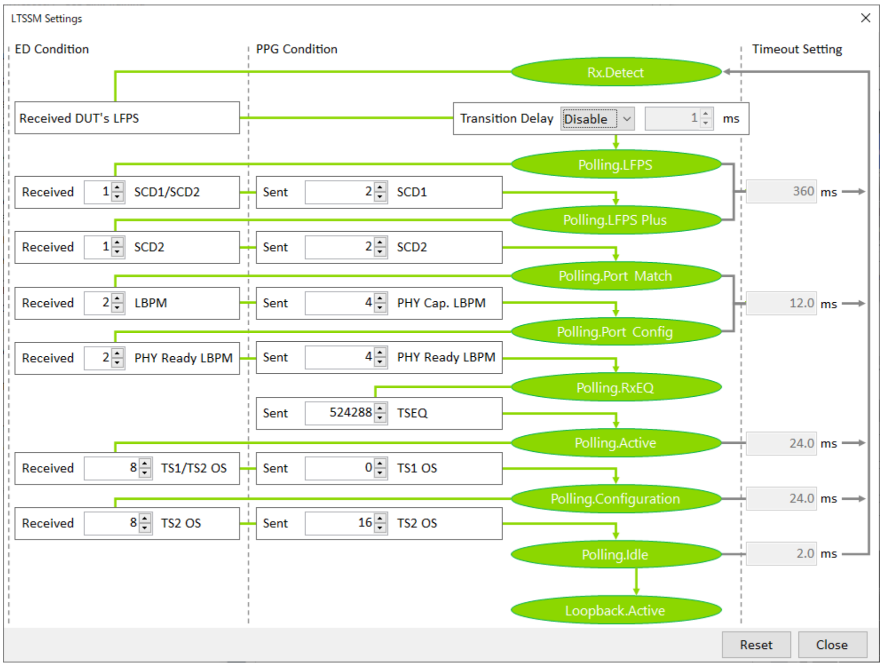
Polling.Active 12.0 ms

Polling.Configuration 12.0 ms

Polling.Idle 2.0 ms

Figure 4.10.2-3 LTSSM Settings Dialog Box (When Gen1x1 Is Seleted)

By clicking **LTSSM Setting** shown in Figure 4.10.2-1 when **Gen1x2 (5.0 GT/s x2)**, **Gen2x1 (10.0 GT/s x1)**, or **Gen2x2 (10.0 GT/s x2)** is selected for USB3.2 Specification, you will see the LTSSM Settings dialog box shown in Figure 4.10.2-4, where you can set the state transition conditions of LTSSM.



Received DUT's LFPS

Transition Delay Disable 1 ms

Received 1 SCD1/SCD2 — Sent 2 SCD1

Received 1 SCD2 — Sent 2 SCD2

Received 2 LBPM — Sent 4 PHY Cap. LBPM

Received 2 PHY Ready LBPM — Sent 4 PHY Ready LBPM

Sent 524288 TSEQ

Received 8 TS1/TS2 OS — Sent 0 TS1 OS

Received 8 TS2 OS — Sent 16 TS2 OS

360 ms

12.0 ms

24.0 ms

24.0 ms

2.0 ms

Figure 4.10.2-4 LTSSM Settings Dialog Box (When Gen1x2 or Gen2xX Is Selected)

In the **LTSSM Settings** dialog box, changes can be made to the settings so that link training can be performed on the DUT that is different from the default LTSSM transition conditions.

Table 4.10.2-1 shows the setting items in Figure 4.10.2-1.

Table 4.10.2-1 USB Link Training Setup Items

Item	Description
USB 3.2 Specification	Select and set the USB specification from **Gen1x1 (5.0 GT/s)**, **Gen1x2 (5.0 GT/s x2)***, **Gen2x1 (10.0 GT/s x1)**, or **Gen2x2 (10.0 GT/s x2)***. When installing MU181000A/B, set Operation Bitrate of SI PPG to Gen1xX: 5.0 GT/s, Gen2xX: 10.0 GT/s respectively.
Not Wait for The LFPS Signal	When this item is checked, link training will start immediately after clicking **Link Start**. If **Link Start** is clicked without checking this item, the application waits to receive the LFPS signal from the DUT.
LTSSM Log	Open the screen that displays log captured during training. For details, refer to 4.10.4 “Displaying USB Link Training Results”.
Send Ping LFPS	When this button is clicked, Ping LFPS signal is output.
Test Pattern	After completing the transmission of the link training sequence, select the test pattern that is repeatedly output at the end from Compliance/USER. When Compliance is selected, USB standard test pattern selection controller is displayed. When USER is selected, the test pattern sent to SI PPG with MX190000A is set. When Compliance is set, a pattern corresponding to the condition for SI PPG is set. Selectable value changes depending on the value set for USB 3.2 Specification.

*: Available when the MX183000A-PL023 USB 3.2 x 2 Link Training is activated.

Table 4.10.2-2 shows the setting items in Figure 4.10.2-2.

Table 4.10.2-2 Option Setting Items

Item	Description
Lane	The SKP and Emphasis parameters for Lane 0 can be set when **Gen1x1 (5.0 GT/s x1)** or **Gen2x1 (10.0 GT/s x1)** is selected for USB 3.2 Specification. The SKP and Emphasis parameters for Lane 0 and Lane 1 can be set when **Gen1x2 (5.0 GT/s x2)** or **Gen2x2 (10.0 GT/s x2)** is selected for USB 3.2 Specification. When the **Independent** check box is selected, different values can be set for each lane. When the **Independent** check box is not selected, the parameters for all lanes are set to the same values.
SKP	
Insert	Sets whether to insert SKP OS while transmitting TS.
Filter	Sets whether to remove SKP OS at the BER measurement.
Symbol Length	Specifies the SKP OS length.
Interval	Specifies the SKP OS interval.
Double SKP	Sets whether to insert double SKP into the test pattern (CP/MCP) to send at Loopback.Active.
Emphasis	
Enable Preset	Sets the Emphasis Preset value enabled for 5.0 GT/s or 10.0 GT/s signal during Link Training.
Copy the output setting of Lane0 to Lane1	**Copy**: Copies the output settings for Lane0 to Lane1.
PPG AUX Output Trigger	
Trigger	Selects a trigger type.
Link Speed	Outputs trigger signal (pulse) when the measuring instrument transits to the link speed specified by this item and to the conditions specified by State or Change Preset during link training.
State	Outputs trigger signal (pulse) from PPG Aux Out when the measuring instrument transits to the LTSSM State that was specified by this item during link training. This parameter is enabled when **LTSSM** is selected for Trigger. Because the pulse signal output from Aux Out changes from 0 to –1 during the transition to the specified state, set the Scope trigger to Fall Edge. When transits from the specified state to the next state, the pulse signal changes from –1 to 0. Set the Scope trigger to Rise Edge. When using the negative side of the Aux Out connector, the operation is reversed.

Table 4.10.2-2 Option Setting Items (Cont'd)

Item	Description
Switch to LFPS Rx Test	Sets whether to switch to LFPS Rx Test mode. When selected, the following parameters are available, and it is required to change to the connection dedicated to LFPS Rx Test. Do not select the check box if the connection dedicated to LFPS Rx Test is unknown.
LFPS Duty	Sets the duty ratio of the LFPS signal to 40%, 50%, or 60%.
LFPS Vdiff-pp	Sets the amplitude of the LFPS signal to **Default**[*], **1000mVpp**, or **1200mVpp**. When set to **1000 mVpp** or **1200 mVpp**, fine-tuning can be made to the voltage with the spin box on the right in the range of –300 to +300.

*: The amplitude is 3300 mVpp when set to **Default**.

Table 4.10.2-3 shows the setting items in Figure 4.10.2-3.

Table 4.10.2-3 LTSSM Settings Items (When Gen1x1 Is Selected)

Item	Description
Transition Delay	When Enable is selected: You can set the delay between BERT receiving LFPS output from DUT and transition to the Polling.LFPS state. The time can be set in ms units. When Disable is selected: LFPS from DUT is received by BERT and simultaneously it transits to the Polling.LFPS state.
Received LFPS	Sets the condition to make a transition from Polling.LFPS. When the number of received LFPS reaches the value set here, the transition condition is met. Range: 2 to 255, Initial value: 2
Sent bursts LFPS1	Sets the condition to make a transition from Polling.LFPS. When the number of sent LFPS reaches the value set here, the transition condition is met. Range: 16 to 255, Initial value: 16
Sent bursts LFPS2	Sets the condition to make a transition from Polling.LFPS. After the MP1900A receives the LFPS signal, when the number of sent LFPS reaches the value set here, the transition condition is met. Range: 4 to 255, Initial value: 4
Sent TSEQ	Sets the condition to make a transition from Polling.RxEQ. When the number of sent TSEQ reaches the value set here, the transition condition is met. Range: 65536 to 1048575, Initial value: 65536
Received TS1/TS2 OS	Sets the condition to make a transition from Polling.Active. When the number of received TS1 / TS2 OS reaches the value set here, the transition condition is met. Range: 8 to 65535, Initial value: 8
Sent TS1 OS	Sets the condition to make a transition from Polling.Active. When the number of sent TS1 OS reaches the value set here, the transition condition is met. Range: 0 to 65535, Initial value: 0
Received TS2 OS	Sets the condition to make a transition from Polling.Configuration. When the number of received TS2 OS reaches the value set here, the transition condition is met. Range: 8 to 65535, Initial value: 8
Sent TS2 OS	Sets the condition to make a transition from Polling.Configuration. When the number of sent TS2 OS reaches the value set here, the transition condition is met. Range: 16 to 65535, Initial value: 16
Reset	Resets the values set in the **LTSSM Settings** dialog box to the initial values.

Table 4.10.2-4 shows the setting items in Figure 4.10.2-4.

Table 4.10.2-4 LTSSM Settings Items (When Gen1x2, Gen2x1, or Gen2x2 Is Selected)

Item	Description
Transition Delay	When Enable is selected: You can set the delay between BERT receiving LFPS output from DUT and transition to the Polling.LFPS state. The time can be set in ms units. When Disable is selected: LFPS from DUT is received by BERT and simultaneously it transits to the Polling.LFPS state.
Received SCD1/SCD2	Sets the condition to make a transition from Polling.LFPS. When the number of received SCD1 / SCD2 reaches the value set here, the transition condition is met. Range: 1 to 255, Initial value: 1
Sent SCD1	Sets the condition to make a transition from Polling.LFPS. When the number of sent SCD1 reaches the value set here, the transition condition is met. Range: 2 to 255, Initial value: 2
Received SCD2	Set the condition to make a transition from Polling.LFPS Plus. When the number of received SCD2 reaches the value set here, the transition condition is met. Range: 1 to 255, Initial value: 1
Sent SCD2	Sets the condition to make a transition from Polling.LFPS Plus. When the number of sent SCD2 reaches the value set here, the transition condition is met. Range: 2 to 255, Initial value: 2
Received LBPM	Sets the condition to make a transition from Polling.Port Match. When the number of received LBPM reaches the value set here, the transition condition is met. Range: 2 to 255, Initial value: 2
Sent PHY Cap. LBPM	Sets the condition to make a transition from Polling.Port Match. When the number of sent PHY Capability LBPM reaches the value set here, the transition condition is met. Range: 4 to 255, Initial value: 4
Received PHY Ready LBPM	Sets the condition to make a transition from Polling.Port Config. When the number of received PHY Ready LBPM reaches the value set here, the transition condition is met. Range: 2 to 255, Initial value: 2
Sent PHY Ready LBPM	Sets the condition to make a transition from Polling.Port Config. When the number of sent PHY Ready LBPM reaches the value set here, the transition condition is met. Range: 4 to 255, Initial value: 4

Table 4.10.2-4 LTSSM Settings Items (When Gen1x2, Gen2x1, or Gen2x2 Is Selected) (Cont'd)

Item	Description
Sent TSEQ	Sets the condition to make a transition from Polling.RxEQ. When the number of sent TSEQ reaches the value set here, the transition condition is met. Range: 65536 to 1048575, Initial value: 65536 (When Gen1x2 is selected) 524288 to 1048575, Initial value: 524288 (When Gen2x1 or Gen2x2 is selected)
Received TS1/TS2 OS	Sets the condition to make a transition from Polling.Active. When the number of received TS1 / TS2 OS reaches the value set here, the transition condition is met. Range: 8 to 65535, Initial value: 8 (When Gen1x2 is selected) 8 to 65535, Initial value: 8 (When Gen2x1 or Gen2x2 is selected)
Sent TS1 OS	Sets the condition to make a transition from Polling.Active. When the number of sent TS1 OS reaches the value set here, the transition condition is met. Range: 0 to 65535, Initial value: 0 (When Gen1x2 is selected) 0 to 65535, Initial value: 0 (When Gen2x1 or Gen2x2 is selected)
Received TS2 OS	Sets the condition to make a transition from Polling.Configuration. When the number of received TS2 OS reaches the value set here, the transition condition is met. Range: 8 to 65535, Initial value: 8 (When Gen1x2 is selected) 8 to 65535, Initial value: 8 (When Gen2x1 or Gen2x2 is selected)
Sent TS2 OS	Sets the condition to make a transition from Polling.Configuration. When the number of sent TS2 OS reaches the value set here, the transition condition is met. Range: 16 to 65535, Initial value: 16 (When Gen1x2 is selected) 16 to 65535, Initial value: 16 (When Gen2x1 or Gen2x2 is selected)
Reset	Resets the values set in the **LTSSM Settings** dialog box to the initial values.

4.10.3 Starting USB Link Training

1. Click **Link Start**. Then, the PPG will wait for receiving LFPS signal and the button changes to **Stop**.
2. In this state, when the USB Test Fixture connector is connected to the DUT, the DUT detects the USB connection and outputs the LFPS signal. PPG receives the LFPS signal by the DUT with AUX Input and link training begins.

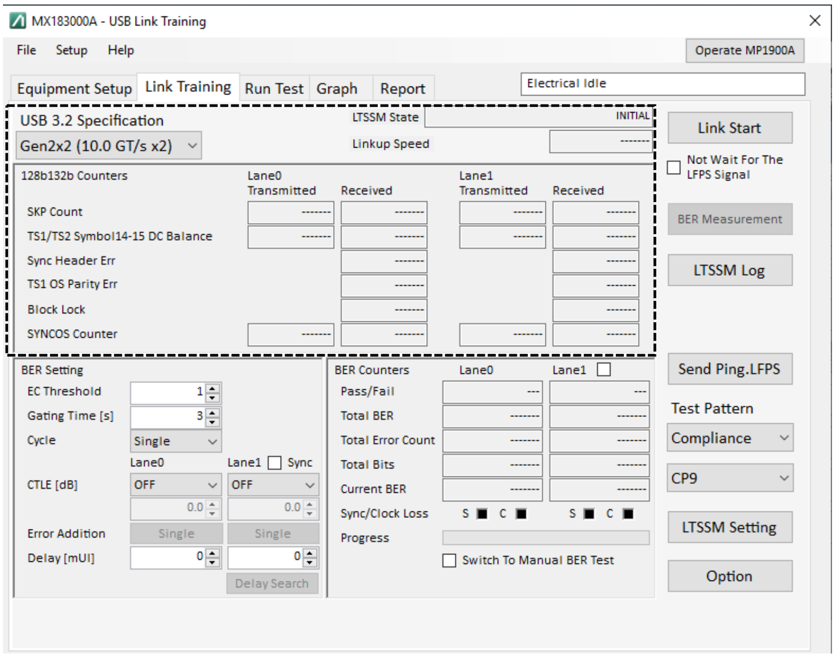
   Link Start changes to **Stop** during link training. It changes to **Unlink** when the link training is completed and the **DUT** status changes from Electrical Idle to Loopback Active. At that time, PPG sends a test pattern.
3. Clicking Unlink while the test pattern is being sent aborts the test pattern transmission, and the PPG returns to Electrical Idle status.

   For how to display link success/failure or LTSSM transition log, refer to 4.10.4 “Displaying USB Link Training Results” and 4.10.5 “Displaying LTSSM Log of USB Link Training”.
4. If you wish to measure Jitter Tolerance after this, refer to 4.6 “Jitter Tolerance Test” for details of the **Run Test** tab, **Graph** tab, and **Report** tab.
5. If you wish to measure BER after this, click **BER Measurement**. For details of the BER Measurement, refer to 4.10.6 “Setting up USB Link Training BER Measurement” and 4.10.7 “Starting USB Link Training BER Measurement”.

4.10.4 Displaying USB Link Training results

After performing link training as explained in 4.10.3, the results can be displayed.

When the MX183000A-PL023 USB 3.2 x 2 Link Training is activated, the Lane1 counters can be displayed in addition to Lane0.



Electrical Idle

USB 3.2 Specification: Gen2x2 (10.0 GT/s x2)

LTSSM State: INITIAL

Linkup Speed: -------

EC Threshold: 1

Gating Time [s]: 3

Cycle: Single

CTLE [dB]: OFF / OFF

Test Pattern: Compliance, CP9

Figure 4.10.4-1 USB Link Training Results

Table 4.10.4-1 USB Link Training Result Items

Item	Description
Common Parameter	
LTSSM State	Displays LTSSM State of measuring instrument.
Linkup Speed	Displays Link Speed (5.0 or 10.0 GT/s).
8b10b Counters*	This is displayed when **Gen1x1 (5.0 GT/s x1)** or **Gen1x2 (5.0 GT/s x2)** is selected for USB 3.2 Specification.
SKP Count (Rx, Tx)	Displays the SKP OS number counted during link training. Rx and Tx have separate counts
Symbol Error	Displays the Symbol Error number counted during link training.
Current RD Error	Displays the Running Disparity number during link training.
Symbol Lock	Displays the Symbol Lock state.
128b132b Counters*	This is displayed when **Gen2x1 (10.0 GT/s x1)** or **Gen2x2 (10.0 GT/s x2)** is selected for USB 3.2 Specification.
SKP Count (Rx, Tx)	Displays the SKP OS number counted during link training. Rx and Tx have separate counts
TS1/TS2 Symbol 14-15 DC Balance (Rx, Tx)	Displays the DC balance obtained during link training. If the data stream contains more 1s than 0s, the difference is counted as a positive value. If more 0s than 1s, a negative value. Rx and Tx have separate counts.
Sync Header Error	Displays the Sync Header Error number counted during link training or in the Loopback.Active state.
TS1 OS Parity Error	Displays the Parity Error number counted during link training.
Block Lock	Displays the Block Lock number counted during link training.
SYNCOS Counter (Rx, Tx)	Displays the number of SYNCOS counted during Link Training or in the Loopback.Active state. Rx and Tx have separate counts

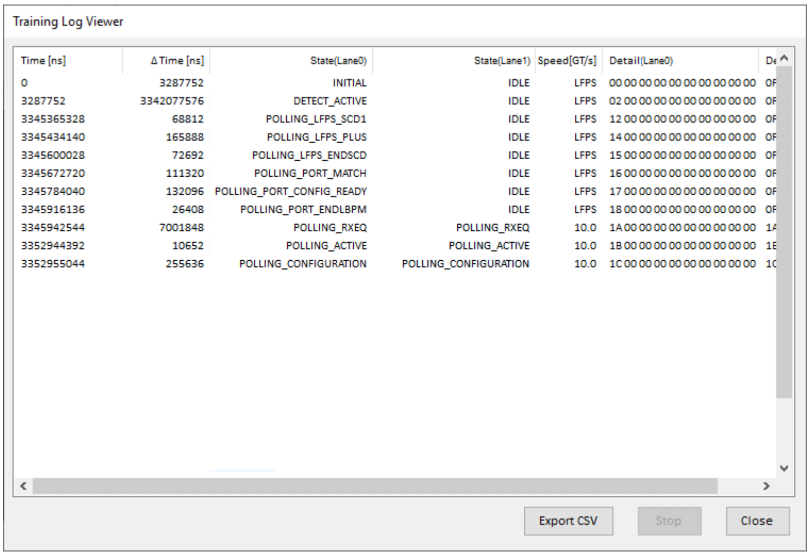
*: Lane1 is available when both of the following are met.

- The MX183000A-PL023 USB 3.2 x 2 Link Training is activated.
- **Gen1x2 (5.0 GT/s x2)** or **Gen2x2 (10.0 GT/s x2)** is selected for USB 3.2 Specification.

4.10.5 Displaying LTSSM Log of USB Link Training

After performing link training as explained in 4.10.3, click **LTSSM Log** to display log.

Log data of each row is recorded when the LTSSM state is changed.



Training Log Viewer

Time [ns]	ΔTime [ns]	State(Lane0)	State(Lane1)	Speed[GT/s]	Detail(Lane0)	De
0	3287752	INITIAL	IDLE	LFPS	00 00 00 00 00 00 00 00 00 00	0F
3287752	3342077576	DETECT_ACTIVE	IDLE	LFPS	02 00 00 00 00 00 00 00 00 00	0F
3345365328	68812	POLLING_LFPS_SCD1	IDLE	LFPS	12 00 00 00 00 00 00 00 00 00	0F
3345434140	165888	POLLING_LFPS_PLUS	IDLE	LFPS	14 00 00 00 00 00 00 00 00 00	0F
3345600028	72692	POLLING_LFPS_ENDSCD	IDLE	LFPS	15 00 00 00 00 00 00 00 00 00	0F
3345672720	111320	POLLING_PORT_MATCH	IDLE	LFPS	16 00 00 00 00 00 00 00 00 00	0F
3345784040	132096	POLLING_PORT_CONFIG_READY	IDLE	LFPS	17 00 00 00 00 00 00 00 00 00	0F
3345916136	26408	POLLING_PORT_ENDLBPM	IDLE	LFPS	18 00 00 00 00 00 00 00 00 00	0F
3345942544	7001848	POLLING_RXEQ	POLLING_RXEQ	10.0	1A 00 00 00 00 00 00 00 00 00	1A
3352944392	10652	POLLING_ACTIVE	POLLING_ACTIVE	10.0	1B 00 00 00 00 00 00 00 00 00	1B
3352955044	255636	POLLING_CONFIGURATION	POLLING_CONFIGURATION	10.0	1C 00 00 00 00 00 00 00 00 00	1C

Figure 4.10.5-1 LTSSM Log Viewer

Table 4.10.5-1 LTSSM Log Viewer

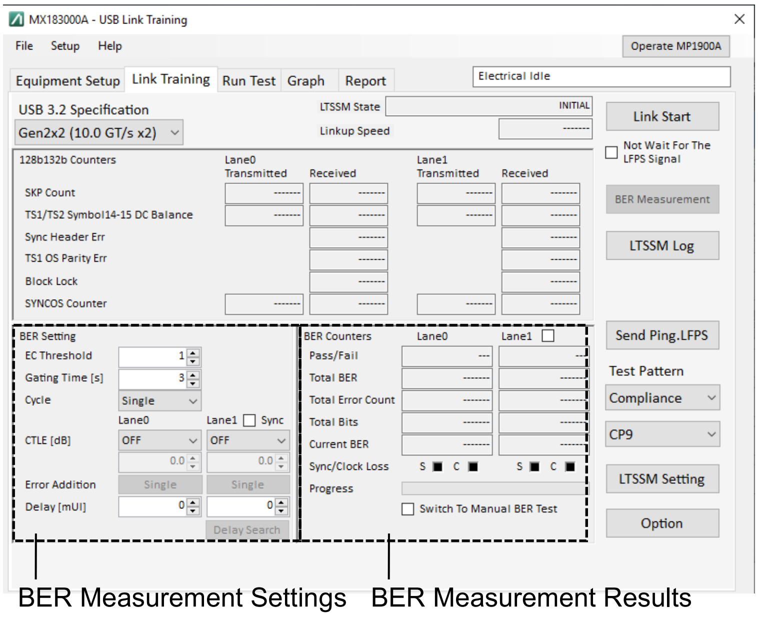
Item	Description
Time [ns]	Displays the time the log data was acquired. The start of acquisition is zero.
ΔTime [ns]	Displays the time interval between when the log data was acquired and when next log data was acquired.
State(Lane0)	Displays the LTSSM State on Lane0 side.
State(Lane1)*	Displays the LTSSM State on Lane1 side.
Speed[GT/s]	Displays Link Speed [GT/s].
HEX Dump(Lane0)	Displays the management code on Lane0 side in hexadecimal.
HEX Dump(Lane1)*	Displays the management code on Lane1 side in hexadecimal.
Detail	Displays the management code.
Progress bar	Displays log decoding progress. It disappears when the decoding is completed.
Stop	Aborts log decoding.
Close	Closes Log Viewer.

*: Lane1 is available when both of the following are met.

- The MX183000A-PL023 USB 3.2 x 2 Link Training is activated.
- **Gen1x2 (5.0 GT/s x2)** or **Gen2x2 (10.0 GT/s x2)** is selected for USB 3.2 Specification.

4.10.6 Setting up USB Link Training BER Measurement

BER Measurement function is enabled in Loopback.Active state after link training sequence transmission is completed. Also, it is enabled when SI ED is installed.



USB 3.2 Specification: Gen2x2 (10.0 GT/s x2)

LTSSM State: INITIAL

EC Threshold: 1

Gating Time [s]: 3

Cycle: Single

CTLE [dB]: Lane0 OFF, 0.0; Lane1 OFF, 0.0

Delay [mUI]: Lane0 0; Lane1 0

Test Pattern: Compliance, CP9

Figure 4.10.6-1 BER Measurement Settings for USB Link Training

Table 4.10.6-1 Setting Items for BER Measurement

Item	Description
EC Threshold	Sets a pass/fail threshold of the BER measurement.
Gating Time [s]	Sets the measurement cycle by seconds.
Cycle	Sets the measurement operation. Repeat: Repeats the measurement in the cycle specified at Gating Time. Single: Ends the measurement in one cycle.
CTLE [dB]*1	Sets the CTLE gain. It is enabled only when SI ED with MU195040A-x11 or x21 is installed.
Sync	This is available when **Gen1x2 (5.0 GT/s x2)** or **Gen2x2 (10.0 GT/s x2)** is selected for USB 3.2 Specification. When selected, the CTLE parameter for Lane 0 is set synchronized to and the same value as Lane 1. When not selected, the CTLE parameters for Lane 0 and Lane 1 can be set independently.
Error Addition *1,*2	Add single bit error to test pattern during BER measurement.
Delay [mUI] *1	Sets the clock phase delay in 2 mUI units.
Delay Search*1	Starts searching for the optimum phase delay of the Lane1 clock, changing the button name to **Stop**. To stop the search, click **Stop**.

*1: Lane1 is available when both of the following are met.

- The MX183000A-PL023 USB 3.2 x 2 Link Training is activated.
- **Gen1x2 (5.0 GT/s x2)** or **Gen2x2 (10.0 GT/s x2)** is selected for USB 3.2 Specification.

*2: If a single error is inserted during BER measurement with CP0 pattern when **Gen1x1 (5.0 GT/s x1)** or **Gen1x2 (5.0 GT/s x2)** is selected for USB3.2 Specification, a Sync Loss may occur in the error-inserted lane, depending on the DUT.
This is because if a single error is inserted into the CP0 pattern, the Running Disparity is inverted and cannot synchronize with the CP0 pattern.
In this case, errors are not counted and Sync Loss occurs. After a while, it will be restored in synchronization with the inverted CP0 pattern.

Table 4.10.6-2 Display Items of BER Measurement Results

Item	Description
Lane1 BER Count	When selected, simultaneous BER measurement of Lane0 and Lane1 is performed. A clock signal is recovered from the signal input to the Data1 Input connector. Therefore, BER of Lane1 can be measured only when synchronization has been established between DUT signals of Lane0 and Lane1.
Pass/Fail*	Pass: Passed, Fail: Failed It is judged as "Fail" if Total Error Count exceeds EC Threshold when the measurement of the time set by Gating Time has completed.
Total BER*	Displays the error rate.
Total Error Count*	Displays the error count.
Total Bits*	Displays the amount of measurement data.
Current BER*	Displays the error rate in 100 ms.
Sync Loss*	Lights up in red in the sync loss status.
Clock Loss	Lights up in red when the clock is not reproduced from the data input in ED.
Measurement Progress Bar	Displays the measurement progress rate.
Switch To Manual BER Test	Displays the Manual BER Test dialog box (Figure 4.10.6-2) so that BER can be checked on the MX190000A screen.

*: Lane1 is available when both of the following are met.

- The MX183000A-PL023 USB 3.2 x 2 Link Training is activated.
- **Gen1x2 (5.0 GT/s x2)** or **Gen2x2 (10.0 GT/s x2)** is selected for USB 3.2 Specification.

When **Switch To Manual BER Test** is clicked during BER Measurement, the dialog box shown in Figure 4.10.6-2 is displayed. While this dialog box is displayed, the MU181500B and MU195020A settings can be changed checking BER on the MU195040A. Refer to "Table 4.3.4-1 Setting Items for Operating" for the main setting items.

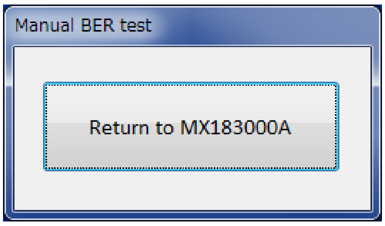
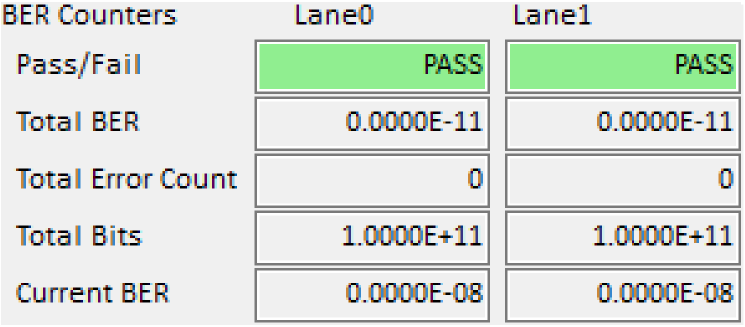


Figure 4.10.6-2 Manual BER Test Dialog Box

4.10.7 Starting USB Link Training BER Measurement

Clicking **BER Measurement** starts measurement.
The measurement results are displayed in the BER measurement result display window, and Pass or Fail is displayed. Clicking **Stop** stops the measurement.

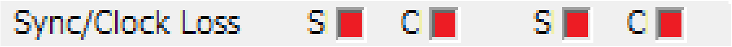
When the DUT is already in the Loopback state, the **Total BER**, **Total Error Count**, **Total Bits** counters start counting.



BER Counters	Lane0	Lane1
Pass/Fail	PASS	PASS
Total BER	0.0000E-11	0.0000E-11
Total Error Count	0	0
Total Bits	1.0000E+11	1.0000E+11
Current BER	0.0000E-08	0.0000E-08

Figure 4.10.7-1 BER Measurement Result Display (When Link Establishment is Successful)

When the DUT is not in the Loopback state or failed to send the test pattern normally, **Sync Loss** and **Clock Loss** indicators turn red.



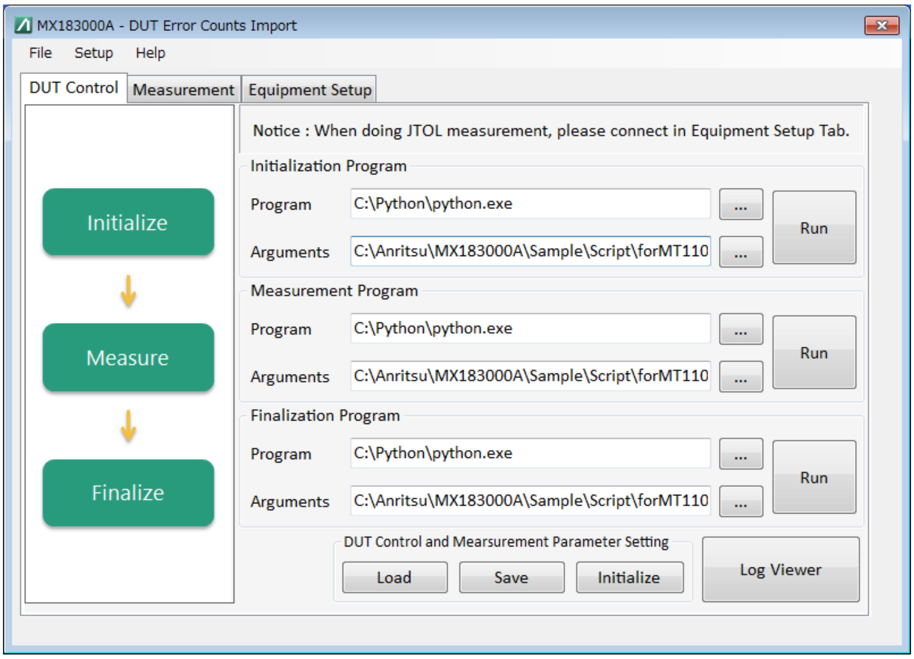
Sync/Clock Loss S 🟥 C 🟥 S 🟥 C 🟥

Figure 4.10.7-2 BER Measurement Result Display (When Link Establishment is Failed)

4.11 DUT Error Counts Import

4.11.1 DUT Control tab

This section explains how to select user programs for controlling DUT.


MX183000A - DUT Error Counts Import

Notice : When doing JTOL measurement, please connect in Equipment Setup Tab.

Initialization Program
Program: C:\Python\python.exe
Arguments: C:\Anritsu\MX183000A\Sample\Script\forMT110

Measurement Program
Program: C:\Python\python.exe
Arguments: C:\Anritsu\MX183000A\Sample\Script\forMT110

Finalization Program
Program: C:\Python\python.exe
Arguments: C:\Anritsu\MX183000A\Sample\Script\forMT110

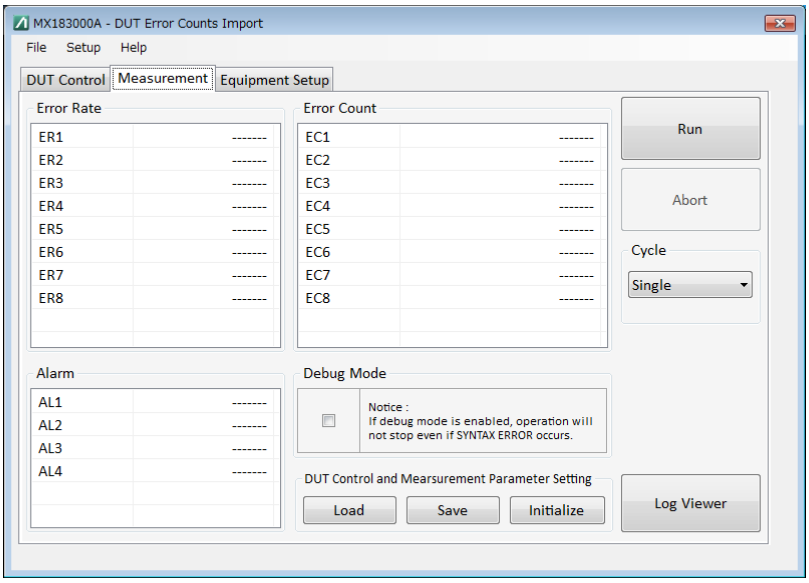
Figure 4.11.1-1 DUT Control Tab

Table 4.11.1-1 DUT Control Tab

Item	Description
Initialization Program	Allows you to select a program file for initializing DUT. A path to program and a path to start-up argument can be specified.
Run button	Starts the Initialization program.
Measurement Program	Allows you to select a program file for performing measurement for DUT. A path to program and a path to start-up argument can be specified.
Run button	Starts the Measurement program. Clicking this button displays the **Measurement** tab.
Finalization Program	Allows you to select a program file for finalizing DUT. A path to program and a path to start-up argument can be specified.
Run button	Starts the selected Finalization program.
Log Viewer button	Displays the window to view log for each program.
DUT Control and Measurement Parameter Setting	Saves/loads/initializes parameters on the **DUT Control** and **Measurement** tabs.
Load	Loads the saved parameter file to the **DUT Control** tab and **Measurement** tab.
Save	Saves parameters on the **DUT Control** tab and **Measurement** tab in a file.
Initialize	Initializes parameters on the **DUT Control** tab and **Measurement** tab.

4.11.2 Measurement tab

This section explains the start of measurement and the display of measurement results.



Cycle: Single

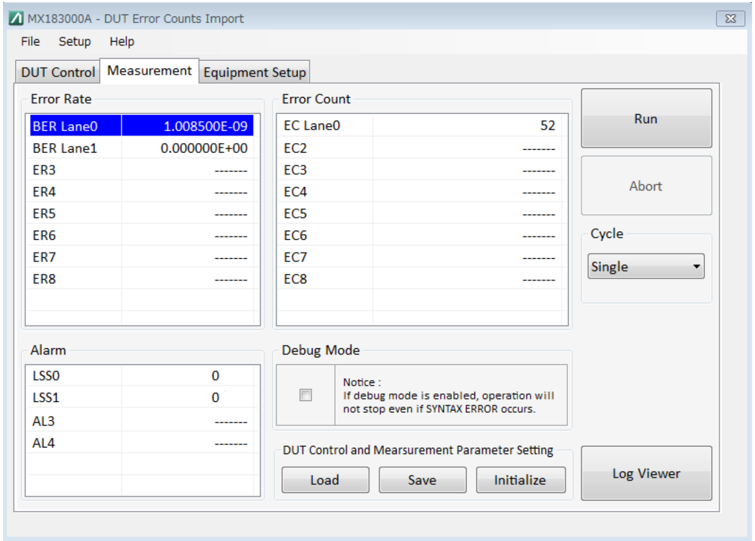
☐ Notice : If debug mode is enabled, operation will not stop even if SYNTAX ERROR occurs.

Figure 4.11.2-1 Measurement Tab

Table 4.11.2-1 Elements on Measurement Tab

Item	Description
Result display area	Displays the results of error rate, error count, and alarm. ER1 to 8: display error rates . 0, 0.0001E–18 to 1.0000E00 EC1 to 8: display the number of error counts. 0 to 18,446,744,073,709,551,615 AL1 to 4: display whether alarms are given or not. 1 or 0 is displayed. If NA is acquired as value, “-------” (seven hyphen characters) is displayed. Conditions for Jitter Tolerance measurement are the parameters defined by ER1, EC1, and AL1 to 4 in the Measure program. Also, by definitions, background colors of the results can be specified. For details on the definition method, refer to Appendix C “User Program Definitions”.

Table 4.11.2-1 Elements on Measurement Tab (Cont'd)

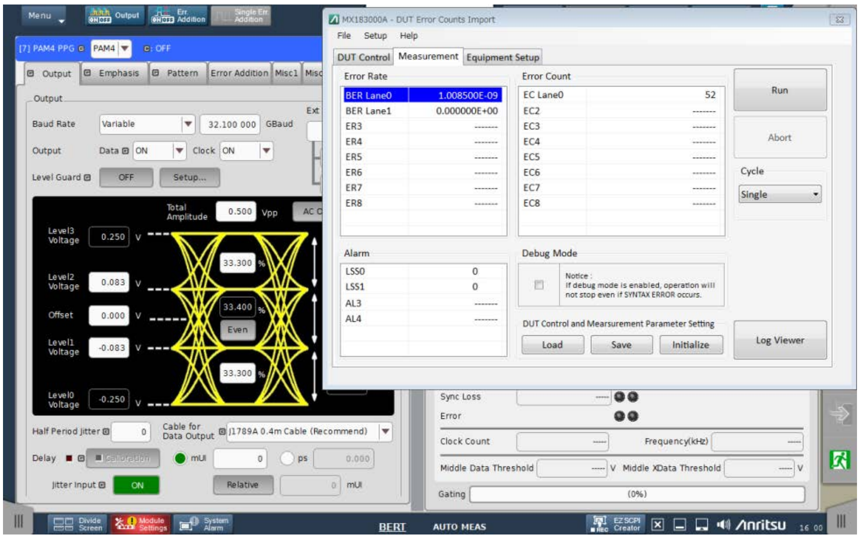
Item	Description
Result display area (Cont'd)	 MX183000A - DUT Error Counts Import File Setup Help DUT Control Measurement Equipment Setup Run Abort Log Viewer Load Save InitializeError Rate BER Lane0 1.008500E-09 BER Lane1 0.000000E+00 ER3 ------- ER4 ------- ER5 ------- ER6 ------- ER7 ------- ER8 ------- Error Count EC Lane0 52 EC2 ------- EC3 ------- EC4 ------- EC5 ------- EC6 ------- EC7 ------- EC8 ------- Cycle Single Alarm LSS0 0 LSS1 0 AL3 ------- AL4 ------- Debug Mode ☐ Notice : If debug mode is enabled, operation will not stop even if SYNTAX ERROR occurs. DUT Control and Mearsurement Parameter Setting
Cycle	Changes measurement cycle. Single: 1-cycle measurement (running the Measurement program once) Repeat: Repeated measurement (running the Measurement program repeatedly)
Run/Stop button	Starts or stops the measurement. Run: Starts the measurement. Runs the Measurement program. Stop: Stops the measurement after the Measurement program being run ends.
Abort button	Aborts the measurement. Unlike the Stop button, this button stops the measurement even if the Measurement program is being run.
Debug Mode check box	When selecting the check box, the Measurement program continues to run with ignoring syntax errors.
Log Viewer button	Displays the Log dialog box. The Log dialog box shows the following. For more details, refer to 4.11.5 "Log Viewer function". ● Messages at the start and end of the user program ● Strings output from the user program ● Syntax errors in the user program detected by MX183000A

4.11.3 Operating MX190000A

This section explains how to operate MX190000A when using the DUT Error Counts Import function.

You can change settings through the MX190000A screen even if the DUT Error Counts Import function acquires the measurement results from DUT.

Figure 4.11.3-1 shows an example of the screen displayed when the BER measurement is performed using MU196020A PAM4 PPG as a pattern generator.



MX183000A - DUT Error Counts Import

File Setup Help

DUT Control | Measurement | Equipment Setup

Error Rate

BER Lane0	1.008500E-09
BER Lane1	0.000000E+00
ER3	--------
ER4	--------
ER5	--------
ER6	--------
ER7	--------
ER8	--------

Error Count

EC Lane0	52
EC2	--------
EC3	--------
EC4	--------
EC5	--------
EC6	--------
EC7	--------
EC8	--------

Alarm

LSS0	0
LSS1	0
AL3	--------
AL4	--------

Debug Mode

☐ Notice : If debug mode is enabled, operation will not stop even if SYNTAX ERROR occurs.

DUT Control and Mearsurement Parameter Setting

Load Save Initialize

Run

Abort

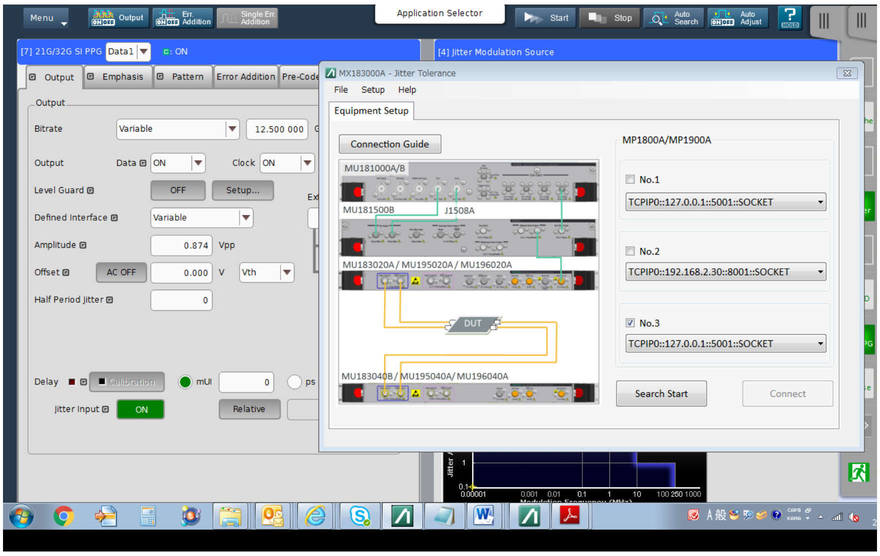
Cycle: Single

Log Viewer

Figure 4.11.3-1 DUT Error Counts Import and MX190000A Screens

However, for Jitter Tolerance measurement described in 4.11.4 “Measuring Jitter Tolerance”, you must click **Disconnect** of MX183000A before operating MX190000A.

Figure 4.11.3-2 shows an example of the screen displayed when the Jitter Tolerance measurement is performed using MU196020A PAM4 PPG as a pattern generator.



Data1
●: ON

Bitrate: Variable, 12.500 000
Output: Data ON, Clock ON
Level Guard: OFF
Defined Interface: Variable
Amplitude: 0.874 Vpp
Offset: AC OFF, 0.000 V, Vth
Half Period Jitter: 0
Delay: ● mUI 0, ○ ps
Jitter Input: ON

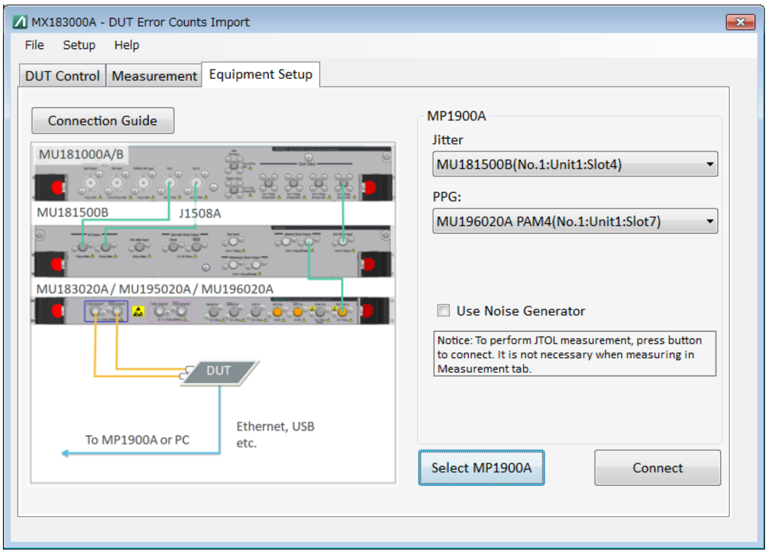
☐ No.1: TCPIP0::127.0.0.1::5001::SOCKET
☐ No.2: TCPIP0::192.168.2.30::8001::SOCKET
☑ No.3: TCPIP0::127.0.0.1::5001::SOCKET

Figure 4.11.3-2 Jitter Tolerance and MX190000A Screens

4.11.4 Measuring Jitter Tolerance

This section explains procedures to acquire measurement results from the DUT counter using DUT Error Counts Import function and to measure jitter tolerance. A Jitter module, a PPG module, and the MX183000A-PL001 Jitter Tolerance Test are required for the measurement. For details on the modules required for the measurement, refer to 3.1 “Target Equipment”.

1. On the **Equipment Setup** tab, select the jitter module and the PPG module to be used to measure jitter tolerance, and then click **Connect**.



Jitter
MU181500B(No.1:Unit1:Slot4)

PPG:
MU196020A PAM4(No.1:Unit1:Slot7)

☐ Use Noise Generator

Notice: To perform JTOL measurement, press button to connect. It is not necessary when measuring in Measurement tab.

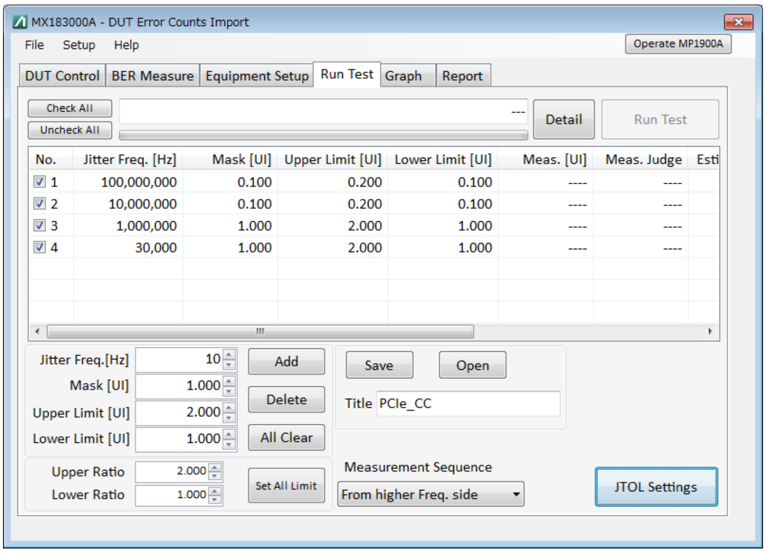
Figure 4.11.4-1 Equipment Setup Tab

2. On the **Run Test** tab, set parameters for Jitter Tolerance measurement. For each parameter, refer to 4.6 “Jitter Tolerance Test”. However, when using the DUT Error Counts Import function, some functions such as Clock Selection, Auto Search, and Gating Time don’t appear.

   The parameters defined in ER1, EC1, and AL1 to 4 in the Measurement program are available for Detection that allows defining condition for Jitter Tolerance measurement. Correspondence between Detection setting parameters and measurement items is as follows:

ER1:	Error Rate
EC1:	Error Count
AL1 to AL4:	Alarms that are termination conditions for Jitter Tolerance Test

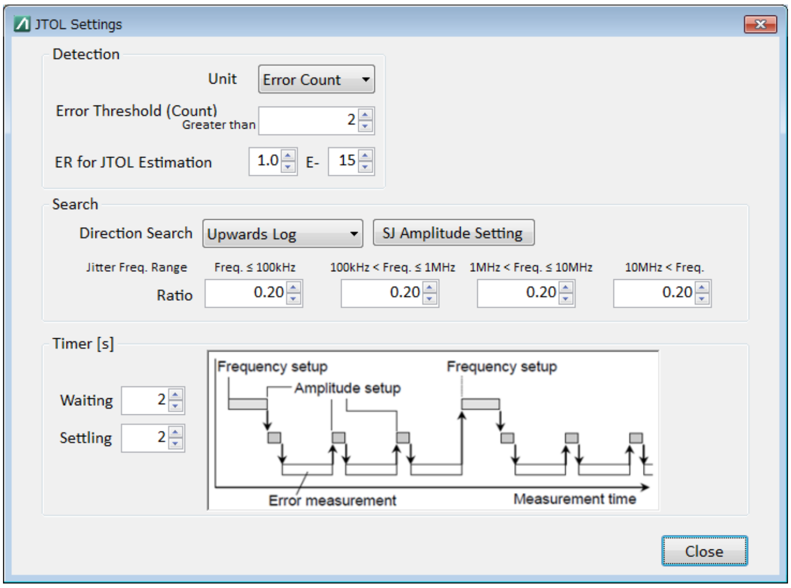
   For details on the Measurement program, refer to Appendix C “User Program Specifications”.



No.	Jitter Freq. [Hz]	Mask [UI]	Upper Limit [UI]	Lower Limit [UI]	Meas. [UI]	Meas. Judge	Esti
☑ 1	100,000,000	0.100	0.200	0.100	----	----	
☑ 2	10,000,000	0.100	0.200	0.100	----	----	
☑ 3	1,000,000	1.000	2.000	1.000	----	----	
☑ 4	30,000	1.000	2.000	1.000	----	----	

Jitter Freq.[Hz] 10
Mask [UI] 1.000
Upper Limit [UI] 2.000
Lower Limit [UI] 1.000
Upper Ratio 2.000
Lower Ratio 1.000
Title PCIe_CC
Measurement Sequence From higher Freq. side

Figure 4.11.4-2 Run Test Tab



Unit Error Count
Error Threshold (Count) Greater than 2
ER for JTOL Estimation 1.0 E- 15
Direction Search Upwards Log

Jitter Freq. Range	Freq. ≤ 100kHz	100kHz < Freq. ≤ 1MHz	1MHz < Freq. ≤ 10MHz	10MHz < Freq.
Ratio	0.20	0.20	0.20	0.20

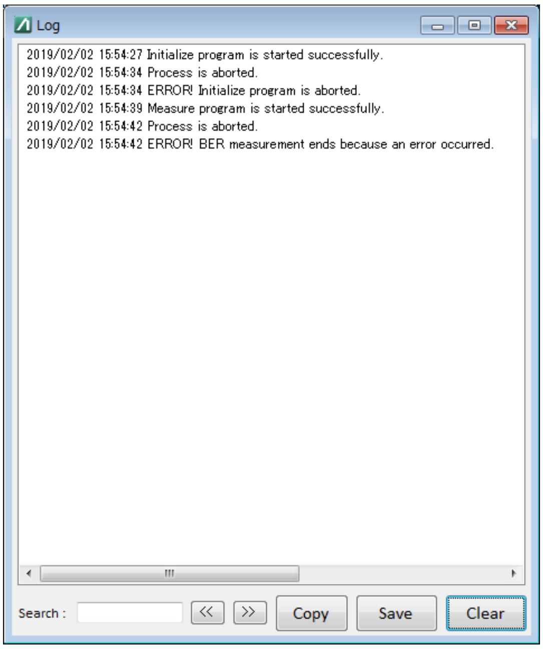
Waiting 2
Settling 2

Figure 4.11.4-3 JTOL Setting Setup Dialog Box

3. Click **Run Test** to start Jitter Tolerance measurement and display the measurement results. Also, the **Graph** tab and the **Report** tab are available. For details on the displayed measurement results, refer to 4.6 “Jitter Tolerance Test”.

4.11.5 Log Viewer function

This section explains the Log Viewer function. On the **DUT Control** tab or the **Measurement** tab, click **Log Viewer,** and the Log Viewer function will start. The Log Viewer function can hold event log up to 3000 lines. If the number of lines reaches the limit, the older one will be deleted. For details on formats of event log and examples of messages, refer to C.5.6 “Examples of Syntax Errors”.



```
2019/02/02 15:54:27 Initialize program is started successfully.
2019/02/02 15:54:34 Process is aborted.
2019/02/02 15:54:34 ERROR! Initialize program is aborted.
2019/02/02 15:54:39 Measure program is started successfully.
2019/02/02 15:54:42 Process is aborted.
2019/02/02 15:54:42 ERROR! BER measurement ends because an error occurred.
```

Figure 4.11.5-1 Log Viewer Dialog Box

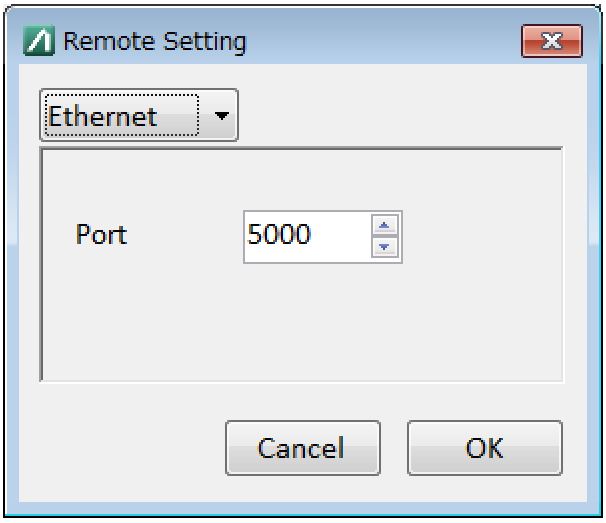
Chapter 5 Remote Control

This chapter describes the remote control method and remote commands of MX183000A.

5.1 Setting Interface for Remote Control

This section describes the remote interface setting method for MX183000A.

1. Click **Menu** → **Setup** → **Remote** on the MX183000A Main screen.



Port 5000

Figure 5.1-1 Remote Setting Screen

2. Select either **Ethernet** or **GPIB**.
3. When **Ethernet** of Remote Interface is selected

   TCP Port can be set. Set a number that does not duplicate the TCP Port setting for the SQA or control PC on which the MX183000A is installed.

TCP Port setting initial value:	5000
TCP Port setting range:	1024 to 5001

   The IP address cannot be changed on the Remote Setting screen. Change the IP address on the Setup Utility of the MP1800A, the Remote Control of the MP1900A, or the Network Setting of the control PC.
4. If **GPIB** is selected

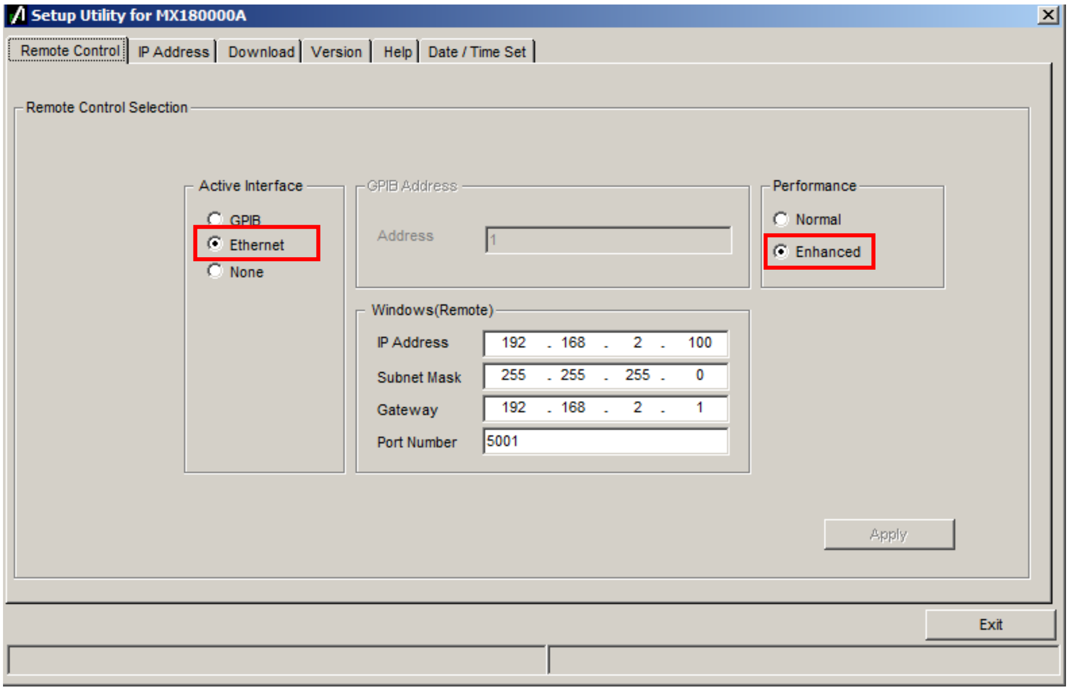
   Set the GPIB address within 1 to 30. The initial value is 3.

5.2 Remote Control Procedure

It describes how to control the MP1800A from a remote-control PC via an Ethernet or GPIB.

Set the MP1800A Setup Utility as follows for both Ethernet and GPIB.

Activate Interface:	Ethernet
Performance:	Enhanced



Active Interface
○ GPIB
● Ethernet
○ None

GPIB Address
Address: 1

Performance
○ Normal
● Enhanced

Windows(Remote)
IP Address: 192 . 168 . 2 . 100
Subnet Mask: 255 . 255 . 255 . 0
Gateway: 192 . 168 . 2 . 1
Port Number: 5001

Figure 5.2-1 MP1800A Setup Utility Settings

The default values are as below for the MP1900A.

Port Number: 5001
IP Address: 192.168.2.100
Subnet Mask: 255.255.255.0

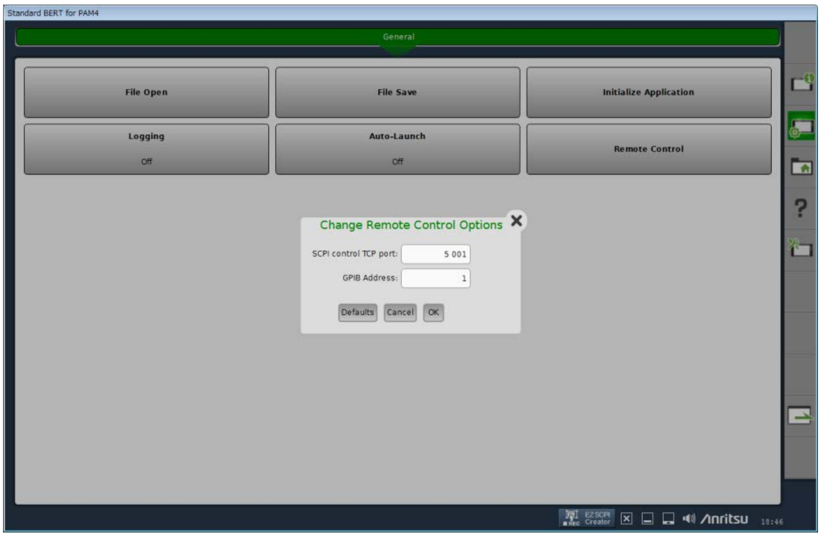
To change the values, perform the setting on the following windows.

Port Number

Remote Control window of MX190000A System Configuration

IP Address and Subnet Mask

Network and Sharing Center window of Windows



Standard BERT for PAM4

Change Remote Control Options

SCPI control TCP port: 5 001

GPIB Address: 1

Logging: Off

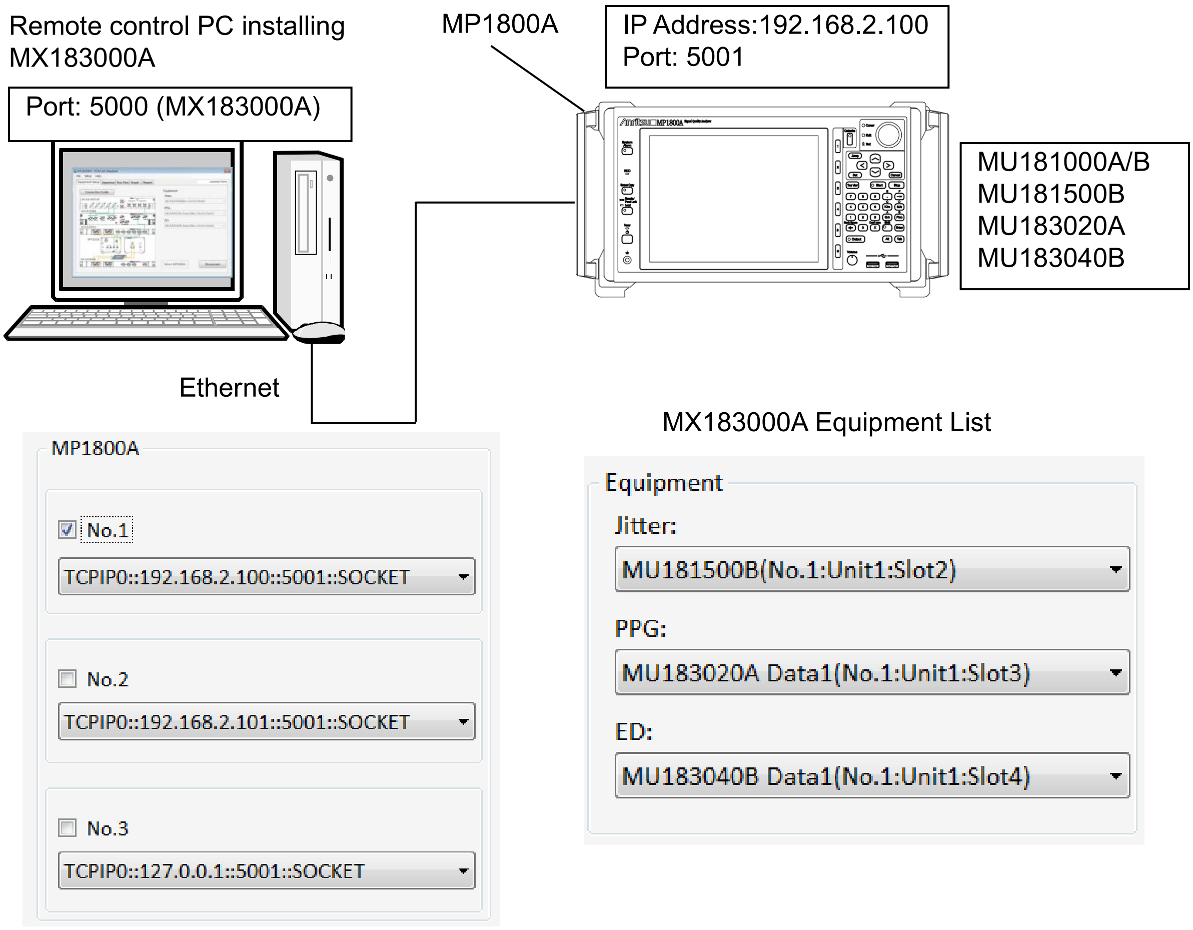
Auto-Launch: Off

Figure 5.2-2 MP1900A Remote Control Settings

When controlling the MP1800A via Ethernet

There are two following methods when MX183000A is remotely controlled via Ethernet:

- Controlling MX183000A installed in the PC for the remote control
- Controlling MX183000A installed in the MP1800A



MP1800A

☑ No.1
TCPIP0::192.168.2.100::5001::SOCKET

☐ No.2
TCPIP0::192.168.2.101::5001::SOCKET

☐ No.3
TCPIP0::127.0.0.1::5001::SOCKET

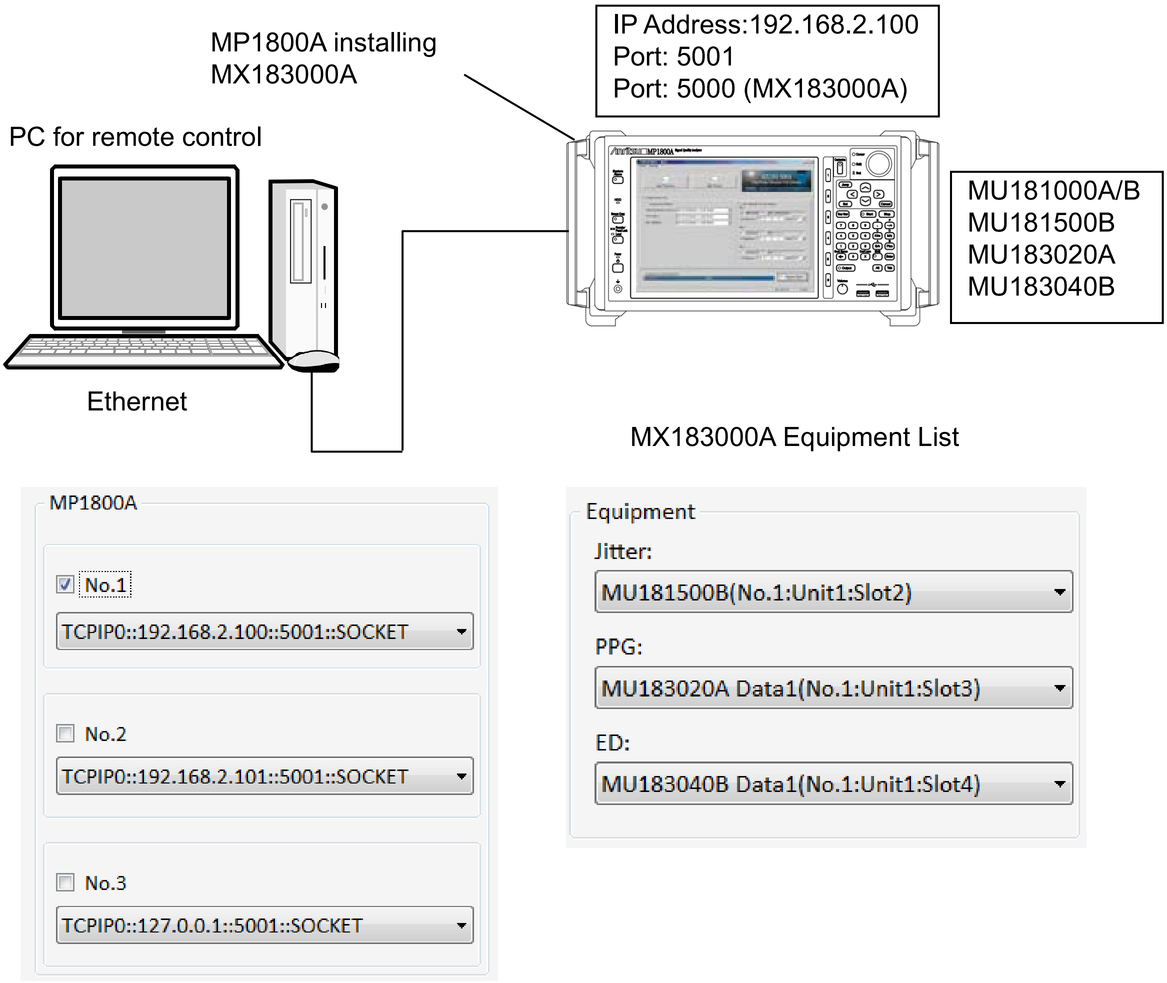
Equipment

Jitter: MU181500B(No.1:Unit1:Slot2)

PPG: MU183020A Data1(No.1:Unit1:Slot3)

ED: MU183040B Data1(No.1:Unit1:Slot4)

Figure 5.2-3 Remote Control System Configuration (Ethernet Control 1)



MP1800A

☑ No.1
TCPIP0::192.168.2.100::5001::SOCKET

☐ No.2
TCPIP0::192.168.2.101::5001::SOCKET

☐ No.3
TCPIP0::127.0.0.1::5001::SOCKET

Equipment

Jitter:
MU181500B(No.1:Unit1:Slot2)

PPG:
MU183020A Data1(No.1:Unit1:Slot3)

ED:
MU183040B Data1(No.1:Unit1:Slot4)

Figure 5.2-4 Remote Control System Configuration (Ethernet Control 2)

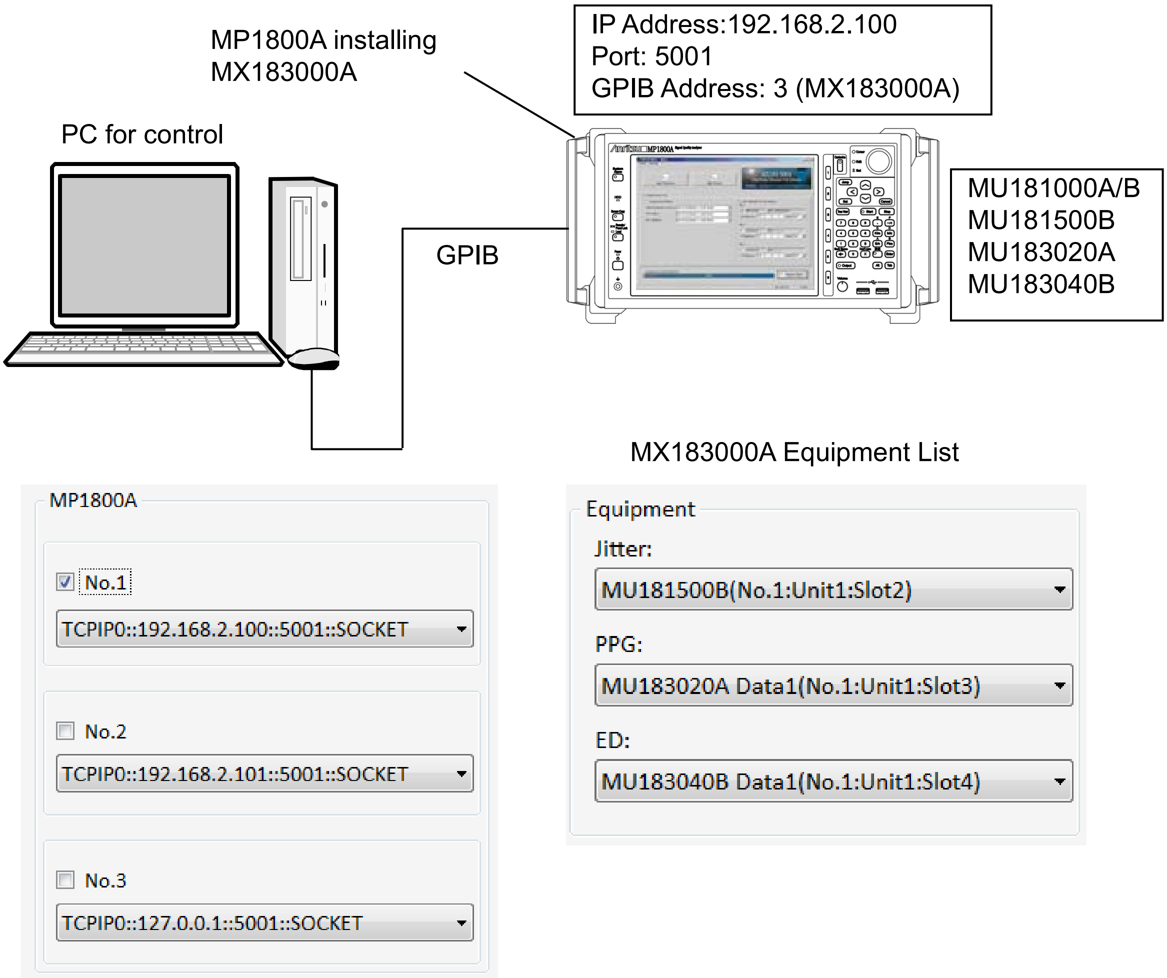
In the system configuration as shown in Figure 5.2-3, the IP address for transmitting MX183000A to the remote control software is “127.0.0.1” and the port number is “5000”.
In the system configuration as shown in Figure 5.2-4, the IP address for transmitting MX183000A to the remote control software is “192.168.2.100” and the port number is “5000”.

When controlling the MP1800A via GPIB

MX183000A can be controlled remotely via GPIB as follows.

- Controlling MX183000A installed in the MP1800A

Note that the MP1800A cannot be controlled via GPIB from MX183000A on the control PC.



MP1800A

☑ No.1

TCPIP0::192.168.2.100::5001::SOCKET

☐ No.2

TCPIP0::192.168.2.101::5001::SOCKET

☐ No.3

TCPIP0::127.0.0.1::5001::SOCKET

Equipment

Jitter: MU181500B(No.1:Unit1:Slot2)

PPG: MU183020A Data1(No.1:Unit1:Slot3)

ED: MU183040B Data1(No.1:Unit1:Slot4)

Figure 5.2-5 Remote Control System Configuration (GPIB Control)

In the system configuration in Figure 5.2-5, the GPIB address for communication between the remote control software and MX183000A is "3".

Note:

MX183000A cannot be controlled via GPIB when it is installed on MP1900A.

This is an example of the procedure for performing a jitter tolerance test.

1. Connect the MP1800A and the control PC with Ethernet or GPIB.
2. Start MX183000A, and wait until the Selector screen appears.
3. Click **Menu** → **Setup** → **Remote (R)**.
4. Set the remote interface port number for MX183000A to 5000 or the GPIB address to 3. Refer to 5.1 “Setting Interface for Remote Control”.
5. Start the Jitter Tolerance test application.
```
:SYSTem:MEASure:SELect TOL
```
6. Send the following commands to search the MP1800A in the controller.
```
:SYSTem:EQUipment:SEARch:SETTing
TCPIP0::127.0.0.1::5001::SOCKET,1
:SYSTem:EQUipment:SEARch:ENABle 1,1
:SYSTem:EQUipment:SEARch:ENABle 0,2
:SYSTem:EQUipment:SEARch:ENABle 0,3
:SYSTem:EQUipment:SEARch:STARt
```
7. Check the unit numbers of detected equipment.
```
:SYSTem:EQUipment:SETTing? JITTer
:SYSTem:EQUipment:SETTing? PPG
:SYSTem:EQUipment:SETTing? ED
```
8. Set the unit number for the equipment detected.
```
:SYSTem:EQUipment:SETTing JITTer,1,1,2
:SYSTem:EQUipment:SETTing PPG,1,1,3
:SYSTem:EQUipment:SETTing ED,1,1,4
```
9. Connect to the controller.
```
:SYSTem:EQUipment:CONNect
```
10. Start the Tolerance measurement.
```
:DISPlay:MEASure:CHANge RUNTest
:SENSe:MEASure:JITTer:STARt
```
11. During Tolerance measurement, the only remote control operations possible are measurement stop and obtain measurement status.
```
:SENSe:MEASure:JITTer:STATe?
:SENSe:MEASure:JITTer:STOP
```
12. Acquire the measurement result after the Tolerance measurement is finished.
```
:CALCulate:RESult:DATA? ALL
```

13. Save the report in HTML/CSV format.
```
:SYSTem:MMEMory:RESult:STORe
"D:\test_folder\test",HTML
:SYSTem:MMEMory:RESult:STORe
"D:\test_folder\test",CSV
```
14. Close the application.
```
:SENSe:MEASure:JITTer:STOP
:SYSTem:MEASure:SELect NONE
```

This is an example of the procedure for jitter tolerance testing using a PCIe device.

1. Start the PCIe Link Sequence application.
```
:SYSTem:MEASure:SELect PCI
```
2. Connect using steps 6 to 9 in the jitter tolerance test example procedure.
3. Set the test target specification to Revision 3.
```
:DISPlay:MEASure:CHANge SEQuence
:LTRaining:SEQuence:SPECification REV3
```
4. Set the test pattern to Modified Compliance Pattern.
```
:SOURce:PATTern:TYPE COMPliance
:LTRaining:SEQuence:TEST:PATTern MCP
```
5. Send a sequence to loopback the DUT.
```
:LTRaining:SEQuence:STARt
```
6. During sequence execution, the only remote control operations possible are measurement stop and obtain measurement status.
```
:LTRaining:SEQuence:STATe?
:LTRaining:SEQuence:STOP
```
7. When the MX183000A-PL001 is installed, perform the jitter tolerance test on the DUT in loopback status using steps 10 to 13 in the jitter tolerance test example procedure.
8. Close the application.
```
:SENSe:MEASure:JITTer:STOP
:LTRaining:SEQuence:STOP
:SYSTem:MEASure:SELect NONE
```

This is an example of the procedure for sending a Link Sequence using a USB device.

1. Start the USB Link Sequence application.
   ```
   :SYSTem:MEASure:SELect USB
   ```
2. Connect using steps 6 to 9 in the jitter tolerance test example procedure.
3. Set the test target specification to GEN 1.
   ```
   :DISPlay:MEASure:CHANge SEQuence
   :LTRaining:SEQuence:SPECification GEN1
   ```
4. Set the test pattern to Compliance Pattern CP0.
   ```
   :SOURce:PATTern:TYPE COMPliance
   :LTRaining:SEQuence:TEST:PATTern 0
   ```
5. Send a sequence to loopback the DUT. *
   ```
   :LTRaining:SEQuence:STARt
   ```
   *: When this command is sent, the DUT should be connected to the USB test fixture.
6. During sequence execution, the only remote control operations possible are measurement stop and obtain measurement status.
   ```
   :LTRaining:SEQuence:STATe?
   :LTRaining:SEQuence:STOP
   ```
7. Close the application.
   ```
   :LTRaining:SEQuence:STOP
   :SYSTem:MEASure:SELect NONE
   ```

5.3 Command Description Method

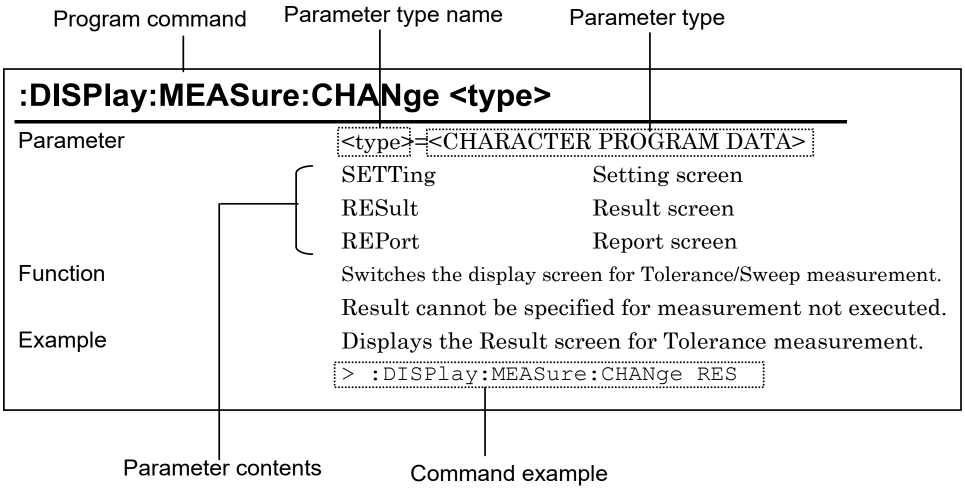
This chapter explains the notations used in the message syntax.

Table 5.3-1 Notation used in Command Syntax

Symbol	Usage
<>	Parameters enclosed in < > are character strings input to the program.
[]	Messages or parameters enclosed in square brackets can be omitted.
|	Choose one from multiple choices. A | B | C | D means choose from A, B, C, and D.
{}	Groups choice in braces. A | B({C | D}) means choose one of A, B(C), and B(D).
<CHARACTER PROGRAM DATA> <CHRACTER RESPONSE DATA>	Short alphabet or alphanumeric
<DECIMAL NUMERIC PROGRAM DATA>	Decimal numeric value Example: –1.00, 256000, 1.3E–1
<NR1 NUMERIC RESPONSE DATA>	Decimal integer value Example: –100, 12500000
<NR2 NUMERIC RESPONSE DATA>	Decimal fraction Example: –0.02, 2.35
<STRING PROGRAM DATA> <STRING RESPONSE DATA>	Alphanumeric data Double or single quotes are required before and after the data.
<BOOLEAN PROGRAM DATA>	Data indicating logical true or false

The following shows the description example of command.

- Example of program command

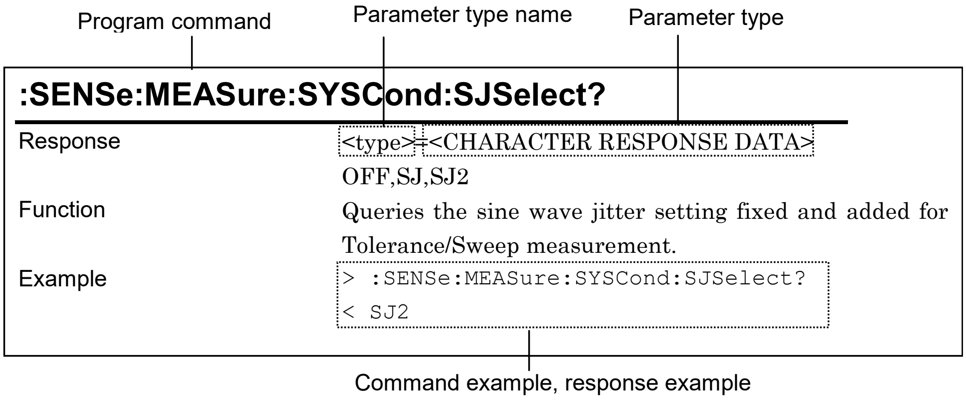


:DISPlay:MEASure:CHANge <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	SETTing	Setting screen
	RESult	Result screen
	REPort	Report screen
Function	Switches the display screen for Tolerance/Sweep measurement. Result cannot be specified for measurement not executed.	
Example	Displays the Result screen for Tolerance measurement.	

```
> :DISPlay:MEASure:CHANge RES
```

- Example of query command



:SENSe:MEASure:SYSCond:SJSelect?

Response	<type>=<CHARACTER RESPONSE DATA> OFF,SJ,SJ2
Function	Queries the sine wave jitter setting fixed and added for Tolerance/Sweep measurement.
Example	

```
> :SENSe:MEASure:SYSCond:SJSelect?
< SJ2
```

The < and > in the example indicate the response and the program message respectively.

Notes:

- Any commands for MX183000A are sequential commands.
- If commands have restrictions, other settings may be affected. For the setting items to be affected and conditions to be restricted, refer to the *MX180000A Signal Quality Analyzer Control Software Operation Manual* and operation manual for each module.
- When the parameters of program command and query command are same, the parameter of query command may be omitted.

5.4 IEEE488.2 Common Commands

MX183000A supports the following IEEE188.2 common commands.

Table 5.4-1 IEEE488.2 Common Commands List

Mnemonic	Command's full spell
*CLS	Clear Status Command
*IDN?	Identification Query

*CLS Clear Status Command

Parameter None

Function Clears any event register and queue excluding output queues and their MAV summary messages for MX183000A.

Example

```
> *CLS
```

*IDN? Identification Query

Parameter None

Response <Manufacturer>, <Model>, <Serial No.>

<Manufacturer>, <Model>=<CHARACTER RESPONSE DATA>
ANRITSU
MX183000A
<Serial No.>=<NR1 NUMERIC RESPONSE DATA>
0000000000
The serial No. of MX183000A is always "0000000000".
Main frame Serial number

Function Reports manufacture name, model, etc.

Example

```
> :MFRame:ID 0
> *IDN?
< ANRITSU,MX183000A,0000000000
```

5.5 MX183000A Command List (Tree)

The command list of MX183000A is displayed in tree.

The compatibilities of the MX181500A remote commands are listed below.

✓: Compatible
†: Partially compatible
–: Not compatible (new MX183000A function)

Table 5.5-1 MX183000A Command Tree

Command Header 1	Command Header 2	Command Header 3	Command Header 4	Command Header 5	Command/ Query	MX181500A Compatibility
:CALCulate	:DATA	:EALarm			Q	–
	:RESult	:DATA			Q	✓
		:DETail			Q	–
		:EMONitor			Q	–
		:MAXPass			Q	–
		:MINFail			Q	–
		:STATus			Q	✓
:DISPlay	:MEASure	:CHANge			C	✓
	:RESult	:BER			C/Q	–
		:ESTimate			C/Q	–
			:ERATe		C/Q	–
	:SETTing	:LEQ			C/Q	–
		:LEFT			C/Q	–
		:RIGHt			C/Q	–
	:SIZE				C/Q	–
:INPut	:CLOCk	:DELay			C/Q	–
		:SELection			C/Q	–*1
	:CTLE	:SETTing			C/Q	–
		:TRACKing			C/Q	–
	:DATA	:EQUalizer	:AMPLitude		C/Q	–
		:INTerface			C/Q	–
	:DFF	:SETTing			C/Q	–
	:VREF	:SETTing			C/Q	–

*1: This command is compatible with the MU183040A and MU183041A remote commands.

Table 5.5-1 MX183000A Command Tree (Cont'd)

Command Header 1	Command Header 2	Command Header 3	Command Header 4	Command Header 5	Command Header 6	Command /Query	MX181500A Compatibility
:LTRaining	:LTSSm	:PACTive	:8B10B	:RX	:TS12	C/Q	–
				:TX	:TS1	C/Q	–
			:128B132B	:RX	:TS1	C/Q	–
				:TX	:TS2	C/Q	–
		:PCONfig	:8B10B	:RX	:TS2	C/Q	–
				:TX	:TS2	C/Q	–
			:128B132B	:RX	:TS2	C/Q	–
				:TX	:TS2	C/Q	–
			:RX	:LBPM		C/Q	–
			:TX	:LBPM		C/Q	–
		:PLFPs	:RX	:LFPS		C/Q	–
				:SCD12		C/Q	–
			:TX	:LFPS1		C/Q	–
				:LFPS2		C/Q	–
				:SCD1		C/Q	–
		:PLPLus	:RX	:SCD2		C/Q	–
			:TX	:SCD2		C/Q	–
		:PPMAtch	:RX	:LBPM		C/Q	–
			:TX	:LBPM		C/Q	–
		:PRXEq	:8B10B	:TX	:TSEQ	C/Q	–
			:128B132B	:TX	:TSEQ	C/Q	–
	:POLling	:LFPS	:DELay			C/Q	–
				:ENAB		C/Q	–
	:SEQuence	ATUNe				C	–
			:RESet			C	–
			:STATe			Q	–
		:AUTO	:AWAit	:TIME		C/Q	–
			:CTRigger			C	–
				:TIME		C/Q	–
			:PCYCle			C	–
				:TIME		C/Q	–
			:PRESet			C	–
				:TIME		C/Q	–
			:RESet			C/Q	–

Table 5.5-1 MX183000A Command Tree (Cont'd)

Command Header 1	Command Header 2	Command Header 3	Command Header 4	Command Header 5	Command /Query	MX181500A Compatibility
:LTRaining	:SEQuence	:BMATrix	:BER	:RTIMe	C/Q	–
				:TIME	C/Q	–
			:BTRaining		C/Q	–
			:DISPlay		C/Q	–
			:ELAPsed		Q	–
			:EXPort		Q	–
			:FSWing		C/Q	–
			:LFRequency		Q	–
			:MRESume		C	–
			:PDISplay		C/Q	–
			:PRESet		C	–
			:PROGress		Q	–
			:PSEL		C/Q	–
			:REMaining		Q	–
			:RESult		Q	–
			:SCAN		C/Q	–
			:SDIRection		C/Q	–
			:STARt		C	–
			:STATe		Q	–
			:STOP		C	–
			:TSEL		C/Q	–
		:CRECeive			C/Q	–
		:CSPeed			C/Q	–
		:DELAy	:SEARCh	STARt	C	–
				STATe	Q	–
				STOP	C	–
		:DESign	:GEN1		C/Q	
			:GEN2		C/Q	–
			:REV1	:CONFiguration	C/Q	–
			:REV2	:CONFiguration	C/Q	–
				:RECovery	C/Q	–

Table 5.5-1 MX183000A Command Tree (Cont'd)

Command Header 1	Command Header 2	Command Header 3	Command Header 4	Command Header 5	Command /Query	MX181500A Compatibility
:LTRaining	:SEQuence	:DESign	:REV3	:CONFiguration	C/Q	–
				:RECovery	C/Q	–
				:UPReset	C/Q	–
			:REV4	:CONFiguration	C/Q	–
				:RECovery	C/Q	–
				:UPReset	C/Q	–
		:DSCRamble			C/Q	–
		:DSYMbol			C/Q	–
		:DUT			C/Q	–
		:EIEos	:FORMat		C/Q	–
			:INTerval		C/Q	–
		:EITime			C/Q	–
		:ENABLe	:PRESet		C/Q	–
		:FSWing			C/Q	–
		:FTS			C/Q	–
		:INITialize			C	–
		:LANenum			C/Q	–
		:LENTry	:TS		C/Q	–
		:LEQTest	:REV3		C/Q	–
			:REV4		C/Q	–
			:REV5		C/Q	–
		:LFRequency			C/Q	–
		:LINKnum			C/Q	–
		:LTHRough			C	–
		:LTSSm	:EXIT	:DACTive	C/Q	–
			:LOG	:EXPort	C	–
				:GATing	Q	–
				:STARt	C	–
				:STATe	Q	–
				:STOP	C	–
		:MCP			C/Q	–
		:PACTive	:TS		C/Q	–
		:PCoding			C/Q	–

Table 5.5-1 MX183000A Command Tree (Cont'd)

Command Header 1	Command Header 2	Command Header 3	Command Header 4	Command Header 5	Command Header 6	Command /Query	MX181500A Compatibility
:LTRaining	:SEQuence	:RESult				Q	–
			:CSKP			Q	–
			:ELBC			Q	–
			:MTS			Q	–
			:PCODing			Q	–
		:REV2	:DEMPhasis			C/Q	–
		:REV3	:DSTReam	:CPReset		C/Q	–
				:HPRESet		C/Q	–
				:PRESet		C/Q	–
				:RECovery	:UCURsor	C/Q	–
				:UCURsor		C/Q	–
			:RECovery	:ALGorithm		C/Q	–
				:PH2_3		C/Q	–
			:REPeat	:ENDPoint		C/Q	–
				:ROOT		C/Q	–
			:UPReset			C/Q	–
			:USTReam	:CPReset		C/Q	–
				:HPRESet		C/Q	–
				:PRESet		C/Q	–
				:RECovery	:UCURsor	C/Q	–
				:UCURsor		C/Q	–
		:REV4	:DSTReam	:CPReset		C/Q	–
				:PRESet		C/Q	–
				:RECovery	:UCURsor	C/Q	–
				:UCURsor		C/Q	–
			:RECovery	:ALGorithm		C/Q	–
				:PH2_3		C/Q	–
			:REPeat	:ENDPoint		C/Q	–
				:ROOT		C/Q	–
			:UPReset			C/Q	–
			:USTReam	:CPReset		C/Q	–
				:PRESet		C/Q	–
				:RECovery	:UCURsor	C/Q	–
				:UCURsor		C/Q	–

Table 5.5-1 MX183000A Command Tree (Cont'd)

Command Header 1	Command Header 2	Command Header 3	Command Header 4	Command Header 5	Command Header 6	Command /Query	MX181500A Compatibility
:LTRaining	:SEQuence	:REV5	:DSTReam	:CPReset		C/Q	–
				:PRESet		C/Q	–
				:RECovery	:UCURsor	C/Q	–
				:UCURsor		C/Q	–
			:RECovery	:ALGorithm		C/Q	–
				:PH2_3		C/Q	–
			:REPeat	:ENDPoint		C/Q	–
				:ROOT		C/Q	–
			:UPReset			C/Q	–
			:USTReam	:CPReset		C/Q	–
				:PRESet		C/Q	–
				:RECovery	:UCURsor	C/Q	–
				:UCURsor		C/Q	–
		:RXPCording				C/Q	–
		:SCURsor	:REV3			Q	–
			:REV4			Q	–
			:REV5			Q	–
		:SKP				C/Q	–
			:REMove			C/Q	–
			:DOUBle	:8B10B		C/Q	–
				:128B130B		C/Q	–
			:SLENgth	:8B10B		C/Q	–
				:128B130B		C/Q	–
				:128B132B		C/Q	–
			:INTerval	:8B10B		C/Q	–
				:128B130B		C/Q	–
				:128B132B		C/Q	–
		:SPECification				C/Q	–
		:SRIS				C/Q	–
		:STARt				C	–
		:STATe				Q	–
		:STOP				C	–

Table 5.5-1 MX183000A Command Tree (Cont'd)

Command Header 1	Command Header 2	Command Header 3	Command Header 4	Command Header 5	Command /Query	MX181500A Compatibility
:LTRaining	:SEQuence	:TEST	:PATTern		C/Q	–
				:EADDition	C	–
				:STOP	C	–
				:TRANsmit	C	–
		:TOUT	:CONFiguration	:COMPlete	C/Q	–
				:IDLE	C/Q	–
				:LACCept	C/Q	–
				:LSTArt	C/Q	–
				:LWAit	C/Q	–
			:DISable		C/Q	–
			:DQUiet		C/Q	–
			:HOTReset		C/Q	–
			:INITialize		C	–
			:LBENtry	:ACTive	C/Q	–
				:EXIT	C/Q	–
				:SELect	C/Q	–
			:POLLing	:ACTive	C/Q	–
				:CONFiguration	C/Q	–
			:RECovery	:EEQP1	C/Q	–
				:EEQP2	C/Q	–
				:EEQP3	C/Q	–
				:IDLE	C/Q	–
				:RCFG	C/Q	–
				:REQP0	C/Q	–
				:REQP1	C/Q	–
				:REQP2	C/Q	–
				:REQP3	C/Q	–
				:RLOCk	C/Q	–
				:SPEed	C/Q	–
		:TRIGger	:CPReset		C/Q	–
			:SELect		C/Q	–
			:SPEed		C/Q	–
			:STATe		C/Q	–
		:TXCursor			C/Q	–
		:TXPCording			C/Q	–

Table 5.5-1 MX183000A Command Tree (Cont'd)

Command Header 1	Command Header 2	Command Header 3	Command Header 4	Command Header 5	Command /Query	MX181500A Compatibility
:LTRaining	:SEQuence	:TXPReset	:DEMPhasis		C/Q	–
			:IPReset		C/Q	–
			:LPReset		C/Q	–
				:PRESet	C/Q	–
			:PSHoot		C/Q	–
			:SELect		C/Q	–
:OUTPut	:DATA	:AMPLitude	*2		C/Q	–
			:RANGe	*2	Q	–
		:BAUDrate			Q	–
		:DEFault	*2		C	–
		:DELay	*2		C/Q	–
		:EAMPlitude	*2		Q	–
		:INTerface	*2		C/Q	–
		:LEVel	*2		C/Q	–
		:OUTPut	*2		C/Q	–
		:SELect	*2		C/Q	–
		:SKEW	*2		C/Q	–
		:TRACking	*2		C/Q	–
		:TYPE	*2		C/Q	–
:SENSe	:ASEarch	:CTLE			C/Q	–
		:DFF			C/Q	–
		:MODE			C/Q	–
		:SELPpg			C/Q	–
		:STARt			C	–
		:STATe			Q	–
		:STOP			C	–
	:DECoder	:SERial			Q	–
	:JITTer	:TABLe	:ADD		C	–
			:ADELete		C	–
			:DELete		C	–
			:FREQuency		Q	–
			:INDex		Q	–

*2: :PPG1, :PPG2, :PPG3, or :PPG4 can be specified. If omitted, :PPG1 is specified.

Table 5.5-1 MX183000A Command Tree (Cont'd)

Command Header 1	Command Header 2	Command Header 3	Command Header 4	Command Header 5	Command /Query	MX181500A Compatibility
:SENSe	:MEASure	:BER	:ABORt		C	–
			:ECTHreshold		C/Q	–
			:IPADdress		C/Q	–
			:MODE		C/Q	–
			:STARt		C	–
			:STATe		Q	–
			:STOP		C	–
			:TIME		C/Q	–
		:BERCond	:ASEarch		C/Q	✓
			:GTIMe		C/Q	†
			:MANual	:DATA	C/Q	–
				:DELay	C/Q	–
				:INTerface	Q	–
				:XDATa	C/Q	–
			:MTYPe		C/Q	–
			:PATTern		C/Q	–
			:RATiosetting		C/Q	†
			:RESolution		C/Q	✓
			:SEARch		C/Q	✓
			:SEQuence		C/Q	✓
			:SJ	:SSTep	C/Q	–
			:SSETing		C/Q	✓
			:STIMe		C/Q	✓
			:THReshold		C/Q	✓
			:UNIT		C/Q	✓
			:WTIMe		C/Q	✓
		:JITTer	:STARt		C	✓
			:STATe		Q	✓
			:STOP		C	✓
		:SYSCond	:BITRate		Q	✓
		:TABLedata	:OPEN		C	✓
			:SELect		Q	✓
			:SAVe		C	–

Table 5.5-1 MX183000A Command Tree (Cont'd)

Command Header 1	Command Header 2	Command Header 3	Command Header 4	Command Header 5	Command /Query	MX181500A Compatibility
:SOURce	:PATTern	:EADDition	SINGle		C	–
		:PRBS	:LENGth		C/Q	–*3
		:TYPe			C/Q	–*2
			:TRACking		C/Q	–
:SYSTem	:ERRor				Q	✓
	:EQUipment	:ADJust			C/Q	–
		:CONNect			C	–
		:DCONNect			C	–
		:DUT	:FINalize		C	–
				:ABORt	C	–
				:CONdition	Q	–
				:STARt	C	–
				:STATe	Q	–
			:INITialize		C	–
				:ABORt	C	–
				:CONdition	Q	–
				:STARt	C	–
				:STATe	Q	–
			:MEASure		C	–
			:SETTing	:INITialize	C	–
				:RECall	C	–
				:STORe	C	–
		:ECOMbination			C/Q	–
		:EXTatt			C/Q	–
		:LFPS			C/Q	–
		:SEARch	:ENABle		C/Q	✓
			:SETTing		C/Q	✓
			:STARt		C	✓
		:SELConverter			C/Q	–
			:NUMBer		C/Q	–

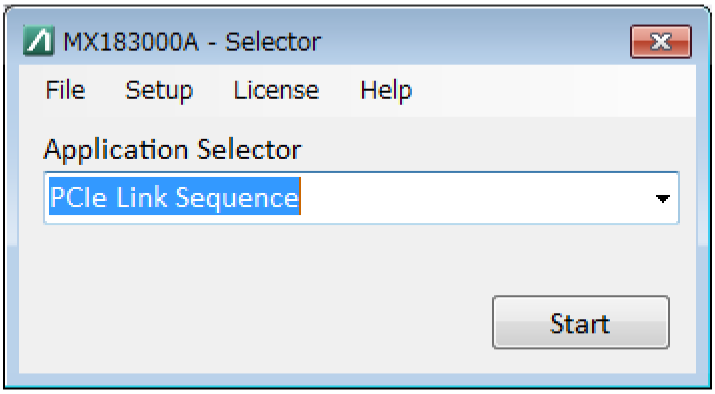
*3: This command is compatible with the MU183020A and MU183021A remote commands.

Table 5.5-1 MX183000A Command Tree (Cont'd)

Command Header 1	Command Header 2	Command Header 3	Command Header 4	Command Header 5	Command /Query	MX181500A Compatibility
:SYSTem	:EQUipment	:SELDecoder			C/Q	–
		:SETTing			C/Q	✓
			:MODule		Q	✓
		:USBConnection			C/Q	–
		:USENoise			C/Q	–
	:MEASure	:EXIT			C	–
		:INITialize			C	✓
		:SELect			C/Q	✓
			:STATe		Q	–
	:MMEMory	:RESult	:STORe		C	✓
		:SETTing	:RECall		C	✓
			:SCURsor	:RECall	C	–
				:STORe	C	–
			:STORe		C	✓
	:TERMination				C/Q	✓

5.6 Common Commands

This section explains the commands for the common setting and function of MX183000A.



Application Selector: PCIe Link Sequence

Figure 5.6-1 Selector Screen

Table 5.6-1 Common Commands

Setting Item	Command
Queries error message	:SYSTem:ERRor?
Sets terminator	:SYSTem:TERMination
	:SYSTem:TERMination?
Start application setting	:SYSTem:MEASure:SELect
	:SYSTem:MEASure:SELect?
Displayed tab switching	:DISPlay:MEASure:CHANge

:SYSTem:ERRor?

Parameter	None
Response	<error/event_number>,"<error/event_description>" <error/event_number>=<NR1 NUMERIC RESPONSE DATA> –32768 to 32767 The value of zero indicates no error or no event occurrence. Others return standard errors reserved by SCPI or equipment-specific errors. <error/event_description>=<STRING RESPONSE DATA> Error messages corresponding to each <error/event_number>. The maximum length of this character string is 255 characters.
Function	Queries error messages that exist in errors or event queues.

Example	`> :SYSTem:ERRor?`
	`< 0, "No error"`

:SYSTem:TERMination <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0	LF + EOI
	1	CR + LF + EOI
Function	Sets terminator type of response data.	
Example	To set terminator type to LF + EOI: `> :SYSTem:TERMination 0`	

:SYSTem:TERMination?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	LF + EOI
	1	CR + LF + EOI
Function	Queries terminator of response data	

Example	`> :SYSTem:TERMination?`
	`< 0`	

:SYSTem:MEASure:SELect <item>

Parameter	<item>=<CHARACTER PROGRAM DATA>	
	NONE	Selector
	TOL	Jitter Tolerance Test
	PCIS	PCIe Link Sequence
	PCIT	PCIe Link Training
	USBS	USB Link Sequence
	USBT	USB Link Training
	PAM	PAM4 Control (with G0375/6A)
Function	Selects the application to be started.	
Example	To select and start PCIe Link Sequence:	

```
> :SYSTem:MEASure:SELect PCIS
```

:SYSTem:MEASure:SELect?

Response	<item>=<CHARACTER RESPONSE DATA> NONE, TOL, PCIS, PCIT, USBS, USBT, PAM
Function	Queries the application running.
Example	

```
> :SYSTem:MEASure:SELect?
< PCIS
```

:SYSTem:MEASure:SELect:STATe?

Response	<item>=<NR1 NUMERIC RESPONSE DATA>	
	0	Not ready
	1	Ready
Function	Queries whether MX183000A is ready for :SYST:MEAS:SEL. If the response to this command is 0, the :SYST:MEAS:SEL command results in the error –221 “Setting conflict”.	
Example		

```
> :SYSTem:MEASure:SELect:STATe?
< 1
```

:DISPlay:MEASure:CHANge <type>

Parameter

<type>=<CHARACTER PROGRAM DATA>

EQUipment	Equipment Setup tab
SEQuence	Sequence tab
TRAining	Link Training tab
RUNTest	Run Test tab
GRAPh	Graph tab
REPort	Report tab
PAM	PAM4 Control tab

Function

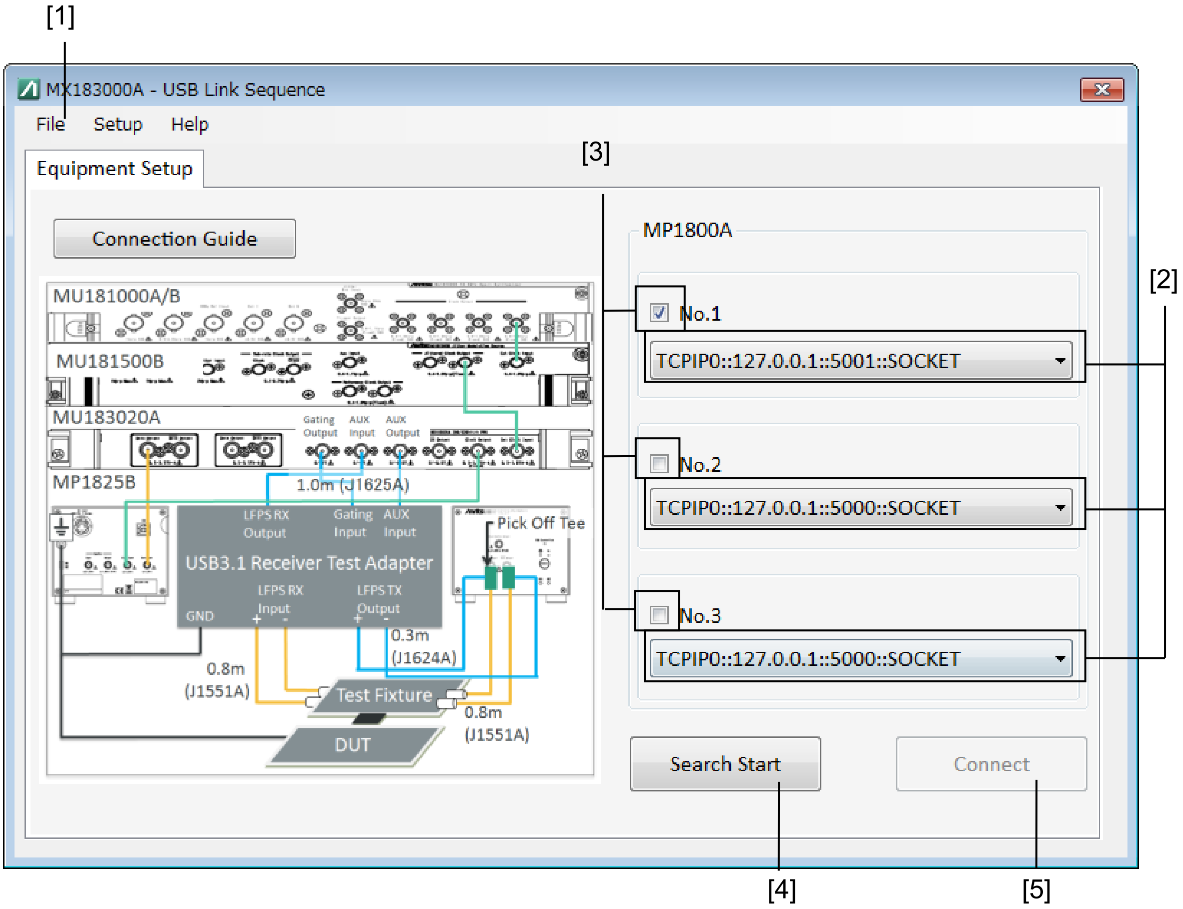
Switches between application display screens.
This command can be used after the application has been started using the :SYSTem:MEASure:SELect command and connected to the SQA using :SYSTem:EQUipment:CONNect.
Some screens may not be available depending on the particular MX183000A license.

Example

To display the Tolerance Measurement **Report** tab:

```
> :DISPlay:MEASure:CHANge REPort
```

5.7 Setting Measurement System

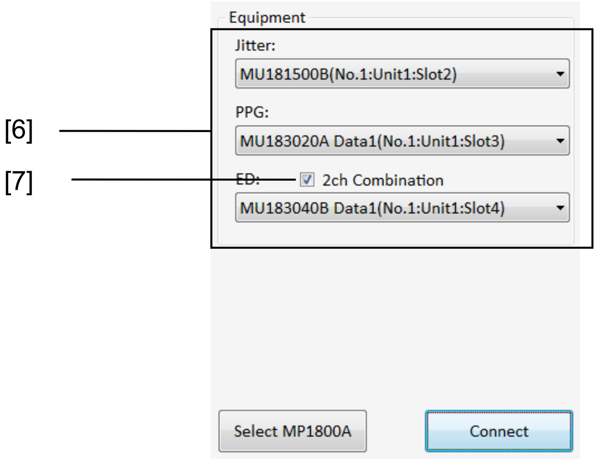


☑ No.1
TCPIP0::127.0.0.1::5001::SOCKET

☐ No.2
TCPIP0::127.0.0.1::5000::SOCKET

☐ No.3
TCPIP0::127.0.0.1::5000::SOCKET

Figure 5.7-1 Equipment Setup Screen



Jitter:
MU181500B(No.1:Unit1:Slot2)

PPG:
MU183020A Data1(No.1:Unit1:Slot3)

ED: ☑ 2ch Combination
MU183040B Data1(No.1:Unit1:Slot4)

Figure 5.7-2 Equipment Setup Screen After Search Completion

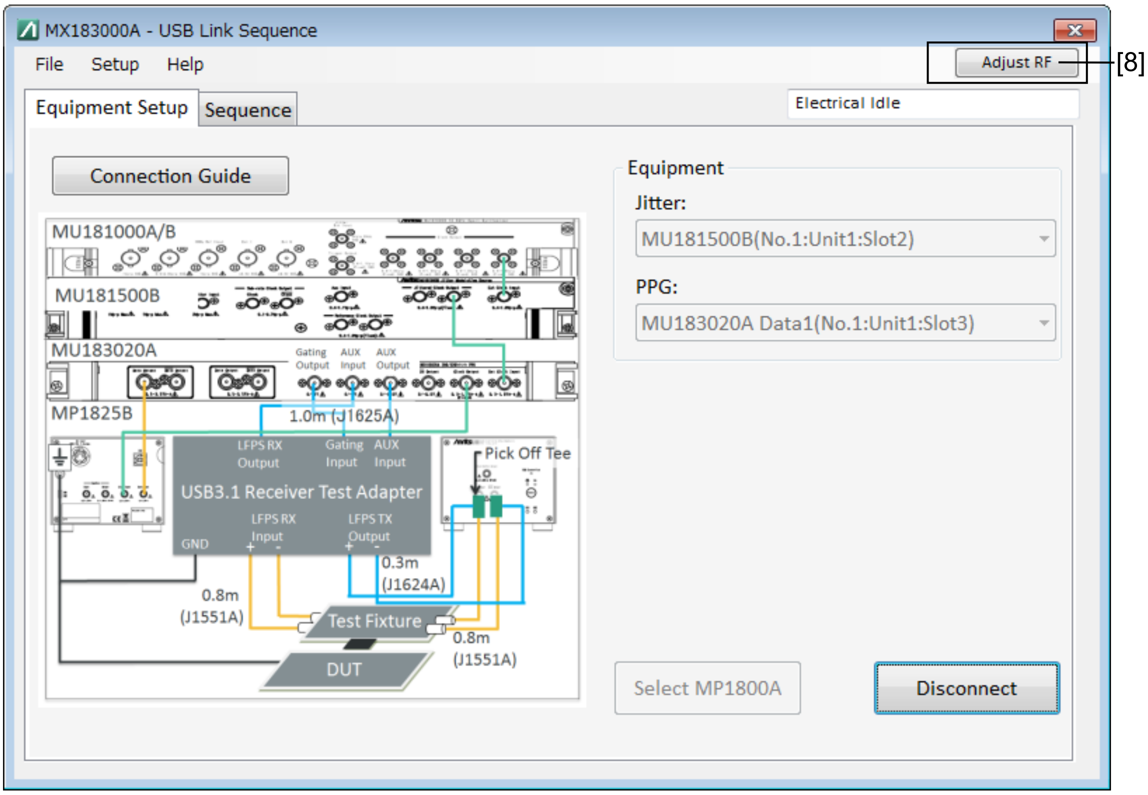
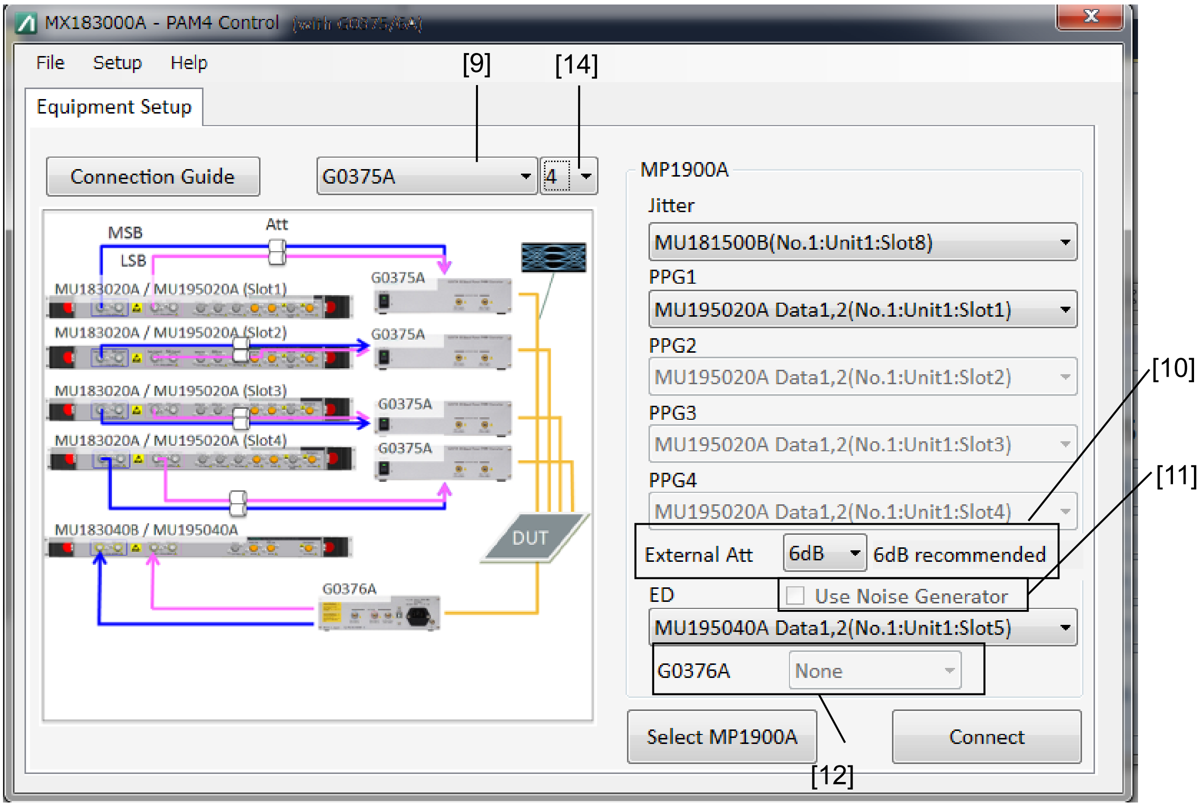


Figure 5.7-3 Equipment Setup Screen After Connect Completion

Note:

":SYSTem:EQUipment:CONNect" must be used to connect to the SQA except when using the following commands.

:SYSTem:MEASure:SELect
:SYSTem:MEASure:EXIT
:SYSTem:EQUipment:SEARch:SETTing
:SYSTem:EQUipment:SEARch:STARt
:SYSTem:EQUipment:SEARch:ENABle
:SYSTem:EQUipment:SEARch:SETTing
:SYSTem:EQUipment:SETTing:MODule
:SYSTem:EQUipment:CONNect



G0375A 4

MP1900A

Jitter: MU181500B(No.1:Unit1:Slot8)

PPG1: MU195020A Data1,2(No.1:Unit1:Slot1)

PPG2: MU195020A Data1,2(No.1:Unit1:Slot2)

PPG3: MU195020A Data1,2(No.1:Unit1:Slot3)

PPG4: MU195020A Data1,2(No.1:Unit1:Slot4)

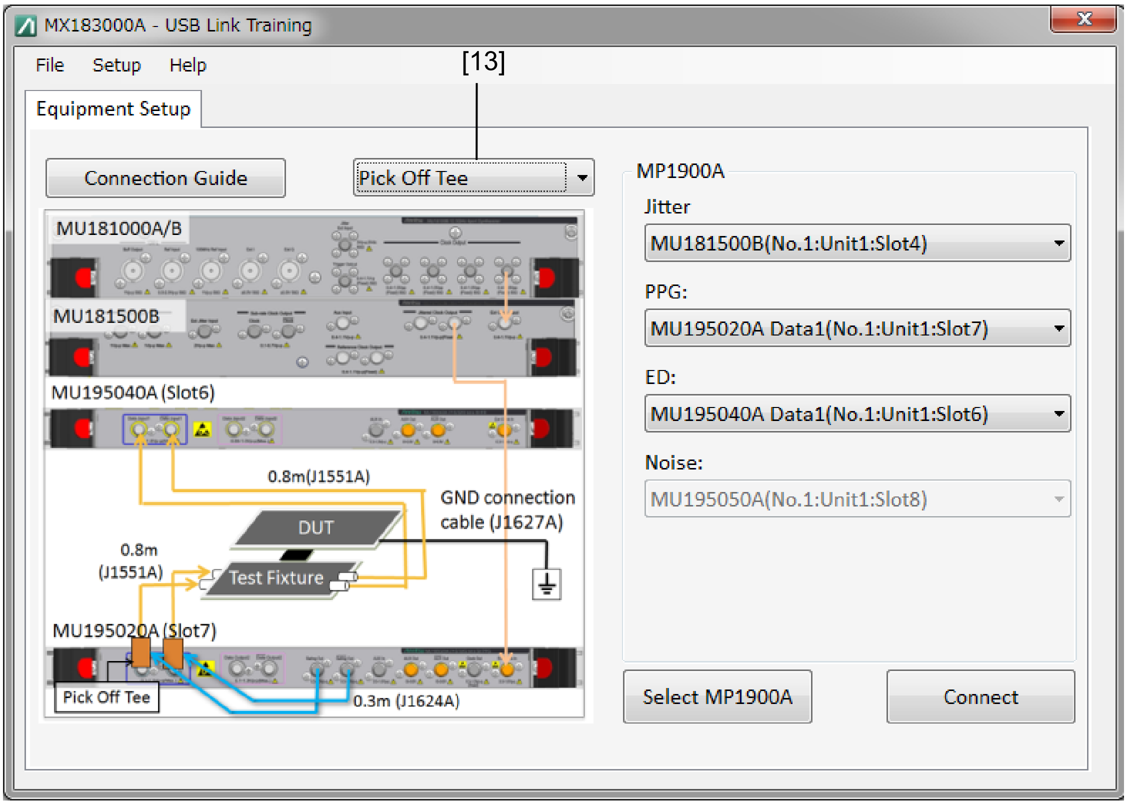
External Att 6dB 6dB recommended

ED ☐ Use Noise Generator

MU195040A Data1,2(No.1:Unit1:Slot5)

G0376A None

Figure 5.7-4 Equipment Setup Screen After Search (PAM4 Control)



Pick Off Tee

MP1900A

Jitter: MU181500B(No.1:Unit1:Slot4)

PPG: MU195020A Data1(No.1:Unit1:Slot7)

ED: MU195040A Data1(No.1:Unit1:Slot6)

Noise: MU195050A(No.1:Unit1:Slot8)

Figure 5.7-5 Equipment Setup Screen after Search Completion (USB Link Training)

Table 5.7-1 Setting Commands of Main Window

No.	Setting Item	Command
[1]	Exit	:SYSTem:MEASure:EXIT
	Initialize	:SYSTem:MEASure:INITialize
	Save	:SYSTem:MMEMory:SETTing:STORe
	Load	:SYSTem:MMEMory:SETTing:RECall
[2]	SQA	:SYSTem:EQUipment:SEARch:SETTing
		:SYSTem:EQUipment:SEARch:SETTing?
[3]	Search Enable	:SYSTem:EQUipment:SEARch:ENABle
		:SYSTem:EQUipment:SEARch:ENABle?
[4]	Search Start	:SYSTem:EQUipment:SEARch:STARt
[5]	Connect	:SYSTem:EQUipment:CONNect
	Disconnect	:SYSTem:EQUipment:DCONnect
[6]	Equipment	:SYSTem:EQUipment:SETTing
		:SYSTem:EQUipment:SETTing?
		:SYSTem:EQUipment:SETTing:MODule?
[7]	Equipment	:SYSTem:EQUipment:ECOMbination
		:SYSTem:EQUipment:ECOMbination?
[8]	Operate MP1800A/MP1900A	:SYSTem:EQUipment:ADJust
		:SYSTem:EQUipment:ADJust?
[9]	Selecting G0375A	:SYSTem:EQUipment:SELConverter
		:SYSTem:EQUipment:SELConverter?
[10]	External Att	:SYSTem:EQUipment:EXTatt
		:SYSTem:EQUipment:EXTatt?
[11]	Use Noise Genrator	:SYSTem:EQUipment:USENoise
		:SYSTem:EQUipment:USENoise?
[12]	Selecting G0376A	:SYSTem:EQUipment:SELDecoder
		:SYSTem:EQUipment:SELDecoder?
[13]	Selecting LFPS combining method	:SYSTem:EQUipment:USBConnection
		:SYSTem:EQUipment:USBConnection?
[14]	Selecting number of G0375As	:SYSTem:EQUipment:SELConverter:NUMBer
		:SYSTem:EQUipment:SELConverter:NUMBer?

:SYSTem:MEASure:EXIT

Parameter	None
Function	Closes the application.
Example	`> :SYSTem:MEASure:EXIT`

:SYSTem:MEASure:INITialize

Parameter	None
Function	Initializes the various measurement setting conditions.
Example	`> :SYSTem:MEASure:INITialize`

:SYSTem:MMEMory:SETTing:STORe <file_name>

Parameter

<file_name>=<STRING PROGRAM DATA>
"<drv>:\<dir1>\<dir2>\<file>"

<drv>=C, D, E, F	Drive name
<dir>=xxxxxxxx	Directory name
<file>=xxxxxxxxx	File name

Function

Saves the measurement setting conditions.

Example

```
> :SYSTem:MMEMory:SETTing:STORe
"C:\test_folder\test_setting"
```

:SYSTem:MMEMory:SETTing:RECall <file_name>

Parameter

<file_name>=<STRING PROGRAM DATA>
"<drv>:\<dir1>\<dir2>\<file>"

<drv>=C, D, E, F	Drive name
<dir>=xxxxxxxx	Directory name
<file>=xxxxxxxxx	File name

Function

Loads measurement setting conditions.

Example

```
> :SYSTem:MMEMory:SETTing:RECall
"C:\test_folder\test_setting"
```

:SYSTem:EQUipment:SEARch:SETTing <info>,<number>

Parameter
<info>=<STRING PROGRAM DATA>
TCPIP0::<address>::<port>::SOCKET
<address>=xxx.xxx.xxx.xxx IP address
<port>=xxxx port
<number>=<DECIMAL NUMERIC PROGRAM DATA>
1 to 3 No.1 to 3

Function
Specifies the controller number, and sets the IP address and port.

Example
Set the MP1800A assigned the IP Address 192.168.2.100 and port 5001 to controller No. 2.

```
>:SYSTem:EQUipment:SEARch:SETTing
TCPIP0::192.168.2.100::5001::SOCKET,2
```

:SYSTem:EQUipment:SEARch:SETTing? <number/type>

Parameter
<number>=<DECIMAL NUMERIC PROGRAM DATA>
1 to 3 No.1 to 3
<type>=<CHARACTER PROGRAM DATA >
LIST Connection target candidate list

Response
For argument <number>
<string>=<STRING RESPONSE DATA>
<string>=TCPIP0::<address>::<port>::SOCKET
<address>=<STRING RESPONSE DATA>
Output in form 223.255.255.254
<port>=<NR1 NUMERIC RESPONSE DATA >
1024 to 5001
For argument <type>
<string>=<STRING RESPONSE DATA>
<string>="TCPIP0::<address1>::<port1>::SOCKET,
TCPIP0::<address2>::<port2>::SOCKET,
…
TCPIP0::<address8>::<port8>::SOCKET,
TCPIP0::<address9>::<port9>::SOCKET"

Function
Specifies the controller number, and queries the IP address and port.
Displays the connection target candidate list.

Example
To query the IP address and port for the controller No. 2 MP1800A

```
> :SYSTem:EQUipment:SEARch:SETTing? 2
< TCPIP0::192.168.2.100::5001::SOCKET
```

Displays the connection target candidate list.

```
> :SYSTem:EQUipment:SEARch:SETTing? LIST
"TCPIP0::192.168.2.100::5001::SOCKET,TCPIP0::192.168.2.1
01::5001::SOCKET,TCPIP0::127.0.0.1::5001::SOCKET
```

:SYSTem:EQUipment:SEARch:ENABle <boolean>[,<number>]

Parameter	< boolean>=<BOOLEAN PROGRAM DATA>	
	ON or 1	Search ON
	OFF or 0	Search OFF
	<number>=<DECIMAL NUMERIC PROGRAM DATA>	
	1 to 3	No.1 to 3
	Note: When <number> is omitted, No.1 is set.	
Function	Selects the search target equipment (SQA or MT1810A main unit).	
Example	To set No.2 as the search target: `> :SYSTem:EQUipment:SEARch:ENABle 1,2`	

:SYSTem:EQUipment:SEARch:ENABle? [<number>]

Parameter	<number>=<DECIMAL NUMERIC PROGRAM DATA>	
	1 to 3	No.1 to 3
	Note: When <number> is omitted, No.1 is queried.	
Response	<boolean>=<NR1 NUMERIC RESPONSE DATA>	
	1	Search ON
	0	Search OFF
Function	Queries the ON/OFF setting of the search target.	
Example	To query the search setting of No.2: `> :SYSTem:EQUipment:SEARch:ENABle? 2`	

:SYSTem:EQUipment:SEARch:STARt

Parameter	None
Function	Starts searching for the modules installed on the SQA specified as the controller.
Example	`> :SYSTem:EQUipment:SEARch:STARt`

:SYSTem:EQUipment:SETTing <type>,<number>,<unit>,<slot>[,<data_if>][,<mode>]

Parameter

<type>=<CHARACTER PROGRAM DATA>

JITTer	Jitter Modulation Source
PPG	PPG
PPG2	PPG2
ED	ED
NOISe	Noise Module
PAMPpg	PAM4 PPG
PAMEd	PAM4 ED

<number>=<DECIMAL NUMERIC PROGRAM DATA>

1 to 3	SQA No.1 to 3

<unit>=<DECIMAL NUMERIC PROGRAM DATA>

1 to 4	Unit 1	MP1900A/MP1800A
	Unit 1 to 4	MT1810A

<slot>=<DECIMAL NUMERIC PROGRAM DATA>

1 to 6	Slot 1 to 6	MP1800A
1 to 8	Slot 1 to 8	MP1900A

[<data_if>]=<DECIMAL NUMERIC PROGRAM DATA>

1 to 4	Data 1 to 4

Note:

<data_if> can be set when the module installed in slot is below:
MU183020A, MU183021A, MU183040A/B, MU183041A/B, MU195020A
Data 1 is specified when omitted.

If <data_if> is set to other modules, the parameter error occurs.

With PCIe Link Sequence and USB Link Sequence, PPG <data_if> can be set to "1" only.

[<mode>]=<CHARACTER PROGRAM DATA>

NRZ	NRZ mode
PAM4	PAM4 mode

Note:

<mode> can be set when the module installed in slot is below:
NRZ is specified when omitted.
MU196020A, MU196040A, MU196040B

If <mode> is set to other modules, the parameter error occurs.

Function

Selects the equipment to be used for the measurement.

Example

To assign MP1800A No.1, Unit 1, and Slot 4 to MU181500B:

```
> :SYSTem:EQUipment:SETTing JITTer,1,1,4
```

Assign MP1800A No. 1, Unit 1, Slot 4, Data 2 to the 28G/32G PPG.

```
> :SYSTem:EQUipment:SETTing PPG,1,1,4,2
```

Assign MP1900A No. 1, Unit 1, Slot 7, PAM4 mode to the PAM4 PPG.

```
> :SYSTem:EQUipment:SETTing PAMPpg,1,1,7,PAM4
```

:SYSTem:EQUipment:SETTing? <type>

Parameter

<type>=<CHARACTER PROGRAM DATA>

JITTer	Jitter Modulation Source
PPG	PPG
PPG2	PPG2
ED	ED
NOISe	Noise Module
PAMPpg	PAM4 PPG
PAMEd	PAM4 ED

Response

<number>=<NR1 NUMERIC RESPONSE DATA>

1 to 3	SQA No.1 to 3
0	None

<unit>=<NR1 NUMERIC RESPONSE DATA>

1 to 4	Unit 1 to 4

<slot>=<NR1 NUMERIC RESPONSE DATA>

1 to 8	Slot 1 to 8
0	None

[<data_if>]=<NR1 NUMERIC RESPONSE DATA>

1 to 4	Data 1 to 4

Note:

<data_if> returns when the module installed in slot is below:
MU183020A, MU183021A, MU183040A/B, MU183041A/B

[<mode>]=<CHARACTER RESPONSE DATA>

NRZ	NRZ mode
PAM4	PAM4 mode

Note:

<mode> returns when the module installed in slot is below:
MU196020A, MU196040A, MU196040B

Function

Queries the equipment used for the measurement.

Example

To query the equipment and slot used for the MU181500B.

```
> :SYSTem:EQUipment:SETTing? JITTer
< 1,1,4
```

When equipment is not assigned, the response of (None) is as follows:

```
< 0,0,0
```

To query the SQA and slot to which the PAM4 PPG is assigned.

```
> :SYSTem:EQUipment:SETTing? PAMPpg
< 1,1,7,PAM4
```

:SYSTem:EQUipment:SETTing:MODule? <type>

Parameter

<type>=<CHARACTER PROGRAM DATA>

JITTer	Jitter Modulation Source
PPG	PPG
ED	ED
NOISe	Noise Module
PAMPpg	PAM4 PPG
PAMEd	PAM4 ED

Response

<string>=<STRING RESPONSE DATA>

"<number>,<unit>,<slot>[,<data_if>]" (Up to 12)

<number>=<NR1 NUMERIC RESPONSE DATA>

1 to 3	SQA No.1 to 3
0	None

<unit>=<NR1 NUMERIC RESPONSE DATA>

1 to 4	Unit 1 to 4

<slot>=<NR1 NUMERIC RESPONSE DATA>

1 to 8	Slot 1 to 8
0	None

[<data_if>]=<NR1 NUMERIC RESPONSE DATA>

1 to 4	Data 1 to 4

Note:

<data_if> returns when the module installed in slot is below:
MU183020A, MU183021A, MU183040A/B, MU183041A/B

[<mode>]=<CHARACTER RESPONSE DATA>

NRZ	NRZ mode
PAM4	PAM4 mode

Note:

<mode> returns when the module installed in slot is below:
MU196020A, MU196040A, MU196040B

Function

Queries the equipment candidate to be used for the measurement. Selectable main unit No., Unit, and Slot are selected from the already searched equipment units.

Example

To query the equipment candidate for the MU181500B:

```
> :SYSTem:EQUipment:SETTing:MODule? JITTer
< "1,1,4","2,1,4","3,1,4"
```

When the equipment candidate does not exist, the response is as follows:

```
< 0,0,0
```

When MU183020A-x22/x23 are candidates for PPG, the response is as follows:

```
< "1,1,3,1","1,1,3,2"
```

When a PAM4 ED candidate is queried, the response is as follows:

```
< "1,1,6,PAM4"
```

:SYSTem:EQUipment:CONNect

Parameter	None
Function	Connects to the SQA with the IP address selected by :SYSTem:EQUipment:SEARch:ENABle. This command can be used after searching for equipment using :SYSTem:EQUipment:SEARch:SETTing.
Example	To connect to the SQA

```
> :SYSTem:EQUipment:CONNect
```

:SYSTem:EQUipment:DCONnect

Parameter	None
Function	Disconnects from the SQA.
Example	To disconnect from the SQA

```
> :SYSTem:EQUipment:DCONnect
```

:SYSTem:EQUipment:ECOMbination <boolean>

Parameter <boolean>=<BOOLEAN PROGRAM DATA>

OFF or 0	Does not test in 2ch Combination.
ON or 1	Tests in 2ch Combination.

Function Sets up testing in 2ch Combination.

This command is available after having searched the equipment by ":SYSTem:EQUipment:SEARch:SETTing" and before connecting MX183000A to the equipment by ":SYSTem:EQUipment:CONNect". Also, this command is available only when Jitter Tolerance Test application is running.

Example

```
> :SYSTem:EQUipment:ECOMbination 1
```

:SYSTem:EQUipment:ECOMbination?

Response <numeric>=<NR1 NUMERIC RESPONSE DATA>

0	Does not test in 2ch Combination.
1	Tests in 2ch Combination.

Function Queries whether to test in 2ch Combination.

This command is available only when Jitter Tolerance Test application is running.

Example

```
> :SYSTem:EQUipment:ECOMbination?
< 1
```

:SYSTem:EQUipment:ADJust <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	Releases Operate MP1800A/MP1900A mode.
	ON or 1	Sets Operate MP1800A/MP1900A mode.

Function

Selects the mode so that MX180000A or MX190000A can be directly remote-controlled from a remote tool by disconnecting the TCPIP connection between MX183000A and MX180000A or MX190000A temporarily.

This command is available after connecting MX183000A to MX180000A or MX190000A by ":SYSTem:EQUipment:CONNect".

Note:

After completing remote control of MX180000A or MX190000A, make sure to set this parameter to OFF.

For details of this function, refer to 4.3.4 "RF setting of MX180000A and MX190000A" as well.

Example

```
> :SYSTem:EQUipment:ADJust 1
```

:SYSTem:EQUipment:ADJust?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Not in Operate MP1800A/MP1900A mode.
	1	In Operate MP1800A/MP1900A mode.

Function

Query if the system is in Operate MP1800A/MP1900A mode.

This command is available after connecting MX183000A to MX180000A or MX190000A by ":SYSTem:EQUipment:CONNect".

Example

```
> :SYSTem:EQUipment:ADJust?
< 1
```

:SYSTem:EQUipment:SELConverter <item>

Parameter	<item>=<CHARACTER PROGRAM DATA>	
	G0375A	Using G0375A
	COMBiner	Using G0375A and Combiner
Function	Selects the PAM4 Converter used for measurement.	
Example	To select G0375A as the PAM Converter.	

```
> :SYSTem:EQUipment:SELConverter G0375A
```

:SYSTem:EQUipment:SELConverter?

Response	<item>=<CHARACTER RESPONSE DATA>	
	G0375A	Using G0375A
	COMBiner	Using G0375A and Combiner
Function	Queries the PAM4 Converter used for measurement.	
Example		

```
> :SYSTem:EQUipment:SELConverter?
< G0375A
```

:SYSTem:EQUipment:EXTatt <att>

Parameter	<att>=<DECIMAL NUMERIC PROGRAM DATA>	
	0	An External attenuator is not used.
	6	An external 6 dB attenuator is used.
Function	Selects the external attenuator used for measurement.	
Example		

```
> :SYSTem:EQUipment:EXTatt 6
```

:SYSTem:EQUipment:EXTatt?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	An External attenuator is not used.
	6	An external 6 dB attenuator is used.
	Queries the external attenuator used for measurement.	
Example		

```
> :SYSTem:EQUipment:EXTatt?
< 6
```

:SYSTem:EQUipment:USENoise <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	The Noise Generator is not used.
	ON or 1	The Noise Generator is used.
Function	Sets if the Nose Generator is used or not.	
Example	`> :SYSTem:EQUipment:USENoise 1`	

:SYSTem:EQUipment:USENoise?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	The Noise Generator is not used.
	1	The Noise Generator is used.
Function	Queries if the Nose Generator is used or not.	

Example	`> :SYSTem:EQUipment:USENoise?`
	`< 1`	

:SYSTem:EQUipment:SELDecoder <item>

Parameter	<item>=<CHARACTER PROGRAM DATA>	
	COM1 to 16	Select the COM No. of the G0376A for measurement, from 1 to 16.
	None	G0376A is not used.
Function	Selects the PAM4 Decoder for measurement.	
Example	To set COM1 as the PAM4 Decoder. `> :SYSTem:EQUipment:SELDecoder COM1`	

:SYSTem:EQUipment:SELDecoder?

Response	<item>=<CHARACTER RESPONSE DATA>	
	COM1 to 16	Select the COM No. of the G0376A for measurement
	None	G0376A is not used.
Function	Queries the PAM4 Decoder for measurement.	

Example	`> :SYSTem:EQUipment:SELDecoder?`
	`< COM1`	

:SYSTem:EQUipment:USBConnection <item>

Parameter	<item>=<CHARACTER PROGRAM DATA>	
	PICK	Selects the system to use Pick Off Tee.
	NOISe	Selects the system to use Noise Module.
Function	Selects the connection system in the USB Link Training application. A method for combining LFPS signals differs depending on the connection system.	
Example	To select the connection system using Pick Off Tee by the USB Link Training application.	

```
> :SYSTem:EQUipment:USBConnection PICK
```

:SYSTem:EQUipment:USBConnection?

Response	<item>=<CHARACTER RESPONSE DATA>	
	PICK	Selects the system to use Pick Off Tee.
	NOISe	Selects the system to use Noise Module.
Function	Queries the connection system setting using Pick Off Tee by the USB Link Training application.	
Example		

```
> :SYSTem:EQUipment:USBConnection?
< PICK
```

:SYSTem:EQUipment:SELConverter:NUMBer <num>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	1 to 4	Number of G0375As to be controlled
Function	Specifies the number of G0375As used for the measurement.	
Example	To set the number of G0375As used for the measurement to 2:	

```
> :SYSTem:EQUipment:SELConverter:NUMBer 2
```

:SYSTem:EQUipment:SELConverter:NUMBer?

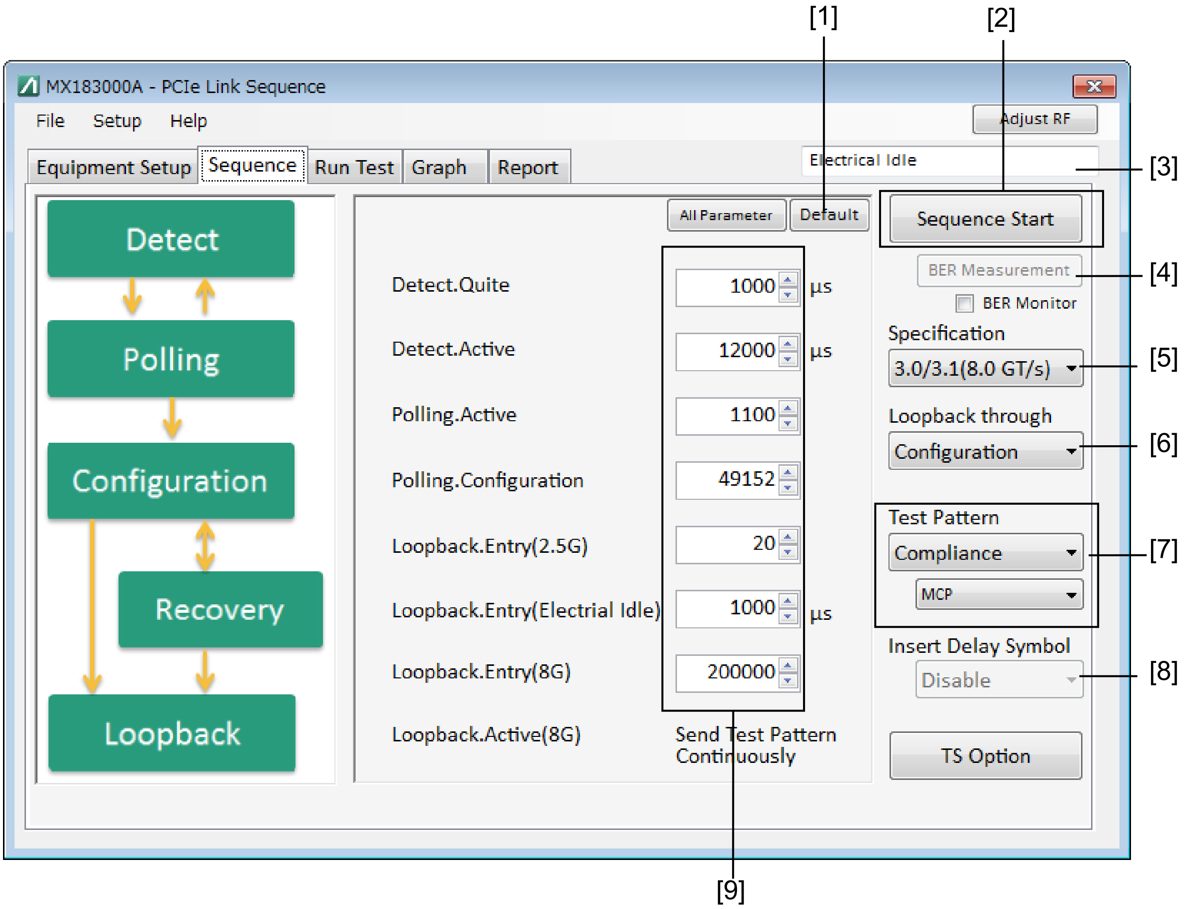
Response	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	1 to 4	Number of G0375As to be controlled
Function	Queries the number of G0375As used for the measurement.	
Example		

```
> :SYSTem:EQUipment:SELConverter:NUMBer?
< 2
```

5.8 PCIe Link Sequence Setup Screen (With MX183000A-PL011 Installed)

This setup screen is available only when MX183000A-PL011 is installed, when **PCIe Link Sequence** is started on the table 4.3.1-1 Selector screen, and when the SQA has been connected using Equipment Setup.

5.8.1 Link Sequence screen



Electrical Idle

Detect.Quite 1000 µs
Detect.Active 12000 µs
Polling.Active 1100
Polling.Configuration 49152
Loopback.Entry(2.5G) 20
Loopback.Entry(Electrial Idle) 1000 µs
Loopback.Entry(8G) 200000
Loopback.Active(8G) Send Test Pattern Continuously

Specification: 3.0/3.1(8.0 GT/s)
Loopback through: Configuration
Test Pattern: Compliance, MCP
Insert Delay Symbol: Disable

Figure 5.8.1-1 Link Sequence Screen

Table 5.8.1-1 Sequence Screen Setup Commands

No.	Setting Item	Command
[1]	Default	:LTRaining:SEQuence:INITialize
[2]	Sequence Start	:LTRaining:SEQuence:STARt
	Sequence Stop	:LTRaining:SEQuence:STOP
	Sequence State	:LTRaining:SEQuence:STATe?
[3]	28G/32G ED	:CALCulate:RESult:EMONitor?
[4]	BER Measurement Start	:SENSe:MEASure:BER:STARt
	BER Measurement Stop	:SENSe:MEASure:BER:STOP
	BER Measurement State	:SENSe:MEASure:BER:STATe?
[5]	Specification	:LTRaining:SEQuence:SPECification
		:LTRaining:SEQuence:SPECification?
[6]	Loopback through	:LTRaining:SEQuence:LTHRough
		:LTRaining:SEQuence:LTHRough?
[7]	Test Pattern	:SOURce:PATTern:TYPE
		:SOURce:PATTern:TYPE?
		:LTRaining:SEQuence:TEST:PATTern
		:LTRaining:SEQuence:TEST:PATTern?
		:SOURce:PATTern:PRBS:LENGth
		:SOURce:PATTern:PRBS:LENGth?
[8]	Insert Delay Symbol	:LTRaining:SEQuence:DSYMbol
		:LTRaining:SEQuence:DSYMbol?
[9]	Sequence	:LTRaining:SEQuence:DESign:REV1:CONF
		:LTRaining:SEQuence:DESign:REV1:CONF?
		:LTRaining:SEQuence:DESign:REV2:CONF
		:LTRaining:SEQuence:DESign:REV2:CONF?
		:LTRaining:SEQuence:DESign:REV2:REC
		:LTRaining:SEQuence:DESign:REV2:REC?
		:LTRaining:SEQuence:DESign:REV3:CONF
		:LTRaining:SEQuence:DESign:REV3:CONF?
		:LTRaining:SEQuence:DESign:REV3:REC
		:LTRaining:SEQuence:DESign:REV3:REC?
		:LTRaining:SEQuence:DESign:REV4:CONF
		:LTRaining:SEQuence:DESign:REV4:CONF?
		:LTRaining:SEQuence:DESign:REV4:REC
		:LTRaining:SEQuence:DESign:REV4:REC?

:LTRaining:SEQuence:STARt

Parameter	None
Function	Starts transmitting a link training sequence for looping back DUT. Once the transmission is complete, the pattern selected by Test Pattern is sent.
Example	`> :LTRaining:SEQuence:STARt`

:LTRaining:SEQuence:STOP

Parameter	None
Function	Stops transmitting link training sequence and test pattern and sets to Electrical Idle.
Example	`> :LTRaining:SEQuence:STOP`

:LTRaining:SEQuence:STATe?

Response <numeric>=<NR1 NUMERIC RESPONSE DATA>

0	Stop
1	Sending
2	Sending test pattern

Function Queries the link training sequence transmission status.

Example

```
> :LTRaining:SEQuence:STATe?
< 1
```

:LTRaining:SEQuence:SPECification <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	REV1	Revision1.0/1.1
	REV2	Revision2.0
	REV3	Revision3.0/3.1
	REV4	Revision4.0
Function	Selects the environment (revision) to loopback the DUT (Revision).	
Example	To set the environment to REV4(16.0 GT/s):	

```
> :LTRaining:SEQuence:SPECification REV4
```

Note:

The clock frequency input to MU181500B must be changed by the user when MU181000A/B is not installed.

:LTRaining:SEQuence:SPECification?

Response <type>=<CHARACTER RESPONSE DATA>

REV1, REV2, REV3, REV4

Function Queries the environment to loopback the DUT.

Example

```
> :LTRaining:SEQuence:SPECification?
< REV4
```

:LTRaining:SEQuence:LTHRough <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	CONFiguration	Configuration route
	RECovery	Recovery route
Function	Select the LTSSM route to loopback the DUT.	
Example	To set the state route to Configuration route:	

```
> :LTRaining:SEQuence:LTHRough CONFiguration
```

:LTRaining:SEQuence:LTHRough?

Response <type>=<CHARACTER RESPONSE DATA>

REC, CONF

Function Queries the LTSSM route to loopback the DUT.

Example

```
> :LTRaining:SEQuence:LTHRough?
< CONF
```

:SOURce:PATTern:TYPE <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	COMPliance	Compliance pattern
	PRBS	PRBS pattern
Function	Selects the test pattern to be sent after completing the link training sequence transmission.	
Example	To set the test pattern to Compliance Pattern: `>:SOURce:PATTern:TYPE COMPliance`	

:SOURce:PATTern:TYPE?

Response	<type>=<CHARACTER RESPONSE DATA> COMP, PRBS
Function	Queries the test pattern to be sent after completing the link training sequence transmission.

Example	`> :SOURce:PATTern:TYPE?`
	`< COMP`

:LTRaining:SEQuence:TEST:PATTern <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	CP	Compliance Pattern
	MCP	Modified Compliance Pattern
	JTMP	Jitter Tolerance Measurement Pattern*
	*: This parameter can be set when SI PPG is installed and Rev. 3.x or 4.0 is selected.	
Function	Selects the type of Compliance Pattern to be sent when test pattern ":SOURce:PATTern:TYPE" is set to Compliance.	
Example	`> :LTRaining:SEQuence:TEST:PATTern CP`	

:LTRaining:SEQuence:TEST:PATTern?

Response	<type>=<CHARACTER RESPONSE DATA>	
	CP	Compliance Pattern
	MCP	Modified Compliance Pattern
	JTMP	Jitter Tolerance Measurement Pattern
Function	Queries the type of Compliance Pattern to be sent.	

Example	`> :LTRaining:SEQuence:TEST:PATTern?`
	`< CP`	

:SOURce:PATTern:PRBS:LENGth <numeric >

Parameter

<numeric>=<DECIMAL NUMERIC PROGRAM DATA>

7	2^n-1 (n=7)
9	2^n-1 (n=9)
10	2^n-1 (n=10)
11	2^n-1 (n=11)
15	2^n-1 (n=15)
20	2^n-1 (n=20)
23	2^n-1 (n=23)
31	2^n-1 (n=31)

Function

Sets the number of stages (2^n-1 (n=7, 9, 10, 11, 15, 20, 23, or 31)) for PRBS pattern reception.

Example

To set the number of stages for PRBS pattern reception to 2^7-1:

```
> :SOURce:PATTern:PRBS:LENGth 7
```

:SOURce:PATTern:PRBS:LENGth?

Response

<numeric>=<NR1 NUMERIC RESPONSE DATA>

7, 9, 10, 11, 15, 20, 23, 31

Function

Queries the number of stages for PRBS pattern reception.

Example

```
> :SOURce:PATTern:PRBS:LENGth?
< 7
```

:LTRaining:SEQuence:DSYMbol <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	Delay Symbol not inserted
	ON or 1	Delay Symbol inserted
Function	Selects whether to insert a Delay Symbol.	
Example	`> :LTRaining:SEQuence:DSYMbol ON`	

:LTRaining:SEQuence:DSYMbol?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Delay Symbol not inserted
	1	Delay Symbol inserted
Function	Queries whether the Delay Symbol is to be inserted.	

Example	`> :LTRaining:SEQuence:DSYMbol?`
	`< 1`	

:LTRaining:SEQuence:INITialize [<spec>][,<state>]

Parameter	<spec>=<CHARACTER PROGRAM DATA>	
	REV1	Revision1.0/1.1
	REV2	Revision2.0
	REV3	Revision3.0/3.1
	REV4	Revision4.0
	<state>=<CHARACTER PROGRAM DATA>	
	CONFiguration	Configuration root
	RECovery	Recovery root

Note:

If <state> is omitted, the <spec> pattern specified is initialized.
If <spec><state> is omitted, all patterns are initialized.

Function	Sets all parameters for the link training sequence to the initial values.
Example	To initialize the parameters for REV2 Recovery Root: `> :LTRaining:SEQuence:INITialize REV2,RECovery`

:LTRaining:SEQuence:DESign:REV1:CONFiguration <type>,<numeric>

Parameter

<type>=<CHARACTER PROGRAM DATA>

DQUiet	DETECT_QUIET (wait)
DACTive	DETECT_ACTIVE
PACTive	POLLING_ACTIVE
PCONfiguration	POLLING_CONFIGURATION
LEMaster	LOOPBACK_ENTRY_LEAD

<numeric>=<DECIMAL NUMERIC PROGRAM DATA>

1 to 1000000	1 to 1000000 cycles TS transmission cycles per step
1 to 1000000	1 to 1000000 µs Wait time, 1 µs step

Function

Sets a sequence pattern to loopback the DUT (REV1).

Example

To set the wait for DETECT_QUIET to 100 µs:

```
> :LTRaining:SEQuence:DESign:REV1:CONFiguration DQU,100
```

To set the number of times POLLING_ACTIVE patterns are sent to 1024:

```
> :LTRaining:SEQuence:DESign:REV1:CONFiguration
PACTive,1024
```

:LTRaining:SEQuence:DESign:REV1:CONFiguration? <type>

Parameter

<type>=<CHARACTER PROGRAM DATA>

DQUiet	DETECT_QUIET (wait)
DACTive	DETECT_ACTIVE
PACTive	POLLING_ACTIVE
PCONfiguration	POLLING_CONFIGURATION
LEMaster	LOOPBACK_ENTRY_LEAD

Response

<numeric>=<NR1 NUMERIC RESPONSE DATA>

1 to 1000000	1 to 1000000 cycles TS transmission cycles
1 to 1000000	1 to 1000000 µs Wait time

Function

Queries the sequence pattern to loopback the DUT. (REV1)

Example

```
>:LTRaining:SEQuence:DESign:REV1:CONFiguration? DQUiet
< 100
>:LTRaining:SEQuence:DESign:REV1:CONFiguration? PACTive
< 1024
```

:LTRaining:SEQuence:DESign:REV2:CONFiguration<type>,<numeric>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	DQUiet	DETECT_QUIET (wait)
	DACTive	DETECT_ACTIVE
	PACTive	POLLING_ACTIVE
	PCONfiguration	POLLING_CONFIGURATION
	LEMaster1	LOOPBACK_ENTRY_LEAD
	LEMChange	LOOPBACK_ENTRY_LEAD_CHANGE (wait)
	LEMaster2	LOOPBACK_ENTRY_LEAD
	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	1 to 1000000	1 to 1000000 cycles TS transmission cycles per step
	1 to 1000000	1 to 1000000 µs Wait time, 1 µs step
Function	Sets a sequence pattern to loopback the DUT (REV2).	

Example

To set the wait for DETECT_QUIET to 100 µs:

```
> :LTRaining:SEQuence:DESign:REV2:CONFiguration
DQUiet,100
```

To set the number of times POLLING_ACTIVE patterns are sent to 1024:

```
> :LTRaining:SEQuence:DESign:REV2:CONFiguration
PACTive,1024
```

:LTRaining:SEQuence:DESign:REV2:CONFiguration? <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	DQUiet	DETECT_QUIET (wait)
	DACTive	DETECT_ACTIVE
	PACTive	POLLING_ACTIVE
	PCONfiguration	POLLING_CONFIGURATION
	LEMaster1	LOOPBACK_ENTRY_LEAD
	LEMChange	LOOPBACK_ENTRY_LEAD_CHANGE (wait)
	LEMaster2	LOOPBACK_ENTRY_LEAD
Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	1 to 1000000	1 to 1000000 cycles TS transmission cycles
	1 to 1000000	1 to 1000000 µs Wait time
Function	Queries the sequence pattern to loopback the DUT. (REV2)	

Example

```
>:LTRaining:SEQuence:DESign:REV2:CONFiguration? DQU
< 100
>:LTRaining:SEQuence:DESign:REV2:CONFiguration? PACT
< 1024
```

:LTRaining:SEQuence:DESign:REV2:RECovery <type>,<numeric>

Parameter

<type>=<CHARACTER PROGRAM DATA>

DQUiet	DETECT_QUIET (wait)
DACTive	DETECT_ACTIVE
PACTive	POLLING_ACTIVE
PCONfiguration	POLLING_CONFIGURATION
CLIStart	CONFIGURATION_LINKWIDTH_START
CLIaccept	CONFIGURATION_LINKWIDTH_ACCEPT
CLAWait	CONFIGURATIONS_LANE_WAIT
CLAaccept	CONFIGURATIONS_LANE_ACCEPT
CCOMplete	CONFIGURATION_COMPLETE
CIDLe	CONFIGURATION_IDLE (wait)
RRLock1	RECOVERY_RCVR_LOCK
RRCeqts2	RECOVERY_RCVR_CFG_EQTS2
RSPeed	RECOVERY_SPEED (wait)
RRLock2	RECOVERY_RCVR_LOCK
RRCTs2	RECOVERY_RCVR_CFG_TS2
LEMaster	LOOPBACK_ENTRY_LEAD

<numeric>=<DECIMAL NUMERIC PROGRAM DATA>

1 to 1000000	1 to 1000000 cycles TS transmission cycles per step
1 to 1000000	1 to 1000000 µs Wait time, 1 µs step

Function

Sets a sequence pattern to loopback the DUT (REV2).

Example

To set the wait for DETECT_QUIET to 100 µs:

```
> :LTRaining:SEQuence:DESign:REV2:RECovery DQUiet,100
```

To set the number of times POLLING_ACTIVE patterns are sent to 1024:

```
> :LTRaining:SEQuence:DESign:REV2:RECovery PACTive,1024
```

:LTRaining:SEQuence:DESign:REV2:RECovery? <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	DQUiet	DETECT_QUIET (wait)
	DACTive	DETECT_ACTIVE
	PACTive	POLLING_ACTIVE
	PCONfiguration	POLLING_CONFIGURATION
	CLIStart	CONFIGURATION_LINKWIDTH_START
	CLIaccept	CONFIGURATION_LINKWIDTH_ACCEPT
	CLAWait	CONFIGURATIONS_LANE_WAIT
	CLAaccept	CONFIGURATIONS_LANE_ACCEPT
	CCOMplete	CONFIGURATION_COMPLETE
	CIDLe	CONFIGURATION_IDLE (wait)
	RRLock1	RECOVERY_RCVR_LOCK
	RRCeqts2	RECOVERY_RCVR_CFG_EQTS2
	RSPeed	RECOVERY_SPEED (wait)
	RRLock2	RECOVERY_RCVR_LOCK
	RRCTs2	RECOVERY_RCVR_CFG_TS2
	LEMaster	LOOPBACK_ENTRY_LEAD
Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	1 to 1000000	1 to 1000000 cycles TS transmission cycles
	1 to 1000000	1 to 1000000 µs Wait time
Function	Queries the sequence pattern to loopback the DUT. (REV2)	

Example

```
>:LTRaining:SEQuence:DESign:REV2:RECovery? DQUiet
< 100
>:LTRaining:SEQuence:DESign:REV2:RECovery? PACTive
< 1024
```

:LTRaining:SEQuence:DESign:REV3:CONFiguration <type>,<numeric>

Parameter

<type>=<CHARACTER PROGRAM DATA>

DQUiet	DETECT_QUIET (wait)
DACTive	DETECT_ACTIVE
PACTive	POLLING_ACTIVE
PCONfiguration	POLLING_CONFIGURATION
LEMaster1	LOOPBACK_ENTRY_LEAD
LEMChange	LOOPBACK_ENTRY_LEAD_CHANGE (wait)
LEMaster2	LOOPBACK_ENTRY_LEAD

<numeric>=<DECIMAL NUMERIC PROGRAM DATA>

1 to 1000000	1 to 1000000 cycles TS transmission cycles per step
1 to 1000000	1 to 1000000 μs Wait time, 1 μs step

Function

Sets a sequence pattern to loopback the DUT (REV3).

Example

To set the wait for DETECT_QUIET to 100 μs:

```
> :LTRaining:SEQuence:DESign:REV3:CONFiguratuion
DQUiet,100
```

To set the number of times POLLING_ACTIVE patterns are sent to 1024:

```
> :LTRaining:SEQuence:DESign:REV3:CONFiguratuion
PACTive,1024
```

:LTRaining:SEQuence:DESign:REV3:CONFiguration? <type>

Parameter

<type>=<CHARACTER PROGRAM DATA>

DQUiet	DETECT_QUIET (wait)
DACTive	DETECT_ACTIVE
PACTive	POLLING_ACTIVE
PCONfiguration	POLLING_CONFIGURATION
LEMaster1	LOOPBACK_ENTRY_LEAD
LEMChange	LOOPBACK_ENTRY_LEAD_CHANGE (wait)
LEMaster2	LOOPBACK_ENTRY_LEAD

Response

<numeric>=<NR1 NUMERIC RESPONSE DATA>

1 to 1000000	1 to 1000000 cycles TS transmission cycles
1 to 1000000	1 to 1000000 μs Wait time

Function

Queries the sequence pattern to loopback the DUT. (REV3)

Example

```
>:LTRaining:SEQuence:DESign:REV3:CONFiguratuion? DQUiet
< 100
>:LTRaining:SEQuence:DESign:REV3:CONFiguratuion? PACTive
< 1024
```

:LTRaining:SEQuence:DESign:REV3:RECovery <type>,<numeric>

Parameter

<type>=<CHARACTER PROGRAM DATA>

DQUiet	DETECT_QUIET (wait)
DACTive	DETECT_ACTIVE
PACTive	POLLING_ACTIVE
PCONfiguration	POLLING_CONFIGURATION
CLIStart	CONFIGURATION_LINKWIDTH_START
CLIaccept	CONFIGURATION_LINKWIDTH_ACCEPT
CLAWait	CONFIGURATIONS_LANE_WAIT
CLAaccept	CONFIGURATIONS_LANE_ACCEPT
CCOMplete	CONFIGURATION_COMPLETE
CIDLe	CONFIGURATION_IDLE (wait)
RRLock1	RECOVERY_RCVRLOCK
RRCeqts2	RECOVERY_RCVRCFG EQTS2
RSPeed	RECOVERY_SPEED (wait)
RRLock2	RECOVERY_RCVR_LOCK
REPHase1	RECOVERY_EQUALIZATION PHASE1
RRLock3	RECOVERY_RCVRLOCK
RRCTs2	RECOVERY_RCVRCFG TS2
LEMaster	LOOPBACK_ENTRY_LEAD

<numeric>=<DECIMAL NUMERIC PROGRAM DATA>

1 to 1000000	1 to 1000000 cycles TS transmission cycles per step
1 to 1000000	1 to 1000000 µs Wait time, 1 µs step

Function

Sets a sequence pattern to loopback the DUT (REV3).

Example

To set the wait for DETECT_QUIET to 100 µs:

```
> :LTRaining:SEQuence:DESign:REV3:RECovery DQUiet,100
```

To set the number of times POLLING_ACTIVE patterns are sent to 1024:

```
> :LTRaining:SEQuence:DESign:REV3:RECovery PACTive,1024
```

:LTRaining:SEQuence:DESign:REV3:RECovery? <type>

Parameter

<type>=<CHARACTER PROGRAM DATA>

DQUiet	DETECT_QUIET (wait)
DACTive	DETECT_ACTIVE
PACTive	POLLING_ACTIVE
PCONfiguration	POLLING_CONFIGURATION
CLIStart	CONFIGURATION_LINKWIDTH_START
CLIaccept	CONFIGURATION_LINKWIDTH_ACCEPT
CLAWait	CONFIGURATIONS_LANE_WAIT
CLAaccept	CONFIGURATIONS_LANE_ACCEPT
CCOMplete	CONFIGURATION_COMPLETE
CIDLe	CONFIGURATION_IDLE (wait)
RRLock1	RECOVERY_RCVRLOCK
RRCeqts2	RECOVERY_RCVRCFG EQTS2
RSPeed	RECOVERY_SPEED (wait)
RRLock2	RECOVERY_RCVR_LOCK
REPHase1	RECOVERY_EQUALIZATION PHASE1
RRLock3	RECOVERY_RCVRLOCK
RRCTs2	RECOVERY_RCVRCFG TS2
LEMaster	LOOPBACK_ENTRY_LEAD

Response

<numeric>=<NR1 NUMERIC RESPONSE DATA>

1 to 1000000	1 to 1000000 cycles TS transmission cycles
1 to 1000000	1 to 1000000 µs Wait time

Function

Queries the sequence pattern to loopback the DUT. (REV3)

Example

```
>:LTRaining:SEQuence:DESign:REV3:RECovery? DQUiet
< 100
>:LTRaining:SEQuence:DESign:REV3:RECovery? PACTive
< 1024
```

:LTRaining:SEQuence:DESign:REV4:CONFiguration <type>,<numeric>

Parameter

<type>=<CHARACTER PROGRAM DATA>

DQUiet	DETECT_QUIET (wait)
DACTive	DETECT_ACTIVE
PACTive	POLLING_ACTIVE
PCONfiguration	POLLING_CONFIGURATION
LEMaster1	LOOPBACK_ENTRY_LEAD
LEMChange	LOOPBACK_ENTRY_LEAD_CHANGE (wait)
LEMaster2	LOOPBACK_ENTRY_LEAD

<numeric>=<DECIMAL NUMERIC PROGRAM DATA>

1 to 1000000	1 to 1000000 cycles TS transmission cycles per step
1 to 1000000	1 to 1000000 µs Wait time, 1 µs step

Function

Sets a sequence pattern to loopback the DUT (REV4).

Example

To set the wait for DETECT_QUIET to 100 µs:

```
> :LTRaining:SEQuence:DESign:REV4:CONFiguratuion
DQUiet,100
```

To set the number of times POLLING_ACTIVE patterns are sent to 1024:

```
> :LTRaining:SEQuence:DESign:REV3:CONFiguratuion
PACTive,1024
```

:LTRaining:SEQuence:DESign:REV4:CONFiguration? <type>

Parameter

<type>=<CHARACTER PROGRAM DATA>

DQUiet	DETECT_QUIET (wait)
DACTive	DETECT_ACTIVE
PACTive	POLLING_ACTIVE
PCONfiguration	POLLING_CONFIGURATION
LEMaster1	LOOPBACK_ENTRY_LEAD
LEMChange	LOOPBACK_ENTRY_LEAD_CHANGE (wait)
LEMaster2	LOOPBACK_ENTRY_LEAD

Response

<numeric>=<NR1 NUMERIC RESPONSE DATA>

1 to 1000000	1 to 1000000 cycles TS transmission cycles
1 to 1000000	1 to 1000000 µs Wait time

Function

Queries the sequence pattern to loopback the DUT. (REV4)

Example

```
>:LTRaining:SEQuence:DESign:REV3:CONFiguratuion? DQUiet
< 100
>:LTRaining:SEQuence:DESign:REV3:CONFiguratuion? PACTive
< 1024
```

:LTRaining:SEQuence:DESign:REV4:RECovery <type>,<numeric>

Parameter

<type>=<CHARACTER PROGRAM DATA >

DQUiet	DETECT_QUIET (wait)
DACTive	DETECT_ACTIVE
PACTive	POLLING_ACTIVE
PCONfiguration	POLLING_CONFIGURATION
CLIStart	CONFIGURATION_LINKWIDTH_START
CLIaccept	CONFIGURATION_LINKWIDTH_ACCEPT
CLAWait	CONFIGURATIONS_LANE_WAIT
CLAaccept	CONFIGURATIONS_LANE_ACCEPT
CCOMplete	CONFIGURATION_COMPLETE
CIDLe	CONFIGURATION_IDLE (wait)
RRLock1	RECOVERY_RCVR_LOCK
RRCeqts21	RECOVERY_RCVR_CFG_EQTS2
RSPeed1	RECOVERY_SPEED (wait)
RRLock2	RECOVERY_RCVR_LOCK
REPHase11	RECOVERY_EQUALIZATION_PHASE1
RRLock3	RECOVERY_RCVR_LOCK
RRCTs21	RECOVERY_RCVR_CFG_TS2
RIDLe	RECOVERY_IDLE (wait)
RRLock4	RECOVERY_RCVR_LOCK
RRCeqts22	RECOVERY_RCVR_CFG_EQTS2
RSPeed2	RECOVERY_SPEED (wait)
RRLock5	RECOVERY_RCVR_LOCK
REPHase12	RECOVERY_EQUALIZATION_PHASE1
RRLock6	RECOVERY_RCVR_LOCK
RRCTs22	RECOVERY_RCVR_CFG_TS2
LEMaster	LOOPBACK_ENTRY_LEAD

<numeric>=<DECIMAL NUMERIC PROGRAM DATA>

1 to 1000000	1 to 1000000 cycles TS transmission cycles per step
1 to 1000000	1 to 1000000 µs Wait time, 1 µs step

Function

Sets a sequence pattern to loopback the DUT (REV4).

Example

To set the wait for DETECT_QUIET to 100 µs:

```
> :LTRaining:SEQuence:DESign:REV4:RECovery DQUiet,100
```

To set the number of times POLLING_ACTIVE patterns are sent to 1024:

```
> :LTRaining:SEQuence:DESign:REV4:RECovery PACTive,1024
```

:LTRaining:SEQuence:DESign:REV4:RECovery? <type>

Parameter <type>=<CHARACTER PROGRAM DATA>

DQUiet	DETECT_QUIET (wait)
DACTive	DETECT_ACTIVE
PACTive	POLLING_ACTIVE
PCONfiguration	POLLING_CONFIGURATION
CLIStart	CONFIGURATION_LINKWIDTH_START
CLIaccept	CONFIGURATION_LINKWIDTH_ACCEPT
CLAWait	CONFIGURATIONS_LANE_WAIT
CLAaccept	CONFIGURATIONS_LANE_ACCEPT
CCOMplete	CONFIGURATION_COMPLETE
CIDLe	CONFIGURATION_IDLE (wait)
RRLock1	RECOVERY_RCVR_LOCK
RRCeqts21	RECOVERY_RCVR_CFG_EQTS2
RSPeed1	RECOVERY_SPEED (wait)
RRLock2	RECOVERY_RCVR_LOCK
REPHase11	RECOVERY_EQUALIZATION_PHASE1
RRLock3	RECOVERY_RCVR_LOCK
RRCTs21	RECOVERY_RCVR_CFG_TS2
RIDLe	RECOVERY_IDLE (wait)
RRLock4	RECOVERY_RCVR_LOCK
RRCeqts22	RECOVERY_RCVR_CFG_EQTS2
RSPeed2	RECOVERY_SPEED (wait)
RRLock5	RECOVERY_RCVR_LOCK
REPHase12	RECOVERY_EQUALIZATION_PHASE1
RRLock6	RECOVERY_RCVR_LOCK
RRCTs22	RECOVERY_RCVR_CFG_TS2
LEMaster	LOOPBACK_ENTRY_LEAD

Response <numeric>=<NR1 NUMERIC RESPONSE DATA>

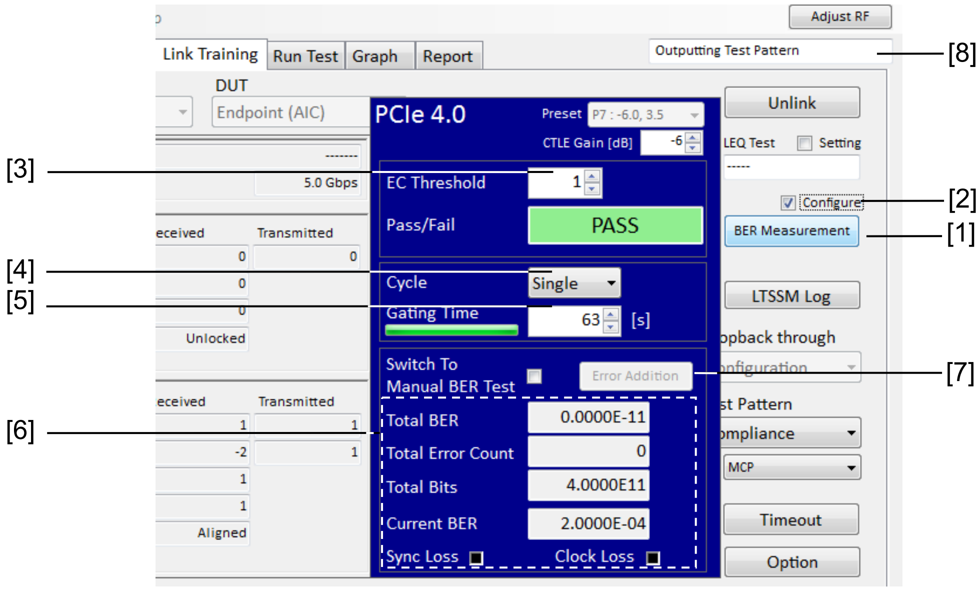
1 to 1000000	1 to 1000000 cycles TS transmission cycles
1 to 1000000	1 to 1000000 μs Wait time

Function Queries the sequence pattern to loopback the DUT. (REV4)

Example

```
>:LTRaining:SEQuence:DESign:REV4:RECovery? DQUiet
< 100
>:LTRaining:SEQuence:DESign:REV4:RECovery? PACTive
< 1024
```

5.8.2 BER Measurement screen



Outputting Test Pattern

DUT: Endpoint (AIC)

Preset: P7 : -6.0, 3.5

CTLE Gain [dB]: -6

EC Threshold: 1

Pass/Fail: PASS

Cycle: Single

Gating Time: 63 [s]

Total BER: 0.0000E-11

Total Error Count: 0

Total Bits: 4.0000E11

Current BER: 2.0000E-04

Figure 5.8.2-1 BER Measurement Screen

Table 5.8.2-1 BER Measurement Commands

No.	Setting Item	Command
[1]	BER Measurement Start	:SENSe:MEASure:BER:STARt
	BER Measurement Stop	:SENSe:MEASure:BER:STOP
	BER Measurement State	:SENSe:MEASure:BER:STATe?
[2]	Configure BER Measurement	:DISPlay:RESult:BER
		:DISPlay:RESult:BER?
[3]	Error Count Threshold	:SENSe:MEASure:BER:ECTHreshold
		:SENSe:MEASure:BER:ECTHreshold?
[4]	Cycle	:SENSe:MEASure:BER:MODE
		:SENSe:MEASure:BER:MODE?
[5]	Gating Time	:SENSe:MEASure:BER:TIME
		:SENSe:MEASure:BER:TIME?
[6]	Result	:CALCulate:DATA:EALarm?
[7]	Error Addition	:SOURce:PATTern:EADDition:SINGle
[8]	BERT State	:CALCulate:RESult:EMONitor?

:SENSe:MEASure:BER:STARt

Parameter	None
Function	Starts BER Measurement.
Example	`> :SENSe:MEASure:BER:STARt`

:SENSe:MEASure:BER:STOP

Parameter	None
Function	Stops BER Measurement.
Example	`> :SENSe:MEASure:BER:STOP`

:SENSe:MEASure:BER:STATe?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	1	Being measured
	0	Stopped
Function	Queries the BER measurement status.	

Example	`> :SENSe:MEASure:BER:STATe?`
	`< 1`	

:DISPlay:RESult:BER <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	Hides the BER measurement setting window.
	ON or 1	Displays the BER measurement setting window.
Function	Sets whether the BER Measurement results area is displayed or hidden.	
Example	`> :DISPlay:RESult:BER 1`	

:DISPlay:RESult:BER?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Hides the BER measurement setting window.
	1	Displays the BER measurement setting window.
Function	Queries the BER Measurement results area display status.	

Example	`> :DISPlay:RESult:BER?`
	`< 1`	

:SENSe:MEASure:BER:ECTHreshold <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>
	0 to 1000 0 to 1000, 1 step
Function	Sets an evaluation threshold of the BER measurement. When the number of bit errors exceeds the evaluation threshold, the BER measurement is judged as Fail.
Example	To set the evaluation threshold of the BER measurement to 1: `>:SENS:MEAS:BER:ECTHreshold 1`

:SENSe:MEASure:BER:ECTHreshold?

Response	<numeric>=<NR1 NUMERIC RESPONESE DATA>
	0 to 1000 0 to 1000
Function	Queries the evaluation threshold of the BER measurement.

Example	`>:SENSe:MEASure:BER:ECTHreshold?`
	`< 1`

:SENSe:MEASure:BER:MODE <mode>

Parameter	<mode>=<CHARACTER PROGRAM DATA>
	SINGle Performs the measurement once.
	REPeat Performs the measurement repeatedly.
Function	Sets the measurement processing mode for the BER measurement.
Example	To set the measurement processing mode for the BER measurement to Repeat: `> :SENSe:MEASure:BER:MODE REPeat`

:SENSe:MEASure:BER:MODE?

Response	<mode>=<CHARACTER PROGRAM DATA>
	SING, REP
Function	Queries the measurement processing mode for the BER measurement.

Example	`>:SENSe:MEASure:BER:MODE?`
	`< REP`

:SENSe:MEASure:BER:TIME <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>
	1 to 100 1 to 100 s, 1s step
Function	Sets the Gating Time of the BER measurement.
Example	To set the Gating Time of the BER measurement to 6 s:
	`>:SENSe:MEASure:BER:TIME 6`

:SENSe:MEASure:BER:TIME?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>
	1 to 100
Function	Queries the Gating Time of the BER measurement.
Example	`>:SENSe:MEASure:BER:TIME?`
	`< 6`

:SOURce:PATTern:EADDition:SINGle

Function	Adds a single error to the test pattern.
Example	`> :SOURce:PATTern:EADDition:SINGle`

:CALCulate:DATA:EALarm? <result>

Parameter	<result>=<STRING PROGRAM DATA> For details on <result>, refer to Table 5.8.2-2.
Response	<string>=<STRING RESPONSE DATA>

Table 5.8.2-2 Parameter

Items	<result1>	Format
Error Count	"EC"	Form1
Bit Count	"BITS"	Form1
Bit Error Rate	"BER"	Form2
Sync Loss	"PSLoss"	"Occur" "Not Occur"
Clock Loss	"CLOSs"	
Pass/fail judgment	"JUDGe"	String("PASS","FAIL","---")

Table 5.8.2-3 Response Format

Items	Format	Description
Form1 Integer	"XXXXXXX"	For 0 to 9999999
	"X.XXXXEXX"	For 1.0000E07 to 9.9999E17
	"-------"	No data corresponds to a query.
Form2 Decimal	"X.XXXXE-XX"	For 0.0001E–18 to 1.0000E00
	"-------"	No data corresponds to a query.

Function: Queries the BER Measurement results (BITS).

Example:

```
> :CALCulate:DATA:EALarm? "BITS"
< "1.0000E12"
```

:CALCulate:RESult:EMONitor?

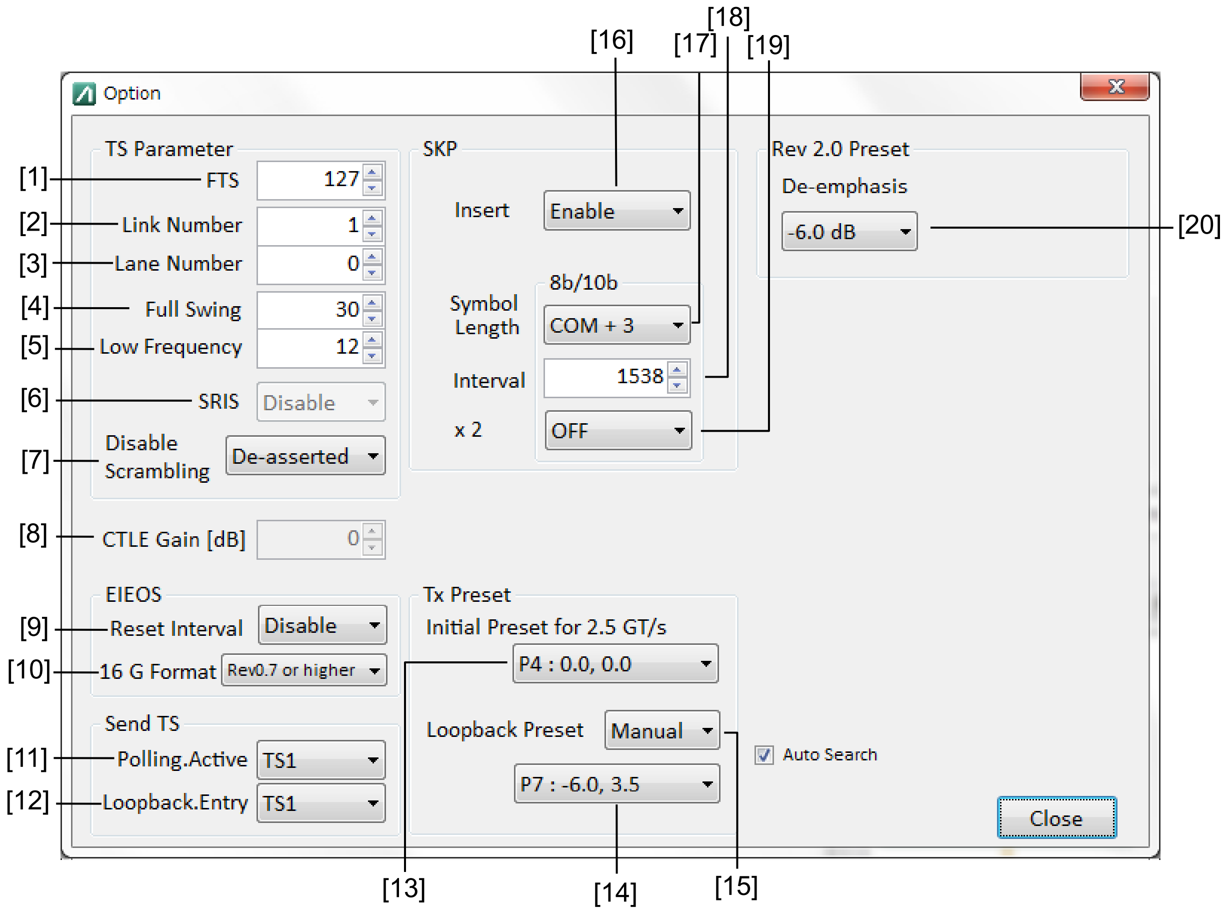
Response: <string>=<STRING RESPONSE DATA>

Function: Queries the MP1800A/MP1900A state.

Example:

```
> :CALCulate:RESult:EMONitor?
< "Outputting Test Pattern"
```

5.8.3 Option dialog box



Option

TS Parameter

FTS 127

Link Number 1

Lane Number 0

Full Swing 30

Low Frequency 12

SRIS Disable

Disable Scrambling De-asserted

CTLE Gain [dB] 0

EIEOS

Reset Interval Disable

16 G Format Rev0.7 or higher

Send TS

Polling.Active TS1

Loopback.Entry TS1

SKP

Insert Enable

8b/10b

Symbol Length COM + 3

Interval 1538

x 2 OFF

Tx Preset

Initial Preset for 2.5 GT/s

P4 : 0.0, 0.0

Loopback Preset Manual

P7 : -6.0, 3.5

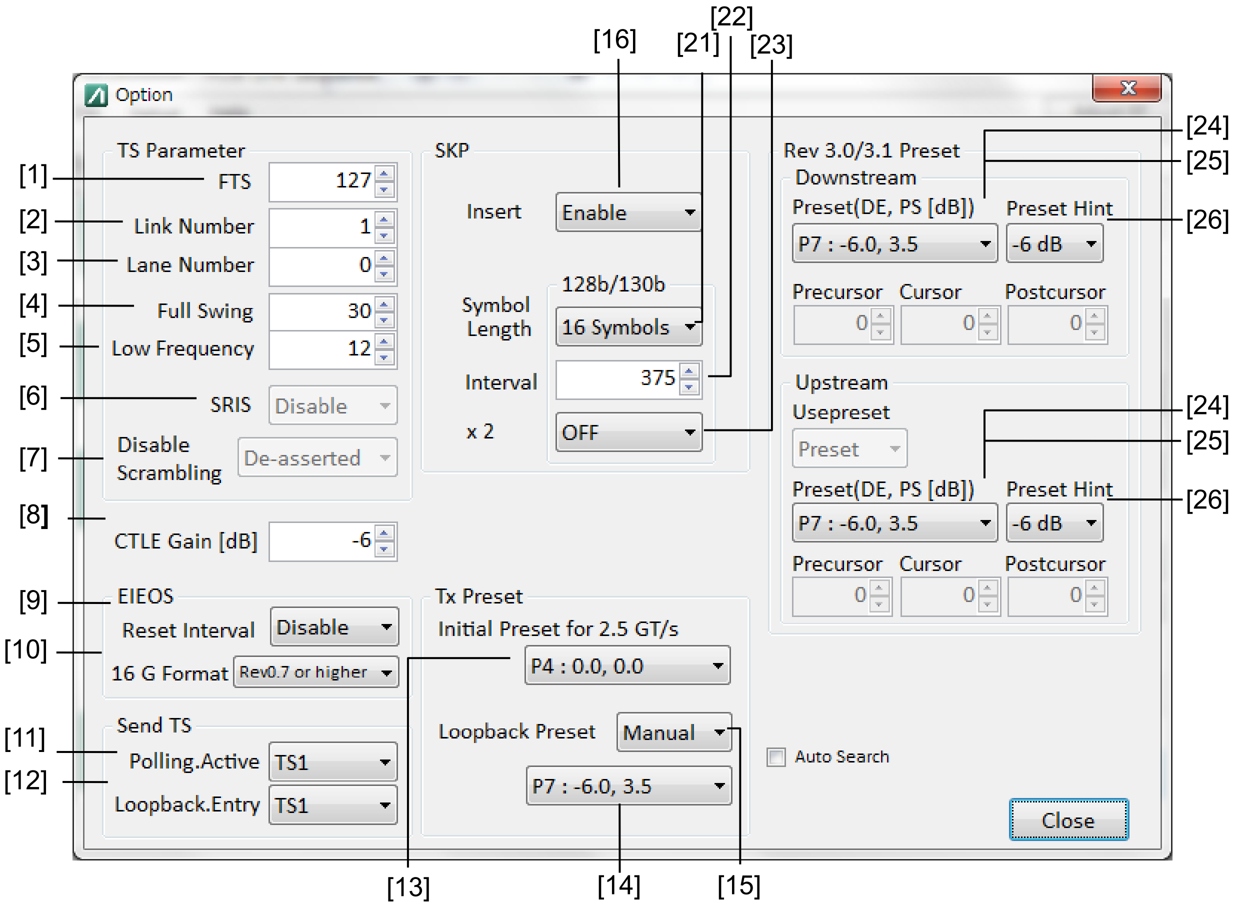
Rev 2.0 Preset

De-emphasis

-6.0 dB

☑ Auto Search

Figure 5.8.3-1 Option Dialog Box (Rev1, Rev2)



TS Parameter
FTS 127
Link Number 1
Lane Number 0
Full Swing 30
Low Frequency 12
SRIS Disable
Disable Scrambling De-asserted
CTLE Gain [dB] -6

EIEOS
Reset Interval Disable
16 G Format Rev0.7 or higher

Send TS
Polling.Active TS1
Loopback.Entry TS1

SKP
Insert Enable
128b/130b
Symbol Length 16 Symbols
Interval 375
x 2 OFF

Tx Preset
Initial Preset for 2.5 GT/s P4 : 0.0, 0.0
Loopback Preset Manual
P7 : -6.0, 3.5

Rev 3.0/3.1 Preset
Downstream
Preset(DE, PS [dB]) P7 : -6.0, 3.5
Preset Hint -6 dB
Precursor 0
Cursor 0
Postcursor 0

Upstream
Usepreset Preset
Preset(DE, PS [dB]) P7 : -6.0, 3.5
Preset Hint -6 dB
Precursor 0
Cursor 0
Postcursor 0

☐ Auto Search

Figure 5.8.3-2 Option Dialog Box (Rev3, Rev4)

Table 5.8.3-1 Sequence Option Dialog Box Setup Command

No.	Setting Item	Command
[1]	FTS	:LTRaining:SEQuence:FTS
		:LTRaining:SEQuence:FTS?
[2]	Link Number	:LTRaining:SEQuence:LINKnum
		:LTRaining:SEQuence:LINKnum?
[3]	Lane Number	:LTRaining:SEQuence:LANenum
		:LTRaining:SEQuence:LANenum?
[4]	Full Swing	:LTRaining:SEQuence:FSWing
		:LTRaining:SEQuence:FSWing?
[5]	Low Frequency	:LTRaining:SEQuence:LFRequency
		:LTRaining:SEQuence:LFRequency?
[6]	SRIS	:LTRaining:SEQuence:SRIS
[7]	Disable Scrambling	:LTRaining:SEQuence:DSCRamble
		:LTRaining:SEQuence:DSCRamble?
[8]	CTLE Gain	:INPut:DATA:EQUalizer:AMPLitude
		:INPut:DATA:EQUalizer:AMPLitude?
[9]	EIEOS Reset Interval	:LTRaining:SEQuence:REIeos:INTerval
		:LTRaining:SEQuence:REIeos:INTerval?
[10]	EIEOS 16G Format	:LTRaining:SEQuence:EIEos:FORMat
		:LTRaining:SEQuence:EIEos:FORMat?
[11]	Send TS Polling.Active	:LTRaining:SEQuence:PACTive:TS
		:LTRaining:SEQuence:PACTive:TS?
[12]	Send TS Loopback.Entry	:LTRaining:SEQuence:LENTry:TS
		:LTRaining:SEQuence:LENTry:TS?
[13]	Initial Preset for 2.5GT/s	:LTRaining:SEQuence:TXPReset:IPReset
		:LTRaining:SEQuence:TXPReset:ILPReset?
[14]	Loopback Preset	:LTRaining:SEQuence:TXPReset:LPReset:PRESet
		:LTRaining:SEQuence:TXPReset:LPReset:PRESet?
[15]	Loopback Preset Select	:LTRaining:SEQuence:TXPReset:LPReset
		:LTRaining:SEQuence:TXPReset:LPReset?
[16]	SKP Insert	:LTRaining:SEQuence:SKP
		:LTRaining:SEQuence:SKP?
[17]	Symbol Length 8b/10b	:LTRaining:SEQuence:SKP:SLENgth:8B10B
		:LTRaining:SEQuence:SKP:SLENgth:8B10B?
[18]	Interval 8b/10b	:LTRaining:SEQuence:SKP:INTerval:8B10B
		:LTRaining:SEQuence:SKP:INTerval:8B10B?

Table 5.8.3-1 Sequence Option Dialog Box Setup Command (Cont'd)

No.	Setting Item	Command
[19]	Double SKP (8b/10b)	:LTRaining:SEQuence:SKP:DOUBle:8B10B
		:LTRaining:SEQuence:SKP:DOUBle:8B10B?
[20]	De-emphasis	:LTRaining:SEQuence:REV2:DEMPhasis
		:LTRaining:SEQuence:REV2:DEMPhasis?
[21]	Symbol Length 128b/130b	:LTRaining:SEQuence:SKP:SLENgth:128B130B
		:LTRaining:SEQuence:SKP:SLENgth:128B130B?
[22]	Interval 128b/130b	:LTRaining:SEQuence:SKP:INTerval:128B130B
		:LTRaining:SEQuence:SKP:INTerval:128B130B?
[23]	Double SKP (128b/130b)	:LTRaining:SEQuence:SKP:DOUBle:128B130B
		:LTRaining:SEQuence:SKP:DOUBle:128B130B?
[24]	Preset (Rev 3.x)	:LTRaining:SEQuence:REV3:DSTReam:PRESet
		:LTRaining:SEQuence:REV3:DSTReam:PRESet?
		:LTRaining:SEQuence:REV3:USTReam:PRESet
		:LTRaining:SEQuence:REV3:USTReam:PRESet?
[25]	Preset (Rev 4.0)	:LTRaining:SEQuence:REV4:DSTReam:PRESet
		:LTRaining:SEQuence:REV4:DSTReam:PRESet?
		:LTRaining:SEQuence:REV4:USTReam:PRESet
		:LTRaining:SEQuence:REV4:USTReam:PRESet?
[26]	Preset Hint (Rev 3.x)	:LTRaining:SEQuence:REV3:DSTReam:HPRESet
		:LTRaining:SEQuence:REV3:DSTReam:HPRESet?
		:LTRaining:SEQuence:REV3:USTReam:HPRESet
		:LTRaining:SEQuence:REV3:USTReam:HPRESet?

:LTRaining:SEQuence:FTS <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>
	0 to 255 0 to 255, 1 step
Function	Sets the TS FTS value.
Example	To set the TS FTS value to 127:

```
> :LTRaining:SEQuence:FTS 127
```

:LTRaining:SEQuence:FTS?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>
	0 to 255 0 to 255
Function	Queries the TS FTS setting.
Example	

```
> :LTRaining:SEQuence:FTS?
< 127
```

:LTRaining:SEQuence:LINKnum <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0 to 255	0 to 255, 1 step
Function	Sets the TS Link Number.	
Example	To set the Link Number to 1:	
	`> :LTRaining:SEQuence:LINKnum 1`	

:LTRaining:SEQuence:LINKnum?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0 to 255	0 to 255
Function	Queries the TS Link Number.	
Example	`>:LTRaining:SEQuence:LINKnum?`	
	`< 1`	

:LTRaining:SEQuence:LANEnum <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0 to 255	0 to 255, 1 step
Function	Sets the TS Lane Number.	
Example	To set the Lane Number to 1:	
	`> :LTRaining:SEQuence:LANEnum 100`	

:LTRaining:SEQuence:LANEnum?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0 to 255	0 to 255
Function	Queries the TS Lane Number.	
Example	`> :LTRaining:SEQuence:LANEnum?`	
	`< 100`	

:LTRaining:SEQuence:FSWing <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	12 to 63	12 to 63, 1 step
Function	Sets the TS Full Swing value.	
Example	To set the TS Full Swing value to 30:	

```
> :LTRaining:SEQuence:FSWing 30
```

:LTRaining:SEQuence:FSWing?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	12 to 63	12 to 63, 1 step
Function	Queries the TS Full Swing value.	
Example		

```
> :LTRaining:SEQuence:FSWing?
< 30
```

:LTRaining:SEQuence:LFRequency <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	12 to 63	12 to 63, 1 Step
Function	Sets the TS Low Frequency value.	
Example	To set the Low Frequency value to 30:	

```
> :LTRaining:SEQuence:LFRequency 30
```

:LTRaining:SEQuence:LFRequency?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	12 to 63	12 to 63, 1step
Function	Queries the TS Low Frequency value.	
Example		

```
> :LTRaining:SEQuence:LFRequency?
< 30
```

:LTRaining:SEQuence:SRIS?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Disable
	1	Enable
Function	Queries whether to operate using Separate Reference clock with Independent SSC. When PCIe Link Sequence is started, this parameter is fixed to Disable. Also, the setting command is available only when PCIe Link Training is running.	

Example	`> :LTRaining:SEQuence:SRIS?`
	`< 0`	

:LTRaining:SEQuence:DSCRamble <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	De-assert
	ON or 1	Assert
Function	Sets the TS Disable scramble bit.	
Example	To set Disable scramble to Asset: `> :LTRaining:SEQuence:DSCRamble 1`	

:LTRaining:SEQuence:DSCRamble?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	De-assert
	1	Assert
Function	Queries the TS Disable scramble bit value.	

Example	`> :LTRaining:SEQuence:DSCRamble?`
	`< 1`	

:LTRaining:SEQuence:REIeos:INTerval <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	Disables the EIEOS Reset Interval Count bit.
	ON or 1	Enables the EIEOS Reset Interval Count bit.
Function	Sets the TS EIEOS Reset Interval Count bit value.	
Example	`> :LTRaining:SEQuence:REIeos:INTerval ON`	

:LTRaining:SEQuence:REIeos:INTerval?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	The EIEOS Reset Interval Count bit disabled.
	1	The EIEOS Reset Interval Count bit enabled.
Function	Queries the TS EIEOS Reset Interval Count bit value.	

Example	`> :LTRaining:SEQuence:REIeos:INTerval?`
	`< 1`	

:LTRaining:SEQuence:EIEos:FORMat <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0	Older than Rev 0.7
	1	Rev 0.7 or later
Function	Sets EIEOS format to PCIe 4 Rev 0.7 or later. This parameter is available only when SI PPG is installed.	
Example	`> :LTRaining:SEQuence:EIEos:FORMat 1`	

:LTRaining:SEQuence:EIEos:FORMat?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Older than Rev 0.7
	1	Rev 0.7 or later
Function	Queries if EIEOS format is PCIe 4 Rev 0.7 or later. This parameter is available only when SI PPG is installed.	

Example	`> :LTRaining:SEQuence:EIEos:FORMat?`
	`< 1`	

:LTRaining:SEQuence:SKP <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	SKP OS not inserted
	ON or 1	SKP OS inserted
Function	Selects whether to insert SKP OS during link sequence.	
Example	To insert SKP OS	

```
> :LTRaining:SEQuence:SKP ON
```

:LTRaining:SEQuence:SKP?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	SKP OS not inserted
	1	SKP OS inserted
Function	Queries whether SKP OS is inserted while executing a link sequence.	
Example		

```
>: LTRaining:SEQuence:SKP?
< 1
```

:LTRaining:SEQuence:SKP:SLENgth:8B10B <numeric>

Parameter	<numeric>=<NR1 NUMERIC PROGRAM DATA>	
	1	COM + 1 symbol
	2	COM + 2 symbols
	3	COM + 3 symbols
	4	COM + 4 symbols
	5	COM + 5 symbols
Function	Sets the number of SKP symbols to be inserted by SKP Ordered Set for 8b/10b encoding.	
Example	To set the number of SKP OS SKP symbols to 3:	

```
>:LTRaining:SEQuence:SKP:SLENgth:8B10B 3
```

:LTRaining:SEQuence:SKP:SLENgth:8B10B?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA> 1, 2, 3, 4, 5
Function	Queries the number of SKP symbols to be inserted by SKP Ordered Set for 8b/10b encoding.
Example	

```
> :LTRaining:SEQuence:SKP:SLENgth:8B10B?
< 3
```

:LTRaining:SEQuence:SKP:INTerval:8B10B <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	80 to 3076	80 to 3076, 2 step
Function	Sets the interval for SKP Ordered Set occurring during link sequence execution for 8b/10b encoding.	
Example	To generate an SKP OS once after every 1538 symbols sent:	

```
>:LTRaining:SEQuence:SKP:INTerval:8B10B 1538
```

:LTRaining:SEQuence:SKP:INTerval:8B10B?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	80 to 3076	80 to 3076, 2 step
Function	Queries the interval for SKP Ordered Set occurring during link sequence execution for 8b/10b encoding.	
Example		

```
>:LTRaining:SEQuence:SKP:INTerval:8B10B?
< 1538
```

:LTRaining:SEQuence:SKP:DOUBle:8B10B <boolean>

Parameter

<boolean>=<BOOLEAN PROGRAM DATA>

OFF or 0	Double SKP OS not inserted.
ON or 1	Double SKP OS inserted.

Function

Selects whether to insert double SKP OS while transmitting a test pattern with 8b/10b encoding and in Loopback.Active state.

This parameter is available only when SI PPG is installed.

Example

To insert double SKP OS.

```
> :LTRaining:SEQuence:DOUBle:8B10B 1
```

:LTRaining:SEQuence:SKP:DOUBle:8B10B?

Response

<numeric>=<NR1 NUMERIC RESPONSE DATA>

0	Double SKP OS not inserted.
1	Double SKP OS inserted.

Function

Queries whether to insert double SKP OS while transmitting a test pattern with 8b/10b encoding and in Loopback.Active state.

This parameter is available only when SI PPG is installed.

Example

```
> :LTRaining:SEQuence:DOUBle:8B10B?
< 1
```

:LTRaining:SEQuence:SKP:SLENgth:128B130B <numeric>

Parameter

<numeric>=<DECIMAL NUMERIC PROGRAM DATA>

8	8 Symbols
12	12 Symbols
16	16 Symbols
20	20 Symbols
24	24 Symbols

Function

Sets the number of SKP symbols to be inserted by SKP Ordered Set for 128b/130b encoding.

Example

To set the number of SKP OS SKP symbols to 8:

```
> :LTRaining:SEQuence:SKP:SLENgth:128B130B 8
```

:LTRaining:SEQuence:SKP:SLENgth:128B130B?

Response

<numeric>=<NR1 NUMERIC RESPONSE DATA>

8, 12, 16, 20, 24

Function

Queries the number of SKP symbols to be inserted by SKP Ordered Set for 128b/130b encoding.

Example

```
> :LTRaining:SEQuence:SKP:SLENgth:128B130B?
< 8
```

:LTRaining:SEQuence:SKP:INTerval:128B130B <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	20 to 750	20 to 750, 1 step
Function	Sets the interval for SKP Ordered Set occurring during link sequence execution for 128b/130b encoding.	
Example	To generate an SKP OS once after every 375 blocks sent: `>:LTRaining:SEQuence:SKP:INTerval:128B130B 375`	

:LTRaining:SEQuence:SKP:INTerval:128B130B?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	20 to 750	20 to 750
Function	Queries the interval for SKP Ordered Set occurring during link sequence execution for 128b/130b encoding.	

Example	`>:LTRaining:SEQuence:SKP:INTerval:128b130b?`
	`< 375`	

:LTRaining:SEQuence:SKP:DOUBle:128B130B <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	Double SKP OS not inserted.
	ON or 1	Double SKP OS inserted.
Function	Selects whether to insert double SKP OS while transmitting a test pattern with 128b/130b encoding and in Loopback.Active state. This parameter is available only when SI PPG is installed.	
Example	To insert double SKP OS. `> :LTRaining:SEQuence:DOUBle:128B130B 1`	

:LTRaining:SEQuence:SKP:DOUBle:128B130B?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Double SKP OS not inserted.
	1	Double SKP OS inserted.
Function	Queries whether to insert double SKP OS while transmitting a test pattern with 128b/130b encoding and in Loopback.Active state. This parameter is available only when SI PPG is installed.	

Example	`> :LTRaining:SEQuence:DOUBle:128B130B?`
	`< 1`	

:LTRaining:SEQuence:PACTive:TS <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0	Transmits TS1 Ordered Set.
	1	Transmits EQ TS1 Ordered Set.
Function	Selects the type of TS transmitted for Polling.Active State.	
Example	To set the TS to be transmitted for Polling.Active State to TS1 Ordered Set:	

```
> :LTRaining:SEQuence:PACTive:TS 0
```

:LTRaining:SEQuence:PACTive:TS?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Transmits TS1 Ordered Set.
	1	Transmits EQ TS1 Ordered Set.
Function	Queries the type of TS transmitted for Polling.Active State.	
Example		

```
> :LTRaining:SEQuence:PACTive:TS?
< 0
```

:LTRaining:SEQuence:LENTry:TS <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	0	Transmits TS1 Ordered Set.
	1	Transmits EQ TS1 Ordered Set.
Function	Selects the type of TS transmitted for Loopback.Entry State.	
Example	To set the TS to be transmitted for Loopback.Entry State to TS1 Ordered Set:	

```
> :LTRaining:SEQuence:LENTry:TS 0
```

:LTRaining:SEQuence:LENTry:TS?

Response	<type>=<CHARACTER RESPONSE DATA>	
	0	Transmits TS1 Ordered Set.
	1	Transmits EQ TS1 Ordered Set.
Function	Queries the type of TS transmitted for Polling.Active State.	
Example		

```
> :LTRaining:SEQuence:LENTry:TS?
< 0
```

:LTRaining:SEQuence:TXPReset:LPReset <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA> 0 Auto 1 Manual
Function	Sets whether to change manually the Preset value to be used in Loopback.Active state. This parameter is available only when SI PPG is installed.

Example	`> :LTRaining:SEQuence:LENTry:TS?`
	To set manually the Preset value to be used in Loopback.Active state.
	`> :LTRaining:SEQuence:TXPReset:LPReset 1`

:LTRaining:SEQuence:TXPReset:LPReset?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA> 0 Auto 1 Manual
Function	Queries whether to change manually the Preset value to be used in Loopback.Active state. This parameter is available only when SI PPG is installed.

Example	`> :LTRaining:SEQuence:LENTry:TS?`
	`> :LTRaining:SEQuence:TXPReset:LPReset?`
	`< 1`

:LTRaining:SEQuence:TXPReset:LPReset:PRESet <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA> 0 to 10 P0 to P10, 1 step
Function	Sets the Preset value to be used in Loopback.Active state. This parameter is available only when SI PPG is installed.
Example	To set the Preset value to P7. `> :LTRaining:SEQuence:TXPReset:LPReset:PRESet 7`

:LTRaining:SEQuence:TXPReset:LPReset:PRESet?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA> 0 to 10 P0 to P10
Function	Queries the Preset value to be used in Loopback.Active state.

Example	`> :LTRaining:SEQuence:TXPReset:LPReset:PRESet?`
	`< 7`

:LTRaining:SEQuence:TXPReset:IPReset <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0 to 10	P0 to P10, 1 step
Function	Sets the Preset value to use at the sequence start (2.5 GT/s transmission). This parameter is available only when SI PPG is installed.	
Example	To set the Preset value to P7. `> :LTRaining:SEQuence:TXPReset:IPReset 7`	

:LTRaining:SEQuence:TXPReset:IPReset?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0 to 10	P0 to P10
Function	Queries the Preset value to use at the sequence start (2.5 GT/s transmission).	

Example	`> :LTRaining:SEQuence:TXPReset:IPReset?`
	`< 7`	

:LTRaining:SEQuence:REV2:DEMPhasis <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	–6.0	–6.0 dB
	–3.5	–3.5 dB
Function	Sets De-emphasis for PCIe 2.0 operation. This parameter is available only when SI PPG is installed.	
Example	To set De-emphasis to –6.0 dB. `> :LTRaining:SEQuence:REV2:DEMPhasis -6.0`	

:LTRaining:SEQuence:REV2:DEMPhasis?

Response	<numeric>=<NR2 NUMERIC RESPONSE DATA> –6.0, –3.5
Function	Queries De-emphasis for PCIe 2.0 operation. This parameter is available only when SI PPG is installed.

Example	`> :LTRaining:SEQuence:REV2:DEMPhasis?`
	`< -6.0`

:LTRaining:SEQuence:REV3:DSTReam:PRESet <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0 to 10	P0 to P10, 1 step
Function	Sets the Preset value that is notified to DUT and used by SI PPG in PCIe 3.0 operation. This parameter is available only when SI PPG is installed.	
Example	To set the Preset value to P7.	

```
> :LTRaining:SEQuence:REV3:DSTReam:PRESet 7
```

:LTRaining:SEQuence:REV3:DSTReam:PRESet?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0 to 10	P0 to P10
Function	Queries the Preset value that is notified to DUT and used by SI PPG in PCIe 3.0 operation.	
Example		

```
> :LTRaining:SEQuence:REV3:DSTReam:PRESet?
< 7
```

:LTRaining:SEQuence:REV3:USTReam:PRESet <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0 to 10	P0 to P10, 1 step
Function	Sets the Preset value that is notified to DUT and used by SI PPG in PCIe 3.0 operation. This parameter is available only when SI PPG is installed.	
Example	To set the Preset value to P7.	

```
> :LTRaining:SEQuence:REV3:USTReam:PRESet 7
```

:LTRaining:SEQuence:REV3:USTReam:PRESet?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0 to 10	P0 to P10
Function	Queries the Preset value that DUT is requested for in PCIe 3.0 operation.	
Example		

```
> :LTRaining:SEQuence:REV3:USTReam:PRESet?
< 7
```

:LTRaining:SEQuence:REV3:DSTReam:HPRESet <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	–12 to –6	–12 to –6 dB, 1 step
Function	Sets the Preset Hint value that is notified to DUT in PCIe 3.0 operation. This parameter is available only when SI PPG is installed.	
Example	To set Preset Hint to –10 dB. `> :LTRaining:SEQuence:REV3:DSTReam:HPRESet -10`	

:LTRaining:SEQuence:REV3:DSTReam:HPRESet?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	–12 to –6	–12 to –6 dB
Function	Queries the Preset Hint value that is notified to DUT in PCIe 3.0 operation.	

Example	`> :LTRaining:SEQuence:REV3:DSTReam:HPRESet?`
	`< -10`	

:LTRaining:SEQuence:REV3:USTReam:HPRESet <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	–12 to –6	–12 to –6 dB, 1 step
Function	Sets the Preset Hint value that is notified to DUT in PCIe 3.0 operation. This parameter is available only when SI PPG is installed.	
Example	To set Preset Hint to –10 dB. `> :LTRaining:SEQuence:REV3:USTReam:HPRESet -10`	

:LTRaining:SEQuence:REV3:USTReam:HPRESet?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	–12 to –6	–12 to –6 dB
Function	Queries the Preset value that DUT is requested for in PCIe 3.0 operation.	

Example	`> :LTRaining:SEQuence:REV3:USTReam:HPRESet?`
	`< -10`	

:LTRaining:SEQuence:REV4:DSTReam:PRESet <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0 to 10	P0 to P10, 1 step
Function	Sets the Preset value that is notified to DUT and used by SI PPG in PCIe 4.0 operation. This parameter is available only when SI PPG is installed.	
Example	To set the Preset value to P7.	

```
> :LTRaining:SEQuence:REV4:DSTReam:PRESet 7
```

:LTRaining:SEQuence:REV4:DSTReam:PRESet?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0 to 10	P0 to P10
Function	Queries the Preset value that is notified to DUT and used by SI PPG in PCIe 4.0 operation.	
Example		

```
> :LTRaining:SEQuence:REV4:DSTReam:PRESet?
< 7
```

:LTRaining:SEQuence:REV4:USTReam:PRESet <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0 to 10	P0 to P10, 1 step
Function	Sets the Preset value that is notified to DUT in PCIe 4.0 operation. This parameter is available only when SI PPG is installed.	
Example	To set the Preset value to P7.	

```
> :LTRaining:SEQuence:REV4:USTReam:PRESet 7
```

:LTRaining:SEQuence:REV4:USTReam:PRESet?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0 to 10	P0 to P10
Function	Queries the Preset value that DUT is requested for in PCIe 4.0 operation.	
Example		

```
> :LTRaining:SEQuence:REV4:USTReam:PRESet?
< 7
```

:INPut:DATA:EQUalizer:AMPLitude <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	–12 to 0	–12 to 0 dB, 1 step
Function	Sets CTLE Gain to be used in PCIe 3.0 or PCIe 4.0 operation. This parameter is available only when SI ED (with MU195040A-x11/x21) is installed.	
Example	To set CTLE Gain to –8 dB.	

```
> :INPut:DATA:EQUalizer:AMPLitude -8
```

:INPut:DATA:EQUalizer:AMPLitude?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	–12 to 0	–12 to 0 dB, 1 step
Function	Queries CTLE Gain to be used in PCIe 3.0 or PCIe 4.0 operation. This parameter is available only when SI ED (with MU195040A-x11/x21) is installed.	

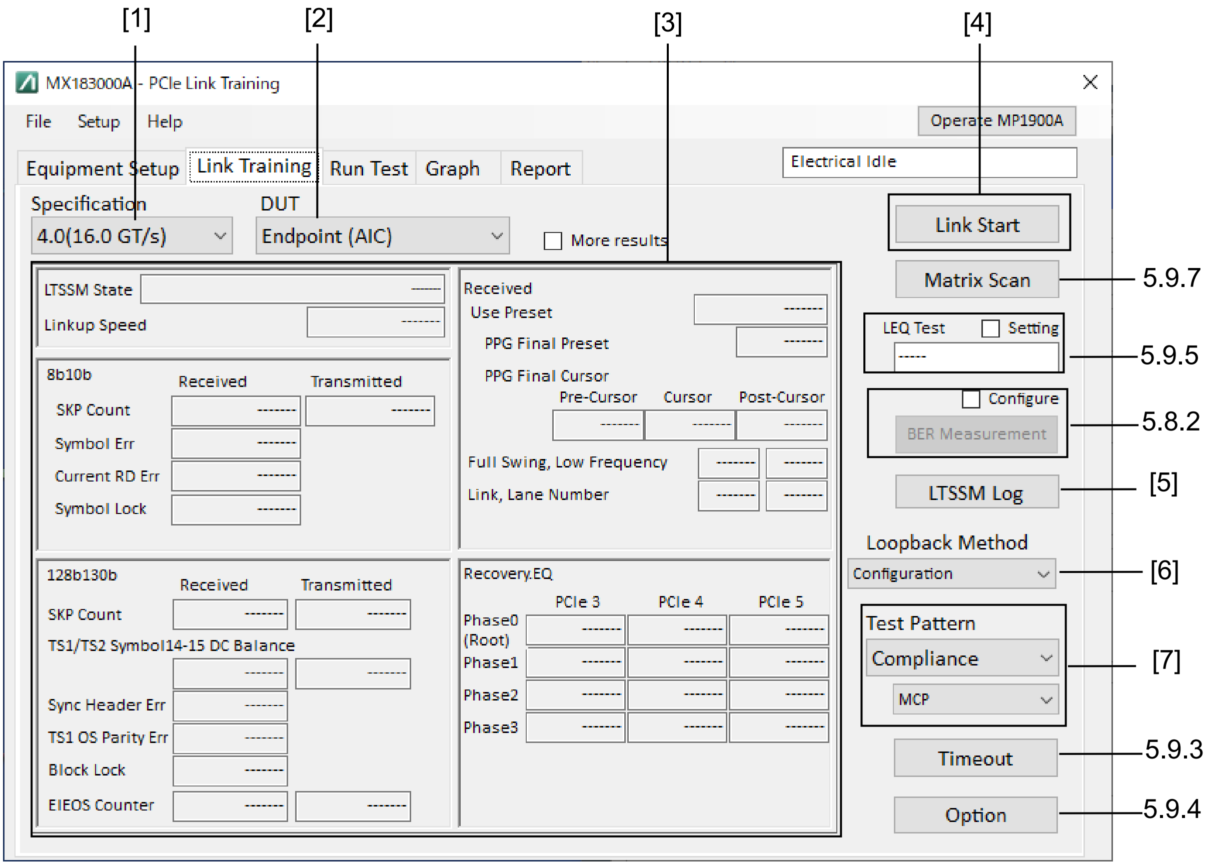
Example

```
> :INPut:DATA:EQUalizer:AMPLitude?
< -8
```

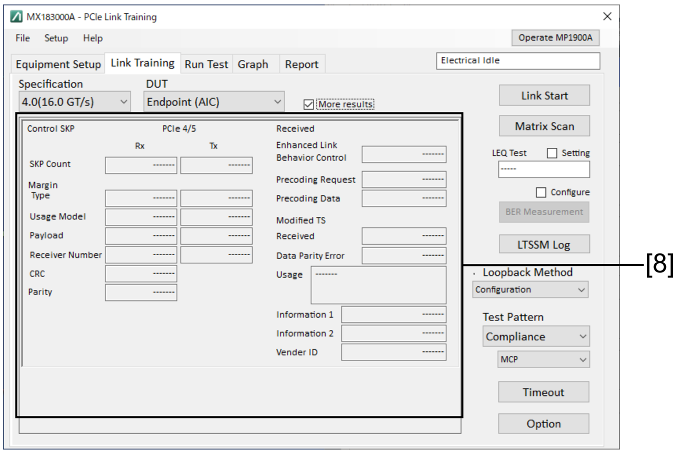
5.9 PCIe Link Training Setup Screen (With MX183000A-PL021 Installed)

This setup screen is available only when MX183000A-PL021 is installed, when **PCIe Link Training** is started on the Figure 4.3.1-1 “Selector Screen”, and when the SQA has been connected using Equipment Setup.

5.9.1 Link Training screen



Specification: 4.0(16.0 GT/s)
DUT: Endpoint (AIC)
Electrical Idle
LEQ Test: -----
Loopback Method: Configuration
Test Pattern: Compliance
MCP



Specification: 4.0(16.0 GT/s)
DUT: Endpoint (AIC)
Electrical Idle
LEQ Test: -----
Loopback Method: Configuration
Test Pattern: Compliance
MCP

Figure 5.9.1-1 Link Training Screen

Table 5.9.1-1 Training Setting Items and Result Query Commands

No.	Setting Item	Command
[1]	Specification	:LTRaining:SEQuence:SPECification
		:LTRaining:SEQuence:SPECification?
[2]	DUT	:LTRaining:SEQuence:DUT
		:LTRaining:SEQuence:DUT?
[3]	Training Result	:LTRaining:SEQuence:RESult?
[4]	Sequence Start	:LTRaining:SEQuence:STARt
	Sequence Stop	:LTRaining:SEQuence:STOP
	Sequence State	:LTRaining:SEQuence:STATe?
[5]	LTSSM Log	:LTRaining:SEQuence:LTSSm:LOG:STARt
		:LTRaining:SEQuence:LTSSm:LOG:STOP
		:LTRaining:SEQuence:LTSSm:LOG:STATe?
		:LTRaining:SEQuence:LTSSm:LOG:GATing?
		:LTRaining:SEQuence:LTSSm:LOG:EXPort
[6]	Loopback Method	:LTRaining:SEQuence:LTHRough
		:LTRaining:SEQuence:LTHRough?
[7]	Test Pattern	:SOURce:PATTern:TYPE
		:SOURce:PATTern:TYPE?
		:LTRaining:SEQuence:TEST:PATTern
		:LTRaining:SEQuence:TEST:PATTern?
		:SOURce:PATTern:PRBS:LENGth
		:SOURce:PATTern:PRBS:LENGth?
[8]	Training Result (More results)	:LTRaining:SEQuence:RESult:CSKP?
	Enhanced Link Behavior Control	:LTRaining:SEQuence:RESult:ELBC?
	Precoding	:LTRaining:SEQuence:RESult:PCODing?
	Modified TS	:LTRaining:SEQuence:RESult:MTS?

:LTRaining:SEQuence:STARt

Parameter	None
Function	Starts transmitting a link training sequence for looping back DUT. Once the transmission is complete, the pattern selected by Test Pattern is sent.
Example	`> :LTRaining:SEQuence:STARt`

:LTRaining:SEQuence:STOP

Parameter	None
Function	Stops transmitting link training sequence and test pattern and sets to Electrical Idle.
Example	`> :LTRaining:SEQuence:STOP`

:LTRaining:SEQuence:STATe?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Stop
	1	Sending
	2	Sending test pattern
Function	Queries the link training sequence transmission status.	

Example	`> :LTRaining:SEQuence:STATe?`
	`< 1`	

:LTRaining:SEQuence:SPECification <type>

Parameter <type>=<CHARACTER PROGRAM DATA>

REV1	Revision1.0/1.1
REV2	Revision2.0
REV3	Revision3.0/3.1
REV4	Revision4.0
REV5	Revision5.0

Function Selects the environment (revision) to loopback the DUT (Revision).

Example To set the environment to REV4(16.0 GT/s):

```
> :LTRaining:SEQuence:SPECification REV4
```

Note:

The clock frequency input to MU181500B must be changed by the user when MU181000A/B is not installed.

:LTRaining:SEQuence:SPECification?

Response <type>=<CHARACTER RESPONSE DATA>

REV1, REV2, REV3, REV4, REV5

Function Queries the environment to loopback the DUT.

Example

```
> :LTRaining:SEQuence:SPECification?
< REV4
```

:LTRaining:SEQuence:LTHRough <type>

Parameter <type>=<CHARACTER PROGRAM DATA>

CONFiguration	Configuration route (PCIe 1.0/1.1 to PCIe 4.0)
RECovery	Recovery route (PCIe 2.0 to PCIe 4.0)
BCONfiguration	Config 32G Bypass EQ (PCIe 5.0)
ECONfiguration	Config 32G No EQ (PCIe 5.0)
BRECovery	Recovery 32G Bypass EQ (PCIe 5.0)
FRECovery	Recovery 32G Full EQ (PCIe 5.0)

Function Select the LTSSM route to loopback the DUT. Available parameters vary depending on the specification.

Example To set the state route to Configuration route:

```
> :LTRaining:SEQuence:LTHRough CONFiguration
```

:LTRaining:SEQuence:LTHRough?

Response <type>=<CHARACTER RESPONSE DATA>

REC, CONF, BCON, ECON, BREC, FREC

Function Queries the LTSSM route to loopback the DUT.

Example

```
> :LTRaining:SEQuence:LTHRough?
< CONF
```

:SOURce:PATTern:TYPE <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	COMPliance	Compliance pattern
	PRBS	PRBS pattern
Function	Selects the test pattern to be sent after completing the link training sequence transmission.	
Example	To set the test pattern to Compliance Pattern:	

```
> :SOURce:PATTern:TYPE COMPliance
```

:SOURce:PATTern:TYPE?

Response <type>=<CHARACTER RESPONSE DATA>

COMP, PRBS

Function Queries the test pattern to be sent after completing the link training sequence transmission.

Example

```
> :SOURce:PATTern:TYPE?
< COMP
```

:LTRaining:SEQuence:TEST:PATTern <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	CP	Compliance Pattern
	MCP	Modified Compliance Pattern
	JTMP	Jitter Tolerance Measurement Pattern*

*: This parameter can be set when SI PPG or PAM4 PPG is installed and Rev. 3.x or higher is selected.

Function Selects the type of Compliance Pattern to be sent when test pattern “:SOURce:PATTern:TYPE” is set to Compliance

Example

```
> :LTRaining:SEQuence:TEST:PATTern CP
```

:LTRaining:SEQuence:TEST:PATTern?

Response	<type>=<CHARACTER RESPONSE DATA>	
	CP	Compliance Pattern
	MCP	Modified Compliance Pattern
	JTMP	Jitter Tolerance Measurement Pattern

Function Queries the type of Compliance Pattern to be sent.

Example

```
> :LTRaining:SEQuence:TEST:PATTern?
< CP
```

:SOURce:PATTern:PRBS:LENGth <numeric>

Parameter

<numeric>=<DECIMAL NUMERIC PROGRAM DATA>

7	2^n-1 (n=7)
9	2^n-1 (n=9)
10	2^n-1 (n=10)
11	2^n-1 (n=11)
15	2^n-1 (n=15)
20	2^n-1 (n=20)
23	2^n-1 (n=23)
31	2^n-1 (n=31)

Function

Sets the number of stages (2^n-1 (n=7, 9, 10, 11, 15, 20, 23, or 31)) for PRBS pattern reception.

Example

To set the number of stages for PRBS pattern reception to 2^7-1:

```
> :SOURce:PATTern:PRBS:LENGth 7
```

:SOURce:PATTern:PRBS:LENGth?

Response

<numeric>=<NR1 NUMERIC RESPONSE DATA>

7, 9, 10, 11, 15, 20, 23, 31

Function

Queries the number of stages for PRBS pattern reception.

Example

```
> :SOURce:PATTern:PRBS:LENGth?
< 7
```

:LTRaining:SEQuence:DUT <type>

Parameter

<type>=<CHARACTER PROGRAM DATA>

END	End Point
ROOT	Root Complex

Function

Selects the DUT type.

Example

To set the DUT to End Point.

```
> :LTRaining:SEQuence:DUT END
```

:LTRaining:SEQuence:DUT?

Response

<type>=<CHARACTER RESPONSE DATA>

END, ROOT

Function

Queries the DUT type.

Example

```
> :LTRaining:SEQuence:DUT?
< END
```

:LTRaining:SEQuence:LTSSm:LOG:STARt

Parameter	None
Function	Starts acquiring LTSSM Log.
Example	`> :LTRaining:SEQuence:LTSSm:LOG:STARt`

:LTRaining:SEQuence:LTSSm:LOG:STOP

Parameter	None
Function	Aborts acquiring LTSSM Log.
Example	`> :LTRaining:SEQuence:LTSSm:LOG:STOP`

:LTRaining:SEQuence:LTSSm:LOG:EXPort <file_name>

Parameter	<file_name>=<STRING PROGRAM DATA>	
	"<drv>:\<dir1>\<dir2>\<file>"	
	<drv>=C, D, E, F	Drive name
	<dir>=xxxxxxxx	Directory name
	<file>=xxxxxxxxx	File name
Function	Stores LTSSM Log in CSV format specifying a file name and format.	
Example	To store LTSSM Log.	

```
>:LTRaining:SEQuence:LTSSm:LOG:EXPort
"D:\test_folder\test.csv"
```

:LTRaining:SEQuence:LTSSm:LOG:STATe?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Stop
	1	Acquiring Log
Function	Queries the status of log acquisition.	
Example		

```
> :LTRaining:SEQuence:STATe?
< 1
```

:LTRaining:SEQuence:LTSSm:LOG:GATing?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0 to 100	0 to 100%
Function	Queries the progress of log acquisition.	
Example		

```
> :LTRaining:SEQuence:LTSSm:LOG:GATing?
< 1
```

:LTRaining:SEQuence:RESult? <type>

Parameter < type>=<CHARACTER PROGRAM DATA>

STATe	LTSSM State
LSPeed	Linkup Speed
TXSCount	SKP Count Tx
RXSCount	SKP Count Rx
SERR	Symbol Err
CRERr	Current RD Err
SLOCk	Symbol Lock
TXDC	DC Balance Tx
RXDC	DC Balance Rx
SHERr	Sync Header Err
PERR	Parity Err
BLOCk	Block Lock
LERequest	Link Eq Request
LEPhase0	Link Eq Phase0
LEPhase1	Link Eq Phase1
LEPhase2	Link Eq Phase2
LEPhase3	Link Eq Phase3
UPReset	Use Preset
TXPReset	PPG Final Preset
PRECursor	PPG Final Pre-Cursor
CURSor	PPG Final Cursor
POSTcursor	PPG Final Post-Cursor
RFSWing	Full Swing
RLFRequency	Low Frequency
RLINk	Link Number
RLANe	Lane Number
RREQualization	Root Complex Request Equalization
RXEIeos	Rx EIEOS Counter
TXEIeos	Tx EIEOS Counter

Response <string>=<STRING RESPONSE DATA>

Function Queries the measurement data of the desired parameter.

Example

```
> :LTRaining:SEQuence:RESult? STATe
< Loopback.Active.Master
```

:LTRaining:SEQuence:RESult:CSKP? <type>

Parameter

<type>=<CHARACTER RESPONSE DATA>

TXCount	Control SKP Count Tx
RXCount	Control SKP Count Rx
TXMType	Control SKP Margin Type Tx
RXMType	Control SKP Margin Type Rx
TXUModel	Control SKP Usage Model Tx
RXUModel	Control SKP Usage Model Rx
TXPayload	Control SKP Payload Tx
RXPayload	Control SKP Payload Rx
TXRNumber	Control SKP Receiver Number Tx
RXRNumber	Control SKP Receiver Number Rx
CRC	Control SKP CRC
PARity	Control SKP Parity

Response

<type>=<CHARACTER RESPONSE DATA>

Function

Queries the measurement data related to the Control SKP parameters.

Example

```
> :LTRaining:SEQuence:RESult:CSKP? TXCount
< 100
```

:LTRaining:SEQuence:RESult:ELBC?

Parameter

None

Response

<type>=<CHARACTER RESPONSE DATA>

00	Full Equalization required
01	Equalization bypass to highest rate support
10	No Equalization Needed
11	Modified TS1/TS2 Ordered Sets supported

Function

Queries the Enhanced Link Behavior Control value.

Example

```
> :LTRaining:SEQuence:RESult:ELBC?
< 00
```

:LTRaining:SEQuence:RESult:PCODing? <type>

Parameter

<type>=<CHARACTER PROGRAM DATA>

REQuest	Precoding Request
DATA	Precoding Data

Response

<type>=<CHARACTER RESPONSE DATA>

Function

Queries the measurement data related to the Precoding parameter.

Example

```
> :LTRaining:SEQuence:RESult:PCODing? DATA
< 1
```

:LTRaining:SEQuence:RESult:MTS? <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	RECeived	Received Number
	PARity	Data Parity Error
	USAGe	Usage
	INF1	Information 1
	INF2	Information 2
	VENDer	Vender ID
Response	<type>=<CHARACTER RESPONSE DATA>	
	Decimal number	Value of the specified parameter obtained from the DUT
	- (hyphen)	Returned if no value is obtained from the DUT yet.
	For explanation of numeric responses, refer to Modified TS in “Table 4.8.4-1 PCIe Link Training Results”.	
Function	Queries the measurement data related to the Modified TS parameter.	

Example	`> :LTRaining:SEQuence:RESult:MTS? RECeived`
	`< 100`	

5.9.2 BER Measurement screen

For explanation of [1] to [8], refer to 5.8.2 “BER Measurement ”.

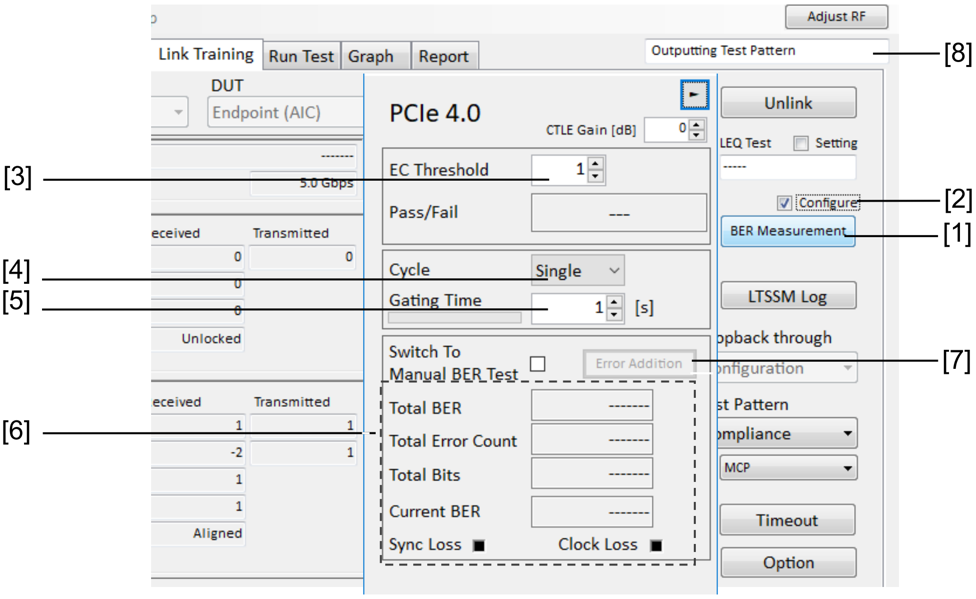


Figure 5.9.2-1 BER Measurement Screen

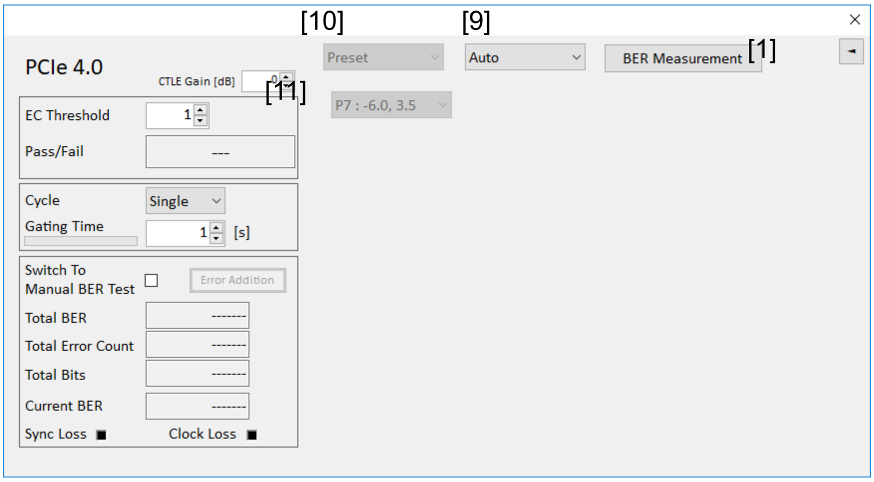
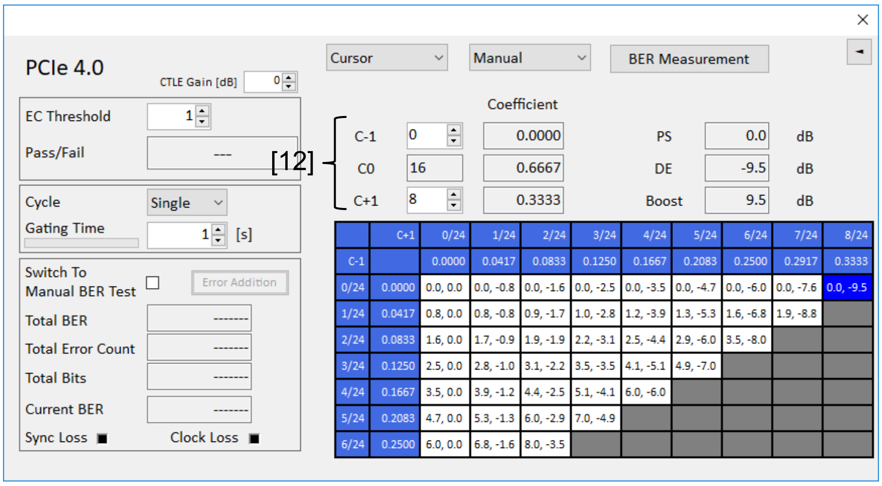


Figure 5.9.2-2 Equalization Setup Screen (Preset)



CTLE Gain [dB] 0

EC Threshold 1

Pass/Fail ---

Cycle Single

Gating Time 1 [s]

Switch To Manual BER Test ☐

Total BER -------

Total Error Count -------

Total Bits -------

Current BER -------

Sync Loss ■ Clock Loss ■

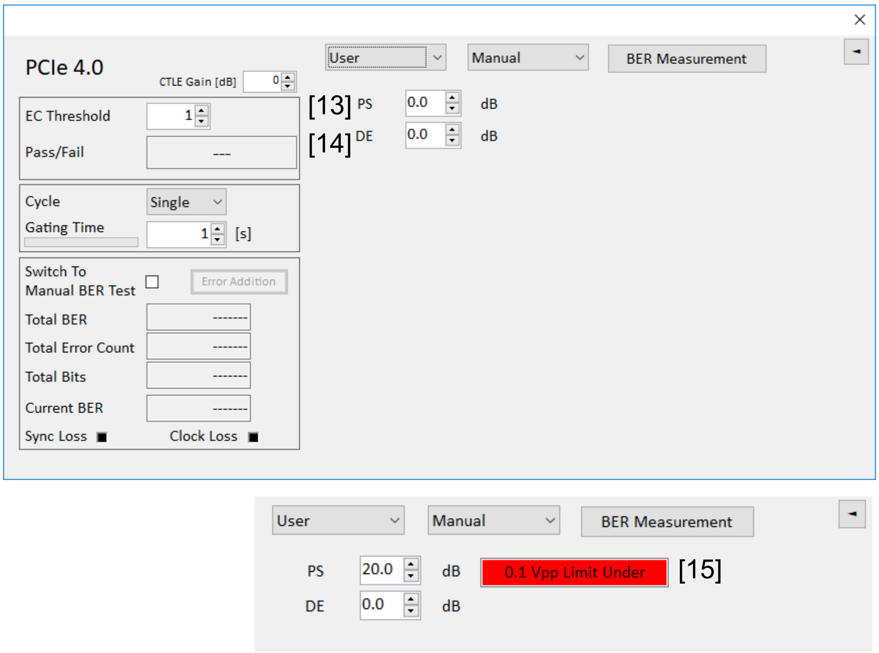
C-1 0 0.0000 PS 0.0 dB

C0 16 0.6667 DE -9.5 dB

C+1 8 0.3333 Boost 9.5 dB

	C+1	0/24	1/24	2/24	3/24	4/24	5/24	6/24	7/24	8/24
C-1		0.0000	0.0417	0.0833	0.1250	0.1667	0.2083	0.2500	0.2917	0.3333
0/24	0.0000	0.0, 0.0	0.0, -0.8	0.0, -1.6	0.0, -2.5	0.0, -3.5	0.0, -4.7	0.0, -6.0	0.0, -7.6	0.0, -9.5
1/24	0.0417	0.8, 0.0	0.8, -0.8	0.9, -1.7	1.0, -2.8	1.2, -3.9	1.3, -5.3	1.6, -6.8	1.9, -8.8	
2/24	0.0833	1.6, 0.0	1.7, -0.9	1.9, -1.9	2.2, -3.1	2.5, -4.4	2.9, -6.0	3.5, -8.0		
3/24	0.1250	2.5, 0.0	2.8, -1.0	3.1, -2.2	3.5, -3.5	4.1, -5.1	4.9, -7.0			
4/24	0.1667	3.5, 0.0	3.9, -1.2	4.4, -2.5	5.1, -4.1	6.0, -6.0				
5/24	0.2083	4.7, 0.0	5.3, -1.3	6.0, -2.9	7.0, -4.9					
6/24	0.2500	6.0, 0.0	6.8, -1.6	8.0, -3.5						

Figure 5.9.2-3 Equalization Setup Screen (Cursor)



CTLE Gain [dB] 0

EC Threshold 1

Pass/Fail ---

Cycle Single

Gating Time 1 [s]

Switch To Manual BER Test ☐

Total BER -------

Total Error Count -------

Total Bits -------

Current BER -------

Sync Loss ■ Clock Loss ■

PS 0.0 dB

DE 0.0 dB

User Manual BER Measurement

PS 20.0 dB 0.1 Vpp Limit Under

DE 0.0 dB

Figure 5.9.2-4 Equalization Setup Screen (User)

Table 5.9.2-1 Equalization Setting and Query Commands

No.	Setting Item	Command
[9]	Tx Equalization for Loopback.Active State (Auto/Manual)	:LTRaining:SEQuence:TXPReset:LPReset
		:LTRaining:SEQuence:TXPReset:LPReset?
[10]	Equalization for Loopback.Active State	:LTRaining:SEQuence:TXPReset:SELect
		:LTRaining:SEQuence:TXPReset:SELect?
[11]	Preset	:LTRaining:SEQuence:TXPReset:LPReset:PRESet
		:LTRaining:SEQuence:TXPReset:LPReset:PRESet?
[12]	Cursor	:LTRaining:SEQuence:TXCursor
		:LTRaining:SEQuence:TXCursor?
[13]	PS (Pre-Shoot)	:LTRaining:SEQuence:TXPReset:PSHoot
		:LTRaining:SEQuence:TXPReset:PSHoot?
[14]	DE (De-Emphasis)	:LTRaining:SEQuence:TXPReset:DEMPhasis
		:LTRaining:SEQuence:TXPReset:DEMPhasis?
[15]	Alarm	:SOURce:EMPHasis:EALarm?
-	CDR Tune	:LTRaining:SEQuence:ATUNe
		:LTRaining:SEQuence:ATUNe:RESet
		:LTRaining:SEQuence:ATUNe:STATe?

:LTRaining:SEQuence:TXPReset:LPReset <numeric>

Parameter
<numeric>=<DECIMAL NUMERIC PROGRAM DATA>

0	Auto
1	Manual

Function
Sets whether to manually switch Equalization to be used in Loopback.Active state.

Example
To manually set Equalization to be used in Loopback.Active state:

```
> :LTRaining:SEQuence:TXPReset:LPReset 1
```

:LTRaining:SEQuence:TXPReset:LPReset?

Response
<numeric>=<NR1 NUMERIC RESPONSE DATA>

0	Auto
1	Manual

Function
Queries whether to manually switch Equalization to be used in Loopback.Active state.

Example

```
> :LTRaining:SEQuence:TXPReset:LPReset?
< 1
```

:LTRaining:SEQuence:TXPReset:SELect <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	PRESet	Sets Equalization mode to Preset.
	CURSor	Sets Equalization mode to Cursor.
	USER	Sets Equalization mode to User, which enables Equalization to be set in dB.
Function	Sets PPG's Equalization mode to Preset.	

Example

```
> :LTRaining:SEQuence:TXPReset:SELect PRESet
```

:LTRaining:SEQuence:TXPReset:SELect?

Response	<type>=<CHARACTER PROGRAM DATA>	
	PRES	Sets Equalization mode to Preset.
	CURS	Sets Equalization mode to Cursor.
	USER	Sets Equalization mode to User, which enables Equalization to be set in dB.
Function	Queries PPG's Equalization mode.	

Example

```
> :LTRaining:SEQuence:TXPReset:SELect?
< PRES
```

:LTRaining:SEQuence:TXPReset:LPReset:PRESet <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0 to 10	P0 to P10, 1 step
Function	Sets the Preset value to be used in Loopback.Active state. This command is available when Preset is selected by :LTRaining:SEQuence:TXPReset:SELect.	

Example

To set the Preset value to P7:

```
> :LTRaining:SEQuence:TXPReset:LPReset:PRESet 7
```

:LTRaining:SEQuence:TXPReset:LPReset:PRESet?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0 to 10	P0 to P10
Function	Queries the Preset value to be used in Loopback.Active state. This command is available when Preset is selected by :LTRaining:SEQuence:TXPReset:SELect.	

Example

```
> :LTRaining:SEQuence:TXPReset:LPReset:PRESet?
< 7
```

:LTRaining:SEQuence:TXCursor <type>,<number>

Parameter	<type>=<CHARACTER PROGRAM DATA>

C–1	Sets the Cursor value for C–1.
C+1	Sets the Cursor value for C+1.

<number>=<DECIMAL NUMERIC PROGRAM DATA>

0 to 8 Cursor 0 to 8

Note:

The maximum values for C–1 and C+1 are respectively 6 and 8, and each of them depends on the setting of the other. For the setting ranges, refer to "Figure 5.9.2-3 Equalization Setup Screen (Cursor)".

Function

Sets the Cursor value to be used in Loopback.Active state.
This command is available when Cursor is selected by :LTRaining:SEQuence:TXPReset:SELect.

Example

To set C–1 to 1 and C+1 to 6:

```
> :LTRaining:SEQuence:TXCursor C-1,1
> :LTRaining:SEQuence:TXCursor C+1,6
```

:LTRaining:SEQuence:TXCursor? <type>

Parameter

<type>=<CHARACTER PROGRAM DATA>

C–1	Queries the Cursor value of C–1.
C+1	Queries the Cursor value of C+1.

Note:

The maximum values for C–1 and C+1 are respectively 6 and 8. Also, they are affected by the settings of C–1 and C+1. For the setting ranges, refer to "Figure 5.9.2-3 Equalization Setup Screen (Cursor)".

Response

<numeric>=<NR1 NUMERIC RESPONSE DATA>

0 to 8

Function

Queries the Cursor value to be used in Loopback.Active state.
This command is available when Cursor is selected by :LTRaining:SEQuence:TXPReset:SELect.

Example

To query the value set for C+1:

```
> :LTRaining:SEQuence:TXCursor? C+1
< 6
```

:LTRaining:SEQuence:TXPReset:PSHoot <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA> 0.0 to 20.0 0.0 to 20.0 dB, 0.1 dB step
Function	Sets the Pre-Shoot value (dB) to be used in Loopback.Active state. This command is available when User is selected by :LTRaining:SEQuence:TXPReset:SELect.
Example	To set the Pre-Shoot value to 3.5 dB: `> :LTRaining:SEQuence:TXPReset:PSHoot 3.5`

:LTRaining:SEQuence:TXPReset:PSHoot?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA> 0.0 to 20.0 0.0 to 20.0 dB
Function	Queries the Pre-Shoot value (dB) to be used in Loopback.Active state. This command is available when User is selected by :LTRaining:SEQuence:TXPReset:SELect.

Example	`> :LTRaining:SEQuence:TXPReset:PSHoot?`
	`< 3.5`

:LTRaining:SEQuence:TXPReset:DEMPhasis <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA> –20.0 to 0.0 –20.0 to 0.0 dB, 0.1 dB step
Function	Sets the Pre-Shoot value (dB) to be used in Loopback.Active state. This command is available when User is selected by :LTRaining:SEQuence:TXPReset:SELect.
Example	To set the Pre-Shoot value to –6.0 dB: `> :LTRaining:SEQuence:TXPReset:DEMPhasis -6.0`

:LTRaining:SEQuence:TXPReset:DEMPhasis?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA> –20.0 to 0.0 –20.0 to 0.0 dB
Function	Queries the Pre-Shoot value (dB) to be used in Loopback.Active state. This command is available when User is selected by :LTRaining:SEQuence:TXPReset:SELect.

Example	`> :LTRaining:SEQuence:TXPReset:DEMPhasis?`
	`< -6.0`

:SOURce:EMPHasis:EALarm?

Response	<sel> = <CHARACTER RESPONSE DATA>	
	PASS	The Emphasis parameters have integrity.
	L_OVER	1.5 Vpp Limit Over
	L_UNDER	0.1 Vpp Limit Under
	L_HW	Hardware Limit Over
Function	Queries whether the PPG's output amplitude is within the setting range of the emphasis peak voltage. This command is available when User is selected by :LTRaining:SEQuence:TXPReset:SELect.	

Example	`> :SOURce:EMPHasis:EALarm?`
	`< PASS`	

:LTRaining:SEQuence:ATUNe

Parameter	N/A
Function	Tunes the ED CDR Equalizer to the input signal.
Example of Use	`> :LTRaining:SEQuence:ATUNe`

:LTRaining:SEQuence:ATUNe:RESet

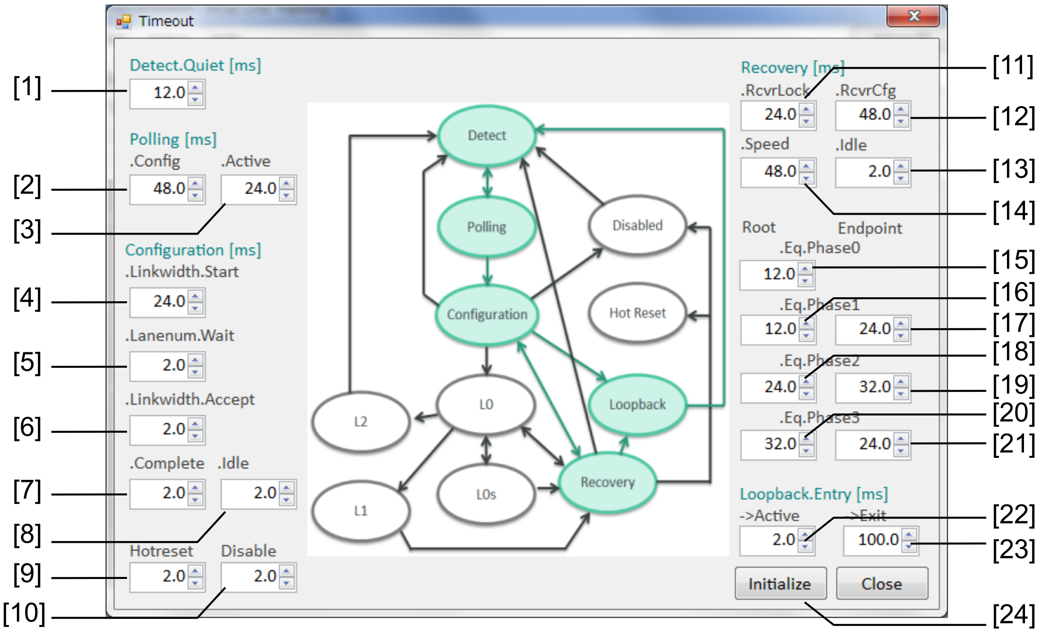
Parameter	N/A
Function	Initializes the ED CDR Equalizer.
Example of Use	`> :LTRaining:SEQuence:ATUNe:RESet`

:LTRaining:SEQuence:ATUNe:STATe?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	CDR in initial state
	1	CDR under auto tuning
	2	CDR optimized
Function	Queries the current state of the CDR auto tuning function.	

Example of Use	`> :LTRaining:SEQuence:ATUNe:STATe?`
	`< 2`	

5.9.3 Timeout screen



Detect.Quiet [ms]
12.0

Polling [ms]
.Config 48.0
.Active 24.0

Configuration [ms]
.Linkwidth.Start 24.0
.Lanenum.Wait 2.0
.Linkwidth.Accept 2.0
.Complete 2.0
.Idle 2.0

Hotreset 2.0
Disable 2.0

Recovery [ms]
.RcvrLock 24.0
.RcvrCfg 48.0
.Speed 48.0
.Idle 2.0

Root Endpoint
.Eq.Phase0 12.0
.Eq.Phase1 12.0 24.0
.Eq.Phase2 24.0 32.0
.Eq.Phase3 32.0 24.0

Loopback.Entry [ms]
->Active 2.0
->Exit 100.0

Figure 5.9.3-1 Timeout Setup Screen

Table 5.9.3-1 Training Timeout Setup Commands

No.	Setting Item	Command
[1]	Detect.Quiet	:LTRaining:SEQuence:TOUT:DQUiet
		:LTRaining:SEQuence:TOUT:DQUiet?
[2]	Polling.Config	:LTRaining:SEQuence:TOUT:POLLing:CONFiguration
		:LTRaining:SEQuence:TOUT:POLLing:CONFiguration?
[3]	Polling.Active	:LTRaining:SEQuence:TOUT:POLLing:ACTive
		:LTRaining:SEQuence:TOUT:POLLing:ACTive?
[4]	.Linkwidth.Start	:LTRaining:SEQuence:TOUT:CONFiguration:LSTart
		:LTRaining:SEQuence:TOUT:CONFiguration:LSTart?
[5]	.Lanenum.Wait	:LTRaining:SEQuence:TOUT:CONFiguration:LWAit
		:LTRaining:SEQuence:TOUT:CONFiguration:LWAit?
[6]	.Linkwidth.Accept	:LTRaining:SEQuence:TOUT:CONFiguration:LACCept
		:LTRaining:SEQuence:TOUT:CONFiguration:LACCept?
[7]	.Complete	:LTRaining:SEQuence:TOUT:CONFiguration:COMPlete
		:LTRaining:SEQuence:TOUT:CONFiguration:COMPlete?
[8]	.Idle	:LTRaining:SEQuence:TOUT:CONFiguration:IDLE
		:LTRaining:SEQuence:TOUT:CONFiguration:IDLE?

Table 5.9.3-1 Training Timeout Setup Commands (Cont'd)

No.	Setting Item	Command
[9]	Hotreset	:LTRaining:SEQuence:TOUT:HOTReset
		:LTRaining:SEQuence:TOUT:HOTReset?
[10]	Disable	:LTRaining:SEQuence:TOUT:DISable
		:LTRaining:SEQuence:TOUT:DISable?
[11]	.RcvrLock	:LTRaining:SEQuence:TOUT:RECovery:RLOCk
		:LTRaining:SEQuence:TOUT:RECovery:RLOCk?
[12]	.RcvrCfg	:LTRaining:SEQuence:TOUT:RECovery:RCFG
		:LTRaining:SEQuence:TOUT:RECovery:RCFG?
[13]	.Idle	:LTRaining:SEQuence:TOUT:RECovery:IDLE
		:LTRaining:SEQuence:TOUT:RECovery:IDLE?
[14]	.Speed	:LTRaining:SEQuence:TOUT:RECovery:SPEed
		:LTRaining:SEQuence:TOUT:RECovery:SPEed?
[15]	Root	:LTRaining:SEQuence:TOUT:RECovery:REQP0
	.Eq.Phase0	:LTRaining:SEQuence:TOUT:RECovery:REQP0?
[16]	Root	:LTRaining:SEQuence:TOUT:RECovery:REQP1
	.Eq.Phase1	:LTRaining:SEQuence:TOUT:RECovery:REQP1?
[17]	Endpoint	:LTRaining:SEQuence:TOUT:RECovery:EEQP1
	.Eq.Phase1	:LTRaining:SEQuence:TOUT:RECovery:EEQP1?
[18]	Root	:LTRaining:SEQuence:TOUT:RECovery:REQP2
	.Eq.Phase2	:LTRaining:SEQuence:TOUT:RECovery:REQP2?
[19]	Endpoint	:LTRaining:SEQuence:TOUT:RECovery:EEQP2
	.Eq.Phase2	:LTRaining:SEQuence:TOUT:RECovery:EEQP2?
[20]	Root	:LTRaining:SEQuence:TOUT:RECovery:REQP3
	.Eq.Phase3	:LTRaining:SEQuence:TOUT:RECovery:REQP3?
[21]	Endpoint	:LTRaining:SEQuence:TOUT:RECovery:EEQP3
	.Eq.Phase3	:LTRaining:SEQuence:TOUT:RECovery:EEQP3?
[22]	->Active	:LTRaining:SEQuence:TOUT:LBENtry:ACTive
		:LTRaining:SEQuence:TOUT:LBENtry:ACTive?
[23]	->Exit	:LTRaining:SEQuence:TOUT:LBENtry:EXIT
		:LTRaining:SEQuence:TOUT:LBENtry:EXIT?
[24]	Initialize Timeout	:LTRaining:SEQuence:TOUT:INITialize

:LTRaining:SEQuence:TOUT:DQUiet <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>
	6.0 to 24.0 6.0 to 24.0 ms, 0.1 ms
Function	Sets the timeout of Detect Quiet state.
Example	To set the timeout to 12.0 ms.
	`> :LTRaining:SEQuence:TOUT:DQUiet 12.0`

:LTRaining:SEQuence:TOUT:DQUiet?

Response	<numeric>=<NR2 NUMERIC RESPONSE DATA>
	6.0 to 24.0
Function	Queries the timeout of Detect Quiet state.
Example	`> :LTRaining:SEQuence:TOUT:DQUiet?`
	`< 12.0`

:LTRaining:SEQuence:TOUT:POLLing:CONFiguration <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>
	24.0 to 72.0 24.0 to 72.0 ms, 0.1 ms
Function	Sets the timeout of Polling.Configuration state.
Example	To set the timeout to 48.0 ms.
	`> :LTRaining:SEQuence:TOUT:POLLing:CONFiguration 48.0`

:LTRaining:SEQuence:TOUT:POLLing:CONFiguration?

Response	<numeric>=<NR2 NUMERIC RESPONSE DATA>
	24.0 to 72.0
Function	Queries the timeout of Polling.Configuration state.
Example	`> :LTRaining:SEQuence:TOUT:POLLing:CONFiguration?`
	`< 48.0`

:LTRaining:SEQuence:TOUT:POLLing:ACTive <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	12.0 to 36.0	12.0 to 36.0 ms, 0.1 ms step
Function	Sets the timeout of Polling.Active state.	
Example	To set the timeout to 24.0 ms.	

```
> :LTRaining:SEQuence:TOUT:POLLing:ACTive 24.0
```

:LTRaining:SEQuence:TOUT:POLLing:ACTive?

Response	<numeric>=<NR2 NUMERIC RESPONSE DATA>
	12.0 to 36.0
Function	Queries the timeout of Polling.Active state.
Example	

```
> :LTRaining:SEQuence:TOUT:POLLing:ACTive?
< 24.0
```

:LTRaining:SEQuence:TOUT:CONFiguration:LSTart <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	12.0 to 36.0	12.0 to 36.0 ms, 0.1 ms step
Function	Sets the timeout of Configuration.Linkwidth.Start state.	
Example	To set the timeout to 24.0 ms.	

```
> :LTRaining:SEQuence:TOUT:CONFiguration:LSTart 24.0
```

:LTRaining:SEQuence:TOUT:CONFiguration:LSTart?

Response	<numeric>=<NR2 NUMERIC RESPONSE DATA>
	12.0 to 36.0
Function	Queries the timeout of Configuration.Linkwidth.Start state.
Example	

```
> :LTRaining:SEQuence:TOUT:CONFiguration:LSTart?
< 24.0
```

:LTRaining:SEQuence:TOUT:CONFiguration:LWAit <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA> 1.0 to 3.0 1.0 to 3.0 ms, 0.1 ms step
Function	Sets the timeout of Configuration.Lanenum.Wait state.
Example	To set the timeout to 2.0 ms. `> :LTRaining:SEQuence:TOUT:CONFiguration:LWAit 2.0`

:LTRaining:SEQuence:TOUT:CONFiguration:LWAit?

Response	<numeric>=<NR2 NUMERIC RESPONSE DATA> 1.0 to 3.0
Function	Queries the timeout of Configuration.Lanenum.Wait state.

Example	`> :LTRaining:SEQuence:TOUT:CONFiguration:LWAit?`
	`< 2.0`

:LTRaining:SEQuence:TOUT:CONFiguration:LACCept <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA> 1.0 to 3.0 1.0 to 3.0 ms, 0.1 ms step
Function	Sets the timeout of Configuration.Linkwidth.Accept state.
Example	To set the timeout to 2.0 ms. `> :LTRaining:SEQuence:TOUT:CONFiguration:LACCept 2.0`

:LTRaining:SEQuence:TOUT:CONFiguration:LACCept?

Response	<numeric>=<NR2 NUMERIC RESPONSE DATA> 1.0 to 3.0
Function	Queries the timeout of Configuration.Linkwidth.Accept state.

Example	`> :LTRaining:SEQuence:TOUT:CONFiguration:LACCept?`
	`< 2.0`

:LTRaining:SEQuence:TOUT:CONFiguration:COMPlete <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	1.0 to 3.0	1.0 to 3.0 ms, 0.1 ms step
Function	Sets the timeout of Configuration.Complete state.	
Example	To set the timeout to 2.0 ms.	

```
> :LTRaining:SEQuence:TOUT:CONFiguration:COMPlete 2.0
```

:LTRaining:SEQuence:TOUT:CONFiguration:COMPlete?

Response	<numeric>=<NR2 NUMERIC RESPONSE DATA> 1.0 to 3.0
Function	Queries the timeout of Configuration.Complete state.
Example	

```
> :LTRaining:SEQuence:TOUT:CONFiguration:COMPlete?
< 2.0
```

:LTRaining:SEQuence:TOUT:CONFiguration:IDLE <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	1.0 to 3.0	1.0 to 3.0 ms, 0.1 ms step
Function	Sets the timeout of Configuration.Idle state.	
Example	To set the timeout to 2.0 ms.	

```
> :LTRaining:SEQuence:TOUT:CONFiguration:IDLE 2.0
```

:LTRaining:SEQuence:TOUT:CONFiguration:IDLE?

Response	<numeric>=<NR2 NUMERIC RESPONSE DATA> 1.0 to 3.0
Function	Queries the timeout of Configuration.Idle state.
Example	

```
> :LTRaining:SEQuence:TOUT:CONFiguration:IDLE?
< 2.0
```

:LTRaining:SEQuence:TOUT:HOTReset <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	1.0 to 3.0	1.0 to 3.0 ms, 0.1 ms step
Function	Sets the timeout of Hotreset state.	
Example	To set the timeout to 2.0 ms.	
	`> :LTRaining:SEQuence:TOUT:HOTReset 2.0`	

:LTRaining:SEQuence:TOUT:HOTReset?

Response	<numeric>=<NR2 NUMERIC RESPONSE DATA>
	1.0 to 3.0
Function	Queries the timeout of Hotreset state.
Example	`> :LTRaining:SEQuence:TOUT:HOTReset?`
	`< 2.0`

:LTRaining:SEQuence:TOUT:DISable <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	1.0 to 3.0	1.0 to 3.0 ms, 0.1 ms step
Function	Sets the timeout of Disable state.	
Example	To set the timeout to 2.0 ms.	
	`> :LTRaining:SEQuence:TOUT:DISable 2.0`	

:LTRaining:SEQuence:TOUT:DISable?

Response	<numeric>=<NR2 NUMERIC RESPONSE DATA>
	1.0 to 3.0
Function	Queries the timeout of Disable state.
Example	`> :LTRaining:SEQuence:TOUT:DISable?`
	`< 2.0`

:LTRaining:SEQuence:TOUT:RECovery:RLOCk <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>
	12.0 to 36.0 12.0 to 36.0 ms, 0.1 ms step
Function	Sets the timeout of Recovery.RcvrLock state.
Example	To set the timeout to 24.0 ms.

```
> :LTRaining:SEQuence:TOUT:RECovery:RLOCk 24.0
```

:LTRaining:SEQuence:TOUT:RECovery:RLOCk?

Response	<numeric>=<NR2 NUMERIC RESPONSE DATA> 12.0 to 36.0
Function	Queries the timeout of Recovery.RcvrLock state.
Example	

```
> :LTRaining:SEQuence:TOUT:RECovery:RLOCk?
< 24.0
```

:LTRaining:SEQuence:TOUT:RECovery:RCFG <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>
	24.0 to 72.0 24.0 to 72.0 ms, 0.1 ms step
Function	Sets the timeout of Recovery.RcvrCfg state.
Example	To set the timeout to 48.0 ms.

```
> :LTRaining:SEQuence:TOUT:RECovery:RCFG 48.0
```

:LTRaining:SEQuence:TOUT:RECovery:RCFG?

Response	<numeric>=<NR2 NUMERIC RESPONSE DATA> 24.0 to 72.0
Function	Queries the timeout of Recovery.RcvrCfg state.
Example	

```
> :LTRaining:SEQuence:TOUT:RECovery:RCFG?
< 48.0
```

:LTRaining:SEQuence:TOUT:RECovery:SPEed <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	24.0 to 72.0	24.0 to 72.0 ms, 0.1 ms step
Function	Sets the timeout of Recovery.Speed state.	
Example	To set the timeout to 48.0 ms.	

```
> :LTRaining:SEQuence:TOUT:RECovery:SPEed 48.0
```

:LTRaining:SEQuence:TOUT:RECovery:SPEed?

Response	<numeric>=<NR2 NUMERIC RESPONSE DATA> 24.0 to 72.0
Function	Queries the timeout of Recovery.Speed state.
Example	

```
> :LTRaining:SEQuence:TOUT:RECovery:SPEed?
< 48.0
```

:LTRaining:SEQuence:TOUT:RECovery:IDLE <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	1.0 to 3.0	1.0 to 3.0 ms, 0.1 ms step
Function	Sets the timeout of Recovery.Idle state.	
Example	To set the timeout to 2.0 ms.	

```
> :LTRaining:SEQuence:TOUT:RECovery:IDLE 2.0
```

:LTRaining:SEQuence:TOUT:RECovery:IDLE?

Response	<numeric>=<NR2 NUMERIC RESPONSE DATA> 1.0 to 3.0
Function	Queries the timeout of Recovery.Idle state.
Example	

```
> :LTRaining:SEQuence:TOUT:RECovery:IDLE?
< 2.0
```

:LTRaining:SEQuence:TOUT:RECovery:EEQP1 <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	12.0 to 36.0	12.0 to 36.0 ms, 0.1 ms step
Function	Sets the timeout of Recovery.Equalization.Phase1 (End point) state.	
Example	To set the timeout to 24.0 ms.	

```
> :LTRaining:SEQuence:TOUT:RECovery:EEQP1 24.0
```

:LTRaining:SEQuence:TOUT:RECovery:EEQP1?

Response	<numeric>=<NR2 NUMERIC RESPONSE DATA>
	12.0 to 36.0
Function	Queries the timeout of Recovery.Equalization.Phase1 (End point) state.
Example	

```
> :LTRaining:SEQuence:TOUT:RECovery:EEQP1?
< 24.0
```

:LTRaining:SEQuence:TOUT:RECovery:EEQP2 <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	16.0 to 48.0	16.0 to 48.0 ms, 0.1 ms step
Function	Sets the timeout of Recovery.Equalization.Phase2 (End point) state.	
Example	To set the timeout to 32.0 ms.	

```
> :LTRaining:SEQuence:TOUT:RECovery:EEQP2 32.0
```

:LTRaining:SEQuence:TOUT:RECovery:EEQP2?

Response	<numeric>=<NR2 NUMERIC RESPONSE DATA>
	16.0 to 48.0
Function	Queries the timeout of Recovery.Equalization.Phase2 (End point) state.
Example	

```
> :LTRaining:SEQuence:TOUT:RECovery:EEQP2?
< 32.0
```

:LTRaining:SEQuence:TOUT:RECovery:EEQP3 <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	12.0 to 36.0	12.0 to 36.0 ms, 0.1 ms step
Function	Sets the timeout of Recovery.Equalization.Phase3 (End point) state.	
Example	To set the timeout to 24.0 ms. `> :LTRaining:SEQuence:TOUT:RECovery:EEQP3 24.0`	

:LTRaining:SEQuence:TOUT:RECovery:EEQP3?

Response	<numeric>=<NR2 NUMERIC RESPONSE DATA> 12.0 to 36.0
Function	Queries the timeout of Recovery.Equalization.Phase3 (End point) state.

Example	`> :LTRaining:SEQuence:TOUT:RECovery:EEQP3?`
	`< 24.0`

:LTRaining:SEQuence:TOUT:RECovery:REQP0 <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	6.0 to 18.0	6.0 to 18.0 ms, 0.1 ms step
Function	Sets the timeout of Recovery.Equalization.Phase0 (Root Complex) state.	
Example	To set the timeout to 12.0 ms. `> :LTRaining:SEQuence:TOUT:RECovery:REQP0 12.0`	

:LTRaining:SEQuence:TOUT:RECovery:REQP0?

Response	<numeric>=<NR2 NUMERIC RESPONSE DATA> 6.0 to 18.0
Function	Queries the timeout of Recovery.Equalization.Phase0 (Root Complex) state.

Example	`> :LTRaining:SEQuence:TOUT:RECovery:REQP0?`
	`< 12.0`

:LTRaining:SEQuence:TOUT:RECovery:REQP1 <numeric>

Parameter

<numeric>=<DECIMAL NUMERIC PROGRAM DATA>

6.0 to 18.0	6.0 to 18.0 ms, 0.1 ms step

Function

Sets the timeout of Recovery.Equalization.Phase1 (Root Complex) state.

Example

To set the timeout to 12.0 ms.

```
> :LTRaining:SEQuence:TOUT:RECovery:REQP1 12.0
```

:LTRaining:SEQuence:TOUT:RECovery:REQP1?

Response

<numeric>=<NR2 NUMERIC RESPONSE DATA>

6.0 to 18.0

Function

Queries the timeout of Recovery.Equalization.Phase1 (Root Complex) state.

Example

```
> :LTRaining:SEQuence:TOUT:RECovery:REQP1?
< 12.0
```

:LTRaining:SEQuence:TOUT:RECovery:REQP2 <numeric>

Parameter

<numeric>=<DECIMAL NUMERIC PROGRAM DATA>

12.0 to 36.0	12.0 to 36.0 ms, 0.1 ms step

Function

Sets the timeout of Recovery.Equalization.Phase2 (Root Complex) state.

Example

To set the timeout to 24.0 ms.

```
> :LTRaining:SEQuence:TOUT:RECovery:REQP2 24.0
```

:LTRaining:SEQuence:TOUT:RECovery:REQP2?

Response

<numeric>=<NR2 NUMERIC RESPONSE DATA>

12.0 to 36.0

Function

Queries the timeout of Recovery.Equalization.Phase2 (Root Complex) state.

Example

```
> :LTRaining:SEQuence:TOUT:RECovery:REQP2?
< 24.0
```

:LTRaining:SEQuence:TOUT:RECovery:REQP3 <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA> 16.0 to 48.0 16.0 to 48.0 ms, 0.1 ms step
Function	Sets the timeout of Recovery.Equalization.Phase3 (Root Complex) state.
Example	To set the timeout to 32.0 ms. `> :LTRaining:SEQuence:TOUT:RECovery:REQP3 32.0`

:LTRaining:SEQuence:TOUT:RECovery:REQP3?

Response	<numeric>=<NR2 NUMERIC RESPONSE DATA> 16.0 to 48.0
Function	Queries the timeout of Recovery.Equalization.Phase3 (Root Complex) state.

Example	`> :LTRaining:SEQuence:TOUT:RECovery:REQP3?`
	`< 32.0`

:LTRaining:SEQuence:TOUT:LBENtry:ACTive <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA> 1.0 to 3.0 1.0 to 3.0 ms, 0.1 ms step
Function	Sets the timeout of Loopback.Entry to Active state.
Example	To set the timeout to 2.0 ms. `> :LTRaining:SEQuence:TOUT:LBENtry:ACTive 2.0`

:LTRaining:SEQuence:TOUT:LBENtry:ACTive?

Response	<numeric>=<NR2 NUMERIC RESPONSE DATA> 1.0 to 3.0
Function	Queries the timeout of Loopback.Entry to Active state.

Example	`> :LTRaining:SEQuence:TOUT:LBENtry:ACTive?`
	`< 2.0`

:LTRaining:SEQuence:TOUT:LBENtry:EXIT <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	50.0 to 150.0	50.0 to 150.0 ms, 0.1 ms step
Function	Sets the timeout of Loopback.Entry to Exit state.	
Example	To set the timeout to 100.0 ms.	

```
> :LTRaining:SEQuence:TOUT:LBENtry:EXIT 100.0
```

:LTRaining:SEQuence:TOUT:LBENtry:EXIT?

Response	<numeric>=<NR2 NUMERIC RESPONSE DATA> 50.0 to 150.0
Function	Queries the timeout of Loopback.Entry to Exit state.
Example	

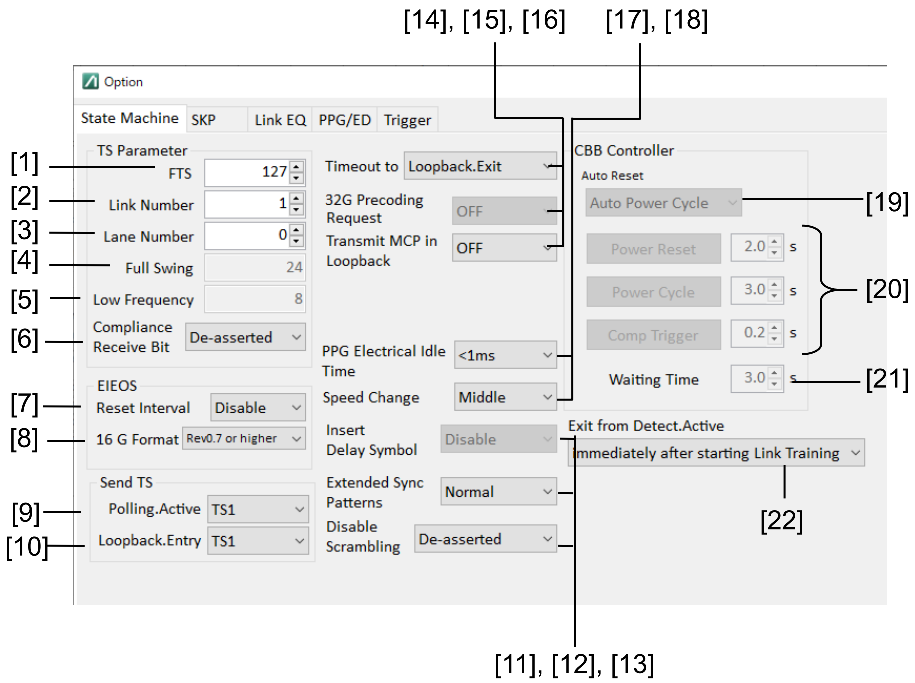
```
> :LTRaining:SEQuence:TOUT:LBENtry:EXIT?
< 100.0
```

:LTRaining:SEQuence:TOUT:INITialize

Parameter	None
Function	Initialize the set values of Timeout.
Example	To initialize the set values of Timeout.

```
> :LTRaining:SEQuence:TOUT:INITialize
```

5.9.4 Option dialog box



TS Parameter
FTS 127
Link Number 1
Lane Number 0
Full Swing 24
Low Frequency 8
Compliance Receive Bit De-asserted

EIEOS
Reset Interval Disable
16 G Format Rev0.7 or higher

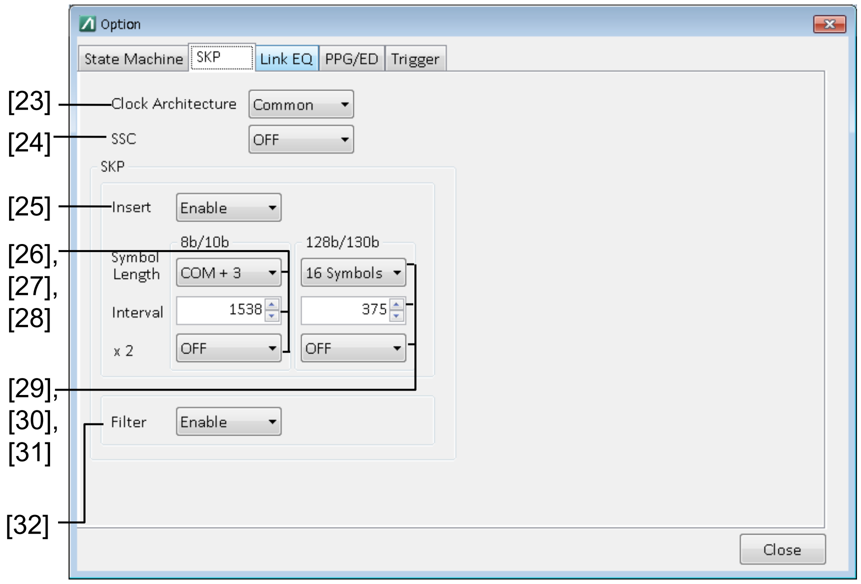
Send TS
Polling.Active TS1
Loopback.Entry TS1

Timeout to Loopback.Exit
32G Precoding Request OFF
Transmit MCP in Loopback OFF
PPG Electrical Idle Time <1ms
Speed Change Middle
Insert Delay Symbol Disable
Extended Sync Patterns Normal
Disable Scrambling De-asserted

CBB Controller
Auto Reset
Auto Power Cycle
Power Reset 2.0 s
Power Cycle 3.0 s
Comp Trigger 0.2 s
Waiting Time 3.0 s

Exit from Detect.Active
Immediately after starting Link Training

Figure 5.9.4-1 Option Dialog Box (State Machine)



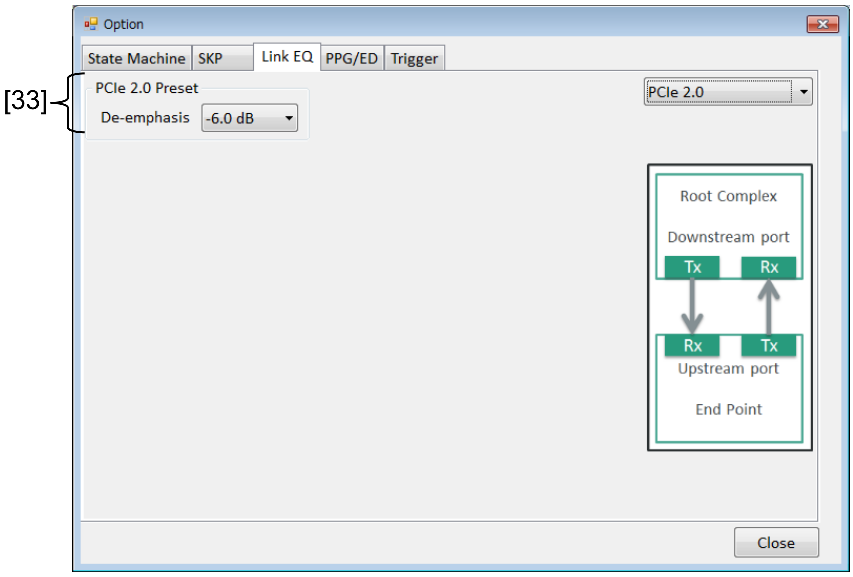
Clock Architecture Common
SSC OFF

SKP
Insert Enable

	8b/10b	128b/130b
Symbol Length	COM + 3	16 Symbols
Interval	1538	375
x 2	OFF	OFF

Filter Enable

Figure 5.9.4-2 Option Dialog Box (SKP)

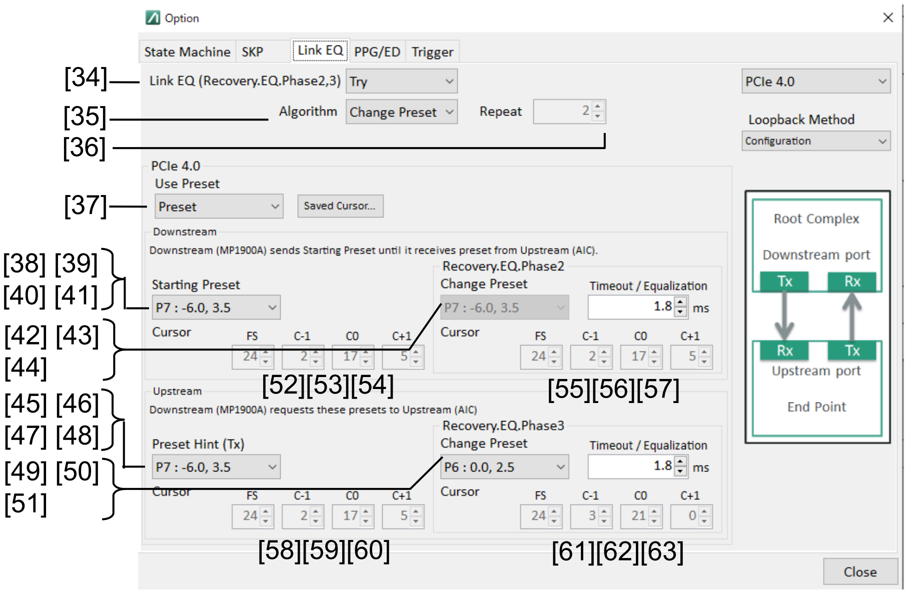


PCIe 2.0 Preset

De-emphasis: -6.0 dB

PCIe 2.0

Figure 5.9.4-3 Option Dialog Box (Link EQ – PCIe 2.0)



Link EQ (Recovery.EQ.Phase2,3): Try

Algorithm: Change Preset

Repeat: 2

PCIe 4.0

Loopback Method: Configuration

PCIe 4.0

Use Preset: Preset

Downstream

Downstream (MP1900A) sends Starting Preset until it receives preset from Upstream (AIC).

Starting Preset: P7 : -6.0, 3.5

Cursor: FS 24, C-1 2, C0 17, C+1 5

Recovery.EQ.Phase2

Change Preset: P7 : -6.0, 3.5

Timeout / Equalization: 1.8 ms

Cursor: FS 24, C-1 2, C0 17, C+1 5

Upstream

Downstream (MP1900A) requests these presets to Upstream (AIC)

Preset Hint (Tx): P7 : -6.0, 3.5

Cursor: FS 24, C-1 2, C0 17, C+1 5

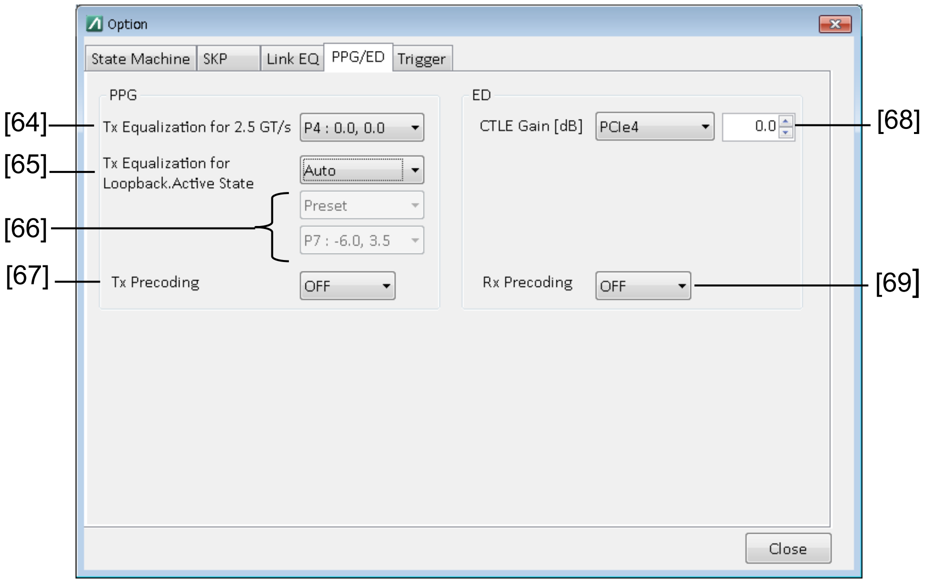
Recovery.EQ.Phase3

Change Preset: P6 : 0.0, 2.5

Timeout / Equalization: 1.8 ms

Cursor: FS 24, C-1 3, C0 21, C+1 0

Figure 5.9.4-4 Option Dialog Box (Link EQ – PCIe 3.0 to PCIe 5.0)



Tx Equalization for 2.5 GT/s: P4 : 0.0, 0.0

Tx Equalization for Loopback.Active State: Auto

Preset

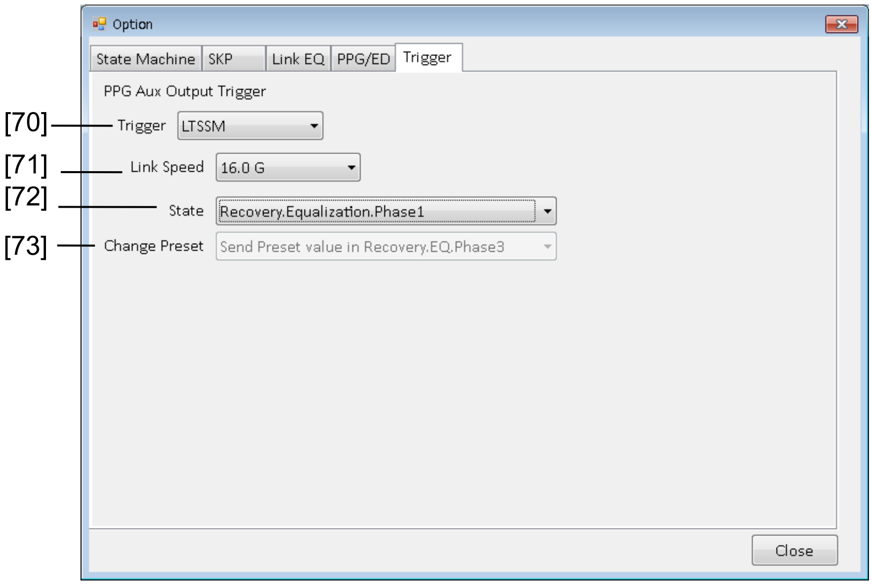
P7 : -6.0, 3.5

Tx Precoding: OFF

CTLE Gain [dB]: PCIe4 0.0

Rx Precoding: OFF

Figure 5.9.4-5 Option Dialog Box (PPG/ED)



PPG Aux Output Trigger

Trigger: LTSSM

Link Speed: 16.0 G

State: Recovery.Equalization.Phase1

Change Preset: Send Preset value in Recovery.EQ.Phase3

Figure 5.9.4-6 Option Dialog Box (Trigger)

Table 5.9.4-1 Sequence Option Dialog Box Setup Commands

No.	Setting Item	Command
[1]	FTS	:LTRaining:SEQuence:FTS
		:LTRaining:SEQuence:FTS?
[2]	Link Number	:LTRaining:SEQuence:LINKnum
		:LTRaining:SEQuence:LINKnum?
[3]	Lane Number	:LTRaining:SEQuence:LANenum
		:LTRaining:SEQuence:LANenum?
[4]	Full Swing	:LTRaining:SEQuence:FSWing?
[5]	Low Frequency	:LTRaining:SEQuence:LFRequency?
[6]	Compliance Receive Bit	:LTRaining:SEQuence:CRECeive
		:LTRaining:SEQuence:CRECeive?
[7]	EIEOS Reset Interval	:LTRaining:SEQuence:REIeos:INTerval
		:LTRaining:SEQuence:REIeos:INTerval?
[8]	EIEOS 16G Format	:LTRaining:SEQuence:REIeos:FORMat
		:LTRaining:SEQuence:REIeos:FORMat?
[9]	Send TS Polling.Active	:LTRaining:SEQuence:PACTive:TS
		:LTRaining:SEQuence:PACTive:TS?
[10]	Send TS Loopback.Entry	:LTRaining:SEQuence:LENTry:TS
		:LTRaining:SEQuence:LENTry:TS?
[11]	Insert Delay Symbol	:LTRaining:SEQuence:DSYMbol
		:LTRaining:SEQuence:DSYMbol?
[12]	Extended Sync Patterns	:LTRaining:SEQuence:ESYNc:PATTern
		:LTRaining:SEQuence:ESYNc:PATTern?
[13]	Disable Scrambling	:LTRaining:SEQuence:DSCRamble
		:LTRaining:SEQuence:DSCRamble?
[14]	Timeout to	:LTRaining:SEQuence:TOUT:LBENtry:SELect
		:LTRaining:SEQuence:TOUT:LBENtry:SELect?
[15]	32G Precoding Request	:LTRaining:SEQuence:PCODing
		:LTRaining:SEQuence:PCODing?
[16]	Transmit MCP in Loopback	:LTRaining:SEQuence:MCP
		:LTRaining:SEQuence:MCP?
[17]	PPG Electrical Idle Time	:LTRaining:SEQuence:EITime
		:LTRaining:SEQuence:EITime?
[18]	Speed Change	:LTRaining:SEQuence:CSPeed
		:LTRaining:SEQuence:CSPeed?
[19]	Auto Reset	:LTRaining:SEQuence:AUTO:RESet
		:LTRaining:SEQuence:AUTO:RESet?

Table 5.9.4-1 Sequence Option Dialog Box Setup Commands (Cont'd)

No.	Setting Item	Command
[20]	Power Reset Power Cycle Comp Trigger	:LTRaining:SEQuence:AUTO:PRESet
		:LTRaining:SEQuence:AUTO:PCYCle
		:LTRaining:SEQuence:AUTO:CTRIgger
		:LTRaining:SEQuence:AUTO:PRESet:TIME
		:LTRaining:SEQuence:AUTO:PRESet:TIME?
		:LTRaining:SEQuence:AUTO:PCYCle:TIME
		:LTRaining:SEQuence:AUTO:PCYCle:TIME?
		:LTRaining:SEQuence:AUTO:CTRIgger:TIME
		:LTRaining:SEQuence:AUTO:CTRIgger:TIME?
[21]	Waiting Time	:LTRaining:SEQuence:AUTO:AWAit:TIME
		:LTRaining:SEQuence:AUTO:AWAit:TIME?
[22]	Exit from Detect.Active	:LTRaining:SEQuence:LTSSm:EXIT:DACTive
		:LTRaining:SEQuence:LTSSm:EXIT:DACTive?
[23]	Clock Architecture	:LTRaining:SEQuence:SRIS
		:LTRaining:SEQuence:SRIS?
[24]	SSC	:LTRaining:SEQuence:SSC
		:LTRaining:SEQuence:SSC?
[25]	SKP Insert	:LTRaining:SEQuence:SKP
		:LTRaining:SEQuence:SKP?
[26]	Symbol Length 8b/10b	:LTRaining:SEQuence:SKP:SLENgth:8B10B
		:LTRaining:SEQuence:SKP:SLENgth:8B10B?
[27]	Interval 8b/10b	:LTRaining:SEQuence:SKP:INTerval:8B10B
		:LTRaining:SEQuence:SKP:INTerval:8B10B?
[28]	Double SKP (8b/10b)	:LTRaining:SEQuence:SKP:DOUBle:8B10B
		:LTRaining:SEQuence:SKP:DOUBle:8B10B?
[29]	Symbol Length 128b/130b	:LTRaining:SEQuence:SKP:SLENgth:128B130B
		:LTRaining:SEQuence:SKP:SLENgth:128B130B?
[30]	Interval 128b/130b	:LTRaining:SEQuence:SKP:INTerval:128B130B
		:LTRaining:SEQuence:SKP:INTerval:128B130B?
[31]	Double SKP (128b/130b)	:LTRaining:SEQuence:SKP:DOUBle:128B130B
		:LTRaining:SEQuence:SKP:DOUBle:128B130B?
[32]	Filter	:LTRaining:SEQuence:FILTer
		:LTRaining:SEQuence:FILTer?
[33]	De-emphasis	:LTRaining:SEQuence:REV2:DEMPhasis
		:LTRaining:SEQuence:REV2:DEMPhasis?
[34]	Link EQ (Recovery Phase2, 3)	:LTRaining:SEQuence:REV3:RECovery:PH2_3
		:LTRaining:SEQuence:REV3:RECovery:PH2_3?
		:LTRaining:SEQuence:REV4:RECovery:PH2_3
		:LTRaining:SEQuence:REV4:RECovery:PH2_3?
		:LTRaining:SEQuence:REV5:RECovery:PH2_3
		:LTRaining:SEQuence:REV5:RECovery:PH2_3?

Table 5.9.4-1 Sequence Option Dialog Box Setup Commands (Cont'd)

No.	Setting Item	Command
[35]	Algorithm	:LTRaining:SEQuence:REV3:RECovery:ALGorithm
		:LTRaining:SEQuence:REV3:RECovery:ALGorithm?
		:LTRaining:SEQuence:REV4:RECovery:ALGorithm
		:LTRaining:SEQuence:REV4:RECovery:ALGorithm?
		:LTRaining:SEQuence:REV5:RECovery:ALGorithm
		:LTRaining:SEQuence:REV5:RECovery:ALGorithm?
[36]	Repeat	:LTRaining:SEQuence:REV3:REPeat:ROOT
		:LTRaining:SEQuence:REV3:REPeat:ROOT?
		:LTRaining:SEQuence:REV3:REPeat:ENDPoint
		:LTRaining:SEQuence:REV3:REPeat:ENDPoint?
		:LTRaining:SEQuence:REV4:REPeat:ROOT
		:LTRaining:SEQuence:REV4:REPeat:ROOT?
		:LTRaining:SEQuence:REV4:REPeat:ENDPoint
		:LTRaining:SEQuence:REV4:REPeat:ENDPoint?
		:LTRaining:SEQuence:REV5:REPeat:ROOT
		:LTRaining:SEQuence:REV5:REPeat:ROOT?
		:LTRaining:SEQuence:REV5:REPeat:ENDPoint
		:LTRaining:SEQuence:REV5:REPeat:ENDPoint?
[37]	Usepreset (PCIe 3.0)	:LTRaining:SEQuence:REV3:UPReset
		:LTRaining:SEQuence:REV3:UPReset?
	Usepreset (PCIe 4.0)	:LTRaining:SEQuence:REV4:UPReset
		:LTRaining:SEQuence:REV4:UPReset?
	Usepreset (PCIe 5.0)	:LTRaining:SEQuence:REV5:UPReset
		:LTRaining:SEQuence:REV5:UPReset?
[38]	Preset (Rev 3.x)	:LTRaining:SEQuence:REV3:DSTReam:PRESet
		:LTRaining:SEQuence:REV3:DSTReam:PRESet?
[39]	Preset Hint (Rx) (Rev 3.x)	:LTRaining:SEQuence:REV3:DSTReam:HPRESet
		:LTRaining:SEQuence:REV3:DSTReam:HPRESet?
[40]	Preset (Rev 4.0)	:LTRaining:SEQuence:REV4:DSTReam:PRESet
		:LTRaining:SEQuence:REV4:DSTReam:PRESet?
[41]	Preset (Rev 5.0)	:LTRaining:SEQuence:REV5:DSTReam:PRESet
		:LTRaining:SEQuence:REV5:DSTReam:PRESet?
[42]	Change Preset (Rev 3.x)	:LTRaining:SEQuence:REV3:DSTReam:CPReset
		:LTRaining:SEQuence:REV3:DSTReam:CPReset?
[43]	Change Preset (Rev 4.0)	:LTRaining:SEQuence:REV4:DSTReam:CPReset
		:LTRaining:SEQuence:REV4:DSTReam:CPReset?
[44]	Change Preset (Rev 5.0)	:LTRaining:SEQuence:REV5:DSTReam:CPReset
		:LTRaining:SEQuence:REV5:DSTReam:CPReset?

Table 5.9.4-1 Sequence Option Dialog Box Setup Commands (Cont'd)

No.	Setting Item	Command
[45]	Preset (Rev 3.x)	:LTRaining:SEQuence:REV3:USTReam:PRESet :LTRaining:SEQuence:REV3:USTReam:PRESet?
[46]	Preset Hint (Tx) (Rev 3.x)	:LTRaining:SEQuence:REV3:USTReam:HPRESet :LTRaining:SEQuence:REV3:USTReam:HPRESet?
[47]	Preset (Rev 4.0)	:LTRaining:SEQuence:REV4:USTReam:PRESet :LTRaining:SEQuence:REV4:USTReam:PRESet?
[48]	Preset (Rev 5.0)	:LTRaining:SEQuence:REV5:USTReam:PRESet :LTRaining:SEQuence:REV5:USTReam:PRESet?
[49]	Change Preset (Rev 3.x)	:LTRaining:SEQuence:REV3:USTReam:CPReset :LTRaining:SEQuence:REV3:USTReam:CPReset?
[50]	Change Preset (Rev 4.0)	:LTRaining:SEQuence:REV4:USTReam:CPReset :LTRaining:SEQuence:REV4:USTReam:CPReset?
[51]	Change Preset (Rev 5.0)	:LTRaining:SEQuence:REV5:USTReam:CPReset :LTRaining:SEQuence:REV5:USTReam:CPReset?
[52]	User Cursor (Rev 3.x)	:LTRaining:SEQuence:REV3:DSTReam:UCURsor :LTRaining:SEQuence:REV3:DSTReam:UCURsor?
[53]	User Cursor (Rev 4.0)	:LTRaining:SEQuence:REV4:DSTReam:UCURsor :LTRaining:SEQuence:REV4:DSTReam:UCURsor?
[54]	User Cursor (Rev 5.0)	:LTRaining:SEQuence:REV5:DSTReam:UCURsor :LTRaining:SEQuence:REV5:DSTReam:UCURsor?
[55]	Recovery.EQ.Phase2 User Cursor (Rev 3.x)	:LTRaining:SEQuence:REV3:DSTReam:RECovery:UCURsor :LTRaining:SEQuence:REV3:DSTReam:RECovery:UCURsor?
[56]	Recovery.EQ.Phase2 User Cursor (Rev 4.0)	:LTRaining:SEQuence:REV4:DSTReam:RECovery:UCURsor :LTRaining:SEQuence:REV4:DSTReam:RECovery:UCURsor?
[57]	Recovery.EQ.Phase2 User Cursor (Rev 5.0)	:LTRaining:SEQuence:REV5:DSTReam:RECovery:UCURsor :LTRaining:SEQuence:REV5:DSTReam:RECovery:UCURsor?
[58]	User Cursor (Rev 3.x)	:LTRaining:SEQuence:REV3:USTReam:UCURsor :LTRaining:SEQuence:REV3:USTReam:UCURsor?
[59]	User Cursor (Rev 4.0)	:LTRaining:SEQuence:REV4:USTReam:UCURsor :LTRaining:SEQuence:REV4:USTReam:UCURsor?
[60]	User Cursor (Rev 5.0)	:LTRaining:SEQuence:REV5:USTReam:UCURsor :LTRaining:SEQuence:REV5:USTReam:UCURsor?

Table 5.9.4-1 Sequence Option Dialog Box Setup Commands (Cont'd)

No.	Setting Item	Command
[61]	Recovery.EQ.Phase3 User Cursor (Rev 3.x)	:LTRaining:SEQuence:REV3:USTReam:RECovery:UCURsor :LTRaining:SEQuence:REV3:USTReam:RECovery:UCURsor?
[62]	Recovery.EQ.Phase3 User Cursor (Rev 4.0)	:LTRaining:SEQuence:REV4:USTReam:RECovery:UCURsor :LTRaining:SEQuence:REV4:USTReam:RECovery:UCURsor?
[63]	Recovery.EQ.Phase3 User Cursor (Rev 5.0)	:LTRaining:SEQuence:REV5:USTReam:RECovery:UCURsor :LTRaining:SEQuence:REV5:USTReam:RECovery:UCURsor?
[64]	Tx Equalization for 2.5GT/s	:LTRaining:SEQuence:TXPReset:IPReset
		:LTRaining:SEQuence:TXPReset:IPReset?
[65]	Tx Equalization for Loopback.Active State (Auto/Manual)	:LTRaining:SEQuence:TXPReset:LPReset
		:LTRaining:SEQuence:TXPReset:LPReset?
[66]	Equalization for Loopback.Active State	:LTRaining:SEQuence:TXPReset:SELect
		:LTRaining:SEQuence:TXPReset:SELect?
		:LTRaining:SEQuence:TXPReset:LPReset:PRESet
		:LTRaining:SEQuence:TXPReset:LPReset:PRESet?
[67]	Tx Precoding	:LTRaining:SEQuence:TXPCoding
		:LTRaining:SEQuence:TXPCoding?
[68]	CTLE Gain	:INPut:DATA:EQUalizer:AMPLitude
		:INPut:DATA:EQUalizer:AMPLitude?
[69]	Rx Precoding	:LTRaining:SEQuence:RXPCoding
		:LTRaining:SEQuence:RXPCoding?
[70]	Trigger	:LTRaining:SEQuence:TRIGger:SELect
		:LTRaining:SEQuence:TRIGger:SELect?
[71]	Link Speed	:LTRaining:SEQuence:TRIGger:SPEed
		:LTRaining:SEQuence:TRIGger:SPEed?
[72]	State	:LTRaining:SEQuence:TRIGger:STATe
		:LTRaining:SEQuence:TRIGger:STATe?
[73]	Change Preset	:LTRaining:SEQuence:TRIGger:CPReset
		:LTRaining:SEQuence:TRIGger:CPReset?

:LTRaining:SEQuence:FTS <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0 to 255	0 to 255, 1 step
Function	Sets the TS FTS value.	
Example	To set the TS FTS value to 127:	
	`> :LTRaining:SEQuence:FTS 127`	

:LTRaining:SEQuence:FTS?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0 to 255	0 to 255
Function	Queries the TS FTS setting.	
Example	`> :LTRaining:SEQuence:FTS?`	
	`< 127`	

:LTRaining:SEQuence:LINKnum <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0 to 255	0 to 255, 1 step
Function	Sets the TS Link Number.	
Example	To set the Link Number to 1:	
	`> :LTRaining:SEQuence:LINKnum 1`	

:LTRaining:SEQuence:LINKnum?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0 to 255	0 to 255
Function	Queries the TS Link Number.	
Example	`>:LTRaining:SEQuence:LINKnum?`	
	`< 1`	

:LTRaining:SEQuence:LANenum <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0 to 255	0 to 255, 1 step
Function	Sets the TS Lane Number.	
Example	To set the Lane Number to 1:	

```
> :LTRaining:SEQuence:LANenum 100
```

:LTRaining:SEQuence:LANenum?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0 to 255	0 to 255
Function	Queries the TS Lane Number.	
Example		

```
> :LTRaining:SEQuence:LANenum?
< 100
```

:LTRaining:SEQuence:FSWing?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>
	24
Function	Queries the TS Full Swing value.
Example	

```
> :LTRaining:SEQuence:FSWing?
< 24
```

:LTRaining:SEQuence:LFRequency?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>
	8
Function	Queries the TS Low Frequency value.
Example	

```
> :LTRaining:SEQuence:LFRequency?
< 8
```

:LTRaining:SEQuence:CRECeive <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	Disables the Compliance Receive bit
	ON or 1	Enables the Compliance Receive bit
Function	Sets the TS Compliance Receive bit value.	
Example	`> :LTRaining:SEQuence:CRECeive ON`	

:LTRaining:SEQuence:CRECeive?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	The Compliance Receive bit disabled.
	1	The Compliance Receive bit enabled.
Function	Queries the TS Compliance Receive bit value.	

Example	`> :LTRaining:SEQuence:CRECeive?`
	`< 1`	

:LTRaining:SEQuence:REIeos:INTerval <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	Disables the EIEOS Reset Interval Count bit.
	ON or 1	Enables the EIEOS Reset Interval Count bit.
Function	Sets the TS EIEOS Reset Interval Count bit value.	
Example	`> :LTRaining:SEQuence:REIeos:INTerval ON`	

:LTRaining:SEQuence:REIeos:INTerval?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	The EIEOS Reset Interval Count bit disabled.
	1	The EIEOS Reset Interval Count bit enabled.
Function	Queries the TS EIEOS Reset Interval Count bit value.	

Example	`> :LTRaining:SEQuence:REIeos:INTerval?`
	`< 1`	

:LTRaining:SEQuence:REIeos:FORMat <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0	Older than Rev 0.7
	1	Rev 0.7 or later
Function	Sets EIEOS format to PCIe 4.0 Rev 0.7 or later.	
Example	`> :LTRaining:SEQuence:REIeos:FORMat 1`	

:LTRaining:SEQuence:REIeos:FORMat?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Older than Rev 0.7
	1	Rev 0.7 or later
Function	Queries if EIEOS format is PCIe 4.0 Rev 0.7 or later.	

Example	`> :LTRaining:SEQuence:REIeos:FORMat?`
	`< 1`	

:LTRaining:SEQuence:PACTive:TS <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0	Transmits TS1 Ordered Set.
	1	Transmits EQ TS1 Ordered Set.
Function	Selects the type of TS transmitted for Polling.Active State.	
Example	To set the TS to be transmitted for Polling.Active State to TS1 Ordered Set: `> :LTRaining:SEQuence:PACTive:TS 0`	

:LTRaining:SEQuence:PACTive:TS?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Transmits TS1 Ordered Set.
	1	Transmits EQ TS1 Ordered Set.
Function	Queries the type of TS transmitted for Polling.Active State.	

Example	`> :LTRaining:SEQuence:PACTive:TS?`
	`< 0`	

:LTRaining:SEQuence:LENTry:TS <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	0	Transmits TS1 Ordered Set.
	1	Transmits EQ TS1 Ordered Set.
Function	Selects the type of TS transmitted for Loopback.Entry State.	
Example	To set the TS to be transmitted for Loopback.Entry State to TS1 Ordered Set:	

```
> :LTRaining:SEQuence:LENTry:TS 0
```

:LTRaining:SEQuence:LENTry:TS?

Response	<type>=<CHARACTER RESPONSE DATA>	
	0	Transmits TS1 Ordered Set.
	1	Transmits EQ TS1 Ordered Set.
Function	Queries the type of TS transmitted for Polling.Active State.	
Example		

```
> :LTRaining:SEQuence:LENTry:TS?
< 0
```

:LTRaining:SEQuence:DSYMbol <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	Delay Symbol not inserted
	ON or 1	Delay Symbol inserted
Function	Selects whether to insert a Delay Symbol.	
Example		

```
> :LTRaining:SEQuence:DSYMbol ON
```

:LTRaining:SEQuence:DSYMbol?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Delay Symbol not inserted
	1	Delay Symbol inserted
Function	Queries whether the Delay Symbol is to be inserted.	
Example		

```
> :LTRaining:SEQuence:DSYMbol?
< 1
```

:LTRaining:SEQuence:ESYNc:PATTern <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	NORMal	Sets normal transition conditions.
	EXTended	Sets extended transition conditions.
Function	Sets whether to transmit at least 1024 continuous TS1 OS as the transition conditions from Recovery.RcvrLock to Recovery.RcvrCfg State.	
Example	To set the Preset value to EXTended.	
	`> :LTRaining:SEQuence:ESYNc:PATTern EXTended`	

:LTRaining:SEQuence:ESYNc:PATTern?

Response	<type>=<CHARACTER RESPONSE DATA>
	NORM, EXT
Function	Queries whether to transmit at least 1024 continuous TS1 OS as the transition conditions from Recovery.RcvrLock to Recovery.RcvrCfg State.
Example	`> :LTRaining:SEQuence:ESYNc:PATTern?`
	`< EXT`

:LTRaining:SEQuence:DSCRamble <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	De-assert
	ON or 1	Assert
Function	Sets the TS Disable scramble bit value.	
Example	To set Disable scramble to Asset:	
	`> :LTRaining:SEQuence:DSCRamble 1`	

:LTRaining:SEQuence:DSCRamble?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	De-assert
	1	Assert
Function	Queries the TS Disable scramble bit value.	
Example	`> :LTRaining:SEQuence:DSCRamble?`	
	`< 1`	

:LTRaining:SEQuence:TOUT:LBENtry:SELect <numeric>

Parameter
<numeric>=<DECIMAL NUMERIC PROGRAM DATA>

0	Times out to the Loopback.Exit state.
1	Times out to the Loopback.Active state.

Function
Sets the next state when the MP1900A times out in the Loopback.Entry state.

Example
To change the state to the Loopback.Active state when the MP1900A times out in the Loopback.Entry state.

```
> :LTRaining:SEQuence:TOUT:LBENtry:SELect 1
```

:LTRaining:SEQuence:TOUT:LBENtry:SELect?

Response
<numeric>=<NR1 NUMERIC RESPONSE DATA>

0	Times out to the Loopback.Exit state.
1	Times out to the Loopback.Active state.

Function
Queries the next state when the MP1900A times out in the Loopback.Entry state.

Example

```
> :LTRaining:SEQuence:TOUT:LBENtry:SELect?
< 1
```

:LTRaining:SEQuence:PCODing <boolean>

Parameter
<boolean>=<BOOLEAN PROGRAM DATA>

OFF or 0	Disables 32G Precoding Request.
ON or 1	Enables 32G Precoding Request.

Function
Sets whether to perform precoding of the pattern to be transmitted by the PPG during Link Training.

Example

```
> :LTRaining:SEQuence:PCODing ON
```

:LTRaining:SEQuence:PCODing?

Response
<numeric>=<NR1 NUMERIC RESPONSE DATA>

0	32G Precoding Request is disabled.
1	32G Precoding Request is enabled.

Function
Queries whether precoding is performed for the pattern to be transmitted by the PPG during Link Training.

Example

```
> :LTRaining:SEQuence:PCODing?
< 1
```

:LTRaining:SEQuence:MCP <boolean>

Parameter <boolean>=<BOOLEAN PROGRAM DATA>

OFF or 0	Does not transmit MCP to lanes other than the lane under test.
ON or 1	Transmits MCP to lanes including the lane under test.

Function Sets whether to transmit MCP from the DUT to lanes other than the lane under test when operating at 32.0GT/s.

Example

```
> :LTRaining:SEQuence:MCP ON
```

:LTRaining:SEQuence:MCP?

Response <numeric>=<NR1 NUMERIC RESPONSE DATA>

0	Does not transmit MCP to lanes other than the lane under test.
1	Transmits MCP to lanes including the lane under test.

Function Queries whether MCP is transmitted from the DUT to lanes other than the lane under test when operating at 32.0GT/s.

Example

```
> :LTRaining:SEQuence:MCP?
< 1
```

:LTRaining:SEQuence:EITime <type>

Parameter <type>=<DECIMAL NUMERIC PROGRAM DATA>

0	< 1 ms
1	≥ 1 ms

Function Sets the PPG's Electrical Idle time before the MP1900A changes the bit rate. For details of parameter settings, refer to the description of **PPG Electrical Idle Time** in 4.8.2 "Setting PCIe Link Training".

Example To set the Electrical Idle Time of the MP1900A to less than 1 ms:

```
> :LTRaining:SEQuence:EITime 0
```

:LTRaining:SEQuence:EITime?

Response <type>=<NR1 NUMERIC RESPONSE DATA>

0	< 1 ms
1	≥ 1 ms

Function Queries the PPG's Electrical Idle time before the MP1900A changes the bit rate.

Example

```
> : LTRaining: SEQuence: EITime?
< 0
```

:LTRaining:SEQuence:CSPeed <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	FAST	Sets the time for changing data rate to Fast.
	MIDDle	Sets the time for changing data rate to Middle.
	SLOW	Sets the time for changing data rate to Slow.
Function	Sets the time required for the MP1900A to change the data rate. For details on how to use, see the explanation of Speed Change in “4.8.1 PCIe Link Training Setting Screen”.	
Example	To set the time for changing data rate of the MP1900A to Slow.	

```
> :LTRaining:SEQuence:CSPeed SLOW
```

:LTRaining:SEQuence:CSPeed?

Response	<type>=<CHARACTER PROGRAM DATA>	
	FAST	Sets the time for changing data rate to Fast.
	MIDD	Sets the time for changing data rate to Middle.
	SLOW	Sets the time for changing data rate to Slow.
Function	Queries the time for changing data rate by the MP1900A.	
Example		

```
> :LTRaining:SEQuence:CSPeed?
< SLOW
```

:LTRaining:SEQuence:AUTO:RESet <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	OFF	Does not send any signal.
	RESet	Sends a power reset signal.
	PCYCle	Sends a power OFF signal.
Function	Upon receipt of the :LTRaining:SEQuence:STARt command, sends the specified signal to the CBB control pins before starting Link Training.	
Example	`> :LTRaining:SEQuence:AUTO:RESet RESet`	

:LTRaining:SEQuence:AUTO:RESet?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	OFF	Does not send any signal.
	RES	Sends a power reset signal.
	PCYC	Sends a power OFF signal.
Function	Queries whether to send a signal to the CBB control pins before starting Link Training.	

Example	`> :LTRaining:SEQuence:AUTO:RESet?`
	`< RES`	

:LTRaining:SEQuence:AUTO:PRESet

Parameter	None
Function	Sends a power reset signal to the PCIe CBB 4.0.
Example	`> :LTRaining:SEQuence:AUTO:PRESet`

:LTRaining:SEQuence:AUTO:PCYCle

Parameter	None
Function	Sends a power OFF signal to the PCIe CBB 4.0.
Example	`> :LTRaining:SEQuence:AUTO:PCYCle`

:LTRaining:SEQuence:AUTO:CTRigger

Parameter	None
Function	Sends a Comp Trigger signal to the PCIe CBB 4.0.
Example	`> :LTRaining:SEQuence:AUTO:CTRigger`

:LTRaining:SEQuence:AUTO:PRESet:TIME <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0.1 to 20.0	0.1 to 20.0, 0.1 step
Function	Sets the time (seconds) to send a power reset signal.	
Example	To send a power reset signal for 3 seconds.	

```
>:LTRaining:SEQuence:AUTO:PRESet:TIME 3.0
```

:LTRaining:SEQuence:AUTO:PRESet:TIME?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0.1 to 20.0	0.1 to 20.0, 0.1 step
Function	Queries the time (seconds) to send a power reset signal.	
Example		

```
>:LTRaining:SEQuence:AUTO:PRESet:TIME?
< 3.0
```

:LTRaining:SEQuence:AUTO:PCYCle:TIME <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0.1 to 20.0	0.1 to 20.0, 0.1 step
Function	Sets the time (seconds) to send a power OFF signal.	
Example	To send a power OFF signal for 3 seconds.	

```
>:LTRaining:SEQuence:AUTO:PCYCle:TIME 3.0
```

:LTRaining:SEQuence:AUTO:PCYCle:TIME?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0.1 to 20.0	0.1 to 20.0, 0.1 step
Function	Queries the time (seconds) to send a power OFF signal.	
Example		

```
>:LTRaining:SEQuence:AUTO:PCYCle:TIME?
< 3.0
```

:LTRaining:SEQuence:AUTO:CTRigger:TIME <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0.1 to 1.0	0.1 to 1.0, 0.1 step
Function	Sets the time (seconds) to send a Compliance Trigger signal.	
Example	To send a Compliance Trigger signal for 0.1 second.	

```
>:LTRaining:SEQuence:AUTO:CTRigger:TIME 0.1
```

:LTRaining:SEQuence:AUTO:CTRigger:TIME?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0.1 to 1.0	0.1 to 1.0, 0.1 step
Function	Queries the time (seconds) to send a Compliance Trigger signal.	
Example		

```
>:LTRaining:SEQuence:AUTO:CTRigger:TIME?
< 0.1
```

:LTRaining:SEQuence:AUTO:AWAit:TIME <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0.1 to 300.0	0.1 to 300.0, 0.1 step
Function	Sets the time to wait after **Link Start** is clicked, a power reset or power OFF signal is sent and the power is turned ON, and before Link Training is started (DUT is stabilized).	
Example	To set the wait time to 5 seconds.	

```
>:LTRaining:SEQuence:AUTO:AWAit:TIME 5.0
```

:LTRaining:SEQuence:AUTO:AWAit:TIME?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0.1 to 300.0	0.1 to 300.0, 0.1 step
Function	Queries the time to wait after **Link Start** is clicked, a power reset or power OFF signal is sent and the power is turned ON, and before Link Training is started (DUT is stabilized).	
Example		

```
>:LTRaining:SEQuence:AUTO:AWAit:TIME?
< 5.0
```

:LTRaining:SEQuence:LTSSm:EXIT:DACTive <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	IMMediate	Makes a state transition immediately after Link Start.
	DSIGnal	Makes a state transition when ED receives 8b10 signals from DUT after Link Start.
Function	Sets the condition to make a transition from Detect.Active state to Polling.Active state during Link Training.	
Example	`> :LTRaining:SEQuence:LTSSm:EXIT:DACTive IMMediate`	

:LTRaining:SEQuence:LTSSm:EXIT:DACTive?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	IMM	Makes a state transition immediately after Link Start.
	DSIG	Makes a state transition when ED receives 8b10 signals from DUT after Link Start.
Function	Queries the condition to make a transition from Detect.Active state to Polling.Active state during Link Training.	

Example	`> :LTRaining:SEQuence:LTSSm:EXIT:DACTive?`
	`< IMM`	

:LTRaining:SEQuence:SRIS <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	OFF or 0	Common Ref Clock (SRIS Disable)
	ON or 1	SRIS (SRIS Enable)
	2	SRNS
Function	Sets a clock architecture. (Equivalent to the existing parameter SRIS) Existing arguments can be used directly.	
Example	To operate using Separate Reference clock with Independent SSC (SRIS).	

```
> :LTRaining:SEQuence:SRIS 1
```

:LTRaining:SEQuence:SRIS?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Common Ref Clock (SRIS Disable)
	1	SRIS (SRIS Enable)
	2	SRNS
Function	Queries the clock architecture.	
Example		

```
> :LTRaining:SEQuence:SRIS?
< 1
```

:LTRaining:SEQuence:SSC <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	SSC OFF
	ON or 1	SSC ON
Function	Sets whether to apply SSC to MP1900A.	
Example	To turn on SSC:	

```
> :LTRaining:SEQuence:SSC 1
```

:LTRaining:SEQuence:SSC?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	SSC OFF
	1	SSC ON
Function	Queries whether SSC is applied to MP1900A.	
Example		

```
> :LTRaining:SEQuence:SSC?
< 1
```

:LTRaining:SEQuence:SKP <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	SKP OS not inserted
	ON or 1	SKP OS inserted
Function	Selects whether to insert SKP OS during link training.	
Example	To insert SKP OS	

```
> :LTRaining:SEQuence:SKP ON
```

:LTRaining:SEQuence:SKP?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	SKP OS not inserted
	1	SKP OS inserted
Function	Queries whether SKP OS is inserted during link training.	
Example		

```
> :LTRaining:SEQuence:SKP?
< 1
```

:LTRaining:SEQuence:SKP:SLENgth:8B10B <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	1	COM + 1 symbol
	2	COM + 2 symbols
	3	COM + 3 symbols
	4	COM + 4 symbols
	5	COM + 5 symbols
Function	Sets the number of SKP symbols to be inserted by SKP Ordered Set for 8b/10b encoding.	
Example	To set the number of SKP OS SKP symbols to 3:	

```
>:LTRaining:SEQuence:SKP:SLENgth:8B10B 3
```

:LTRaining:SEQuence:SKP:SLENgth:8B10B?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA> 1, 2, 3, 4, 5
Function	Queries the number of SKP symbols to be inserted by SKP Ordered Set for 8b/10b encoding.
Example	

```
> :LTRaining:SEQuence:SKP:SLENgth:8B10B?
< 3
```

:LTRaining:SEQuence:SKP:INTerval:8B10B <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA> 80 to 3076 80 to 3076, 2 step
Function	Sets the interval for SKP Ordered Set occurring during link training execution for 8b/10b encoding.
Example	To generate an SKP OS once after every 1538 symbols sent: `>:LTRaining:SEQuence:SKP:INTerval:8B10B 1538`

:LTRaining:SEQuence:SKP:INTerval:8B10B?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA> 80 to 3076 80 to 3076, 2 step
Function	Queries the interval for SKP Ordered Set occurring during link training execution for 8b/10b encoding.

Example	`>:LTRaining:SEQuence:SKP:INTerval:8B10B?`
	`< 1538`

:LTRaining:SEQuence:SKP:DOUBle:8B10B <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA> OFF or 0 Double SKP OS not inserted. ON or 1 Double SKP OS inserted.
Function	Selects whether to insert double SKP OS while transmitting a test pattern with 8b/10b encoding and in Loopback.Active state.
Example	To insert double SKP OS. `> :LTRaining:SEQuence:DOUBle:8B10B 1`

:LTRaining:SEQuence:SKP:DOUBle:8B10B?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA> 0 Double SKP OS not inserted. 1 Double SKP OS inserted.
Function	Queries whether to insert double SKP OS while transmitting a test pattern with 8b/10b encoding and in Loopback.Active state.

Example	`> :LTRaining:SEQuence:DOUBle:8B10B?`
	`< 1`

:LTRaining:SEQuence:SKP:SLENgth:128B130B <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	8	8 Symbols
	12	12 Symbols
	16	16 Symbols
	20	20 Symbols
	24	24 Symbols
Function	Sets the number of SKP symbols to be inserted by SKP Ordered Set for 128b/130b encoding.	
Example	To set the number of SKP OS SKP symbols to 8:	

```
> :LTRaining:SEQuence:SKP:SLENgth:128B130B 8
```

:LTRaining:SEQuence:SKP:SLENgth:128B130B?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA> 8, 12, 16, 20, 24
Function	Queries the number of SKP symbols to be inserted by SKP Ordered Set for 128b/130b encoding.
Example	

```
> :LTRaining:SEQuence:SKP:SLENgth:128B130B?
< 8
```

:LTRaining:SEQuence:SKP:INTerval:128B130B <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	20 to 750	20 to 750, 1 step
Function	Sets the interval for SKP Ordered Set occurring during link training execution for 128b/130b encoding.	
Example	To generate an SKP OS once after every 375 blocks sent:	

```
>:LTRaining:SEQuence:SKP:INTerval:128B130B 375
```

:LTRaining:SEQuence:SKP:INTerval:128B130B?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	20 to 750	20 to 750
Function	Queries the interval for SKP Ordered Set occurring during link training execution for 128b/130b encoding.	
Example		

```
>:LTRaining:SEQuence:SKP:INTerval:128b130b?
< 375
```

:LTRaining:SEQuence:SKP:DOUBle:128B130B <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	Double SKP OS not inserted.
	ON or 1	Double SKP OS inserted.
Function	Selects whether to insert double SKP OS while transmitting a test pattern with 128b/130b encoding and in Loopback.Active state.	
Example	To insert double SKP OS.	
	`> :LTRaining:SEQuence:DOUBle:128B130B 1`	

:LTRaining:SEQuence:SKP:DOUBle:128B130B?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Double SKP OS not inserted.
	1	Double SKP OS inserted.
Function	Queries whether to insert double SKP OS while transmitting a test pattern with 128b/130b encoding and in Loopback.Active state.	
Example	`> :LTRaining:SEQuence:DOUBle:128B130B?`	
	`< 1`	

:LTRaining:SEQuence:FILTer <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	Does not filter SKP OS.
	ON or 1	Filters SKP OS.
Function	Sets whether to filter SKP OS at the BER measurement.	
Example	To filter SKP OS.	
	`> :LTRaining:SEQuence:FILTer ON`	

:LTRaining:SEQuence:FILTer?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	SKP OS is not filtered.
	1	SKP OS is filtered.
Function	Queries whether to filter SKP OS at the BER measurement.	
Example	`> :LTRaining:SEQuence:FILTer?`	
	`< 1`	

:LTRaining:SEQuence:REV2:DEMPhasis <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	–6.0	–6.0 dB
	–3.5	–3.5 dB
Function	Sets De-emphasis for PCIe 2.0 operation.	
Example	To set De-emphasis to –6.0 dB.	

```
> :LTRaining:SEQuence:REV2:DEMPhasis -6.0
```

:LTRaining:SEQuence:REV2:DEMPhasis?

Response	<numeric>=<NR2 NUMERIC RESPONSE DATA> –6.0, –3.5
Function	Queries De-emphasis for PCIe 2.0 operation.
Example	

```
> :LTRaining:SEQuence:REV2:DEMPhasis?
< -6.0
```

:LTRaining:SEQuence:REV3:RECovery:PH2_3 <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	TRY	Tries Recovery.Equalization.Phase2 and 3.
	SKIP	Skips Recovery.Equalization.Phase2 and 3.
Function	Sets whether to try Recovery.Equalization.Phase2 and 3.	
Example	To set Recovery.Equalization.Phase2 and 3 to TRY.	

```
> :LTRaining:SEQuence:REV3:RECovery:PH2_3 TRY
```

:LTRaining:SEQuence:REV3:RECovery:PH2_3?

Response	<type>=<CHARACTER RESPONSE DATA> TRY, SKIP
Function	Queries whether to try Recovery.Equalization.Phase2 and 3.
Example	

```
> :LTRaining:SEQuence:REV3:RECovery:PH2_3?
< TRY
```

:LTRaining:SEQuence:REV4:RECovery:PH2_3 <type>

Parameter <type>=<CHARACTER PROGRAM DATA>

TRY	Tries Recovery.Equalization.Phase2 and 3.
SKIP	Skips Recovery.Equalization.Phase2 and 3.

Function Sets whether to try Recovery.Equalization.Phase2 and 3.

Example To set Recovery.Equalization.Phase2 and 3 to TRY.

```
> :LTRaining:SEQuence:REV4:RECovery:PH2_3 TRY
```

:LTRaining:SEQuence:REV4:RECovery:PH2_3?

Response <type>=<CHARACTER RESPONSE DATA>

TRY, SKIP

Function Queries whether to try Recovery.Equalization.Phase2 and 3.

Example

```
> :LTRaining:SEQuence:REV4:RECovery:PH2_3?
< TRY
```

:LTRaining:SEQuence:REV5:RECovery:PH2_3 <type>

Parameter <type>=<CHARACTER PROGRAM DATA>

TRY	Tries Recovery.Equalization.Phase2 and 3.
SKIP	Skips Recovery.Equalization.Phase2 and 3.

Function Sets whether to try Recovery.Equalization.Phase2 and 3.

Example To set Recovery.Equalization.Phase2 and 3 to TRY.

```
> :LTRaining:SEQuence:REV5:RECovery:PH2_3 TRY
```

:LTRaining:SEQuence:REV5:RECovery:PH2_3?

Response <type>=<CHARACTER RESPONSE DATA>

TRY, SKIP

Function Queries whether to try Recovery.Equalization.Phase2 and 3.

Example

```
> :LTRaining:SEQuence:REV5:RECovery:PH2_3?
< TRY
```

:LTRaining:SEQuence:REV3:RECovery:ALGorithm <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0	Increment
	1	Change Preset
Function	Sets Preset change method of Recovery.Equalization.Phase2 and 3 (Gen3).	
Example	To set Preset change method to Change Preset. `> :LTRaining:SEQuence:REV3:RECovery:ALGorithm 1`	

:LTRaining:SEQuence:REV3:RECovery:ALGorithm?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Increment
	1	Change Preset
Function	Queries Preset change method of Recovery.Equalization.Phase2 and 3 (Gen3).	

Example	`> :LTRaining:SEQuence:REV3:RECovery:ALGorithm?`
	`< 1`	

:LTRaining:SEQuence:REV4:RECovery:ALGorithm <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0	Increment
	1	Change Preset
Function	Sets Preset change method of Recovery.Equalization.Phase2 and 3 (Gen4).	
Example	To set Preset change method to Change Preset. `> :LTRaining:SEQuence:REV4:RECovery:ALGorithm 1`	

:LTRaining:SEQuence:REV4:RECovery:ALGorithm?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Increment
	1	Change Preset
Function	Queries Preset change method of Recovery.Equalization.Phase2 and 3 (Gen4).	

Example	`> :LTRaining:SEQuence:REV4:RECovery:ALGorithm?`
	`< 1`	

:LTRaining:SEQuence:REV5:RECovery:ALGorithm <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0	Increment
	1	Change Preset
Function	Sets Preset change method of Recovery.Equalization.Phase2 and 3 (Gen5).	
Example	To set Preset change method to Change Preset. `> :LTRaining:SEQuence:REV5:RECovery:ALGorithm 1`	

:LTRaining:SEQuence:REV5:RECovery:ALGorithm?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Increment
	1	Change Preset
Function	Queries Preset change method of Recovery.Equalization.Phase2 and 3 (Gen5).	

Example	`> :LTRaining:SEQuence:REV5:RECovery:ALGorithm?`
	`< 1`	

:LTRaining:SEQuence:REV3:REPeat:ROOT <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	1 to 12	1 to 12, 1 step
Function	Sets the number of times Recovery.Equalization is tried during Root Complex test.	
Example	To set the number of times Recovery.Equalization is tried to 5.	

```
> :LTRaining:SEQuence:REV3:REPeat:ROOT 5
```

:LTRaining:SEQuence:REV3:REPeat:ROOT?

Response <numeric>=<NR1 NUMERIC RESPONSE DATA>

1 to 12

Function Queries the number of times Recovery.Equalization is tried during Root Complex test.

Example

```
> :LTRaining:SEQuence:REV3:REPeat:ROOT?
< 5
```

:LTRaining:SEQuence:REV3:REPeat:ENDPoint <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	1 to 12	1 to 12, 1 step
Function	Sets the number of times Recovery.Equalization is tried during End Point test.	
Example	To set the number of times Recovery.Equalization is tried to 5.	

```
> :LTRaining:SEQuence:REV3:REPeat:ENDPoint 5
```

:LTRaining:SEQuence:REV3:REPeat:ENDPoint?

Response <numeric>=<NR1 NUMERIC RESPONSE DATA>

1 to 12

Function Queries the number of times Recovery.Equalization is tried during End Point test.

Example

```
> :LTRaining:SEQuence:REV3:REPeat:ENDPoint?
< 5
```

:LTRaining:SEQuence:REV4:REPeat:ROOT <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	1 to 12	1 to 12, 1 step
Function	Sets the number of times Recovery.Equalization is tried during Root Complex test.	
Example	To set the number of times Recovery.Equalization is tried to 5. `> :LTRaining:SEQuence:REV4:REPeat:ROOT 5`	

:LTRaining:SEQuence:REV4:REPeat:ROOT?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA> 1 to 12
Function	Queries the number of times Recovery.Equalization is tried during Root Complex test.

Example	`> :LTRaining:SEQuence:REV4:REPeat:ROOT?`
	`< 5`

:LTRaining:SEQuence:REV4:REPeat:ENDPoint <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	1 to 12	1 to 12, 1 step
Function	Sets the number of times Recovery.Equalization is tried during End Point test.	
Example	To set the number of times Recovery.Equalization is tried to 5. `> :LTRaining:SEQuence:REV4:REPeat:ENDPoint 5`	

:LTRaining:SEQuence:REV4:REPeat:ENDPoint?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA> 1 to 12
Function	Queries the number of times Recovery.Equalization is tried during End Point test.

Example	`> :LTRaining:SEQuence:REV4:REPeat:ENDPoint?`
	`< 5`

:LTRaining:SEQuence:REV5:REPeat:ROOT <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA> 1 to 12 1 to 12, 1 step
Function	Sets the number of times Recovery.Equalization is tried during Root Complex test.
Example	To set the number of times Recovery.Equalization is tried to 5.

```
> :LTRaining:SEQuence:REV5:REPeat:ROOT 5
```

:LTRaining:SEQuence:REV5:REPeat:ROOT?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA> 1 to 12
Function	Queries the number of times Recovery.Equalization is tried during Root Complex test.
Example	

```
> :LTRaining:SEQuence:REV5:REPeat:ROOT?
< 5
```

:LTRaining:SEQuence:REV5:REPeat:ENDPoint <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA> 1 to 12 1 to 12, 1 step
Function	Sets the number of times Recovery.Equalization is tried during End Point test.
Example	To set the number of times Recovery.Equalization is tried to 5.

```
> :LTRaining:SEQuence:REV5:REPeat:ENDPoint 5
```

:LTRaining:SEQuence:REV5:REPeat:ENDPoint?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA> 1 to 12
Function	Queries the number of times Recovery.Equalization is tried during End Point test.
Example	

```
> :LTRaining:SEQuence:REV5:REPeat:ENDPoint?
< 5
```

:LTRaining:SEQuence:REV3:UPReset <type>

Parameter <type>=<CHARACTER PROGRAM DATA>

UCURsor	Requests an Equalizer change to the DUT using User Cursor.
PRESet	Requests an Equalizer change to the DUT using Preset.
CURSor	Requests an Equalizer change to the DUT using Cursor.
SCURsor	Requests an Equalizer change to the DUT using Saved Cursor.

Function Requests an Equalizer change to the DUT when the MP1900A operates using PCIe 3.0 and is in the Recovery.Equalization state. The value used by Equalizer (Use Preset) is specified by the parameter.

Example To set Use Preset of PCIe 3.0 to Cursor.

```
> :LTRaining:SEQuence:REV3:UPReset CURSor
```

:LTRaining:SEQuence:REV3:UPReset?

Response <type>=<CHARACTER PROGRAM DATA>

UCUR	Requests an Equalizer change to the DUT using User Cursor.
PRES	Requests an Equalizer change to the DUT using Preset.
CURS	Requests an Equalizer change to the DUT using Cursor.
SCUR	Requests an Equalizer change to the DUT using Saved Cursor.

Function Queries the method for requesting an Equalizer change to the DUT when the MP1900A operates using PCIe 3.0 and is in the Recovery.Equalization state.

Example

```
> :LTRaining:SEQuence:REV3:UPReset?
< CURS
```

:LTRaining:SEQuence:REV4:UPReset <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	UCURsor	Requests an Equalizer change to the DUT using User Cursor.
	PRESet	Requests an Equalizer change to the DUT using Preset.
	CURSor	Requests an Equalizer change to the DUT using Cursor.
	SCURsor	Requests an Equalizer change to the DUT using Saved Cursor.
Function	Requests an Equalizer change to the DUT when the MP1900A operates using PCIe 4.0 and is in the Recovery.Equalization state. The value used by Equalizer (Use Preset) is specified by the parameter.	
Example	To set Use Preset of PCIe 4.0 to Cursor.	

```
> :LTRaining:SEQuence:REV4:UPReset CURSor
```

:LTRaining:SEQuence:REV4:UPReset?

Response	<type>=<CHARACTER PROGRAM DATA>	
	UCUR	Requests an Equalizer change to the DUT using User Cursor.
	PRES	Requests an Equalizer change to the DUT using Preset.
	CURS	Requests an Equalizer change to the DUT using Cursor.
	SCUR	Requests an Equalizer change to the DUT using Saved Cursor.
Function	Queries the method for requesting an Equalizer change to the DUT when the MP1900A operates using PCIe 4.0 and is in the Recovery.Equalization state.	
Example		

```
> :LTRaining:SEQuence:REV4:UPReset?
< CURS
```

:LTRaining:SEQuence:REV5:UPReset <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	UCURsor	Requests an Equalizer change to the DUT using User Cursor.
	PRESet	Requests an Equalizer change to the DUT using Preset.
	CURSor	Requests an Equalizer change to the DUT using Cursor.
	SCURsor	Requests an Equalizer change to the DUT using Saved Cursor.
Function	Requests an Equalizer change to the DUT when the MP1900A operates using PCIe 5.0 and is in the Recovery.Equalization state. The value used by Equalizer (Use Preset) is specified by the parameter.	
Example	To set Use Preset of PCIe 5.0 to Cursor.	

```
> :LTRaining:SEQuence:REV5:UPReset CURSor
```

:LTRaining:SEQuence:REV5:UPReset?

Response	<type>=<CHARACTER PROGRAM DATA>	
	UCUR	Requests an Equalizer change to the DUT using User Cursor.
	PRES	Requests an Equalizer change to the DUT using Preset.
	CURS	Requests an Equalizer change to the DUT using Cursor.
	SCUR	Requests an Equalizer change to the DUT using Saved Cursor.
Function	Queries the method for requesting an Equalizer change to the DUT when the MP1900A operates using PCIe 5.0 and is in the Recovery.Equalization state.	
Example		

```
> :LTRaining:SEQuence:REV5:UPReset?
< CURS
```

:LTRaining:SEQuence:REV3:DSTReam:PRESet <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0 to 10	P0 to P10, 1 step
Function	Sets the Preset value to be notified to the DUT when the DUT is operating as Downstream Port (Root Complex) in PCIe 3.0. Sets the Preset value used by SI PPG or PAM4 PPG when the DUT is operating as Upstream Port (Endpoint).	
Example	To set the Preset value to P7.	

```
> :LTRaining:SEQuence:REV3:DSTReam:PRESet 7
```

:LTRaining:SEQuence:REV3:DSTReam:PRESet?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0 to 10	P0 to P10
Function	Queries the Preset value to be notified to the DUT when the DUT is operating as Downstream Port (Root Complex) in PCIe 3.0. Queries the Preset value used by SI PPG or PAM4 PPG when the DUT is operating as Upstream Port (Endpoint).	
Example		

```
> :LTRaining:SEQuence:REV3:DSTReam:PRESet?
< 7
```

:LTRaining:SEQuence:REV3:DSTReam:HPRESet <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	–12 to –6	–12 to –6 dB, 1 step
Function	Sets the Preset Hint value to be notified to the DUT when the DUT is operating as Downstream Port (Root Complex) in PCIe 3.0. Sets the Preset Hint value when the DUT is operating as Upstream Port (Endpoint).	
Example	To set Preset Hint to –10 dB.	

```
> :LTRaining:SEQuence:REV3:DSTReam:HPRESet -10
```

:LTRaining:SEQuence:REV3:DSTReam:HPRESet?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	–12 to –6	–12 to –6 dB
Function	Queries the Preset Hint value to be notified to the DUT when the DUT is operating as Downstream Port (Root Complex) in PCIe 3.0. Queries the Preset Hint value to be notified to the DUT when the DUT is operating as Upstream Port (Endpoint).	
Example		

```
> :LTRaining:SEQuence:REV3:DSTReam:HPRESet?
< -10
```

:LTRaining:SEQuence:REV4:DSTReam:PRESet <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0 to 10	P0 to P10, 1 step
Function	Sets the Preset value to be notified to the DUT when the DUT is operating as Downstream Port (Root Complex) in PCIe 4.0. Sets the Preset value used by SI PPG or PAM4 PPG when the DUT is operating as Upstream Port (Endpoint).	
Example	To set the Preset value to P7. `> :LTRaining:SEQuence:REV4:DSTReam:PRESet 7`	

:LTRaining:SEQuence:REV4:DSTReam:PRESet?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0 to 10	P0 to P10
Function	Queries the Preset value to be notified to the DUT when the DUT is operating as Downstream Port (Root Complex) in PCIe 4.0. Queries the Preset value used by SI PPG or PAM4 PPG when the DUT is operating as Upstream Port (Endpoint).	

Example	`> :LTRaining:SEQuence:REV4:DSTReam:PRESet?`
	`< 7`	

:LTRaining:SEQuence:REV5:DSTReam:PRESet <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0 to 10	P0 to P10, 1 step
Function	Sets the Preset value to be notified to the DUT when the DUT is operating as Downstream Port (Root Complex) in PCIe 5.0. Sets the Preset value used by SI PPG or PAM4 PPG when the DUT is operating as Upstream Port (Endpoint).	
Example	To set the Preset value to P7. `> :LTRaining:SEQuence:REV5:DSTReam:PRESet 7`	

:LTRaining:SEQuence:REV5:DSTReam:PRESet?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0 to 10	P0 to P10
Function	Queries the Preset value to be notified to the DUT when the DUT is operating as Downstream Port (Root Complex) in PCIe 5.0. Queries the Preset value used by SI PPG or PAM4 PPG when the DUT is operating as Upstream Port (Endpoint).	

Example	`> :LTRaining:SEQuence:REV5:DSTReam:PRESet?`
	`< 7`	

:LTRaining:SEQuence:REV3:DSTReam:CPReset <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA> 0 to 10 P0 to P10, 1 step
Function	Sets the Change Preset value that DUT (Downstream Port, Root Complex) is requested for in PCIe 3.0 operation.
Example	To set the Change Preset value to P7. `> :LTRaining:SEQuence:REV3:DSTReam:CPReset 7`

:LTRaining:SEQuence:REV3:DSTReam:CPReset?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA> 0 to 10 P0 to P10
Function	Queries the Change Preset value that DUT (Downstream Port, Root Complex) is requested for in PCIe 3.0 operation.

Example	`> :LTRaining:SEQuence:REV3:DSTReam:CPReset?`
	`< 7`

:LTRaining:SEQuence:REV4:DSTReam:CPReset <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA> 0 to 10 P0 to P10, 1 step
Function	Sets the Change Preset value that DUT (Downstream Port, Root Complex) is requested for in PCIe 4.0 operation.
Example	To set the Change Preset value to P7. `> :LTRaining:SEQuence:REV4:DSTReam:CPReset 7`

:LTRaining:SEQuence:REV4:DSTReam:CPReset?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA> 0 to 10 P0 to P10
Function	Queries the Change Preset value that DUT (Downstream Port, Root Complex) is requested for in PCIe 4.0 operation.

Example	`> :LTRaining:SEQuence:REV4:DSTReam:CPReset?`
	`< 7`

:LTRaining:SEQuence:REV5:DSTReam:CPReset <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0 to 10	P0 to P10, 1 step
Function	Sets the Change Preset value that DUT (Downstream Port, Root Complex) is requested for in PCIe 5.0 operation.	
Example	To set the Change Preset value to P7.	

```
> :LTRaining:SEQuence:REV5:DSTReam:CPReset 7
```

:LTRaining:SEQuence:REV5:DSTReam:CPReset?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0 to 10	P0 to P10
Function	Queries the Change Preset value that DUT (Downstream Port, Root Complex) is requested for in PCIe 5.0 operation.	
Example		

```
> :LTRaining:SEQuence:REV5:DSTReam:CPReset?
< 7
```

:LTRaining:SEQuence:REV3:USTReam:PRESet <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA> 0 to 10 P0 to P10, 1 step
Function	Sets the Preset value to be notified to the DUT when the DUT is operating as Upstream Port (Endpoint) in PCIe 3.0. Sets the Preset value used by SI PPG or PAM4 PPG when the DUT is operating as Downstream Port (Root Complex).
Example	To set the Preset value to P7.

```
> :LTRaining:SEQuence:REV3:USTReam:PRESet 7
```

:LTRaining:SEQuence:REV3:USTReam:PRESet?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA> 0 to 10 P0 to P10
Function	Queries the Preset value to be notified to the DUT when the DUT is operating as Upstream Port (Endpoint) in PCIe 3.0. Queries the Preset value used by SI PPG or PAM4 PPG when the DUT is operating as Downstream Port (Root Complex).
Example	

```
> :LTRaining:SEQuence:REV3:USTReam:PRESet?
< 7
```

:LTRaining:SEQuence:REV3:USTReam:HPRESet <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA> –12 to –6 –12 to –6 dB, 1 step
Function	Sets the Preset Hint value to be notified to the DUT when the DUT is operating as Upstream Port (Endpoint) in PCIe 3.0. Sets the Preset Hint value used by SI PPG or PAM4 PPG when the DUT is operating as Downstream Port (Root Complex).
Example	To set Preset Hint to –10 dB.

```
> :LTRaining:SEQuence:REV3:USTReam:HPRESet -10
```

:LTRaining:SEQuence:REV3:USTReam:HPRESet?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA> –12 to –6 –12 to –6 dB
Function	Queries the Preset Hint value to be notified to the DUT when the DUT is operating as Upstream Port (Endpoint) in PCIe 3.0. Queries the Preset Hint value used by SI PPG or PAM4 PPG when the DUT is operating as Downstream Port (Root Complex).
Example	

```
> :LTRaining:SEQuence:REV3:USTReam:HPRESet?
< -10
```

:LTRaining:SEQuence:REV4:USTReam:PRESet <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0 to 10	P0 to P10, 1 step
Function	Sets the Preset value to be notified to the DUT when the DUT is operating as Upstream Port (Endpoint) in PCIe 4.0. Sets the Preset value used by SI PPG or PAM4 PPG when the DUT is operating as Downstream Port (Root Complex).	
Example	To set the Preset value to P7.	

```
> :LTRaining:SEQuence:REV4:USTReam:PRESet 7
```

:LTRaining:SEQuence:REV4:USTReam:PRESet?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0 to 10	P0 to P10
Function	Queries the Preset value to be notified to the DUT when the DUT is operating as Upstream Port (Endpoint) in PCIe 4.0. Queries the Preset value used by SI PPG or PAM4 PPG when the DUT is operating as Downstream Port (Root Complex).	
Example		

```
> :LTRaining:SEQuence:REV4:USTReam:PRESet?
< 7
```

:LTRaining:SEQuence:REV5:USTReam:PRESet <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0 to 10	P0 to P10, 1 step
Function	Sets the Preset value to be notified to the DUT when the DUT is operating as Upstream Port (Endpoint) in PCIe 5.0. Sets the Preset value used by SI PPG or PAM4 PPG when the DUT is operating as Downstream Port (Root Complex)	
Example	To set the Preset value to P7.	

```
> :LTRaining:SEQuence:REV5:USTReam:PRESet 7
```

:LTRaining:SEQuence:REV5:USTReam:PRESet?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0 to 10	P0 to P10
Function	Queries the Preset value to be notified to the DUT when the DUT is operating as Upstream Port (Endpoint) in PCIe 5.0. Queries the Preset value used by SI PPG or PAM4 PPG when the DUT is operating as Downstream Port (Root Complex).	
Example		

```
> :LTRaining:SEQuence:REV5:USTReam:PRESet?
< 7
```

:LTRaining:SEQuence:REV3:USTReam:CPReset <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA> 0 to 10 P0 to P10, 1 step
Function	Sets the Change Preset value that DUT (Upstream Port, Endpoint) is requested for in PCIe 3.0 operation.
Example	To set the Change Preset value to P7. `> :LTRaining:SEQuence:REV3:USTReam:CPReset 7`

:LTRaining:SEQuence:REV3:USTReam:CPReset?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA> 0 to 10 P0 to P10
Function	Queries the Change Preset value that DUT (Upstream Port, Endpoint) is requested for in PCIe 3.0 operation.

Example	`> :LTRaining:SEQuence:REV3:USTReam:CPReset?`
	`< 7`

:LTRaining:SEQuence:REV4:USTReam:CPReset <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA> 0 to 10 P0 to P10, 1 step
Function	Sets the Change Preset value that DUT (Upstream Port, Endpoint) is requested for in PCIe 4.0 operation.
Example	To set the Change Preset value to P7. `> :LTRaining:SEQuence:REV4:USTReam:CPReset 7`

:LTRaining:SEQuence:REV4:USTReam:CPReset?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA> 0 to 10 P0 to P10
Function	Queries the Change Preset value that DUT (Upstream Port, Endpoint) is requested for in PCIe 4.0 operation.

Example	`> :LTRaining:SEQuence:REV4:USTReam:CPReset?`
	`< 7`

:LTRaining:SEQuence:REV5:USTReam:CPReset <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0 to 10	P0 to P10, 1 step
Function	Sets the Change Preset value that DUT (Upstream Port, Endpoint) is requested for in PCIe 5.0 operation.	
Example	To set the Change Preset value to P7.	

```
> :LTRaining:SEQuence:REV5:USTReam:CPReset 7
```

:LTRaining:SEQuence:REV5:USTReam:CPReset?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0 to 10	P0 to P10
Function	Queries the Change Preset value that DUT (Upstream Port, Endpoint) is requested for in PCIe 5.0 operation.	
Example		

```
> :LTRaining:SEQuence:REV5:USTReam:CPReset?
< 7
```

:LTRaining:SEQuence:REV3:DSTReam:UCURsor <type>,<numeric>

Parameter	<type>=<CHARACTER PROGRAM DATA>
	FS Sets the FS value to notify DUT.
	C-1 Sets the C-1 value to notify DUT.
	C+1 Sets the C+1 value to notify DUT.
	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>
	0 to 63 (when FS is set:12 to 63) 1 step
Function	Sets the cursor value to notify DUT when Specification is PCIe 3.0 and DUT is Downstream Port (Root Complex). Sets the cursor value to be used by SI PPG or PAM4 PPG when DUT is Upstream Port (Endpoint). The FS value is fixed to 24 in this case.
Example	To set the FS value to 24.

```
> :LTRaining:SEQuence:REV3:DSTReam:UCURsor FS,24
```

:LTRaining:SEQuence:REV3:DSTReam:UCURsor? <type>

Parameter	<type>=<CHARACTER PROGRAM DATA> FS C-1 C+1
Response	<numeric>=<NR1 NUMERIC RESPONSE DATA> 0 to 63 0 to 63
Function	Queries the cursor value to notify DUT when Specification is PCIe 3.0 and DUT is Downstream Port (Root Complex). Queries the cursor value to be used by SI PPG or PAM4 PPG when DUT is Upstream Port (Endpoint).
Example	

```
> :LTRaining:SEQuence:REV3:DSTReam:UCURsor? FS
< 24
```

:LTRaining:SEQuence:REV4:DSTReam:UCURsor <type>,<numeric>

Parameter

<type>=<CHARACTER PROGRAM DATA>

FS	Sets the FS value to notify DUT.
C-1	Sets the C-1 value to notify DUT.
C+1	Sets the C+1 value to notify DUT.

<numeric>=<DECIMAL NUMERIC PROGRAM DATA>

0 to 63 (when FS is set:12 to 63) 1 step

Function

Sets the cursor value to notify DUT when Specification is PCIe 4.0 and DUT is Downstream Port (Root Complex).

Sets the cursor value to be used by SI PPG or PAM4 PPG when DUT is Upstream Port (Endpoint). The FS value is fixed to 24 in this case.

Example

To set the FS value to 24.

```
> :LTRaining:SEQuence:REV4:DSTReam:UCURsor FS,24
```

:LTRaining:SEQuence:REV4:DSTReam:UCURsor? <type>

Parameter

<type>=<CHARACTER PROGRAM DATA>

FS

C-1

C+1

Response

<numeric>=<NR1 NUMERIC RESPONSE DATA>

0 to 63	0 to 63

Function

Queries the cursor value to notify DUT when Specification is PCIe 4.0 and DUT is Downstream Port (Root Complex).

Queries the cursor value to be used by SI PPG or PAM4 PPG when DUT is Upstream Port (Endpoint).

Example

```
> :LTRaining:SEQuence:REV4:DSTReam:UCURsor? FS
< 24
```

:LTRaining:SEQuence:REV5:DSTReam:UCURsor <type>,<numeric>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	FS	Sets the FS value to notify DUT.
	C-1	Sets the C-1 value to notify DUT.
	C+1	Sets the C+1 value to notify DUT.
	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0 to 63 (when FS is set:12 to 63) 1 step	
Function	Sets the cursor value to notify DUT when Specification is PCIe 5.0 and DUT is Downstream Port (Root Complex). Sets the cursor value to be used by SI PPG or PAM4 PPG when DUT is Upstream Port (Endpoint). The FS value is fixed to 24 in this case.	
Example	To set the FS value to 24.	

```
> :LTRaining:SEQuence:REV5:DSTReam:UCURsor FS,24
```

:LTRaining:SEQuence:REV5:DSTReam:UCURsor? <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	FS	
	C-1	
	C+1	
Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0 to 63	0 to 63
Function	Queries the cursor value to notify DUT when Specification is PCIe 5.0 and DUT is Downstream Port (Root Complex). Queries the cursor value to be used by SI PPG or PAM4 PPG when DUT is Upstream Port (Endpoint).	
Example		

```
> :LTRaining:SEQuence:REV5:DSTReam:UCURsor? FS
< 24
```

:LTRaining:SEQuence:REV3:DSTReam:RECovery:UCURsor <type>,<numeric>

Parameter

<type>=<CHARACTER PROGRAM DATA>

FS	Sets the FS value to notify DUT.
C-1	Sets the C-1 value to notify DUT.
C+1	Sets the C+1 value to notify DUT.

<numeric>=<DECIMAL NUMERIC PROGRAM DATA>

0 to 63 (when FS is set:12 to 63) 1 step

Function

Sets the cursor value, which MP1900A requests from DUT (Downstream Port, Root Complex) at Recovery.EQ.Phase2, when Specification is PCIe 3.0.

Example

To set the FS value to 24.

```
> :LTRaining:SEQuence:REV3:DSTReam:RECovery:UCURsor FS,24
```

:LTRaining:SEQuence:REV3:DSTReam:RECovery:UCURsor? <type>

Parameter

<type>=<CHARACTER PROGRAM DATA>

FS

C-1

C+1

Response

<numeric>=<NR1 NUMERIC RESPONSE DATA>

0 to 63	0 to 63

Function

Queries the cursor value, which MP1900A requests from DUT (Downstream Port, Root Complex) at Recovery.EQ.Phase2, when Specification is PCIe 3.0.

Example

```
> :LTRaining:SEQuence:REV3:DSTReam:RECovery:UCURsor? FS
< 24
```

:LTRaining:SEQuence:REV4:DSTReam:RECovery:UCURsor <type>,<numeric>

Parameter

<type>=<CHARACTER PROGRAM DATA>

FS	Sets the FS value to notify DUT.
C-1	Sets the C-1 value to notify DUT.
C+1	Sets the C+1 value to notify DUT.

<numeric>=<DECIMAL NUMERIC PROGRAM DATA>

0 to 63 (when FS is set:12 to 63) 1 step

Function

Sets the cursor value, which MP1900A requests from DUT (Downstream Port, Root Complex) at Recovery.EQ.Phase2, when Specification is PCIe 4.0.

Example

To set the FS value to 24.

```
> :LTRaining:SEQuence:REV4:DSTReam:RECovery:UCURsor FS,24
```

:LTRaining:SEQuence:REV4:DSTReam:RECovery:UCURsor? <type>

Parameter

<type>=<CHARACTER PROGRAM DATA>

FS
C-1
C+1

Response

<numeric>=<NR1 NUMERIC RESPONSE DATA>

0 to 63	0 to 63

Function

Queries the cursor value, which MP1900A requests from DUT (Downstream Port, Root Complex) at Recovery.EQ.Phase2, when Specification is PCIe 4.0.

Example

```
> :LTRaining:SEQuence:REV4:DSTReam:RECovery:UCURsor? FS
< 24
```

:LTRaining:SEQuence:REV5:DSTReam:RECovery:UCURsor <type>,<numeric>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	FS	Sets the FS value to notify DUT.
	C-1	Sets the C-1 value to notify DUT.
	C+1	Sets the C+1 value to notify DUT.
	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0 to 63 (when FS is set:12 to 63) 1 step	
Function	Sets the cursor value, which MP1900A requests from DUT (Downstream Port, Root Complex) at Recovery.EQ.Phase2, when Specification is PCIe 5.0.	
Example	To set the FS value to 24.	

```
> :LTRaining:SEQuence:REV5:DSTReam:RECovery:UCURsor FS,24
```

:LTRaining:SEQuence:REV5:DSTReam:RECovery:UCURsor? <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	FS	
	C-1	
	C+1	
Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0 to 63	0 to 63
Function	Queries the cursor value, which MP1900A requests from DUT (Downstream Port, Root Complex) at Recovery.EQ.Phase2, when Specification is PCIe 5.0.	
Example		

```
> :LTRaining:SEQuence:REV5:DSTReam:RECovery:UCURsor? FS
< 24
```

:LTRaining:SEQuence:REV3:USTReam:UCURsor <type>,<numeric>

Parameter

<type>=<CHARACTER PROGRAM DATA>

FS	Sets the FS value to notify DUT.
C-1	Sets the C-1 value to notify DUT.
C+1	Sets the C+1 value to notify DUT.

<numeric>=<DECIMAL NUMERIC PROGRAM DATA>

0 to 63 (when FS is set:12 to 63) 1 step

Function

Sets the cursor value to notify DUT when Specification is PCIe 3.0 and DUT is Upstream Port (Endpoint).

Sets the cursor value to be used by SI PPG or PAM4 PPG when DUT is Downstream Port (Root Complex). The FS value is fixed to 24 in this case.

Example

To set the FS value to 24.

```
> :LTRaining:SEQuence:REV3:USTReam:UCURsor FS,24
```

:LTRaining:SEQuence:REV3:USTReam:UCURsor? <type>

Parameter

<type>=<CHARACTER PROGRAM DATA>

FS

C-1

C+1

Response

<numeric>=<NR1 NUMERIC RESPONSE DATA>

0 to 63	0 to 63

Function

Queries the cursor value to notify DUT when Specification is PCIe 3.0 and DUT is Upstream Port (Endpoint).

Queries the cursor value to be used by SI PPG or PAM4 PPG when DUT is Downstream Port (Root Complex).

Example

```
> :LTRaining:SEQuence:REV3:USTReam:UCURsor? FS
< 24
```

:LTRaining:SEQuence:REV4:USTReam:UCURsor <type>,<numeric>

Parameter	<type>=<CHARACTER PROGRAM DATA>
	FS Sets the FS value to notify DUT.
	C-1 Sets the C-1 value to notify DUT.
	C+1 Sets the C+1 value to notify DUT.
	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>
	0 to 63 (when FS is set:12 to 63) 1 step
Function	Sets the cursor value to notify DUT when Specification is PCIe 4.0 and DUT is Upstream Port (Endpoint). Sets the cursor value to be used by SI PPG or PAM4 PPG when DUT is Downstream Port (Root Complex). The FS value is fixed to 24 in this case.
Example	To set the FS value to 24.

```
> :LTRaining:SEQuence:REV4:USTReam:UCURsor FS,24
```

:LTRaining:SEQuence:REV4:USTReam:UCURsor? <type>

Parameter	<type>=<CHARACTER PROGRAM DATA> FS C-1 C+1
Response	<numeric>=<NR1 NUMERIC RESPONSE DATA> 0 to 63 0 to 63
Function	Queries the cursor value to notify DUT when Specification is PCIe 4.0 and DUT is Upstream Port (Endpoint). Queries the cursor value to be used by SI PPG or PAM4 PPG when DUT is Downstream Port (Root Complex).
Example	

```
> :LTRaining:SEQuence:REV4:USTReam:UCURsor? FS
< 24
```

:LTRaining:SEQuence:REV5:USTReam:UCURsor <type>,<numeric>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	FS	Sets the FS value to notify DUT.
	C-1	Sets the C-1 value to notify DUT.
	C+1	Sets the C+1 value to notify DUT.
	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0 to 63 (when FS is set:12 to 63) 1 step	
Function	Sets the cursor value to notify DUT when Specification is PCIe 5.0 and DUT is Upstream Port (Endpoint). Sets the cursor value to be used by SI PPG or PAM4 PPG when DUT is Downstream Port (Root Complex). The FS value is fixed to 24 in this case.	
Example	To set the FS value to 24.	

```
> :LTRaining:SEQuence:REV5:USTReam:UCURsor FS,24
```

:LTRaining:SEQuence:REV5:USTReam:UCURsor? <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	FS	
	C-1	
	C+1	
Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0 to 63	0 to 63
Function	Queries the cursor value to notify DUT when Specification is PCIe 5.0 and DUT is Upstream Port (Endpoint). Queries the cursor value to be used by SI PPG or PAM4 PPG when DUT is Downstream Port (Root Complex).	
Example		

```
> :LTRaining:SEQuence:REV5:USTReam:UCURsor? FS
< 24
```

:LTRaining:SEQuence:REV3:USTReam:RECovery:UCURsor <type>,<numeric>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	FS	Sets the FS value to notify DUT.
	C-1	Sets the C-1 value to notify DUT.
	C+1	Sets the C+1 value to notify DUT.
	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0 to 63 (when FS is set:12 to 63) 1 step	
Function	Sets the cursor value, which MP1900A requests from DUT (Upstream Port, Endpoint) at Recovery.EQ.Phase3, when Specification is PCIe 3.0.	
Example	To set the FS value to 24.	

```
> :LTRaining:SEQuence:REV3:USTReam:RECovery:UCURsor FS,24
```

:LTRaining:SEQuence:REV3:USTReam:RECovery:UCURsor? <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	FS	
	C-1	
	C+1	
Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0 to 63	0 to 63
Function	Queries the cursor value, which MP1900A requests from DUT (Upstream Port, Endpoint) at Recovery.EQ.Phase3, when Specification is PCIe 3.0.	
Example		

```
> :LTRaining:SEQuence:REV3:USTReam:RECovery:UCURsor?
< 24
```

:LTRaining:SEQuence:REV4:USTReam:RECovery:UCURsor <type>,<numeric>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	FS	Sets the FS value to notify DUT.
	C-1	Sets the C-1 value to notify DUT.
	C+1	Sets the C+1 value to notify DUT.
	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0 to 63 (when FS is set:12 to 63) 1 step	
Function	Sets the cursor value, which MP1900A requests from DUT (Upstream Port, Endpoint) at Recovery.EQ.Phase3, when Specification is PCIe 4.0.	
Example	To set the FS value to 24.	

```
> :LTRaining:SEQuence:REV4:USTReam:RECovery:UCURsor FS,24
```

:LTRaining:SEQuence:REV4:USTReam:RECovery:UCURsor? <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	FS	
	C-1	
	C+1	
Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0 to 63	0 to 63
Function	Queries the cursor value, which MP1900A requests from DUT (Upstream Port, Endpoint) at Recovery.EQ.Phase3, when Specification is PCIe 4.0.	
Example		

```
> :LTRaining:SEQuence:REV4:USTReam:RECovery:UCURsor? FS
< 24
```

:LTRaining:SEQuence:REV5:USTReam:RECovery:UCURsor <type>,<numeric>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	FS	Sets the FS value to notify DUT.
	C-1	Sets the C-1 value to notify DUT.
	C+1	Sets the C+1 value to notify DUT.
	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0 to 63 (when FS is set:12 to 63) 1 step	
Function	Sets the cursor value, which MP1900A requests from DUT (Upstream Port, Endpoint) at Recovery.EQ.Phase3, when Specification is PCIe 5.0.	
Example	To set the FS value to 24.	

```
> :LTRaining:SEQuence:REV5:USTReam:RECovery:UCURsor FS,24
```

:LTRaining:SEQuence:REV5:USTReam:RECovery:UCURsor? <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	FS	
	C-1	
	C+1	
Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0 to 63	0 to 63
Function	Queries the cursor value, which MP1900A requests from DUT (Upstream Port, Endpoint) at Recovery.EQ.Phase3, when Specification is PCIe 5.0.	
Example		

```
> :LTRaining:SEQuence:REV5:USTReam:RECovery:UCURsor? FS
< 24
```

:LTRaining:SEQuence:TXPReset:IPReset <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0 to 10	P0 to P10, 1 step
Function	Sets the Preset value to use at the sequence start (2.5 GT/s transmission).	
Example	To set the Preset value to P7. `> :LTRaining:SEQuence:TXPReset:IPReset 7`	

:LTRaining:SEQuence:TXPReset:IPReset?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0 to 10	P0 to P10
Function	Queries the Preset value to use at the sequence start (2.5 GT/s transmission).	

Example	`> :LTRaining:SEQuence:TXPReset:IPReset?`
	`< 7`	

:LTRaining:SEQuence:TXPReset:LPReset <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0	Auto
	1	Manual
Function	Sets whether to change manually the Equalization to use in Loopback.Active state.	
Example	To set manually the Equalization to use in Loopback.Active state. `> :LTRaining:SEQuence:TXPReset:LPReset 1`	

:LTRaining:SEQuence:TXPReset:LPReset?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Auto
	1	Manual
Function	Queries whether to change manually the Equalization to use in Loopback.Active state.	

Example	`> :LTRaining:SEQuence:TXPReset:LPReset?`
	`< 1`	

:LTRaining:SEQuence:TXPReset:SELect <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	PRESet	Sets Equalization mode to Preset.
	CURSor	Sets Equalization mode to Cursor.
	USER	Sets Equalization mode to User, which enables Equalization to be set in dB.
Function	To set PPG's Equalization mode to Preset:	
Example	`> :LTRaining:SEQuence:TXPReset:SELect PRESet`	

:LTRaining:SEQuence:TXPReset:SELect?

Response	<type>=<CHARACTER PROGRAM DATA>	
	PRESet	Sets Equalization mode to Preset.
	CURSor	Sets Equalization mode to Cursor.
	USER	Sets Equalization mode to User, which enables Equalization to be set in dB.
Function	Queries PPG's Equalization mode.	

Example	`> :LTRaining:SEQuence:TXPReset:SELect?`
	`< PRES`	

:LTRaining:SEQuence:TXPReset:LPReset:PRESet <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0 to 10	P0 to P10, 1 step
Function	Sets the Preset value to be used in Loopback.Active state. This command is available when **Preset** is selected by :LTRaining:SEQuence:TXPReset:SELect.	
Example	To set the Preset value to P7. `> :LTRaining:SEQuence:TXPReset:LPReset:PRESet 7`	

:LTRaining:SEQuence:TXPReset:LPReset:PRESet?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0 to 10	P0 to P10
Function	Queries the Preset value to be used in Loopback.Active state. This command is available when **Preset** is selected by :LTRaining:SEQuence:TXPReset:SELect.	

Example	`> :LTRaining:SEQuence:TXPReset:LPReset:PRESet?`
	`< 7`	

:LTRaining:SEQuence:TXPCoding <boolean>

Parameter <boolean>=<BOOLEAN PROGRAM DATA>

OFF or 0	Does not perform precoding of Tx data.
ON or 1	Performs precoding of Tx data.

Function Sets whether to perform precoding of the data to be transmitted from MP1900A.

Example

```
> :LTRaining:SEQuence:TXPCoding ON
```

:LTRaining:SEQuence:TXPCoding?

Response <numeric>=<NR1 NUMERIC RESPONSE DATA>

0	Does not perform precoding of Tx data.
1	Performs precoding of Tx data.

Function Queries whether precoding is performed for the data to be transmitted from MP1900A.

Example

```
> :LTRaining:SEQuence:TXPCoding?
< 1
```

:INPut:DATA:EQUalizer:AMPLitude <numeric>

Parameter <numeric>=<DECIMAL NUMERIC PROGRAM DATA>

–12 to 0	–12 to 0 dB, 1 step

Function Sets CTLE Gain to be used in PCIe 3.0 or PCIe 4.0 operation.

This parameter is available only when SI ED (with MU195040A-x11/x21) is installed.

Example To set CTLE Gain to –8 dB.

```
> :INPut:DATA:EQUalizer:AMPLitude -8
```

:INPut:DATA:EQUalizer:AMPLitude?

Response <numeric>=<NR1 NUMERIC RESPONSE DATA>

–12 to 0	–12 to 0 dB, 1 step

Function Queries CTLE Gain to be used in PCIe 3.0 or PCIe 4.0 operation.

This parameter is available only when SI ED (with MU195040A-x11/x21) is installed.

Example

```
> :INPut:DATA:EQUalizer:AMPLitude?
< -8
```

:LTRaining:SEQuence:RXPCoding <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	Does not perform precoding of Rx data.
	ON or 1	Performs precoding of Rx data.
Function	Sets whether to perform precoding of the data to be received by MP1900A.	
Example	`> :LTRaining:SEQuence:RXPCoding ON`	

:LTRaining:SEQuence:RXPCoding?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Does not perform precoding of Rx data.
	1	Performs precoding of Rx data.
Function	Queries whether precoding is performed for the data to be received by MP1900A.	

Example	`> :LTRaining:SEQuence:RXPCoding?`
	`< 1`	

:LTRaining:SEQuence:TRIGger:SELect <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	OFF	Does not output a trigger.
	LEQ	Outputs a trigger when the MP1900A is in the condition specified at Change Preset during LEQ.
	LTSSm	Outputs a trigger when the MP1900A changes to the specified LTSSM during executing Link Training .
Function	Sets the condition when the MP1900A outputs a trigger from the AUX Output of SI PPG or PAM4 PPG.	
Example	To set the trigger output condition to LEQ. `> :LTRaining:SEQuence:TRIGger:SELect LEQ`	

:LTRaining:SEQuence:TRIGger:SELect?

Response <type>=<CHARACTER PROGRAM DATA>

OFF	Does not output a trigger.
LEQ	Outputs a trigger when the MP1900A is in the condition specified at Change Preset during LEQ.
LTSS	Outputs a trigger when the MP1900A changes to the specified LTSSM during executing Link Training .

Function Queries the condition when the MP1900A outputs a trigger from the AUX Output of SI PPG or PAM4 PPG.

Example

```
> :LTRaining:SEQuence:TRIGger:SELect?
< LEQ
```

:LTRaining:SEQuence:TRIGger:SPEed <numeric>

Parameter <numeric>=<DECIMAL NUMERIC PROGRAM DATA>

2.5	2.5 GT/s
5.0	5.0 GT/s
8.0	8.0 GT/s
16.0	16.0 GT/s
32.0	32.0 GT/s

Function Sets the operating data rate condition when the MP1900A outputs a trigger during executing Link Training.

Example To set the trigger output condition to 16.0 GT/s.

```
> :LTRaining:SEQuence:TRIGger:SPEed 16.0
```

:LTRaining:SEQuence:TRIGger:SPEed?

Response <numeric>=<NR2 NUMERIC RESPONSE DATA>

2.5	2.5 GT/s
5.0	5.0 GT/s
8.0	8.0 GT/s
16.0	16.0 GT/s
32.0	32.0 GT/s

Function Queries the operating data rate condition when the MP1900A outputs a trigger during executing Link Training.

Example

```
> :LTRaining:SEQuence:TRIGger:SPEed?
< 16.0
```

:LTRaining:SEQuence:TRIGger:STATe <type>

Parameter

<numeric>=<DECIMAL NUMERIC PROGRAM DATA>

1	Detect.Quiet
2	Detect.Active
17	Polling.Active_TS1
18	Polling.Active_EQTS1
19	Polling.Compliance.Pattern(CP)
20	Polling.Compliance.Change
21	Polling.Compliance.Exit
22	Polling.Configuration
27	Polling.Compliance.Pattern(MCP)
33	Configuration.Linkwidth.Start
34	Configuration.Linkwidth.Accept
35	Configuration.Lanenum.Wait
36	Configuration.Lanenum.Accept
37	Configuration.Complete
38	Configuration.Idle
49	Recovery.Rcvr.Lock
50	Recovery.Speed
51	Recovery.Rcvr.Cfg.TS2
52	Recovery.Rcvr.Cfg.EQTS2
53	Recovery.Idle
56	Recovery.Equalization.Phase0
57	Recovery.Equalization.Phase1
58	Recovery.Equalization.Phase2
59	Recovery.Equalization.Phase3
65	L0
97	Loopback.Entry.Lead.TS1
98	Loopback.Entry.Lead.EQTS1
99	Loopback.Entry.Lead.Change
100	Loopback.Active.Lead
101	Loopback.Exit.Lead
105	Loopback.Entry.Follower
106	Loopback.Active.Follower
107	Loopback.Exit.Follower

Function

Sets the state condition when the MP1900A outputs a trigger during executing Link Training.
This is enabled when **LTSSM** is selected at Trigger Select.

Example

To output a trigger when the MP1900A changes to the Loopback.Active state during executing Link Training.

```
> :LTRaining:SEQuence:TRIGger:STATe 100
```

:LTRaining:SEQuence:TRIGger:STATe?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA> For the return value, refer to the parameter of the `:LTRaining:SEQuence:TRIGger:STATe` command.
Function	Sets the state condition when the MP1900A outputs a trigger during executing Link Training. This is enabled when **LTSSM** is selected at Trigger Select.

Example	`> :LTRaining:SEQuence:TRIGger:STATe?`
	`< 100`

:LTRaining:SEQuence:TRIGger:CPReset <type>

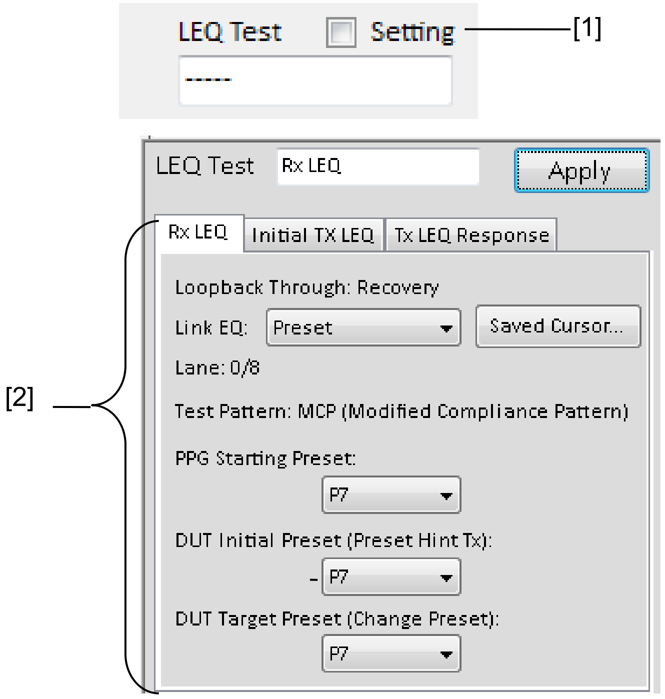
Parameter	<type>=<CHARACTER PROGRAM DATA>	
	SEND	Outputs a trigger when the MP1900A sends Change Preset.
	RECeive	Outputs a trigger when the MP1900A receives Change Preset.
Function	Sets the condition when the MP1900A outputs a trigger during LEQ. This is enabled when **LEQ** is selected at Trigger.	
Example	To output a trigger when the MP1900A sends the Change Preset signal during LEQ. `> :LTRaining:SEQuence:TRIGger:CPReset SEND`	

:LTRaining:SEQuence:TRIGger:CPReset?

Response	<type>=<CHARACTER PROGRAM DATA>	
	SEND	Outputs a trigger when the MP1900A sends Change Preset.
	REC	Outputs a trigger when the MP1900A receives Change Preset.
Function	Sets the condition when the MP1900A outputs a trigger during LEQ. This is enabled when **LEQ** is selected at Trigger.	

Example	`> :LTRaining:SEQuence:TRIGger:CPReset?`
	`< SEND`	

5.9.5 Link Equalization Test setup screen



LEQ Test: ------

LEQ Test: Rx LEQ

Loopback Through: Recovery

Link EQ: Preset

Lane: 0/8

Test Pattern: MCP (Modified Compliance Pattern)

PPG Starting Preset: P7

DUT Initial Preset (Preset Hint Tx): - P7

DUT Target Preset (Change Preset): P7

Figure 5.9.5-1 Link Equalization Test Setup Screen

Table 5.9.5-1 Link Equalization Test Setup Screen and Query Command

No.	Setting Item	Command
[1]	LEQ Test Window	:DISPlay:SETTing:LEQ
		:DISPlay:SETTing:LEQ?
[2]	LEQ Test	:LTRaining:SEQuence:LEQTest:REV3
		:LTRaining:SEQuence:LEQTest:REV3?
		:LTRaining:SEQuence:LEQTest:REV4
		:LTRaining:SEQuence:LEQTest:REV4?
		:LTRaining:SEQuence:LEQTest:REV5
		:LTRaining:SEQuence:LEQTest:REV5?

:DISPlay:SETTing:LEQ <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	Does not display the LEQ Test window.
	ON or 1	Displays the LEQ Test window.
Function	Displays or hides the LEQ Test window.	
Example	To display the LEQ Test window.	

```
> :DISPlay:SETTing:LEQ ON
```

:DISPlay:SETTing:LEQ?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Does not display the LEQ Test window.
	1	Displays the LEQ Test window.
Function	Queries whether the LEQ Test window is displayed.	
Example		

```
> :DISPlay:SETTing:LEQ?
< 1
```

:LTRaining:SEQuence:LEQTest:REV3 <type1>*1,<type2>,<type2>,<type2>*2,<type3>*3

Parameter

<type1>=<CHARACTER PROGRAM DATA>

TXINitial	Initial Tx LEQ Test
TXResponse	Tx LEQ Response Test
RXLeq	Rx LEQ Test

*1: When DUT is System, TXIN cannot be set.

<type2>=<CHARACTER PROGRAM DATA>

P0 to P10	Preset Number

*2: When TXIN is selected at the first argument, the third type 2 cannot be set.

Sets PPG Starting Preset, DUT Initial Preset (Preset Hint Tx), and DUT Target preset (Change Preset).

<type3>=<CHARACTER PROGRAM DATA>

PRESet	Preset
CURSor	Cursor
SCURsor	Saved Cursor

*3: When TXIN is selected at the first argument, this setting cannot be performed.

Note:

When this command is sent, the processing equivalent to clicking the **Apply** is performed.
This command can be set independently for PCIe 3.0, 4.0, and 5.0.

Function

Sets the conditions of LEQ Tests.

Example

To set as follows in the Initial Tx LEQ Test:

P7:	PPG Starting Preset
P0:	DUT Initial Preset

This command cannot be used when System is selected as the DUT item.

```
> :LTRaining:SEQuence:LEQTest:REV3 TXINitial,P7,P0
```

To set as follows in the Tx LEQ Response Test:

P7:	PPG Starting Preset
P4:	DUT Initial Preset
P5:	DUT Target Preset
Link EQ method:	Preset

```
>:LTRaining:SEQuence:LEQTest:REV3
TXResponse,P7,P4,P5,PRESet
```

To set as follows in the Rx LEQ Test:

P7:	PPG Starting Preset, DUT Initial Preset to P7
P8:	DUT Target Preset
Link EQ method:	Cursor

```
> :LTRaining:SEQuence:LEQTest:REV3 RXLeq,P7,P7,P8,CURSor
```

:LTRaining:SEQuence:LEQTest:REV3? <type>

Parameter

<type>=<CHARACTER PROGRAM DATA>

TXINitial	Initial Tx LEQ Test
TXResponse	Tx LEQ Response Test
RXLeq	Rx LEQ Test

Response

< type2>=<CHARACTER PROGRAM DATA>

P0 to P10	Preset Number

<type3>=<CHARACTER PROGRAM DATA>

PRES	Preset
CURS	Cursor
SCUR	Saved Cursor

Function

Queries the parameters set for the LEQ Test.

Example

To query the settings of the Initial Tx LEQ Test.

```
> :LTRaining:SEQuence:LEQTest:REV3? TXINitial
< P7,P0
```

To query the settings of the Tx LEQ Response Test.

```
> :LTRaining:SEQuence:LEQTest:REV3? TXResponse
< P7,P4,P5,PRES
```

To query the settings of the Rx LEQ Test.

```
> :LTRaining:SEQuence:LEQTest:REV3? RXLeq
< P7,P7,P8,CURS
```

:LTRaining:SEQuence:LEQTest:REV4 <type1>*1,<type2>,<type2>,<type2>*2,<type3>*3

Parameter

<type1>=<CHARACTER PROGRAM DATA>

TXINitial	Initial Tx LEQ Test
TXResponse	Tx LEQ Response Test
RXLeq	Rx LEQ Test

*1: When DUT is System, TXIN cannot be set.

<type2>=<CHARACTER PROGRAM DATA>

P0 to P10	Preset Number

*2: When TXIN is selected at the first argument, the third type 2 cannot be set.

Sets PPG Starting Preset, DUT Initial Preset (Preset Hint Tx), and DUT Target preset (Change Preset).

<type3>=<CHARACTER PROGRAM DATA>

PRESet	Preset
CURSor	Cursor
SCURsor	Saved Cursor

*3: When TXIN is selected at the first argument, this setting cannot be performed.

Note:

When this command is sent, the processing equivalent to clicking the **Apply** is performed.

This command can be set independently for PCIe 3.0, 4.0, and 5.0.

Function

Sets the conditions of the LEQ Tests.

Example

To set as follows in the Initial Tx LEQ Test:

P7:	PPG Starting Preset
P0:	DUT Initial Preset

This command cannot be used when System is selected as the DUT item.

```
> :LTRaining:SEQuence:LEQTest:REV4 TXINitial,P7,P0
```

To set as follows in the Tx LEQ Response Test:

P7:	PPG Starting Preset
P4:	DUT Initial Preset
P5:	DUT Target Preset
Link EQ method:	Preset

```
>:LTRaining:SEQuence:LEQTest:REV4
TXResponse,P7,P4,P5,PRESet
```

To set as follows in the Rx LEQ Test:

P7:	PPG Starting Preset, DUT Initial Preset
P8:	DUT Target Preset
Link EQ method:	Cursor

```
> :LTRaining:SEQuence:LEQTest:REV4 RXLeq,P7,P7,P8,CURSor
```

:LTRaining:SEQuence:LEQTest:REV4? <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	TXINitial	Initial Tx LEQ Test
	TXResponse	Tx LEQ Response Test
	RXLeq	Rx LEQ Test
Response	< type2>=<CHARACTER PROGRAM DATA>	
	P0 to P10	Preset Number
	<type3>=<CHARACTER PROGRAM DATA>	
	PRES	Preset
	CURS	Cursor
	SCUR	Saved Cursor
Function	Queries the parameters set for the LEQ Test.	

Example

To query the settings of the Initial Tx LEQ Test.

```
> :LTRaining:SEQuence:LEQTest:REV4? TXINitial
< P7,P0
```

To query the settings of the Tx LEQ Response Test.

```
> :LTRaining:SEQuence:LEQTest:REV4? TXResponse
< P7,P4,P5,PRES
```

To query the settings of the Rx LEQ Test.

```
> :LTRaining:SEQuence:LEQTest:REV4? RXLeq
< P7,P7,P8,CURS
```

:LTRaining:SEQuence:LEQTest:REV5 <type1>*1,<type2>,<type2>,<type2>*2,<type3>*3

Parameter

<type1>=<CHARACTER PROGRAM DATA>

TXINitial	Initial Tx LEQ Test
TXResponse	Tx LEQ Response Test
RXLeq	Rx LEQ Test

*1: When DUT is System, TXIN cannot be set.

<type2>=<CHARACTER PROGRAM DATA>

P0 to P10	Preset Number

*2: When TXIN is selected at the first argument, the third type 2 cannot be set.

Sets PPG Starting Preset, DUT Initial Preset (Preset Hint Tx), and DUT Target preset (Change Preset).

<type3>=<CHARACTER PROGRAM DATA>

PRESet	Preset
CURSor	Cursor
SCURsor	Saved Cursor

*3: When TXIN is selected at the first argument, this setting cannot be performed.

Note:

When this command is sent, the processing equivalent to clicking the **Apply** is performed.
This command can be set independently for PCIe 3.0, 4.0, and 5.0.

Function

Sets the conditions of the LEQ Tests.

Example

To set as follows in the Initial Tx LEQ Test:

P7:	PPG Starting Preset
P0:	DUT Initial Preset

This command cannot be used when System is selected as the DUT item.

```
> :LTRaining:SEQuence:LEQTest:REV5 TXINitial,P7,P0
```

To set as follows in the Tx LEQ Response Test:

P7:	PPG Starting Preset
P4:	DUT Initial Preset
P5:	DUT Target Preset
Link EQ method:	Preset

```
> :LTRaining:SEQuence:LEQTest:REV5
TXResponse,P7,P4,P5,PRESet
```

To set as follows in the Rx LEQ Test:

P7:	PPG Starting Preset, DUT Initial Preset
P8:	DUT Target Preset
Link EQ method:	Cursor

```
> :LTRaining:SEQuence:LEQTest:REV5 RXLeq,P7,P7,P8,CURSor
```

:LTRaining:SEQuence:LEQTest:REV5? <type>

Parameter

<type>=<CHARACTER PROGRAM DATA>

TXINitial	Initial Tx LEQ Test
TXResponse	Tx LEQ Response Test
RXLeq	Rx LEQ Test

Response

< type2>=<CHARACTER PROGRAM DATA>

P0 to P10	Preset Number

<type3>=<CHARACTER PROGRAM DATA>

PRES	Preset
CURS	Cursor
SCUR	Saved Cursor

Function

Queries the parameters set for the LEQ Test.

Example

To query the settings of the Initial Tx LEQ Test.

```
> :LTRaining:SEQuence:LEQTest:REV5? TXINitial
< P7,P0
```

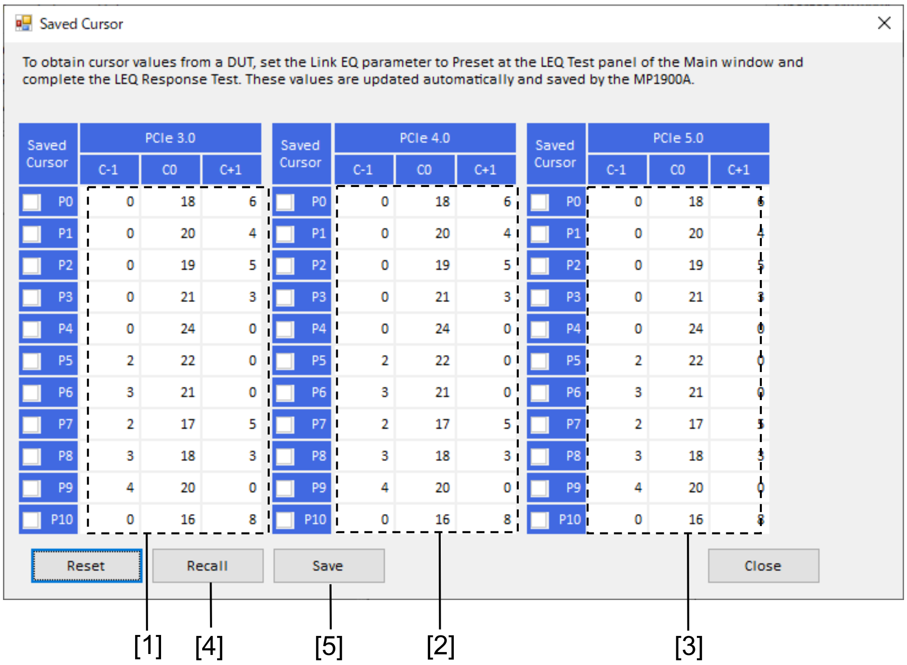
To query the settings of the Tx LEQ Response Test.

```
> :LTRaining:SEQuence:LEQTest:REV5? TXResponse
< P7,P4,P5,PRES
```

To query the settings of the Rx LEQ Test.

```
> :LTRaining:SEQuence:LEQTest:REV5? RXLeq
< P7,P7,P8,CURS
```

5.9.6 Saved Cursor dialog box



To obtain cursor values from a DUT, set the Link EQ parameter to Preset at the LEQ Test panel of the Main window and complete the LEQ Response Test. These values are updated automatically and saved by the MP1900A.

Saved Cursor	PCIe 3.0			Saved Cursor	PCIe 4.0			Saved Cursor	PCIe 5.0		
	C-1	C0	C+1		C-1	C0	C+1		C-1	C0	C+1
☐ P0	0	18	6	☐ P0	0	18	6	☐ P0	0	18	6
☐ P1	0	20	4	☐ P1	0	20	4	☐ P1	0	20	4
☐ P2	0	19	5	☐ P2	0	19	5	☐ P2	0	19	5
☐ P3	0	21	3	☐ P3	0	21	3	☐ P3	0	21	3
☐ P4	0	24	0	☐ P4	0	24	0	☐ P4	0	24	0
☐ P5	2	22	0	☐ P5	2	22	0	☐ P5	2	22	0
☐ P6	3	21	0	☐ P6	3	21	0	☐ P6	3	21	0
☐ P7	2	17	5	☐ P7	2	17	5	☐ P7	2	17	5
☐ P8	3	18	3	☐ P8	3	18	3	☐ P8	3	18	3
☐ P9	4	20	0	☐ P9	4	20	0	☐ P9	4	20	0
☐ P10	0	16	8	☐ P10	0	16	8	☐ P10	0	16	8

Figure 5.9.6-1 Saved Cursor Dialog Box

Table 5.9.6-1 Saved Cursor Query Commands

No.	Setting Item	Command
[1]	PCIe 3.0	:LTRaining:SEQuence:SCURsor:REV3?
[2]	PCIe 4.0	:LTRaining:SEQuence:SCURsor:REV4?
[3]	PCIe 5.0	:LTRaining:SEQuence:SCURsor:REV5?
[4]	Recall	:SYSTem:MMEMory:SETTing:SCURsor:RECall
[5]	Save	:SYSTem:MMEMory:SETTing:SCURsor:STORe

:LTRaining:SEQuence:SCURsor:REV3? <type>

Parameter

<type>=<CHARACTER PROGRAM DATA>

P0 to P10	Preset Number

Response

<C-1>=<NR1 NUMERIC RESPONSE DATA>

0 to 63	Cursor (C–1) value

<C0>=<NR1 NUMERIC RESPONSE DATA>

0 to 63	Cursor (C0) value

<C+1>=<NR1 NUMERIC RESPONSE DATA>

0 to 63	Cursor (C+1) value

<Done>=<NR1 NUMERIC RESPONSE DATA>

1	The value sent from the DUT has been kept.
0	The value sent from the DUT has not been kept yet.

Function

Queries the cursor value sent from the DUT corresponding to Presets of 0 to 10 in PCIe 3.0.

To use this function, the Link Training between the DUT and the measuring instrument must be complete with Usepreset being set to Preset.

Example

To query the cursor value sent from the DUT for Preset 7:

```
> :LTRaining:SEQuence:SCURsor:REV3? P7
< 5,17,2,1
```

:LTRaining:SEQuence:SCURsor:REV4? <type>

Parameter

<type>=<CHARACTER PROGRAM DATA>

P0 to P10	Preset Number

Response

<C-1>=<NR1 NUMERIC RESPONSE DATA>

0 to 63	Cursor (C–1) value

<C0>=<NR1 NUMERIC RESPONSE DATA>

0 to 63	Cursor (C0) value

<C+1>=<NR1 NUMERIC RESPONSE DATA>

0 to 63	Cursor (C+1) value

<Done>=<NR1 NUMERIC RESPONSE DATA>

1	The value sent from the DUT has been kept.
0	The value sent from the DUT has not been kept yet.

Function

Queries the cursor value sent from the DUT corresponding to Presets of 0 to 10 in PCIe 4.0.

To use this function, the device testing and Link Training must be complete with Preset.

Example

To query the cursor value sent from the DUT for Preset 7:

```
> :LTRaining:SEQuence:SCURsor:REV4? P7
< 5,17,2,1
```

:LTRaining:SEQuence:SCURsor:REV5? <type>

Parameter

<type>=<CHARACTER PROGRAM DATA>

P0 to P10	Preset Number

Response

<C-1>=<NR1 NUMERIC RESPONSE DATA>

0 to 63	Cursor (C–1) value

<C0>=<NR1 NUMERIC RESPONSE DATA>

0 to 63	Cursor (C0) value

<C+1>=<NR1 NUMERIC RESPONSE DATA>

0 to 63	Cursor (C+1) value

<Done>=<NR1 NUMERIC RESPONSE DATA>

1	The value sent from the DUT has been kept.
0	The value sent from the DUT has not been kept yet.

Function

Queries the cursor value sent from the DUT corresponding to Presets of 0 to 10 in PCIe 5.0.

To use this function, the device testing and Link Training must be complete with Preset.

Example

To query the cursor value sent from the DUT for Preset 7:

```
> :LTRaining:SEQuence:SCURsor:REV5? P7
< 5,17,2,1
```

:SYSTem:MMEMory:SETTing:SCURsor:STORe <file_name>

Parameter	<file_name>=<STRING PROGRAM DATA>	
	"<drv>:\<dir1>\<dir2>\<file>"	
	<drv>=C, D, E, F	Drive name
	<dir>=xxxxxxxx	Directory name
	<file>=xxxxxxxxx	File name
Function	Saves Saved Cursor values to a file.	
	<extension>=.sc3, .sc4, .sc5, scall	

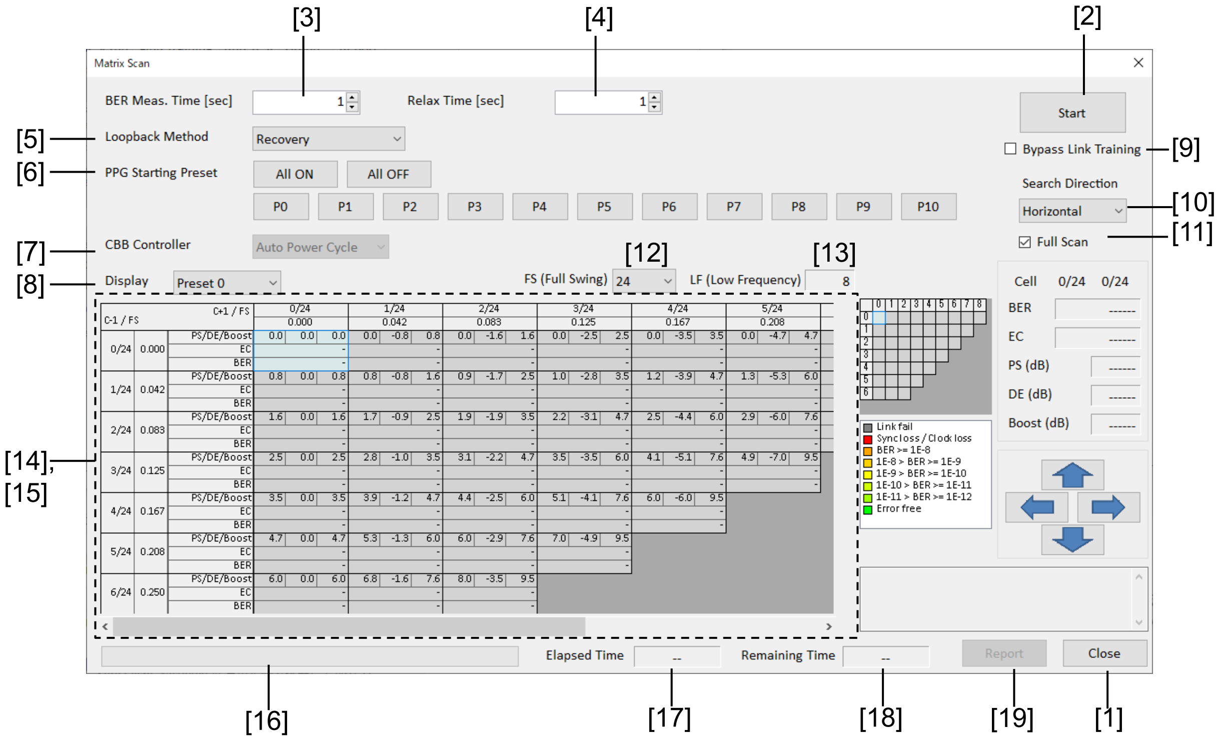
Example	`> :SYSTem:MMEMory:SETTing:SCURsor:STORe`
	`"C:\Temp\saved_cursor.scall"`	

:SYSTem:MMEMory:SETTing:SCURsor:RECall <file_name>

Parameter	<file_name>=<STRING PROGRAM DATA>	
	"<drv>:\<dir1>\<dir2>\<file><extension>"	
	<drv>=C, D, E, F	Drive name
	<dir>=xxxxxxxx	Directory name
	<file>=xxxxxxxxx	File name
	<extension>=.sc3, .sc4, .sc5, scall	
Function	Recalls Saved Cursor values from a file.	

Example	`> :SYSTem:MMEMory:SETTing:SCURsor:RECall`
	`"C:\Temp\saved_cursor.scall"`	

5.9.7 Matrix Scan



BER Meas. Time [sec] 1

Relax Time [sec] 1

Loopback Method Recovery

PPG Starting Preset

CBB Controller Auto Power Cycle

Display Preset 0

FS (Full Swing) 24

LF (Low Frequency) 8

☐ Bypass Link Training

Search Direction Horizontal

☑ Full Scan

C-1 / FS		C+1 / FS	0/24 0.000	1/24 0.042	2/24 0.083	3/24 0.125	4/24 0.167	5/24 0.208
0/24	0.000	PS/DE/Boost	0.0 0.0 0.0	0.0 -0.8 0.8	0.0 -1.6 1.6	0.0 -2.5 2.5	0.0 -3.5 3.5	0.0 -4.7 4.7
		EC	-	-	-	-	-	-
		BER	-	-	-	-	-	-
1/24	0.042	PS/DE/Boost	0.8 0.0 0.8	0.8 -0.8 1.6	0.9 -1.7 2.5	1.0 -2.8 3.5	1.2 -3.9 4.7	1.3 -5.3 6.0
		EC	-	-	-	-	-	-
		BER	-	-	-	-	-	-
2/24	0.083	PS/DE/Boost	1.6 0.0 1.6	1.7 -0.9 2.5	1.9 -1.9 3.5	2.2 -3.1 4.7	2.5 -4.4 6.0	2.9 -6.0 7.6
		EC	-	-	-	-	-	-
		BER	-	-	-	-	-	-
3/24	0.125	PS/DE/Boost	2.5 0.0 2.5	2.8 -1.0 3.5	3.1 -2.2 4.7	3.5 -3.5 6.0	4.1 -5.1 7.6	4.9 -7.0 9.5
		EC	-	-	-	-	-	-
		BER	-	-	-	-	-	-
4/24	0.167	PS/DE/Boost	3.5 0.0 3.5	3.9 -1.2 4.7	4.4 -2.5 6.0	5.1 -4.1 7.6	6.0 -6.0 9.5	
		EC	-	-	-	-	-	
		BER	-	-	-	-	-	
5/24	0.208	PS/DE/Boost	4.7 0.0 4.7	5.3 -1.3 6.0	6.0 -2.9 7.6	7.0 -4.9 9.5		
		EC	-	-	-	-		
		BER	-	-	-	-		
6/24	0.250	PS/DE/Boost	6.0 0.0 6.0	6.8 -1.6 7.6	8.0 -3.5 9.5			
		EC	-	-	-			
		BER	-	-	-			

- ▨ Link fail
- 🟥 Sync loss / Clock loss
- 🟧 BER >= 1E-8
- 🟧 1E-8 > BER >= 1E-9
- 🟨 1E-9 > BER >= 1E-10
- 🟩 1E-10 > BER >= 1E-11
- 🟩 1E-11 > BER >= 1E-12
- 🟩 Error free

Cell 0/24 0/24

BER ------

EC ------

PS (dB) ------

DE (dB) ------

Boost (dB) ------

Elapsed Time --

Remaining Time --

Figure 5.9.7-1 Matrix Scan Setup Screen

Table 5.9.7-1 Matrix Scan Setup Screen and Query Commands

No.	Setting Item	Command
[1]	Close*1	:LTRaining:SEQuence:BMATrix:DISPlay
		:LTRaining:SEQuence:BMATrix:DISPlay?
[2]	Start / Stop	:LTRaining:SEQuence:BMATrix:STARt
		:LTRaining:SEQuence:BMATrix:MRESume
		:LTRaining:SEQuence:BMATrix:STATe?
		:LTRaining:SEQuence:BMATrix:STOP
[3]	BER Meas. Time [sec]	:LTRaining:SEQuence:BMATrix:BER:TIME
		:LTRaining:SEQuence:BMATrix:BER:TIME?
[4]	Relax Time [sec]	:LTRaining:SEQuence:BMATrix:BER:RTIMe
		:LTRaining:SEQuence:BMATrix:BER:RTIMe?
[5]	Loopback Through*2	:LTRaining:SEQuence:LTHRough
[6]	PPG Starting Preset	:LTRaining:SEQuence:BMATrix:PRESet
		:LTRaining:SEQuence:BMATrix:PSEL
		:LTRaining:SEQuence:BMATrix:PSEL?

*1: **Close** is used only to close the Matrix Scan Setup screen. To open the Matrix Scan Setup screen, use **Matrix Scan** shown in Figure 5.9.1-1.

*2: Refer to “Loopback through” in 5.9.1 “Link Training Screen”.

Table 5.9.7-1 Matrix Scan Setup Screen and Query Commands (Cont'd)

No.	Setting Item	Command
[7]	CBB Controller*3	:LTRaining:SEQuence:AUTO:RESet
[8]	Display	:LTRaining:SEQuence:BMATrix:PDISplay
		:LTRaining:SEQuence:BMATrix:PDISplay?
[9]	Bypass Link Training	:LTRaining:SEQuence:BMATrix:BTRaining
		:LTRaining:SEQuence:BMATrix:BTRaining?
[10]	Search Direction	:LTRaining:SEQuence:BMATrix:SDIRection
		:LTRaining:SEQuence:BMATrix:SDIRection?
[11]	Full Scan	:LTRaining:SEQuence:BMATrix:SCAN
		:LTRaining:SEQuence:BMATrix:SCAN?
[12]	FS (Full Swing)	:LTRaining:SEQuence:BMATrix:FSWing
		:LTRaining:SEQuence:BMATrix:FSWing?
[13]	LF (Low Frequency)*4	:LTRaining:SEQuence:BMATrix:LFRequency?
[14]	Matrix Table*5	:LTRaining:SEQuence:BMATrix:TSEL
		:LTRaining:SEQuence:BMATrix:TSEL?
[15]	Matrix Table*6	:LTRaining:SEQuence:BMATrix:RESult?
[16]	Progress bar	:LTRaining:SEQuence:BMATrix:PROGress?
[17]	Elapsed Time	:LTRaining:SEQuence:BMATrix:ELAPsed?
[18]	Remaining Time	:LTRaining:SEQuence:BMATrix:REMaining?
[19]	Report	:LTRaining:SEQuence:BMATrix:EXPort

*3: Refer to “CBB Controller” in 5.9.4 “Option dialog ”.

*4: Query only

*5: Selecting a cell in the table

*6: Querying the result of the cell in the table

:LTRaining:SEQuence:BMATrix:DISPlay <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	Does not show Matrix Scan setup screen.
	ON or 1	Shows Matrix Scan setup screen.
Function	Shows or hides the Matrix Scan setup screen.	
Example	To show the Matrix Scan setup screen: `> :LTRaining:SEQuence:BMATrix:DISPlay ON`	

:LTRaining:SEQuence:BMATrix:DISPlay?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Does not show Matrix Scan setup screen.
	1	Shows Matrix Scan setup screen.
Function	Queries whether the Matrix Scan setup screen is currently shown.	

Example	`> :LTRaining:SEQuence:BMATrix:DISPlay?`
	`< 1`	

:LTRaining:SEQuence:BMATrix:STARt

Parameter	None
Function	Starts Matrix Scan.
Example	`> :LTRaining:SEQuence:BMATrix:STARt`

:LTRaining:SEQuence:BMATrix:MRESume

Parameter	None
Function	When 2 is returned as the response of `:LTRaining:SEQuence:BMATrix:STATe?` (Requesting to reset DUT), sending this command resumes the measurement.
Example	`> :LTRaining:SEQuence:BMATrix:MRESume`

:LTRaining:SEQuence:BMATrix:STOP

Parameter	None
Function	Stops Matrix Scan,
Example	`> :LTRaining:SEQuence:BMATrix:STOP`

:LTRaining:SEQuence:BMATrix:STATe?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Stopped
	1	Being performed
	2	Being requesting DUT resetting
Function	Queries the measurement status of Matrix Scan. Note that when 2 is returned, reset the DUT to start Link Training before sending the `:LTRaining:SEQuence:BMATrix:RESTart` command.	

Example	`> :LTRaining:SEQuence:BMATrix:STATe?`
	`< 1`	

:LTRaining:SEQuence:BMATrix:BER:TIME <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	1 to 300 seconds	1 sec/step
Function	Sets the BER measurement time for each cell.	
Example	`> :LTRaining:SEQuence:BMATrix:BER:TIME 5`	

:LTRaining:SEQuence:BMATrix:BER:TIME?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA> 1 to 300 second
Function	Queries the BER measurement time for each cell.

Example	`> :LTRaining:SEQuence:BMATrix:BER:TIME?`
	`< 5`

:LTRaining:SEQuence:BMATrix:BER:RTIMe <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0 to 60 seconds	1 sec/step
Function	Sets the waiting time until the BER measurement starts, after setting the Cursor value for each cell during the Matrix Scan.	
Example	`> :LTRaining:SEQuence:BMATrix:BER:RTIMe 3`	

:LTRaining:SEQuence:BMATrix:BER:RTIMe?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA> 0 to 60 seconds
Function	Queries the waiting time until the BER measurement starts, after setting the Cursor value for each cell during the Matrix Scan.

Example	`> :LTRaining:SEQuence:BMATrix:BER:RTIMe?`
	`< 3`

:LTRaining:SEQuence:BMATrix:PRESet <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	Turns off all PPG Starting Presets.
	ON or 1	Turns on all PPG Starting Presets.
Function	Turns on or off all PPG Starting Presets.	
Example	`> :LTRaining:SEQuence:BMATrix:PRESet ON`	

:LTRaining:SEQuence:BMATrix:PSEL <numeric>,<numeric>,<numeric>,<numeric>,<numeric>,<numeric>,<numeric>,<numeric>,<numeric>,<numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA> 0 or 1
Function	Specifies each PPG Starting Preset value of Preset 0 to 10 in that order separated by commas.
Example	To turn on only Preset0 and Preset7: `> :LTRaining:SEQuence:BMATrix:PSEL 1,0,0,0,0,0,0,1,0,0,0`

:LTRaining:SEQuence:BMATrix:PSEL?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Preset is off.
	1	Preset is on.
Function	Returns the values of PPG Starting Presets in the order of Preset0 to Preset10 separated by commas.	

Example	When only Preset0 and Preset7 are on, the values are returned as below:
	`> :LTRaining:SEQuence:BMATrix:PSEL?`
	`< 1,0,0,0,0,0,0,1,0,0,0`	

:LTRaining:SEQuence:BMATrix:PDISplay <type>

Parameter <type>=<CHARACTER PROGRAM DATA>

P0 to P10

Function Selects the result (Preset0 to 10) to be displayed in the matrix table area.

Example

```
> :LTRaining:SEQuence:BMATrix:PDISplay P7
```

:LTRaining:SEQuence:BMATrix:PDISplay?

Response <type>=<CHARACTER RESPONSE DATA>

P0 to P10

Function Queries the result currently displayed in the matrix table area.

Example

```
> :LTRaining:SEQuence:BMATrix:PDISplay?
< P7
```

:LTRaining:SEQuence:BMATrix:BTRaining <boolean>

Parameter <boolean>=<BOOLEAN PROGRAM DATA>

OFF or 0	Turns off Bypass Link Training.
ON or 1	Turns on Bypass Link Training.

Function Sets whether to bypass Link Training when starting Matrix Scan. When set to OFF, Link Training is performed.

Example To turn on Bypass Link Training.

```
> :LTRaining:SEQuence:BMATrix:BTRaining ON
```

:LTRaining:SEQuence:BMATrix:BTRaining?

Response <numeric>=<NR1 NUMERIC RESPONSE DATA>

0	OFF
1	ON

Function Queries whether to bypass Link Training when starting Matrix Scan.

OFF: Link Training is performed.

Example

```
> :LTRaining:SEQuence:BMATrix:BTRaining?
< 1
```

:LTRaining:SEQuence:BMATrix:SDIRection <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	HORizontal	Performs measurement from the selected cell to the right.
	VERTical	Performs measurement downward from the selected cell.
	BOOSt	Performs measurement diagonally downward to the left, from the selected cell.
Function	Sets the order of cells to be measured in Matrix Scan.	
Example	`> :LTRaining:SEQuence:BMATrix:SDIRection HORizontal`	

:LTRaining:SEQuence:BMATrix:SDIRection?

Response	<type>=<CHARACTER RESPONSE DATA> HOR, VERT, BOOS
Function	Queries the order of cells to be measured in Matrix Scan.

Example	`> :LTRaining:SEQuence:BMATrix:SDIRection?`
	`< HOR`

:LTRaining:SEQuence:BMATrix:SCAN <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	Does not perform Full Scan.
	ON or 1	Performs Full Scan.
Function	Turns on or off Full Scan (sets whether to measure all cells from the top-left cell on the matrix table).	
Example	To turn on Full Scan: `> :LTRaining:SEQuence:BMATrix:SCAN ON`	

:LTRaining:SEQuence:BMATrix:SCAN?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Does not perform Full Scan.
	1	Performs Full Scan.
Function	Queries whether to measure all cells in Matrix Scan.	

Example	`> :LTRaining:SEQuence:BMATrix:SCAN?`
	`< 1`	

:LTRaining:SEQuence:BMATrix:FSWing

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA> 24, 48, 63
Function	Sets the Full Swing.
Example	To set Full Swing to 63:

```
> :LTRaining:SEQuence:BMATrix:FSWing 63
```

:LTRaining:SEQuence:BMATrix:FSWing?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA> 24, 48, 63
Function	Queries the value of Full Swing.
Example	

```
> :LTRaining:SEQuence:BMATrix:FSWing?
< 63
```

:LTRaining:SEQuence:BMATrix:LFRequency?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA> 8, 16, 21
Function	Queries the value of Low Frequency.
Example	

```
> :LTRaining:SEQuence:BMATrix:LFRequency?
< 21
```

:LTRaining:SEQuence:BMATrix:TSEL <numeric1>,<numeric2>

Parameter

<numeric1>=<DECIMAL NUMERIC PROGRAM DATA>

0 to 21	When Full Swing 63 is selected.
0 to 16	When Full Swing 48 is selected.
0 to 8	When Full Swing 24 is selected.

<numeric2>=<DECIMAL NUMERIC PROGRAM DATA>

0 to 16	When Full Swing 63 is selected.
0 to 12	When Full Swing 48 is selected.
0 to 6	When Full Swing 24 is selected.

Function

Selects a cell on the matrix. The setting range is limited by the value of Full Swing.

Example

To select the cell ((C+1) : 4, (C–1) : 3) on the matrix:

```
> :LTRaining:SEQuence:BMATrix:TSEL 4,3
```

:LTRaining:SEQuence:BMATrix:TSEL?

Response	<numeric>,<numeric>=<NR1 NUMERIC RESPONSE DATA> 0 to 21
Function	Queries the cell currently selected on the matrix. The values of the selected cell are returned in the order of C+1, C–1, and a comma separates the values.
Example	For example, when the cell ((C+1) : 4, (C–1) : 3) is selected, the values are returned as below:

```
> :LTRaining:SEQuence:BMATrix:TSEL?
< 4,3
```

:LTRaining:SEQuence:BMATrix:RESult? <numeric1>,<numeric2>,<type>

Parameter

<numeric1>=<DECIMAL NUMERIC PROGRAM DATA>

0 to 21	When Full Swing 63 is selected.
0 to 16	When Full Swing 48 is selected.
0 to 8	When Full Swing 24 is selected.

<numeric2>=<DECIMAL NUMERIC PROGRAM DATA>

0 to 16	When Full Swing 63 is selected.
0 to 12	When Full Swing 48 is selected.
0 to 6	When Full Swing 24 is selected.

<type>=<CHARACTER RESPONSE DATA>

EC	Error Count
BER	BER
PS	Pre-Shoot (dB)
DE	De-Emphasis (dB)
BOOSt	Boost (dB)

Response	<string>=<STRING RESPONSE DATA>
Function	Queries the information with specifying the cell.
Example	

```
> :LTRaining:SEQuence:BMATrix:RESult? 1,3,BER
< "1.0E-9"
> :LTRaining:SEQuence:BMATrix:RESult? 1,3,DE
< "-1.0"
```

:LTRaining:SEQuence:BMATrix:PROGress?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA> 0 to 100
Function	Queries the progress (%) of the measurement.
Example	

```
> :LTRaining:SEQuence:BMATrix:PROGress?
< 100
```

:LTRaining:SEQuence:BMATrix:ELAPsed?

Response

“<hour>,<min>,<second>”=< NR1 NUMERIC RESPONSE DATA >

<hour>

0 to 23	0 to 23 hours

<min>

0 to 59	0 to 59 minutes

<second>

0 to 59	0 to 59 seconds

Function

Queries the time elapsed from the start time of the measurement.

Example

```
> :LTRaining:SEQuence:BMATrix:ELAPsed?
< "00:02:05"
```

:LTRaining:SEQuence:BMATrix:REMaining?

Response

“<hour>,<min>,<second>”=< NR1 NUMERIC RESPONSE DATA >

<hour>

0 to 23	0 to 23 hours

<min>

0 to 59	0 to 59 minutes

<second>

0 to 59	0 to 59 seconds

Function

Queries the assumed remaining time until the measurement ends.

Example

```
> :LTRaining:SEQuence:BMATrix:REMaining?
< "00:01:30"
```

:LTRaining:SEQuence:BMATrix:EXPort <file_name>,<type>

Parameter

<file_name>=<STRING PROGRAM DATA>

"<drv>:\<dir1>\<dir2>\<file>"

<drv>=C, D, E, F	Drive name
<dir>=xxxxxxxx	Directory name
<file>=xxxxxxxxx	File name

<type>=<CHARACTER PROGRAM DATA>

HTML	HTML format
CSV	CSV format

Function

Saves the Matrix scan measurement results on the PC or MP1900A where MX183000A is installed, specifying the file name and file format.

Example

To save the measurement results in html format:

```
> :LTRaining:SEQuence:BMATrix:EXPort?
"C:\test\Matrix",HTML
```

5.10 USB Link Sequence Setup Screen (With MX183000A-PL012 Installed)

This setup screen is available only when MX183000A-PL012 is installed, when USB Link Sequence is started on the Selector screen (Figure 4.3.1-1), and when the SQA has been connected using Equipment Setup.

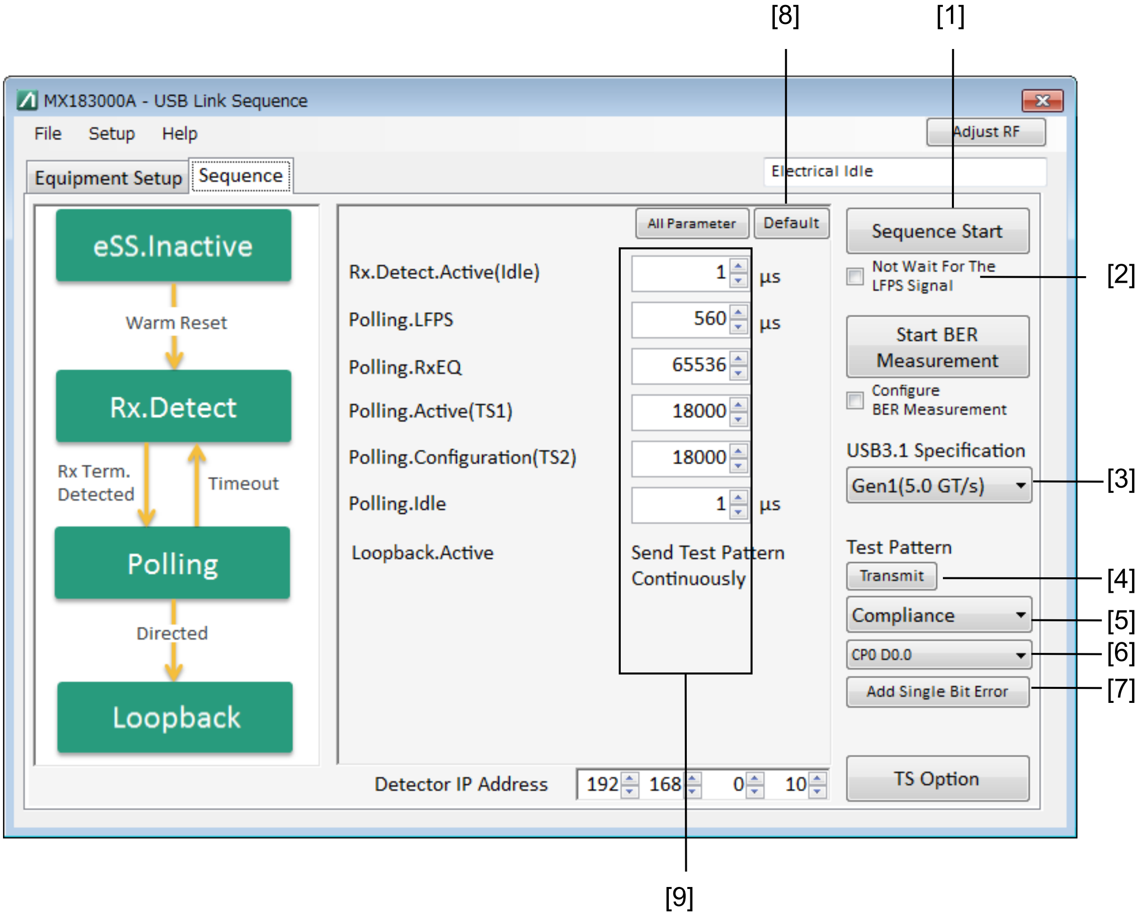


Figure 5.10-1 Sequence Screen

Table 5.10-1 Sequence Screen Setup Commands

No.	Setting Item	Command
[1]	Sequence Start	:LTRaining:SEQuence:STARt
	Sequence Stop	:LTRaining:SEQuence:STOP
	Sequence State	:LTRaining:SEQuence:STATe?
[2]	Not Wait For The LFPS signal	:LTRaining:SEQuence:NWAit:LFPS
		:LTRaining:SEQuence:NWAit:LFPS?
[3]	Specification	:LTRaining:SEQuence:SPECification
		:LTRaining:SEQuence:SPECification?
[4]	Transmit Test Pattern	:LTRaining:SEQuence:TEST:PATTern:TRANsmit
	Stop Test Pattern	:LTRaining:SEQuence:TEST:PATTern:STOP
[5]	Test pattern	:SOURce:PATTern:TYPE
		:SOURce:PATTern:TYPE?
[6]	Test pattern	:LTRaining:SEQuence:TEST:PATTern
		:LTRaining:SEQuence:TEST:PATTern?
[7]	Add Single Bit Error	:LTRaining:SEQuence:TEST:PATTern:EADDition
[8]	Reset	:LTRaining:SEQuence:INITialize
[9]	Sequence	:LTRaining:SEQuence:DESign:GEN1
		:LTRaining:SEQuence:DESign:GEN1?
		:LTRaining:SEQuence:DESign:GEN2
		:LTRaining:SEQuence:DESign:GEN2?

:LTRaining:SEQuence:STARt

Parameter	None
Function	Changes PPG to the wait status for receiving LFPS from DUT. The link training sequence for looping back DUT is transmitted after receiving LFPS. After the transmission, the pattern selected at Test Pattern is sent continuously.
Example	`> :LTRaining:SEQuence:STARt`

:LTRaining:SEQuence:STOP

Parameter	None
Function	Stops transmitting link training sequence and test pattern and sets to Electrical Idle.
Example	`> :LTRaining:SEQuence:STOP`

:LTRaining:SEQuence:STATe?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Stop
	1	Sending Sequence Pattern
	2	Sending Test Pattern
Function	Queries the link training sequence transmission status.	

Example	`> :LTRaining:SEQuence:STATe?`
	`< 1`	

:LTRaining:SEQuence:NWAit:LFPS <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	Starts the link training sequence transmission after receiving the LFPS signal.
	ON or 1	Starts the link training sequence transmission without waiting for receiving the LFPS signal.
Function	Sets the conditions for starting the link training sequence transmission.	
Example	To set the mode for starting the link training sequence transmission without waiting for the LFPS signal:	

```
> :LTRaining:SEQuence:NWAit:LFPS 1
```

:LTRaining:SEQuence:NWAit:LFPS?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Starts a sequence after receiving the LFPS signal.
	1	Starts a sequence without waiting for receiving the LFPS signal.
Function	Queries the conditions for starting the link training sequence transmission.	
Example		

```
> :LTRaining:SEQuence:NWAit:LFPS?
< 1
```

:LTRaining:SEQuence:SPECification <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	GEN1	SuperSpeed (5.0 GT/s)
	GEN2	SuperSpeedPlus (10.0 GT/s)
Function	Selects an environment to loopback the DUT supporting USB3.0/3.1.	
Example	To set the link training sequence to GEN1(5.0 GT/s):	

```
> :LTRaining:SEQuence:SPECification GEN1
```

:LTRaining:SEQuence:SPECification?

Response	<type>=<CHARACTER RESPONSE DATA> GEN1, GEN 2
Function	Queries the environment to loopback the DUT supporting USB3.0/3.1.
Example	

```
> :LTRaining:SEQuence:SPECification?
< GEN1
```

:LTRaining:SEQuence:TEST:PATTern:TRANsmit

Parameter	None
Function	Transmits the pattern selected at Test Pattern continuously.
Example	`> :LTRaining:SEQuence:TEST:PATTern:TRANsmit`

:LTRaining:SEQuence:TEST:PATTern:STOP

Parameter	None
Function	Stops sending the test pattern.
Example	`> :LTRaining:SEQuence:TEST:PATTern:STOP`

:SOURce:PATTern:TYPE <type>

Parameter

<type>=<CHARACTER PROGRAM DATA>

COMPliance	Compliance pattern
USER	USER pattern

Function

Selects the test pattern to be sent after completing the link training sequence transmission.

Selecting USER outputs the test pattern selected on the MX180000A MU183020A setup screen.

Example

To set the test pattern to Compliance Pattern:

```
>:SOURce:PATTern:TYPE COMPliance
```

:SOURce:PATTern:TYPE?

Response

<type>=<CHARACTER RESPONSE DATA>

COMP, USER

Function

Queries the test pattern to be sent after completing the link training sequence transmission.

Example

```
> :SOURce:PATTern:TYPE?
< COMP
```

:LTRaining:SEQuence:TEST:PATTern <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA> When Specification setting is GEN1: 0 to 6 CP0 to CP6 When Specification setting is GEN2: 9 CP9
Function	Selects the type of Compliance Pattern to be sent when test pattern is set to Compliance.
Example	`> :LTRaining:SEQuence:TEST:PATTern 0`

:LTRaining:SEQuence:TEST:PATTern?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA> When Specification setting is GEN1: 0 to 6 CP0 to CP6 When Specification setting is GEN2: 9 CP9
Function	Queries the test pattern to be sent.

Example	`> :LTRaining:SEQuence:TEST:PATTern?`
	`< 0`

:LTRaining:SEQuence:TEST:PATTern:EADDition

Parameter	None
Function	Adds a single error to the sending test pattern.
Example	`> :LTRaining:SEQuence:TEST:PATTern:EADDition`

:LTRaining:SEQuence:INITialize [<spec>]

Parameter	<spec>=<CHARACTER PROGRAM DATA> GEN1 GEN2 ***Note:*** When <spec> is omitted, all parameters for the link training sequences are initialized.
Function	Sets all parameters for the specified link training sequences to the initial values.
Example	To initialize the parameter set by GEN2 `> :LTRaining:SEQuence:INITialize GEN2`

:LTRaining:SEQuence:DESign:GEN1 <type>,<numeric>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	RDACtive	RX_DETECT_ACTIVE (wait)
	PLFPs	POLLING_LFPS (LFPS transmission time)
	PRXeq	POLLING_RXEQ
	PACTive	POLLING_ACTIVE
	PCONfiguration	POLLING_CONFIGURATION
	PIDLe	POLLING_IDLE (wait)
	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	1 to 1000000	1 to 1000000 cycles TS transmission cycles per step
	1 to 1000000	1 to 1000000 µs Wait or signal transmission time/1 µs Step
Function	Sets a sequence pattern to loopback the DUT (GEN1).	
Example	To set the number of times POLLING_ACTIVE patterns are sent to 1024:	

```
> :LTRaining:SEQuence:DESign:GEN1 PACTive,1024
```

:LTRaining:SEQuence:DESign:GEN1? <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	RDACtive	RX_DETECT_ACTIVE
	PLFPs	POLLING_LFPS (LFPS transmission time)
	PRXeq	POLLING_RXEQ
	PACTive	POLLING_ACTIVE
	PCONfiguration	POLLING_CONFIGURATION
	PIDLe	POLLING_IDLE (wait)
Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	1 to 1000000	1 to 1000000 cycles TS transmission cycles
	1 to 1000000	1 to 1000000 µs Wait or signal transmission time
Function	Queries the sequence pattern to loopback the DUT. (GEN1)	
Example		

```
>:LTRaining:SEQuence:DESign:GEN1? PACTive
< 1024
```

:LTRaining:SEQuence:DESign:GEN2 <type>,<numeric>

Parameter

<type>=<CHARACTER PROGRAM DATA>

RDACtive	RX_DETECT_ACTIVE
PLSCd1	POLLING_LFPS SCD1 (SCD1 transmission time)
PLSCd2	POLLING_LFPS SCD2 (SCD2 transmission time)
PPMatch	POLLING_PORTMATCH (LBPM transmission time)
PRXeq	POLLING_RXEQ
PACTive	POLLING_ACTIVE
PCONfiguration	POLLING_CONFIGURATION
PIDLe	POLLING_IDLE (wait)

<numeric>=<DECIMAL NUMERIC PROGRAM DATA>

1 to 1000000	1 to 1000000 cycles TS transmission cycles per step
1 to 1000000	1 to 1000000 µs Wait or signal transmission time/1 µs Step

Function Sets a sequence pattern to loopback the DUT (GEN2).

Example To set the number of times POLLING_ACTIVE patterns are sent to 1024:

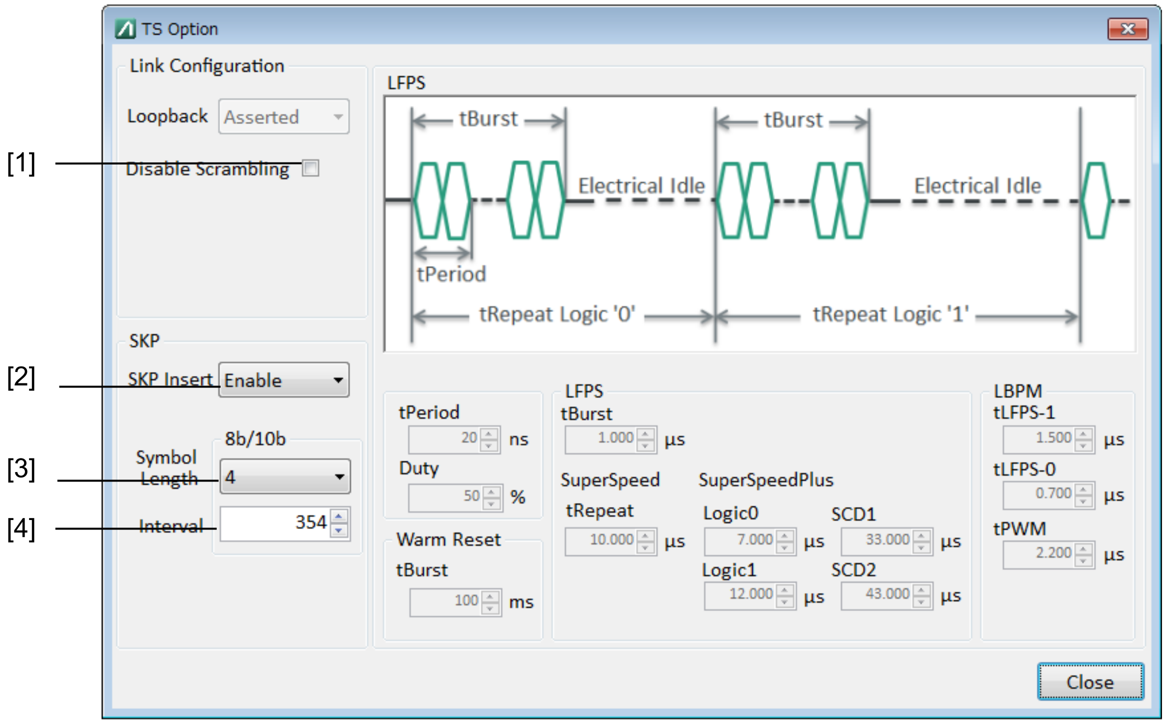
```
> :LTRaining:SEQuence:DESign:GEN2 PACTive,1024
```

:LTRaining:SEQuence:DESign:GEN2? <numeric>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	RDACtive	RX_DETECT_ACTIVE
	PLSCd1	POLLING_LFPS SCD1 (SCD1 transmission time)
	PLSCd2	POLLING_LFPS SCD2 (SCD2 transmission time)
	PPMatch	POLLING_PORTMATCH (LBPM transmission time)
	PRXeq	POLLING_RXEQ
	PACTive	POLLING_ACTIVE
	PCONfiguration	POLLING_CONFIGURATION
	PIDLe	POLLING_IDLE (wait)
Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	1 to 1000000	1 to 1000000 cycles TS transmission cycles
	1 to 1000000	1 to 1000000 μs Wait or signal transmission time
Function	Queries the sequence pattern to loopback the DUT. (GEN2)	

Example

```
>:LTRaining:SEQuence:DESign:GEN2? PACTive
< 1024
```



Link Configuration

Loopback: Asserted

Disable Scrambling ☐

SKP

SKP Insert: Enable

8b/10b

Symbol Length: 4

Interval: 354

tPeriod: 20 ns

Duty: 50 %

Warm Reset

tBurst: 100 ms

LFPS

tBurst: 1.000 µs

SuperSpeed

tRepeat: 10.000 µs

SuperSpeedPlus

Logic0: 7.000 µs

SCD1: 33.000 µs

Logic1: 12.000 µs

SCD2: 43.000 µs

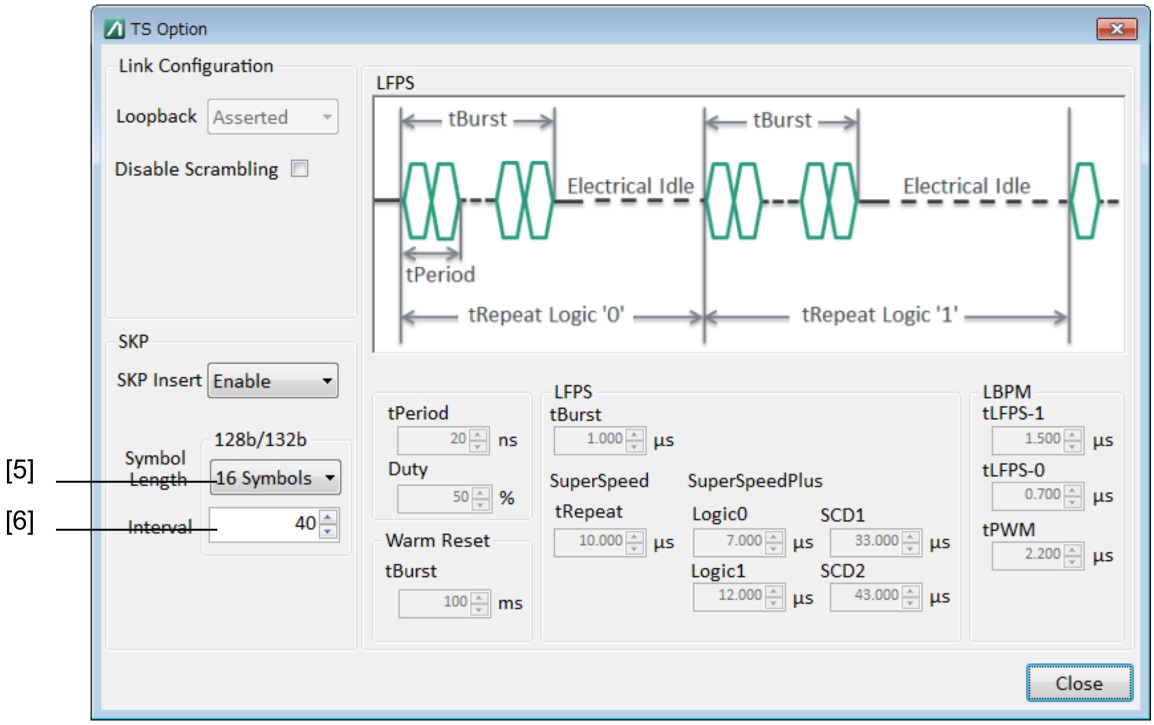
LBPM

tLFPS-1: 1.500 µs

tLFPS-0: 0.700 µs

tPWM: 2.200 µs

Figure 5.10-2 Option Dialog Box (Gen1)



Link Configuration

Loopback: Asserted

Disable Scrambling ☐

SKP

SKP Insert: Enable

128b/132b

Symbol Length: 16 Symbols

Interval: 40

tPeriod: 20 ns

Duty: 50 %

Warm Reset

tBurst: 100 ms

LFPS

tBurst: 1.000 µs

SuperSpeed

tRepeat: 10.000 µs

SuperSpeedPlus

Logic0: 7.000 µs

SCD1: 33.000 µs

Logic1: 12.000 µs

SCD2: 43.000 µs

LBPM

tLFPS-1: 1.500 µs

tLFPS-0: 0.700 µs

tPWM: 2.200 µs

Figure 5.10-3 Option Dialog Box (Gen2)

Table 5.10-2 Sequence Screen Setup Commands

No.	Setting Item	Command
[1]	Disable Scrambling	:LTRaining:SEQuence:DSCRamble
		:LTRaining:SEQuence:DSCRamble?
[2]	SKP Insert	:LTRaining:SEQuence:SKP
		:LTRaining:SEQuence:SKP?
[3]	Symbol Length 8b/10b	:LTRaining:SEQuence:SKP:SLENgth:8B10B
		:LTRaining:SEQuence:SKP:SLENgth:8B10B?
[4]	Interval 8b/10b	:LTRaining:SEQuence:SKP:INTerval:8B10B
		:LTRaining:SEQuence:SKP:INTerval:8B10B?
[5]	Symbol Length 128b/132b	:LTRaining:SEQuence:SKP:SLENgth:128B132B
		:LTRaining:SEQuence:SKP:SLENgth:128B132B?
[6]	Interval 128b/132b	:LTRaining:SEQuence:SKP:INTerval:128B132B
		:LTRaining:SEQuence:SKP:INTerval:128B132B?

:LTRaining:SEQuence:DSCRamble <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	Disabled
	ON or 1	Enabled
Function	Sets the Disable scramble bit of the training sequence pattern.	
Example	To enable Disable scramble	

```
> :LTRaining:SEQuence:DSCRamble ON
```

:LTRaining:SEQuence:DSCRamble?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Not scrambled
	1	Scrambled
Function	Queries the training sequence pattern Disable scramble bit during sequence transmission.	

Example

```
> :LTRaining:SEQuence:DSCRamble?
< 1
```

:LTRaining:SEQuence:SKP:SLENgth:8B10B <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	2	2 symbols
	4	4 symbols
	6	6 symbols
Function	Sets the number of SKP symbols to be inserted by SKP Ordered Set for 8b/10b encoding.	
Example	To set the number of SKP OS SKP symbols to 2:	

```
>:LTRaining:SEQuence:SKP:SLENgth:8B10B 2
```

:LTRaining:SEQuence:SKP:SLENgth:8B10B?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>
	2, 4, 6
Function	Queries the number of SKP symbols to be inserted by SKP Ordered Set for 8b/10b encoding.
Example	

```
> :LTRaining:SEQuence:SKP:SLENgth:8B10B?
< 2
```

:LTRaining:SEQuence:SKP:INTerval:8B10B <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	176 to 708	176 to 708, 2 step
Function	Sets the interval for SKP Ordered Set occurring during link sequence execution for 8b/10b encoding.	
Example	To generate an SKP OS once after every 354 symbols sent:	

```
>:LTRaining:SEQuence:SKP:INTerval:8B10B 354
```

:LTRaining:SEQuence:SKP:INTerval:8B10B?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	176 to 708	176 to 708, 2 step
Function	Queries the interval for SKP Ordered Set occurring during link sequence execution for 8b/10b encoding.	
Example		

```
>:LTRaining:SEQuence:SKP:INTerval:8B10B?
< 354
```

:LTRaining:SEQuence:SKP:SLENgth:128B132B <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	8	8 Symbols
	12	12 Symbols
	16	16 Symbols
	20	20 Symbols
	24	24 Symbols
	28	28 Symbols
	32	32 Symbols
	36	36 Symbols
	40	40 Symbols
Function	Sets the number of SKP symbols to be inserted by SKP Ordered Set for 128b/132b encoding.	
Example	To set the number of SKP OS SKP symbols to 8:	

```
> :LTRaining:SEQuence:SKP:SLENgth:128B132B 8
```

:LTRaining:SEQuence:SKP:SLENgth:128B132B?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA> 8, 12, 16, 20, 24, 28, 32, 26, 40
Function	Queries the number of SKP symbols to be inserted by SKP Ordered Set for 128b/132b encoding.
Example	

```
> :LTRaining:SEQuence:SKP:SLENgth:128B132B?
< 8
```

:LTRaining:SEQuence:SKP:INTerval:128B132B <numeric>

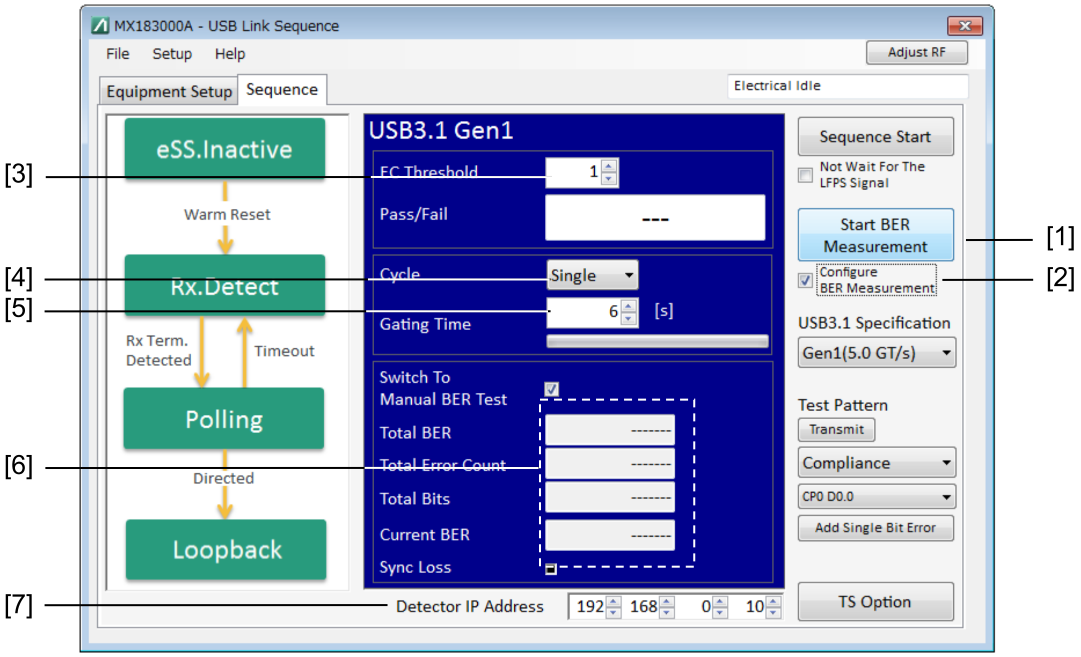
Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA> 20 to 80　　20 to 80, 1 step
Function	Sets the interval for SKP Ordered Set occurring during link sequence execution for 128b/132b encoding.
Example	To generate an SKP OS once after every 40 blocks sent:

```
>:LTRaining:SEQuence:SKP:INTerval:128B132B 40
```

:LTRaining:SEQuence:SKP:INTerval:128B132B?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA> 20 to 80　　20 to 80
Function	Queries the interval for SKP Ordered Set occurring during link sequence execution for 128b/132b encoding.
Example	

```
>:LTRaining:SEQuence:SKP:INTerval:128B132B?
< 40
```



EC Threshold 1

Cycle Single

Gating Time 6 [s]

☐ Not Wait For The LFPS Signal

☑ Configure BER Measurement

☑ Switch To Manual BER Test

USB3.1 Specification Gen1(5.0 GT/s)

Test Pattern Compliance

CP0 D0.0

Detector IP Address 192 168 0 10

Figure 5.10-4 BER Measurement Setting Window

Table 5.10-3 BER Measurement Setting Command

No.	Setting Item	Command
[1]	BER Measurement Start	:SENSe:MEASure:BER:STARt
	BER Measurement Stop	:SENSe:MEASure:BER:STOP
	BER Measurement State	:SENSe:MEASure:BER:STATe?
[2]	Configure BER Measurement	:DISPlay:RESult:BER
		:DISPlay:RESult:BER?
[3]	Error Count Threshold	:SENSe:MEASure:BER:ECTHreshold
		:SENSe:MEASure:BER:ECTHreshold?
[4]	Cycle	:SENSe:MEASure:BER:MODE
		:SENSe:MEASure:BER:MODE?
[5]	Gating Time	:SENSe:MEASure:BER:TIME
		:SENSe:MEASure:BER:TIME?
[6]	Result	:CALCulate:DATA:EALarm?
[7]	Detector IP Address	:SENSe:MEASure:BER:IPADdress
		:SENSe:MEASure:BER:IPADdress?

:SENSe:MEASure:BER:STARt

Parameter	None	
Function	Starts the BER measurement.	
Example	`>:SENSe:MEASure:BER:STARt`	

:SENSe:MEASure:BER:STOP

Parameter	None	
Function	Stops the BER measurement.	
Example	`>:SENSe:MEASure:BER:STOP`	

:SENSe:MEASure:BER:STATe?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	1	Being measured
	0	Stopped
Function	Queries the BER measurement status.	

Example	`>:SENSe:MEASure:BER:STATe?`
	`< 1`	

:DISPlay:RESult:BER <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	Hides the BER measurement setting window.
	ON or 1	Displays the BER measurement setting window.
Function	Displays or hides the BER measurement setting window.	
Example	To display the BER measurement setting window `>:DISPlay:RESult:BER ON`	

:DISPlay:RESult:BER?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Hides the BER measurement setting window.
	1	Displays the BER measurement setting window.
Function	Queries the BER measurement setting window display status.	

Example	`>:DISPlay:RESult:BER?`
	`< 1`	

:SENSe:MEASure:BER:ECTHreshold <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0 to 1000	0 to 1000, 1 step
Function	Sets an evaluation threshold of the BER measurement. When the number of bit errors exceeds the evaluation threshold, the BER measurement is judged as Fail.	
Example	To set the evaluation threshold of the BER measurement to 1:	

```
>:SENS:MEAS:BER:ECTHreshold 1
```

:SENSe:MEASure:BER:ECTHreshold?

Response	<numeric>=<NR1 NUMERIC RESPONESE DATA>	
	0 to 1000	0 to 1000
Function	Queries the evaluation threshold of the BER measurement.	
Example		

```
>:SENSe:MEASure:BER:ECTHreshold?
< 1
```

:SENSe:MEASure:BER:MODE <mode>

Parameter	<mode>=<CHARACTER PROGRAM DATA>	
	SINGle	Performs the measurement once.
	REPeat	Performs the measurement repeatedly.
Function	Sets the measurement processing mode for the BER measurement.	
Example	To set the measurement processing mode for the BER measurement to Repeat:	

```
> :SENSe:MEASure:BER:MODE REPeat
```

:SENSe:MEASure:BER:MODE?

Response	<mode>=<CHARACTER RESPONSE DATA>
	SING, REP
Function	Queries the measurement processing mode for the BER measurement.
Example	

```
>:SENSe:MEASure:BER:MODE?
< REP
```

:SENSe:MEASure:BER:TIME <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	1 to 100	1 to 100 s, 1s step
Function	Sets the Gating Time of the BER measurement.	
Example	To set the Gating Time of the BER measurement to 6 s:	

```
>:SENSe:MEASure:BER:TIME 6
```

:SENSe:MEASure:BER:TIME?

Response <numeric>=<NR1 NUMERIC RESPONSE DATA>

1 to 100

Function Queries the Gating Time of the BER measurement.

Example

```
>:SENSe:MEASure:BER:TIME?
< 6
```

:CALCulate:DATA:EALarm? <result>

Parameter <result>=<STRING PROGRAM DATA>

Refer to Table 5.10-4 for details of <result>.

Response <string>=<STRING RESPONSE DATA>

Table 5.10-4 Parameter

Items	<result1>	Format
Error Count	"EC"	Form1
Bit Count	"BITS"	Form1
Bit Error Rate	"BER"	Form2
Pass/fail judgment	"JUDGe"	String("PASS","FAIL","---")

Table 5.10-5 Response Format

Items	Format	Description
Form1 Integer	"XXXXXXX"	For 0 to 9999999
	"X.XXXXEXX"	For 1.0000E07 to 9.9999E17
	"-------"	No data corresponds to a query.
Form2 Decimal	"X.XXXXE-XX"	For 0.0001E–18 to 1.0000E00
	"-------"	No data corresponds to a query.

Function Queries the BER Measurement results (BITS).

Example

```
> :CALCulate:DATA:EALarm? "BITS"
< "1.0000E12"
```

:SENSe:MEASure:BER:IPADdress <address>

Parameter	<address>=<STRING PROGRAM DATA> "xxx.xxx.xxx.xxx" IP address
Function	Sets an IP address of the USB3.1 Receiver Test Adapter to be connected.
Example	To set the IP address 192.168.0.10: `>:SENSe:MEASure:BER:IPADdress "192.168.0.10"`

:SENSe:MEASure:BER:IPADdress?

Response	<address>=<STRING RESPONSE DATA> "xxx.xxx.xxx.xxx" Outputs the format 223.255.255.254.
Function	Queries the setting value of the connection destination IP address.

Example	`>:SENSe:MEASure:BER:IPADdress?`
	`< "192.168.0.10"`

5.11 USB Link Training Setup Screen (With MX183000A-PL022 Installed)

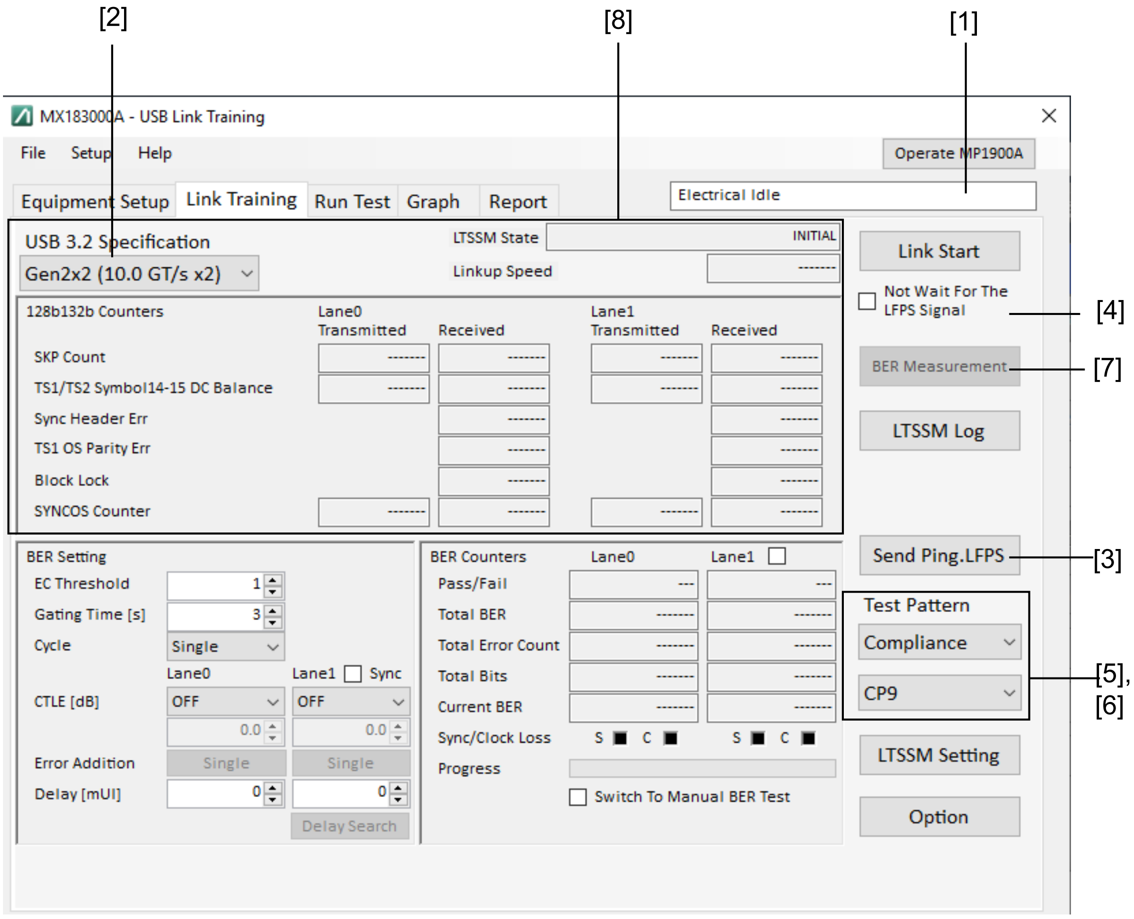
This setup screen is available when all of the following conditions are met.

- MX183000A-PL022 is installed.
- **USB Link Training** on the Figure 4.3.1-1 “Selector Screen” is started.
- The SQA has been connected using Equipment Setup.

Note that Lane1 can be selected for Lane when both of the following conditions are met.

- The MX183000A-PL023 USB 3.2 x 2 Link Training is activated.
- **Gen1x2 (5.0 GT/s x2)** or **Gen2x2 (10.0 GT/s x2)** is selected for USB 3.2 Specification.

5.11.1 Link Training screen



USB 3.2 Specification: Gen2x2 (10.0 GT/s x2)
LTSSM State: INITIAL
Linkup Speed: -------
EC Threshold: 1
Gating Time [s]: 3
Cycle: Single
CTLE [dB]: Lane0 OFF, 0.0; Lane1 OFF, 0.0
Delay [mUI]: 0, 0
Test Pattern: Compliance, CP9

Figure 5.11.1-1 Link Training Screen

Table 5.11.1-1 Training Setting Items and Result Query Commands

No.	Setting Item	Command
[1]	Sequence Start	:LTRaining:SEQuence:STARt
	Sequence Stop	:LTRaining:SEQuence:STOP
	Sequence State	:LTRaining:SEQuence:STATe?
[2]	Specification	:LTRaining:SEQuence:SPECification
		:LTRaining:SEQuence:SPECification?
[3]	Ping LFPS	:LTRaining:SEQuence:PING
[4]	Not Wait For The LFPS signal	:LTRaining:SEQuence:NWAit:LFPS
		:LTRaining:SEQuence:NWAit:LFPS?
[5]	Test pattern	:SOURce:PATTern:TYPE
		:SOURce:PATTern:TYPE?
[6]	Test pattern	:LTRaining:SEQuence:TEST:PATTern
		:LTRaining:SEQuence:TEST:PATTern?
[7]	LTSSM Log	:LTRaining:SEQuence:LTSSm:LOG:STARt
		:LTRaining:SEQuence:LTSSm:LOG:STOP
		:LTRaining:SEQuence:LTSSm:LOG:STATe?
		:LTRaining:SEQuence:LTSSm:LOG:GATing?
		:LTRaining:SEQuence:LTSSm:LOG:EXPort
[8]	Training Result	:LTRaining:SEQuence:RESult?

:LTRaining:SEQuence:STARt

Parameter	None
Function	Transits PPG to the status of waiting for LFPS signal from DUT. And, Link Training Sequence for DUT loop-back is started after receiving LFPS signal. Once the transmission is complete, the pattern selected by Test Pattern is sent.
Example	`> :LTRaining:SEQuence:STARt`

:LTRaining:SEQuence:STOP

Parameter	None
Function	Stops transmitting link training sequence and test pattern and sets to Electrical Idle.
Example	`> :LTRaining:SEQuence:STOP`

:LTRaining:SEQuence:STATe?

Response <numeric>=<NR1 NUMERIC RESPONSE DATA>

0	Stop
1	Sending Sequence Pattern
2	Sending test pattern

Function Queries the link training sequence transmission status.

Example

```
> :LTRaining:SEQuence:STATe?
< 1
```

:LTRaining:SEQuence:SPECification <type>

Parameter <type>=<CHARACTER PROGRAM DATA>

G1X1	SuperSpeed (5.0 GT/s)
G2X1	SuperSpeedPlus (10.0 GT/s)
G1X2	SuperSpeedPlus (5.0 GT/s x2)
G2X2	SuperSpeedPlus (10.0 GT/s x2)
GEN1	Same as G1X1 (for compatibility)
GEN2	Same as G2X1 (for compatibility)

Function Selects the environment for loopback of the USB3.0/3.1/3.2-supported DUT.

Example To select GEN1(5.0 GT/s) as the Link Training Sequence:

```
> :LTRaining:SEQuence:SPECification GEN1
```

:LTRaining:SEQuence:SPECification?

Response <type>=<CHARACTER RESPONSE DATA>

GEN1, GEN 2, G1X1, G2X1, G1X2, G2X2

Function Queries the environment for loopback of the USB3.0/3.1/3.2-supported DUT.

Example

```
> :LTRaining:SEQuence:SPECification?
< GEN1
```

:LTRaining:SEQuence:PING

Parameter None

Function Outputs the Ping.LFPS signal.

Example

```
>:LTRaining:SEQuence:PING
```

:LTRaining:SEQuence:NWAit:LFPS <boolean>

Parameter <boolean>=<BOOLEAN PROGRAM DATA>

OFF or 0	Starts Link Training after receiving LFPS signal.
ON or 1	Starts Link Training without waiting LFPS.

Function Selects the condition to start Link Training.

Example To start Link Training without waiting LFPS signal:

```
> :LTRaining:SEQuence:NWAit:LFPS 1
```

:LTRaining:SEQuence:NWAit:LFPS?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Starts Link Training after receiving LFPS signal.
	1	Starts Link Training without waiting LFPS.
Function	Queries the condition to start Link Training.	

Example	`> :LTRaining:SEQuence:NWAit:LFPS?`
	`< 1`	

:SOURce:PATTern:TYPE <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	COMPliance	Compliance pattern
	USER	USER pattern
Function	Selects the test pattern to be sent after completing the link training sequence transmission. Selecting USER outputs the test pattern selected on the MX180000A MU183020A setup screen.	
Example	To set the test pattern to Compliance Pattern: `>:SOURce:PATTern:TYPE COMPliance`	

:SOURce:PATTern:TYPE?

Response	<type>=<CHARACTER RESPONSE DATA> COMP, USER
Function	Queries the test pattern to be sent after completing the link training sequence transmission.

Example	`> :SOURce:PATTern:TYPE?`
	`< COMP`

:LTRaining:SEQuence:TEST:PATTern <pattern>

Parameter	<pattern>=<CHARACTER PROGRAM DATA>	
	When Specification setting is GEN1:	
	CP0P, CP0M	CP0 RD+, DP0 RD–
	CP1 to CP6	CP1 to CP6
	When Specification setting is GEN2:	
	CP9	CP9
Function	Selects the type of Compliance pattern to be sent when test pattern is set to Compliance.	
Example	`> :LTRaining:SEQuence:TEST:PATTern CP9`	

:LTRaining:SEQuence:TEST:PATTern?

Response	<pattern>=<CHARACTER RESPONSE DATA>	
	When Specification setting is GEN1:	
	CP0P, CP0M	CP0 RD+, DP0 RD–
	CP1 to CP6	CP1 to CP6
	When Specification setting is GEN2:	
	CP9	CP9
Function	Queries the test pattern to be sent.	

Example	`> :LTRaining:SEQuence:TEST:PATTern?`
	`< CP9`	

:LTRaining:SEQuence:LTSSm:LOG:STARt

Parameter	None
Function	Starts acquiring LTSSM Log.
Example	`> :LTRaining:SEQuence:LTSSm:LOG:STARt`

:LTRaining:SEQuence:LTSSm:LOG:STOP

Parameter	None
Function	Aborts acquiring LTSSM Log.
Example	`> :LTRaining:SEQuence:LTSSm:LOG:STOP`

:LTRaining:SEQuence:LTSSm:LOG:EXPort <file_name>

Parameter	<file_name>=<STRING PROGRAM DATA>	
	"<drv>:\<dir1>\<dir2>\<file>"	
	<drv>=C, D, E, F	Drive name
	<dir>=xxxxxxxx	Directory name
	<file>=xxxxxxxxx	File name
Function	Stores LTSSM Log in CSV format specifying a file name and format.	
Example	To store LTSSM Log.	
	`>:LTRaining:SEQuence:LTSSm:LOG:EXPort`	
	`"D:\test_folder\test.csv"`	

:LTRaining:SEQuence:LTSSm:LOG:STATe?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Stop
	1	Acquiring Log
Function	Queries the status of log acquisition.	
Example	`> :LTRaining:SEQuence:STATe?`	
	`< 1`	

:LTRaining:SEQuence:LTSSm:LOG:GATing?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0 to 100	0 to 100%
Function	Queries the progress of log acquisition.	
Example	`> :LTRaining:SEQuence:LTSSm:LOG:GATing?`	
	`< 1`	

:LTRaining:SEQuence:RESult? <type>[,<lane>]

Parameter

<type>=<CHARACTER PROGRAM DATA>

STATe	LTSSM State
LSPeed	Linkup Speed
TXSCount	SKP Count Tx
RXSCount	SKP Count Rx
SERR	Symbol Err
CRERr	Current RD Err
SLOCk	Symbol Lock
TXDC	Tx TS1/TS2 Symbol14-15 DC Balance
RXDC	Rx TS1/TS2 Symbol14-15 DC Balance
SHERr	Sync Header Err
PERR	TS1 OS Parity Err
BLOCk	Block Lock
RXSYncos	Rx SYNCOS Counter
TXSYncos	Tx SYNCOS Counter

<lane>=<DECIMAL NUMERIC PROGRAM DATA>

0	Lane0
1	Lane1

Note:

If the <lane> parameter is omitted, Lane0 is selected.

Response

<string>=<STRING RESPONSE DATA>

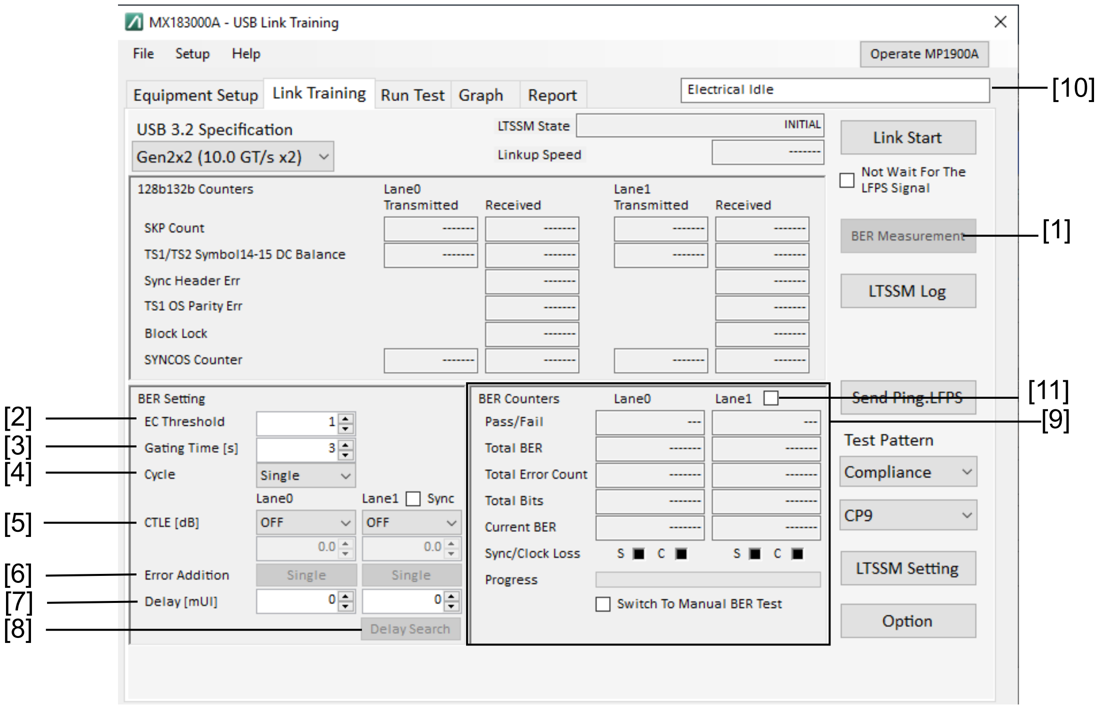
Function

Queries the measurement data, specifying the parameter and Lane.

Example

```
> :LTRaining:SEQuence:RESult? STATe
< Loopback.Active.Master
```

5.11.2 BER Measurement screen



Electrical Idle

USB 3.2 Specification: Gen2x2 (10.0 GT/s x2)

LTSSM State: INITIAL

EC Threshold: 1

Gating Time [s]: 3

Cycle: Single

CTLE [dB]: Lane0 OFF 0.0, Lane1 OFF 0.0

Delay [mUI]: Lane0 0, Lane1 0

Test Pattern: Compliance, CP9

Figure 5.11.2-1 BER Measurement Screen

Table 5.11.2-1 BER Measurement Commands

No.	Setting Item	Command
[1]	BER Measurement Start	:SENSe:MEASure:BER:STARt
	BER Measurement Stop	:SENSe:MEASure:BER:STOP
	BER Measurement State	:SENSe:MEASure:BER:STATe?
[2]	Error Count Threshold	:SENSe:MEASure:BER:ECTHreshold
		:SENSe:MEASure:BER:ECTHreshold?
[3]	Gating Time	:SENSe:MEASure:BER:TIME
		:SENSe:MEASure:BER:TIME?
[4]	Cycle	:SENSe:MEASure:BER:MODE
		:SENSe:MEASure:BER:MODE?
[5]	CTLE [dB]	:INPut:DATA:EQUalizer:SYNC
		:INPut:DATA:EQUalizer:SYNC?
	CTLE ON/OFF	:INPut:DATA:EQUalizer:SET
		:INPut:DATA:EQUalizer:SET?
	CTLE Gain	:INPut:DATA:EQUalizer:AMPLitude
		:INPut:DATA:EQUalizer:AMPLitude?
[6]	Error Addition	:SOURce:PATTern:EADDition:SINGle
[7]	Delay [mUI]	:INPut:CLOCk:DELay
		:INPut:CLOCk:DELay?
[8]	Delay Search	:LTRaining:SEQuence:DELAy:SEARCh:STARt
		:LTRaining:SEQuence:DELAy:SEARCh:STOP
		:LTRaining:SEQuence:DELAy:SEARCh:STATe?
[9]	BER Counters	:CALCulate:DATA:EALarm?
[10]	ED Status	:CALCulate:RESult:EMONitor?
[11]	Lane1 BER Count	:SENSe:MEASure:BER:LANe1 :SENSe:MEASure:BER:LANe1?

:SENSe:MEASure:BER:STARt

Parameter	None	
Function	Starts BER Measurement.	
Example	`> :SENSe:MEASure:BER:STARt`	

:SENSe:MEASure:BER:STOP

Parameter	None	
Function	Stops BER Measurement.	
Example	`> :SENSe:MEASure:BER:STOP`	

:SENSe:MEASure:BER:STATe?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	1	Being measured
	0	Stopped
Function	Queries the BER measurement status.	

Example	`> :SENSe:MEASure:BER:STATe?`
	`< 1`	

:SENSe:MEASure:BER:ECTHreshold <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0 to 1000	0 to 1000, 1 step
Function	Sets an evaluation threshold of the BER measurement. When the number of bit errors exceeds the evaluation threshold, the BER measurement is judged as Fail.	
Example	To set the evaluation threshold of the BER measurement to 1: `>:SENS:MEAS:BER:ECTHreshold 1`	

:SENSe:MEASure:BER:ECTHreshold?

Response	<numeric>=<NR1 NUMERIC RESPONESE DATA>	
	0 to 1000	0 to 1000
Function	Queries the evaluation threshold of the BER measurement.	

Example	`>:SENSe:MEASure:BER:ECTHreshold?`
	`< 1`	

:SENSe:MEASure:BER:TIME <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	1 to 100	1 to 100 s, 1 s step
Function	Sets the Gating Time of the BER measurement.	
Example	To set the Gating Time of the BER measurement to 6 s:	

```
>:SENSe:MEASure:BER:TIME 6
```

:SENSe:MEASure:BER:TIME?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA> 1 to 100
Function	Queries the Gating Time of the BER measurement.
Example	

```
>:SENSe:MEASure:BER:TIME?
< 6
```

:SENSe:MEASure:BER:MODE <mode>

Parameter	<mode>=<CHARACTER PROGRAM DATA>	
	SINGle	Performs the measurement once.
	REPeat	Performs the measurement repeatedly.
Function	Sets the measurement processing mode for the BER measurement.	
Example	To set the measurement processing mode for the BER measurement to repeat:	

```
> :SENSe:MEASure:BER:MODE REPeat
```

:SENSe:MEASure:BER:MODE?

Response	<mode>=<CHARACTER RESPONSE DATA> SING, REP
Function	Queries the measurement processing mode for the BER measurement.
Example	

```
>:SENSe:MEASure:BER:MODE?
< REP
```

:INPut:DATA:EQUalizer:SYNC <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	Turns off the sync of the CTLE settings between Lane0 and Lane1.
	ON or 1	Turns on the sync of the CTLE settings between Lane0 and Lane1.
Function	Turns on/off the sync of the CTLE settings between Lane0 and Lane1.	
Example	To turn on the sync of the CTLE settings:	

```
> :INPut:DATA:EQUalizer:SYNC ON
```

:INPut:DATA:EQUalizer:SYNC?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Sync of the CTLE settings between Lane0 and Lane1 is off.
	1	Sync of the CTLE settings between Lane0 and Lane1 is on.
Function	Queries the on/off state of the sync of the CTLE settings between Lane0 and Lane1.	
Example		

```
> :INPut:DATA:EQUalizer:SYNC?
< 1
```

:INPut:DATA:EQUalizer:SET <boolean>[,<lane>]

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	CTLE OFF
	ON or 1	CTLE ON
	<lane>=<DECIMAL NUMERIC PROGRAM DATA>	
	0	Lane0
	1	Lane1

Note:

If the <lane> parameter is omitted, Lane0 is selected.

Function: Turns on/off the CTLE, specifying Lane.

Example: To turn on the CTLE:

```
> :INPut:DATA:EQUalizer:SET ON
```

:INPut:DATA:EQUalizer:SET? [<lane>]

Parameter	<lane>=<DECIMAL NUMERIC PROGRAM DATA>	
	0	Lane0
	1	Lane1

Note:

If the <lane> parameter is omitted, Lane0 is selected.

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	CTLE OFF
	1	CTLE ON

Function: Queries the on/off state of the CTLE, specifying Lane.

Example:

```
> :INPut:DATA:EQUalizer:SET?
< 1
```

:INPut:DATA:EQUalizer:AMPLitude <numeric>[,<lane>]

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	–12.0 to 0.0	–12.0 to 0.0 dB, 0.1 dB step
	<lane>=<DECIMAL NUMERIC PROGRAM DATA>	
	0	Lane0
	1	Lane1

Note:

If the <lane> parameter is omitted, Lane0 is selected.

Function Sets the CLTE Gain.

Example To set the CLTE Gain to –6.0 dB, specifying Lane:

```
> :INPut:DATA:EQUalizer:AMPLitude -6.0
```

:INPut:DATA:EQUalizer:AMPLitude? [<lane>]

Parameter	<lane>=<DECIMAL NUMERIC PROGRAM DATA>	
	0	Lane0
	1	Lane1

Note:

If the <lane> parameter is omitted, Lane0 is selected.

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	–12.0 to 0.0	–12.0 to 0.0 dB

Function Queries the CTLE setting, specifying Lane.

Example

```
> :INPut:DATA:EQUalizer:AMPLitude?
< -6.0
```

:SOURce:PATTern:EADDition:SINGle [<lane>]

Parameter	<lane>=<DECIMAL NUMERIC PROGRAM DATA>	
	0	Lane0
	1	Lane1

Note:

If the <lane> parameter is omitted, Lane0 is selected.

Function Adds a single error to the test pattern, specifying Lane.

Example

```
> :SOURce:PATTern:EADDition:SINGle
```

:INPut:CLOCk:DELay <numeric>[,<lane>]

Parameter

<numeric>=<DECIMAL NUMERIC PROGRAM DATA>

–1000 to 1000	–1000 to 1000 mUI, in 2 mUI steps

<lane>=<DECIMAL NUMERIC PROGRAM DATA>

0	Lane0
1	Lane1

Note:

If the <lane> parameter is omitted, Lane0 is selected.

Function

Sets the clock phase delay.

Example

To set the delay to –100m UI:

```
> :INPut:CLOCk:DELay -100,1
```

:INPut:CLOCk:DELay? [<lane>]

Parameter

<lane>=<DECIMAL NUMERIC PROGRAM DATA>

0	Lane0
1	Lane1

Note:

If the <lane> parameter is omitted, Lane0 is selected.

Response

<numeric>=<NR1 NUMERIC RESPONSE DATA>

–1000 to 1000	–1000 to 1000 mUI

Function

Queries the clock phase delay.

Example

```
> :INPut:CLOCk:DELay? 1
< -100
```

:LTRaining:SEQuence:DELAy:SEARCh:STARt

Parameter	None
Function	Starts searching for the optimum phase delay of the Lane1 clock.
Example	`> :LTRaining:SEQuence:DELAy:SEARCh:STARt`

:LTRaining:SEQuence:DELAy:SEARCh:STOP

Parameter	None
Function	Stops searching for the optimum phase delay of the Lane1 clock.
Example	`> :LTRaining:SEQuence:DELAy:SEARCh:STOP`

:LTRaining:SEQuence:DELAy:SEARCh:STATe?

Response <numeric>=<NR1 NUMERIC RESPONSE DATA>

1	Search is in progress.
0	Search is stopped.

Function Queries the execution state of the optimal clock phase delay search on Lane1.

Example

```
> :LTRaining:SEQuence:DELAy:SEARCh:STATe?
< 1
```

:CALCulate:DATA:EALarm? <result>[,<lane>]

Parameter

<result>=<STRING PROGRAM DATA>

For details on <result>, refer to Table 5.8.2-2.

<lane>=<DECIMAL NUMERIC PROGRAM DATA>

0	Lane0
1	Lane1

Note:

If the <lane> parameter is omitted, Lane0 is selected.

Response

<string>=<STRING RESPONSE DATA>

Table 5.11.2-2 Parameter

Items	<result1>	Format
Error Count	"EC"	Form1
Bit Count	"BITS"	Form1
Bit Error Rate	"BER"	Form2
Pass/fail judgment	"JUDGe"	String ("PASS","FAIL","---")

Table 5.11.2-3 Response Format

Items	Format	Description
Form1 Integer	"XXXXXXX"	For 0 to 9999999
	"X.XXXXEXX"	For 1.0000E07 to 9.9999E17
	"-------"	No data corresponds to a query.
Form2 Decimal	"X.XXXXE-XX"	For 0.0001E–18 to 1.0000E00
	"-------"	No data corresponds to a query.

Function

Queries the BER measurement result (BITS), specifying Lane.

Example

```
> :CALCulate:DATA:EALarm? "BITS"
< "1.0000E12"
```

:CALCulate:RESult:EMONitor?

Response

<string>=<STRING RESPONSE DATA>

Function

Queries the MP1800A/MP1900A state.

Example

```
> :CALCulate:RESult:EMONitor?
< "Outputting Test Pattern"
```

:SENSe:MEASure:BER:LANe1 <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	Performs BER measurement of Lane0 only.
	ON or 1	Performs simultaneous BER measurement of Lane0 and Lane1.
Function	Sets ON/OFF of simultaneous BER measurement of Lane0 and Lane1.	
Example	To perform simultaneous BER measurement of Lane0 and Lane1:	

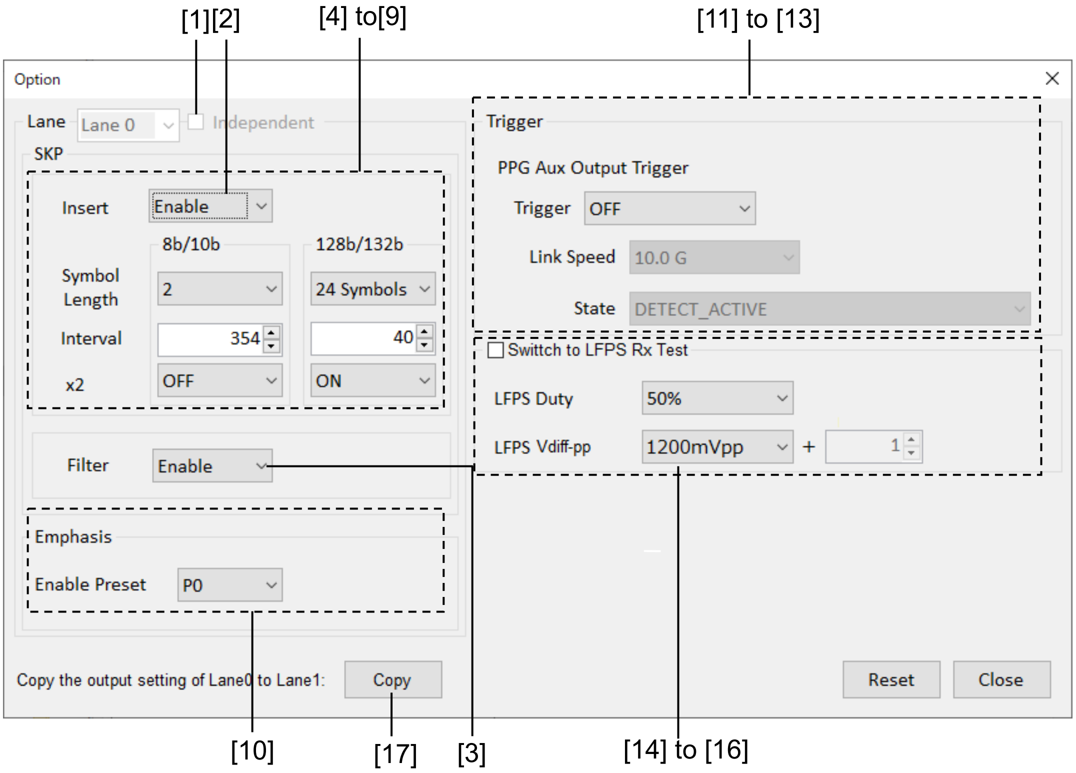
```
> :SENSe:MEASure:BER:LANe1 ON
```

:SENSe:MEASure:BER:LANe1?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	BER measurement of only Lane0
	1	Simultaneous BER measurement of Lane0 and Lane1
Function	Queries the on/off state of simultaneous BER measurement of Lane0 and Lane1.	
Example		

```
> :SENSe:MEASure:BER:LANe1?
< 1
```

5.11.3 Option dialog box



Lane: Lane 0 ☐ Independent

SKP

Insert: Enable

8b/10b / 128b/132b

Symbol Length: 2 / 24 Symbols

Interval: 354 / 40

x2: OFF / ON

Filter: Enable

Emphasis

Enable Preset: P0

Copy the output setting of Lane0 to Lane1: Copy

Trigger

PPG Aux Output Trigger

Trigger: OFF

Link Speed: 10.0 G

State: DETECT_ACTIVE

☐ Switch to LFPS Rx Test

LFPS Duty: 50%

LFPS Vdiff-pp: 1200mVpp + 1

Reset Close

Figure 5.11.3-1 Option Dialog Box

Table 5.11.3-1 Option Dialog Box Commands

No.	Setting Item	Command
[1]	Independent	:LTRaining:SEQuence:INDEpendent :LTRaining:SEQuence:INDEpendent?
[2]	SKP Insert	:LTRaining:SEQuence:SKP :LTRaining:SEQuence:SKP?
[3]	SKP Filter	:LTRaining:SEQuence:FILTer :LTRaining:SEQuence:FILTer?
[4]	Symbol Length 8b/10b	:LTRaining:SEQuence:SKP:SLENgth:8B10B :LTRaining:SEQuence:SKP:SLENgth:8B10B?
[5]	Interval 8b/10b	:LTRaining:SEQuence:SKP:INTerval:8B10B :LTRaining:SEQuence:SKP:INTerval:8B10B?
[6]	Double SKP (8b/10b)	:LTRaining:SEQuence:SKP:DOUBle:8B10B :LTRaining:SEQuence:SKP:DOUBle:8B10B?

Table 5.11.3-2 Option Dialog Box Commands (Cont'd)

No.	Setting Item	Command
[7]	Symbol Length 128b/132b	:LTRaining:SEQuence:SKP:SLENgth:128B132B
		:LTRaining:SEQuence:SKP:SLENgth:128B132B?
[8]	Interval 128b/132b	:LTRaining:SEQuence:SKP:INTerval:128B132B
		:LTRaining:SEQuence:SKP:INTerval:128B132B?
[9]	Double SKP (128b/132b)	:LTRaining:SEQuence:SKP:DOUBle:128B132B
		:LTRaining:SEQuence:SKP:DOUBle:128B132B?
[10]	Enable Preset	:LTRaining:SEQuence:ENABle:PRESet :LTRaining:SEQuence:ENABle:PRESet?
[11]	PPG AUX Output Trigger	:LTRaining:SEQuence:TRIGger:SELect
		:LTRaining:SEQuence:TRIGger:SELect?
[12]	Trigger Link Speed	:LTRaining:SEQuence:TRIGger:SPEed <numeric>
		:LTRaining:SEQuence:TRIGger:SPEed?
[13]	Trigger State	:LTRaining:SEQuence:TRIGger:STATe
		:LTRaining:SEQuence:TRIGger:STATe?
[14]	Switch to LFPS Rx Test	:LTRaining:POLling:LFPS:RXTEst
		:LTRaining:POLling:LFPS:RXTEst?
[15]	LFPS Duty	:LTRaining:POLling:LFPS:DUTY
		:LTRaining:POLling:LFPS:DUTY?
[16]	LFPS Vdiff-pp	:LTRaining:POLling:LFPS:VDIFfpp
		:LTRaining:POLling:LFPS:VDIFfpp?
		:LTRaining:POLling:LFPS:TN10
		:LTRaining:POLling:LFPS:TN10?
		:LTRaining:POLling:LFPS:TN12
		:LTRaining:POLling:LFPS:TN12
[17]	Copy the output setting of Lane0 to Lane1	:OUTPut:DATA:COPY

:LTRaining:SEQuence:INDEpendent <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	Returns from Independent mode. (Sets the same parameters for Lane0 and Lane1.)
	ON or 1	Turns on Independent mode. (Sets the parameters for Lane0 and Lane1, independently.)
Function	Turns on/off Independent mode.	
Example	To turn on Independent mode:	

```
> :LTRaining:SEQuence:INDEpendent ON
```

:LTRaining:SEQuence:INDEpendent?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Not in Independent mode
	1	In Independent mode
Function	Queries the on/off state of Independent mode.	
Example		

```
> :LTRaining:SEQuence:SKP?
< 1
```

:LTRaining:SEQuence:SKP <boolean>[,<lane>]

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	SKP OS not inserted
	ON or 1	SKP OS inserted
	<lane>=<DECIMAL NUMERIC PROGRAM DATA>	
	0	Lane0
	1	Lane1

Note:

If the <lane> parameter is omitted, Lane0 is selected.

Function: Sets whether to insert SKP OS during Link Training, specifying Lane.

Example: To insert SKP OS.

```
> :LTRaining:SEQuence:SKP ON
```

:LTRaining:SEQuence:SKP? [<lane>]

Parameter	<lane>=<DECIMAL NUMERIC PROGRAM DATA>	
	0	Lane0
	1	Lane1

Note:

If the <lane> parameter is omitted, Lane0 is selected.

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	SKP OS not inserted
	1	SKP OS inserted

Function: Queries whether SKP OS is set to be inserted during Link Training, specifying Lane.

Example:

```
> :LTRaining:SEQuence:SKP?
< 1
```

:LTRaining:SEQuence:FILTer <boolean>[,<lane>]

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	SKP OS is not filtered.
	ON or 1	SKP OS is filtered.
	<lane>=<DECIMAL NUMERIC PROGRAM DATA>	
	0	Lane0
	1	Lane1
	Note: If the <lane> parameter is omitted, Lane0 is selected.	
Function	Sets whether to filter SKP OS at the BER measurement, specifying Lane.	
Example	To filter SKP OS.	

```
> :LTRaining:SEQuence:FILTer ON
```

:LTRaining:SEQuence:FILTer? [<lane>]

Parameter	<lane>=<DECIMAL NUMERIC PROGRAM DATA>	
	0	Lane0
	1	Lane1
	Note: If the <lane> parameter is omitted, Lane0 is selected.	
Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	SKP OS is not filtered.
	1	SKP OS is filtered.
Function	Queries whether SKP OS is set to be filtered at the BER measurement, specifying Lane.	
Example		

```
> :LTRaining:SEQuence:FILTer?
< 1
```

:LTRaining:SEQuence:SKP:SLENgth:8B10B <numeric>[,<lane>]

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	2	2 symbols
	4	4 symbols
	6	6 symbols
	<lane>=<DECIMAL NUMERIC PROGRAM DATA>	
	0	Lane0
	1	Lane1

Note:

If the <lane> parameter is omitted, Lane0 is selected.

Function

Sets the number of SKP Symbols to be inserted in SKP Ordered Set, specifying Lane, when performing the 8b/10b encoding.

Example

To set the number of SKP OS SKP symbols to 2:

```
>:LTRaining:SEQuence:SKP:SLENgth:8B10B 2
```

:LTRaining:SEQuence:SKP:SLENgth:8B10B? [<lane>]

Parameter	<lane>=<DECIMAL NUMERIC PROGRAM DATA>	
	0	Lane0
	1	Lane1

Note:

If the <lane> parameter is omitted, Lane0 is selected.

Response

<numeric>=<NR1 NUMERIC RESPONESE DATA>

2, 4, 6

Function

Queries the number of SKP Symbols to be inserted in SKP Ordered Set, specifying Lane, when performing the 8b/10b encoding.

Example

```
> :LTRaining:SEQuence:SKP:SLENgth:8B10B?
< 2
```

:LTRaining:SEQuence:SKP:INTerval:8B10B <numeric>[,<lane>]

Parameter

<numeric>=<DECIMAL NUMERIC PROGRAM DATA>

76 to 708	76 to 708, 2 step

<lane>=<DECIMAL NUMERIC PROGRAM DATA>

0	Lane0
1	Lane1

Note:

If the <lane> parameter is omitted, Lane0 is selected.

Function

Sets the interval of SKP Ordered Sets to be inserted during Link Training, specifying Lane, when performing the 8b/10b encoding.

Example

To generate an SKP OS once after every 354 symbols sent:

```
>:LTRaining:SEQuence:SKP:INTerval:8B10B 354
```

:LTRaining:SEQuence:SKP:INTerval:8B10B? [<lane>]

Parameter

<lane>=<DECIMAL NUMERIC PROGRAM DATA>

0	Lane0
1	Lane1

Note:

If the <lane> parameter is omitted, Lane0 is selected.

Response

<numeric>=<NR1 NUMERIC RESPONESE DATA>

76 to 708	76 to 708, 2 step

Function

Queries the interval of SKP Ordered Sets to be inserted during Link Training, specifying Lane, when performing the 8b/10b encoding.

Example

```
>:LTRaining:SEQuence:SKP:INTerval:8B10B?
< 354
```

:LTRaining:SEQuence:SKP:DOUBle:8B10B <boolean>[,<lane>]

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	Double SKP OS not inserted.
	ON or 1	Double SKP OS inserted.
	<lane>=<DECIMAL NUMERIC PROGRAM DATA>	
	0	Lane0
	1	Lane1

Note:

If the <lane> parameter is omitted, Lane0 is selected.

Function

Sets whether to insert double SKP OS, specifying Lane, when both of the following are met:

- When performing the 8b/10b encoding
- While sending a test pattern in Loopback.Active State

Example

To insert double SKP OS.

```
> :LTRaining:SEQuence:SKP:DOUBle:8B10B 1
```

:LTRaining:SEQuence:SKP:DOUBle:8B10B? [<lane>]

Parameter	<lane>=<DECIMAL NUMERIC PROGRAM DATA>	
	0	Lane0
	1	Lane1

Note:

If the <lane> parameter is omitted, Lane0 is selected.

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Double SKP OS not inserted.
	1	Double SKP OS inserted.

Function

Queries whether double SKP OS is set to be inserted, specifying Lane, when both of the following are met:

- When performing the 8b/10b encoding
- While sending a test pattern in Loopback.Active State

Example

```
> :LTRaining:SEQuence:SKP:DOUBle:8B10B?
< 1
```

:LTRaining:SEQuence:SKP:SLENgth:128B132B <numeric>[,<lane>]

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	8	8 Symbols
	12	12 Symbols
	16	16 Symbols
	20	20 Symbols
	24	24 Symbols
	28	28 Symbols
	32	32 Symbols
	36	36 Symbols
	40	40 Symbols
	<lane>=<DECIMAL NUMERIC PROGRAM DATA>	
	0	Lane0
	1	Lane1

Note:

If the <lane> parameter is omitted, Lane0 is selected.

Function

Sets the number of SKP Symbols to be inserted in SKP Ordered Set, specifying Lane, when performing the 128b/132b encoding.

Example

To set the number of SKP OS SKP symbols to 8:

```
> :LTRaining:SEQuence:SKP:SLENgth:128B132B 8
```

:LTRaining:SEQuence:SKP:SLENgth:128B132B? [<lane>]

Parameter	<lane>=<DECIMAL NUMERIC PROGRAM DATA>	
	0	Lane0
	1	Lane1

Note:

If the <lane> parameter is omitted, Lane0 is selected.

Response

<numeric>=<NR1 NUMERIC RESPONESE DATA>

8, 12, 16, 20, 24, 28, 32, 26, 40

Function

Queries the number of SKP Symbols to be inserted in SKP Ordered Set, specifying Lane, when performing the 128b/132b encoding.

Example

```
> :LTRaining:SEQuence:SKP:SLENgth:128B132B?
< 8
```

:LTRaining:SEQuence:SKP:INTerval:128B132B <numeric>[,<lane>]

Parameter

<numeric>=<DECIMAL NUMERIC PROGRAM DATA>

20 to 80	20 to 80, 1 step

<lane>=<DECIMAL NUMERIC PROGRAM DATA>

0	Lane0
1	Lane1

Note:

If the <lane> parameter is omitted, Lane0 is selected.

Function

Sets the interval of SKP Ordered Sets to be inserted during Link Training, specifying Lane, when performing the 128b/132b encoding.

Example

To generate an SKP OS once after every 40 blocks sent:

```
>:LTRaining:SEQuence:SKP:INTerval:128B132B 40
```

:LTRaining:SEQuence:SKP:INTerval:128B132B? [<lane>]

Parameter

<lane>=<DECIMAL NUMERIC PROGRAM DATA>

0	Lane0
1	Lane1

Note:

If the <lane> parameter is omitted, Lane0 is selected.

Response

<numeric>=<NR1 NUMERIC RESPONESE DATA>

20 to 80	20 to 80

Function

Queries the interval of SKP Ordered Sets to be inserted during Link Training, specifying Lane, when performing the 128b/132b encoding.

Example

```
>:LTRaining:SEQuence:SKP:INTerval:128B132B?
< 40
```

:LTRaining:SEQuence:SKP:DOUBle:128B132B <boolean>[,<lane>]

Parameter

<boolean>=<BOOLEAN PROGRAM DATA>

OFF or 0	Double SKP OS not inserted.
ON or 1	Double SKP OS inserted.

<lane>=<DECIMAL NUMERIC PROGRAM DATA>

0	Lane0
1	Lane1

Note:

If the <lane> parameter is omitted, Lane0 is selected.

Function

Sets whether to insert double SKP OS, specifying Lane, when both of the following are met:

- When performing the 128b/132b encoding
- While sending a test pattern in Loopback.Active State

Example

To insert double SKP OS.

```
> :LTRaining:SEQuence:SKP:DOUBle:128B132B 1
```

:LTRaining:SEQuence:SKP:DOUBle:128B132B? [<lane>]

Parameter

<lane>=<DECIMAL NUMERIC PROGRAM DATA>

0	Lane0
1	Lane1

Note:

If the <lane> parameter is omitted, Lane0 is selected.

Response

<numeric>=<NR1 NUMERIC RESPONSE DATA>

0	Double SKP OS not inserted.
1	Double SKP OS inserted.

Function

Queries whether double SKP OS is set to be inserted, specifying Lane, when both of the following are met:

- When performing the 128b/132b encoding
- While sending a test pattern in Loopback.Active State

Example

```
> :LTRaining:SEQuence:SKP:DOUBle:128B132B?
< 1
```

:LTRaining:SEQuence:ENABle:PRESet <numeric>[,<lane>]

Parameter

<numeric>=<CHARACTER PROGRAM DATA>

P0 to P1	P0 to P1, 1 step

<lane>=<DECIMAL NUMERIC PROGRAM DATA>

0	Lane0
1	Lane1

Note:

If the <lane> parameter is omitted, Lane0 is selected.

Function

Sets the Preset value to be used in 5.0 GT/s or 10.0 GT/s state, specifying Lane.

Example

To set the Preset value to P0.

```
> :LTRaining:SEQuence:ENABle:PRESet P0
```

:LTRaining:SEQuence:ENABle:PRESet? [<lane>]

Parameter

<lane>=<DECIMAL NUMERIC PROGRAM DATA>

0	Lane0
1	Lane1

Note:

If the <lane> parameter is omitted, Lane0 is selected.

Response

<numeric>=<CHARACTER RESPONSE DATA>

P0 to P1	P0 to P1

Function

Queries the Preset value to be used in 5.0 GT/s or 10.0 GT/s state, specifying Lane.

Example

```
> :LTRaining:SEQuence:ENABle:PRESet?
< P0
```

:LTRaining:SEQuence:TRIGger:SELect <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	OFF	Does not output a trigger.
	LTSSm	Outputs a trigger at the time the MP1900A makes a transition to the specified LTSSM during Link Training.
Function	Sets the condition when the MP1900A outputs a trigger from the AUX Output of SI PPG.	
Example	To set the trigger output condition to LTSSM.	

```
> :LTRaining:SEQuence:TRIGger:SELect LTSSm
```

:LTRaining:SEQuence:TRIGger:SELect?

Response	<type>=<CHARACTER RESPONSE DATA>	
	OFF	Does not output a trigger.
	LTSS	Outputs a trigger at the time the MP1900A makes a transition to the specified LTSSM during Link Training.
Function	Queries the condition when the MP1900A outputs a trigger from the AUX Output of SI PPG.	
Example		

```
> :LTRaining:SEQuence:TRIGger:SELect?
< LTSS
```

:LTRaining:SEQuence:TRIGger:SPEed <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	5.0	5.0 GT/s
	10.0	10.0 GT/s
Function	Sets the operating data rate condition when the MP1900A outputs a trigger during executing Link Training.	
Example	To set the trigger output condition to 10.0 GT/s.	

```
> :LTRaining:SEQuence:TRIGger:SPEed 10.0
```

:LTRaining:SEQuence:TRIGger:SPEed?

Response	<numeric>=<NR2 NUMERIC RESPONSE DATA>	
	5.0	5.0 GT/s
	10.0	10.0 GT/s
Function	Queries the operating data rate condition when the MP1900A outputs a trigger during executing Link Training.	
Example		

```
> :LTRaining:SEQuence:TRIGger:SPEed?
< 10.0
```

:LTRaining:SEQuence:TRIGger:STATe <type>

Parameter

<numeric>=<DECIMAL NUMERIC PROGRAM DATA>

1	Detect.Quiet
2	Detect.Active
3	Detect.Reset
17	Polling.LFPS
18	Polling.LFPS(SCD1
19	Polling.LFPS(SCD2)
20	Polling.LFPSPlus
21	Polling.LFPS(END of SCD)
22	Polling.PortMatch
23	Polling.PortConfig(PHY Ready LBPM)
24	Polling.PortConfig(End of LBPM)
25	Polling.PortConfig(Change)
26	Polling.RxEQ
27	Polling.Active
28	Polling.Configuration
29	Polling.Idle
30	Polling.LFPS(End)
33	Compliance Mode
49	Ping.LFPS
65	L0
81	eSS.Disabled
97	Loopback.Active(BRST)
98	Loopback.Active(BDAT)
99	Loopback.Active(BREC)
100	Loopback.Active(CP0 to 9)
101	Loopback.Exit
113	Hot Reset.Active(assert)
114	Hot Reset.Active(de-assert)
115	Hot Reset.Exit

Function

Sets the state condition when the MP1900A outputs a trigger during executing Link Training.

This is enabled when **LTSSM** is selected at Trigger Select.

Example

To output a trigger when the MP1900A changes to the Loopback.Active state during executing Link Training.

```
> :LTRaining:SEQuence:TRIGger:STATe 100
```

:LTRaining:SEQuence:TRIGger:STATe?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA> For the return value, refer to the parameter of the `:LTRaining:SEQuence:TRIGger:STATe` command.
Function	Sets the state condition when the MP1900A outputs a trigger during executing Link Training. This is enabled when **LTSSM** is selected at Trigger Select.

Example	`> :LTRaining:SEQuence:TRIGger:STATe?`
	`< 100`

:LTRaining:POLling:LFPS:RXTEst <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	Returns from LFPS Rx Test mode.
	ON or 1	Turns on LFPS Rx Test mode.
Function	Sets whether to turn on LFPS Rx Test mode.	
Example	To turn on LFPS Rx Test mode: `> :LTRaining:POLling:LFPS:RXTEst ON`	

:LTRaining:POLling:LFPS:RXTEst?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Not in LFPS Rx Test mode
	1	In LFPS Rx Test mode
Function	Queries the on/off state of LFPS Rx Test mode.	

Example	`> :LTRaining:POLling:LFPS:RXTEst?`
	`< 1`	

:LTRaining:POLling:LFPS:DUTY <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	40	Duty ratio of 40%
	50	Duty ratio of 50%
	60	Duty ratio of 60%
Function	Sets the duty ratio of the output LFPS signal.	
Example	To set the duty ratio of the output LFPS signal to 40%:	

```
> :LTRaining:POLling:LFPS:DUTY 40
```

:LTRaining:POLling:LFPS:DUTY?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA> 40, 50, 60
Function	Queries the duty ratio of the output LFPS signal.
Example	

```
> :LTRaining:POLling:LFPS:DUTY?
< 40
```

:LTRaining:POLling:LFPS:VDIFfpp <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	DEFAult	Default
	10	1000mVpp
	12	1200mVpp
Function	Sets the amplitude of the output LFPS signal.	
Example	To set the amplitude of the output LFPS signal to Default:	

```
> :LTRaining:POLling:LFPS:VDIFfpp DEFAult
```

:LTRaining:POLling:LFPS:VDIFfpp?

Response	<type>=<CHARACTER RESPONSE DATA> DEFAult, 10, 12
Function	Queries the amplitude of the output LFPS signal.
Example	

```
> :LTRaining:POLling:LFPS:VDIFfpp?
< DEFA
```

:LTRaining:POLling:LFPS:TN10 <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	–300 to 300	–300 to 300, 1 step
Function	Sets the adjustment value for LFPS Vdiff-pp of 1000mVpp.	
Example	To set the adjustment value for LFPS Vdiff-pp of 1000mVpp to –30:	

```
>:LTRaining:POLling:LFPS:TN10 -30
```

:LTRaining:POLling:LFPS:TN10?

Response	<numeric>=<NR1 NUMERIC RESPONESE DATA>	
	–300 to 300	–300 to 300, 1 step
Function	Queries the adjustment value for LFPS Vdiff-pp of 1000mVpp.	
Example		

```
>:LTRaining:POLling:LFPS:TN10?
< -30
```

:LTRaining:POLling:LFPS:TN12 <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	–300 to 300	–300 to 300, 1 step
Function	Sets the adjustment value for LFPS Vdiff-pp of 1200mVpp.	
Example	To set the adjustment value for LFPS Vdiff-pp of 1200mVpp to –30:	

```
>:LTRaining:POLling:LFPS:TN12 -30
```

:LTRaining:POLling:LFPS:TN12?

Response	<numeric>=<NR1 NUMERIC RESPONESE DATA>	
	–300 to 300	–300 to 300, 1 step
Function	Queries the adjustment value for LFPS Vdiff-pp of 1200mVpp.	
Example		

```
>:LTRaining:POLling:LFPS:TN12?
< -30
```

:OUTPut:DATA:COPY

Parameter	None
Function	Copies the output settings for Lane0 to Lane1.

Note:

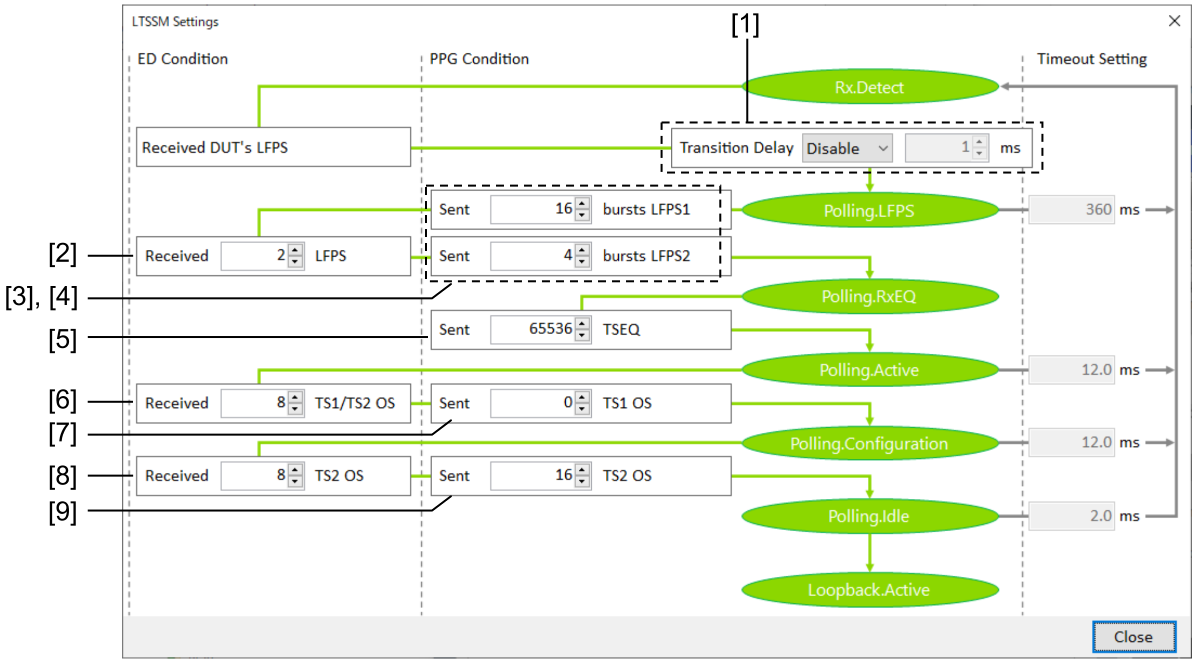
This command is available when both of the following are met.

- The MX183000A-PL023 USB 3.2 x 2 Link Training is activated.
- **Gen1x2 (5.0 GT/s x2)** or **Gen2x2 (10.0 GT/s x2)** is selected for USB 3.2 Specification.

Example

```
> :OUTPut:DATA:COPY
```

5.11.4 LTSSM Settings dialog box



Transition Delay Disable 1 ms

Sent 16 bursts LFPS1

Received 2 LFPS

Sent 4 bursts LFPS2

Sent 65536 TSEQ

Received 8 TS1/TS2 OS

Sent 0 TS1 OS

Received 8 TS2 OS

Sent 16 TS2 OS

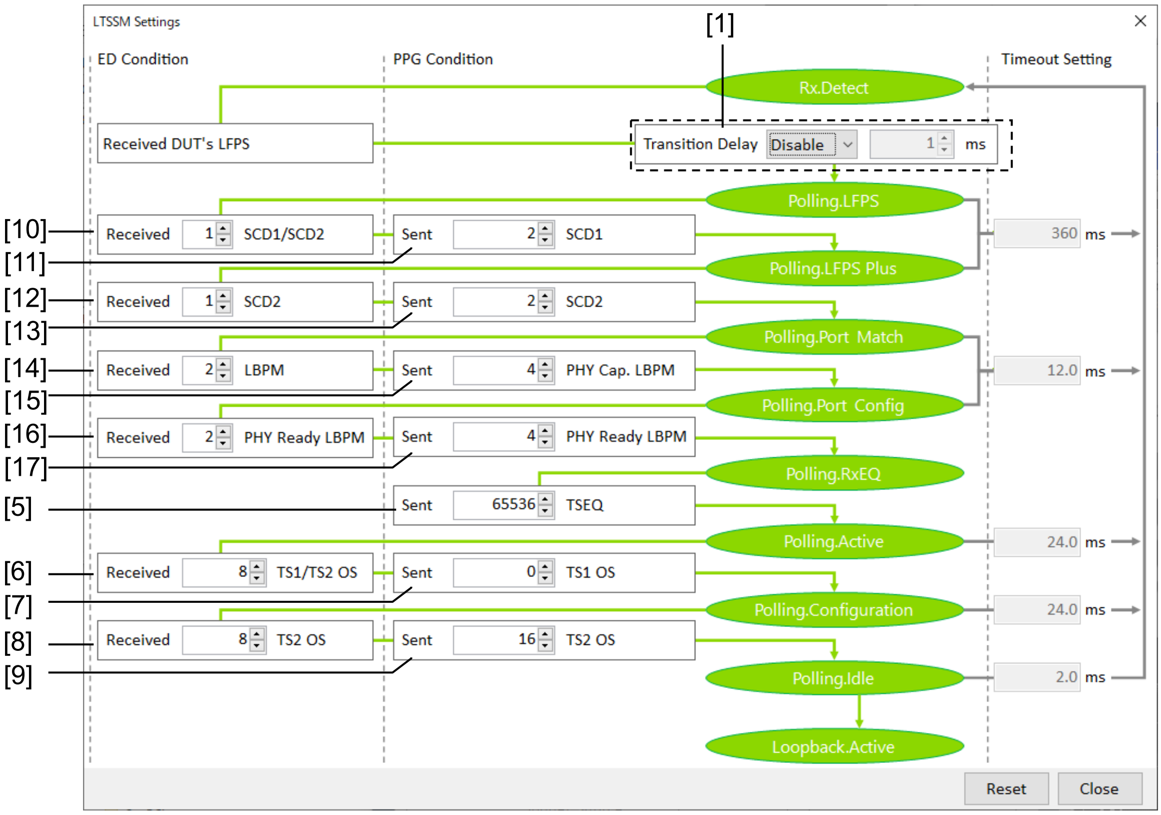
Polling.LFPS 360 ms

Polling.Active 12.0 ms

Polling.Configuration 12.0 ms

Polling.Idle 2.0 ms

Figure 5.11.4-1 LTSSM Settings Dialog Box (When Gen1x1 Is selected)



Transition Delay Disable 1 ms

Received 1 SCD1/SCD2

Sent 2 SCD1

Received 1 SCD2

Sent 2 SCD2

Received 2 LBPM

Sent 4 PHY Cap. LBPM

Received 2 PHY Ready LBPM

Sent 4 PHY Ready LBPM

Sent 65536 TSEQ

Received 8 TS1/TS2 OS

Sent 0 TS1 OS

Received 8 TS2 OS

Sent 16 TS2 OS

Polling.LFPS / Polling.LFPS Plus 360 ms

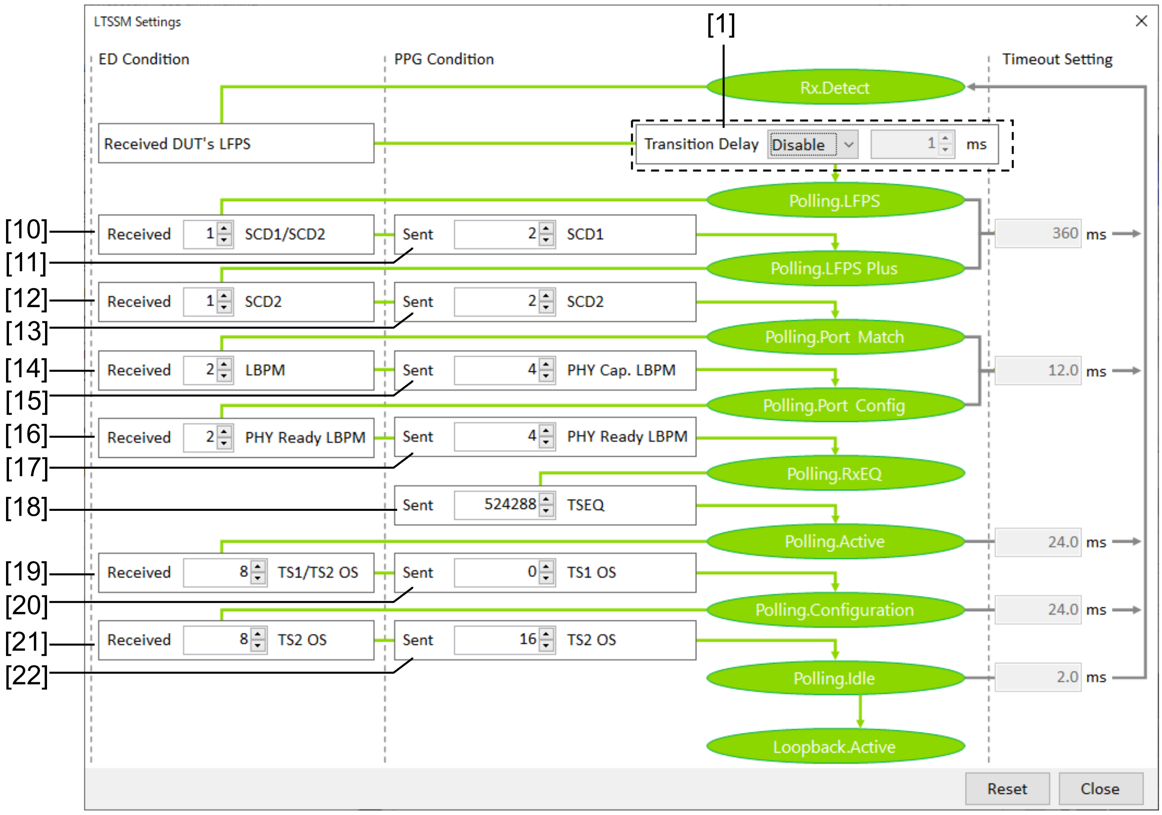
Polling.Port Match / Polling.Port Config 12.0 ms

Polling.Active 24.0 ms

Polling.Configuration 24.0 ms

Polling.Idle 2.0 ms

Figure 5.11.4-2 LTSSM Settings Settings Dialog Box (When Gen1x2 Is selected)



Received DUT's LFPS

Transition Delay Disable 1 ms

Received 1 SCD1/SCD2 — Sent 2 SCD1

Received 1 SCD2 — Sent 2 SCD2

Received 2 LBPM — Sent 4 PHY Cap. LBPM

Received 2 PHY Ready LBPM — Sent 4 PHY Ready LBPM

Sent 524288 TSEQ

Received 8 TS1/TS2 OS — Sent 0 TS1 OS

Received 8 TS2 OS — Sent 16 TS2 OS

360 ms

12.0 ms

24.0 ms

24.0 ms

2.0 ms

Figure 5.11.4-3 LTSSM Settings Dialog Box (When Gen2x1 or Gen2x2 Is selected)

Table 5.11.4-1 LTSSM Settings Dialog Box Commands

No.	Setting Item	Command
[1]	Transition Delay	:LTRaining:POLling:LFPS:DELay:ENAB
		:LTRaining:POLling:LFPS:DELay:ENAB?
		:LTRaining:POLling:LFPS:DELay
		:LTRaining:POLling:LFPS:DELay?
[2]	Received LFPS	:LTRaining:LTSSm:PLFPs:RX:LFPS
		:LTRaining:LTSSm:PLFPs:RX:LFPS?
[3]	Sent bursts LFPS1	:LTRaining:LTSSm:PLFPs:TX:LFPS1
		:LTRaining:LTSSm:PLFPs:TX:LFPS1?
[4]	Sent bursts LFPS2	:LTRaining:LTSSm:PLFPs:TX:LFPS2
		:LTRaining:LTSSm:PLFPs:TX:LFPS2?
[5]	Sent TSEQ	:LTRaining:LTSSm:PRXEq:8B10B:TX:TSEQ
		:LTRaining:LTSSm:PRXEq:8B10B:TX:TSEQ?
[6]	Received TS1/TS2 OS	:LTRaining:LTSSm:PACTive:8B10B:RX:TS12
		:LTRaining:LTSSm:PACTive:8B10B:RX:TS12?
[7]	Sent TS1 OS	:LTRaining:LTSSm:PACTive:8B10B:TX:TS1
		:LTRaining:LTSSm:PACTive:8B10B:TX:TS1?
[8]	Received TS2 OS	:LTRaining:LTSSm:PCONfig:8B10B:RX:TS2
		:LTRaining:LTSSm:PCONfig:8B10B:RX:TS2?

Table 5.11.4-1 LTSSM Settings Dialog Box Commands (Cont'd)

No.	Setting Item	Command
[9]	Sent TS2 OS	:LTRaining:LTSSm:PCONfig:8B10B:TX:TS2
		:LTRaining:LTSSm:PCONfig:8B10B:TX:TS2?
[10]	Received SCD1/SCD2	:LTRaining:LTSSm:PLFPs:RX:SCD12
		:LTRaining:LTSSm:PLFPs:RX:SCD12?
[11]	Sent SCD1	:LTRaining:LTSSm:PLFPs:TX:SCD1
		:LTRaining:LTSSm:PLFPs:TX:SCD1?
[12]	Received SCD2	:LTRaining:LTSSm:PLPLus:RX:SCD2
		:LTRaining:LTSSm:PLPLus:RX:SCD2?
[13]	Sent SCD2	:LTRaining:LTSSm:PLPLus:TX:SCD2
		:LTRaining:LTSSm:PLPLus:TX:SCD2?
[14]	Received LBPM	:LTRaining:LTSSm:PPMAtch:RX:LBPM
		:LTRaining:LTSSm:PPMAtch:RX:LBPM?
[15]	Sent PHY Cap. LBPM	:LTRaining:LTSSm:PPMAtch:TX:LBPM
		:LTRaining:LTSSm:PPMAtch:TX:LBPM?
[16]	Received PHY Ready LBPM	:LTRaining:LTSSm:PPCOnfig:RX:LBPM
		:LTRaining:LTSSm:PPCOnfig:RX:LBPM?
[17]	Sent PHY Ready LBPM	:LTRaining:LTSSm:PPCOnfig:TX:LBPM
		:LTRaining:LTSSm:PPCOnfig:TX:LBPM?
[18]	Sent TSEQ	:LTRaining:LTSSm:PRXEq:128B132B:TX:TSEQ
		:LTRaining:LTSSm:PRXEq:128B132B:TX:TSEQ?
[19]	Received TS1/TS2 OS	:LTRaining:LTSSm:PACTive:128B132B:RX:TS12
		:LTRaining:LTSSm:PACTive:128B132B:RX:TS12?
[20]	Sent TS1 OS	:LTRaining:LTSSm:PACTive:128B132B:TX:TS1
		:LTRaining:LTSSm:PACTive:128B132B:TX:TS1?
[21]	Received TS2 OS	:LTRaining:LTSSm:PCONfig:128B132B:RX:TS2
		:LTRaining:LTSSm:PCONfig:128B132B:RX:TS2?
[22]	Sent TS2 OS	:LTRaining:LTSSm:PCONfig:128B132B:TX:TS2
		:LTRaining:LTSSm:PCONfig:128B132B:TX:TS2?

:LTRaining:POLling:LFPS:DELay:ENAB <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	Does not delay the transition to the Polling.LFPS state.
	ON or 1	Delays the transition to the Polling.LFPS state.
Function	Sets whether to delay BERT's transition from reception of LFPS output by DUT to the Polling.LFPS state.	
Example	To delay the transition to the Polling.LFPS state. `> :LTRaining:POLling:LFPS:DELay:ENAB ON`	

:LTRaining:POLling:LFPS:DELay:ENAB?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Does not delay the transition to the Polling.LFPS state.
	1	Delays the transition to the Polling.LFPS state.
Function	Queries whether to delay BERT's transition from reception of LFPS output by DUT to the Polling.LFPS state.	

Example	`> :LTRaining:POLling:LFPS:DELay:ENAB?`
	`< 1`	

:LTRaining:POLling:LFPS:DELay <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	1 to 250	1 to 250 ms, 1 ms step
Function	Sets the delay in BERT's transition from reception of LFPS output by DUT to the Polling.LFPS state.	
Example	To set the delay in transition to the Polling.LFPS state to 5 ms. `>:LTRaining:POLling:LFPS:DELay 5`	

:LTRaining:POLling:LFPS:DELay?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	1 to 250	
Function	Queries the delay between BERT receiving LFPS output from DUT and transition to the Polling.LFPS state	

Example	`>:LTRaining:POLling:LFPS:DELay?`
	`< 5`	

:LTRaining:LTSSm:PLFPs:RX:LFPS <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA> 2 to 255 2 to 255, Initial value: 2
Function	Sets the required number of times LFPS is received for transition from Polling.LFPS in Gen1x1 link training.
Example	To set the number of times LFPS is received to 2: `> :LTRaining:LTSSm:PLFPs:RX:LFPS 2`

:LTRaining:LTSSm:PLFPs:RX:LFPS?

Response	<numeric>=<NR1 NUMERIC RESPONESE DATA> 2 to 255 2 to 255
Function	Queries the required number of times LFPS is received for transition from Polling.LFPS in Gen1x1 link training.

Example	`> :LTRaining:LTSSm:PLFPs:RX:LFPS?`
	`< 2`

:LTRaining:LTSSm:PLFPs:TX:LFPS1 <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA> 16 to 255 16 to 255, Initial value: 16
Function	Sets the required number of times LFPS1 is transmitted for transition from Polling.LFPS in Gen1x1 link training.
Example	To set the number of times LFPS1 is transmitted to 16: `> :LTRaining:LTSSm:PLFPs:TX:LFPS1 16`

:LTRaining:LTSSm:PLFPs:TX:LFPS1?

Response	<numeric>=<NR1 NUMERIC RESPONESE DATA> 16 to 255 16 to 255
Function	Queries the required number of times LFPS1 is transmitted for transition from Polling.LFPS in Gen1x1 link training.

Example	`> :LTRaining:LTSSm:PLFPs:TX:LFPS1?`
	`< 16`

:LTRaining:LTSSm:PLFPs:TX:LFPS2 <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	4 to 255	4 to 255, Initial value: 4
Function	Sets the required number of times LFPS2 is transmitted for transition from Polling.LFPS in Gen1x1 link training.	
Example	To set the number of times LFPS2 is transmitted to 4:	

```
> :LTRaining:LTSSm:PLFPs:TX:LFPS2 4
```

:LTRaining:LTSSm:PLFPs:TX:LFPS2?

Response	<numeric>=<NR1 NUMERIC RESPONESE DATA>	
	4 to 255	4 to 255
Function	Queries the required number of times LFPS2 is transmitted for transition from Polling.LFPS in Gen1x1 link training.	
Example		

```
> :LTRaining:LTSSm:PLFPs:TX:LFPS2?
< 4
```

:LTRaining:LTSSm:PRXEq:8B10B:TX:TSEQ <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	65536 to 1048575	65536 to 1048575, Initial value: 65536
Function	Sets the required number of times TSEQ is transmitted for transition from Polling.RxEQ in Gen1x1 and Gen1x2 link training.	
Example	To set the number of times TSEQ is transmitted to 65536:	

```
> :LTRaining:LTSSm:PRXEq:8B10B:TX:TSEQ 65536
```

:LTRaining:LTSSm:PRXEq:8B10B:TX:TSEQ?

Response	<numeric>=<NR1 NUMERIC RESPONESE DATA>	
	65536 to 1048575	65536 to 1048575
Function	Queries the required number of times TSEQ is transmitted for transition from Polling.LFPS in Gen1x1 and Gen1x2 link training.	
Example		

```
> :LTRaining:LTSSm:PRXEq:8B10B:TX:TSEQ?
< 65536
```

:LTRaining:LTSSm:PACTive:8B10B:RX:TS12 <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	8 to 65535	8 to 65535, Initial value: 8
Function	Sets the required number of times TS1/TS2 OS is received for transition from Polling.Active in Gen1x1 and Gen1x2 link training.	
Example	To set the number of times TS1/TS2 OS is received to 8:	

```
> :LTRaining:LTSSm:PACTive:8B10B:RX:TS12 8
```

:LTRaining:LTSSm:PACTive:8B10B:RX:TS12?

Response	<numeric>=<NR1 NUMERIC RESPONESE DATA>	
	8 to 65535	8 to 65535
Function	Queries the required number of times TS1/TS2 OS is received for transition from Polling.Active in Gen1x1 and Gen1x2 link training.	
Example		

```
> :LTRaining:LTSSm:PACTive:8B10B:RX:TS12?
< 8
```

:LTRaining:LTSSm:PACTive:8B10B:TX:TS1 <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0 to 65535	0 to 65535, Initial value: 0
Function	Sets the required number of times TS1 OS is transmitted for transition from Polling.Active in Gen1x1 and Gen1x2 link training.	
Example	To set the number of times TS1 OS is transmitted to 0:	

```
> :LTRaining:LTSSm:PACTive:8B10B:TX:TS1 0
```

:LTRaining:LTSSm:PACTive:8B10B:TX:TS1?

Response	<numeric>=<NR1 NUMERIC RESPONESE DATA>	
	0 to 65535	0 to 65535
Function	Queries the required number of times TS1 OS is transmitted for transition from Polling.Active in Gen1x1 and Gen1x2 link training.	
Example		

```
> :LTRaining:LTSSm:PACTive:8B10B:TX:TS1?
< 0
```

:LTRaining:LTSSm:PCONfig:8B10B:RX:TS2 <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	8 to 65535	8 to 65535, Initial value: 8
Function	Sets the required number of times TS2 OS is received for transition from Polling.Configuration in Gen1x1 and Gen1x2 link training.	
Example	To set the number of times TS2 OS is received to 8:	

```
> :LTRaining:LTSSm:PCONfig:8B10B:RX:TS2 8
```

:LTRaining:LTSSm:PCONfig:8B10B:RX:TS2?

Response	<numeric>=<NR1 NUMERIC RESPONESE DATA>	
	8 to 65535	8 to 65535
Function	Queries the required number of times TS2 OS is received for transition from Polling.Configuration in Gen1x1 and Gen1x2 link training.	
Example		

```
> :LTRaining:LTSSm:PCONfig:8B10B:RX:TS2?
< 8
```

:LTRaining:LTSSm:PCONfig:8B10B:TX:TS2 <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	16 to 65535	16 to 65535, Initial value: 16
Function	Sets the required number of times TS2 OS is transmitted for transition from Polling.Configuration in Gen1x1 and Gen1x2 link training.	
Example	To set the number of times TS2 OS is transmitted to 16:	

```
> :LTRaining:LTSSm:PCONfig:8B10B:TX:TS2 16
```

:LTRaining:LTSSm:PCONfig:8B10B:TX:TS2?

Response	<numeric>=<NR1 NUMERIC RESPONESE DATA>	
	16 to 65535	16 to 65535
Function	Queries the required number of times TS2 OS is transmitted for transition from Polling.Configuration in Gen1x1 and Gen1x2 link training.	
Example		

```
> :LTRaining:LTSSm:PCONfig:8B10B:TX:TS2?
< 16
```

:LTRaining:LTSSm:PLFPs:RX:SCD12 <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA> 1 to 255 1 to 255, Initial value: 1
Function	Sets the required number of times SCD1/SCD2 is received for transition from Polling.LFPS in Gen1x2, Gen2x1, and Gen2x2 link training.
Example	To set the number of times SCD1/SCD2 is received to 1: `> :LTRaining:LTSSm:PLFPs:RX:SCD12 1`

:LTRaining:LTSSm:PLFPs:RX:SCD12?

Response	<numeric>=<NR1 NUMERIC RESPONESE DATA> 1 to 255 1 to 255
Function	Queries the required number of times SCD1/SCD2 is received for transition from Polling.LFPS in Gen1x2, Gen2x1, and Gen2x2 link training.

Example	`> :LTRaining:LTSSm:PLFPs:RX:SCD12?`
	`< 1`

:LTRaining:LTSSm:PLFPs:TX:SCD1 <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA> 2 to 255 2 to 255, Initial value: 2
Function	Sets the required number of times SCD1 is transmitted for transition from Polling.LFPS in Gen1x2, Gen2x1, and Gen2x2 link training.
Example	To set the number of times SCD1 is transmitted to 2: `> :LTRaining:LTSSm:PLFPs:TX:SCD1 2`

:LTRaining:LTSSm:PLFPs:TX:SCD1?

Response	<numeric>=<NR1 NUMERIC RESPONESE DATA> 2 to 255 2 to 255
Function	Queries the required number of times SCD1 is transmitted for transition from Polling.LFPS in Gen1x2, Gen2x1, and Gen2x2 link training.

Example	`> :LTRaining:LTSSm:PLFPs:TX:SCD1?`
	`< 2`

:LTRaining:LTSSm:PLPLus:RX:SCD2 <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	1 to 255	1 to 255, Initial value: 1
Function	Sets the required number of times SCD2 is received for transition from Polling.LFPS Plus in Gen1x2, Gen2x1, and Gen2x2 link training.	
Example	To set the number of times SCD2 is received to 1:	

```
> :LTRaining:LTSSm:PLPLus:RX:SCD2 1
```

:LTRaining:LTSSm:PLPLus:RX:SCD2?

Response	<numeric>=<NR1 NUMERIC RESPONESE DATA>	
	1 to 255	1 to 255
Function	Queries the required number of times SCD2 is received for transition from Polling.LFPS Plus in Gen1x2, Gen2x1, and Gen2x2 link training.	
Example		

```
> :LTRaining:LTSSm:PLPLus:RX:SCD2?
< 1
```

:LTRaining:LTSSm:PLPLus:TX:SCD2 <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	2 to 255	2 to 255, Initial value: 2
Function	Sets the required number of times SCD2 is transmitted for transition from Polling.LFPS Plus in Gen1x2, Gen2x1, and Gen2x2 link training.	
Example	To set the number of times SCD2 is transmitted to 2:	

```
> :LTRaining:LTSSm:PLPLus:TX:SCD2 2
```

:LTRaining:LTSSm:PLPLus:TX:SCD2?

Response	<numeric>=<NR1 NUMERIC RESPONESE DATA>	
	2 to 255	2 to 255
Function	Queries the required number of times SCD2 is transmitted for transition from Polling.LFPS Plus in Gen1x2, Gen2x1, and Gen2x2 link training.	
Example		

```
> :LTRaining:LTSSm:PLPLus:TX:SCD2?
< 2
```

:LTRaining:LTSSm:PPMAtch:RX:LBPM <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA> 2 to 255 2 to 255, Initial value: 2
Function	Sets the required number of times LBPM is received for transition from Polling.Port Match in Gen1x2, Gen2x1, and Gen2x2 link training.
Example	To set the number of times LBPM is received to 2:

```
> :LTRaining:LTSSm:PPMAtch:RX:LBPM 2
```

:LTRaining:LTSSm:PPMAtch:RX:LBPM?

Response	<numeric>=<NR1 NUMERIC RESPONESE DATA> 2 to 255 2 to 255
Function	Queries the required number of times LBPM is received for transition from Polling.Port Match in Gen1x2, Gen2x1, and Gen2x2 link training.
Example	

```
> :LTRaining:LTSSm:PPMAtch:RX:LBPM?
< 2
```

:LTRaining:LTSSm:PPMAtch:TX:LBPM <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA> 4 to 255 4 to 255, Initial value: 4
Function	Sets the required number of times PHY Cap. LBPM is transmitted for transition from Polling.Port Match in Gen1x2, Gen2x1, and Gen2x2 link training.
Example	To set the number of times PHY Cap. LBPM is transmitted to 4:

```
> :LTRaining:LTSSm:PPMAtch:TX:LBPM 4
```

:LTRaining:LTSSm:PPMAtch:TX:LBPM?

Response	<numeric>=<NR1 NUMERIC RESPONESE DATA> 4 to 255 4 to 255
Function	Queries the required number of times PHY Cap. LBPM is transmitted for transition from Polling.Port Match in Gen1x2, Gen2x1, and Gen2x2 link training.
Example	

```
> :LTRaining:LTSSm:PPMAtch:TX:LBPM?
< 4
```

:LTRaining:LTSSm:PPCOnfig:RX:LBPM <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA> 2 to 255 2 to 255, Initial value: 2
Function	Sets the required number of times PHY Ready LBPM is received for transition from Polling.Port Config in Gen1x2, Gen2x1, and Gen2x2 link training.
Example	To set the number of times PHY Ready LBPM is received to 2: `> :LTRaining:LTSSm:PPCOnfig:RX:LBPM 2`

:LTRaining:LTSSm:PPCOnfig:RX:LBPM?

Response	<numeric>=<NR1 NUMERIC RESPONESE DATA> 2 to 255 2 to 255
Function	Queries the required number of times PHY Ready LBPM is received for transition from Polling.Port Config in Gen1x2, Gen2x1, and Gen2x2 link training.

Example	`> :LTRaining:LTSSm:PPCOnfig:RX:LBPM?`
	`< 2`

:LTRaining:LTSSm:PPCOnfig:TX:LBPM <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA> 4 to 255 4 to 255, Initial value: 4
Function	Sets the required number of times PHY Ready LBPM is transmitted for transition from Polling.Port Config in Gen1x2, Gen2x1, and Gen2x2 link training.
Example	To set the number of times PHY Ready LBPM is transmitted to 4: `> :LTRaining:LTSSm:PPCOnfig:TX:LBPM 4`

:LTRaining:LTSSm:PPCOnfig:TX:LBPM?

Response	<numeric>=<NR1 NUMERIC RESPONESE DATA> 4 to 255 4 to 255
Function	Queries the required number of times PHY Ready LBPM is transmitted for transition from Polling.Port Config in Gen1x2, Gen2x1, and Gen2x2 link training.

Example	`> :LTRaining:LTSSm:PPCOnfig:TX:LBPM?`
	`< 4`

:LTRaining:LTSSm:PRXEq:128B132B:TX:TSEQ <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	524288 to 1048575	524288 to 1048575, Initial value: 524288
Function	Sets the required number of times TSEQ is transmitted for transition from Polling.RxEQ in Gen2x1 and Gen2x2 link training.	
Example	To set the number of times TSEQ is transmitted to 524288: `> :LTRaining:LTSSm:PRXEq:128B132B:TX:TSEQ 524288`	

:LTRaining:LTSSm:PRXEq:128B132B:TX:TSEQ?

Response	<numeric>=<NR1 NUMERIC RESPONESE DATA>	
	524288 to 1048575	524288 to 1048575
Function	Queries the required number of times TSEQ is transmitted for transition from Polling.RxEQ in Gen2x1 and Gen2x2 link training.	

Example	`> :LTRaining:LTSSm:PRXEq:128B132B:TX:TSEQ?`
	`< 524288`	

:LTRaining:LTSSm:PACTive:128B132B:RX:TS12 <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	8 to 65535	8 to 65535, Initial value: 8
Function	Sets the required number of times TS1/TS2 OS is received for transition from Polling.Active in Gen2x1 and Gen2x2 link training.	
Example	To set the number of times TS1/TS2 OS is received to 8: `> :LTRaining:LTSSm:PACTive:128B132B:RX:TS12 8`	

:LTRaining:LTSSm:PACTive:128B132B:RX:TS12?

Response	<numeric>=<NR1 NUMERIC RESPONESE DATA>	
	8 to 65535	8 to 65535
Function	Queries the required number of times TS1/TS2 OS is received for transition from Polling.Active in Gen2x1 and Gen2x2 link training.	

Example	`> :LTRaining:LTSSm:PACTive:128B132B:RX:TS12?`
	`< 8`	

:LTRaining:LTSSm:PACTive:128B132B:TX:TS1 <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0 to 65535	0 to 65535, Initial value: 0
Function	Sets the required number of times TS1 OS is transmitted for transition from Polling.Active in Gen2xX link training.	
Example	To set the number of times TS1 OS is transmitted to 0:	

```
> :LTRaining:LTSSm:PACTive:128B132B:TX:TS1 0
```

:LTRaining:LTSSm:PACTive:128B132B:TX:TS1?

Response	<numeric>=<NR1 NUMERIC RESPONESE DATA>	
	0 to 65535	0 to 65535
Function	Queries the required number of times TS1 OS is transmitted for transition from Polling.Active in Gen2xX link training.	
Example		

```
> :LTRaining:LTSSm:PACTive:128B132B:TX:TS1?
< 0
```

:LTRaining:LTSSm:PCONfig:128B132B:RX:TS2 <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	8 to 65535	8 to 65535, Initial value: 8
Function	Sets the required number of times TS2 OS is received for transition from Polling.Configuration in Gen2xX link training.	
Example	To set the number of times TS2 OS is received to 8:	

```
> :LTRaining:LTSSm:PCONfig:128B132B:RX:TS2 8
```

:LTRaining:LTSSm:PCONfig:128B132B:RX:TS2?

Response	<numeric>=<NR1 NUMERIC RESPONESE DATA>	
	8 to 65535	8 to 65535
Function	Queries the required number of times TS2 OS is received for transition from Polling.Configuration in Gen2xX link training.	
Example		

```
> :LTRaining:LTSSm:PCONfig:128B132B:RX:TS2?
< 8
```

:LTRaining:LTSSm:PCONfig:128B132B:TX:TS2 <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA> 16 to 65535 16 to 65535, Initial value: 16
Function	Sets the required number of times TS2 OS is transmitted for transition from Polling.Configuration in Gen2xX link training.
Example	To set the number of times TS2 OS is transmitted to 16: `> :LTRaining:LTSSm:PCONfig:128B132B:TX:TS2 16`

:LTRaining:LTSSm:PCONfig:128B132B:TX:TS2?

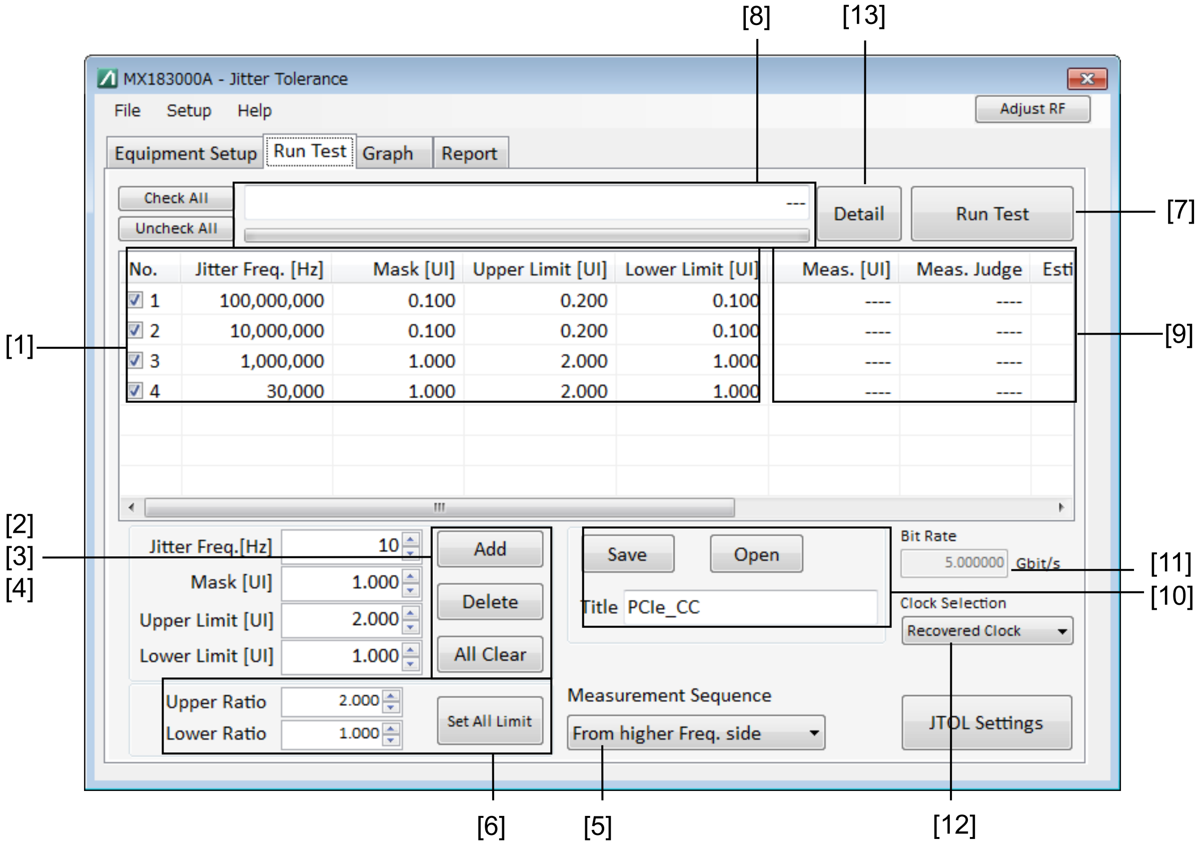
Response	<numeric>=<NR1 NUMERIC RESPONESE DATA> 16 to 65535 16 to 65535
Function	Queries the required number of times TS2 OS is transmitted for transition from Polling.Configuration in Gen2xX link training.

Example	`> :LTRaining:LTSSm:PCONfig:128B132B:TX:TS2?`
	`< 16`

5.12 Jitter Tolerance Setup Screen

5.12.1 Run Test screen

This setup screen is available only when MX183000A-PL001 is installed, when **Jitter Tolerance Test** or **PCIe Link Sequence** is started on the Selector screen (Figure 4.3.1-1), and when the SQA has been connected using Equipment Setup.



No.	Jitter Freq. [Hz]	Mask [UI]	Upper Limit [UI]	Lower Limit [UI]	Meas. [UI]	Meas. Judge	Esti
☑ 1	100,000,000	0.100	0.200	0.100	----	----	
☑ 2	10,000,000	0.100	0.200	0.100	----	----	
☑ 3	1,000,000	1.000	2.000	1.000	----	----	
☑ 4	30,000	1.000	2.000	1.000	----	----	

Jitter Freq.[Hz] 10
Mask [UI] 1.000
Upper Limit [UI] 2.000
Lower Limit [UI] 1.000
Upper Ratio 2.000
Lower Ratio 1.000
Title PCIe_CC
Bit Rate 5.000000 Gbit/s
Clock Selection Recovered Clock
Measurement Sequence From higher Freq. side

Figure 5.12.1-1 Run Test Screen

Table 5.12.1-1 Run Test Screen Setup Commands

No.	Setting Item	Command
[1]	Jitter Tolerance Table	:SENSe:JITTer:TABLe:FREQuency? :SENSe:JITTer:TABLe:INDex?
[2]	Add	:SENSe:JITTer:TABLe:ADD
[3]	Delete	:SENSe:JITTer:TABLe:DELete
[4]	All Clear	:SENSe:JITTer:TABLe:ADELete
[5]	Order	:SENSe:MEASure:BERCond:SEQuence
		:SENSe:MEASure:BERCond:SEQuence?
[6]	Set All Limit	:SENSe:MEASure:BERCond:RATiosetting :SENSe:MEASure:BERCond:RATiosetting?
[7]	Run Test	:SENSe:MEASure:JITTer:STARt :SENSe:MEASure:JITTer:STOP :SENSe:MEASure:JITTer:STATe?
[8]	Status	:CALCulate:RESult:STATus?
[9]	Data	:CALCulate:RESult:DATA?
[10]	Save	:SENSe:MEASure:TABLedata:SAVE
	Open	:SENSe:MEASure:TABLedata:Open
	Title	:SENSe:MEASure:TABLedata:SELect?
[11]	Bit Rate	:SENSe:MEASure:SYSCond:BITRate?
[12]	Clock Selection	:INPut:CLOCk:SELection
		:INPut:CLOCk:SELection?
[13]	Detail	:CALCulate:RESult:MAXPass?
		:CALCulate:RESult:MINFail?
		:CALCulate:RESult:DETail?
		:CALCulate:RESult:DETail:MASK?
		:CALCulate:RESult:DETail:ULIMit?
		:CALCulate:RESult:DETail:LLIMit?
		:CALCulate:RESult:DETail:SYMBol?
		:CALCulate:RESult:DETail:BIT?
		:CALCulate:RESult:DETail:MSB?
		:CALCulate:RESult:DETail:LSB?

:SENSe:JITTer:TABLe:FREQuency? <freq>

Parameter

<freq>=<DECIMAL NUMERIC PROGRAM DATA>

10 to 250000000	10 to 250000000 Hz, 1Hz step

Response

<string>=<STRING RESPONSE DATA>

<string>="<number>,<freq>,<mask>,<upperlimit><lowerlimit>"

<number>=<NR1 NUMERIC RESPONSE DATA>

1 to 50	Jitter Tolerance Table index No.1 to 50

<freq>=<NR1 NUMERIC RESPONSE DATA>

10 to 250000000	Modulation frequency registered in the Jitter Tolerance Table

<mask>=<NR1 NUMERIC RESPONSE DATA>

0 to 2000	Mask value registered in the Jitter Tolerance Table

<upperlimit>=<NR1 NUMERIC RESPONSE DATA>

0 to 2000	Upper Limit value registered in the Jitter Tolerance Table

<lowerlimit>=<NR1 NUMERIC RESPONSE DATA>

0 to 2000	Lower Limit value registered in the Jitter Tolerance Table

Function

Reads in values registered in the Jitter Tolerance Table by specifying the modulation frequency.

Example

```
> :SENSe:JITTer:TABLe:FREQuency? 150000000
< "1,150000000, 0.100, 0.200, 0.030"
```

:SENSe:JITTer:TABLe:INDex? <number>

Parameter

<number>=<DECIMAL NUMERIC PROGRAM DATA>
1 to 50

Response

<string>=<STRING RESPONSE DATA>
<string>="<number>,<freq>,<mask>,<upperlimit><lowerlimit>"

<number>=<NR1 NUMERIC RESPONSE DATA>

1 to 50	Jitter Tolerance Table index No.1 to 50

<freq>=<NR1 NUMERIC RESPONSE DATA>

10 to 250000000	Modulation frequency registered in the Jitter Tolerance Table

<mask>=<NR1 NUMERIC RESPONSE DATA>

0 to 2000	Mask value registered in the Jitter Tolerance Table

<upperlimit>=<NR1 NUMERIC RESPONSE DATA>

0 to 2000	Upper Limit value registered in the Jitter Tolerance Table

<lowerlimit>=<NR1 NUMERIC RESPONSE DATA>

0 to 2000	Lower Limit value registered in the Jitter Tolerance Table

Function

Reads in values registered in the Jitter Tolerance Table by specifying the Index.

Example

```
>:SENSe:JITTer:TABLe:IND? 1
< "1,150000000, 0.100, 0.200, 0.030"
```

:SENSe:JITTer:TABLe:ADD <freq>,<mask>,<upperlimit>,<lowerlimit>

Parameter

<freq>=<DECIMAL NUMERIC PROGRAM DATA>

10 to 250000000	Modulation frequency registered in the Jitter Tolerance Table

<mask>=<DECIMAL NUMERIC PROGRAM DATA>

0 to 2000	Mask value registered in the Jitter Tolerance Table

<upperlimit>=<DECIMAL NUMERIC PROGRAM DATA>

0 to 2000	Upper Limit value registered in the Jitter Tolerance Table

<lowerlimit>=<DECIMAL NUMERIC PROGRAM DATA>

0 to 2000	Lower Limit value registered in the Jitter Tolerance Table

Function

Adds modulation frequencies to be measured to the Jitter Tolerance measurement.

Example

```
> :SENSe:JITTer:TABLe:ADD 100000000,0.100,0.5,0.1
```

Note:

In accordance with the SJ specifications in 1.3.2 “Jitter Modulation Performance” of *MU181500B Jitter Modulation Source Instruction Manual*.

:SENSe:JITTer:TABLe:DELete <number>

Parameter

<number>=<DECIMAL NUMERIC PROGRAM DATA>

1 to 50	1 to 50, 1 step

Function

Deletes those items on the Jitter Tolerance Table specified by number.

Example

```
> :SENSe:JITTer:TABLe:DELete 1
```

:SENSe:JITTer:TABLe:ADELete

Parameter

None

Function

Deletes all elements on the Jitter Tolerance Table.

Example

```
> :SENSe:JITTer:TABLe:ADELete
```

:SENSe:MEASure:BERCond:SEQuence <type>

Parameter

<type>=<CHARACTER PROGRAM DATA>

LOWerfreq	Measures in sequence from the lower modulation frequency.
HIGHerfreq	Measures in sequence from the higher modulation frequency.

Function

Selects the tolerance measurement sequence direction.

Example

To set to measure from the higher modulation frequency side:

```
> :SENSe:MEASure:BERCond:SEQuence HIGHerfreq
```

:SENSe:MEASure:BERCond:SEQuence?

Response

<type>=<CHARACTER PROGRAM DATA>

LOW, HIGH

Function

Queries the tolerance measurement start point.

Example

```
>:SENSe:MEASure:BERCond:SEQuence?
< HIGH
```

:SENSe:MEASure:BERCond:RATiosetting <upper>,<lower>

Parameter

<upper>=<DECIMAL NUMERIC PROGRAM DATA>

1.000 to 1000.000	1.000 to 1000 times

<lower>=<DECIMAL NUMERIC PROGRAM DATA>

0.001 to 1.000	0.001 to 1.000 times

Function

Sets the upper and lower limits of the jitter modulation amplitude on the Jitter Tolerance Table as ratios of the mask.

Example

To set the upper limit to x10 from the mask line and the lower limit to 1/10 from the mask line:

```
> :SENSe:MEASure:BERCond:RATiosetting 10,0.1
```

:SENSe:MEASure:BERCond:RATiosetting?

Response

<upper>,<lower>

<upper>=<NR2 NUMERIC RESPONESE DATA>

1.000 to 1000.000

<lower>=<NR2 NUMERIC RESPONESE DATA>

0.001 to 1.000

Function

Queries the upper and lower limits of the jitter modulation amplitude of jitter measurements as ratios of the mask.

Example

```
> :SENSe:MEASure:BERCond:RATiosetting?
< 10,0.1
```

:SENSe:MEASure:JITTer:STARt [<lane>]

Parameter	<lane>=<DECIMAL NUMERIC PROGRAM DATA>

0	Lane0
1	Lane1

Note:

The setting for Lane is available when both of the following are met.

- The MX183000A-PL023 USB 3.2 **x** 2 Link Training has been activated.
- In the USB Link Training application, **Gen1x2 (5.0 GT/s x2)** or **Gen2x2 (10.0 GT/s x2)** is selected for USB 3.2 Specification.

If omitted, Lane0 is selected.

Function: Starts the tolerance measurement.

Example: `>:SENSe:MEASure:JITTer:STARt`

:SENSe:MEASure:JITTer:STOP

Parameter: None

Function: Stops the tolerance measurement.

Example: `>:SENSe:MEASure:JITTer:STOP`

:SENSe:MEASure:JITTer:STATe? [<lane>]

Parameter	<lane>=<DECIMAL NUMERIC PROGRAM DATA>	
	0	Lane0
	1	Lane1

Note:

The setting for Lane is available when both of the following are met.

- The MX183000A-PL023 USB 3.2 x 2 Link Training has been activated.
- In the USB Link Training application, **Gen1x2 (5.0 GT/s x2)** or **Gen2x2 (10.0 GT/s x2)** is selected for USB 3.2 Specification.

If omitted, Lane0 is selected.

Response	<numeric>=<NR1 NUMERIC RESPONESE DATA>	
	1	Being measured
	0	Stopped

Function: Queries the tolerance measurement status.

Example:

```
> :SENSe:MEASure:JITTer:STATe?
< 1
```

:CALCulate:RESult:STATus?

Response: <string>=<STRING RESPONSE DATA>

"---"	Before measurement start
"Setting system…"	Setup in progress
"Auto Search Started."	Auto Search start
"Auto Search Completed."	Auto Search complete
"Measurement Completed."	Measurement complete
"Measurement: <Freq>Hz, <Curval>UIp-p"	Measurement result

Function: Queries the tolerance measurement status.

Example:

```
> :CALCulate:RESult:STATus?
< "---"
```

:CALCulate:RESult:DATA? <type>[,<numeric>]

Parameter

<type>=<CHARACTER PROGRAM DATA>

ALL	All measurement points
POINt	Specified point

<numeric>=<DECIMAL NUMERIC PROGRAM DATA>

1 to 50	Measurement points No.1 to 50

When <type> is ALL, <numeric> can be omitted.

Response

<string>=<STRING RESPONSE DATA>

<string>="<number>,<freq>,<measui>,<measjudge>,<estimateui>,<r2>,<estimatejudge>,<flow>"

<number>=<NR1 NUMERIC RESPONSE DATA>

1 to 50	Measurement point No.1 to 50

<freq>=<NR1 NUMERIC RESPONSE DATA>

10 to 250000000	Hz modulation frequency

<measui>=<NR2 NUMERIC RESPONSE DATA>

0.001 to 2000.000	UIp-p modulation amount

<measjudge>=<NR1 NUMERIC RESPONSE DATA>

1	Pass
0	Fail
–1	Not measured

<estimateui>=<NR2 NUMERIC RESPONSE DATA>

0.000 to 2000.000	UIp-p modulation amount

<r2>=<<NR2 NUMERIC RESPONSE DATA>

0 to 1	Coefficient of determination with degree of freedom determined, no units

<estimatejudge>=<NR1 NUMERIC RESPONSE DATA>

1	Pass
0	Fail
–1	Not measured

<flow>=<NR1 NUMERIC RESPONSE DATA>

1	overflow
0	no overflow
–1	Not measured

Function

Acquires tolerance measurement results.

Example

To acquire all measurement results of the Tolerance measurement.

```
> :CALCulate:RESult:DATA? ALL
< "1,1000,5.000,1,2.000,0.995,1,1", "2,1000,5.000,1, 2.000,
0.995,1,1", "3,1000,5.000,1, 2.000, 0.995,1,1",···
"20,200000000,0.150,1,0.100, 0.995,1,1"
```

To acquire measurement data for tolerance measurement No. 10

```
> :CALCulate:RESult:DATA? POINt,10
< "10,100000,1.000,0,0.600, 0.995,0,0"
```

:SENSe:MEASure:SYSCond:BITRate?

Response	<numeric>=<NR2 NUMERIC RESPONSE DATA> 2.400000 to 32.100000 2.400000 to 32.100000 Gbit/s
Function	Queries the tolerance measurement bitrate monitor value.

Example	`> :SENSe:MEASure:SYSCond:BITRate?`
	`< 8.000000`

:SENSe:MEASure:TABLedata:SAVe <file_name>

Parameter	<file_name>=<STRING PROGRAM DATA> "<drv>:\<dir1>\<dir2>\<file>" <drv>=C, D, E, F Drive name <dir>=xxxxxxxx Directory name <file>=xxxxxxxxx File name
Function	Saves the jitter tolerance table contents (measurement points and masks).

Example	`> :SENSe:MEASure:TABLedata:SAVe`
	`"C:\test_folder\test_table"`

:SENSe:MEASure:TABLedata:OPEN <file_name>

Parameter	<file_name>=<STRING PROGRAM DATA> "<drv>:\<dir1>\<dir2>\<file><extension>" <drv>=C, D, E, F Drive name <dir>=xxxxxxxx Directory name <file>=xxxxxxxxx File name <extension>=.umsk, .mask
Function	Reads in jitter tolerance table contents (measurement points and masks).

Example	`> :SENSe:MEASure:TABLedata:OPEN`
	`"C:\test_folder\test_table.umsk"`

:SENSe:MEASure:TABLedata:SELect?

Response	<item>=<STRING RESPONSE DATA> "xxxxxxxxxxx" File name
Function	Queries the selected table data.

Example	`> :SENSe:MEASure:TABLedata:SELect?`
	`< "PCI"`

:INPut:CLOCk:SELection <sel>

Parameter	<sel>=<CHARACTER PROGRAM DATA>	
	RECovered	Recovered Clock
	EXTernal	External Clock
Function	Sets the clock input type.	
Example	To set the clock input type to the Recovered Clock:	

```
> :INPut:CLOCk:SELection RECovered
```

:INPut:CLOCk:SELection?

Response	<sel>=<CHARACTER RESPONSE DATA>	
	REC	Recovered Clock
	EXT	External Clock
Function	Queries the clock input type.	
Example		

```
> :INPut:CLOCk:SELection?
< EXT
```

:CALCulate:RESult:MAXPass? <numeric>

Parameter	<numeric>=<NR1 NUMERIC RESPONESE DATA>	
	1 to 50	Jitter Tolerance Table index No.1 to 50
	If the settings are made as shown in "Figure 5.12.1-1 Run Test Screen", this query with parameter set to "2" returns measurement results for 10,000,000 [Hz].	
Response	<type>=<CHARACTER RESPONSE DATA>	
	SJ modulation amount (UI) and the error count at the time the SJ modulation amount was set are returned as a comma-separated list. The Max Pass criterion is that the SJ modulation amount is equal to or less than the Error Count value set for Error Threshold in the JTOL Settings screen. If there is no corresponding data, "-----" is returned. If Sync Loss has occurred, "Sync Loss" is returned instead of the error count.	
Function	Queries the max SJ modulation amount not exceeding Error Threshold, and the Error Count value at the time.	
Example		

```
> :CALCulate:RESult:MAXPass? 2
< 0.680,0
```

:CALCulate:RESult:MINFail? <numeric>

Parameter	<numeric>=<NR1 NUMERIC RESPONESE DATA> 1 to 50　　Jitter Tolerance Table index No.1 to 50 If the settings are made as shown in “Figure 5.12.1-1　Run Test Screen”, this query with parameter set to “2” returns measurement results for 10,000,000 [Hz].
Response	<type>=<CHARACTER RESPONSE DATA> SJ modulation amount (UI) and the error count at the time the SJ modulation amount was set are returned as a comma-separated list. The Min Fail criterion is that the SJ modulation amount exceeds the Error Count value set for Error Threshold in the JTOL Settings screen. If there is no corresponding data, “ -----” is returned. If Sync Loss has occurred, “Sync Loss” is returned instead of the error count.
Function	Queries the min SJ modulation amount exceeding Error Threshold, and the Error Count value at the time.
Example	

```
> :CALCulate:RESult:MINFail? 2
< 0.700,51
```

:CALCulate:RESult:DETail? <numeric>

Parameter	<numeric>=< NR1 NUMERIC RESPONESE DATA > 1 to 50 Jitter Tolerance Table index No.1 to 50 If the settings are made as shown in "Figure 5.12.1-1 Run Test Screen", this query with parameter set to "2" returns measurement results for 10,000,000 [Hz].
Response	<type>=<CHARACTER RESPONSE DATA> A comma-separated list of the following items of every specified Index No.: SJ modulation amount (UI), and the error count at the time the SJ modulation amount was set. [SJ modulation amount],[Error Count],[SJ modulation amount],[Error Count], …
Function	Queries the SJ modulation amount (UI), and the error count at the time the SJ modulation amount was set, of every specified Index No. The response depends on the measurement type. For PAM4, the "Symbol" error count is returned, and for NRZ, the "Bit" error count. If there is no corresponding data, "-----" is returned. If Sync Loss has occurred, "Sync Loss" is returned instead of the error count.
Example	

```
> :CALCulate:RESult:DETail? 2
<
0.100,0,0.120,0,0.140,0,0.160,0,0.180,0,0.200,0,0.220,0,
0.240,0,0.260,0,0.280,0,0.300,0,0.320,0,0.340,0,0.360,0,
0.380,0,0.400,0,0.420,0,0.440,0,0.460,0,0.480,0,0.500,0,
0.520,0,0.540,0,0.560,0,0.580,0,0.600,0,0.620,0,0.640,0,
0.660,1,0.680,12,0.700,51,0.740,Sync Loss
```

:CALCulate:RESult:DETail:MASK? <numeric>

Parameter	<numeric>=< NR1 NUMERIC RESPONESE DATA > 1 to 50 Jitter Tolerance Table index No.1 to 50 If the settings are made as shown in " Figure 5.12.1-1 Run Test Screen", this query with the parameter set to "2" returns the settings for 10,000,000 [Hz].
Response	<type>=<CHARACTER RESPONSE DATA> 0.002 to 2000
Function	Queries the Jitter Tolerance Table for the Mask value (UI) of the specified Index No.
Example	

```
> :CALCulate:RESult:DETail:MASK? 2
< 0.100
```

:CALCulate:RESult:DETail:ULIMit? <numeric>

Parameter	<numeric>=< NR1 NUMERIC RESPONESE DATA > 1 to 50　　Jitter Tolerance Table index No.1 to 50 If the settings are made as shown in " Figure 5.12.1-1　Run Test Screen", this query with the parameter set to "2" returns the settings for 10,000,000 [Hz].
Response	<type>=<CHARACTER RESPONSE DATA> 0.002 to 2000
Function	Queries the Jitter Tolerance Table for the Upper Limit value (UI) of the specified Index No.

Example	`> :CALCulate:RESult:DETail:ULIMit? 2`
	`< 0.200`

:CALCulate:RESult:DETail:LLIMit? <numeric>

Parameter	<numeric>=< NR1 NUMERIC RESPONESE DATA > 1 to 50　　Jitter Tolerance Table index No.1 to 50 If the settings are made as shown in " Figure 5.12.1-1　Run Test Screen", this query with the parameter set to "2" returns the settings for 10,000,000 [Hz].
Response	<type>=<CHARACTER RESPONSE DATA> 0.002 to 2000
Function	Queries the Jitter Tolerance Table for the Lower Limit value (UI) of the specified Index No.

Example	`> :CALCulate:RESult:DETail:LLIMit? 2`
	`< 0.100`

:CALCulate:RESult:DETail:SYMBol? <numeric>

Parameter	<numeric>=< NR1 NUMERIC RESPONESE DATA > 1 to 50 Jitter Tolerance Table index No.1 to 50 If the settings are made as shown in “Figure 5.12.1-1 Run Test Screen”, this query with parameter set to “2” returns measurement results for 10,000,000 [Hz].
Response	<type>=<CHARACTER RESPONSE DATA> A comma-separated list of the following items of every specified Index No.: SJ modulation amount (UI) “Meas.[UI]”, and the Symbol error count “Symbol” at the time “Meas.[UI]” was set [Meas.[UI]], [Symbol], [Meas.[UI]], [Symbol], …
Function	Queries the SJ modulation amount (UI), and the Symbol error count at the time the SJ modulation amount was set, of every specified Index No. If there is no corresponding data, “-----” is returned. If Sync Loss has occurred, “Sync Loss” is returned instead of the error count.

Example

```
> :CALCulate:RESult:DETail:SYMBol? 2
<
0.100,0,0.120,0,0.140,0,0.160,0,0.180,0,0.200,0,0.220,0,
0.240,0,0.260,0,0.280,0,0.300,0,0.320,0,0.340,0,0.360,0,
0.380,0,0.400,0,0.420,0,0.440,0,0.460,0,0.480,0,0.500,0,
0.520,0,0.540,0,0.560,0,0.580,0,0.600,0,0.620,0,0.640,0,
0.660,1,0.680,12,0.700,51,0.740,Sync Loss
```

:CALCulate:RESult:DETail:BIT? <numeric>

Parameter	<numeric>=< NR1 NUMERIC RESPONESE DATA > 1 to 50 Jitter Tolerance Table index No.1 to 50 If the settings are made as shown in "Figure 5.12.1-1 Run Test Screen", this query with parameter set to "2" returns measurement results for 10,000,000 [Hz].
Response	<type>=<CHARACTER RESPONSE DATA> A comma-separated list of the following items of every specified Index No.: SJ modulation amount (UI) "Meas.[UI]", and the Bit error count "Bit" at the time "Meas.[UI]" was set [Meas.[UI]], [Bit], [Meas.[UI]], [Bit],…
Function	Queries the SJ modulation amount (UI), and the Bit error count at the time the SJ modulation amount was set, of every specified Index No. If there is no corresponding data, "-----" is returned. If Sync Loss has occurred, "Sync Loss" is returned instead of the error count.

Example

```
> :CALCulate:RESult:DETail:BIT? 2
<
0.100,0,0.120,0,0.140,0,0.160,0,0.180,0,0.200,0,0.220,0,
0.240,0,0.260,0,0.280,0,0.300,0,0.320,0,0.340,0,0.360,0,
0.380,0,0.400,0,0.420,0,0.440,0,0.460,0,0.480,0,0.500,0,
0.520,0,0.540,0,0.560,0,0.580,0,0.600,0,0.620,0,0.640,0,
0.660,1,0.680,12,0.700,51,0.740,Sync Loss
```

:CALCulate:RESult:DETail:MSB? <numeric>

Parameter

<numeric>=< NR1 NUMERIC RESPONESE DATA >

1 to 50 Jitter Tolerance Table index No.1 to 50

If the settings are made as shown in “Figure 5.12.1-1 Run Test Screen”, this query with parameter set to “2” returns measurement results for 10,000,000 [Hz].

Response

<type>=<CHARACTER RESPONSE DATA>

A comma-separated list of the following items of every specified Index No.: SJ modulation amount (UI) “Meas.[UI]”, and the MSB error count “MSB” at the time “Meas.[UI]” was set

[Meas.[UI]], [MSB], [Meas.[UI]], [MSB],…

Function

Queries the SJ modulation amount (UI), and the MSB error count at the time the SJ modulation amount was set, of every specified Index No.

If there is no corresponding data, “-----” is returned.

If Sync Loss has occurred, “Sync Loss” is returned instead of the error count.

Example

```
> :CALCulate:RESult:DETail:MSB? 2
<
0.100,0,0.120,0,0.140,0,0.160,0,0.180,0,0.200,0,0.220,0,
0.240,0,0.260,0,0.280,0,0.300,0,0.320,0,0.340,0,0.360,0,
0.380,0,0.400,0,0.420,0,0.440,0,0.460,0,0.480,0,0.500,0,
0.520,0,0.540,0,0.560,0,0.580,0,0.600,0,0.620,0,0.640,0,
0.660,1,0.680,12,0.700,51,0.740,Sync Loss
```

:CALCulate:RESult:DETail:LSB? <numeric>

Parameter

<numeric>=< NR1 NUMERIC RESPONESE DATA >

1 to 50	Jitter Tolerance Table index No.1 to 50

If the settings are made as shown in “Figure 5.12.1-1 Run Test Screen”, this query with parameter set to “2” returns measurement results for 10,000,000 [Hz].

Response

<type>=<CHARACTER RESPONSE DATA>

A comma-separated list of the following items of every specified Index No.: SJ modulation amount (UI) “Meas.[UI]”, and the LSB error count “LSB” at the time “Meas.[UI]” was set

[Meas.[UI]], [LSB], [Meas.[UI]], [LSB],…

Function

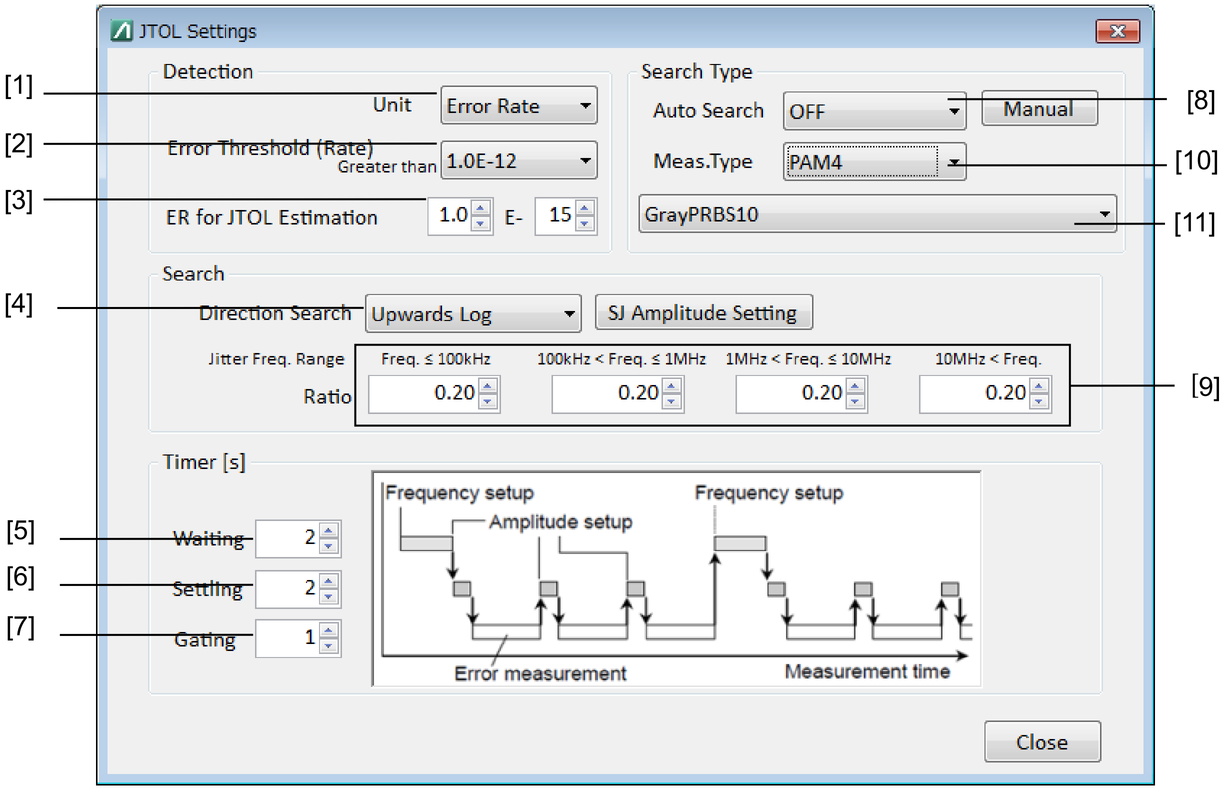
Queries the SJ modulation amount (UI), and the LSB error count at the time the SJ modulation amount was set, of every specified Index No.

If there is no corresponding data, “-----” is returned.

If Sync Loss has occurred, “Sync Loss” is returned instead of the error count.

Example

```
> :CALCulate:RESult:DETail:LSB? 2
<
0.100,0,0.120,0,0.140,0,0.160,0,0.180,0,0.200,0,0.220,0,
0.240,0,0.260,0,0.280,0,0.300,0,0.320,0,0.340,0,0.360,0,
0.380,0,0.400,0,0.420,0,0.440,0,0.460,0,0.480,0,0.500,0,
0.520,0,0.540,0,0.560,0,0.580,0,0.600,0,0.620,0,0.640,0,
0.660,1,0.680,12,0.700,51,0.740,Sync Loss
```


JTOL Settings

Detection

Unit: Error Rate

Error Threshold (Rate) Greater than: 1.0E-12

ER for JTOL Estimation: 1.0 E- 15

Search Type

Auto Search: OFF

Meas.Type: PAM4

GrayPRBS10

Search

Direction Search: Upwards Log

Jitter Freq. Range	Freq. ≤ 100kHz	100kHz < Freq. ≤ 1MHz	1MHz < Freq. ≤ 10MHz	10MHz < Freq.
Ratio	0.20	0.20	0.20	0.20

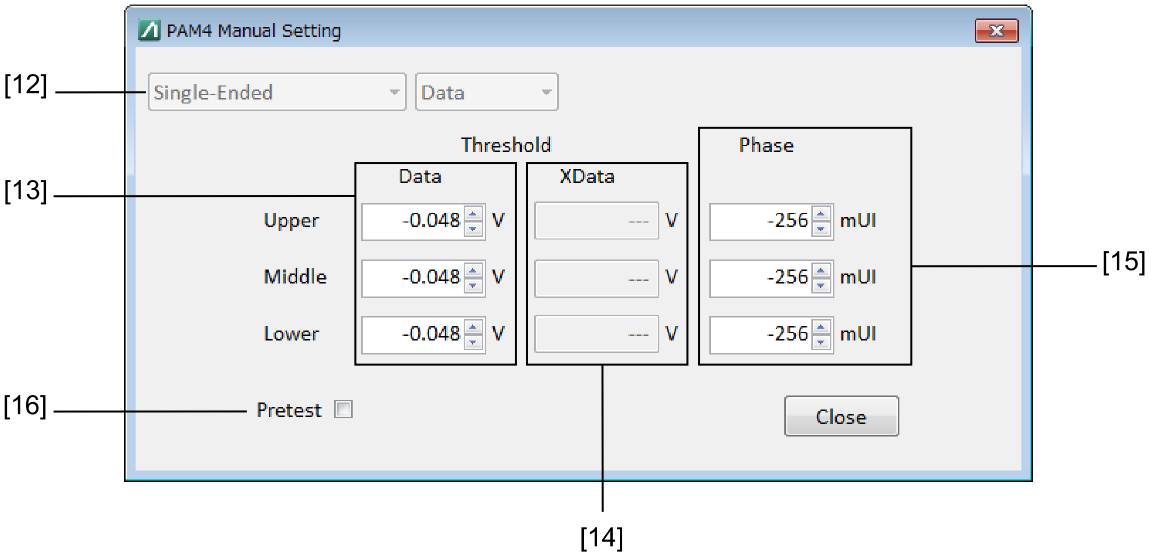
Timer [s]

Waiting: 2

Settling: 2

Gating: 1

Figure 5.12.1-2 JTOL Settings Screen


PAM4 Manual Setting

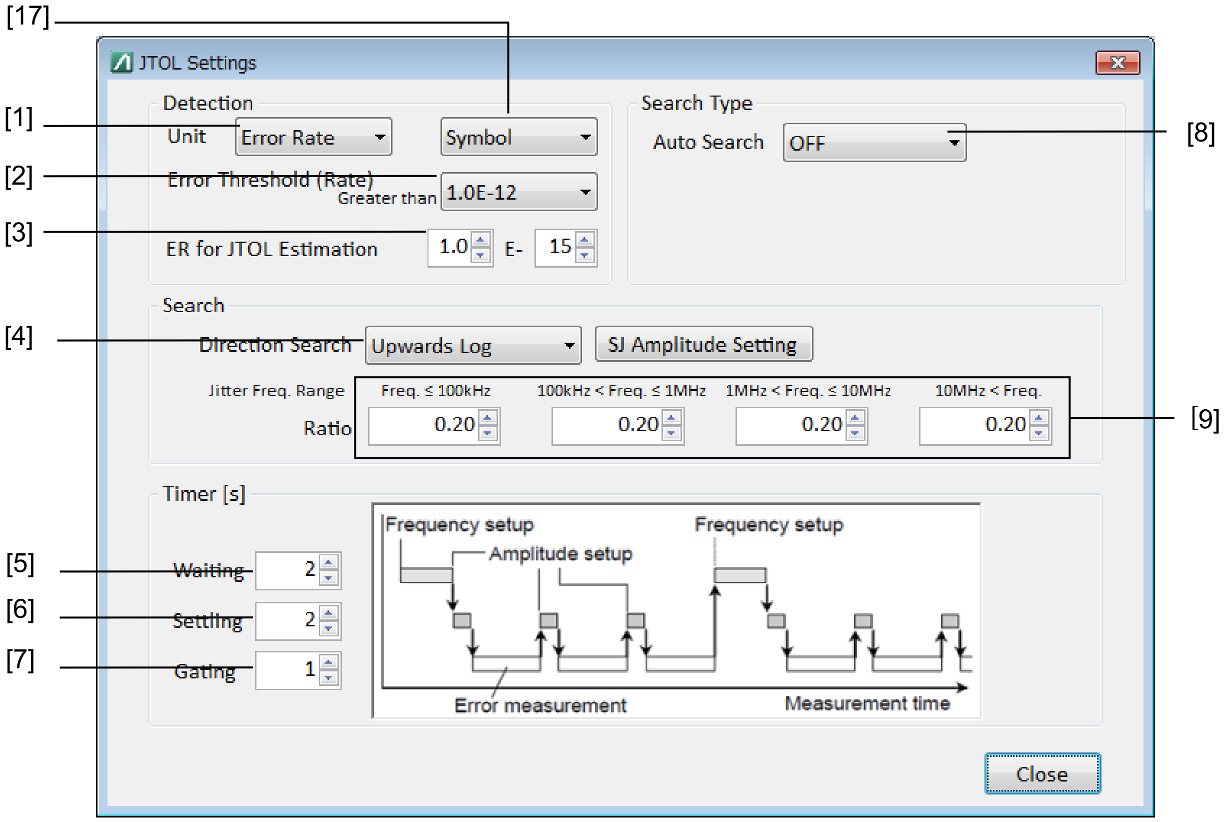
Single-Ended / Data

Threshold

	Data		XData		Phase	
Upper	-0.048	V	---	V	-256	mUI
Middle	-0.048	V	---	V	-256	mUI
Lower	-0.048	V	---	V	-256	mUI

Pretest ☐

Figure 5.12.1-3 PAM4 Manual Setting Screen



JTOL Settings

Detection

Unit: Error Rate, Symbol

Error Threshold (Rate) Greater than: 1.0E-12

ER for JTOL Estimation: 1.0 E- 15

Search Type

Auto Search: OFF

Search

Direction Search: Upwards Log

Jitter Freq. Range	Freq. ≤ 100kHz	100kHz < Freq. ≤ 1MHz	1MHz < Freq. ≤ 10MHz	10MHz < Freq.
Ratio	0.20	0.20	0.20	0.20

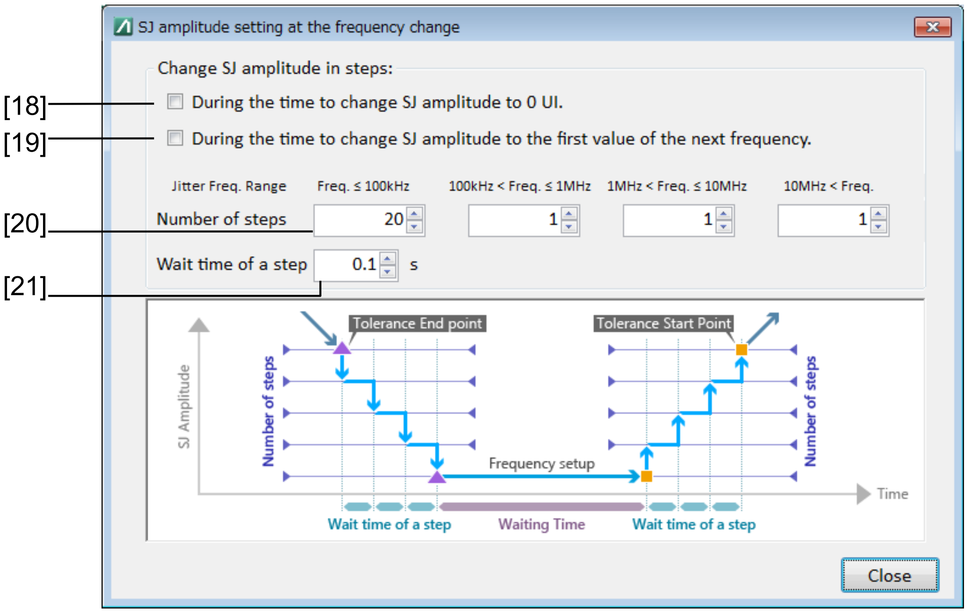
Timer [s]

Waiting: 2

Settling: 2

Gating: 1

Figure 5.12.1-4 JTOL Settings Screen (When Using PAM4 ED in PAM4 Mode)



SJ amplitude setting at the frequency change

Change SJ amplitude in steps:

☐ During the time to change SJ amplitude to 0 UI.

☐ During the time to change SJ amplitude to the first value of the next frequency.

Jitter Freq. Range	Freq. ≤ 100kHz	100kHz < Freq. ≤ 1MHz	1MHz < Freq. ≤ 10MHz	10MHz < Freq.
Number of steps	20	1	1	1

Wait time of a step: 0.1 s

Figure 5.12.1-5 SJ Division Setting Dialog Box

Table 5.12.1-2 JTOL Settings Screen Setup Commands

No.	Setting Item	Command
[1]	Unit	:SENSe:MEASure:BERCond:UNIT
		:SENSe:MEASure:BERCond:UNIT?
[2]	Error Threshold	:SENSe:MEASure:BERCond:THReshold
		:SENSe:MEASure:BERCond:THReshold?
[3]	BER for JTOL Estimation	:DISPlay:RESult:ESTimate:ERATe
		:DISPlay:RESult:ESTimate:ERATe?
[4]	Direction Search	:SENSe:MEASure:BERCond:SEARch
		:SENSe:MEASure:BERCond:SEARch?
[5]	Waiting Timer	:SENSe:MEASure:BERCond:WTIMe
		:SENSe:MEASure:BERCond:WTIMe?
[6]	Settling Timer	:SENSe:MEASure:BERCond:STIMe
		:SENSe:MEASure:BERCond:STIMe?
[7]	Gating Timer	:SENSe:MEASure:BERCond:GTIMe
		:SENSe:MEASure:BERCond:GTIMe?
[8]	Auto Search	:SENSe:MEASure:BERCond:ASEarch
		:SENSe:MEASure:BERCond:ASEarch?
[9]	Step	:SENSe:MEASure:BERCond:SSETting
		:SENSe:MEASure:BERCond:SSETting?
[10]	Measurement Type	:SENSe:MEASure:BERCond:MTYPe
		:SENSe:MEASure:BERCond:MTYPe?
[11]	PAM4 Pattern	:SENSe:MEASure:BERCond:PATTern
		:SENSe:MEASure:BERCond:PATTern?
[12]	ED Input Condition	:SENSe:MEASure:BERCond:MANual:INTerface?
[13]	Threshold for ED Data Input	:SENSe:MEASure:BERCond:MANual:DATA
		:SENSe:MEASure:BERCond:MANual:DATA?
[14]	Threshold for ED XData Input	:SENSe:MEASure:BERCond:MANual:XDATa
		:SENSe:MEASure:BERCond:MANual:XDATa?
[15]	ED Phase	:SENSe:MEASure:BERCond:MANual:DELay
		:SENSe:MEASure:BERCond:MANual:DELay?
[16]	Pretest	:SENSe:MEASure:BERCond:TEST
		:SENSe:MEASure:BERCond:TEST?
[17]	Unit (When using PAM4 ED)	:SENSe:MEASure:BERCond:TARGet
		:SENSe:MEASure:BERCond:TARGet?

Table 5.12.1-2 JTOL Settings Screen Setup Commands (Cont'd)

No.	Setting Item	Command
[18]	Set SJ step by step (ON/OFF) When decreasing SJ When setting to 0 UI	:SENSe:MEASure:BERCond:SJ:SSTep:TOZero :SENSe:MEASure:BERCond:SJ:SSTep:TOZero?
[19]	Set SJ step by step (ON/OFF) When increasing SJ When setting the next measurement point	:SENSe:MEASure:BERCond:SJ:SSTep:FIRStvalue :SENSe:MEASure:BERCond:SJ:SSTep:FIRStvalue?
[20]	Division number	:SENSe:MEASure:BERCond:SJ:SSTep :SENSe:MEASure:BERCond:SJ:SSTep?
[21]	Step setting time	:SENSe:MEASure:BERCond:SJ:SSTep:WTIMe :SENSe:MEASure:BERCond:SJ:SSTep:WTIMe?

:SENSe:MEASure:BERCond:UNIT <type>

Parameter <type>=<CHARACTER PROGRAM DATA>

RATE	Error rate
COUNt	Error count
ESTimate	Estimate
CWRAte	Uncorrectable CW (Rate)
CWCOunt	Uncorrectable CW (Count)

Function Sets the error type used as a Pass/Fail judgment criterion.

Example To set the error rate for the Pass/Fail judgment:

```
> :SENSe:MEASure:BERCond:UNIT RATE
```

:SENSe:MEASure:BERCond:UNIT?

Response <type>=<CHARACTER RESPONSE DATA>

RATE, CWRA, CWCO, COUN, EST

Function Queries the setting of the Pass/Fail judgement

Example

```
> :SENSe:MEASure:BERCond:UNIT?
< RATE
```

:SENSe:MEASure:BERCond:THReshold <value>

Parameter	<value>=<DECIMAL NUMERIC PROGRAM DATA>	
	When Unit is set to Error Rate:	
	3 to 12	Error Rate E–3 to E–12/E–1 step
	When Unit is set to Error Count:	
	0 to 10000000	Number of Error Count 0 to 10000000, 1 Step
Function	Sets the evaluation threshold value.	
Example	Sets the error rate threshold to 1E–9 when Unit is set to Error Rate.	

```
> :SENSe:MEASure:BERCond:THReshold 9
```

Sets the error rate threshold to 100 when Unit is set to Error Count.

```
> :SENSe:MEASure:BERCond:THReshold 100
```

:SENSe:MEASure:BERCond:THReshold?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	When Unit is set to Error Rate:	
	3 to 12	Error Rate E–3 to E–12/E–1
	When Unit is set to Error Count:	
	0 to 10000000	Error count 0 to 10000000
Function	Queries the evaluation threshold value of error rate	
Example		

```
> :SENSe:MEASure:BERCond:THReshold?
< 9
```

:DISPlay:RESult:ESTimate:ERATe <numeric1>,<numeric2>

Parameter	<numeric1>=<DECIMAL PROGRAM DATA>	
	1.0 to 9.9	XX:XXE-YY
	<numeric2>=<DECIMAL PROGRAM DATA>	
	9 to 20	YY:XXE-YY
Function	Sets the BER for JTOL Estimation.	
Example	To set the BER for JTOL Estimation to 5.5E–15:	
	`> :DISPlay:RESult:ESTimate:ERATe 5.5,15`	
Compatibility	Incompatible with existing models.	

:DISPlay:RESult:ESTimate:ERATe?

Response	<numeric1>,<numeric2>	
	<numeric1>=<DECIMAL RESPONSE DATA>	
	1.0 to 9.9	XX:XXE-YY
	<numeric2>=<DECIMAL RESPONSE DATA>	
	9 to 20	YY:XXE-YY
Function	Queries the error rate setting set for BER for JTOL Estimation.	
Example	`> :DISPlay:RESult:ESTimate:ERATe?`	
	`< 5.5,15`	
Compatibility	Incompatible with existing models.	

:SENSe:MEASure:BERCond:SEARch <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	BINary	Binary
	DLINear	Downwards Linear
	DLOG	Downwards Log
	ULINear	Upwards Linear
	ULOG	Upwards Log
	BINLinear	Binary + Linear
Function	Sets the tolerance measurement method.	
Example	To set the tolerance measurement method to Binary:	
	`> :SENSe:MEASure:BERCond:SEARch BIN`	

:SENSe:MEASure:BERCond:SEARch?

Response	<type>=<CHARACTER RESPONSE DATA>
	BIN, DLIN, DLOG, ULIN, ULOG, BINL
Function	Queries the tolerance measurement method.
Example	`> :SENSe:MEASure:BERCond:SEARch?`
	`< BIN`

:SENSe:MEASure:BERCond:WTIMe <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	1 to 99	1 to 99 s, 1 s step
Function	Sets the Waiting Time for the Tolerance measurement.	
Example	To set the Waiting Time to 5 s:	

```
> :SENSe:MEASure:BERCond:WTIMe 5
```

:SENSe:MEASure:BERCond:WTIMe?

Parameter	None	
Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	1 to 99	1 to 99 s
Function	Queries the Waiting Time of the Tolerance measurement.	
Example		

```
> :SENSe:MEASure:BERCond:WTIMe?
< 5
```

:SENSe:MEASure:BERCond:STIMe <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	1 to 99	1 to 99 s, 1 s step
Function	Set the Settling Time for the Tolerance measurement.	
Example	To set the Settling Time to 5 s:	

```
> :SENSe:MEASure:BERCond:STIMe 5
```

:SENSe:MEASure:BERCond:STIMe?

Parameter	None	
Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	1 to 99	1 to 99 s
Function	Queries the Settling Time of the Tolerance measurement.	
Example		

```
> :SENSe:MEASure:BERCond:STIMe?
< 5
```

:SENSe:MEASure:BERCond:GTIMe <time>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	1 to 86400	1 to 86400 s, 1 s step
Function	Set the Gating Time for the bit errors measurement.	
Example	To set the Gating Time to 5 s:	

```
> :SENSe:MEASure:BERCond:GTIMe 5
```

:SENSe:MEASure:BERCond:GTIMe?

Response <numeric>=<NR1 NUMERIC RESPONSE DATA>

0 to 86400

Function Queries the Gating Time.

Example

```
> :SENSe:MEASure:BERCond:GTIMe?
< 30
```

:SENSe:MEASure:BERCond:ASEarch <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	OFF	Auto Search Setting off
	FINE	Auto Search Setting on (Fine mode)
	COARse	Auto Search Setting on (Coarse mode)
	PAMFine	PAM4 Auto Search Setting on (Fine mode)
	PAMCoarse	PAM4 Auto Search Setting on (Coarse mode)
Function	Sets Auto Search on and off for tolerance measurement. Sets Auto Search On/Off of the tolerance measurement.	
Example	To set Auto Search to On (Fine mode):	

```
> :SENSe:MEASure:BERCond:ASEarch FINE
```

:SENSe:MEASure:BERCond:ASEarch?

Response <type>=<CHARACTER RESPONSE DATA>

OFF, FINE, COAR, PAMF, PAMC

Function Queries the Auto Search On/Off of the tolerance measurement.

Example

```
> :SENSe:MEASure:BERCond:ASEarch?
< FINE
```

:SENSe:MEASure:BERCond:SSETting <range>,<step/ratio>

Parameter

<range>=<CHARACTER NUMERIC PROGRAM DATA>

VERYlow	Range Low:	10 Hz<Jitter Freq.≤100 kHz
LOW	Range Low:	100 kHz<Jitter Freq.≤1 MHz
MIDDle	Range Middle:	1 MHz<Jitter Freq.≤10 MHz
HIGH	Range High:	10 MHz<Jitter Freq.

<step>=<DECIMAL NUMERIC PROGRAM DATA>

0.001 to 2000.000 0.001 to 2000 UIp-p

<ratio>=<DECIMAL NUMERIC PROGRAM DATA>

0.01 to 1.00

The resolution for the <step> setting will depend on the value set.

Note:

> The step and ratio setting ranges are in accordance with the SJ specifications in 1.3 2 “Jitter Modulation Performance” of *MU181500B Jitter Modulation Source Instruction Manual.*

Function

Sets the measurement range, including upper and lower limits for tolerance measurement modulation for each modulation frequency band.

Example

To set the modulation steps to UI for the modulation frequency band 10 Hz to 1 MHz when the tolerance measurement method is “Downwards Linear”:

```
> :SENSe:MEASure:BERCond:SSETting LOW,0.2
```

:SENSe:MEASure:BERCond:SSETting? <range>

Parameter

<range>=<CHARACTER PROGRAM DATA>

VERYlow	Range Low:	10 Hz<Jitter Freq.≤100 kHz
LOW	Range Low:	100 kHz<Jitter Freq.≤1 MHz
MIDDle	Range Middle:	1 MHz<Jitter Freq.≤10 MHz
HIGH	Range High:	10 MHz<Jitter Freq.

Response

<step/ratio>

<step>=<NR2 NUMERIC RESPONSE DATA>

0.001 to 2000.000 0.001 to 2000 UIp-p

<ratio>=<NR2 NUMERIC RESPONSE DATA>

0.01 to 1.00

Function

Queries the measurement range such as jitter modulation amplitude upper and lower limits of the Tolerance measurement for each modulation frequency band.

Example

```
> :SENSe:MEASure:BERCond:SSETting? LOW
< 0.200
```

:SENSe:MEASure:BERCond:MTYPe <type>

Parameter

<type>=<CHARACTER PROGRAM DATA>

NRZ	NRZ signal
PAM4	PAM4 signal

Function

Sets the type of signal to be measured in tolerance test.

Example

To set the type of signal to PAM4:

```
> :SENSe:MEASure:BERCond:MTYPe PAM4
```

:SENSe:MEASure:BERCond:MTYPe?

Response

<type>=<CHARACTER RESPONSE DATA>

NRZ, PAM4

Function

Queries the type of signal to be measured in tolerance test.

Example

```
> :SENSe:MEASure:BERCond:MTYPe?
< PAM4
```

:SENSe:MEASure:BERCond:PATTern <type>

Parameter	<type>=<STRING PROGRAM DATA> “file name” Specify the file name according to “Appendix F” in the MU183040B Operation Manual. The following are example settings:
	"PRBS7" PRBS7
	"PRBS9" PRBS9
	"PRBS10" PRBS10
	"PRBS11" PRBS11
	"PRBS15" PRBS15
	"PRBS20" PRBS20
	"PRQS10" PRQS10
Function	Sets the pattern to be used by ED for PAM4 Tolerance measurement.
Example	To set the PRQS10 pattern for PAM4 signal: `> :SENSe:MEASure:BERCond:PATTern "PRQS10"`

:SENSe:MEASure:BERCond:PATTern?

Response	<type>=<STRING RESPONSE DATA> “file name” Specify the file name according to “Appendix F” in the *MU183040B Operation Manual.*
Function	Queries the pattern to be used by ED for PAM4 Tolerance measurement.

Example	`> :SENSe:MEASure:BERCond:PATTern?`
	`< "PRQS10"`

:SENSe:MEASure:BERCond:MANual:INTerface?

Response

<interface>=<CHARACTER RESPONSE DATA>

SING, DIF50, DIF100

Function

Queries the Data Input Condition of ED used for PAM4 Tolerance measurement.

Example

```
> :SENSe:MEASure:BERCond:MANual:INTerface?
< "SING"
```

:SENSe:MEASure:BERCond:MANual:DATA <thre>,<volt>

Parameter

<thre>=<CHARACTER PROGRAM DATA>

UPPer	Upper Eye threshold
MIDDle	Middle Eye threshold
LOWer	Lower Eye threshold

<volt>=<DECIMAL NUMERIC PROGRAM DATA>

–3.500 to 3.300	–3.500 to 3.300 V, 0.001 V step

Function

Sets the eye threshold for the Data Input of ED used for PAM4 Tolerance measurement.

Example

To set the Upper Eye threshold of Data Input to 0.100 V:

```
> :SENSe:MEASure:BERCond:MANual:DATA UPPer,0.100
```

:SENSe:MEASure:BERCond:MANual:DATA? <thre>

Parameter

<thre>=<CHARACTER PROGRAM DATA>

UPPer	Upper Eye threshold
MIDDle	Middle Eye threshold
LOWer	Lower Eye threshold

Response

<volt>=<NR2 NUMERIC RESPONSE DATA>

–3.500 to 3.300	–3.500 to 3.300 V, 0.001 V step

Function

Queries the eye threshold set for Data Input of ED and used for PAM4 Tolerance measurement.

Example

To query the Upper Eye threshold of Data Input:

```
> :SENSe:MEASure:BERCond:MANual:DATA? UPPer
< 0.100
```

:SENSe:MEASure:BERCond:MANual:XDATa <thre>,<volt>

Parameter	<thre>=<CHARACTER PROGRAM DATA>	
	UPPer	Upper Eye threshold
	MIDDle	Middle Eye threshold
	LOWer	Lower Eye threshold
	<volt>=<DECIMAL NUMERIC PROGRAM DATA>	
	–3.500 to 3.300	–3.500 to 3.300 V, 0.001 V step
Function	Sets the eye threshold for the XData Input of ED used for PAM4 Tolerance measurement.	
Example	To set the Lower Eye threshold of XData Input to 0.100 V:	

```
> :SENSe:MEASure:BERCond:MANual:XDATa LOWer,0.100
```

:SENSe:MEASure:BERCond:MANual:XDATa? <thre>

Parameter	<thre>=<CHARACTER PROGRAM DATA>	
	UPPer	Upper Eye threshold
	MIDDle	Middle Eye threshold
	LOWer	Lower Eye threshold
Response	<volt>=<NR2 NUMERIC RESPONSE DATA>	
	–3.500 to 3.300	–3.500 to 3.300 V, 0.001 V step
Function	Queries the eye threshold set for XData Input of ED and used for PAM4 Tolerance measurement.	
Example	To query the Lower Eye threshold of XData Input:	

```
> :SENSe:MEASure:BERCond:MANual:XDATa? LOWer
< 0.100
```

:SENSe:MEASure:BERCond:MANual:DELay <thre>,<delay>

Parameter

<thre>=<CHARACTER PROGRAM DATA>

UPPer	Upper Eye threshold
MIDDle	Middle Eye threshold
LOWer	Lower Eye threshold

<delay>=<DECIMAL NUMERIC PROGRAM DATA>

–1000 to 1000	–1000 to 1000 mUI, 1 mUI step

Function

Sets the phase of ED used for PAM4 Tolerance measurement, specifying the eye threshold.

Example

To set the phase of the Middle Eye threshold to 300 mUI:

```
> :SENSe:MEASure:BERCond:MANual:DELay MIDDle,300
```

:SENSe:MEASure:BERCond:MANual:DELay? <thre>

Parameter

<thre>=<CHARACTER PROGRAM DATA>

UPPer	Upper Eye threshold
MIDDle	Middle Eye threshold
LOWer	Lower Eye threshold

Response

<volt>=<NR1 NUMERIC RESPONSE DATA>

–1000 to 1000	–1000 to 1000 mUI, 1 mUI step

Function

Queries the phase of ED used for PAM4 Tolerance measurement, specifying the eye threshold.

Example

To query the phase of the Middle Eye threshold:

```
> :SENSe:MEASure:BERCond:MANual:DELay? MIDDle
< 300
```

:SENSe:MEASure:BERCond:TEST <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	ON or 1	Verifies the Threshold/Phase settings before measurement.
	OFF or 0	Does not verify the Threshold/Phase settings before measurement.
Function	Sets whether to verify the Threshold/Phase settings before PAM4 Tolerance measurement.	
Example	To turn on the pretest function:	

```
> :SENSe:MEASure:BERCond:TEST ON
```

:SENSe:MEASure:BERCond:TEST?

Response	<boolean>=<NR1 NUMERIC RESPONSE DATA>	
	1	Verifies the Threshold/Phase settings before measurement.
	0	Does not verify the Threshold/Phase settings before measurement.
Function	Queries whether to verify the Threshold/Phase settings before PAM4 Tolerance measurement.	
Example		

```
> :SENSe:MEASure:BERCond:TEST?
< 1
```

:SENSe:MEASure:BERCond:TARGet <type>

Parameter <type>=<CHARACTER PROGRAM DATA>

SYMBol	Symbol error rate
BIT	Bit error rate
MSB	MSB error rate
LSB	LSB error rate

Function Sets the pass/fail evaluation criterion (symbol error rate, bit error rate, MSB error rate or LSB error rate) when using the PAM4 ED.

Example To set to perform a pass/fail evaluation based on the symbol error rate.

```
> :SENSe:MEASure:BERCond:TARGet SYMBol
```

:SENSe:MEASure:BERCond:TARGet?

Response <type>=<CHARACTER RESPONSE DATA>

SYMB, BIT, MSB, LSB

Function Queries the pass/fail evaluation setting.

Example

```
> :SENSe:MEASure:BERCond:TARGet?
< SYMB
```

:SENSe:MEASure:BERCond:SJ:SSTep:TOZero <boolean>

Parameter <boolean>=<BOOLEAN PROGRAM DATA>

ON or 1	Step by step setting ON
OFF or 0	Step by step setting OFF

Function Sets whether or not to use the step by step setting function when resetting the jitter modulation amplitude to 0 UI after measuring the jitter tolerance at a certain modulation frequency.

Example To use (ON) the step by step setting function of jitter modulation amplitude.

```
> :SENSe:MEASure:BERCond:SJ:SSTEp:TOZero ON
```

Compatibility Incompatible with existing models.

:SENSe:MEASure:BERCond:SJ:SSTep:TOZero?

Response <numeric>=<NR1 NUMERIC RESPONSE DATA>

1	Step by step setting ON
0	Step by step setting OFF

Function Queries the step by step setting of jitter modulation amplitude.

Example

```
> :SENSe:MEASure:BERCond:SJ:SSTEp:TOZero?
< 1
```

Compatibility Incompatible with existing models.

:SENSe:MEASure:BERCond:SJ:SSTep:FIRStvalue <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	ON or 1	Step by step setting ON
	OFF or 0	Step by step setting OFF
Function	Sets whether or not to use the step by step setting function when setting the jitter modulation amplitude for next measurement after changing modulation frequencies.	
Example	To use (ON) the step by step setting function of jitter modulation amplitude.	
Compatibility	Incompatible with existing models.	

```
> :SENSe:MEASure:BERCond:SJ:SSTEp:FIRStvalue ON
```

:SENSe:MEASure:BERCond:SJ:SSTep:FIRStvalue?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	1	Step by step setting ON
	0	Step by step setting OFF
Function	Queries step-by-step setting of jitter modulation amplitude.	
Example		
Compatibility	Incompatible with existing models.	

```
> :SENSe:MEASure:BERCond:SJ:SSTEp:FIRStvalue?
< 1
```

:SENSe:MEASure:BERCond:SJ:SSTep <range>,<step>

Parameter

<range>=<CHARACTER NUMERIC PROGRAM DATA >

VERYlow	Range Low:	10 Hz < Jitter Freq.≤100 kHz
LOW	Range Low:	100 kHz < Jitter Freq.≤1 MHz
MIDDle	Range Middle:	1 MHz < Jitter Freq.≤10 MHz
HIGH	Range High:	10 MHz < Jitter Freq.

<step>=<DECIMAL NUMERIC PROGRAM DATA>

1 to 20	1 to 20 / 1 step

Function

Sets the number of divisions to divide the jitter modulation amplitude into for changing the jitter modulation frequency, respectively for each modulation frequency band.

Example

To set 5 for the number of divisions for the modulation frequency band 10 Hz to 1 MHz.

```
> :SENSe:MEASure:BERCond:SJ:SSTep LOW,5
```

:SENSe:MEASure:BERCond:SJ:SSTep? <range>

Parameter

<range>=<CHARACTER PROGRAM DATA>

VERYlow	Range Low:	10 Hz < Jitter Freq.≤100 kHz
LOW	Range Low:	100 kHz < Jitter Freq.≤1 MHz
MIDDle	Range Middle:	1 MHz < Jitter Freq.≤10 MHz
HIGH	Range High:	10 MHz < Jitter Freq.

Response

<step>=<NR2 NUMERIC RESPONSE DATA>

1 to 20	1 to 20

Function

Queries the number of divisions to divide the jitter modulation amplitude into, respectively for each modulation frequency band.

Example

```
> :SENSe:MEASure:BERCond:SJ:SSTep? LOW
< 5
```

:SENSe:MEASure:BERCond:SJ:SSTep:WTIMe <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0.1 to 1.0	0.1 to 1.0 s/ 0.1s step
Function	Sets the time to wait until division settings for the jitter modulation amplitude are applied.	
Example	To set 0.2 s for the time to wait until division settings for the jitter modulation amplitude are applied.	

```
> :SENSe:MEASure:BERCond:SJ:SSTep:WTIMe 0.2
```

:SENSe:MEASure:BERCond:SJ:SSTep:WTIMe?

Response	<step>=<NR2 NUMERIC RESPONSE DATA>	
	0.1 to 1.0	0.1 to 1.0 s/ 0.1s step
Function	Queries the time to wait until division settings for the jitter modulation amplitude are applied.	
Example		

```
> :SENSe:MEASure:BERCond:SJ:SSTep:WTIMe?
< 0.2
```

5.12.2 Graph screen

This setup screen is available only when MX183000A-PL001 is installed, when **Jitter Tolerance Test** or **PCIe Link Sequence** is started on the Selector screen (Figure 4.3.1-1), and when the SQA has been connected using Equipment Setup.

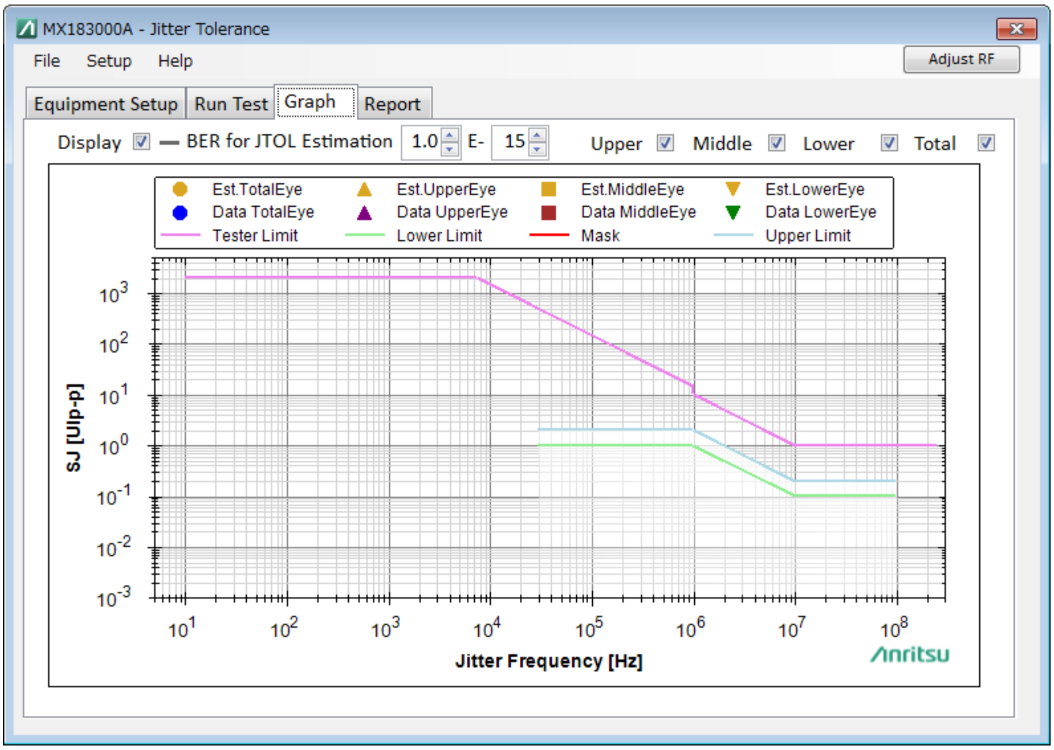


Figure 5.12.2-1 Graph Screen

The following commands are the same as with JTOL Setting. For details refer to the JTOL Settings Setup Screen.
:DISPlay:RESult:ESTimate:ERATe
:DISPlay:RESult:ESTimate:ERATe?

Table 5.12.2-1 Graph Screen Setup Commands

No.	Setting Item	Command
[1]	Estimation result display on/off	:DISPlay:RESult:ESTimate
		:DISPlay:RESult:ESTimate?

:DISPlay:RESult:ESTimate <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	ON or 1	Display selection on
	OFF or 0	Display selection off
Function	Sets whether the Estimation results are displayed on the graph.	
Example	To display the Estimation results are displayed on the graph `> :DISPlay:RESult:ESTimate 1`	
Compatibility	Incompatible with existing models.	

:DISPlay:RESult:ESTimate?

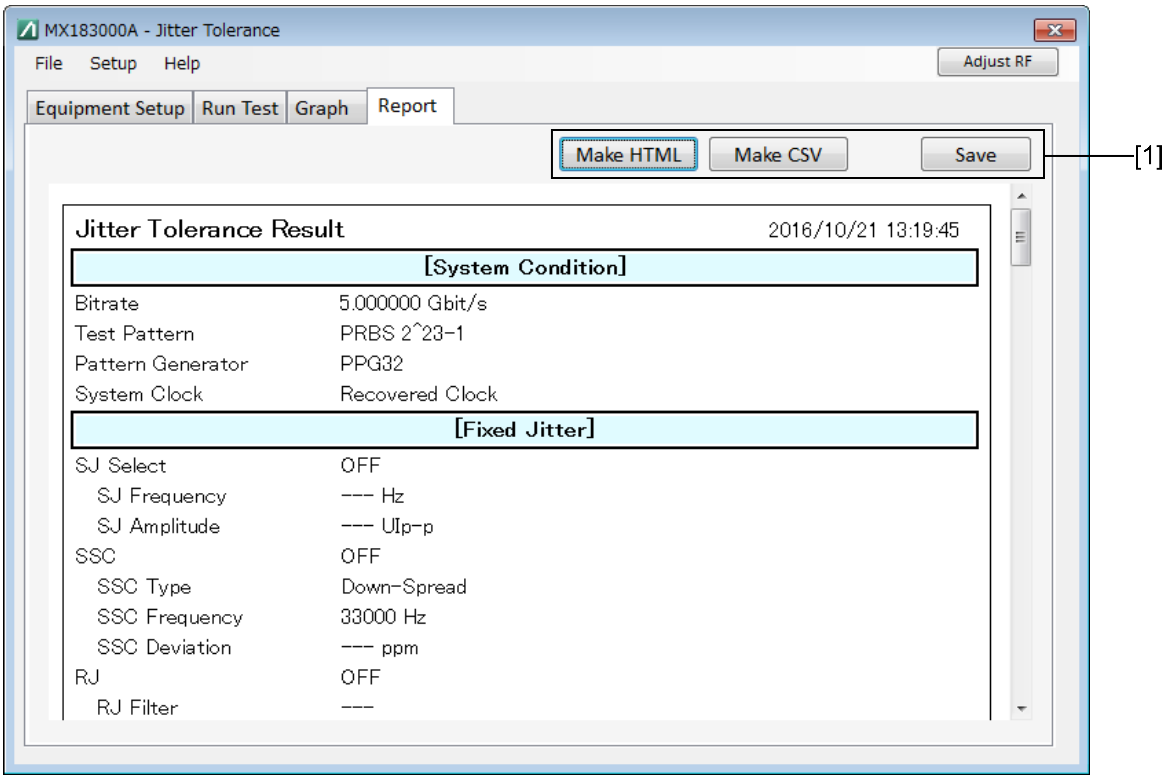
Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	1	Displayed
	0	Not displayed
Function	Queries whether Estimation is displayed or not.	

Example	`> :DISPlay:RESult:ESTimate?`
	`< 1`	

Compatibility	Incompatible with existing models.	

5.12.3 Result screen

This setup screen is available only when MX183000A-PL001 is installed, when **Jitter Tolerance Test** or **PCIe Link Sequence** is started on the Selector screen (Figure 4.3.1-1), and when the SQA has been connected using Equipment Setup.



Jitter Tolerance Result 2016/10/21 13:19:45

[System Condition]

Bitrate	5.000000 Gbit/s
Test Pattern	PRBS 2^23-1
Pattern Generator	PPG32
System Clock	Recovered Clock

[Fixed Jitter]

SJ Select	OFF
SJ Frequency	--- Hz
SJ Amplitude	--- UIp-p
SSC	OFF
SSC Type	Down-Spread
SSC Frequency	33000 Hz
SSC Deviation	--- ppm
RJ	OFF
RJ Filter	---

Figure 5.12.3-1 Result Screen

Table 5.12.3-1 Result Screen Setup Commands

No.	Setting Item	Command
[1]	Save Result	:SYSTem:MMEMory:RESult:STORe

:SYSTem:MMEMory:RESult:STORe <file_name>,<type>

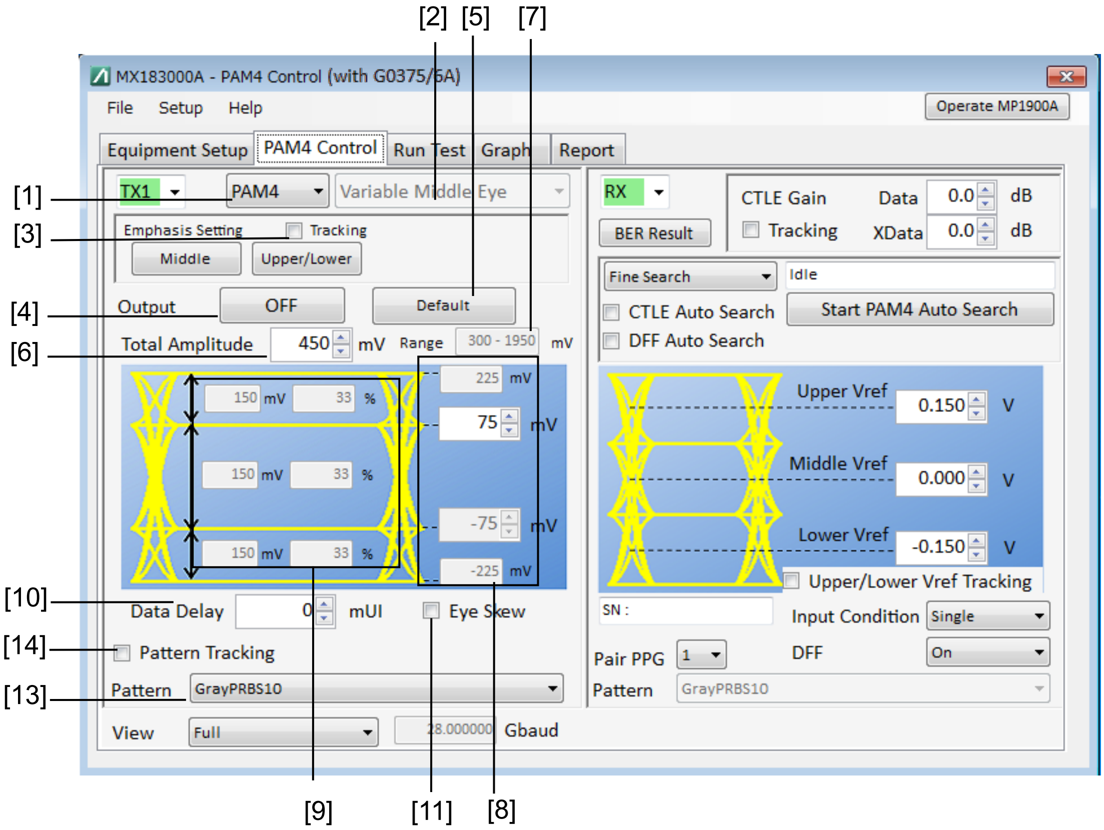
Parameter	<file_name>=<STRING PROGRAM DATA>	
	"<drv>:\<dir1>\<dir2>\<file>"	
	<drv>=C, D, E, F	Drive name
	<dir>=xxxxxxxx	Directory name
	<file>=xxxxxxxxx	File name
	<type>=<CHARACTER PROGRAM DATA>	
	HTML	HTML format
	CSV	CSV format
Function	Stores the Tolerance measurement result with specification of file name and file format.	
Example	Saves the measurement results in HTML format.	

```
> :SYSTem:MMEMory:RESult:STORe "D:\test_folder\test",HTML
```

5.13 PAM4 Setup Screen

This setup screen is shown when **PAM4 Control (with G0375/6A)** is launched on the Figure 4.3.1-1 “Selector Screen”, and this application connects to the SQA using Equipment Setup.

5.13.1 TX1 setup



TX1 | PAM4 | Variable Middle Eye

☐ Tracking

Output OFF

Total Amplitude 450 mV Range 300 - 1950 mV

150 mV 33 %

150 mV 33 %

150 mV 33 %

225 mV

75 mV

-75 mV

-225 mV

Data Delay 0 mUI

☐ Eye Skew

☐ Pattern Tracking

Pattern GrayPRBS10

View Full

28.000000 Gbaud

RX

CTLE Gain Data 0.0 dB

☐ Tracking XData 0.0 dB

Fine Search Idle

☐ CTLE Auto Search

☐ DFF Auto Search

Upper Vref 0.150 V

Middle Vref 0.000 V

Lower Vref -0.150 V

☐ Upper/Lower Vref Tracking

SN :

Input Condition Single

Pair PPG 1

DFF On

Pattern GrayPRBS10

Figure 5.13.1-1 PAM4 Control Tab TX1 Setting

Table 5.13.1-1 PAM4 Control Tab TX1 Setting and Query Commands

No.	Setting Item	Command
[1]	PAM4/NRZ	:OUTPut:DATA:TYPE[:PPG1]
		:OUTPut:DATA:TYPE[:PPG1]?
[2]	PAM4 Eye Selecting	:OUTPut:DATA:SELect
		:OUTPut:DATA:SELect[:PPG1]?
[3]	Emphasis Tracking (Setting ON/OFF)	:OUTPut:DATA:TRACking[:PPG1]
		:OUTPut:DATA:TRACking[:PPG1]?
[4]	Output ON/OFF	:OUTPut:DATA:OUTPut
		:OUTPut:DATA:OUTPut[:PPG1]?
[5]	Default	:OUTPut:DATA:DEFault[:PPG1]
[6]	Total Amplitude	:OUTPut:DATA:AMPLitude[:PPG1]
		:OUTPut:DATA:AMPLitude[:PPG1]?
[7]	Range	:OUTPut:DATA:AMPlitude:RANGe[:PPG1]?
[8]	Level Setting	:OUTPut:DATA:LEVel[:PPG1]
		:OUTPut:DATA:LEVel[:PPG1]?
[9]	Each Eye Amplitude Query	:OUTPut:DATA:EAMPlitude[:PPG1]?
[10]	Data Delay	:OUTPut:DATA:DELay[:PPG1]
		:OUTPut:DATA:DELay[:PPG1]?
[11]	Eye Skew (Setting ON/OFF)	:OUTPut:DATA:INTerface[:PPG1]
		:OUTPut:DATA:INTerface[:PPG1]?
[12]	Eye Skew (Setting Skew)	:OUTPut:DATA:SKEW[:PPG1]
		:OUTPut:DATA:SKEW[:PPG1]?
[13]	Pattern	:SOURce:PATTern:TYPE[:PPG1]
		:SOURce:PATTern:TYPE[:PPG1]?
[14]	Pattern Tracking	:SOURce:PATTern:TYPE:TRACking[:PPG1]
		:SOURce:PATTern:TYPE:TRACking[:PPG1]?

:OUTPut:DATA:TYPE <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	PAM4	Outputs PAM4 signal.
	NRZ	Outputs NRZ signal.
Function	Selects the output signal type, PAM4 or NRZ.	
Example	To select the output signal type PAM4:	

```
> :OUTPut:DATA:TYPE PAM4
```

:OUTPut:DATA:TYPE?

Response
<type>=<CHARACTER RESPONSE DATA>
PAM4, NRZ

Function
Queries the output signal type

Example

```
> :OUTPut:DATA:TYPE?
< PAM4
```

:OUTPut:DATA:SELect <eye>

Parameter	<eye>=<CHARACTER PROGRAM DATA>	
	UPPer	Set the Upper EYE
	MIDDle	Set the Middle EYE
	LOWer	Set the Lower EYE
Function	Selects the Eye to set the amplitude when outputting non-linear PAM4 signal.	
Example	To select Upper Eye to set the amplitude:	

```
> :OUTPut:DATA:SELect UPPer
```

:OUTPut:DATA:SELect?

Response
<eye>=<CHARACTER RESPONSE DATA>
UPP, MIDD, LOW

Function
Queries the Eye to set the amplitude when outputting non-linear PAM4 signal.

Example

```
> :OUTPut:DATA:SELect?
< UPP
```

:OUTPut:DATA:TRACking <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	Emphasis Tracking OFF
	ON or 1	Emphasis Tracking ON
Function	Sets Tracking ON/OFF for the Emphasis setting of Middle Eye and Upper/Lower Eye.	
Example	To Set Tracking ON for the Emphasis: `> :OUTPut:DATA:TRACking ON`	

:OUTPut:DATA:TRACking?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Emphasis Tracking OFF
	1	Emphasis Tracking ON
Function	Queries Tracking ON/OFF for the Emphasis setting of Middle Eye and Upper/Lower Eye.	

Example	`> :OUTPut:DATA:TRACking?`
	`< 1`	

:OUTPut:DATA:OUTPut <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	PAM4/NRZ signal OFF
	ON or 1	PAM4/NRZ signal ON
Function	Sets ON/OFF of PAM4/NRZ output signal.	
Example	To set the PAM4/NRZ output signal ON: `> :OUTPut:DATA:OUTPut ON`	

:OUTPut:DATA:OUTPut?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	PAM4/NRZ signal OFF
	1	PAM4/NRZ signal ON
Function	Queries ON/OFF of PAM4/NRZ output signal.	

Example	`> :OUTPut:DATA:OUTPut?`
	`< 1`	

:OUTPut:DATA:DEFault

Parameter	None	
Function	Sets PAM4/NRZ signal amplitude as factory default.	
Example	`> :OUTPut:DATA:DEFault`	

:OUTPut:DATA:AMPLitude <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	51 to 2200	51 to 2200 mV, 1 mV step
Function	Sets PAM4/NRZ signal amplitude.	
Example	To PAM4/NRZ signal amplitude 600 mV:	
	`> :OUTPut:DATA:AMPLitude 600`	

:OUTPut:DATA:AMPLitude?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	51 to 2200	51 to 2200 mV
Function	Queries PAM4/NRZ signal amplitude.	
Example	`> :OUTPut:DATA:AMPLitude?`	
	`< 600`	

:OUTPut:DATA:AMPLitude:RANGe?

Response	<min>=<NR1 NUMERIC RESPONSE DATA>	
	51 to 1000	51 to 1000 mV
	<max>=<NR1 NUMERIC RESPONSE DATA>	
	300 to 2200	300 to 2200 mV
Function	Queries the range of PAM4/NRZ amplitude that can be set for the signal. maximum	
Example	`> :OUTPut:DATA:AMPLitude:RANGe?`	
	`< 300,1950`	

:OUTPut:DATA:LEVel <level>,<numeric>

Parameter

<level>=<DECIMAL NUMERIC PROGRAM DATA>

1	Level 1 of PAM4 signal (Available for Non-linear PAM4)
2	Level 2 of PAM4 signal

<numeric>=<DECIMAL NUMERIC PROGRAM DATA>

–1100 to 1100	–1100 to 1100 mV, 1 mV step

Function

Sets the voltage of PAM4 Level 1 and Level 2.

Example

To set the PAM4 Level 2 150 mV:

```
> :OUTPut:DATA:LEVel 2,150
```

:OUTPut:DATA:LEVel? <level>

Parameter

<level>=<DECIMAL NUMERIC PROGRAM DATA>

0 to 3	Level 0 to 3 of PAM4 signal

Response

<numeric>=<DECIMAL RESPONSE PROGRAM DATA>

–1100 to 1100	–1100 to 1100 mV

Function

Queries the voltage of each PAM4 Level.

Example

```
> :OUTPut:DATA:LEVel? 2
< -150
```

:OUTPut:DATA:EAMPlitude? <eye>[,<unit>]

Parameter

<eye>=<CHARACTER PROGRAM DATA>

UPPer	Queries the Upper EYE.
MIDDle	Queries the Middle EYE.
LOWer	Queries the Lower EYE.

[<unit>]=<CHARACTER PROGRAM DATA>

MV	mV
PERCent	%

Note:

If the <unit> parameter is omitted, mV is selected.

Response

<numeric>=<DECIMAL RESPONSE PROGRAM DATA>

When <unit> is MV

30 to 1320	30 to 1320 mV

When <unit> is PERCent

20 to 60	20 to 60 %

Function

Queries the PAM4 signal amplitude of each Eye (Upper/Middle/Lower).

Example

```
> :OUTPut:DATA:EAMPlitude? Upper,MV
< 145
```

:OUTPut:DATA:DELay <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	–64000 to 64000	–64,000 to 64,000 mUI, 2 mUI step
Function	Sets delay of PAM4/NRZ signal.	
Example	To set Delay to 200 mUI:	

```
> :OUTPut:DATA:DELay 200
```

:OUTPut:DATA:DELay?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	–64000 to 64000	–64,000 to 64,000 mUI
Function	Queries Delay for PAM4/NRZ signal.	
Example		

```
> :OUTPut:DATA:DELay?
< 200
```

:OUTPut:DATA:INTerface <data>,<boolean>

Parameter	<data>=<DECIMAL NUMERIC PROGRAM DATA>	
	1 to 3	PAM4 data number (Data 1 to Data 3) to set ON/OFF.
	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	Signal output OFF
	ON or 1	Signal output ON
Function	Sets outputs ON/OFF of PAM4 Data 1 to Data 3.	
Example	To set output of Data 1 ON:	

```
> :OUTPut:DATA:INT 1,ON
```

:OUTPut:DATA:INTerface? <data>

Parameter	<data>=<DECIMAL NUMERIC PROGRAM DATA>	
	1 to 3	PAM4 data number (Data 1 to Data 3) to query ON/OFF
Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Signal output OFF
	1	Signal output ON
Function	Queries outputs ON/OFF of PAM4 Data 1 to Data 3.	
Example		

```
> :OUTPut:DATA:INT? 2
< 1
```

:OUTPut:DATA:SKEW <data>,<numeric>

Parameter	<data>=<DECIMAL NUMERIC PROGRAM DATA>	
	1 to 3	PAM4 data number (Data 1 to Data 3) to set skew
	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	–64000 to 64000	–64,000 to 64,000 mUI, 2 mUI step
Function	Sets skew of PAM4 Data 1 to Data 3.	
Example	To set 150 mUI to Data 1 skew:	

```
> :OUTPut:DATA:SKEW 1,150
```

:OUTPut:DATA:SKEW? <data>

Parameter	<data>=<DECIMAL NUMERIC PROGRAM DATA>	
	1 to 3	PAM4 data number (Data 1 to Data 3) to query ON/OFF and skew
Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Signal output OFF
	1	Signal output ON
	<numeric>=<DECIMAL RESPONSE PROGRAM DATA>	
	–64000 to 64000	–64,000 to 64,000 mUI
Function	Queries ON/OFF and skew of PAM4 Data 1 to Data 3.	
Example		

```
> :OUTPut:DATA:SKEW? 2
< 1,-150
```

:SOURce:PATTern:TYPE <type>

Parameter

<type>=<STRING PROGRAM DATA>

“pattern name”

The following are example settings. The number of pattern types may increase depending on future update. Input the pattern name displayed in GUI, enclosing in double quotes.

"PRBS7"	PRBS7
"PRBS9"	PRBS9
"PRBS10"	PRBS10
"PRBS11"	PRBS11
"PRBS13"	PRBS13
"PRBS15"	PRBS15
"PRBS20"	PRBS20
"PRBS31"	PRBS31
"SSPRQ"	SSPRQ
"GrayPRBSX"	GrayPRBSX (X = 7, 9, 10, 11, 15, 20)
"GrayPreQPRBS13-IEEE100GBASE-KP4_LaneX"	GrayPreQPRBS13-IEEE100GBASE-KP4_LaneX (X = 0, 1, 2, 3)
"PRBS13Q"	PRBS13Q
"PRBS31Q"	PRBS31Q

Function

Sets the PAM4 pattern used for the measurement.

Example

To set the pattern to be measured to PRBS31:

```
> :SOURce:PATTern:TYPE "PRBS31"
```

:SOURce:PATTern:TYPE?

Response

<type>=<STRING RESPONSE DATA>

Function

Queries the PAM4 pattern used for the measurement.

Example

```
> :SOURce:PATTern:TYPE?
< "PRBS31"
```

:SOURce:PATTern:TYPE:TRACking <type>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	Pattern Tracking OFF
	ON or 1	Pattern Tracking ON
Function	Sets ON/OFF of the Pattern Tracking setting.	
Example	To set Pattern Tracking for PPG1 to ON:	

```
> :SOURce:PATTern:TYPE:TRACking ON
```

:SOURce:PATTern:TYPE:TRACking?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Pattern Tracking OFF
	1	Pattern Tracking ON
Function	Queries the Pattern Tracking setting for PPG1.	
Example		

```
> :SOURce:PATTern:TYPE:TRACking?
< 1
```

5.13.2 TX2 setup

For details of commands, refer to 5.13.1 “TX1 setup”.

Table 5.13.2-1 PAM4 Control Tab TX2 Setting and Query Commands

No.	Setting Item	Command
[1]	PAM4/NRZ	:OUTPut:DATA:TYPE:PPG2
		:OUTPut:DATA:TYPE:PPG2?
[3]	Emphasis Tracking (Setting ON/OFF)	:OUTPut:DATA:TRACking:PPG2
		:OUTPut:DATA:TRACking:PPG2?
[5]	Default	:OUTPut:DATA:DEFault:PPG2
[6]	Total Amplitude	:OUTPut:DATA:AMPLitude:PPG2
		:OUTPut:DATA:AMPLitude:PPG2?
[7]	Range	:OUTPut:DATA:AMPlitude:RANGe:PPG2?
[8]	Level Setting	:OUTPut:DATA:LEVel:PPG2
		:OUTPut:DATA:LEVel:PPG2?
[9]	Each Eye Amplitude Query	:OUTPut:DATA:EAMPlitude:PPG2?
[10]	Data Delay	:OUTPut:DATA:DELay:PPG2
		:OUTPut:DATA:DELay:PPG2?
[11]	Eye Skew (Setting ON/OFF)	:OUTPut:DATA:INTerface:PPG2
		:OUTPut:DATA:INTerface:PPG2?
[12]	Eye Skew (Setting Skew)	:OUTPut:DATA:SKEW:PPG2
		:OUTPut:DATA:SKEW:PPG2?
[13]	Pattern	:SOURce:PATTern:TYPE:PPG2
		:SOURce:PATTern:TYPE:PPG2?
[14]	Pattern Tracking	:SOURce:PATTern:TYPE:TRACking:PPG2 :SOURce:PATTern:TYPE:TRACking:PPG2?

5.13.3 TX3 setup

For details of commands, refer to 5.13.1 “TX1 setup”.

Table 5.13.3-1 PAM4 Control Tab TX3 Setting and Query Commands

No.	Setting Item	Command
[1]	PAM4/NRZ	:OUTPut:DATA:TYPE:PPG3
		:OUTPut:DATA:TYPE:PPG3?
[2]	PAM4 Eye Selecting	:OUTPut:DATA:SELect:PPG3
		:OUTPut:DATA:SELect:PPG3?
[3]	Emphasis Tracking	:OUTPut:DATA:TRACking:PPG3
	(Setting ON/OFF)	:OUTPut:DATA:TRACking:PPG3?
[5]	Default	:OUTPut:DATA:DEFault:PPG3
[6]	Total Amplitude	:OUTPut:DATA:AMPLitude:PPG3
		:OUTPut:DATA:AMPLitude:PPG3?
[7]	Range	:OUTPut:DATA:AMPlitude:RANGe:PPG3?
[8]	Level Setting	:OUTPut:DATA:LEVel:PPG3
		:OUTPut:DATA:LEVel:PPG3?
[9]	Each Eye Amplitude Query	:OUTPut:DATA:EAMPlitude:PPG3?
[10]	Data Delay	:OUTPut:DATA:DELay:PPG3
		:OUTPut:DATA:DELay:PPG3?
[11]	Eye Skew (Setting ON/OFF)	:OUTPut:DATA:INTerface:PPG3
		:OUTPut:DATA:INTerface:PPG3?
[12]	Eye Skew (Setting Skew)	:OUTPut:DATA:SKEW:PPG3
		:OUTPut:DATA:SKEW:PPG3?
[13]	Pattern	:SOURce:PATTern:TYPE:PPG3
		:SOURce:PATTern:TYPE:PPG3?
[14]	Pattern Tracking	:SOURce:PATTern:TYPE:TRACking:PPG3
		:SOURce:PATTern:TYPE:TRACking:PPG3?

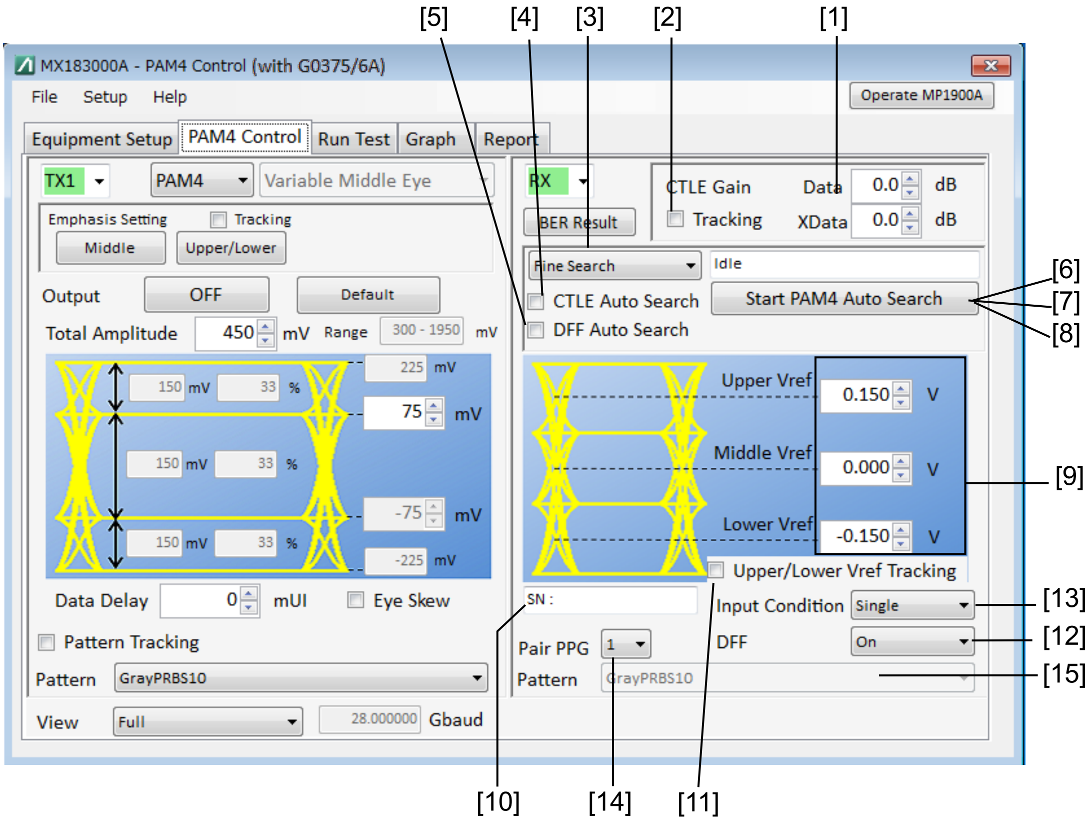
5.13.4 TX4 setup

For details of commands, refer to 5.13.1 “TX1 setup”.

Table 5.13.4-1 PAM4 Control Tab TX4 Setting and Query Commands

No.	Setting Item	Command
[1]	PAM4/NRZ	:OUTPut:DATA:TYPE:PPG4
		:OUTPut:DATA:TYPE:PPG4?
[2]	PAM4 Eye Selecting	:OUTPut:DATA:SELect:PPG4
		:OUTPut:DATA:SELect:PPG4?
[3]	Emphasis Tracking (Setting ON/OFF)	:OUTPut:DATA:TRACking:PPG4
		:OUTPut:DATA:TRACking:PPG4?
[5]	Default	:OUTPut:DATA:DEFault:PPG4
[6]	Total Amplitude	:OUTPut:DATA:AMPLitude:PPG4
		:OUTPut:DATA:AMPLitude:PPG4?
[7]	Range	:OUTPut:DATA:AMPlitude:RANGe:PPG4?
[8]	Level Setting	:OUTPut:DATA:LEVel:PPG4
		:OUTPut:DATA:LEVel:PPG4?
[9]	Each Eye Amplitude Query	:OUTPut:DATA:EAMPlitude:PPG4?
[10]	Data Delay	:OUTPut:DATA:DELay:PPG4
		:OUTPut:DATA:DELay:PPG4?
[11]	Eye Skew (Setting ON/OFF)	:OUTPut:DATA:INTerface:PPG4
		:OUTPut:DATA:INTerface:PPG4?
[12]	Eye Skew (Setting Skew)	:OUTPut:DATA:SKEW:PPG4
		:OUTPut:DATA:SKEW:PPG4?
[13]	Pattern	:SOURce:PATTern:TYPE:PPG4
		:SOURce:PATTern:TYPE:PPG4?
[14]	Pattern Tracking	:SOURce:PATTern:TYPE:TRACking:PPG4
		:SOURce:PATTern:TYPE:TRACking:PPG4?

5.13.5 RX setup



TX1 PAM4 Variable Middle Eye

Emphasis Setting ☐ Tracking Middle Upper/Lower

Output OFF Default

Total Amplitude 450 mV Range 300 - 1950 mV

225 mV, 150 mV 33 %, 75 mV, 150 mV 33 %, -75 mV, 150 mV 33 %, -225 mV

Data Delay 0 mUI ☐ Eye Skew

☐ Pattern Tracking

Pattern GrayPRBS10

View Full 28.000000 Gbaud

RX BER Result Fine Search Idle

CTLE Gain Data 0.0 dB ☐ Tracking XData 0.0 dB

☐ CTLE Auto Search ☐ DFF Auto Search

Upper Vref 0.150 V Middle Vref 0.000 V Lower Vref -0.150 V

☐ Upper/Lower Vref Tracking

Input Condition Single DFF On

Pair PPG 1 Pattern GrayPRBS10

Figure 5.13.5-1 PAM4 Control Tab RX Setting

Table 5.13.5-1 PAM4 Control Tab RX Setting and Query Commands

No.	Setting Item	Command
[1]	CTLE Gain	:INPut:CTLE:SETTing
		:INPut:CTLE:SETTing?
[2]	Tracking Setting	:INPut:CTLE:TRACking
		:INPut:CTLE:TRACking?
[3]	Selecting Auto Search	:SENSe:ASEarch:MODE
		:SENSe:ASEarch:MODE?
[4]	CTLE Auto Search	:SENSe:ASEarch:CTLE
		:SENSe:ASEarch:CTLE?
[5]	DFF Auto Search	:SENSe:ASEarch:DFF
		:SENSe:ASEarch:DFF?
[6]	Starting Auto Search	:SENSe:ASEarch:STARt
[7]	Stoping Auto Search	:SENSe:ASEarch:STOP
[8]	Querying Auto Search Status	:SENSe:ASEarch:STATe?

Table 5.13.5-1 PAM4 Control Tab RX Setting and Query Commands (Cont'd)

No.	Setting Item	Command
[9]	Setting PAM4 Vref	:INPut:VREF:SETTing
		:INPut:VREF:SETTing?
[10]	Querying G0376A SN	:SENSe:DECoder:SERial?
[11]	Upper/Lower Vref Tracking	:INPut:VREF:TRACking
		:INPut:VREF:TRACking?
[12]	DFF	:INPut:DFF:SETTing
		:INPut:DFF:SETTing?
[13]	Input Condition	:INPut:DATA:INTerface
		:INPut:DATA:INTerface?
[14]	Pair PPG	:SENSe:MEASure:SELPpg
		:SENSe:MEASure:SELPpg?
[15]	Rx Pattern	:SENSe:PATTern:TYPE?

:INPut:CTLE:SETTing <interface>,<numeric>

Parameter	<interface>=<CHARACTER PROGRAM DATA>	
	DATA	Sets gain of Data input.
	XDATa	Sets gain of XData input.
	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	–12.0 to 0.0	–12.0 to 0.0 dB, 0.1 dB step
Function	Sets the CTLE gain of Data/XData input.	
Example	To set –6.0 dB to the CTLE gain of Data input:	
	`> :INPut:CTLE:SETTing DATA,-6.0`	

:INPut:CTLE:SETTing? <interface>

Parameter	<interface>=<CHARACTER PROGRAM DATA>	
	DATA	Queries gain of Data input.
	XDATa	Queries gain of XData input.
Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	–12.0 to 0.0	–12.0 to 0.0 dB,
Function	Queries the CTLE gain of Data/XData input.	
Example	`> :INPut:CTLE:SETTing? DATA`	
	`< -6.0`	

:INPut:CTLE:TRACking <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	CTLE Tracking OFF
	ON or 1	CTLE Tracking ON
Function	Sets Tracking ON/OFF of CTLE setting.	
Example	To set Tracking ON of CTLE.	
	`> :INPut:CTLE:TRACking ON`	

:INPut:CTLE:TRACking?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	CTLE Tracking OFF
	1	CTLE Tracking ON
Function	Queries Tracking ON/OFF of CTLE setting.	
Example	`> :INPut:CTLE:TRACking?`	
	`< 1`	

:SENSe:ASEarch:MODE <mode>

Parameter	<mode>=<CHARACTER PROGRAM DATA>	
	FINE	Fine Search
	COARse	Coarse Search
Function	Selects the Auto Search mode.	
Example	To set Fine Search:	
	`> :SENSe:ASEarch:MODE FINE`	

:SENSe:ASEarch:MODE?

Response	<mode>=<CHARACTER RESPONSE DATA>
	FINE, COAR
Function	Queries the Auto Search mode.
Example	`> :SENSe:ASEarch:MODE?`
	`< FINE`

:SENSe:ASEarch:CTLE <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	CTLE Auto Search OFF
	ON or 1	CTLE Auto Search ON
Function	Sets ON/OFF of CTLE Auto Search.	
Example	To set ON of CTLE Auto Search:	
	`> :SENSe:ASEarch:CTLE ON`	

:SENSe:ASEarch:CTLE?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	CTLE Auto Search OFF
	1	CTLE Auto Search ON
Function	Queries ON/OFF of CTLE Auto Search.	
Example	`> :SENSe:ASEarch:CTLE?`	
	`< 1`	

:SENSe:ASEarch:DFF <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	DFF Auto Search OFF
	ON or 1	DFF Auto Search ON
Function	Sets ON/OFF of DFF Auto Search.	
Example	To set ON of DFF Auto Search: `> :SENSe:ASEarch:DFF ON`	

:SENSe:ASEarch:DFF?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	DFF Auto Search OFF
	1	DFF Auto Search ON
Function	Queries ON/OFF of DFF Auto Search.	

Example	`> :SENSe:ASEarch:DFF?`
	`< 1`	

:SENSe:ASEarch:STARt

Parameter	None
Function	Starts PAM4 Auto Search.
Example	`>:SENSe:ASEarch:STARt`

:SENSe:ASEarch:STOP

Parameter	None
Function	Stops PAM4 Auto Search.
Example	`>:SENSe:ASEarch:STOP`

:SENSe:ASEarch:STATe?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	1	Being searched
	0	Stopped
Function	Queries the status of PAM4 Auto Search.	

Example	`>:SENSe:ASEarch:STATe?`
	`< 1`	

:INPut:VREF:SETTing <eye>,<numeric>

Parameter	<eye>=<CHARACTER PROGRAM DATA>	
	UPPer	Sets Vref of Upper Eye.
	MIDDle	Sets Vref of Middle Eye.
	LOWer	Sets Vref of Lower Eye.
	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	–0.400 to 0.400	–0.400 to 0.400 V, 0.001V step
Function	Sets Vref of each Eye (Upper/Middle/Lower).	
Example	To set 0.150 V to the Vref of Upper Eye:	

```
> :INPut:VREF:SETTing UPPer,0.150
```

:INPut:VREF:SETTing? <eye>

Parameter	<eye>=<CHARACTER PROGRAM DATA>	
	UPPer	Queries Vref of Upper Eye.
	MIDDle	Queries Vref of Middle Eye.
	LOWer	Queries Vref of Lower Eye.
Response	<numeric>=<DECIMAL RESPONSE PROGRAM DATA>	
	–0.400 to 0.400	–0.400 to 0.400 V
Function	Queries Vref of each Eye (Upper/Middle/Lower).	
Example		

```
> :INPut:VREF:SETTing? Upper
< 0.150
```

:SENSe:DECoder:SERial?

Response	<STRING>=<STRING RESPONSE DATA> “AIxxxxxx-x”
Function	Queries SN of G0376A Decoder.
Example	

```
> :SENSe:DECoder:SERial?
< "AI12345-6"
```

:INPut:VREF:TRACking <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	Upper/Lower Tracking OFF
	ON or 1	Upper/Lower Tracking ON
Function	Sets Tracking ON/OFF of Upper/Lower Vref.	
Example	To set Tracking ON of Upper/Lower Vref:	

```
> :INPut:VREF:TRACking ON
```

:INPut:VREF:TRACking?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	Upper/Lower Tracking OFF
	1	Upper/Lower Tracking ON
Function	Queries Tracking ON/OFF of Upper/Lower Vref.	
Example		

```
> :INPut:VREF:TRACking?
< 1
```

:INPut:DFF:SETTing <boolean>

Parameter	<boolean>=<BOOLEAN PROGRAM DATA>	
	OFF or 0	DFF OFF
	ON or 1	DFF ON
Function	Sets ON/OFF of the internal DFF.	
Example	To set the internal DFF ON:	

```
> :INPut:DFF:SETTing ON
```

:INPut:DFF:SETTing?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0	DFF OFF
	1	DFF ON
Function	Queries ON/OFF of the internal DFF:	
Example		

```
> :INPut:DFF:SETTing?
< 1
```

:INPut:DATA:INTerface <interface>

Parameter	<interface>=<CHARACTER PROGRAM DATA>	
	SINGle	Single-Ended
	DIFFerential	Differential
Function	Sets the input interface of Decoder Input.	
Example	To set Differential to the input interface:	

```
> :INPut:DATA:INTerface DIFFerential
```

:INPut:DATA:INTerface?

Response
<interface>=<CHARACTER RESPONSE DATA>
SING, DIFF

Function
Queries the input interface of Decoder Input.

Example

```
> :INPut:DATA:INTerface?
< DIFF
```

:SENSe:MEASure:SELPpg <ppg>

Parameter	<ppg >=<CHARACTER PROGRAM DATA>	
	1	PPG specified for TX1
	2	PPG specified for TX2
	3	PPG specified for TX3
	4	PPG specified for TX4
Function	Sets the target PPG for the BER measurement for which ED is used.	
Example	To set the target PPG for the BER measurement for which ED is used, to PPG specified for TX1:	

```
> :SENSe:MEASure:SELPpg 1
```

:SENSe:MEASure:SELPpg?

Response
<ppg >=<CHARACTER PROGRAM DATA>
1, 2, 3, 4

Function
Queries the target PPG for the BER measurement for which ED is used.

Example

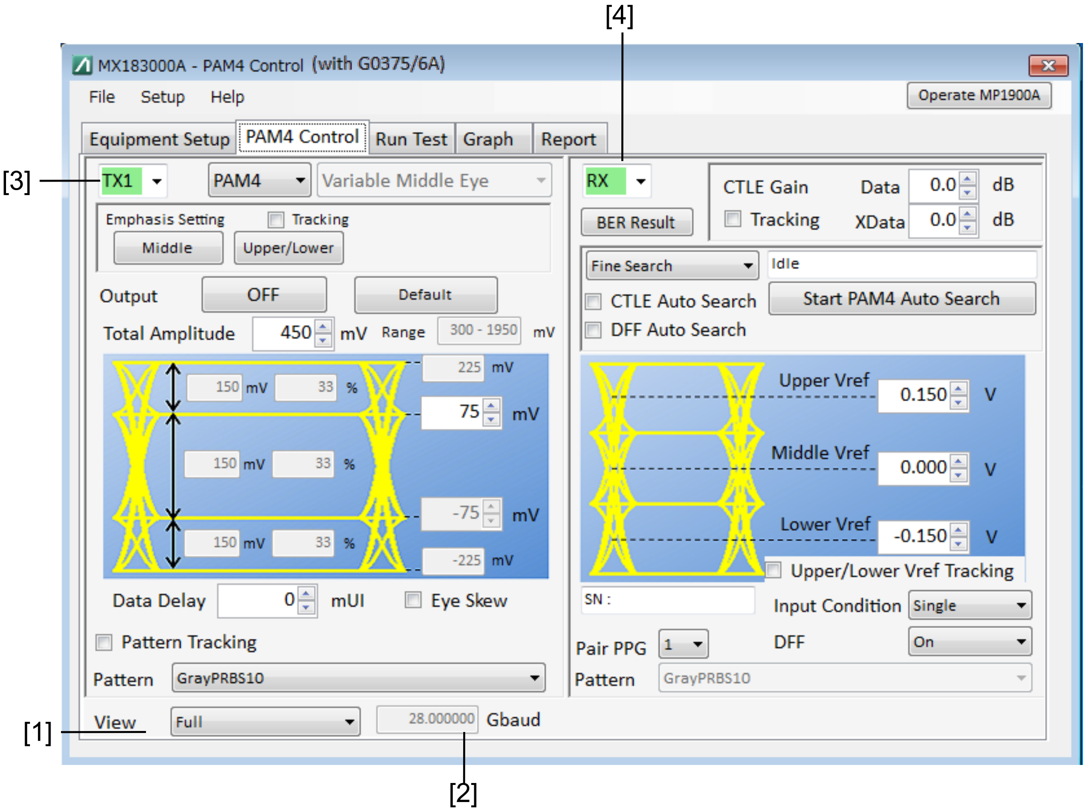
```
> :SENSe:MEASure:SELPpg?
< 1
```

:SENSe:PATTern:TYPE?

Response	<type>=<STRING RESPONSE DATA>
Function	Queries the PAM4 pattern used for the measurement.

Example	`> :SENSe:PATTern:TYPE?`
	`< "PRBS31"`

5.13.6 Common setting



TX1
PAM4
Variable Middle Eye
☐ Tracking
Output OFF
Total Amplitude 450 mV Range 300 - 1950 mV
225 mV
150 mV 33 %
75 mV
150 mV 33 %
-75 mV
150 mV 33 %
-225 mV
Data Delay 0 mUI
☐ Eye Skew
☐ Pattern Tracking
Pattern GrayPRBS10
View Full
28.000000 Gbaud

RX
CTLE Gain Data 0.0 dB
☐ Tracking XData 0.0 dB
Fine Search
Idle
☐ CTLE Auto Search
☐ DFF Auto Search
Upper Vref 0.150 V
Middle Vref 0.000 V
Lower Vref -0.150 V
☐ Upper/Lower Vref Tracking
SN :
Input Condition Single
Pair PPG 1
DFF On
Pattern GrayPRBS10

Figure 5.13.6-1 PAM4 Control Tab Common Setting

Table 5.13.6-1 PAM4 Control Tab Common Setting and Query Commands

No.	Setting Item	Command
[1]	View	:DISPlay:SIZE
		:DISPlay:SIZE?
[2]	Querying baud rate	:OUTPut:DATA:BAUDrate?
[3]	Specifying setup screen to be displayed on left	:DISPlay:SETTing:LEFT
		:DISPlay:SETTing:LEFT?
[4]	Specifying setup screen to be displayed on right	:DISPlay:SETTing:RIGHt
		:DISPlay:SETTing:RIGHt?

:DISPlay:SIZE <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	FULL	Displays full-size TX and RX.
	HALF	Displays half-size.
Function	Sets the display size.	
Example	To set half-size to display.	
	`> :DISPlay:SIZE HALF`	

:DISPlay:SIZE?

Response	<type>=<CHARACTER RESPONSE DATA>
	FULL, HALF
Function	Queries the display size.
Example	`> :DISPlay:SIZE?`
	`< HALF`

:OUTPut:DATA:BAUDrate?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	2.400000 to 32.100000	2.400000 to 32.100000 Gbaud
Function	Queries Baud Rate of PAM4 signal.	
Example	`> :OUTPut:DATA:BAUDrate?`	
	`< 25.000000`	

:DISPlay:SETTing:LEFT <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	RX	Displays the RX setup screen.
	TX1	Displays the TX1 setup screen.
	TX2	Displays the TX2 setup screen.
	TX3	Displays the TX3 setup screen.
	TX4	Displays the TX4 setup screen.

Function: Sets the setup screen to be displayed on the left side of the full screen or on the half screen.

Example: To display the RX setup screen on the left side of the full screen or on the half screen:

```
> :DISPlay:SETTing:LEFT RX
```

:DISPlay:SETTing:LEFT?

Response: <type>=<CHARACTER RESPONSE DATA>
RX, TX1, TX2, TX3, TX4

Function: Queries the setup screen being displayed on the left side of the full screen or on the half screen.

Example:

```
> :DISPlay:SETTing:LEFT?
< RX
```

:DISPlay:SETTing:RIGHt <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	RX	Displays the RX setup screen.
	TX1	Displays the TX1 setup screen.
	TX2	Displays the TX2 setup screen.
	TX3	Displays the TX3 setup screen.
	TX4	Displays the TX4 setup screen.

Function: Sets the setup screen to be displayed on the right side of the full screen.

Example: To display the RX setup screen on the right side of the full screen:

```
> :DISPlay:SETTing:RIGHt RX
```

:DISPlay:SETTing:RIGHt?

Response: <type>=<CHARACTER RESPONSE DATA>
RX, TX1, TX2, TX3, TX4

Function: Queries the setup screen being displayed on the right side of the full screen.

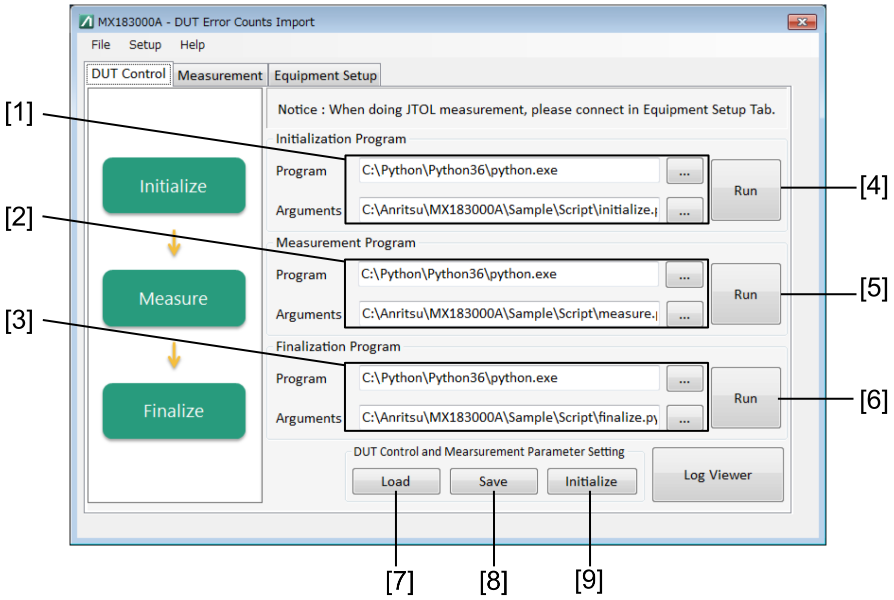
Example:

```
> :DISPlay:SETTing:LEFT?
< RX
```

5.14 DUT Error Counts Import Setup Screen

This setup screen is available only when MX183000A-PL031 is installed, when **DUT Error Counts Import** is started on the Figure 4.3.1-1 "Selector Screen".

5.14.1 DUT Control tab



Notice : When doing JTOL measurement, please connect in Equipment Setup Tab.

Initialization Program
Program: C:\Python\Python36\python.exe
Arguments: C:\Anritsu\MX183000A\Sample\Script\initialize.

Measurement Program
Program: C:\Python\Python36\python.exe
Arguments: C:\Anritsu\MX183000A\Sample\Script\measure.

Finalization Program
Program: C:\Python\Python36\python.exe
Arguments: C:\Anritsu\MX183000A\Sample\Script\finalize.p

Figure 5.14.1-1 DUT Control Tab

Table 5.14.1-1 DUT Control Tab Setup Commands

No.	Setting Item	Command
[1]	Selecting Initialization program	:SYSTem:EQUipment:DUT:INITialize
[2]	Selecting Measurement program	:SYSTem:EQUipment:DUT:MEASure
[3]	Selecting Finalization program	:SYSTem:EQUipment:DUT:FINalize
[4]	Starting Initialization program	:SYSTem:EQUipment:DUT:INITialize:STARt
	Aborting Initialization program	:SYSTem:EQUipment:DUT:INITialize:ABORt
	Status of Initialization program	:SYSTem:EQUipment:DUT:INITialize:STATe?
	Checking execution history of Initialization program	:SYSTem:EQUipment:DUT:INITialize:CONDition?
[5]	Starting Measurement program	:SENSe:MEASure:BER:STARt
	Aborting Measurement program	:SENSe:MEASure:BER:ABORt
	Status of Measurement program	:SENSe:MEASure:BER:STATe?
[6]	Starting Finalization program	:SYSTem:EQUipment:DUT:FINalize:STARt
	Aborting Finalization program	:SYSTem:EQUipment:DUT:FINalize:ABORt
	Status of Finalization program	:SYSTem:EQUipment:DUT:FINalize:STATe?
	Checking execution history of Finalization program	:SYSTem:EQUipment:DUT:FINalize:CONDition?
[7]	Loading parameter settings for DUT Control and Measurement tabs from file	:SYSTem:EQUipment:DUT:SETTing:RECall
[8]	Saving parameter settings on DUT Control and Measurement tabs to a file	:SYSTem:EQUipment:DUT:SETTing:STORe
[9]	Initializing parameter settings on DUT Control and Measurement tabs	:SYSTem:EQUipment:DUT:SETTing:INITialize

:SYSTem:EQUipment:DUT:INITialize <program_path>,<arguments>

Parameter	<program_path>=<STRING PROGRAM DATA> Sets a path to program. Unavailable characters :/*? ”<>| Number of characters: 260 <arguments>=<STRING PROGRAM DATA> Specifies the argument for program. Number of characters: 2000
Function	Specifies the path and argument of the Initialization program.

Example	`> :SYSTem:EQUipment:DUT:INITialize`
	`"C:\test\sample_ini.exe","ini.py"`

:SYSTem:EQUipment:DUT:MEASure <program_path>,<arguments>

Parameter	<program_path>=<STRING PROGRAM DATA> Sets a path to program. Unavailable characters :/*? ”<>| Number of characters: 260 <arguments>=<STRING PROGRAM DATA> Specifies the argument for program. Number of characters: 2000
Function	Specifies the path and argument of the Measurement program.

Example	`> :SYSTem:EQUipment:DUT:MEASure`
	`"C:\test\sample_meas.exe","meas.py"`

:SYSTem:EQUipment:DUT:FINalize <program_path>,<arguments>

Parameter	<program_path>=<STRING PROGRAM DATA> Sets a path to program. Unavailable characters :/*? ”<>| Number of characters: 260 <arguments>=<STRING PROGRAM DATA> Specifies the argument for program. Number of characters: 2000
Function	Specifies the path and argument of the Finalization program.

Example	`> :SYSTem:EQUipment:DUT:FINalize`
	`"C:\test\sample_final.exe","final.py"`

:SYSTem:EQUipment:DUT:INITialize:STARt

Parameter	None
Function	Starts the Initialization program.
Example	`>:SYSTem:EQUipment:DUT:INITialize:STARt`

:SYSTem:EQUipment:DUT:INITialize:ABORt

Parameter	None
Function	Aborts the Initialization program.
Example	`>:SYSTem:EQUipment:DUT:INITialize:ABORt`

:SYSTem:EQUipment:DUT:INITialize:STATe?

Response	<boolean>=<NR1 NUMERIC RESPONSE DATA>	
	1	Started
	0	Not started yet
Function	Queries whether the Initialization program has been run or not.	

Example	`> :SYSTem:EQUipment:DUT:INITialize:STATe?`
	`< 1`	

:SYSTem:EQUipment:DUT:INITialize:CONDition?

Response	<boolean>=<NR1 NUMERIC RESPONSE DATA>	
	1	Successful completion
	0	Other than successful completion, or not started yet
Function	Checks the execution history of the Initialization program.	

Example	`> :SYSTem:EQUipment:DUT:INITialize:CONDition?`
	`< 1`	

:SENSe:MEASure:BER:STARt

Paramete	None
Function	Starts measurement.
Example	`>:SENSe:MEASure:BER:STARt`

:SENSe:MEASure:BER:ABORt

Parameter	None
Function	Aborts the measurement.
Example	`>:SENSe:MEASure:BER:ABORt`

:SENSe:MEASure:BER:STATe?

Response	<numeric>=<NR1 NUMERIC RESPONESE DATA>	
	1	Being measured
	0	Stopped
Function	Queries the measurement state.	

Example	`> :SENSe:MEASure:BER:STATe?`
	`< 1`	

:SYSTem:EQUipment:DUT:FINalize:STARt

Parameter	None
Function	Starts the Finalization program.
Example	`>:SYSTem:EQUipment:DUT:FINalize:STARt`

:SYSTem:EQUipment:DUT:FINalize:ABORt

Parameter	None
Function	Aborts the Finalization program.
Example	`>:SYSTem:EQUipment:DUT:FINalize:ABORt`

:SYSTem:EQUipment:DUT:FINalize:STATe?

Response	<boolean>=<NR1 NUMERIC RESPONSE DATA>	
	1	Started
	0	Not started yet
Function	Queries whether the Finalization program has been run or not.	

Example	`> :SYSTem:EQUipment:DUT:FINalize:STATe?`
	`< 1`	

:SYSTem:EQUipment:DUT:FINalize:CONDition?

Response	<boolean>=<NR1 NUMERIC RESPONSE DATA>	
	1	Successful completion
	0	Other than successful completion, or not started yet
Function	Checks the execution history of the Finalization program.	

Example	`> :SYSTem:EQUipment:DUT:FINalize:CONDition?`
	`< 1`	

:SYSTem:EQUipment:DUT:SETTing:RECall <file_name>

Parameter	<file_name>=<STRING PROGRAM DATA>	
	"<drv>:\<dir1>\<dir2>\<file>"	
	<drv>=C, D, E, F	Drive name
	<dir>=xxxxxxxx	Directory name
	<file>=xxxxxxxxx	File name
Function	Loads parameter settings for the **DUT Control** and **Measurement** tabs.	
Example	`>:SYSTem:EQUipment:DUT:SETTing:RECall "C:\test_folder\test_setting"`	

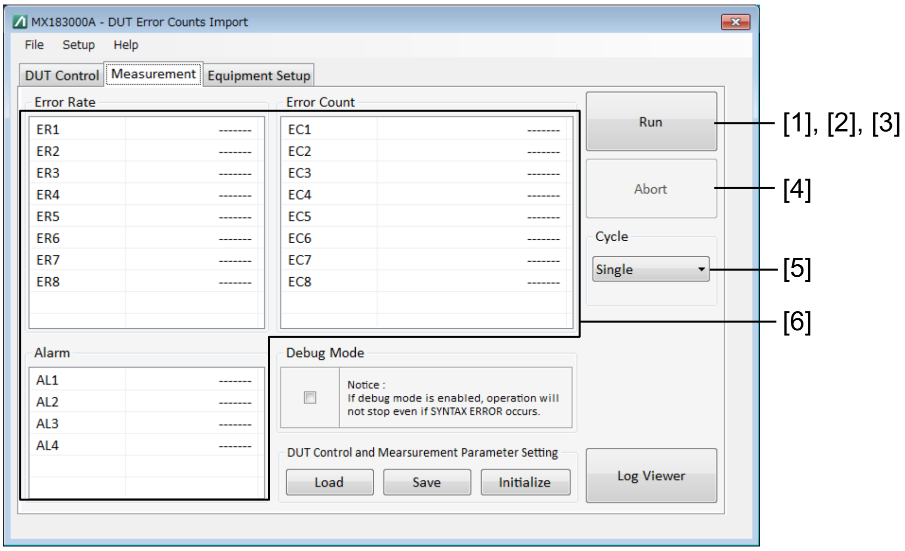
:SYSTem:EQUipment:DUT:SETTing:STORe <file_name>

Parameter	<file_name>=<STRING PROGRAM DATA>	
	"<drv>:\<dir1>\<dir2>\<file>"	
	<drv>=C, D, E, F	Drive name
	<dir>=xxxxxxxx	Directory name
	<file>=xxxxxxxxx	File name
Function	Saves the parameter settings on the **DUT Control** and **Measurement** tabs.	
Example	`>:SYSTem:EQUipment:DUT:SETTing:STORe "C:\test_folder\test_setting"`	

:SYSTem:EQUipment:DUT:SETTing:INITialize

Parameter	None
Function	Initializes the parameter settings on the **DUT Control** and **Measurement** tabs.
Example	`>:SYSTem:EQUipment:DUT:SETTing:INITialize`

5.14.2 Measurement tab



Cycle: Single

☐ Notice :
If debug mode is enabled, operation will not stop even if SYNTAX ERROR occurs.

Figure 5.14.2-1 Measurement Tab

Table 5.14.2-1 Measurement Tab Setup Commands

No.	Setting Item	Command
[1]	Starting Measurement program*	:SENSe:MEASure:BER:STARt
[2]	Stopping Measurement program	:SENSe:MEASure:BER:STOP
[3]	Status of Measurement program*	:SENSe:MEASure:BER:STATe?
[4]	Aborting Measurement program*	:SENSe:MEASure:BER:ABORt
[5]	Setting measurement cycle	:SENSe:MEASure:BER:MODE
		:SENSe:MEASure:BER:MODE?
[6]	Acquiring results of DUT Error Counts Import	:CALCulate:DATA:EALarm?

*: For command descriptions, refer to 5.14.1 “DUT Control tab”.

:SENSe:MEASure:BER:STOP

Paramete	None
Function	Stops measurement.
Example	`>:SENSe:MEASure:BER:STOP`

:SENSe:MEASure:BER:MODE <cycle>

Parameter	<cycle>=<CHARACTER PROGRAM DATA>	
	REPeat	Repeated measurement
	SINGle	1-cycle measurement
Function	Sets the measurement cycle.	
Example	Sets the measurement cycle to Repeat.	
	`> :SENSe:MEASure:BER:MODE REPeat`	

:SENSe:MEASure:BER:MODE?

Response	<sel>=<CHARACTER RESPONSE DATA>	
	REP	Repeated measurement
	SING	1-cycle measurement
Function	Queries the measurement cycle.	
Example	`> :SENSe:MEASure:BER:MODE?`	
	`< REP`	

:CALCulate:DATA:EALarm? <result>

Parameter

<result>=<CHARACTER PROGRAM DATA>

EC1 to EC8	Error rate 1 to 8
ER1 to ER8	Error count 1 to 8
AL1 to AL4	Alarm 1 to 4

Response

<string>=<STRING RESPONSE DATA>

“<comment>,<value>”

<comment>

Xxxxx	any comment, alphanumeric characters

<value>

For EC*

------- (Seven hyphen characters indicate an invalid value.)

0 to 18446744073709551615

For ER*

------- (Seven hyphen characters indicate an invalid value.)

0.0001E–18 to 1.0000E00

For AL*

------- (Seven hyphen characters indicate an invalid value.)

0, 1

Function

Acquires result of DUT Error Counts Import.

Example

Acquires error counts of Channel 1.

```
> :CALCulate:DATA:EALarm? EC1
< "MSB Error Count,1234567"
```

Appendix A Specifications

Table A-1 Configuration

Item	Model	Name	Quantity
Standard Configuration	P0031A	USB Memory (MX183000A/MX190000A Installer, Operation manual)	1
Optional Accessories	W3813AE	MX183000A Operation Manual (Printed, English)	–
	41KC-3	Precision Fixed Attenuator 3 dB	–
	41KC-6	Precision Fixed Attenuator 6 dB	–
	41KC-20	Precision Fixed Attenuator 20 dB	–
	K241C	Power Splitter	–
	J1510A	Pick Off Tee	–
	J1721A	USB Measurement Component Set*1	–
	J1722A	PCIe Measurement Component Set*1	–
	J1508A	BNC-SMA connector cable (30 cm)	–
	J1615A	Coaxial Cable set (Jitter-PPG-Emphasis)	–
	J1627A	GND connection cable	–
	J1815A*2	MP1900A PCIe Measurement Component Set	–
	Z2025A*3	PCIe CBB Controller	–
	Z2029A*4	PCIe Reference Clock Buffer	–

*1: For the USB and PCIe Measurement Component Set configuration, refer to Table 3.1-4 "J1722A PCIe Measurement Component Set Configuration" and Table 3.1-5 "J1721A USB Measurement Component Set Configuration".

*2: A set of cables and components required when PL021 or PL025 or both options are used.

*3: Used for Power Reset of Add-in Card that operates with connected to PCIe CBB 4 in PCIe Link Training.

*4: Used to supply 100 MHz Reference Clock to Add-in Card in PCIe Link Training.

Table A-2 Operation Environment

Item	Specifications
Installation target	MP1800A, MP1900A or a PC
PC specifications	
OS	Windows 7 Professional/Enterprise/Ultimate Windows 10 Professional/Enterprise/IoT English or Japanese version
CPU	1 GHz or higher (For Windows 7) 2 GHz or higher (For Windows 10)
Memory	1 GB or more (For Windows 7, 32-bit) 2 GB or more (For Windows 7, 64-bit) 4 GB or more (For Windows 10, 64-bit)
Hard Disk	Free space 2 GB or more
Remote interface	Ethernet (10BASE-T, 100BASE-TX)
Display	Resolution 800 × 600 or more, Display color 32 bits (For Windows 7) Resolution 1280 × 800 or more, Display color 32 bits (For Windows 10)
Target Equipment	MP1800A, MP1900A, or MT1810A
Required accessory	MP1800A-x02 LAN MP1800A-x07 OS Upgrade to Windows 7 (MP1800A only) MP1800A-x32 32Gbit/s PPG and/or ED Support
Number of Target Equipment	Three or less
Version	To control MP1800A: MX180000A Installer: Version 8.02.00 or later To control MP1900A: MX190000A Installer: Version 1.00.00 or later

Table A-3 Selector Screen Settings

Item	Specifications
Application Selector	PCIe Link Sequence, PCIe Link Training, USB Link Sequence, USB Link Training, Jitter Tolerance Test, PAM4 Control (with G0375/6A), DUT Error Counts Import

Table A-4 Equipment Setup Tab

Item	Specifications
MP1800A	Selects whether to execute search on the selected network device.
No.1:	OFF/ON
No.2:	OFF/ON
No.3:	OFF/ON
MP1800A/MT1810A Connection Setting	Selects a network device to connect. ***Example:*** TCPIP::127.0.0.1::5001::SOCKET,TCPIP::192.168.2.100::5001::SOCKET
Search Start	Click the button to start search and to display the discovered equipment.
Equipment	Display the discovered equipment and select a desired one.
Jitter:	***Example:*** MU181500B(No.1:Unit1:Slot2)
PPG:	***Example:*** MU183020A Data1(No.1:Unit1:Slot3)
ED:	***Example:*** MU183040A Data1(No.1:Unit1:Slot4)
Noise:	***Example:*** MU195050A(No.1:Unit1:Slot8)
Decoder:	***Example:*** G0376A COM1 SN:AI12345-6
Connect/Disconnect	Click the button to connect/disconnect the equipment.
Connection Guide	Displays connection diagram.

Table A-5 Sequence Tab (PCIe)

Item	Specifications
Sequence Start/Stop/Unlink	Sends the sequence set by Editor. Continues sending test patterns after a link sequence is sent.
BER Measurement	Click the button after a sequence is sent to execute the BER measurement.
BER Monitor	OFF/ON
LTSSM State	Detect, Polling, Configuration, Recovery, Loopback
Specification Rev.	1.0/1.1(2.5 GT/s), 2.0(5 GT/s), 3.0/3.1(8 GT/s), 4.0(16 GT/s)
Loopback Through	Configuration /Recovery
Test Pattern	Compliance/PRBS
Compliance	MCP/CP
PRBS	PRBS7, PRBS9, PRBS10, PRBS11, PRBS15, PRBS20, PRBS23, PRBS31
Inset Delay Symbol	Disable/Enable
All parameter	Displays all the sequence setup parameters.
Default	Initialize the sequence setting.
Sequence Editor	Sets a pattern number to send in each state or sets idle time. Can set each parameter for setting the Specification Rev.

Table A-5 Sequence Tab (PCIe) (Cont'd)

Item	Specifications
Rev1.0/1.1 Configuration	
Detect.Quiet	1 to 1000000, 1 step
Detect.Active	1 to 1000000, 1 step
Polling.Active	1 to 1000000, 1 step
Polling.Configuration	1 to 1000000, 1 step
Loopback.Entry	1 to 1000000, 1 step
Rev2.0 Configuration	
Detect.Quiet	1 to 1000000, 1 step
Detect.Active	1 to 1000000, 1 step
Polling.Active	1 to 1000000, 1 step
Polling.Configuration	1 to 1000000, 1 step
Loopback.Entry(2.5G)	1 to 1000000, 1 step
Loopback.Entry (Electrical Idle)	1 to 1000000, 1 step
Loopback.Entry(5G)	1 to 1000000, 1 step
Rev2.0 Recovery	
Detect.Quiet	1 to 1000000, 1 step
Detect.Active	1 to 1000000, 1 step
Polling.Active	1 to 1000000, 1 step
Polling.Configuration	1 to 1000000, 1 step
Configuration.Linkwidth.Start	1 to 1000000, 1 step
Configuration.Linkwidth.Accept	1 to 1000000, 1 step
Configuration.Lane.Wait	1 to 1000000, 1 step
Configuration.Lane.Accept	1 to 1000000, 1 step
Configuration.Complete	1 to 1000000, 1 step
Configuration.Idle	1 to 1000000, 1 step
Recovery.RcvrLock	1 to 1000000, 1 step
Recovery.RcvrCfg(EQTS2)	1 to 1000000, 1 step
Recovery.Speed	1 to 1000000, 1 step
Recovery.RcvrLock	1 to 1000000, 1 step
Recovery.RcvrCfg(TS2)	1 to 1000000, 1 step
Loopback.Entry(5G)	1 to 1000000, 1 step

Table A-5 Sequence Tab (PCIe) (Cont'd)

Item	Specifications
Rev3.0/3.1 Configuration	
Detect.Quiet	1 to 1000000, 1 step
Detect.Active	1 to 1000000, 1 step
Polling.Active	1 to 1000000, 1 step
Polling.Configuration	1 to 1000000, 1 step
Loopback.Entry(2.5G)	1 to 1000000, 1 step
Loopback.Entry (Electrical Idle)	1 to 1000000, 1 step
Loopback.Entry(8G)	1 to 1000000, 1 step
Rev3.0/3.1 Recovery	
Detect.Quiet	1 to 1000000, 1 step
Detect.Active	1 to 1000000, 1 step
Polling.Active	1 to 1000000, 1 step
Polling.Configuration	1 to 1000000, 1 step
Configuration.Linkwidth.Start	1 to 1000000, 1 step
Configuration.Linkwidth.Accept	1 to 1000000, 1 step
Configuration.Lane.Wait	1 to 1000000, 1 step
Configuration.Lane.Accept	1 to 1000000, 1 step
Configuration.Complete	1 to 1000000, 1 step
Configuration.Idle	1 to 1000000, 1 step
Recovery.RcvrLock	1 to 1000000, 1 step
Recovery.RcvrCfg(EQTS2)	1 to 1000000, 1 step
Recovery.Speed(8G)	1 to 1000000, 1 step
Recovery.RcvrLock	1 to 1000000, 1 step
Recovery.Equalization Phase1	1 to 1000000, 1 step
Recovery.RcvrLock	1 to 1000000, 1 step
Recovery.RcvrCfg(TS2)	1 to 1000000, 1 step
Loopback.Entry(8G)	1 to 1000000, 1 step

Table A-5 Sequence Tab (PCIe) (Cont'd)

Item	Specifications
Rev4.0 Recovery	
Detect.Quiet	1 to 1000000, 1 step
Detect.Active	1 to 1000000, 1 step
Polling.Active	1 to 1000000, 1 step
Polling.Configuration	1 to 1000000, 1 step
Configuration.Linkwidth.Start	1 to 1000000, 1 step
Configuration.Linkwidth.Accept	1 to 1000000, 1 step
Configuration.Lane.Wait	1 to 1000000, 1 step
Configuration.Lane.Accept	1 to 1000000, 1 step
Configuration.Complete	1 to 1000000, 1 step
Configuration.Idle	1 to 1000000, 1 step
Recovery.RcvrLock	1 to 1000000, 1 step
Recovery.RcvrCfg(EQTS2)	1 to 1000000, 1 step
Recovery.Speed(8G)	1 to 1000000, 1 step
Recovery.RcvrLock	1 to 1000000, 1 step
Recovery.Equalization Phase1	1 to 1000000, 1 step
Recovery.RcvrLock	1 to 1000000, 1 step
Recovery.RcvrCfg(TS2)	1 to 1000000, 1 step
Recovery.Idle	1 to 1000000, 1 step
Recovery.RcvrLock	1 to 1000000, 1 step
Recovery.RcvrCfg(EQTS2)	1 to 1000000, 1 step
Recovery.Speed(16G)	1 to 1000000, 1 step
Recovery.RcvrLock	1 to 1000000, 1 step
Recovery.Equalization Phase1	1 to 1000000, 1 step
Recovery.RcvrLock	1 to 1000000, 1 step
Recovery.RcvrCfg(TS2)	1 to 1000000, 1 step
Loopback.Entry(16G)	1 to 1000000, 1 step

Table A-5 Sequence Tab (PCIe) (Cont'd)

Item	Specifications
Option	
TS Parameter	
FTS	0 to 255, 1 step
Link Number	0 to 255, 1 step
Lane Number	0 to 255, 1 step
Full Swing	12 to 63, 1 step
Low Frequency	12 to 63, 1 step
SRIS	Disable
Disable Scrambling	OFF/ON
Reset EIEOS Interval	Disable/Enable
SKP	
SKP Insert	Enable/Disable
SKP Length(128b/130b)	8 to 24 Symbol, 4 step
SKP Length(8b/10b)	COM + 1 to 5, 1 step
SKP Interval(128b/130b)	20 to 750, 1 step
SKP Interval(8b/10b)	176 to 3076, 2 step
Send TS	
Polling.Active	TS1/EQTS1
Loopback.Entry	TS1/EQTS1
Rev3.x/Rev4.0 Preset	
Downstream	
Preset(DE, PS [dB])	P7: –6.0, 3.5
Preset Hint	–6 dB
Precursor	0
Cursor	0
Postcursor	0
Upstream	
Usepreset	Preset
Preset(DE, PS [dB])	P7: –6.0, 3.5
Preset Hint	–6 dB
Precursor	0
Cursor	0
Postcursor	0

Table A-6 Sequence Tab (USB)

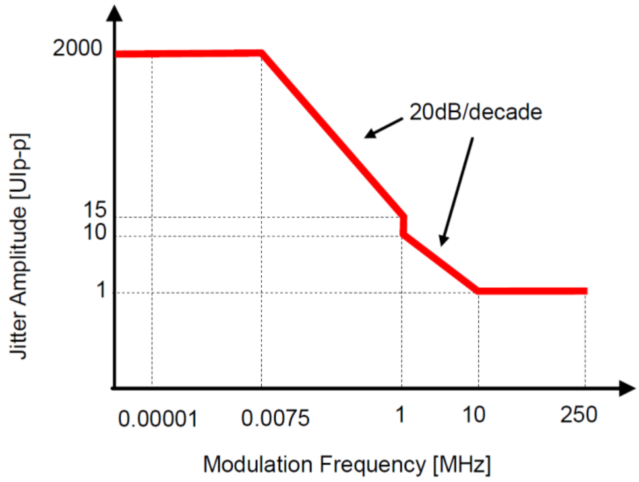
Item	Specifications
LTSSM State	eSS.Inactive, Rx.Detect, Polling, Loopback
Sequence Start/Stop/Unlink	Sends the sequence set by Editor. Starts sending a sequence when a trigger is detected by Aux Input of the MU183020A. Continues sending test patterns after a link sequence is sent.
USB3.1 Specification	Gen1(5.0 GT/s), Gen2(10.0 GT/s)
Test Pattern	Compliance/USER
CPx	Gen1: CP0 D0.0, CP1 D10.2, CP2 D24.3, CP3 K28.5, CP4 LFPS, CP5 K28.7*, CP6 K28.7* Gen2: CP9
All parameter	Displays all sequence setup parameters.
Default	Initialize sequence setting.
Sequence Editor	Sets a pattern number to send in each state or sets idle time.
Gen1	
Rx.Detect.Active(Idle)	1 to 1000000, 1 step
Polling.LFPS	100 to 1000000, 10 step
Polling.RxEQ	1 to 1000000, 1 step
Polling.Active(TS1)	1 to 1000000, 1 step
Polling.Configuration(TS2)	1 to 1000000, 1 step
Polling.Idle	1 to 1000000, 1 step
Gen2	
Rx.Detect.Active(Idle)	1 to 1000000, 1 step
Polling.LFPS(SCD1)	162 to 1000000, 1 step
Polling.LFPSPlus(SCD2)	172 to 1000000, 1 step
Polling.PortMatch (PHY Capability LBPM)	2 to 1000000, 1 step
Polling.PortConfig (PHY Ready LBPM)	2 to 1000000, 1 step
Polling.RxEQ	1 to 1000000, 1 step
Polling.Active(TS1)	1 to 1000000, 1 step
Polling.Configuration(TS2)	1 to 1000000, 1 step
Polling.Idle	1 to 1000000, 1 step

*: Selecting CP5 or CP6 does not change de-emphasis setting that is actually output.

Table A-6 Sequence Tab (USB) (Cont'd)

Item	Specifications
Option	
Loopback	Asserted
Disable Scrambling	OFF/ON
SKP	
SKP Insert	Enable/Disable
Symbol Length(128b/132b)	8 to 40, 2 step
Symbol Length(8b/10b)	2 to 6, 2 step
SKP Interval(128b/132b)	20 to 80, 1 step
SKP Interval(8b/10b)	176 to 708, 2 step
tPeriod	20 ns
Duty	50%
WarmReset	
tBurst	100 ms
LFPS	
tBurst	1.000 µs
SuperSpeed	
tRepeat	10.000 µs
SuperSpeedPlus	
Logic0	7.000 µs
Logic1	12.000 µs
SCD1	33.000 µs
SCD2	43.000 µs
LBPM	
tLFPS-1	1.500 µs
tLFPS-0	0.700 µs
tPWM	2.200 µs

Table A-7 Run Test Tab

Item	Specifications
Run Test/Stop Test	Starts or stops Jitter Tolerance Test.
Detail	Displays settings and results of Jitter Tolerance Table.
Check All	Select the Jitter Tolerance Table checkbox.
Lane*1	Lane0, Lane1
Uncheck	Deselect the Jitter Tolerance Table checkbox.
Jitter Tolerance Table	
JTOL measurement point	Sets SJ modulation frequency to perform measurement, modulation amount (UI) for pass/fail judgement, and range of modulation amount to search.
Jitter frequency setup range	Sets Jitter Freq. [Hz], Mask[UI], Upper Limit [UI], and Lower Limit [UI]. Click the **Add** to add points. Click **Delete** > **All Clear** to delete points. **Detail**: Displays detailed information of points. For setting range, refer to the sinusoidal jitter (SJ or SJ2) modulation frequency setup range shown in Table 1.3-2 "Jitter Modulation Performance" in the *MU181500B Jitter Modulation Source Operation Manual*.
Jitter amplitude setup range	 Note that available jitter frequency and jitter amplitude for jitter measurement depend on the clock frequency set by controller and MU181500B.
Set All Limit	Resets the Upper Limit and Lower Limit values at the ratio set for Mask. Set the ratio to reset for Upper Ratio and Lower Ratio.
Upper Ratio	1.000 to 1000, 0.001 step
Lower Ratio	0.001 to 1.000, 0.001 step
Measurement Sequence	From higher Freq. side, From lower Freq. side
Mask file Save/Open	Saves and opens the mask file for JTOL test.

*1: Displayed when the USB Link Training application is selected.
The setting for Lane is valid when both of the following conditions are met.

- The MX183000A-PL023 USB 3.2 x 2 Link Training has been activated.

- **Gen1×2 (5.0 GT/s ×2)** or **Gen2×2 (10.0 GT/s ×2)** is selected for USB3.2 Specification.

Table A-7 Run Test Tab (Cont'd)

Item	Specifications
JTOL Setting	
Detection	
Unit	Error Rate, Error Count, Estimate, Symbol Error Rate*2, Uncorrectable CW (Rate)*3, Uncorrectable CW (Count)*3
Error Threshold or Uncorrectable CW (Rate)	1E–3 to 10E–12, E–1 step
Error Count or Uncorrectable CW (Count)	0 to 10000000, 1 step
BER for JTOL Estimation*4	1.0E–20 to 9.9E–9, 0.1 step, E–1 step
Search Type	
Auto Search	OFF, FINE, COARSE, PAM4 FINE, PAM4 COARSE
Meas. Type	NRZ/PAM4
PAM4 Pattern	Select the PAM4 signal pattern to be used by ED.
Search	
Direction Search	Binary, Downwards Linear, Downwards Log, Upwards Linear, Upwards Log, Binary + Linear
Step	When Downwards/Upwards Linear is selected:
Jitter Freq. ≤ 100 kHz	0.001 to 2000.000 0.001 step
100 k < Jitter Freq. ≤ 1 MHz	0.001 to 200.000 0.001 step
1M < Jitter Freq. ≤ 10 MHz	0.001 to 15.000 0.001 step
10 MHz < Jitter Freq.	0.001 to 1.000 0.001 step
Ratio	When Downwards/Upwards Log is selected:
Jitter Freq. ≤ 100 kHz	0.01 to 1.00 0.01 step
100 k < Jitter Freq. ≤ 1 MHz	0.01 to 1.00 0.01 step
1 M < Jitter Freq. ≤ 10 MHz	0.01 to 1.00 0.01 step
10 MHz < Jitter Freq.	0.01 to 1.00 0.01 step
Timer[sec.]	
Waiting	1 to 99 seconds, in steps of one second
Setting	1 to 99 seconds, in steps of one second
Gating	1 to 86400 seconds, in steps of one second
SJ Amplitude Setting	SJ amplitude setting ON/OFF
Change SJ Amplitude in Steps	When SJ Amplitude is changed to 0 UI. When SJ Amplitude is set to the first point of measurement modulation frequency.
Number of steps	1 to 20
Wait time of a step	0.1 to 1.0 seconds, in steps of 0.1 seconds

*2: Only for MU196040A/B.

*3: Only for MU196040B-x42.

*4: Not displayed when Uncorrectable CW (Rate) or Uncorrectable CW (Count) is selected for Unit.

Table A-8 Graph Tab

Item	Specifications
Display	OFF, ON
BER for JTOL Estimation*	1.0E–20 to 9.9E–9, 0.1 step, E–1 step

*: Not displayed when in the JTOL Setting screen, Uncorrectable CW (Rate) or Uncorrectable CW (Count) is selected for Unit.

Table A-9 Report Tab

Item	Specifications
Make HTML	Displays the Jitter Tolerance results in HTML.
Make CSV	Displays the Jitter Tolerance results in CSV.
Save	Saves the Jitter Tolerance results in the format displayed on the screen.

Table A-10 Link Training Tab (PCIe)

Item	Specifications
Link Training Tab	Can execute PCIe Link Training (PCIe 1.0 to PCIe 5.0).
Link Start/Stop/Unlink	Starts Link Training. Continues sending test patterns after Link Training.
BER Measurement	Same as sequence.
BER Monitor	Same as sequence.
LTSSM Log	Displays transition logs of LTSSM State during Link Training.
LTSSM Log Display Items	Time, ΔTime, State, Detect Preset, Error Count, Use Preset, Preset, Precursor, Cursor, Postcursor, FS, LF, Precoding Request, Precoding Data
Export CSV	Saves logs in csv format.
Specification	1.0/1.1(2.5 GT/s), 2.0(5 GT/s), 3.0/3.1(8 GT/s), 4.0(16 GT/s), 5.0(32 GT/s)
Loopback Method	PCIe 1.0 to PCIe 4.0: Configuration, Recovery PCIe 5.0: Config EQ Bypass to 32G, Config No EQ, Recovery EQ Bypass to 32G, Recovery Full EQ
Test Pattern	Same as sequence.
Timeout	Sets Timeout in each LTSSM State.
Option	Performs particular settings of Link Training.
LEQ Test	Displays the Setup screen, where you can set Tx/Rx LEQ Test conditions.
Matrix Scan	Measures BER values for cursor coefficients and maps the results.
Result Display of PCIe Link Training	
Common Parameter	LTSSM State, Linkup Speed
SKP128b/130b	SKP Count, TS1/TS2 Symbol14-15 DC Balance, Sync Header Err, Parity Err, Block Lock, EIEOS Counter
SKP 8b/10b	SKP Count, Symbol Err, Current RD Err, Symbol Lock
Link Equalization	Can display results per phase.
Received	Use Preset,PPG Final Preset, PPG Final Cursor, , Full Swing, Low Frequency, Link Number, Lane Number, Request Equalization
PCIe 4.0/5.0 Control SKP	Count, Margin Type, Usage Model, Payload, Receiver Number, CRC, Parity
Link Control	Enhanced Link Behavior Control, Precoding Request, Precoding Data
Modified TS	Received, Data parity Error, Usage, Information1, Information2, Vender ID
LTSSM Trigger	Outputs a trigger from the AUX Output of the SI PPG when the MP1900A enters the specified LTSSM state.

Table A-11 PAM4 Control Tab

Item	Specifications
PAM4 Control Tab	Contains the controls for G0375A and G0376A that can configure the settings for Rx / Tx PAM4 signals.

Table A-12 Link Training Tab (USB)

Item	Specifications
Link Training Tab	When only PL022 is installed: USB Link Training (USB3.1 Gen1/2) can be performed. When PL022 and 023 are installed: USB Link Training (USB3.2 Gen1/2 x1/x2) can be performed.
Link Start/Stop/Unlink	Starts Link Training when LFPS is detected by Data Input of MU195040A. Continues sending test patterns after Link Training.
USB3.2 Specification	Gen1x1 (5.0 GT/s x1), Gen1x2 (5.0 GT/s x2), Gen2x1 (10.0 GT/s x1), Gen2x2 (10.0 GT/s x2)
Not Wait for The LFPS Signal	Starts Link Training by clicking the **Link Start** as a trigger instead of waiting for LFPS signal.
BER Measurement	After Link Training: Performs BER measurement upon clicking this button. When **GenXx2** is selected: Performs BER measurement of 2 lanes at the same time.
LTSSM Log	Displays transition logs of LTSSM.
Display Items of LTSSM Log	Time, ΔTime, State (Lane0), State (Lane1), Speed[GT/s], HEX Dump (Lane0), HEX Dump (Lane1)
Export CSV	Saves logs in csv format.
Send Ping LFPS	Outputs Ping LFPS signal. Switches DUT CP when performing Tx test of USB Compliance Test.
Test Pattern	Same as sequence.
LTSSM Setting	Displays the LTSSM Settings screen where transition conditions and timeout settings for LTSSM can be configured.
Option	Performs particular settings of Link Training.
Result Display of USB Link Training	
Common Parameter	LTSSM State, Linkup Speed
8b10b Counters	SKP Count*, Symbol Err, Current RD Err, Symbol Lock
128b132b Counters	SKP Count*, TS1/TS2 Symbol14-15 DC Balance*, Sync Header Err, TS1 OS Parity Err, Block Lock, SYNCOS Counter*

*: Displayed respectively for Transmitted and Received.

Table A-13 DUT Control Tab (DUT Error Counts Import)

Item	Specifications
DUT Control Tab	Allows you to select and run external programs for controlling DUT.
Initializaion Program	Runs a selected DUT initialization program with **Run**.
Measurement Program	Runs a selected DUT measurement program with **Run**.
Finalization Program	Runs a selected DUT finalization program with **Run**.
Log Viewer button	Displays the log window.

Table A-14 Measurement Tab (DUT Error Counts Import)

Item	Specifications
Measurement Tab	Allows starting and stopping BER measurement, and displaying the measurement results.
Result	Displays the measurement results, which are: error rates, error counts, and whether alarms are given or not.
Cycle	Changes measurement cycle (Single/Repeat).
Run/Stop	Starts or stops the measurement.
Abort	Aborts the measurement.
Debug Mode	Executes the measure programs, ignoring syntax errors.

Appendix B Default Settings

Table B-1 Selector

Item	Default
Application Selector	PCIe Link Sequence

Table B-2 Equipment Setup Tab

Item	Default
MP1800A/MP1900A	
Check box	No.1: ON No.2: OFF No.3: OFF
Equipment	
Jitter	None
PPG	None
ED	None
Noise	None
Decoder	None

Table B-3 Sequence Tab (PCIe)

Item	Default
BER Monitor	OFF
LTSSM State	–
Specification Rev.	3.0/3.1(8.0 GT/s)
Loopback through	Configuration
Test pattern	Compliance
Compliance	MCP
PRBS	PRBS23
Insert Delay symbol	
Sequence Editor	Disable
Rev1.0/1.1 Configuration	
Detect.Quiet	1000 μs
Detect.Active	12000 μs
Polling.Active	1100
Polling.Configuration	49152
Loopback.Entry	20
Rev2.0 Configuration	
Detect.Quiet	1000 μs
Detect.Active	12000 μs
Polling.Active	1100
Polling.Configuration	49152
Loopback.Entry(2.5G)	20
Loopback.Entry(Electrical Idle)	1000 μs
Loopback.Entry(5G)	35000

Table B-3 Sequence Tab (PCIe) (Cont'd)

Item	Default
Rev2.0 Recovery	
Detect.Quiet	1000 µs
Detect.Active	12000 µs
Polling.Active	4000
Polling.Configuration	49152
Configuration.Linkwidth.Start	40
Configuration.Linkwidth.Accept	2
Configuration.Lane.Wait	40
Configuration.Lane.Accept	2
Configuration.Complete	48
Configuration.Idle	5
Recovery.RcvrLock	60
Recovery.RcvrCfg(EQTS2)	60
Recovery.Speed	363
Recovery.RcvrLock	40960
Recovery.RcvrCfg(TS2)	32
Loopback.Entry(5G)	35000
Rev3.0/3.1 Configuration	
Detect.Quiet	1000 µs
Detect.Active	12000 µs
Polling.Active	1100
Polling.Configuration	49152
Loopback.Entry(2.5G)	20
Loopback.Entry(Electrical Idle)	1000
Loopback.Entry(8G)	200000

Table B-3 Sequence Tab (PCIe) (Cont'd)

Item	Default
Rev3.0/3.1 Recovery	
Detect.Quiet	1000 μs
Detect.Active	12000 μs
Polling.Active	4000
Polling.Configuration	49152
Configuration.Linkwidth.Start	40
Configuration.Linkwidth.Accept	2
Configuration.Lane.Wait	40
Configuration.Lane.Accept	2
Configuration.Complete	48
Configuration.Idle	5
Recovery.RcvrLock	60
Recovery.RcvrCfg(EQTS2)	60
Recovery.Speed(8G)	363
Recovery.RcvrLock	32
Recovery.Equalization Phase1	131072
Recovery.RcvrLock	80
Recovery.RcvrCfg(TS2)	32
Loopback.Entry(8G)	32000
Rev4.0 Recovery	
Detect.Quiet	1000 μs
Detect.Active	12000 μs
Polling.Active	4000
Polling.Configuration	49152
Configuration.Linkwidth.Start	40
Configuration.Linkwidth.Accept	2
Configuration.Lane.Wait	40
Configuration.Lane.Accept	2
Configuration.Complete	48
Configuration.Idle	5
Recovery.RcvrLock	60
Recovery.RcvrCfg(EQTS2)	60
Recovery.Speed(8G)	363
Recovery.RcvrLock	32
Recovery.Equalization Phase1	131072
Recovery.RcvrLock	80
Recovery.RcvrCfg(TS2)	32
Recovery.Idle	1
Recovery.RcvrLock	40
Recovery.RcvrCfg(EQTS2)	40
Recovery.Speed(16G)	5
Recovery.RcvrLock	2
Recovery.Equalization Phase1	131072
Recovery.RcvrLock	40
Recovery.RcvrCfg(TS2)	20
Loopback.Entry(16G)	20

Table B-3 Sequence Tab (PCIe) (Cont'd)

Item	Default
TS Option	
TS Parameter	
FTS	127
Link Number	1
Lane Number	0
Full Swing	30
Low Frequency	12
SRIS	Disable
Disable Scrambling	De-asseted
Reset EIEOS Interval	Disable
SKP	
SKP Insert	Enable
SKP Length(128b/130b)	16 Symbols
SKP Length(8b/10b)	COM + 3
SKP Interval(128b/130b)	375
SKP Interval(8b/10b)	1538
Send TS	
Polling.Active	TS1
Loopback.Entry	TS1
Rev3.x/Rev4.0 Preset	
Downstream	
Preset(DE, PS [dB])	P7 : –6.0, 3.5
Preset Hint	–6 dB
Precursor	0
Cursor	0
Postcursor	0
Upstream	
Usepreset	Preset
Preset(DE, PS [dB])	P7 : –6.0, 3.5
Preset Hint	–6 dB
Precursor	0
Cursor	0
Postcursor	0

Table B-4 Sequence Tab (USB)

Item	Default
LTSSM State	
USB3.1 Specification	Gen1(5.0 GT/s)
Test pattern	Compliance
CPx(Gen1)	CP0 D0.0
CPx(Gen2)	CP9
Sequence Editor	
Gen1	
Rx.Detect.Active(Idle)	1 μs
Polling.LFPS	560 μs
Polling.RxEQ	65536 μs
Polling.Active(TS1)	18000
Polling.Configuration(TS2)	18000
Polling.Idle	1 μs
Gen2	
Rx.Detect.Active(Idle)	1 μs
Polling.LFPS(SCD1)	162 μs
Polling.LFPSPlus(SCD2)	172 μs
Polling.PortMatch (PHY Capability LBPM)	132 μs
Polling.PortConfig (PHY Ready LBPM)	343 μs
Polling.RxEQ	524288
Polling.Active(TS1)	18000
Polling.Configuration(TS2)	1100
Polling.Idle	1 μs

Table B-4 Sequence Tab (USB) (Cont'd)

Item	Default
Option	
Loopback	Asserted
Disable Scrambling	OFF
SKP	
SKP Insert	Enable
Symbol Length(128b/132b)	16 Symbols
Symbol Length(8b/10b)	4 Symbols
SKP Interval(128b/132b)	40
SKP Interval(8b/10b)	354
tPeriod	20 ns
Duty	50%
WarmReset	
tBurst	100 ms
LFPS	
tBurst	1.000 μs
SuperSpeed	
tRepeat	10.000 μs
SuperSpeedPlus	
Logic0	7.000 μs
Logic1	12.000 μs
SCD1	33.000 μs
SCD2	43.000 μs
LBPM	
tLFPS-1	1.500 μs
tLFPS-0	0.700 μs
tPWM	2.200 μs

Table B-5 Link Training Tab (PCIe)

Item	Default
BER Monitor	OFF
Specification	4.0 (16.0 GT/s)
DUT	Endpoint
Loopback Method	Configuration
LEQ Test	OFF
Test pattern	Compliance
Compliance	MCP
PRBS	PRBS23
Timeout	
Detect.Quiet	12.0
Polling.Config.	48.0
Polling.Active	24.0
Configuration.Linkwidth.Start	24.0
Configuration.Lanenum.Wait	2.0
Configuration.Linkwidth.Accept	2.0
Configuration.Complete	2.0
Configuration.Idle	2.0
Recovery.RcvrLock	24.0
Recovery.RcvrCfg	48.0
Recovery.Speed	48.0
Recovery.Idle	2.0
Recovery.Eq.Phase0 (Root)	12.0
Recovery.Eq.Phase1 (Root)	12.0
Recovery.Eq.Phase2 (Root)	24.0
Recovery.Eq.Phase3 (Root)	32.0
Recovery.Eq.Phase1 (Endpoint)	24.0
Recovery.Eq.Phase2 (Endpoint)	32.0
Recovery.Eq.Phase3 (Endpoint)	24.0
Loopback.Entry (Active)	2.0
Loopback.Entry (Exit)	100.0
Hotreset	2.0
Disable	2.0

Table B-5 Training Tab (PCIe) (Cont'd)

Item	Default
TS Parameter	
FTS	127
Link Number	1
Lane Number	0
Full Swing	24
Low Frequency	8
Clock Architecture	Common
Disable Scrambling	De-asserted
EIEOS	
Reset Interval	Disable
16 G Format	Rev 0.7 or higher
Send TS	
Polling.Active	TS1
Loopback.Entry	TS1
Disable Scrambling	De-asserted
Timeout to	Loopback.Exit
32G Precoding Request	OFF
Transmit MCP in Loopback	OFF
PPG Electrical Idle Time	<1ms
Speed Change	Middle
Insert Delay symbol	Disable
Extended Sync Patterns	Normal
CBB Controller	
Auto Reset	Auto Power Cycle
Power Reset	2.0 s
Power Cycle	2.0 s
Comp Trigger	2.0 s
Waiting Time	3.0 s
SKP	
SKP Insert	Enable
Symbol Length	16 Symbols
Interval	375
x2	OFF
Filter	Enable
Clock Architecture	Common
SSC	OFF

Table B-5 Training Tab (PCIe) (Cont'd)

Item	Default
Link EQ	
Downstream	
Preset	P7
Preset Hint (PCIe 3)	–6 dB
Upstream	
Preset	P7
Preset Hint (PCIe 3)	–6 dB
De-emphasis (PCIe 2)	–6 dB
Link EQ (Recovery Phase2, 3)	Try
Algorithm	Increment
Repeat Phase2 (Root)	2
Repeat Phase3 (Endpoint)	2
Use Preset	Preset
PPG/ED	
PPG	
Tx Equalization for 2.5 GT/s	P4
Loopback Preset	Auto
Tx Precoding	OFF
ED	
CTLE Gain	PCIe 4, 0.0 dB
Rx Precoding	OFF
Trigger	
PPG Aux Output Trigger	LTSSM
Link Speed	16.0 G
State	Loopback.Active.Lead

Table B-6 Run Test Tab

Item	Default
Jitter Freq [Hz]	10
Mask[UI]	1.000
Upper Limit[UI]	2.000
Lower Limit[UI]	1.000
Upper Ratio	2.000
Lower Ratio	1.000
Title	PCIe_CC
Lane*	Lane0
Measurement Sequence	From higher Freq. side
JTOL Settings	
Detection	
Unit	Error Count
Error Threshold	1E–12
Uncorrectable CW (Rate)	1E–12
Error Count	2
Uncorrectable CW (Count)	2
BER for JTOL Estimation	1.0E–15
Auto Search	OFF
Direction Search	Upwards Log
Step	
Jitter Freq. ≤ 100 kHz	1.000
100k < Jitter Freq.≤ 1 MHz	1.000
1M < Jitter Freq. ≤ 10 MHz	0.100
10 MHz < Jitter Freq.	0.100
Ratio	
Jitter Freq. ≤ 100 kHz	0.20
100k< Jitter Freq. ≤ 1 MHz	0.20
1M < Jitter Freq. ≤ 10 MHz	0.20
10 MHz < Jitter Freq.	0.20
Timer[sec.]	
Waiting	2
Setting	2
Gating	1

*: Displayed when the USB Link Training application is selected.

Table B-7 Graph Tab

Item	Default
Display	ON
BER for JTOL Estimation	1.0E–15

Table B-8 PAM4 Control Tab

Item	Default
Tx Control	
PAM4/NRZ	PAM4
Output	OFF
Emphasis Tracking	OFF
Data Delay	0 mUI
Total Amplitude	450 mV*
Variable Middle Eye	33%
Enlarge Upper/Lower	45%
Rx Control	
CTLE Gain	0.0 dB
CTLE Tracking	OFF
Vref	
Upper	0.150 V
Middle	0.000 V
Lower	–0.150 V
Input Mode	Single
DFF	ON
CTLE Search	OFF
Upper/Lower Vref Tracking	OFF

*: When Total Amplitude cannot be set to 450 mV, it is set to 910 mV. If neither of them is available, it is set to 1250 mV.

Table B-9 Link Training Tab (USB)

Item	Default
USB3.2 Specification	Gen1x1 (5.0 GT/s x1)
Test pattern	Compliance
CPx(Gen1xX)	CP0 D0.0
CPx(Gen2xX)	CP9
BER Setting	
EC Threshold	1
Gating Time [s]	6
Cycle	Single
CTLE [dB]	OFF
Delay [mUI]	0*
SKP	
SKP Insert	Enable
Symbol Length (128b/132b)	24 Symbols
Symbol Length (8b/10b)	2 Symbols
SKP Interval (128b/132b)	354
SKP Interval (8b/10b)	40
x2 (128b/132b)	ON
x2 (8b/10b)	OFF
Filter	Enable
Emphasis	
Enable Preset	P0
Trigger	
PPG Aux Output Trigger	OFF
Link Speed	5.0G
State	DETECT_ACTIVE

*: If a calibration is performed on the **Equipment Setup** tab, calibrated values are displayed for Lane0.

Table B-9 Link Training Tab (USB) (Cont'd)

Item	Default
LTSSM Settings (When Gen1x1 is selected)	
Transition Delay	Disable 1 ms
Received LFPS	2
Sent bursts LFPS1	16
Sent bursts LFPS2	4
Sent TSEQ	65536
Received TS1/TS2 OS	8
Sent TS1 OS	0
Received TS2 OS	8
Sent TS2 OS	16
LTSSM Settings (When Gen1x2 is selected)	
Transition Delay	Disable 1 ms
Received SCD1/SCD2	1
Sent SCD1	2
Received SCD2	1
Sent SCD2	2
Received LBPM	2
Sent PHY Cap. LBPM	4
Received PHY Ready LBPM	2
Sent PHY Ready LBPM	4
Sent TSEQ	65536
Received TS1/TS2 OS	8
Sent TS1 OS	0
Received TS2 OS	8
Sent TS2 OS	16
LTSSM Settings (When Gen2xX is selected)	
Transition Delay	Disable 1 ms
Received SCD1/SCD2	1
Sent SCD1	2
Received SCD2	1
Sent SCD2	2
Received LBPM	2
Sent PHY Cap. LBPM	4
Received PHY Ready LBPM	2
Sent PHY Ready LBPM	4
Sent TSEQ	524288
Received TS1/TS2 OS	8
Sent TS1 OS	0
Received TS2 OS	8
Sent TS2 OS	16

Table B-9 Link Training Tab (USB) (Cont'd)

Item	Default
Switch to LFPS Rx Test	OFF
LFPS Duty	50%
LFPS Vdiff-pp	Default

Table B-10 DUT Control Tab

Item	Default
Log Viewer	OFF

Table B-11 Measurement Tab

Item	Default
Cycle	Single
Debug Mode check box	OFF
Log Viewer	OFF

Appendix C User Program Specifications

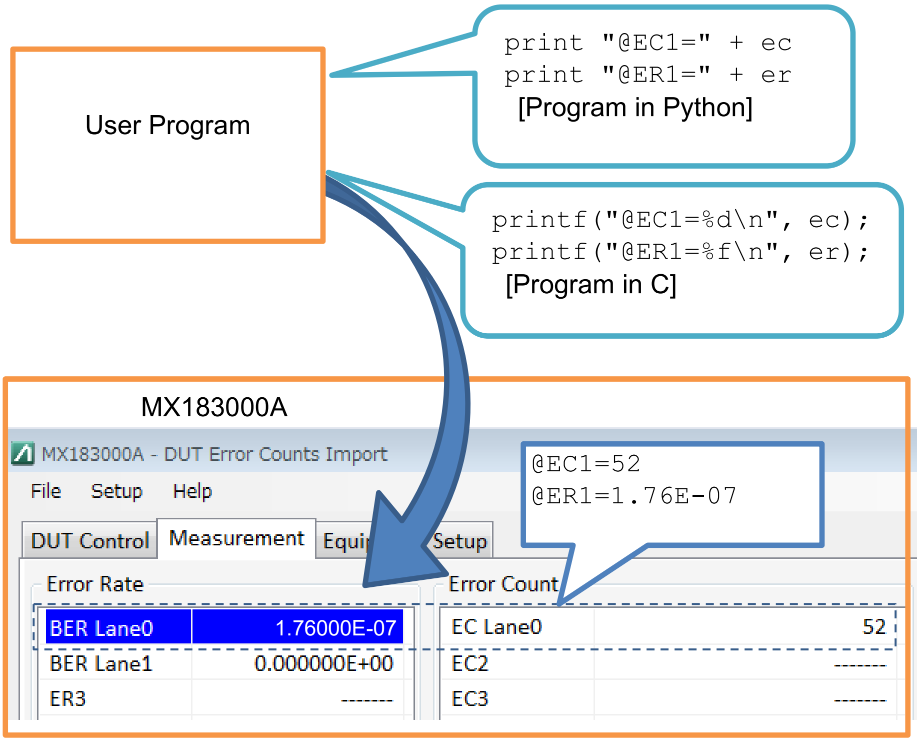
Appendix C explains the specifications of the programs that a user creates (hereinafter, user programs) for controlling DUT which is loaded into MX183000A by MX183000A-PL031 or for obtaining data from DUT.

C.1 Data Transfer Between MX183000A and user programs

For data transfer between MX183000A and user programs, standard input/output is used.

User programs write measurement results in specific format (reserved word) to standard output, and MX183000A reads the results output from the user programs and treats contents written in specific format as measurement results. Items treated as measurement results are specified by users. The results written in other format (optional reserved word) can also be used.

There are no restrictions on development languages and environments, however, MX183000A must be installed on MP1900A or on the control PC.



```
print "@EC1=" + ec
print "@ER1=" + er
```

```
printf("@EC1=%d\n", ec);
printf("@ER1=%f\n", er);
```

```
@EC1=52
@ER1=1.76E-07
```

Error Rate		Error Count	
BER Lane0	1.76000E-07	EC Lane0	52
BER Lane1	0.000000E+00	EC2	-------
ER3	-------	EC3	-------

Figure C.1-1 Data Display on MX183000A using User Program

C.2 Initialization Program

On the **DUT Control** tab, clicking **Run** in the Initialization Program area runs the Initialization program.
The Initialization program performs initialization processing, such as starting DUT and loading firmware. Configure the program so that the Initialization program will return a return code of 0 and end when the initialization processing has completed successfully.
Run the Initialization program so that BER can be acquired by running only the Measurement program.

If the Initialization program returns a return code other than 0, the following dialog box will appear. “X” is the exit code.

ERROR! Initialize program ended with code X.

The life cycle of the Initialization program is shown below.

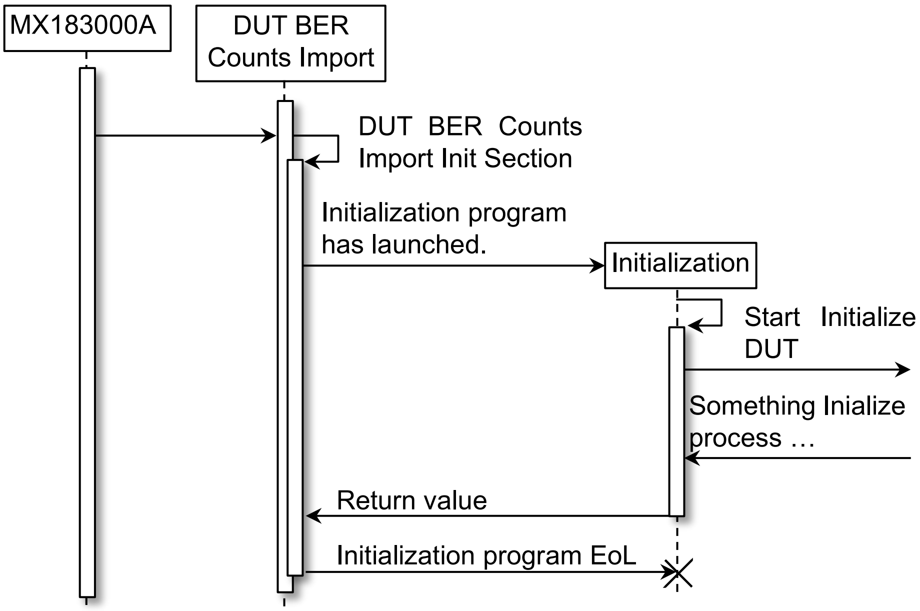

MX183000A
DUT BER Counts Import
DUT BER Counts Import Init Section
Initialization program has launched.
Initialization
Start Initialize DUT
Something Inialize process …
Return value
Initialization program EoL

Figure C.2-1 Initialization Program Life Cycle

C.3 Measurement Program

You can run the Measurement program in the following ways:

- Clicking **Run** for Measurement Program on the **DUT Control** tab
- Clicking **Run** on the **Measurement** tab
- Clicking **Run Test** on the **Run Test** tab

Configure the Measurement program so that measurement results acquired from DUT are output to standard output according to the syntax described in C.5 “Syntax for Standard Input/Output”.
Also, configure the Measurement program so that it will return a return code of 0 and end when measurement has completed successfully.

If the Measurement program does not end normally, the following dialog box will appear. “X” is the exit code

```
ERROR! Measure program ended with code X.
```

If the Measurement program returns a return code other than 0, the following behaviors will be made.

Table C.3-1 Behaviors When Measure Program Does Not End Normally

Operations	Behaviors
Using the Run button for Measurement when Debug Mode is selected	An error message appears in logs.
Using the Run button for Measurement	After an error message appears in logs, the error measurement is interrupted.
JTOL Measurement	After an error message appears in logs, the JTOL measurement is interrupted.

For details on the syntax that the Measurement program outputs to standard output, refer to C.5.2 “Syntax in standard input/output”.

C.4 Finalization Program

On the **DUT Control** tab, clicking **Run** in the Finalization area runs the Finalization program.

The Finalization program performs post-processing to disconnect communication with DUT.

If post-processing is not required, you do not need to prepare the Finalization program.

If post-processing has completed successfully, the Finalization program will return a return code of 0 and end.

If the Finalization program returns a return code other than 0, the following dialog box will appear. “X” is the exit code.

```
ERROR! Finalize program ended with code X.
```

C.5 Syntax for Standard Input/Output

To allow MX183000A to communication with DUT, you need to create programs that satisfy the requirements described in the following pages.

C.5.1 Character encoding

ASCII code is used for character encoding. LF (Line Feed) or CR (Carriage Return) + LF is used for line breaks.

C.5.2 Syntax in standard input/output

Syntax used for user programs is the following.

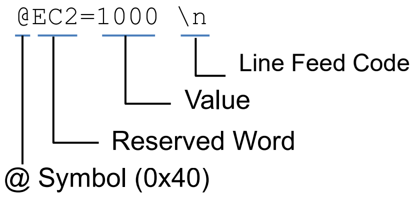


Figure C.5.2-1 Syntax

A program line begins with @ followed by a reserved word, an equal sign, a value, and then ends with a line feed code (0x0a).
To use multiple reserved words, separate the words by commas.
Example:

```
@EC1 = 1000, @NAME = "Total EC", @COLOR = @YELLOW \n
```

The maximum line length is 10000 characters. The line feed code is not included.

For reserved words, refer to C.5.3 “Reserved words and C.5.4 “Optional reserved words”. Reserved words are not case-sensitive.
Put an equal sign “=” (0x3d) between a reserved word and a value.
The same reserved word cannot be specified more than once.
Values to be used should be within the range that are described in the sections “Reserved words” and “Optional reserved words”. The following characters are available for values. If starting without @, the reserved word is ignored and is not output in logs.

Also, reserved words can be modified using optional reserved words. You can put a space (0x20) in between line head, reserved word, equal sign, value, and line end. However, a line length must not exceed the maximum.

If there is a syntax error, the following dialog box will appear and the value specified for the reserved word will not be set. For detail of syntax error logs, refer to C.5.6 “Examples of Syntax Errors”.

```
SYNTAX ERROR! @RESERVERD_WORD = XXXX.
```

XXXX:	indicates the value written in the program.
RESERVERD_WORD:	indicates the reserved word written in the program.

Example:

```
    SYNTAX ERROR! @EC = ABC
```

Table C.5.2-1 Behaviors When Syntax Error Occurs

Operation	Behavior
Using the Run button for Measurement when Debug Mode is selected	The syntax error is output in logs and the operation continues.
Using the Run button for Measurement	After the error dialog box appears, the measurement is interrupted.
JTOL Measurement	After the error dialog box appears, the JTOL measurement is interrupted.

C.5.3 Reserved words

This section describes reserved words that MX183000A can receive in standard input.
Specify the DUT channel number as the reserved word number.
Inputs that do not satisfy the rules described in this section will be output as syntax errors in the log and values will not be displayed on the **Measurement** tab.

ER1-8

Explanation

These reserved words display error rates on the **Measurement** tab.

Value

0, 0.0001E–18 to 1.0000E00

Example

To display an error rate for Channel 2:

```
@ER2 = 1.0E-12
```

EC1-8

Explanation

These reserved words display the error counts on the **Measurement** tab.

Value

0 to 18,446,744,073,709,551,615

Example

To display the error counts for Channel 4:

```
@EC4 = 64000
```

AL1-4

Explanation

These reserved words display whether alarms are given or not on the **Measurement** tab.

Value

0, 1

0	Alarm not given
1	Alarm given

Example

To display an alarm for Channel 4:

```
@AL4 = 0
```

LOG

Explanation

Displays a character string on the log screen. If the string contains more than 10000 characters, up to 10000 characters are displayed, but the characters that come after are discarded.

Value

All characters except control characters are usable.

Example

```
@LOG = BER Measurement finished!  \n
```

C.5.4 Optional reserved words

The following optional reserved words can be used with the reserved words defined in C.5.3 “Reserved words”.
Optional reserved words cannot be used independently. Moreover, optional reserved words can be specified in any order, however, the same one cannot be specified more than once.

NAME

Explanation

Up to 12 characters including spaces can be specified for a name.

Value

Alphanumeric characters + spaces
It must be enclosed in double quotation marks (“”).

Example

To specify the name of error counts for Channel 1:

```
@EC1 = 0, @NAME = "Lane1" \n
```

COLOR

Explanation

Specify the background color to be displayed.

Value

Table C.5.4-1 Reserved Values for Colors

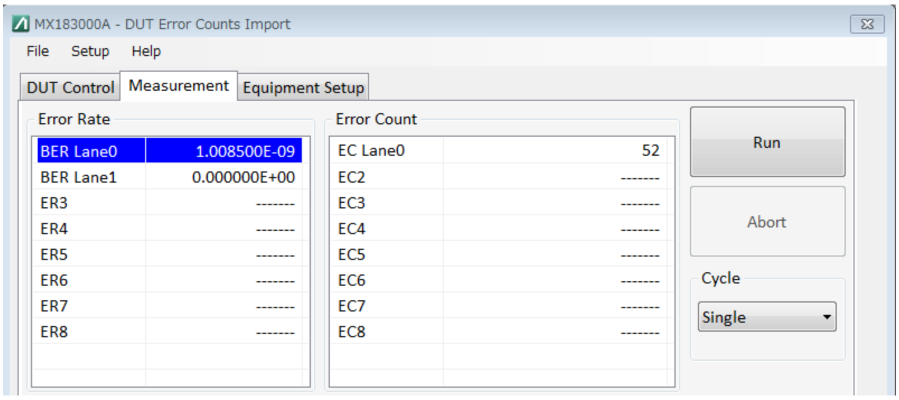
Reserved Values	Color Names	Color Codes	Actual Color Tones
@RED	Red	#FF0000	0
@BLUE	Blue	#0000FF	0
@GREEN	Green	#00FF00	0
@YELLOW	Yellow	#FFFF00	0
@MAGENTA	Magenta	#FF00FF	0
@CYAN	Cyan	#00FFFF	0

If any value that is not in the table above is specified, it will be output to the log as a syntax error and the background color will not be set.

Example

To specify the color of error rate for Channel 1:

```
@ER1 = 1.0085E-9, @COLOR = @BLUE \n
```



Error Rate

BER Lane0	1.008500E-09
BER Lane1	0.000000E+00
ER3	-------
ER4	-------
ER5	-------
ER6	-------
ER7	-------
ER8	-------

Error Count

EC Lane0	52
EC2	-------
EC3	-------
EC4	-------
EC5	-------
EC6	-------
EC7	-------
EC8	-------

Cycle: Single

C.5.5 Invalid values

@NA

Explanation

Even if it is set to the value of reserved word and optional reserved word, it will not result in a syntax error. If the value of reserved word cannot be acquired, send an invalid value.

Example

To specify the invalid value for the background of Channel 4 and error counts:

```
@EC4 = @NA, @COLOR = @NA \n
```

C.5.6 Examples of Syntax Errors

The table below lists the program examples that are not processed and the error messages that appear in logs.

Table C.5.6-1 Examples of Syntax Errors

Example	Reason
EC1 = 0\n	There is no @ (at mark) at beginning of line. The input characters without @ are ignored and are not output in logs.
@ER1 = \n	Any reserved word value is not specified. If no value, specify @NA as a value. ***Example:*** 2019/01/11 14:19:49 SYNTAX ERROR! @ER value does not matched with allowed value.
@EC0 = 0\n	A reserved word that does not exist is used. ***Example:*** 2019/01/11 14:20:45 SYNTAX ERROR! Contains keys are not reserved words
@ER1 = 2\n	Value type does not match. ***Example:*** 2019/01/11 14:22:25 SYNTAX ERROR! @ER value does not matched with allowed value.
@ER1 = 1.0000E+01 \n	The value specified is not within the allowed range. ***Example:*** 2019/01/11 14:23:18 RANGE ERROR! @ER value is over the range.
@EC1 = 0, @NAME = “A”, @NAME = “B” \n	The same reserved word is used more than once. ***Example:*** 2019/01/11 14:24:11 SYNTAX ERROR! Reserved words are duplicated.
@COLOR = @RED, @NAME = “A” \n	An optional reserved word is used independently. ***Example:*** 2019/01/11 14:25:43 SYNTAX ERROR! Reserved word does not contain ER1-8, EC1-8, or AL1-4.
@EC1 = 0, @NAME = “A+B” \n	A symbol is used for the value of @NAME. ***Example:*** 2019/01/11 14:28:50 SYNTAX ERROR! @NAME value does not matched with allowed value.
@EC1 = 0, @COLOR = #00FF00 \n	A value that is not reserved word for color is used. ***Example:*** 2019/01/11 14:29:41 SYNTAX ERROR! @COLOR value does not matched with allowed value.

Table C.5.6-2 Examples of Messages Output to Log

Example	Reason
The external program started.	[External program type] program is started successfully. ***Example:*** 2018/11/12 14:41:37 Initialize program is started successfully.
The external program ended normally.	[External program type] program ended with code 0. ***Example:*** 2018/11/12 14:43:27 Measure program ended with code 0.
The external program was aborted.	ERROR![External program type] program is aborted.
The file was not discovered.	ERROR! Can't find the file at [External program path] ***Example:*** 2018/11/12 14:44:30 ERROR! Can't find the file at C:\test.exe
The argument exceeds 2000 characters.	ERROR! Argument is too long.
Failed to create new process.	SYSTEM ERROR! Can't create new process.
Failed to start the external program.	SYSTEM ERROR! Can't start program.
Input more than 10000 characters in standard input.	SYNTAX ERROR! Inputs exceeding 10000 characters are not accepted.

C.6 Sample Program

This section explains the sample program of MX183000A-PL031 and its example of use.

It is explained how to use the sample program in an environment that Python 3.6 is installed in this section. However, upon your development language for user programs, you need to install software required for the language.

C.6.1 Measurement system of sample program

This sample program is designed for the measuring system that uses the MP1900A and MU196020A as signal generators and Anritsu’s MT1100A Network Master Flex or MT1000A Network Master Pro as a device to obtain error counts.

For details on MT1100A and MT1000A, visit our website:
https://www.anritsu.com/

The following are the equipment configuration and system diagram for measurement. The numbers in parentheses are the quantities required for the measuring system using MT1000A.

Table C.6.1-1 Equipment Configuration

Model	Name	Qt’y
MP1900A	Signal Quality Analyzer-R	1
MU196020A	PAM4 PPG	4 (1)
MU181000B	12.5GHz 4port Synthesizer	1
MU181500B	Jitter Modulation Source	1
MT1100A	Network Master Flex	1
-	CFP Module	1
-	CFP Evaluation Board	1
MT1000A	Network Master Pro	(1)
-	SFP Module	(1)
-	SFP Evaluation Board	(1)

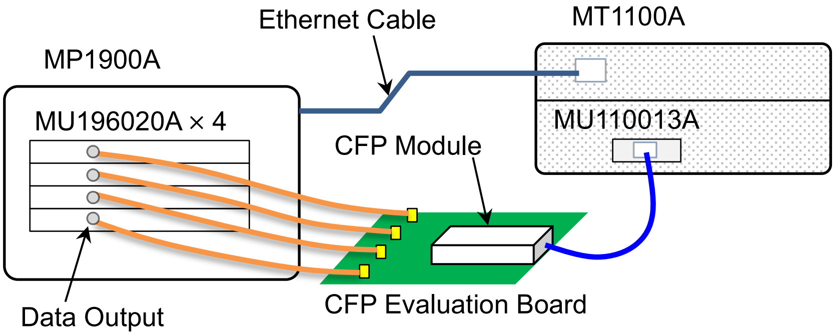


Figure C.6.1-1 Measuring System Using MT1100A

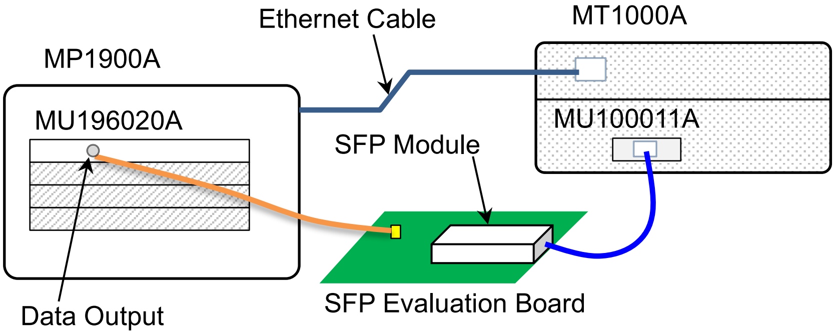


Figure C.6.1-2 Measuring System Using MT1000A

C.6.2 Detail of sample program

The sample program is stored in:
C:\Anritsu\MX183000A\Sample\Script

The sample program can run in a Python environment, and its operation check has been performed in Python 3.6.
The sample program consists of the following files.

Table C.6.2-1 Contents of Sample Program

File Name	Function
initialize.py	MX183000A loads this file. This file configures settings before measurement. The sample file starts the measurement application installed on MT1100A/MT1000A and configures the settings.
measure.py	MX183000A loads this file. This file starts the measurement and acquires its results. The sample file acquires error rate, error counts, and alarms of Lane0.
finalize.py	MX183000A loads this file. This file performs post-processing. The sample file quits the measurement application installed on MT1100A/MT1000A.
communicationMT1100.py	Configures settings for remote communications with MT1100A/MT1000A, such as opening or closing a network socket, or sending commands.
createString.py	Creates strings of the measurement results to be displayed in MX183000A.

The following figure shows the relationship among those files.

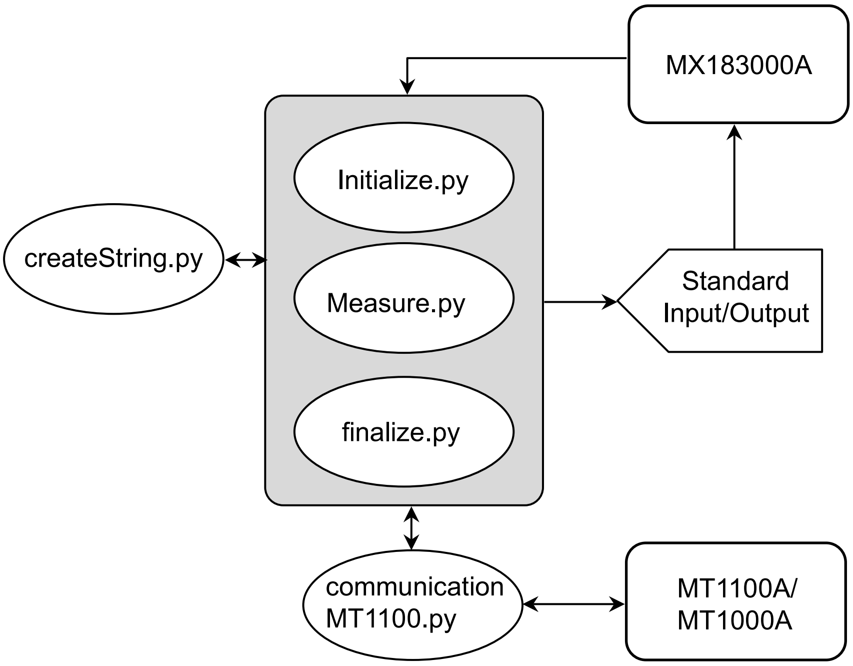


Figure C.6.2-1 Relationship of Files Contained in Sample Program

C.6.3 Operation procedure using sample program

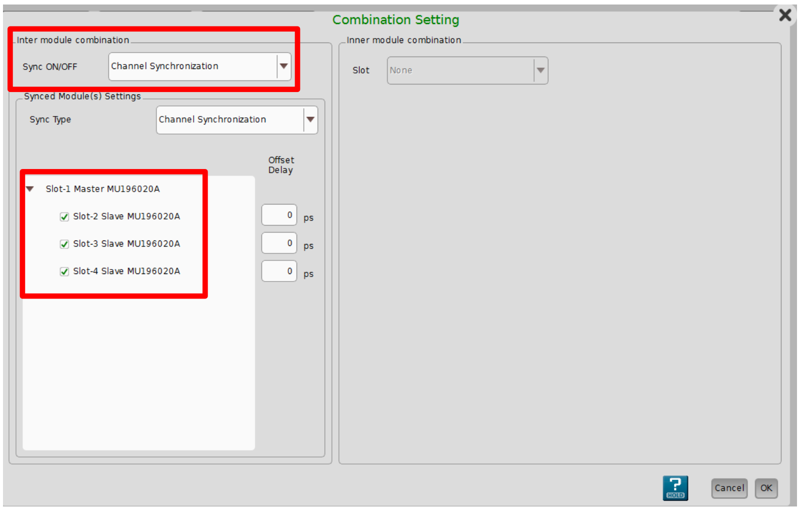
The following is the measurement procedure using the sample program. The operation procedure is described, taking the measuring system using MT1100A as an example.

Note:

This section describes the measurement procedure when Python 3.6 is installed on MP1900A.

Connecting and setting up equipment

1. For MT1100A:
   Connect the Output connector on the CFP module where MU196020A is connected, to the CFP2 module installed on MT1100A.
2. For MP1900A:
   (a) Connect the Data Output connectors for Slot 1 to 4 on MU196020A to the CFP evaluation board.
   (b) In the Combination Setting window for MP1900A, set all the slots (Slot 1 to 4) for MU196020A to **Channel Synchronization**.



Combination Setting

Inter module combination

Sync ON/OFF Channel Synchronization

Synced Module(s) Settings

Sync Type Channel Synchronization

Slot-1 Master MU196020A

☑ Slot-2 Slave MU196020A 0 ps

☑ Slot-3 Slave MU196020A 0 ps

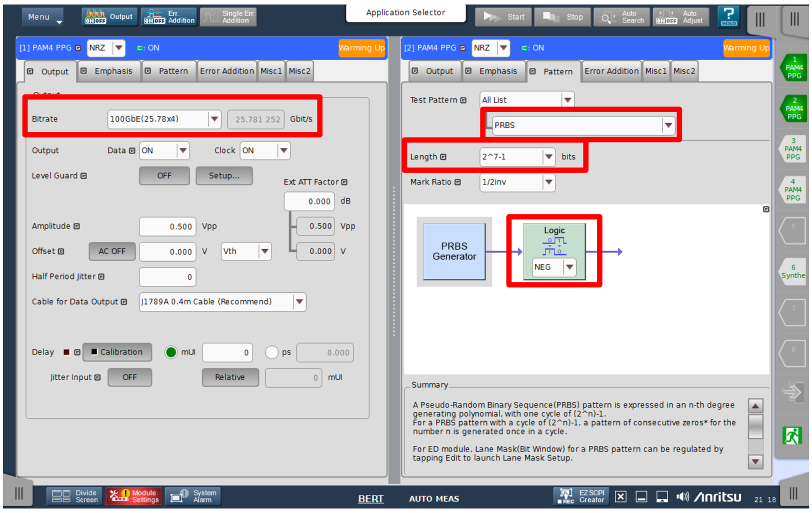
☑ Slot-4 Slave MU196020A 0 ps

Inner module combination

Slot None

   (c) Configure settings of Slot 1 to 4 for MU196020A as follows:

Interface: NRZ
Bit rate: 25.78125 Gbit/s
Test pattern: PRBS7
Logic: NEG



[1] PAM4 PPG: NRZ, ON

Bitrate: 100GbE(25.78x4) 25.781 252 Gbit/s

Output Data: ON Clock: ON

Level Guard: OFF

Ext ATT Factor: 0.000 dB

Amplitude: 0.500 Vpp (0.500 Vpp)

Offset: AC OFF 0.000 V Vth (0.000 V)

Half Period Jitter: 0

Cable for Data Output: J1789A 0.4m Cable (Recommend)

Delay: ● mUI 0 ○ ps 0.000

Jitter Input: OFF 0 mUI

[2] PAM4 PPG: NRZ, ON

Test Pattern: All List

PRBS

Length: 2^7-1 bits

Mark Ratio: 1/2inv

Logic: NEG

Summary

A Pseudo-Random Binary Sequence(PRBS) pattern is expressed in an n-th degree generating polynomial, with one cycle of (2^n)-1.
For a PRBS pattern with a cycle of (2^n)-1, a pattern of consecutive zeros* for the number n is generated once in a cycle.

For ED module, Lane Mask(Bit Window) for a PRBS pattern can be regulated by tapping Edit to launch Lane Mask Setup.

3. Loading the programs

(a) On the **DUT Control** tab in MX183000A, specify the path to the executable file (python.exe) in the Program box for each program, to load the file.

In this example, specify the location as below:

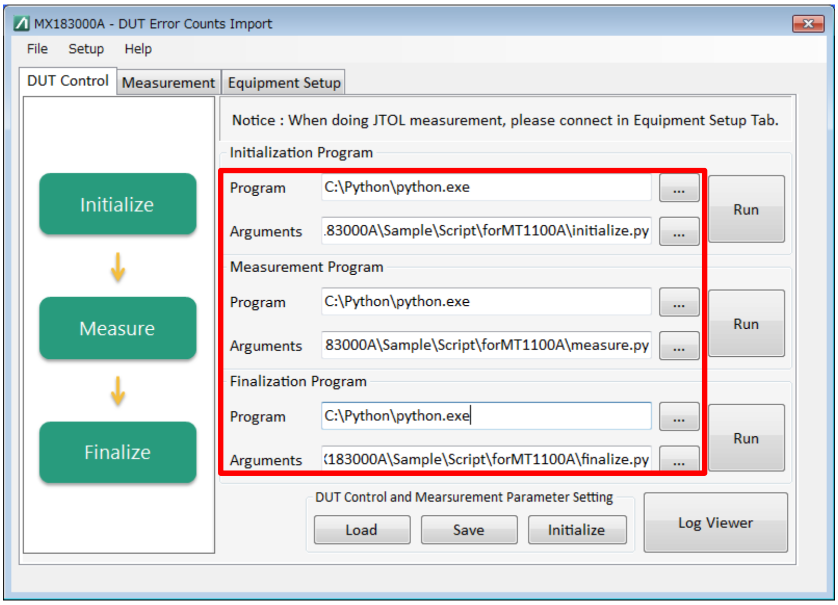
C:\Python\python.exe

(b) Load the following files by specifying their storage location in the Arguments boxes corresponding to the programs:

Initialization Program:	initialize.py
Measurement Program:	measure.py
Finalization Program:	finalize.py

In this example, specify the locations where the sample programs are stored as below:

C:\Anritsu\MX183000A\Sample\Script\ forMT1100A\xxxxx.py



Notice : When doing JTOL measurement, please connect in Equipment Setup Tab.

Initialization Program

Program: C:\Python\python.exe

Arguments: 83000A\Sample\Script\forMT1100A\initialize.py

Measurement Program

Program: C:\Python\python.exe

Arguments: 83000A\Sample\Script\forMT1100A\measure.py

Finalization Program

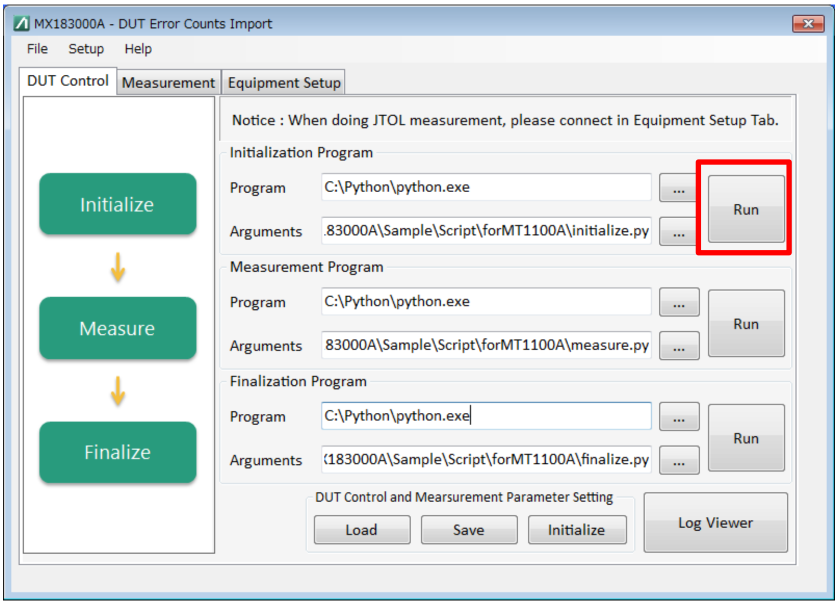
Program: C:\Python\python.exe

Arguments: (183000A\Sample\Script\forMT1100A\finalize.py

4. Running the program to start the measurement

   (a) On the **DUT Control** tab, click **Run** for Initialization Program to perform initialization processing. In this example, the program sets measurement parameters for MT1100A as follows:

   Application: No Frame
   Interface Type: CFP2
   Bit Rate: 100G Ethernet
   Lane Select: 4 Lane
   Test pattern: PRBS7
   Interval length: 2 seconds



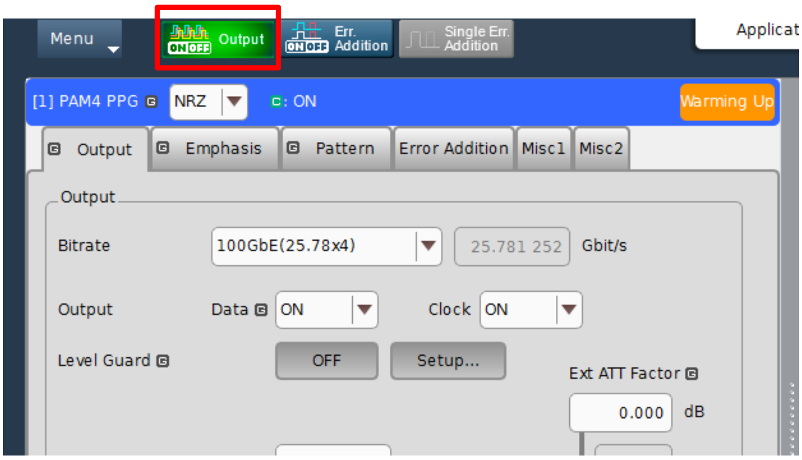
Notice : When doing JTOL measurement, please connect in Equipment Setup Tab.

Initialization Program
Program C:\Python\python.exe
Arguments 83000A\Sample\Script\forMT1100A\initialize.py

Measurement Program
Program C:\Python\python.exe
Arguments 83000A\Sample\Script\forMT1100A\measure.py

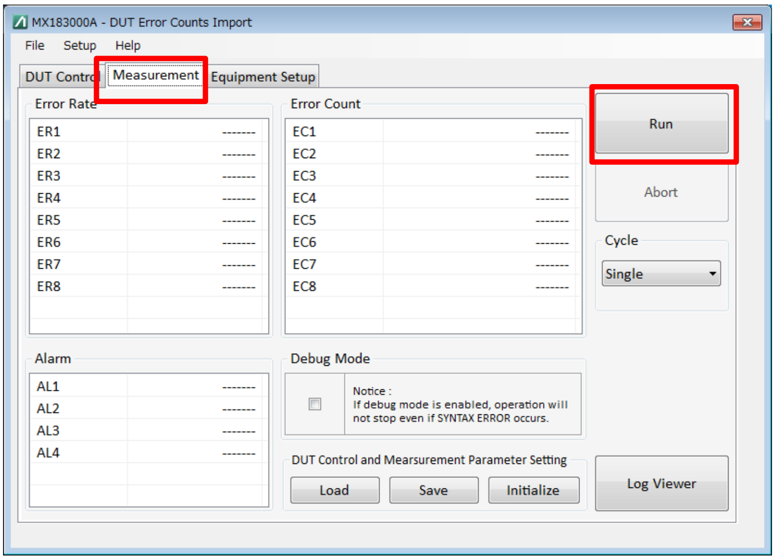
Finalization Program
Program C:\Python\python.exe
Arguments (183000A\Sample\Script\forMT1100A\finalize.py

   (b) On the MP1900A screen, click **Output** to turn on the MU196020A output.

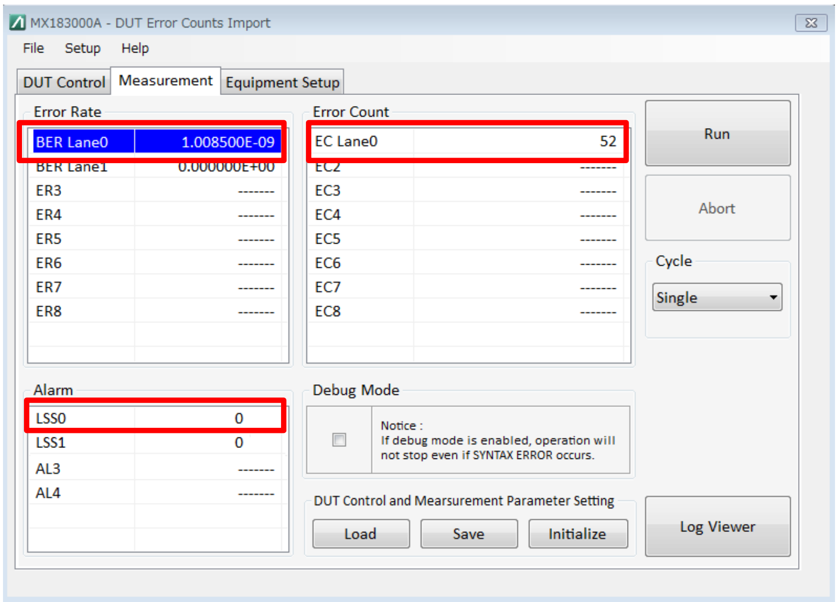


Bitrate 100GbE(25.78x4) 25.781 252 Gbit/s
Output Data ON Clock ON
Level Guard OFF
Ext ATT Factor 0.000 dB
NRZ

(c) On the **Measurement** tab, click **Run** to start the measurement. The button name changes to **Stop** during the measurement.



5. Checking measurement results
In this example, the results of ER Lane0, EC Lane0, and LSS0 are displayed under Error Rate, Error Count, and Alarm.

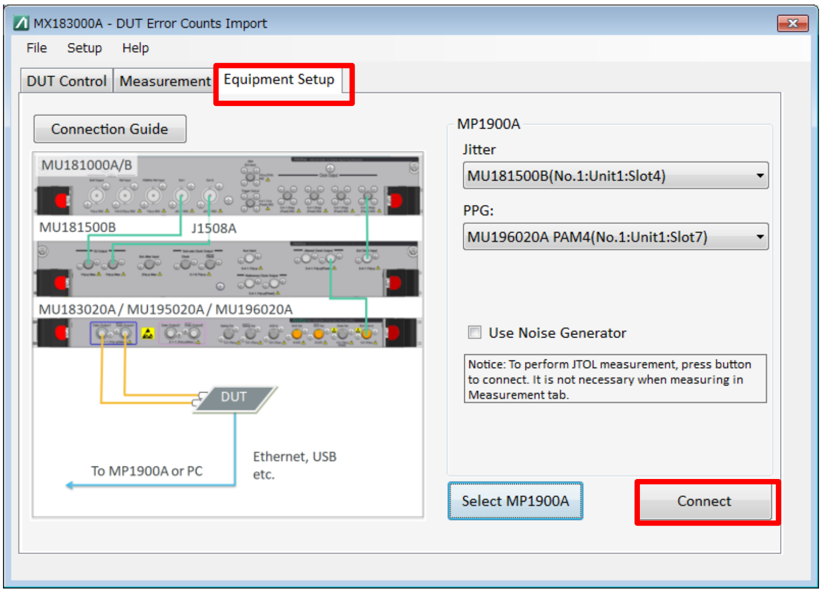

MX183000A - DUT Error Counts Import
File
Setup
Help
DUT Control
Measurement
Equipment Setup
Error Rate
Error Count
Run
Abort
Cycle
Single
Alarm
Debug Mode
Notice :
If debug mode is enabled, operation will not stop even if SYNTAX ERROR occurs.
DUT Control and Mearsurement Parameter Setting
Load
Save
Initialize
Log Viewer

Error Rate
BER Lane0 1.008500E-09
BER Lane1 0.000000E+00
ER3 -------
ER4 -------
ER5 -------
ER6 -------
ER7 -------
ER8 -------

Error Count
EC Lane0 52
EC2 -------
EC3 -------
EC4 -------
EC5 -------
EC6 -------
EC7 -------
EC8 -------

Alarm
LSS0 0
LSS1 0
AL3 -------
AL4 -------

6. Performing the jitter tolerance measurement
   If the MX183000A-PL001 Jitter Tolerance Test is installed, the jitter tolerance measurement can be performed using the error counts obtained by MT1100A.
   (a) On the **Equipment Setup** tab, click **Search Start** to select the Jitter module and PPG module, and then click **Connect**.



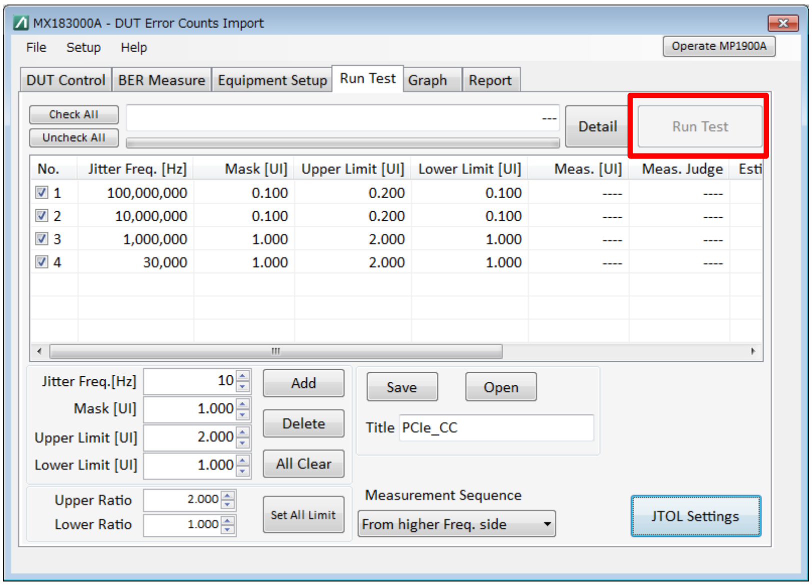
Jitter: MU181500B(No.1:Unit1:Slot4)

PPG: MU196020A PAM4(No.1:Unit1:Slot7)

☐ Use Noise Generator

Notice: To perform JTOL measurement, press button to connect. It is not necessary when measuring in Measurement tab.

   (b) On the **Run Test** tab, click **Run Test** to start the jitter tolerance measurement. In this example, the jitter tolerance measurement is performed using values of ER Lane0, EC Lane0, and LSS0.



No.	Jitter Freq. [Hz]	Mask [UI]	Upper Limit [UI]	Lower Limit [UI]	Meas. [UI]	Meas. Judge	Esti
☑ 1	100,000,000	0.100	0.200	0.100	----	----	
☑ 2	10,000,000	0.100	0.200	0.100	----	----	
☑ 3	1,000,000	1.000	2.000	1.000	----	----	
☑ 4	30,000	1.000	2.000	1.000	----	----	

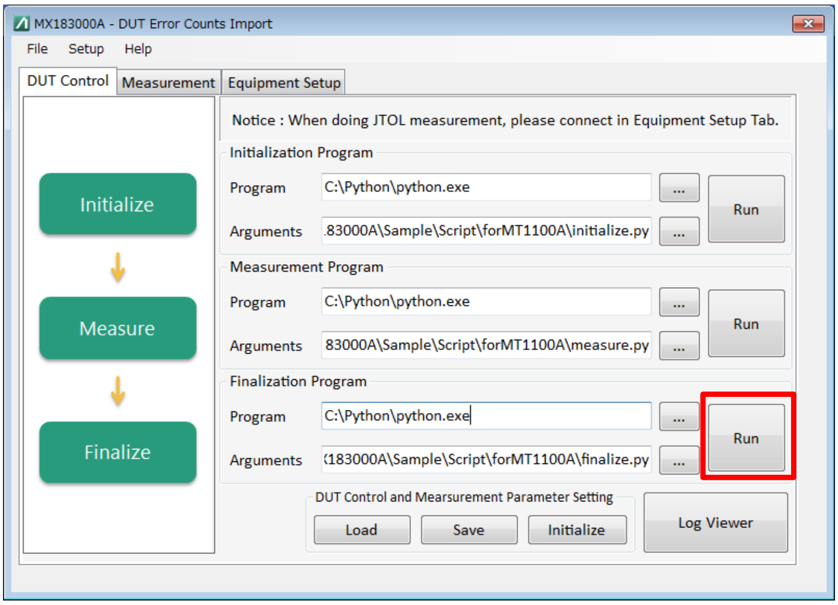
Jitter Freq.[Hz] 10
Mask [UI] 1.000
Upper Limit [UI] 2.000
Lower Limit [UI] 1.000
Upper Ratio 2.000
Lower Ratio 1.000
Title PCIe_CC
Measurement Sequence: From higher Freq. side

7. Performing post-processing

   The post-processing is performed to disconnect communication with the DUT.

   On the **DUT Control** tab, click **Run** for Finalization Program to perform the post-processing.

   In this example, the program quits the measurement application installed on MT1100A.



Notice : When doing JTOL measurement, please connect in Equipment Setup Tab.

Initialization Program
Program C:\Python\python.exe
Arguments .83000A\Sample\Script\forMT1100A\initialize.py

Measurement Program
Program C:\Python\python.exe
Arguments 83000A\Sample\Script\forMT1100A\measure.py

Finalization Program
Program C:\Python\python.exe
Arguments (183000A\Sample\Script\forMT1100A\finalize.py